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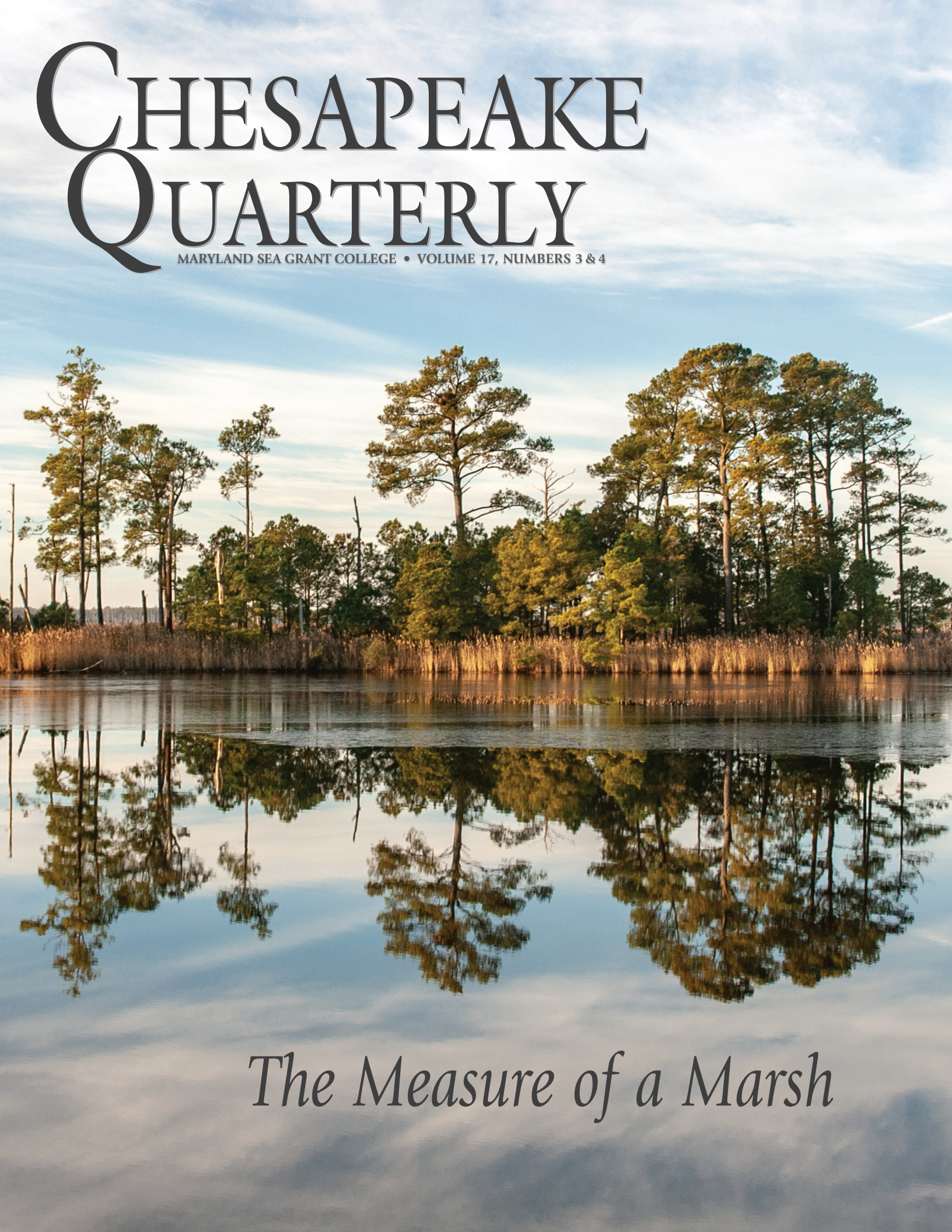

The Measure of a Marsh

contents

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Chesapeake Quarterly explores scientific, environmental, and cultural issues relevant to the Chesapeake Bay and its watershed. The magazine is produced and funded by the Maryland Sea Grant College. The college receives support from the National Oceanic and Atmospheric Administration and the state of Maryland.

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Cover photo: *Marshes at Blackwater National Wildlife Refuge have converted to open water, eroding protection for surrounding communities and important animal habitat.* PHOTO, NICOLE LEHMING / MDSG

Seeing Smithville, and other places in the same boat

Editor Rona Kobell *in the field.*
PHOTO, NICOLE LEHMING / MDSG

Sometimes we look at a place but never really *see* it. Such was the case with Smithville, a small Eastern Shore community on the fringe of Blackwater National Wildlife Refuge in Dorchester County. Smithville's remaining residents worry as a nearby marsh encroaches on their beloved church and adjacent cemetery. Most of the houses were abandoned long ago, but the church is a beacon for the surrounding communities, and the cemetery is an important link to their past.

