

41°N

BUILDING **RESILIENCE**

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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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RAISING HOPE

“YOU’VE GOT TO FIND THINGS THAT GIVE YOU JOY.”

Those words from Cyndi Murray, in our cover story, express her resilience in the face of her decades-long struggle with Lyme disease.

Months ago, as we gathered in an office in the URI Coastal Institute to plan this issue, the editorial team of 41°N decided we wanted to tell stories like this—stories of resilience, focusing on hope, in the face of climate change.

Our writers found planners in cities, towns, and the state who are ensuring that infrastructure and development are taking future sea level rise and storms into account. Health officials are helping people affected by rising temperatures. Medical students are learning about how climate change will impact their patients.

The hope these stories portray is not blind faith that some technological intervention will reverse climate change altogether, but rather recognition that climate change is happening. Even as the world works, unevenly, to curb it, we must—and can—grapple with its effects. While there are examples of growing resilience around Rhode Island, one place where action appears lacking is at the state’s ports. Still, this “Building Resilience” issue looks much different than it would have a few years ago, when municipal decision makers, as Narragansett’s community development director Michael DeLuca alludes to in “Flushing into the Flood,” were far less aware of how climate change would affect their communities. Since then, tools like STORMTOOLS demonstrate what Rhode Island coastal areas will look like under various storm and sea level rise scenarios, municipal leaders have received state-required training in climate change, and new state and local regulations and plans are changing how building happens in vulnerable coastal areas.

All this may not give you joy, exactly, but perhaps optimism for Rhode Island’s future. We certainly hope so.

—MONICA ALLARD COX

Editor

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THE
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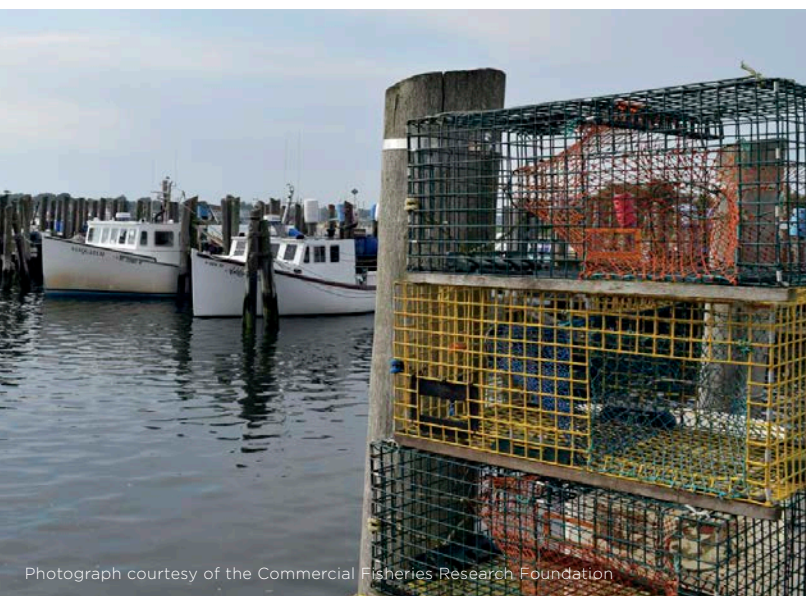
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UNSAFE

RHODE ISLAND PORTS THREATENED
BY RISING SEAS AND STORMS

by **Cathy Shufro**



HARBOR

Photograph by Michael Salerno

A YELLOW-AND-GRAY CRANE TOWERS ABOVE a hill of salt on the ProvPort pier. This late-March delivery from Egypt constitutes just a fraction of the 650,000 tons of road salt that the crane will unload here by year's end—salt shipped from Morocco, from Chile, from the Bahamas. Highway crews will spread it this winter in eastern Connecticut, throughout Rhode Island, and in Massachusetts from Springfield clear out to the islands.

Nearby, on other ProvPort land overlooking Narragansett Bay, roughly 4,000 derelict cars sit in rows on a capped landfill. They are among 30,000 that will be shipped this year from Providence to the Middle East and West Africa, where the cars will be refurbished. The sun glints on their roofs.

Just as it takes an effort to picture icy roads on a balmy afternoon, it's difficult to imagine what the port landscape in the upper bay and along the Providence River would look like in the midst of a raging hurricane, or how the shoreline will alter as the climate heats up and tides rise.

"When the port was developed [in the 1930s], they weren't considering sea level change," says Bill Fischer, the spokesman for ProvPort. The private nonprofit controls 115 acres at Fields Point, south of the city.

"Post-Katrina was when we started hearing people talk about it," says Chris Waterson, general manager of Waterson Terminal Services, which runs ProvPort. "And after Sandy," Fischer adds.

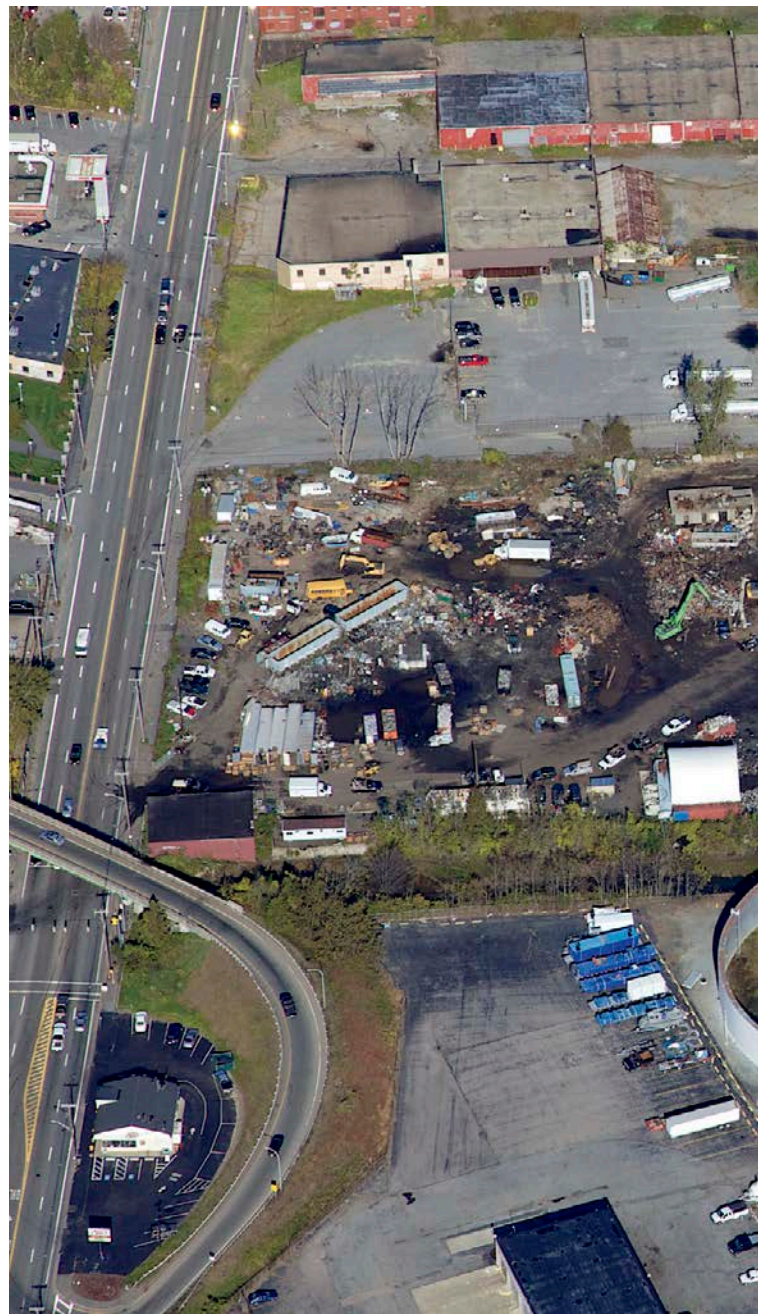
A lucky left hook

Superstorm Sandy was heading straight for New England in October 2012 when it veered westward. On October 29, the storm hit New Jersey instead and then slammed into New York Harbor. The resulting havoc shut down the Port of New York and New Jersey for a week.

Sandy's "left hook" spared Rhode Island and its ports. But when a major hurricane does hit Narragansett Bay (as happened in 1938 and 1954), how will it affect the low-lying coast of Providence and East Providence?

The dikes and gates built at Fox Point following Hurricane Carol in 1954 won't shield the port area from a storm: that barrier was built to protect downtown Providence. To the south lies a dense industrial landscape dotted with storage tanks filled with gasoline, jet fuel, liquid asphalt, and the heating oil that supplies most of Rhode Island. On or near the waterfront are a metals recycling company, a sewage treatment plant, a wholesale distributor of chemicals, and two 400-ton cranes. As ecoRI News notes, 11 of the Providence polluters listed in the Environmental Protection Agency's Toxics Release Inventory Program are located in the port neighborhood.

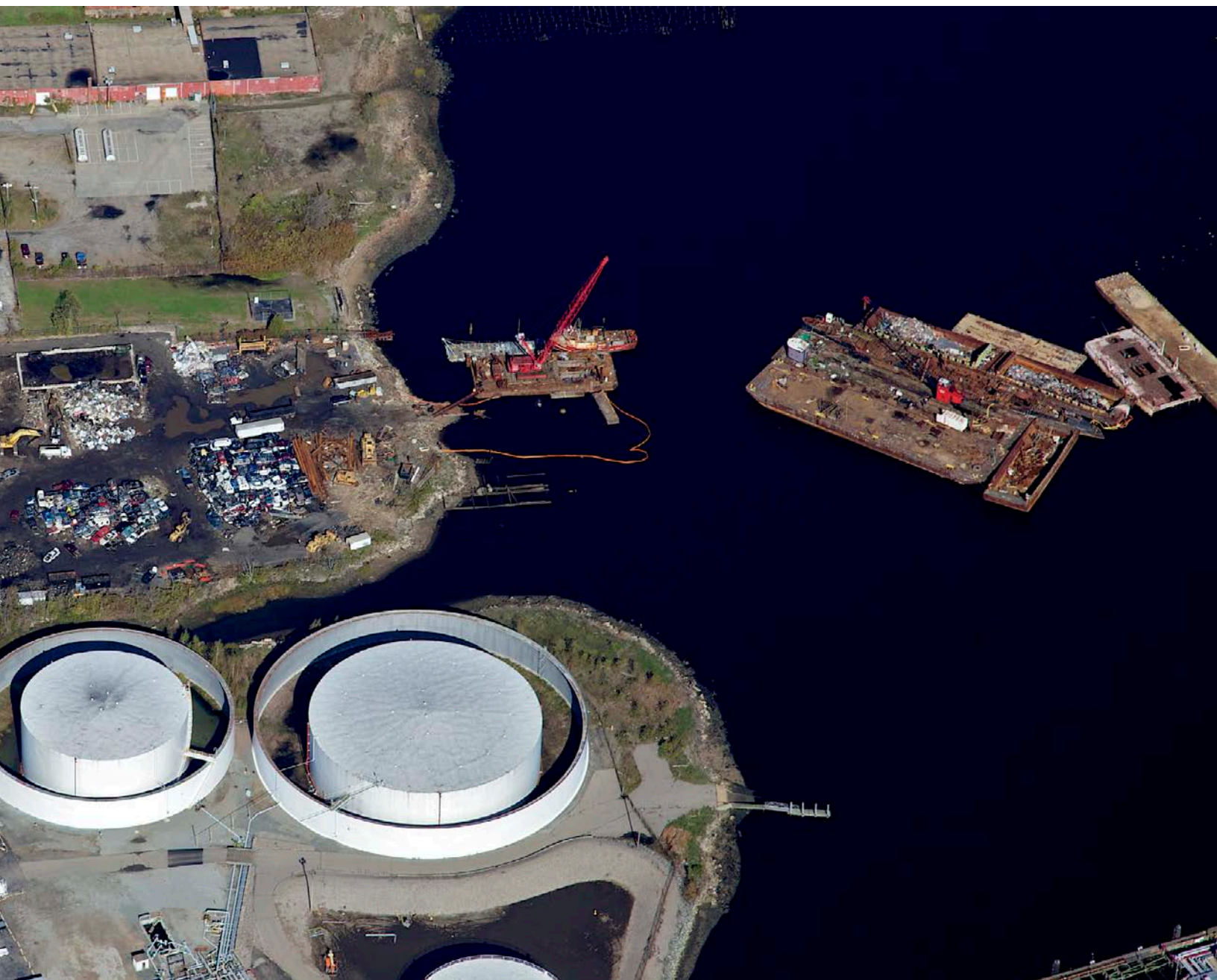
The nation's disaster specialist—the Federal Emer-



Waterfront fuel storage tanks in Providence are the basis of a lawsuit by the Conservation Law Foundation.

Photograph by Maine Imaging

gency Management Agency—has called Narragansett Bay "the Achilles' heel of New England." And Rhode Island politicians, planners, businesspeople, and other citizens worry about storms to come. Still, no one interviewed for this story was willing to speculate much about what a powerful hurricane would do to the Port of Providence (at 41.8° N) and to the smaller Port of Davisville on Quonset Peninsula (at 41.6° N).



RHODE ISLAND POLITICIANS,
PLANNERS, BUSINESS PEOPLE,
AND OTHER CITIZENS
WORRY ABOUT STORMS TO COME



Sandy's impact on the Port of New York and New Jersey could prove to be a preview: Waves there broke records. Port terminals flooded. Sewage plants overflowed, and waste contaminated drinking water in a swath from Hoboken, New Jersey, to Queens, New York. Debris cut off the port from higher land by clogging storm drains and blocking low-lying roads and train tracks. Power lines went down, and fuel for back-up generators was stuck in storage tanks whose pumps had been swamped and ruined. Water poured into sections of the New York City subway system and unin-

dated the highway tunnel linking Brooklyn and Manhattan. The storm damaged or destroyed hundreds of thousands of homes and apartments.

The closure of New York Harbor severed regional and international supply chains, causing billions of dollars in losses. Similarly, Narragansett Bay's two commercial ports handle cargoes from all over the world, and the ports are vital to the region's economy: ProvPort is one of the major deepwater ports in the Northeast, and Davisville is, among other things, a major automobile importer; last year, ships delivered



Scrap metal awaits recycling at the Port of Providence.

Photograph by Frank Carini/ecoRI News

how a hotter climate is already affecting Rhode Island. “For many people,” she said, “climate change and the threat of flooding seem really far away in the future.” Such complacency is one of several barriers to confronting climate change. Impediments include:

Uncertainty about scale: No one knows exactly how bad storms will become or how frequently they will hit. Conservation Law Foundation lawyer Christopher Kilian puts it this way: “Are you engineering for the biblical flood, the one that happens every five years on average, or the 100-year flood?”

Uncertainty about timing: Hurricanes pass within 50 miles of Rhode Island every four years, on average. That doesn’t tell us when a big one will take that left turn. But according to Professor Austin Becker at the University of Rhode Island Marine Affairs Coastal Resilience Lab, “There’s going to be a big hurricane sometime. For sure.”

A culture of short-term planning: We’re used to anticipating problems likely to occur in the months, years, or (at best) a decade ahead. Becker interviewed two dozen port stakeholders to evaluate long-term planning for climate change in Rhode Island. He found that most businesses and government agencies do not look further ahead than 10 or 20 years. A more common planning horizon is two to three years, or the time until the next election. Investments made now might not prove their worth for decades—say, until 2100, when the sea level at Newport could have risen by as much as 9 feet.

Europeans have established their expertise in flood management, a vital aspect of climate change resilience. More than 20 years ago, the Dutch built a huge floodgate to protect Rotterdam, one of the world’s busiest ports. The Maeslant barrier comprises two floating pontoons that normally leave the channel open to the port. Those doors can, in under two hours, join to block the harbor, then fill with water and sink onto a concrete base, creating a wall against a storm surge.

The question of who should pay: Protection will require fortifying some structures, moving others, and finding new ways to block or direct floodwater away from vulnerable areas. It will be very expensive. Often, those likely to benefit from a project are the ones who finance it. But it’s difficult to pinpoint the beneficiaries when it comes to climate change. Destruction or flooding along Narraganset Bay and the Providence River would affect disparate groups of people, including port neighbors whose drinking water might become pol-

240,000 cars to Davisville. Together, the two ports provide jobs for 3,000 people, from stevedores to truck drivers to small business owners. Davisville also serves the adjacent Quonset Business Park, with 11,400 employees. Both ports are expected to play roles in the construction of the proposed offshore wind farm to be built between Montauk, New York, and Martha’s Vineyard, Massachusetts.

Yet Rhode Island has no long-term strategy for protecting these ports. State Rep. Lauren H. Carson (Newport) said that many people are in denial about

luted, residents far from the coastline who might run out of heating oil, people who lose jobs because their workplace has been destroyed, or hospitals forced to operate on generators.

The Great New England Hurricane of 1938 caused region-wide damage costing the equivalent of \$5.4 billion in 2019 dollars. Although governments may be reluctant to pay for prevention, hurricane recovery gets funded; it's easier to evade the costs of planning and protection than to tell people driven from their homes that they should sleep under a bridge. Becker notes that one confounding factor in paying for resilience is the federalist system of government in the United States. Federal money does not always get distributed to states solely according to needs such as level of

Map of Providence Harbor showing the maximum surge from the hypothetical storm scenario "Hurricane Rhody." Flood levels assume the hurricane barrier is not overtopped.

Hurricane Rhody storm model created by Professor Isaac Ginis's lab and map created by Austin Becker's lab.



risk. "Funding isn't always optimal," says Becker, "and it's subject to politics."

But even if enough money is ever forthcoming, it is not going to be obvious how best to use it. Many of the decisions will require technical knowledge across disciplines. As ProvPort general manager Waterson says, "I know the port could have issues, but I don't know right now what I would even recommend to spend money on. That's not my area of expertise: I know how to run a port."

Lack of leadership: No one seems willing or positioned to push the issue forward. Some candidates for leadership include the import-export businesses using ProvPort, corporations like Shell that store fuel on land vulnerable to flooding, the sewage treatment authority, elected officials (from the governor to local town council members), environmental organizations, neighborhood groups, engineers, climate scientists, lawyers, insurance companies, and universities. But which of these should lead? Who has the authority to do so?

Becker and URI graduate student Eric Kretsch used the Port of Providence as a case study to explore this question. They brought together public and private organizations in Rhode Island that would benefit from resilience investments and asked them whether the private or public sector is best suited to take the lead. They found that private-sector representatives wanted the government to do it, while public-sector representatives believed that the private sector should assume some of the burden. The researchers asked each stakeholder to choose the entities or individuals who should take charge, and the 25 participants suggested more than 25 possible leaders. When Becker and Kretsch reported on their research in *Frontiers in Earth Science* in February 2019, they titled their article, "The leadership void for climate adaptation planning."

The Rhode Island government and other organizations have convened panels, held public hearings, and commissioned studies. The most notable report has been "Resilient Rhody," issued in 2018 by the 12-member Executive Climate Change Coordinating Committee that the legislature had established in 2012. Its recommendations exemplify the generalities that have emerged from discussions of climate-change planning. In a section on ports, "Resilient Rhody" recommends that the state "strengthen storm resilience and post-storm recovery of the ports through strategic partnerships and planning." Providence and East Providence "should approach storm resilience and climate change as a business opportunity through inclusion of resilience planning." State agencies should help the ports develop contracts for clean-up after hurricanes. Overall, the advice is to: "Establish a new collaborative partnership between the state and port community to under-

stand the economic implications of severe weather events and benefits of storm resilience planning.”

One exception to the report-generating mode is a lawsuit filed by the Boston-based Conservation Law Foundation. In August 2017, the nonprofit sued Royal Dutch Shell and Shell Oil U.S. for ignoring the dangers that climate change poses to its 25 petroleum storage tanks in Providence. According to the suit, even a Category 1 hurricane would likely flood the facility on Allens Avenue near the west bank of the Providence River.

The suit argues that Shell is violating the terms of its federal permits under the Clean Water Act by failing to harden its facilities (or move them) in the face of sea level rise, increasing rainfall, and other results of climate change. Kilian, the lead lawyer on the case, says Shell should either elevate its storage tanks or move them to higher ground. “My observation is they are willing to gamble with the public risk. It’s arguably impossible for them to adapt this facility and make it safe, because of its location.” The case is being heard in U.S. District Court in Rhode Island.

Uncertainty thwarts action

Ninety percent of goods traded worldwide travel by ship, and coastal ports worldwide face new hazards arising from climate change. Marine ports are by their nature especially vulnerable to hurricanes and typhoons; sea level continues to rise as polar and glacial ice melts and as seawater warms and expands. Storm surges will also worsen because weather patterns are intensifying and sometimes prolonging storms. Members of the Worldwide Network of Port Cities, based in Le Havre, France, have made climate change adaptation their priority. The network recommends that ports reduce or eliminate emissions (to avoid worsening climate change) and develop strategies to prevent flooding. The group also suggests that port cities consider consequences of global heating beyond flooding, such as the effects of hotter temperatures on port laborers.

URI’s Austin Becker says that most sectors of society in the United States do not see enough incentive to engage in climate change adaptation: Businesses strive to profit in the short term, so they have little interest in benefits unlikely to materialize for decades. Politicians are driven by election cycles and not long-term projects that will (or might) bear fruit long after their careers have ended. Because insurance companies rewrite policies annually, their calculation of risk does not factor in change across decades. The public sector is more accustomed to taking a long view. However, government planners are reluctant to spend money on mitigating threats whose timing and magnitude remain uncertain.



Photograph by Michael Salerno

Becker has identified one group that does have incentives to provide leadership: academics. They make a living by addressing complex interdisciplinary problems like climate change. “Our job is to train the next generation, through teaching, and to provide new information, through research. Both of these, we hope, will help society make better choices.”

But for now, there’s much more talk than action in Rhode Island. “I don’t think anything will happen until there’s a major issue,” says ProvPort manager Waterson.

Austin Becker is leading a demonstration site at the Port of Providence to study adaptation measures suitable for port areas. This project is funded by URI’s Coastal Institute, and more information is available on the Coastal Institute website at ci.uri.edu.



FLUSHING INTO THE FLOOD

SEA LEVEL RISE AND STORMS ARE CHANGING HOW COMMUNITIES DEAL WITH WASTEWATER

by **Sue Kennedy**

Photographs by **Jesse Burke**

OVER A HUNDRED YEARS AGO, LOCATING THE state's first sewage treatment plant at Providence's Fields Point, just a few feet above sea level, made total sense, from an engineering standpoint.

"Well, think about it—it was all about gravity," says Bill Patenaude, a principal engineer for the Rhode Island Department of Environmental Management, whose work monitoring wastewater treatment facilities helps ensure they're running smoothly statewide. "Which way does water run? Downhill. Same for waste, right? Downhill."

Downhill. This simple but profoundly effective concept has largely defined wastewater management in coastal communities everywhere for well over a century. It's a strategy that tips its hat to a landscape that, in Rhode Island and along many places on the Eastern Seaboard, slopes downward to the ocean, forming watersheds. And Rhode Island, an early player in America's Industrial Age, leveraged this natural landscape in



its urban infrastructure—the wheel of Pawtucket’s Slater Mill would be powered by a rushing fall of river water; the pipes carrying sewage to Providence’s Fields Point wastewater treatment facility would obey the law of gravity as well.

And while it worked for a long time, with the majority of Rhode Island’s 19 wastewater treatment facilities anchored as firmly downhill as possible along the coast of Narragansett Bay and the rivers that feed it, climate change is turning what was once sublime simplicity into plain difficulty. These facilities face two key problems: Sea level is rising, so the ocean is encroaching upon many treatment plants, while a projected increase in strong storms means greater chance of them flooding during heavy rain. Either way, going under—and potentially going offline—is not an acceptable scenario to those in the daily business of managing wastewater treatment facilities.

The Field’s Point facility, in Providence, is one of the country’s oldest wastewater treatment facilities.