I asked many longtime Eastern Shore residents about Smithville; most hadn't heard of it, though they often drove by it. Like many small Shore towns, Smithville has lost population because of a variety of factors, some environmental and some economic. Many communities — some on islands, some on low-lying places on the mainland — are seeing increased flooding, eroding banks, rising water levels, and marsh migration. Residents aren't certain how to live with these changes.

To help communities discuss the landscape changes happening around them, a group of University of Maryland anthropologists developed a community network they hope can develop solutions. Called collaborative learning, this approach has brought together county officials, residents, faith leaders, and specialists from regional universities. Already, the effort has led to a living shoreline project on Deal Island that will help protect property in a fast eroding area. The Maryland Department of Natural Resources broke ground on the project last summer.

In this issue of *Chesapeake Quarterly,* we share stories and data from the collaborative learning project, as well as features on the changing marshes that help to protect Shore communities. We'll also tell you how Sea Grant funding is helping two fellows learn more about contaminants in Baltimore waterways.

We couldn't produce this work without our talented staff and interns. In this issue, we'll introduce a few people: Taryn Sudol, who is coordinating scientific information on marshes and organizing a summit for researchers; Jennifer Dindinger, a watershed specialist helping Shore communities stay resilient in the face of climate change; communications interns Ben Anderson of the University of Maryland, College Park, and Alexandra Grayson of Howard University; and Wyman Jones Jr. and Jalysa Mayo, filmmakers trained at Morgan State University, who have helped us bring the Smithville story to film. Special thanks to Patricia Delgado at Jug Bay Wetlands Sanctuary for her assistance with the marsh graphic (page 8).

We hope the stories reveal places and issues you might have missed. And if we've neglected something, as always, please let us know.

— *Rona Kobell*

Smithville Tries to Stem the Tide

An Eastern Shore hamlet looks to save its church and cemetery

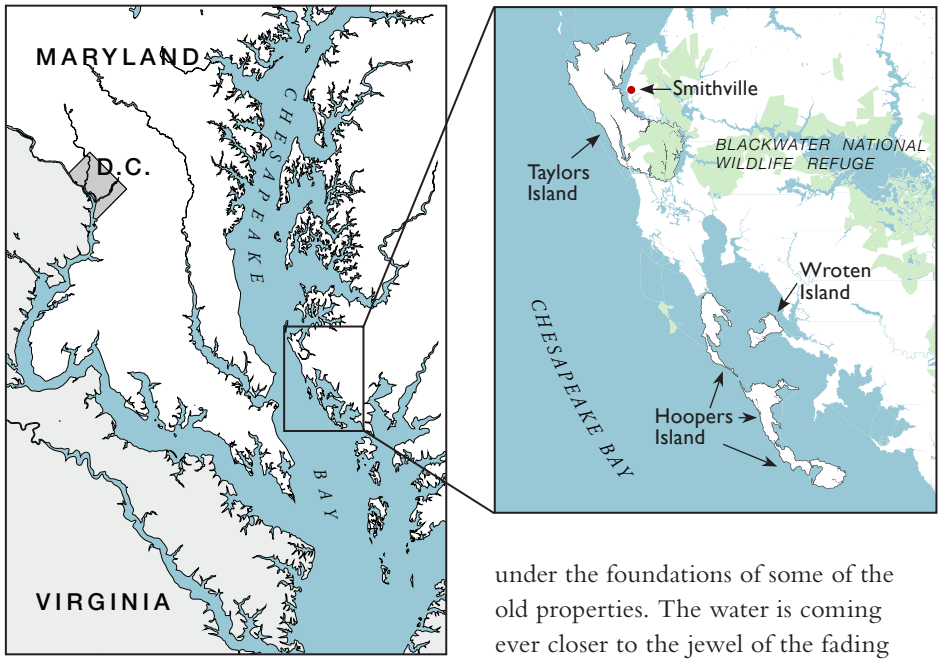
by Rona Kobell

Luther Cornish walks slowly behind the mower, pushing it up the slopes that form the ditch that carries water away from his home. He repeats this task almost every day in summer. He is 89 years old, and on this day, the air is thick with mosquitoes; it's so humid that it feels like he's breathing the steak sauce his relatives used to package on this marshy appendage along Maryland's Eastern Shore. But if he doesn't mow, the overgrown grass would catch the rainwater and block the drainage area, allowing water to saturate the ground and possibly seep toward the home where he and his wife, Doris, have lived for decades and raised five children.