Dealing with downhill

“Climate change wasn’t a big part of the thinking when I started this job,” says Patenaude, who’s been evaluating treatment plants for the state for nearly 30 years. On this drizzly February morning, he dons a hardhat—his very own, he mentions wryly—and joins a group of college students who borrow hats from a bin so they can tour the Fields Point facility with the help of Narragansett Bay Commission (NBC) Public Affairs Manager Jamie Samons. “Now? Resiliency’s probably 50% of what I do. And wastewater facilities are ground zero for this stuff,” Patenaude says.

He nods as Samons tells the two dozen undergraduates that NBC is already, with both its Fields Point facility and its Bucklin Point plant on East Providence’s coast, incorporating best practices into its management plans to deal with excess water. “We are required by the state to have these resiliency plans,” says Samons. “And that’s a good thing, when you recognize that 2018 was our wettest year ever here. Ever.”

Students, all enrolled in a class taught by Emi Uchida, a University of Rhode Island professor of Environmental and Natural Resource Economics (ENRE), scratch pens across notebooks. They’re seniors with varied environmental majors coming together via a URI senior capstone course to explore shared issues, such as climate change. Sarah O’Neil, an ENRE major, came away from the tour connecting dots between climate threats and the infrastructure upon which modern life deeply depends. “It’s important to consider climate change issues and resiliency when talking about wastewater treatment due to the large impacts sea level rise can have on residents and businesses in the area,” she says. “Without improvements made to resiliency efforts, wastewater treatment facilities are essentially waiting to be compromised.”

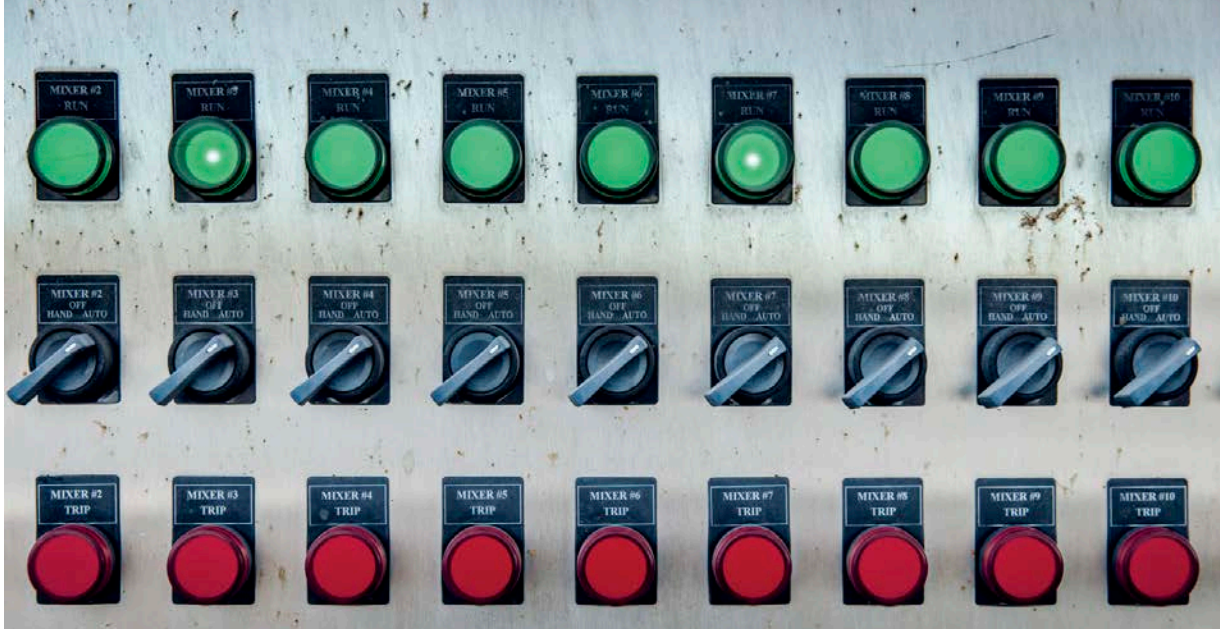
The capstone course is a partnership of Rhode Island Sea Grant and the URI Coastal Resources Center (CRC) that folds in the teaching from several URI programs—ENRE, Ocean Engineering, and Landscape Architecture—and encourages students to work collaboratively across their disciplines to solve shared problems.

Climate change issues present an ideal opportunity for stretching student minds in interdisciplinary directions. Teresa Crean, coastal management extension specialist for CRC and Sea Grant, manages the capstone course. It’s important, she says, for students “to see firsthand how professionals in the field are tackling adaptation and resilience to changing coastal

OPPOSITE

Bill Patenaude spends much of his time assessing the resiliency of wastewater treatment plants to the impacts of climate change.





hazards and how they might develop skills to take with them into the job market. Students are challenged; they're exchanging data and analysis outputs with their classmates in different disciplines, while the working professionals benefit from having fresh sets of eyes on the challenges of their day jobs."

And there's plenty of opportunity at the wastewater facility level. Coastal community plant managers around Rhode Island are increasingly committed to spending at least half their time on the job on the effort of incorporating resiliency into facility planning and management. Their shared goal is clear: Keep water—from the rising ocean to storm deluges—out, so plants can process and people can flush.

Plants with plans

It's not an easy task, what with treatment plants gradually losing ground to sea level rise, while the threat of storm flooding increases, but it's staunchly underway. Today, dealing with downhill—adapting local wastewater treatment facilities to withstand these threats—involves applying climate change data to planning decisions, educating stakeholders and treatment plant customers about why they should care about facility protection, and initiating tough discussions now, instead of waiting until it's too late.

"Look, eventually we're going to come to a point where big decisions are going to have to be made—are you going to continue to armor in place? Are you going to retreat? These are things we're going to have to figure out," says Patenaude. "So we need to learn and adapt now, so the community's prepared to address these issues in the future."

At municipal wastewater treatment facilities, such as the ones operated by Narragansett, Warren, and Warwick, plans are in place, and action is being taken. There isn't a one-size-fits-all solution, but all three exemplify the issue being experienced by coastal community treatment plants: Come up with relatively

affordable plans that are mindful of projected increases in water and can keep facilities dry and working in increasingly wet environments.

"Oh, we knew the time had come to get this done—change is here and everyone knew we had to get to work on this now," says Mike DeLuca, community development director for the town of Narragansett, who, together with town engineer Jeff Ceasrine, started town boards years ago on the process of introducing a resiliency component to their hazard mitigation and community comprehensive plans. "I mean, it had become totally clear that we had to do this, as evidenced by Superstorm Sandy and Hurricane Irene. When you're a planner, and you finally see that you're not getting pushback on this issue of climate change, you're getting support now instead, you know people are really starting to see what's going on," says DeLuca.

What was going on at Narragansett's treatment plant, situated along the bay coast directly south of Scarborough State Beach, was that it needed to be protected from inundation caused by storms. The facility has flooded increasingly over the years, so the town ultimately opted to armor, or shield, the low-lying facility from taking on floodwater. In his office, DeLuca shares pictures of the nearly \$2 million construction project—large metal sheets deeply dug and buried into raised ground around the facility, infrastructure designed to sluice downhill floodwaters away from the area.

It's a success, says DeLuca, and iterations of the comprehensive plans since the construction feature increasingly detailed resiliency components for town infrastructure and assets. Still, DeLuca indicates, there's no getting away from the fact that Mother Nature will probably always win when it comes to sea level rise.

"What we've done for this facility is important and useful—but we're purposely looking no further out than 2050, maybe 2060," says DeLuca. "The fact is that

sea level rise at that time may mean the town's looking to put its wastewater treatment somewhere else. We can't solve everything today, but we've got to keep educating, and we've got to keep talking about it as a community."

It's a sentiment shared by the town of Warren, which is also busy implementing a comprehensive \$20 million plan to keep existing facilities perched on the coast of the Warren River, a part of the bay, dry and functioning for at least the foreseeable future. Town Manager Kate Michaud, who is a former Warren planner, and Bob Rulli, town director of planning and community development, say it's important that Warren's resiliency plan for its wastewater treatment facilities does two things: protect critical infrastructure and respect the many needs of the town's citizenry and businesses.

"It's definitely a balancing act," says Michaud. "On the one hand, we need to stay above water, and clearly, that takes a financial investment. On the other hand, we are a working-class community, so we have issues and focuses that maybe other places don't deal with as much. We're addressing both, and it's meant a lot of balancing and being mindful of many needs."

She says those needs range from workforce housing to economic development to infrastructure repair and maintenance. Climate change is certainly complicating management of such needs, she says, but "we have an opportunity now to mitigate negative impacts in the future if we approach things correctly and give these issues their due attention."

And it's been powerful for Warren to consider the degree to which coastal life, with all its infrastructure, may be impacted by climate change. "We're thinking about it comprehensively, because that's what it means to manage the community," Rulli says. "It's community development, it's housing, it's transportation. It's our real estate, it's all incomes, it's jobs and shopping, and what we're doing with the wastewater treatment is starting it."

Warren's plan focuses on early actions and on implementing changes that are not only affordable, but are viewable, concrete, and can encourage the community to take gradual and effective steps toward resiliency. Elevating facility generators and floodproofing entryways are among the actions, and they are part of the work that the town has undertaken to adopt a comprehensive approach to resiliency building—for wastewater treatment issues and otherwise.

"The generator at the wastewater treatment facility has been elevated above the height of flood-stage water with up to 3 feet of sea level rise. We're using this same methodology, incorporating STORMTOOLS (a URI mapping application) into decision making, to evaluate and upgrade wastewater pump stations around

town," says Michaud. "In our more vulnerable pump stations we're replacing [traditional] pumps with submersible pumps that can continue to operate while flooded, and we'll be further evaluating how to make these facilities more resilient as equipment needs replacing." She says other projects to improve resiliency focus on mitigating the impacts of more intense and frequent precipitation and include increasing the capacity of stormwater systems and restoring floodplain areas.

On the policy side, and similar to other municipalities, Warren has significantly beefed up the resiliency components of its hazard mitigation and comprehensive plans. The town has dedicated time to making sure the members of its elected and volunteer boards learn about climate change issues, and it's using STORMTOOLS to both understand projected changes and adapt policy as needed. Michaud says that it's taken time, but Warren's boards have come to see and support the need for resiliency building in the town—and the wastewater facilities are a prime concern.

Future plans, Michaud says, will include elevating the town's several pump stations located at the water's edge. It's important to get the brick buildings up and dry, she says, but it's a good opportunity, too, to build people's understanding about what it means, in today's day and age, to live on the coast. "People are definitely going to notice the added height, and I'm hoping that they'll be thinking about why we're doing this, and what sea level rise means, and what increased flooding means," she says. "It's going to be noticeable, and that's what these actions are about, getting the community involved in it."

In Warwick, where the wastewater treatment facility sits low in an oxbow of the Pawtuxet River, resiliency efforts have focused on sheltering the plant from the flooding that often swells the river and on retrofitting facility buildings and infrastructure to weather excess water. Not many days go by, says then-plant manager Janine Burke-Wells, when she doesn't think about 2010, the year when the facility was submerged by excessive early spring rains that overflowed the riverbanks and ultimately required an approximate \$14 million repair and improvement effort.

"Never build in an oxbow" sardonically laughs Burke-Wells, trudging up a steep slope of the berm that now protects the northern side of the facility from the river. She points out how the grassy appearance of the berm tricks people into thinking it's nothing more than a pile of dirt. In fact, she says, it took careful design and planning to build the berm out of earthen materials best suited to both absorb and stop floodwater from filling the facility area. A companion berm bounds the plant to the west, and Burke-Wells is proud of, and confident in, the protection the structures pro-

vide. The berms, coupled with the infrastructure retrofits that largely floodproofed the treatment center's buildings and equipment, now provide significant protection to the plant.

The Warwick facility, low as it is, and hard by the river, has often flooded—the facility was first constructed almost three-quarters of a century ago; the original berm went up in 1982—but the changing climate, with its projected increase in storm events, has required the city to step up its whole protection approach. “It could mean that a 2010 storm scenario happens again, and we need to be ready for that,” she says.

Gary Marino, a Warwick resident, agrees. Today he sits on the board of the city's sewer authority, but his memories of the 2010 flood are defined by the loss he and his Natick neighbors experienced as people of a close-knit community submerged by a rain-swollen Pawtuxet River for days on end. He remembers setting up a sump pump for a neighbor; he recalls filling sandbags for the West Warwick Department of Public Works at his parish church, Sacred Heart, with the Boy Scout troop he helped out with.

“NEW ENGLAND IS ALREADY SEEING SOME OF THE HEAVIEST VOLUME AND INTENSITY WITH INCREASED RAINFALL”

He had the small boat that he and his sons used to ferry neighbors to what remained of their homes, in efforts to collect money, clothing, maybe prescription medications. There was a lot of crying. Marino thought he better give his boys some way to cope while people grieved. “I told my sons just look at the bottom of the boat and let them have their moment,” he says. “This was the saddest memory of mine for the entire flood. The raw emotion of someone having their home ruined by floodwaters was something you don't want to experience.”

Which is why, like her colleagues in Narragansett and Warren, Burke-Wells says that education is an important piece of the floodproofing puzzle. While 2010 is not a year she'd like to relive, Burke-Wells says that the learning that emerged from the event has been valuable. The connections that were forged between the government levels—municipal, state, and federal—are still in place, and there is more of a united front within the larger planning community to work

together now to help each other solve these pressing climate change problems impacting wastewater facilities across the state. “What I really am interested in now is seeing if we can have the state and some of Warwick's neighboring communities come together and work together on the planning we have to do and keep up with so we can stay on top of this,” says Burke-Wells. “I am choosing to see this as an opportunity for us all to help each other, because this is a problem that is not going away.”

Getting underground

And while government prepares community wastewater treatment facilities for climate change impacts, scientists are trying to better understand a different angle of wastewater treatment—the issue of what's going on below the surface of lawns in neighborhoods where septic systems are the prime method for treating wastewater. Alissa Cox, a doctoral student in the URI Department of Natural Resources Science, describes the groundwater research effort: “With this project, what we're thinking about is, okay, here are all these homes [in Charlestown] and people maybe are even adapting their houses to climate change, but is anyone thinking about below the surface, below the houses?”

The project is both creating a septic system census from available banks of permit data to get a picture of the general underground landscape and measuring groundwater tables at several specific sites.

Together, says Cox, these efforts may help shed light on how well septic system-reliant communities are prepared to deal with their groundwater being impacted by influxes or inundation from sea level rise and strong storms. And at a very practical level, if the water tables are shown to be rising, that could be an impetus for not only Charlestown, but other coastal communities, to wade into the difficult dialogue about what to do to solve it.

“We know that it's important for septic systems to function properly if they're really going to treat wastewater at the level they should,” says Cox. “But what we may need to start talking about here is that septic systems may not function well at all if the groundwater table rises significantly.”

And regardless of the resiliency target, be it a wastewater treatment facility or a neighborhood's septic systems, the experts say that education is the shared key to adapting both to what is likely a wetter future in Rhode Island. “Whether you're a student, a facility worker, or a stakeholder in the community, it's critical,” says Patenaude, as the student tour at Fields Point winds down. “New England is already seeing some of the heaviest volume and intensity with increased rainfall, so this dialogue is going to need to keep taking place, and we've all got a role in making sure it happens.”

RESILIENCE SHAPES WARREN INFRASTRUCTURE INVESTMENTS

by Jen A. Miller

“Better-prepared municipalities equal a better-prepared Ocean State,” says Shaun O’Rourke, the state’s chief resilience officer and director of stormwater and resiliency at the Rhode Island Infrastructure Bank.

He’s working with municipalities on upgrading their wastewater treatment facilities, like in Warren, which suffered historic flooding in 2010.

The impetus for a better facility came not from the flood, but from the need to reduce the amount of nitrogen going into the Warren River, says Kate Michaud, Warren’s town manager. In evaluating the town’s options, she says they also knew they needed to address flood resilience.

Instead of using Federal Emergency Management Agency (FEMA) flood maps, which are based on historic and current data, to determine how high the facility should be, they used maps generated by STORMTOOLS, a Rhode Island Shoreline Change Special Area Management Plan online mapping tool that draws data from the National Oceanic and Atmospheric Administration, the U.S. Army Corps of Engineers, and the North Atlantic Coast Comprehensive Study, and that takes expected sea level rise into account.

“FEMA only looks backwards, and STORMTOOLS looks forward. We want to be in the future instead of the past,” Michaud says.

From those maps, they decided that in order for the facility to be prepared through 2065 (which is the length of the life of the equipment being installed), they chose to plan for 3 feet of sea level rise.

“Now any new construction in Warren—anything that’s going to require town investment—we are consulting those STORMTOOLS maps and looking at



The Tourister Mill redevelopment has been designed with flooding in mind.

the life of the asset and whether or not it would be protected in the future,” she said. That also includes the town-owned former American Tourister mill building that is being redeveloped into a mix of commercial and residential space. The first floor of the building has no residential units—just parking and commercial space.

Michaud says that partnerships are key, especially for local municipalities.

They’ve partnered with the University of Rhode Island, the Rhode Island Coastal Resources Management Council, the Rhode Island Department of Environmental Management, and the Rhode Island Emergency Management Agency on projects. They’re also currently working with Rhode Island Housing and “looking at some of the vulnerabilities in affordable housing located within these areas,” she says.

“We’re a small town with a very limited budget. There’s no way we would be addressing these things without those partnerships.”





A RISING CHALLENGE

RHODE ISLAND GRAPPLES WITH THE POLICY AND PRACTICE OF COASTAL RESILIENCY

by **Ellen Liberman**

Photographs by **Cate Brown**

WITH JUST A FEW WEEKS TO GO, THE TOWN OF NARRAGANSETT WAS RACING to meet a deadline. On March 1, a new state law would radically alter the way structures could be built in flood zones, by permitting elevated buildings that could turn a town's waterfront into a wall of house-scrappers.

The bill would allow building height to be measured from base flood elevation (BFE), instead of the traditional method of starting at the natural grade of the land. This could reshape a community's shoreline, allowing houses as high as 56 feet to be built along the coast, in an effort to lift them out of the path of floodwaters and sea level rise. Most towns cap residential structure heights at around 35 feet. The addition of another 12 to 20 feet of building height to place the first floor of living space above BFE would blot out the views and irrevocably change the character of seaside cities and towns.

Narragansett was one of a handful of towns to react immediately by amending local zoning regulations to prevent the spread of out-of-scale beach homes. Entire communities had been built up to the water's edge in low-lying areas, to codes that would not pass muster today, and with structures that would be easily swallowed in a storm or rising seas or slowly drowned in chronic flooding. Narragansett's new ordinance would confine property owners who needed to build above some of the highest BFES to a one-story home, with an additional height allowance for a pitched roof. The first reading of the amendments was a quiet affair.

"Nobody spoke against it. Everyone understood the concern," says Michael DeLuca, the town's community development director. "Mother Nature is going to win this battle, and we are not going to push the oceans back."

The hearing was a rare, tiny island of agreement in a sea of conflict over how to make coasts resilient in the age of climate change. There is little consensus on the extent of the threat (How much land will be submerged?), when it will arrive (10 years? 20 years?), what form it will take (Once-in-a-century superstorm? Nuisance tides? Erosion?), and, most importantly, how we will respond (Ignore? Adapt? Retreat?).

At the core of these disputes is the enormous economic impact to individual wealth and, by extension, to a government's property tax base. In 2016, a Rhode Island Special House Commission to Study Economic Risk Due to Flooding and Sea Level Rise reported that as of September 2015, the Federal Emergency Management Agency (FEMA) had over 15,000 active flood insurance policies covering over \$3.8 billion in property in the state. And while many believe the biggest threat comes from a 100-year perfect storm, housing data suggests that the market is already reacting to the less dramatic phenomenon of tidal flooding.

In January, data scientists from First Street Foundation and Columbia University estimated that tidal flooding had already erased more than \$403 million in home values for coastal properties in four New England states.

"We're looking at neighborhoods and roads. And more home value is being lost in neighborhoods with roads that flood," says Steven A. McAlpine, First Street's head of data science. "It is important to understand what is happening to the roads when understanding what is happening to the real estate market."

Rhode Island alone lost nearly \$45 million in relative appreciation, meaning that from 2005 to 2017, the property values of homes that were affected did not rise at the same rate as those that were not. That's a worrisome development to cities and towns.

"A significant portion of our tax base lies on the coast—if we retreat, you are taking away the most valuable property, and your new front row will be farther from the coast," says Chelsea Siefert, who was South Kingstown planning director at the time of this interview. "We are going to be in a significantly trying position when it comes to our tax base."

A road map to resiliency?

Planning requires a consensus on what the future holds. One of the first points of contention has been what estimates of flood risk and sea level rise policymakers should use. The flood maps generated by FEMA have long driven state and municipal-level coastal policies. They remain the basis for the National Flood Insurance Program, which lenders require homeowners in coastal zones to carry. They are also the basis of FEMA's Community Rating System, a voluntary program that gives municipalities incentives to adopt best floodplain management practices to protect structures from flooding. The better the rating, the better the premium discount for residents who buy federal flood insurance.

The Coastal Resources Management Council (CRMC) has argued that FEMA flood maps are outdated, as well as inaccurate in their calculations of winds, wave height, and storm surge. Last June, the CRMC adopted a Shoreline Special Area Management Plan (Beach SAMP)

that established a new "system to educate and encourage resilient building for property within the coastal zone," based on sea level rise estimates from the National Oceanic and Atmospheric Administration, says CRMC Executive Director Grover Fugate. Permit applicants will choose a building design based on the years of building life, coupled with a sea level rise assumption, and a new set of storm surge and floodplain maps that add an accelerated erosion multiplier. The council would inform the applicant of adaptation measures he or she could take.

"Virtually every performance standard we have is premised on today's conditions," Fugate says. "We don't project into the future. Even though we know things are changing, we don't change the performance standards people have to build to. We aren't giving people that information so they can make informed decisions. The Beach SAMP is an educational tool so that at end of the mortgage, you have a marketable house, and you still have a tax base. If we don't do that, we are setting people up for failure."

Last June, the CRMC broke the stranglehold of FEMA's flood maps via legislation that allowed building applicants in a coastal zone to use CRMC's maps if the BFE was higher than that on FEMA's flood insurance maps.

But where the council saw sound policy-making, municipal planners saw disaster. Since 2016, buildings in coastal zones were measured at grade with an allowance of 5 extra feet of freeboard to raise them, with freeboard excluded from the buildings' height calculation. Changing to a BFE standard might keep a house standing in the surge, but it would have negative consequences for whole neighborhoods. Aesthetic impacts aside, a McMansion's robust foundation would disturb fragile land, and the house itself would leave more post-storm debris. Meanwhile, the at-grade roads and the septic systems would be underwater.

"The buildings would get higher the closer you got to the water," says Charlestown Town Planner Jane Weidman. "It doesn't make sense to encourage bigger, bulkier buildings that have more impact to the environment. You really want to talk about sustainability. You might want to talk about retreat. There will be a breaking point."

Charlestown reacted to the new regulation by keeping its height cap at 35 feet for larger lots but changing its height calculations to subtract the existing grade from the BFE. (A house built at a grade that is 6 feet above sea level, with a BFE of 13 feet, would have to raise the first floor by 7 feet, for example.) South Kingstown created special overlay districts, which among other things required bigger side-yard setbacks, and second-story setbacks from the first floor, to soften the visual impact. Builders using the CRMC BFE



will need a special-use permit to ensure construction practices are appropriate to the chosen sea level rise scenario.

But, most of the state's coastal communities are just beginning to incorporate resiliency in their long-term planning. The town of Barrington—two peninsulas, bounded by Narragansett Bay to the east and riven by the Barrington and Warren rivers—is one of the state's most vulnerable communities. A new visualization tool, developed by the CRMC and the University of Rhode Island, shows that a 100-year storm, similar to 1954's Hurricane Carol, plus 5 feet of sea level rise, would submerge the areas around County and Massasoit roads under 15 feet of storm surge, inundating institutions like the high school and the Barrington Congregational Church and cutting off Barrington's main emergency egress.