Anywhere else, a man his age would hire a young neighbor. But Luther and Doris are two of just four people left in Smithville, a Dorchester County hamlet a few miles from Taylors Island and Blackwater National Wildlife Refuge. And the other two are an elderly woman and her caretaker.

A few decades ago, Smithville had 100 residents. There were enough children to field a baseball team, enough jobs in the farms and canning factories

Luther Cornish *stands in the cemetery across from his home. Beyond the tall marsh grass is water.* PHOTO, NICOLE LEHMING / MDSG



Despite heat and mosquitoes, *Luther Cornish (top) mows his lawn several times a week in the summer to keep the drainage area clear. Maps (above) show Smithville's location and nearby lands. Taylors Island and Upper Hooper Island are still solid communities; residents abandoned Wroten Island decades ago for higher ground in Dorchester County.*
PHOTO, RONA KOBELL; MAPS, NICOLE LEHMING (BASE MAPS BY VECTORSTOCK.COM AND DORCHESTER COUNTY DEPARTMENT OF TRANSPORTATION)

to keep a couple dozen houses neat and tidy. But the jobs left and so did the people — though many of their uninhabited homes still remain.

Across the road from those last four residents, a marsh has been slowly converting into open water, standing under the foundations of some of the old properties. The water is coming ever closer to the jewel of the fading town: a white clapboard sanctuary called New Revived United Methodist Church, its adjacent cemetery filled with names that everyone around here knows — Wilson, Wheatley, Ellis, Cornish. It is an almost ghost town next to a ghost forest, where salt marsh has encroached and killed many of the trees.

"This is all the past I've had, because I've been here all of my time. If we lost that [cemetery], it would take away a part of me," said Doris, who is descended from both the Wilson and Wheatley families. "If something isn't done, there won't be any more chance here. But we don't have the money, and we can't seem to get the help."

Holding Back the Water

Recent national climate assessments predict that the Eastern Shore's sea level will rise three feet by 2100. Ming Li, a physical oceanographer at the University of Maryland Center for Environmental Science (UMCES), says that prediction is conservative. But even so, it will put half of Dorchester County underwater, including Smithville, Taylors Island, Hoopers Island, and many other towns on the low-lying peninsula.

Several communities have already disappeared. All that's left of Wroten Island are some jagged headstones in a marsh that's giving way quickly to open water. On Holland Island, evacuated in the 1920s, a few graves are all that remain of a productive fishing village. On Hoopers Island, at Anchor of Hope Cemetery, even some of the graves are washing away.

Dorchester County officials have examined the New Revived Church property to determine if a berm or barrier could protect the church and keep water out of the cemetery. They're not sure of the best course: berms must be maintained, and the church doesn't have a staff to do that, or money to build them.

"We have to work hard and fast to protect the historic and cultural resources here, and that includes New Revived," said Anna Sierra, the county's emergency planner. "There is a spigot of money when you have a disaster. We don't have access to that same funding. There are six fire departments in danger of flooding. The challenges that this county faces are not insignificant."

The Sea Grant Law Center has investigated options available to New Revived Church. The Federal Emergency Management Agency will provide funds for graves flooded in a disaster, but it doesn't provide help in other situations. State law would allow the church to move the graves, which other communities on the Shore have done when their cemeteries flooded. Some communities in Louisiana have opted to record and map the graves

while allowing them to succumb to the waters, given that saving all of the remains would be a huge undertaking.

Bulkheads and berms to save cemeteries will only delay the inevitable onslaught of water, according to geologists Orrin H. Pilkey of Duke University and William J. Neal of Grand Valley State University in Michigan. In an op-ed for the *Raleigh News and Observer,* they argued that an effort to save an Outer Banks cemetery "is repeating the mistakes of the lost islands of Chesapeake Bay that tried to stave off the sea, only to lose all."

Li, who lives on the Shore and works at the UMCES Horn Point Laboratory in Dorchester County, is sympathetic to Smithville's plight. But his research has convinced him that hardening more shoreline to protect property ultimately increases storm surge and flooding in other places. The best bet, he believes, is to work with nature: find low spots, particularly those that are open land, and allow them to be inundated.

He adds that policies to curb greenhouse gases on a global scale will reduce emissions and slow ocean warming. Maryland has been aggressive about that, even suing the EPA over emissions from Midwestern states.