The Pointe development in East Matunuck rises between two salt ponds.

Town Manager Jim Cunha says Barrington is in the midst of a multi-pronged attack against flooding threats. The town has hired a resiliency director and is rebuilding the century-old sea wall that protects Matthewson Road, joining FEMA's Community Rating System, and launching a town-wide campaign to educate residents about flooding and resiliency. It is also building a reserve fund for climate mitigation projects, transforming its Energy Committee into a Resiliency and Energy Committee, developing flooding emergency preparedness exercises, and hunting for federal or state aid.

"In a small community, the planning department is a one-man shop, and we're juggling resiliency," Cunha

“WE DON’T GET AS MANY DIRECT-HIT HURRICANES, BUT SEA LEVEL RISE IS A SIGNIFICANT CONCERN TO A LOT OF COMMUNITIES”

says. “The taxpayers are concerned about the tax rate, [and] we have a heavy focus on education. As we look at mitigation efforts, we’re looking for grants or matching grants. It’s a matter of priorities. No community can afford to do everything.”

Raising the floor

The Pointe is a South Kingstown luxury beach enclave in progress. Clustered on 5 acres amid the marshlands between Potter and Point Judith ponds, its cottages are not massive—the largest is about 1,200-square feet of living space—but they are high. The first floor of living at The Pointe begins 16 feet above the ground. Each house lords over the waving phragmites to claim its 360-degree water views.

On a sunny Sunday afternoon in February, the completed homes shared the commons with three cottages still in the foundation stage. Each consisted of a rectangle of eight concrete pillars that will eventually house the garage and storage, giving passersby a peek of the girding that will eventually be tucked under a skirt of cedar shakes stained a tasteful gray.

Rhode Island builders have long understood how to build resilient homes on the coast, even if they have not always done so. Today’s waterside neighborhoods are a hodgepodge of older, squat shore cottages and more recent towering homes that ensure unobstructed water views but can also withstand hurricane-force winds and storm surge.

“Within the last decade there’s been a heightened sensitivity,” says John V. Marcantonio, executive director of the Rhode Island Builders Association, which represents 900 construction companies in the state. “My generation of builders is certainly aware of the issue of sea level rise and we want to accommodate and balance it off with realistic building practices. It affects a minority of builders because most of the construction is very high end. It’s a limited sector of the economy with more specialized construction methods, field materials, rules, and practices.”

Coastal building codes nationwide toughened in the wake of Hurricane Andrew, a Category 5 storm that

damaged 125,000 South Florida homes in 1992 and caused \$26.5 billion in economic damages. The wind was the most damaging element of Andrew, exploiting deficient building practices that allowed the storm to lift roofs right off houses. In result, local codes were amended to conform to the national code that dictates minimum design loads for structures and requires elements such as impact-resistant glass and mechanical tie downs from the roof to the foundation to keep the building envelope intact.

“Andrew haunted Florida,” says Jeff Sweenor, who has been building homes in South County for 30 years and helped develop The Pointe. “Floodwater is more of a concern specific to Rhode Island. We don’t get as many direct-hit hurricanes, but sea level rise is a significant concern to a lot of communities.”

Builders construct resilient coastal homes with break-away walls on the first levels, finishes that can withstand 24 hours of inundation and be wiped clean—no drywall—and heating and cooling systems above the flood line.

“We now have foundation systems and structures that can easily withstand storm events,” says Dave Caldwell, a builder whose family has over 50 years of experience. “Getting the living space 12 feet in the air—that’s a fairly new development, and the most significant to fortify a home in a flood zone. That building science wasn’t done 30 or 40 years ago.”

Building in resiliency adds significant costs to a project, especially if it is in a coastal high hazard area—Sweenor estimates about 20% in additional expense for new construction. And the process becomes exponentially more complicated when a homeowner seeks to improve an existing structure, initiating a lengthy and multi-agency permitting process.

“And that’s why I say to my clients, when looking at coastal home, be happy with what it is, because if you want to change it you are going to be in for a big shock,” says Lori Joyal, a broker for Lila Delman Real Estate since 2005. “It’s a shocker for people when they find out that a house six or seven streets back from the waterfront is in a flood zone. There’s a lot of complex-

ity in changing an already existing property—that’s why I say to my buyers, ‘look at what it is, not what it can be.’”

And Caldwell says that just because contractors know how to bullet-proof a home against water and wind damage doesn’t mean they should. He is no fan of regulations that permit and encourage people to build on fragile land.

“It’s malpractice,” Caldwell says. “Sea level rise is a big threat, and we shouldn’t be building in a salt marsh. I’m not doing houses in areas where the road’s not going to be there in a couple of years. I’m not interested in that project.”

Building buy-in

When Dov Sax went house-hunting in Barrington in 2017, he was looking for four bedrooms, a big backyard, and peace of mind. His last must-have centered on two words never mentioned on any HGTV show: flood risk. At just 6½ feet above sea level, Barrington, Sax knew, was particularly vulnerable to the effects of climate change. So, like any buyer, he went to lots of open houses. But unlike most buyers, Sax, a Brown University conservation biologist with a research specialty in climate change and species extinction, also cross-referenced potential properties with the town’s FEMA flood maps and weighed the future flood risks. He knew that if his lender compelled him to buy flood insurance, it would boost the cost of homeownership and affect his ability to sell the house later on.

“I wanted to steer clear of current flood zones and even areas classified as low risks because the FEMA maps do not consider sea level rise. In the future, some of those low-flood risk areas might get reclassified. I wanted to be in my new house for 20 years or longer, and I didn’t want it to be on a parcel that might get reclassified because that might lower its value,” he recalled. “It really constrained my homebuying options; it made the search harder. There were houses that were nice, but I thought, ‘Oh, I can’t do that. It’s too risky.’ But it really wasn’t on the radar of most people I talked to.”

Denial about the costs of and the threats posed by sea level rise is not exclusive to the average homeowner. In 2012, the North Carolina legislature passed a measure forbidding the adoption of any “rule, policy, or planning guideline that defines a rate of sea-level change for regulatory purposes” after scientists from the state’s Coastal Resources Commission issued a report estimating a century-long sea level rise of 39 inches. In 2015, the Miami Herald reported that former Gov. Rick Scott prohibited the state’s Department of Environmental Protection officials from using the terms “climate change” and “global warming” in any public or even interagency communications.

Rhode Island policymakers seeking regulatory changes to ensure resilient building and the tax dollars to protect infrastructure and their property tax base know that public understanding is critical to building political support for difficult decisions. The second recommendation of that 2016 House commission considering flooding’s economic risk was: “Increase statewide awareness.” The commission acknowledged the ignorance of many policy makers and recommended mandatory climate, flooding, and sea level rise training for local planning commissions, zoning boards, and Realtors and disseminating CRMC’s flood risk information.

Belief in the impact of sea level rise is starting to affect new housing construction. A study co-authored by Lint Barrage, an assistant professor of economics at the University of California Santa Barbara, found that in locales where there is widespread belief in the threat of sea level rise, there is significantly less new housing construction in counties with more sea level rise exposure.

South Kingstown Realtor Will Litvin expects coastal resiliency to increasingly become an issue.

“I had a buyer considering a property in Jerusalem [in Narragansett] who did a good deal of due diligence, and because of the flood risk and the financials that come with it, he is not pursuing that property,” says Litvin, owner and broker of Lighthouse Real Estate Group. “I think when you have a ready, able, and willing buyer who is educated [and] makes a conscious decision not to go forward, how can that not affect things?”

Still, not all buyers—or owners—are that savvy.

“There’s only so much waterfront, there’s only so much water-view property—that’s the premier demand,” says Joyal, whose clients determined to own a beachfront vacation home don’t really factor in flood risks.

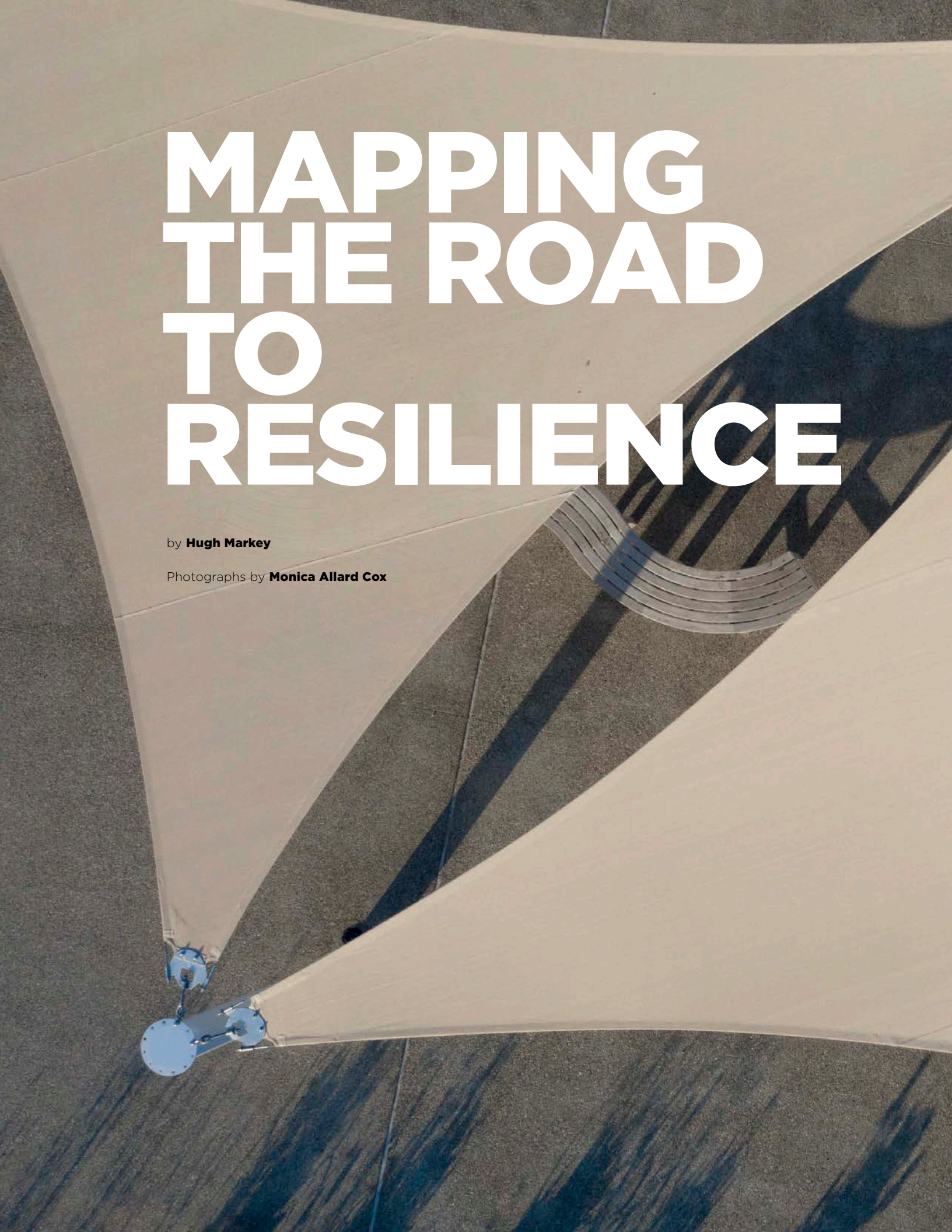
Another study Barrage co-authored with University of Arizona public policy researcher Laura Bakkensen on the intersection between actual flood risk and the average person’s perception of that risk bears that out. The pair studied home price data, conducted a door-to-door survey of residents in flood zones, and used a quantitative coastal housing market model to project coastal home prices across the belief of flood risk and different policy scenarios. They found that residents who live in flood zones appeared to be far less worried about flood damage than those who did not, and an estimated 70% thought that their flood risk was actually below what the inundation model projected.

“If we start slowly, we can spread the pain of transition. If we keep delaying it, you risk these sudden devaluations,” Barrage says. “Beliefs are critical for adaptation to sea level rise. We know we can reduce the overall economic cost if we adapt and look ahead.”