But it's unlikely that those efforts will keep the water out of Smithville. The marsh is only about 10 feet from the cemetery, and a few of the headstones close to the marsh grasses are already in bad shape. When Keith Cornish and Carroll Meekins — Luther and Doris's son and son-in-law — dig new graves, many of the plots fill with water.

That's because the water table in low-lying areas is just a couple of feet from the surface, and the soils are sandy and permeable, explained Scott Phillips, a hydrologist and Chesapeake Bay Coordinator for the U.S. Geological Survey. Cemeteries on the Eastern Shore are getting hit from two directions, Phillips said — from above, with heavier and more frequent rains, and from below, as sea level rise slowly pushes the water table closer to the surface.

"In some places they can't even dig any graves," Phillips said. The shallow groundwater is the reason most Shore homes don't have basements, and most of the soil is ditched so farmers can till it. As sea level rise continues, he said, Eastern Shore families may have to bury their loved ones aboveground, as they do in Louisiana.

Holding on to History

Those who grew up in Smithville remain undeterred. About 25 parishioners drive to New Revived every Sunday from nearby Madison, Church Creek, and Cambridge. After services they share a meal in a cozy hall attached to the church.

Each year New Revived hosts a homecoming weekend that draws 200 visitors. It feels like a family reunion, because it is: "Everybody on Smithville Road, whether you know it or not, is related," said former Smithville resident Deborah Pugh.

Pugh, who now lives in Atlanta, fondly remembers Christmas pageants, Easter Egg hunts, and mountains of snow piled high around the church. When the marsh froze over, the children would skate on it. In the summer, it was dry enough to walk across.

"We will do what we have to do to preserve what [our ancestors] fought so hard for," Pugh said. "It wasn't so easy for them. If you have a heart and a soul, you can't let it go."

In the mid-1800s, Baltimore had the nation's largest population of free African Americans. But it was a different story in Dorchester County, where about half the black population was enslaved. Freed blacks established Smithville around that time. They built Jefferson Methodist Episcopal Church in 1876. When it burned in the 1920s, they gathered timber from the nearby woods and built the current church, renamed New Revived when three nearby parishes merged with it. The building was completed in 1925.

The congregation's oldest member is 102; the youngest, Luther and Doris's great-granddaughter, is 2. At the new Harriet Tubman Underground Railroad Visitors' Center, ranger Angela Crenshaw often tells visitors about Smithville. "The fact that it is still here, and they are still holding services at New Revived, is really important," Crenshaw said.

Smithville natives *often describe the community as idyllic. The town's church, New Revived United Methodist (above), was the social hub. Kids play in the snow (top) during the President's Day storm of 1979.*
PHOTOS, COURTESY OF JOANN SLACUM, CAMBRIDGE, MD

The parishioners have questioned how governments decide which properties are saved and which are allowed to slip into the tides. Most infrastructure coastal protection money goes to wealthy communities, according to Allison Reilly, a civil engineer at the University of Maryland,

College Park, who has researched disparities in flooding mitigation.

Sacoby Wilson, an environmental health professor in the University of Maryland's School of Public Health, studies environmental justice, with a focus on the disproportionate amount of pollution and toxic substances that poor and minority communities have historically had to bear. Wilson said that protecting cultural resources, such as cemeteries, is an important part of his work in disadvantaged communities, whether urban or rural. All over the country, he says, lower-income communities, which tend to sit on low-lying land, are experiencing most of the cultural losses. Smithville appears to be no exception.

"Those cemeteries are part of the legacy of their struggle to be recognized as Americans, as freed people, and those are important cultural assets," Wilson said. "When you think about the environmental justice movement, it's not just about fighting against hazards — it's about protecting culture."

An Uncertain Future

Luther and Doris Cornish have not experienced flooding at their home, in part because of Luther's diligence in clearing the ditch. But they can see the marsh coming closer. Keith Cornish says that the tide goes out, but the water stands in the marsh for days. Carroll Meekins has noticed mold and moss on the church's outer walls from the dampness.

University of Maryland researchers have been working with the Cornishes and other church leaders to try to find solutions to the encroaching water. Indeed, several Shore communities are working with scientists to assess their risks and decide whether to try to mitigate the damage or to retreat, to build higher or to move away (see "Churches," page 15).

On one recent Sunday, the weight of the future seemed too much to bear. Luther stood, a hymnal in his hand, and swayed as Pastor Joan Brooks led the congregation in prayer: "The black church is not dying, God's church is not dying . . . because the church is in me. As long as I'm alive, the church is in me."

Meekins sang along next to his father-in-law. But after services, the longtime delivery truck driver admitted he wasn't so sure. The factory where he and his neighbors canned Chung King Chinese food closed in 1995. It was replaced by a Nabisco factory that received millions in state subsidies. But it closed just seven years later. Like the people, the jobs never returned. Will the land be next to go?

"I'm around, and I've seen things," Meekins said. "And I'm not sure how many more years we've got."

— *kobell@mdsg.umd.edu*

Sea Grant film explores shrinking Smithville

Smithville sits on the edge of Blackwater National Wildlife Refuge on Maryland's Eastern Shore (see "Smithville," page 3). A century ago, Smithville had more than 100 residents; today it has four. Many factors led to the near abandonment of this historic town. It is now a stop on the Harriet Tubman Underground Railroad Tour. Canneries closed, jobs disappeared, opportunities elsewhere beckoned. But central to the town's demise is the marsh that's encroaching on the town's church and its cemetery, key links to its past.

When we decided to write about Smithville, we knew it was a visual story — versions of which could be retold around the Chesapeake Bay, along the Gulf Coast, and in other low-lying areas across the country. The climate is warming, the oceans are expanding, and extreme weather is becoming the norm. The slow encroachment of water, rather than severe storm-driven disasters, is hardest to address, according to Dorchester County emergency managers. Those who are watching their lands disappear, and feel powerless to stop the water, don't often have an opportunity to tell their stories.

We thought a film could tell the story of one community by documenting the perspectives of Smithville residents, the county officials who want to help them but lack the resources, and the anthropologists from the University of Maryland who are studying shifting local attitudes about climate change.

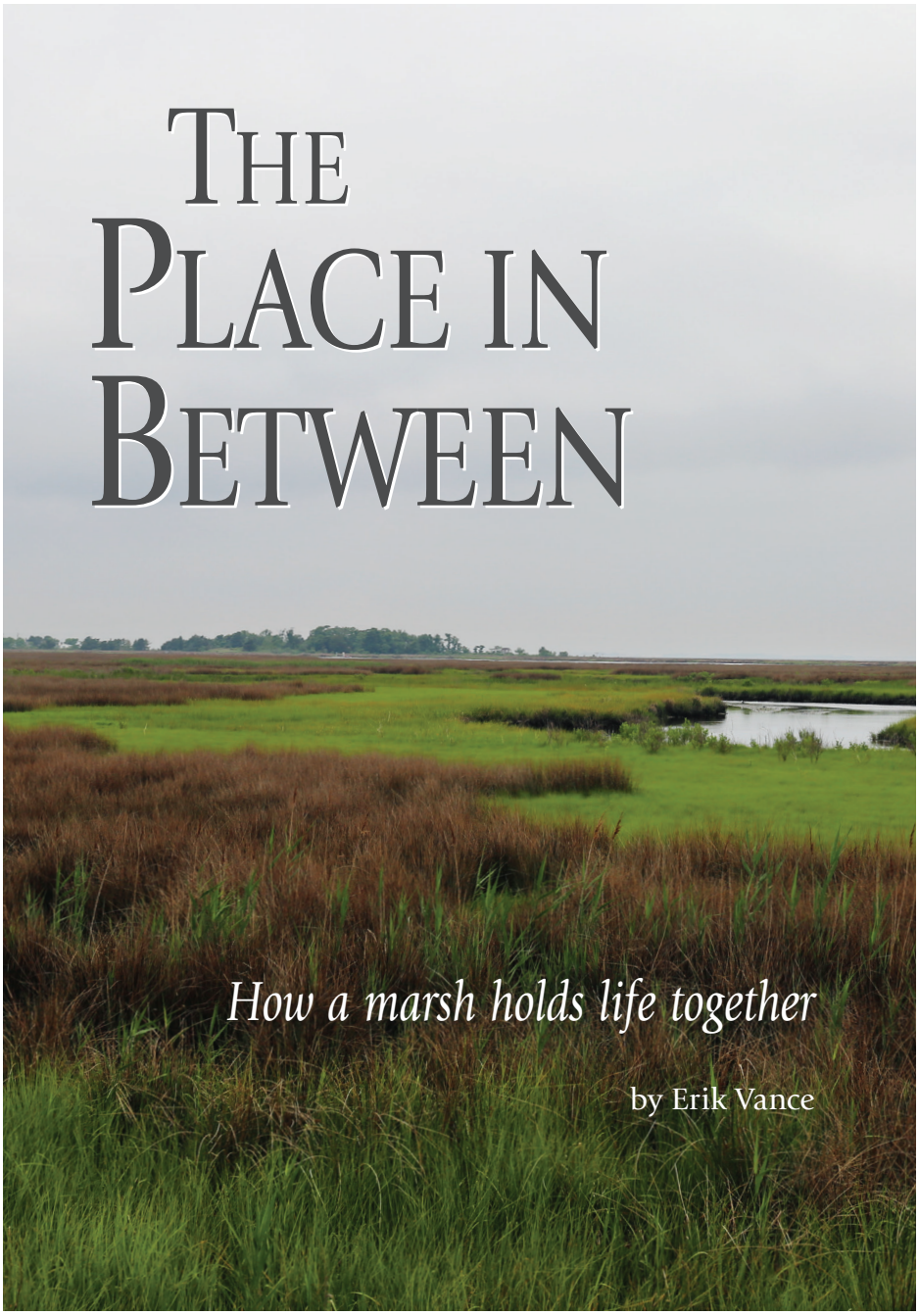
Two interns joined the film project from Morgan State University, where they studied multiplatform production: Wyman Jones Jr. is a senior and Jalysa Mayo graduated in 2017. Maryland Sea Grant science editor and writer Rona Kobell was executive producer and graphic designer and photographer Nicole Lehming assisted with visuals.