MAPPING THE ROAD TO RESILIENCE

by **Hugh Markey**

Photographs by **Monica Allard Cox**







“THEY REALLY CREATED A RESILIENT SYSTEM. THE SAILS CAN BE REMOVED IN A DAY IF A MAJOR STORM IS IN THE FORECAST”



IF YOU LIVE IN ONE OF THE 21 COMMUNITIES

that abut Rhode Island's coastline, you probably know the place. There's a road in the neighborhood that pretty much leads to nowhere.

At one point it might have led to a beach, but now the end of the road has collapsed as storms and sea level rise have undermined the pavement. There's trash along the edge, and whatever precipitation falls carries that trash and other unpleasanties right into the body of water at the edge of the street. Few people go there now except those looking for an easy way to dump construction debris. There should be a way to fix the place up, but who do we contact to find out?

Teresa Crean, coastal management extension specialist for the Coastal Resources Center (CRC) and Rhode Island Sea Grant, says there have been efforts to map out coastline adaptation possibilities like the theoretical one above for a decade or more. Back then, CRC decided to map all 400 miles of the Rhode Island coastline for vulnerabilities to storm surge, sea level rise, and coastal erosion. At the same time, she says, Save The Bay was working on a series of road conversion projects to remove or reduce impervious surfaces and replace them with more natural materials. "The smaller-scale projects began to add up," Crean says.

Eventually, Caitlin Chaffee, policy analyst for the Coastal Resources Management Council (CRMC), recognized the need to put those and other projects into one central portal so that a variety of organizations could access the information and pass along grant opportunities. In 2018, she received a grant from the National Fish and Wildlife Foundation to create the Shoreline Adaptation, Inventory, and Design project, or SAID. The project is a map of roughly 100 current and potential projects identified by state agencies, cities and towns, and local groups.

"The kinds of projects we're looking for involve adapting to sea level rise, coastal hazards, and improving public safety, but also incorporating some nature-based infrastructure, [like] vegetation around coastal areas where habitat can retreat inland," Chaffee says, adding that having an inventory of proposed projects at the ready will make applying for grants simpler, which in turn will result in more shoreline improvements. "When a funding source comes up, you often don't have a lot of time to put together a proposal; they need a quick turnaround time." The SAID site is a storage place for an inventory of shoreline adaptation projects that could move forward rapidly if money becomes available. "We're really excited to have shovel-ready projects and to move others to shovel-ready status. We hope our coastal communities will be better ready to access these resources. We want to give them the tools to apply for these funds if there are projects they have in mind."

Although the project predates the SAID program, Crean points to Grinnell's Beach in Tiverton as a perfect example of the sort of shoreline restoration project SAID was designed to facilitate.

Grinnell Beach: Eyesore to example

On a warm June day, a group of perhaps 30 people mingle on a cement platform overlooking tidy plantings and a small, picturesque beach. Overhead, a series of triangular pieces of cloth referred to as "sails" shields those gathered from the intense sun. It's a celebration of the area's complete transformation. Save The Bay's Wenley Ferguson explains.

"There was a dilapidated vacant gas station on this lot. Some random trash cans kind of marked the edge, that was it. Trash cans, not boulders, nothing. You could drive right up to the edge, and there was some playground equipment in the area that was in poor condition, and a storm drain in the middle of the beach."

A group calling itself the Grinnell Beach Improvement Committee had been trying to get renovations done for years, to no avail. Tricia Hilton, town council member and chair of the committee, says that before Ferguson came on the scene, they had design work proposed for years but no money to fund it. "People in town were incredibly cooperative, but the feeling was like, 'We wish them well, but we're not holding our breath.'"

Ferguson, Save The Bay's director of habitat restoration, had recently done work with Barrington to improve an area that included moving a parking lot inland, creating a protective berm, and planting beach grass. The project had several characteristics in common with Grinnell. "I met with [the committee] and brought the Barrington project as an example," Ferguson says. "I suggested creating a parking area inland marked off with boulders and creating a dune on the other side. They loved the idea. So we started applying for funds for that project."

She describes the dune that now rises to the cement platform that replaced the gas station as the "veneer" of a habitat. The planting began two years earlier. "We did some native planting, and we did get some funding for planting from CRMC. The big grant that took care of the bulk of the project was a DEM [Rhode Island Department of Environmental Management] Parks grant, as well as a Rhode Island Foundation Centennial Grant, plus a lot of in-kind services from the community, which went to funding the removal of the building, the creation of the sail structure, and replacing the cesspool with a tight tank at the bath house."

"Even the sails were chosen for maximum sustainability," she adds. "They went with a sail structure that can be stored in winter. They really created a resilient system. The sails can be removed in a day if a major storm is in the forecast." The completed renovations should inspire similar projects throughout the state.





“We’re using projects like Grinnell as examples [of SAID-eligible projects] and as launching pads to say, ‘OK, what about this next site?’ There’s a lot of low-hanging fruit,” Ferguson says.

Featured at the celebration are photos of Grinnell’s Beach before renovations. The gas station sits abandoned, cars are drawn up to the water’s edge in random parking, and the entire area looks decidedly uninviting. Hilton laughs at her group’s inexperience before the project began: “I was struck by looking at the pictures. I have no idea what we were thinking when we went into this. If we had known what needed to be

done, we would have just said, ‘Are you kidding?’ But we did it. We were pretty naïve when we started this, but I think it turned out OK. Wenley Ferguson was our guardian angel.”

“I hope [our success] might encourage other communities around Rhode Island that might have these gems of waterfront spots that have fallen into disrepair or are in danger of being swallowed up by the bay to see that it’s not impossible.”

Information about the SAID program can be found at www.crmc.ri.gov/coastalresilience.html

One Block

*Misquamicut businesses
seven years after Sandy*

by **Hugh Markey**



Photograph by iStock/DepthofField

In



“You’re gone; there’s nothing”

John Bellone, owner of the Breezeway Resort, had just recently finished buttoning up his Misquamicut hotel and restaurant after the 2012 season. Water was drained from the pipes, and Bellone was feeling good about the situation.

“We’d had a good season. I had just moved to a little cottage on the water in the breachway.” He heard that a severe storm was on its way, but he wasn’t too worried. “Then all hell broke loose. I didn’t know what to expect; I thought, ‘Well, it can’t be that bad.’ After all, we had had Irene a year before so we didn’t think it would be that bad. But I was wrong.”

If Irene had been an ugly but quick encounter of a storm, Superstorm Sandy was an unwelcome guest that wouldn’t leave.

Several days after Sandy, Bellone began to work his way toward his business and saw dumpsters on properties that were three blocks away from where they

belonged. He soon noticed Breezeway barstools blocks away from his hotel, along with bottles of imported Italian water that only they served, “So that was a really bad sign.”

Lisa Konicki, president of the Ocean Community Chamber of Commerce, had not been overly worried before the storm. After a flood in 2010, the chamber felt that they had faced the biggest challenge in their history. Yet Sandy brought a whole new set of difficulties. “Boy, we got tested. That event was training wheels by comparison,” as far as businesses went.

It’s a memory that still causes Konicki distress. “It was horrific. These people have lived here their whole lives. We’re a tight community. They’ve given our kids their first jobs.”

The Andrea Hotel was torn down after it was severely damaged by Superstorm Sandy.

Image taken from YouTube video posted by PospolitySlimak



In all, 29 businesses and 500 jobs in the Misquamicut area were affected, says Konicki. Immediately after the storm, business owner George Tattersal hired a plane to shoot pictures of the devastation along the coast. He texted Konicki and others the photos, along with a chilling message: “You’re gone. There’s nothing.”

“We had to move forward”

After 100 years of operation, The Andrea Hotel had become a bit frowsy. It had character, like the upper floors that listed a bit as one walked through the halls. But it had no handicapped accessibility and suffered from the wear and tear that a century’s hard use will bring.

Roberta Colucci is co-owner of The Andrea, which her family had operated since 1946. Sandy left the hotel’s southwest foundation severely undermined; there was a flat roof section that would come down. Colucci estimated full restoration would cost at least \$2 million. “We just couldn’t justify that for a hundred-year-old building.” It was a tough blow. Roberta and her sister had lost their grandmother a month before, and their mother wanted no part of making such a big decision. In the end, though, they decided the old building would have to come down.

“It took about three weeks to tear down the building,” Colucci says. The slow process made things even tougher on them. “It reminded me of one of those old Italian wakes where they let the body sit in the house for like a week.”

Angela Thoman, business manager at Paddy’s Beach Club, was at home when the storm hit. “With Sandy, we had no indication of how bad it was going to be. Our hurricane preparedness plan was kind of ‘take what you need over the weekend.’ I grabbed my computer, but not much else. In hindsight, I wish we had a better plan for this.”

Thoman had worked with owners Frank Labriola and Paul Doyle since 2002 and was emotionally invested in the club. “When I saw the pictures and realized what it was, I fell to the ground. I was just crying and upset. It was devastating. We put our hearts and souls into that.”

“I moved my office into my home; we held meetings with staff and vendors downstairs in my house.” Though the roof had blown off and the place was unrecognizable, Thoman says the owners weren’t defeated. “At that point it was shock and awe. But almost immediately after the storm, we texted the owners and they said, ‘There’s no time to wait.’ We had to move forward.”

“I’m just happy we’re still in it”

Superstorm Sandy forced many businesses in Misquamicut to reconfigure their operations. Some had already considered changes, and the storm forced them

FIVE HUNDRED JOBS IN THE MISQUAMICUT AREA WERE AFFECTED

to move forward. Bellone made radical changes to the Breezeway’s sister property, the Hotel Maria, which was also damaged by the storm. “Of course we’re concerned about sea level rise. If you let the beach go where it wants to go, the beach is naturally one block in. We’re next to the water and that is a problem. That’s why we put our building 16 feet above sea level.”

Bellone constructed a smaller restaurant on the bottom floor and rebuilt the rest on pilings with a steel and concrete grid system. “Hopefully the next time the wave comes, we’ll be out of the way.” He remains positive even after the experience: “If you worry about everything, you’ll never move forward. We’re very happy with where we are right now.”

Angela Thoman says Paddy’s, like other businesses, successfully made it through the scramble to open the following Memorial Day. “We had no experience working with contractors and designers. We decided to create non-permanent structures. We needed to at least get the bare bones together for Memorial Day.” The design is much the same today. “The outside buildings are temporary structures; the boards are screwed together so they can be easily undone. If we were to need to take something apart, we can do so immediately.” Sales have increased over the years, Colucci says. “We just seat customers on the sand and can store our materials inside the building if we need to.”

Roberta Colucci had originally thought that they would rebuild the hotel. In the short term, they would serve food cooked in the kitchen they were able to salvage to customers seated on the large cement patio where the old building had stood. Though intended as a temporary setup, business was good, and Colucci realized that the new business model would still be profitable. They did spend \$300,000 on a seawall. “Hopefully, that will help out a little bit,” she says. Their equipment is stored in Westerly in the off season and can be quickly moved in an emergency. “We’ve designed it to save as much as we can.”

Colucci, too, remains positive: “I’m not really one to wallow in the past. I’m just happy that we’re still in it.”



UNHEALTHY TEMPERATURE

RETHINKING PUBLIC HEALTH AS CLIMATE CHANGES

by **Jen A. Miller**

Portrait by **Dana Smith**

WHILE THE IMAGES OF CLIMATE CHANGE TEND TO FOCUS ON THE BIG AND bombastic—ocean water cresting over roofs, rescue boats gliding past submerged cars—its everyday effects are being felt right now in impacts to personal health.

The World Health Organization (WHO) estimates that between 2030 and 2050, climate change is expected to cause 250,000 more deaths per year from malnutrition, malaria, diarrhea, and heat stress. WHO also predicts that the direct cost of treating illnesses linked to climate change to be between \$2 billion and \$4 billion a year by 2030.

“When we think about climate change, people think about these global health implications. But how is climate change going to impact small communities?” asks Jordan Emont, a student at the Warren Alpert Medical School of Brown University, who is creating materials to help educate and prepare doctors for climate change.