The film, *Smithville,* is available at youtube.com/user/MDSeaGrant. We'd like to thank the members of New Revived Church and local government officials for their time and generosity.

— Rona Kobell and Nicole Lehming

Wyman Jones Jr. *(foreground) and Jalysa Mayo directed, filmed, and edited* Smithville. PHOTO, RONA KOBELL / MDSG

The Place in Between



How a marsh holds life together

by Erik Vance

There is only one way to properly experience a marsh on the Chesapeake Bay. You need to get in a boat and see it, from the bottom up.

Sliding a kayak into the water at dusk in Blackwater National Wildlife Refuge — a complex of brackish marshes, uplands, and open-water ponds that cover 45 square miles of Maryland's Eastern Shore — seems, at first, like an intrusion. The blackbirds grumble and warn each other of a potential threat. The cordgrass, which normally sways gently like harvest wheat in the failing light, occasionally explodes with an outraged mallard. A great blue heron looks up and eyes you suspiciously.

But after a minute or so the marsh goes on about its business. Above the water's surface, *Spartina* grasses compete with taller *Phragmites*. A bald eagle lazily lifts off from a dead tree, while a kingfisher drops into the water and flies off, seemingly laughing. Tidal channels are mazes of hidden passageways, and you quickly realize how complex the marsh is. The loss of even an inch of water could get you stuck out here all night.

"That's a no man's land," says the guy who rents me the boat. "A few years ago, a guy got lost out there for four days."

I believe it. But his warning illustrates the dual role of marshes in the human imagination. On one hand, they are boggy, impassable, often smelly places filled with spiders, pasty mud, and sharp reeds that poke you in a thousand different places. On the other, they are serene landscapes and among the most important ecosystems on Earth — not just for the animals that inhabit them but also the humans that observe them from shore.

But what does that duality mean? At this time, when so many crucial ecosystems are threatened, why should anyone care about something as seemingly expendable as a smelly little bog by the Bay?

A Dynamic Place

On the surface, a marsh is just a transition zone. Too dry to be bay, too wet to be forest, it's the habitat that can't make up its mind.

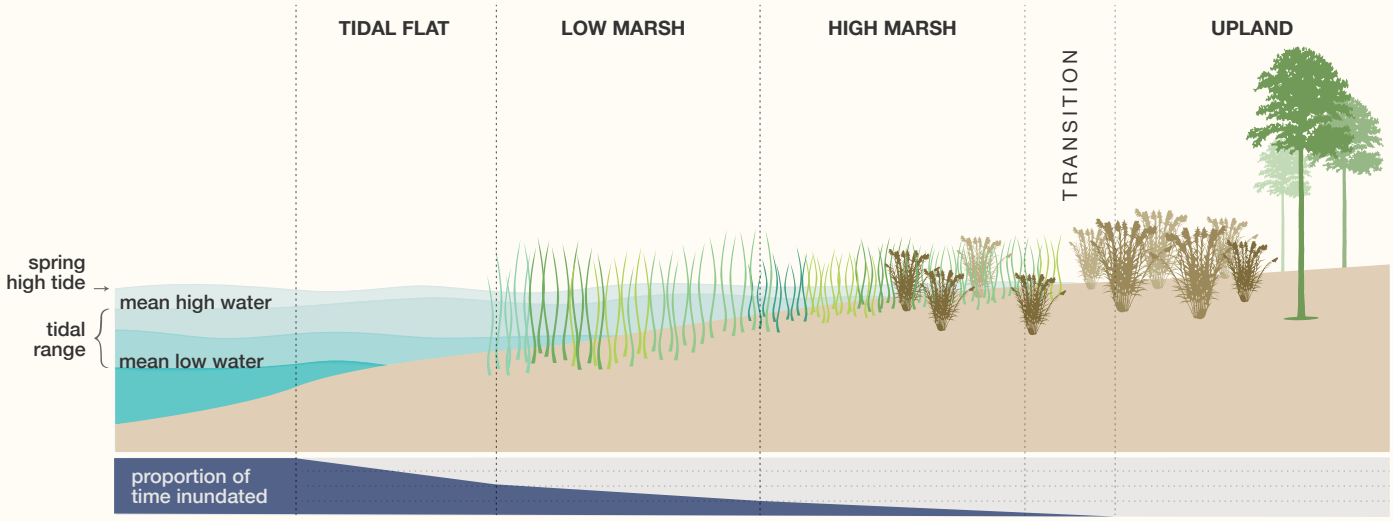
But it's that ambivalence that engenders the ecosystem that's indispensable to both. A marsh forms a bridge between aquatic and terrestrial ecosystems, sustaining life forms that can't live in either.

As the Chesapeake Bay loses much of its land to erosion and sea level rise, marshes reinvent themselves. They lose and gain ground, as sediments ebb and flow. High areas become wet only occasionally, such as during big storms or very high tides, while low areas are inundated with seawater more frequently. But marshes are dynamic and respond to changes in water level by shifting inland. High marsh can become low marsh if water intrudes more often. Plants assist in

A typical marsh *on the Eastern Shore.*
PHOTO, EUDORA MIAO

Anatomy of a saltwater marsh

A marsh is a dynamic ecosystem driven by flooding or inundation from tidal waters. Many habitat characteristics — including the plants that grow there and the animals that live there — are defined by how often and how much part of a marsh floods. The tidal flat and the low marsh get inundated twice daily due to regular tides. Tidal flats are often fertile areas for submerged aquatic vegetation, while plants like *Spartina alterniflora* live in the low marsh. High marsh is inundated during high tides and supports a variety of salt marsh grasses. Upland areas beyond the flooding zone are habitat for poplars, pines, and other tree species. *Phragmites,* which readily adapts to different conditions, often spans the high marsh into the upland. A transition zone, such as a forested wetland or a swamp, often occurs between the high marsh and upland, and it can be inundated during high spring tides or storm surges.



GRAPHIC, NICOLE LEHMING (ORIGINAL GRAPHIC BY VIRGINIA INSTITUTE OF MARINE SCIENCE)

marsh stability by trapping mud. Under favorable conditions, the ecosystem can maintain a dynamic equilibrium with increasing water levels.

A recent study published in the journal *Nature Climate Change* suggests that scientists might have overestimated the vulnerability of these wetlands, including some in the Chesapeake Bay. The research team, led by Matt Kirwan at the Virginia Institute of Marine Science, used models that may be more robust than previous ones. They consider the ability of marshes to migrate inland and build elevation by capturing suspended sediment and also the contribution of organic debris from plants to the marsh surface. If marshes can migrate and are not deprived of sediment from bays and rivers, Kirwan and his team believe that marshes can adapt, even with increasing rates of sea level rise.

Another study — by Leah H. Beckett of the Northwest Indian Fisheries Commission and University of Maryland scientists Andrew Baldwin and Michael Kearney — proposes that sea level rise can help marshes increase elevation with more sediment input that stimulates plant growth and reduces decomposition rates — but only up to a point.

We need marshes to protect the land from the sea, the sea from the land, and the inhabitants from everything else. Perhaps a bigger threat than climate change, say Kirwan and his team, is hardened shoreline and the barriers that humans create to protect themselves. An engineered environment does not let marshes take advantage of natural ebb and flow. With 20 percent of the Chesapeake shoreline hardened, marshes can't be their dynamic selves.

How do marshes protect the land from the sea? Along the Chesapeake Bay, they act like massive sponges absorbing storm energy. Or to put it another way, marshes do to waves what waves do to people who run through them: they trip them up and drag them to a standstill.

When a powerful hurricane or tropical storm, like Sandy or Harvey, slams into the coast, we hear a lot about the ability of marshes to dull the storm's impact. Essentially, they absorb the water and the energy of the waves that nibble at their edges.

Then they replenish themselves with the constant flow of silt from bays and rivers and dead plant material from the wetland itself. With the continual die-off and return of grasses, they produce more than twice as much biomass as a pine forest or a farm field. And all that material sinks back into the soil, decaying into a rich, black clay. In this way, the marsh can be self-correcting, always sitting just above sea level.