Rhode Island is the fastest warming state in the contiguous U.S., according to the Washington Post. Part of the reason for this, says Rachel Calabro, climate change program manager at the Rhode Island Department of Health, is the heat island effect. This means that cities are heating up during the day and not cooling off at night, making it hard for people—especially those without air conditioning—to recuperate from the heat. What that has meant for residents is worsening health for people with underlying conditions and increased numbers of emergency room visits. And climate change is impacting more than temperatures. Increased rainfall is fostering mold growth, which in turn is raising asthma rates, while increasing carbon dioxide emissions are triggering pollen production that aggravates seasonal allergies.

“Climate change is ... a threat multiplier,” Calabro says. “So if you’re already being challenged ... by underlying health conditions or other social or economic issues, climate change is going to make those more challenging.”

Climate & community health

While the Department of Health is working to directly tackle climate change-related health issues, such as by improving the urban tree canopy to try to cool the cities, it is also leading state efforts to address and raise awareness of climate change health issues in local communities.

View up a coal burning power plant cooling tower

Photograph © Michael Turner | Dreamstime.com

“THERE ARE BIG GAPS IN FIGURING OUT HOW WE CONVINCE PEOPLE THAT THIS IS IMPORTANT”

To encourage local-level projects, the Department of Health’s Climate Change Program awarded 10 mini grants to community groups and municipalities for things like workshops on climate change and emergency preparedness, introductions to community school and garden maintenance, and how local food production is a part of combating climate change. The funds also helped senior citizens in Barrington sign up for the CodeRED emergency alert system, which texts, calls, and/or emails residents in a given area with public safety notifications. A youth program used the funds to create emergency preparedness kits and develop materials about the effects of climate change to be part of standard move-in packets for affordable housing units, and the Providence Housing Authority provided air conditioner brackets for residents in family developments. And communities with significant health disparities can apply to become “health equity zones” that receive additional support from the department for interventions to become healthier and more resilient not only to environmental health challenges, but a range of issues from food insecurity to mental health.

The Department of Health is also partnering with other state agencies to identify who most needs information about the public health issues raised by climate change and how to get those messages across.

For example, they worked with infectious disease professionals to identify groups of people who spend a lot of time outdoors—from workers at outdoor clubs to people like youth team coaches and school nurses—to warn them about the dangers of mosquito- and tick-borne illnesses and what they can do to prevent bites. They’ve also partnered with the Pawtucket Red Sox to educate fans at the games about Lyme disease and heat, since the summer is peak time for both tick bites and heat illness.

They have also started a program for outdoor workers, like landscapers and roofers, who are at danger for heat illness, because, says Calabro, they’ve seen an increase in heat illness on high-heat days. “There have been some deaths in the past, so we really want to

make this a priority, especially for employers and the workers ... It’s about how to reach our target populations with some of this messaging who don’t normally engage with the Department of Health.”

Preparing doctors for public health ahead

Emont, the Brown University medical student, is tackling how to prepare doctors to help their patients with climate change-related health issues.

He earned a masters of public health degree from Yale University before coming to Brown, which is when he first became aware of this need.

Climate change, he says, “is likely to be one of the more prominent risk factors for disease for our patients when we become doctors. It doesn’t seem possible that we are getting so little information related to that.”

When he surveyed first-year medical students and asked them about their experience in, current level of knowledge of, and interest in climate change and health, he found that 77.5% had no prior experience with climate change and health. He also found that while 96% of respondents thought that it’s important for medical providers to know about the health impacts of climate change, less than 9% thought their medical school was providing them with sufficient education on it.

As a result of his work, a lecture on climate change has been added to a health science system class. He is also working with the Department of Health to create a video about climate change’s impact on asthma. He hopes that this video—and others—can be given to students as part of their coursework and that he can create a series of podcasts to go with them.

“Across the board in terms of climate change, there are big gaps in figuring out how we convince people that this is important—not just in 20 years, but now,” he says.

OPPOSITE

Jordan Emont is educating fellow medical students about the health risks of climate change.



Living with Lyme

by **Meredith Haas**

Photographs by **Stephanie Craig**

EXPOSED WIRES AND FLOOR JOISTS LOOM ABOVE CYNDI MURRAY'S DINING room table as part of ongoing renovations to remove black mold from her Cape Cod-style home in Middletown.

"Part of our kitchen had to be torn out because of the mold," she adds. "It was plumbing leaks ... the mold had grown inside the walls."

According to Murray, she's part of a small fraction of the population that suffers from chronic inflammatory response syndrome as a result of exposure to biotoxins. In her case, it's a certain species of mold usually found in water-damaged buildings.

While the presence of mold in a home is always a cause for concern, most people don't suffer the symptoms it triggered for Murray, who in addition to mold sensitivity, also has Lyme disease. "You need to have this genetic disposition to be sensitive to mold as well as Lyme or another disease affecting your immune system," she says.





Her sensitivity to mold often exacerbates the Lyme symptoms of confusion or short-term memory loss. She also has some pain in her hands.

"I'm not sure what is from the Lyme or what is from the mold. It's hard to tell where one begins and one ends," she says.

Lyme disease is one of the more well-known tick-borne bacterial diseases that's rapidly spreading across the Northeast and elsewhere because warmer temperatures and milder winters mean an uptick in deer and mice host populations and therefore increasing tick populations. The Northeast is particularly vulnerable because temperatures are rising faster here than anywhere else in the lower 48 U.S. states, according to the National Climate Assessment. Rhode Island alone saw a 22% increase in Lyme cases between 2016 and 2017, according to the Rhode Island Department of Health.

WARMER TEMPERATURES AND Milder WINTERS INCREASE TICK POPULATIONS

But many cases don't get reported, if at all, until well after the infection occurs because the tests still aren't reliable, even after 40 years since the disease was first discovered. Lyme is also known as the "great imitator" because it mimics a whole host of other illnesses from Parkinson's disease and schizophrenia to multiple sclerosis and chronic fatigue syndrome, making it that much more difficult to diagnose.

"We called it my sleeping sickness because no one could figure out what was wrong with me," Murray says, describing the dizziness and extreme fatigue she felt during one summer growing up in Connecticut when she was around 14 years old. "They ruled out mono...but I slept the entire summer."

Now 62, she says she also remembers having concentration problems back in high school and college but seemed to recover and didn't think much about it until she had children.

"Right after I had my second child, I started to notice the symptoms that I couldn't explain. Maybe it

was the hormones that reactivated it," she says, describing similar fatigue but also muscle twitches, heart palpitations, and traveling pain throughout her body.

She was diagnosed with Lyme five years after her younger son was born. As Murray read more about the disease and its symptoms, she became more observant of her children.

"[My younger son] had some strange pains in his head. He would scream and hold his head, and then run off and play," she recalls, adding that he also seemed to have attention problems in school.

She originally thought he might have attention deficit disorder (ADD), but suspected Lyme the more she read about how the disease can imitate other illnesses.

"I had read an article that if you live in a Lyme-endemic area, and your child has been diagnosed with ADD, you should have them tested. That's partly why I thought maybe [he might have it]," she says.

Although his initial test came back negative, Murray says she noticed on the results several bands, or lines, representing different antibodies present in response to a bacterium. To be diagnosed with Lyme disease, five specific bands need to be detected. She wasn't convinced the testing was adequate and brought her son to a specialist in Connecticut who ran a Western blot test, which not only measures antibodies, it also tests them against 10 different proteins found on the Lyme bacteria.

The specialist confirmed that Murray's younger son had Lyme, as well as two common co-infections that can accompany Lyme and produce symptoms such as fevers, fatigue, and headaches.

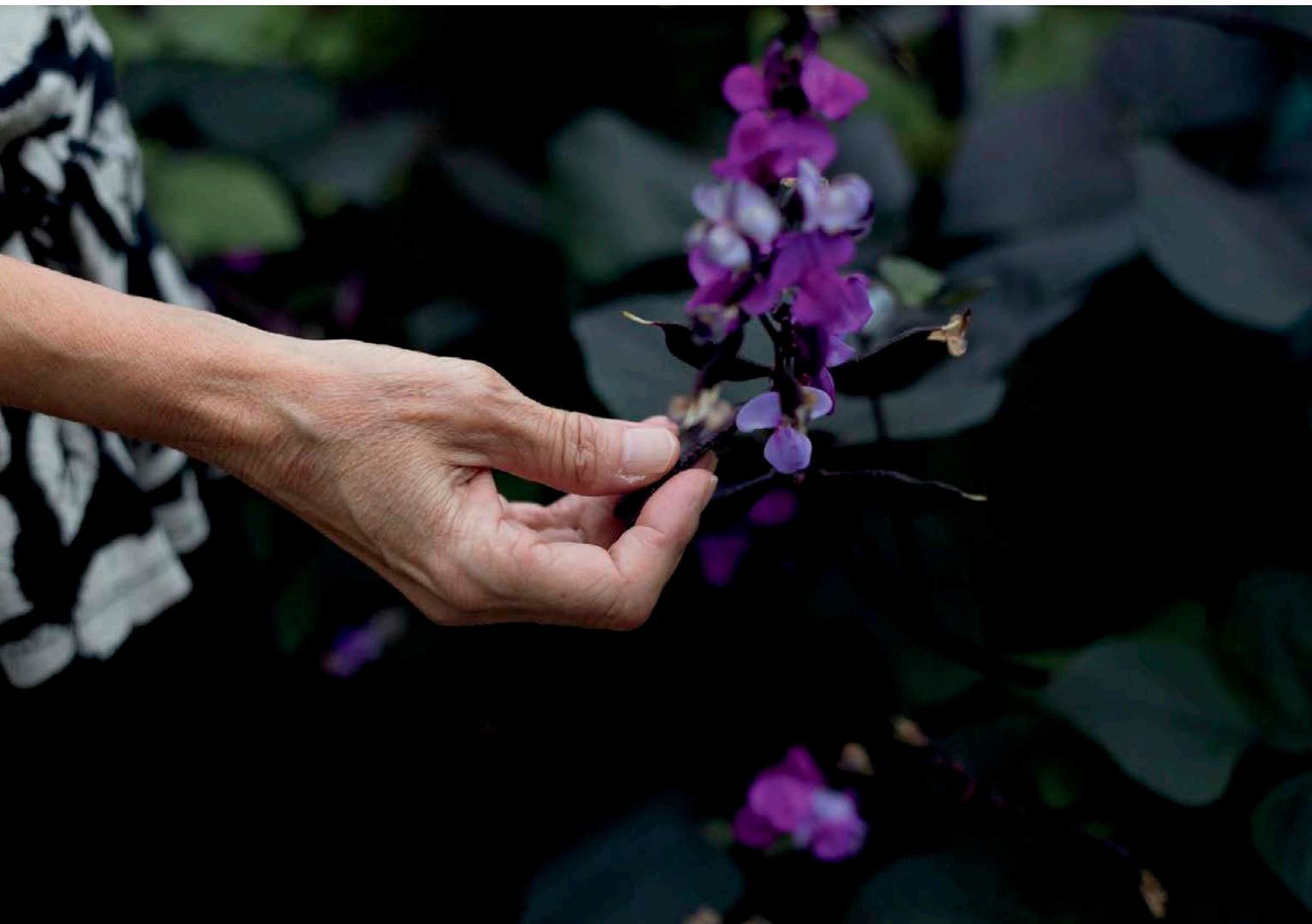
Soon after her son was diagnosed, Murray testified before the Rhode Island General Assembly in 2003 to advocate for insurance coverage for treatment of chronic disease. The assembly passed legislation, the first in the nation, that required that all insurance plans cover diagnostic testing and long-term treatment of Lyme in recognition that when treated early, most patients recover, but when treatment is delayed the bacterium enters the nervous system and can lead to chronic illness.

Murray and her family spent the next 14 years driving from Middletown to New Haven several times a year for treatments with a Lyme disease specialist.

On one of the visits, her younger son described having vibrations in his fingers. Her older son, who accompanied his brother to the appointment, revealed that he also experienced those same vibrations.

"I have to bite my finger to stop it," he said, Murray recalls.

He, too, tested positive for Lyme disease with the same co-infections. Murray later tested positive for



Cyndi Murray enjoys spending time in her garden, despite the risk of ticks.

both infections as well, which is why she believes she must have passed on the disease while pregnant.

“There was no doubt in the doctor’s mind because they were the same diseases and similar protein patterns on the Western blot,” she says.

During that time, her sons were prescribed many different combinations of antibiotics with noticeable improvement, says Murray. “I would see the big difference in their school work and handwriting. Their work improved considerably when they were on antibiotics and deteriorated when they went off of them. It was amazing.”

As for Murray herself, her ongoing health struggles have meant she has had to take a leave from work, and she relies on her husband or sons to drive her to appointments because of a few occasions where she’s momentarily lost consciousness. “I passed out for a

few seconds going over the Jamestown bridge to work one day... That freaked me out.”

Still, between the mold removal and treatments, she was doing well until April.

“My body is rejecting the medication, and I’m feeling worse than ever...so now they’re changing my medicine, and I feel like I’m back to square one after six months,” she says with slight exasperation.

And while Murray will continue to test new treatments to help manage her mold sensitivity and reduce her Lyme symptoms, she is adamant about maintaining an active life.

“I’ve lived with this for so long, and I’m tired of going to doctors,” she says. “But I love to garden, and I know I risk exposure [to ticks] every time I go out, but it gives me joy. You’ve got to find things that give you joy.”

Following the fish

Rhode Island's resilient commercial fishing fleet adapts to species shifts

by **Annie Sherman**

BLACK SEA BASS, ONCE MORE COMMON in the mid-Atlantic than off the coast of New England, has surged northward over the last 10 years to flood local waters. Lobstermen find dozens of these bottom fish in their traps, quahoggers catch them when raking—they are everywhere.

The abundance of this popular fish should have been a jackpot to Rhode Island's commercial fishermen. But 20-year-old state regulations that limit commercial harvest to 50 pounds per day haven't caught up with the burgeoning supply.

"There has been a tremendous shift in black sea bass due to climate change and warmer waters," says Fred Mattera, a retired offshore draggerman and executive director of the Commercial Fisheries Center of Rhode Island. "As many as 20 to 30 years ago, we'd go to New Jersey or the Carolinas to catch sea bass. But now there is an explosion up here, and we could catch tens of thousands of them, but we have to throw them back because of regulations. So there is a shift in dynamics in where and how we fish."

According to the Rhode Island Statewide Climate Resilience Action Strategy, commissioned by Gov. Gina Raimondo in 2016, surface temperatures in Narragansett Bay have risen between 2.5°F and 2.9°F during the past 50 years, and "it appears that the late 20th and early 21st centuries were likely the warmest period the Earth has seen in at least 1,200 years."

A couple of degrees might not seem like a heat wave. But for traditionally colder northern waters like ours, it's a big deal to the marine ecosystem. So, while throngs of this bass and other species are attracted to the area's uncharacteristically warm water, other colder-water animals are driven away. As a result, some fishermen are experiencing really successful harvests in certain species, like crab, scallop, and squid because of a serendipitous alignment of regulations, fish, processors, and market, even though they may have had to change where and what they are fishing. "I used to target strictly lobsters for decades," says Al Eagles, a Newport-based lobsterman and industry advocate for 47 years. "Now I'm branching out and doing crabs and finfishing in season. It wasn't lucrative enough to stay in the bay—the lobster biomass isn't what it used to be. So we have to adjust."

Jamestown lobsterman David Spencer, who has been in the fishing business since 1973, is treasurer of the Commercial Fisheries Research Foundation (CFRF) and also owns the Newport Lobster Shack. He says the population of Jonah crab has filled in, while the lobster population has declined. Fortunately for Spencer, crabs seem to be better adapted to current conditions, and fishing for them does not require a complete overhaul of his gear, method, or fishing locations. And Spencer is not the only one with his sights set on Jonah

crab—their profusion has spawned a new industry for the southern New England lobster fleet. "This is very common. Anywhere from Cape Cod to the south and west, crabs have become a staple for fixed-gear fishermen. It's allowed them to fish year-round," he says. "If they stayed with lobsters, they wouldn't be able to fish year-round because population size is shrinking."

With a long history of being adaptable, the fishing industry sees this upheaval as an opportunity to seek other species, Spencer says. However, fluctuations in fish species took place before climate change, and even today, climate is not the only factor affecting fish populations—water quality and wastewater management, for instance, may also play roles. That, and the cascading effects of climate change that impact predator-prey relationships and increase ocean acidification, for instance, can be hard to predict and adjust to.

"What is out of balance is our ecosystem. We have tremendous abundance of some species, and there are so many possible explanations," Spencer says. "Everybody, from fishermen to regulators, understands that things are changing and they're adapting to the best of their ability. The place for the consumer in all of this is to know what's local, what's in season, and go with that," he adds. "Don't just say 'give me codfish' that isn't in season, because it probably came frozen from a boat in Alaska."



Lobsterman Al Eagles has branched out to harvesting crabs and finfish.

Photograph by Melissa Devine

the trends are and what sells. But there is value in selling local seafood. People have expectations of coming to New England and eating certain local dishes," he says. "You don't go to Florida expecting to eat New England lobster, at least not without paying an arm and a leg for it. I think they come to Newport looking for clam chowder, lobsters, fish and chips, things that are indigenous to here."

Still, keeping pace with the changing fish populations can be challenging for fishermen, who are licensed by the species and have invested in specialized boats and gear; it's typically incredibly expensive for them to switch, which is why many haven't. Like Spencer and Eagles, they fish as many species as they can with their existing gear and licenses, but if something happens to those species, there is no Plan C. This specialization "can severely inhibit the ability of fishing operations to adapt to changes in the timing, spatial distribution, and composition of local fish stocks," says Sarah Schumann, a member of the Rhode Island fishing industry, co-coordinator of the Resilient Fisheries RI project, and co-author of *Simmering the Sea: Diversifying Cookery to Sustain Our Fisheries*. "It also makes it harder for the industry to respond to changes in price and consumer demand for fishery products."

Meanwhile, water temperature and food sources will continue to influence where black sea bass, scup, lobster, and dozens of other species congregate. How fishermen—and consumers, and regulators—are able to adjust may help determine the fate of their industry.

"I feel like Rhode Island has done really well in adapting compared to other other places. But there are so many intersecting stressors," Schumann says. "Are we in a bubble? And if so, when will it burst? If squid or crab were to go away, for whatever reason, it's not at all clear what fishermen would turn to."

Another problem is processing limitations, with facilities shrinking in resources and lacking technology to handle some of the newest abundant landings. Scup is the perfect example. This cute little whitefish has been harvested since the 1800s when it was the most abundant fish of the era. As a result, it was overfished, then highly regulated, and has now rebounded. But it is largely overlooked commercially because while it was restricted, it lost market share and was replaced by tilapia—so at times of plentiful landings, it fetches a mere \$0.10 to \$0.20 apiece on the market. "It's very disillusioning and disappointing, not getting a large return for the effort. So fishermen don't target scup, they just use it to augment their trip," says Mattera. "It's a very underutilized species."

Scup is also difficult to debone and filet, and because Americans generally don't know what to do with a whole fish, he says, he's working through CFRF

in collaboration with Johnson & Wales University and Pier Fish Company in New Bedford to modify an Icelandic filleting machine to streamline this process. This measure could revolutionize the scup industry in the Ocean State.

"We are creating diversity at sea. Instead of shying away from scup, you might be inclined to target it," he says. "These are the things we need to continue to foster, to be resilient, to get through the shifts in markets and climate change and compete with imports, and try to get the consumer to recognize that wild-caught fish right here on your doorstep is the best."

Indeed, Midtown Oyster Bar operations manager Charlie Holder agrees. Scup is not on the menu there yet, but with 60% of the business at his Newport restaurant dedicated to exclusively local seafood and 75% of his menu changing with the varying species available at any given time, Holder won't rule it out.

"There's always a fluctuation of what

Rising

DISPATCHES FROM THE NEW AMERICAN SHORE

By Elizabeth Rush

Reviewed by **Monica Allard Cox**

FROM THE 18TH CENTURY ON, EVERYONE FROM farmers to city leaders to railroad barons filled in millions of acres of wetlands across the U.S., often with federal government support. In 1977, President Jimmy Carter ended that assistance, and the Clean Water Act added further protections for these ecosystems, but filling continued. It wasn't until Hurricane Katrina that the nation's 200-year history of "reclaiming" wetlands was revealed to the public at large as an enterprise that had put swaths of the population at risk.

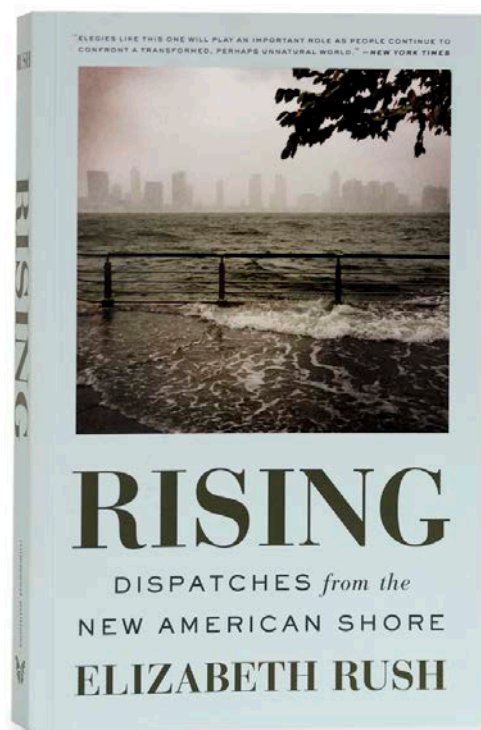
That lesson was reinforced in 2015 with Superstorm Sandy's destruction in New York City's low-lying coastal neighborhoods, many of them developed on filled lands.

So, it may come as a surprise to learn that Facebook recently built a 430,000 square-foot campus on former tidal wetlands in San Francisco, on land that it further filled with 72,500 cubic yards of dirt—while simultaneously donating \$15,000 to the restoration of San Francisco Bay marshes.

Elizabeth Rush relates this ironic anecdote in *Rising: Dispatches from the New American Shore*, which looks at marsh communities—human, plant, and animal—struggling in the face of sea level rise from the Northeast (including Rhode Island) to Florida, Louisiana, Oregon, and California.

While the Facebook story identifies a satisfying culprit (Rush adds that Facebook will benefit from government-funded infrastructure repairs in the event of a flood), most of the book faults U.S. society as a whole for sating its thirst for expansion by filling in wetlands, then relegating the poor to live in those flood-prone areas. When their communities are devastated by storms, these disenfranchised people have few resources with which to move, rebuild, or elevate their homes.

This environmental injustice is at the heart of *Rising*, and Rush discovers no simple answers. She admires the scope of that effort in San Francisco to restore tens of thousands of acres of wetlands, Facebook headquarters notwithstanding. But she also fears that



its secondary effect—reducing flooding in surrounding neighborhoods—will make those areas attractive to wealthy buyers and price current residents out of their homes.

Rush takes more comfort from the stories of residents of one modest-income Staten Island community hit by fatal flooding during Sandy. The survivors banded together, developed a buyout plan, and demanded that they be relocated and that their properties be "returned to nature," not turned over to a developer.

Rush's book is strongest when she lets coastal residents like these tell their own stories. And that, she writes in her afterword, is what may be missing from so much discourse around climate change. A man at a *Rising* book event asks her: "But what do nonbelievers say when you show them the charts that illustrate temperature change over time? How can they deny the climate science?"

"I don't go into my interviews with charts," she answers, "I ... ask residents to tell me their flood stories. I am there to listen."



The bowman frees the jib halyard onboard *Mariette* in St. Tropez, France. *Mariette* was designed by American naval architect Nathanael Greene Herreshoff in his yard at Bristol, Rhode Island, in 1915.

Photographer Michael Kahn specializes in sailing and seascape photography. He captured this image on traditional black and white film and developed the silver gelatin print in his darkroom.

41° N

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