These days, though, some experts wonder if marshes may be losing their battle for survival. As sea levels rise at faster rates, ocean water increasingly washes over these wetlands, sometimes covering them altogether — and it only takes a couple of inches of water to do that.

"It's not about the height of the water, it's about the time of inundation," says Keryn Gedan, a biologist at George Washington University who specializes in marshes and coastal ecosystems. "Especially here in the Chesapeake, where sea level rise is happening faster than nearly anywhere in the world."

The rate of sea level rise between Cape Cod and Cape Hatteras is three times the global average. About a third of that rise is caused by a form of subsidence, called glacial isostatic adjustment, where land was shoved up by glaciers. Now the land is reverting to its original shape. Mostly, though, the rise is due to increasing ocean temperatures.

In the mid-Atlantic, sea level rise is exacerbated by other conditions, including melting of polar ice sheets and changes in the flow of the Gulf Stream. Together they are causing ocean levels to rise at a rate of more than two feet per century, according to the 2013 Maryland Commission on Climate Change report.

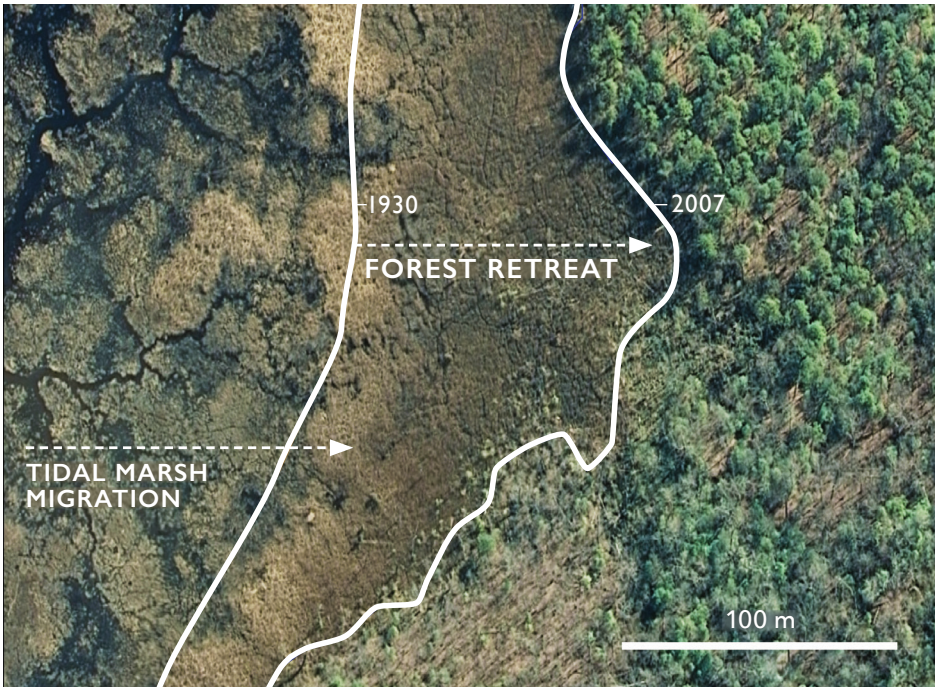
The effects are already visible in Blackwater, where Gedan does research. The rising water and saltwater intrusion has been so severe here that it's covered marshes and killed entire stands of pine trees, creating so-called ghost forests. Trees here appear as clusters of nude sticks protruding from the water or invading marsh, while 50 feet away the forest flourishes.

"The trees are dying faster than they are falling," Gedan says.

Land and Sea

It's not just the land that needs to hold back the sea: the sea also needs to hold back the land. That is the second service that tidal wetlands offer. They take in the runoff of modern civilization and send it out clean. It's no wonder they're often called the kidneys of the Chesapeake.

"You can dump raw sewage into a wetland for a while and it'll work," says the University of Maryland's Baldwin, a marsh ecologist. He quickly points out that this would be a very bad idea for the ecosystem, but it demonstrates the extraordinary filtering power of tidal marshes. In fact, the town of Mayo, south of Annapolis, runs nearly one million gallons of wastewater per day through several types of constructed wetlands, mimicking natural processes to clean the water.



Marshes gain and lose elevation *as they move. The aerial photo (above) shows a marsh and its environs in Delaware Bay. The edge of the forest has shifted as tidal marsh has pushed landward over seven decades (1930–2007). Marshes at Blackwater National Wildlife Refuge (right) have converted to open water.*
GRAPHIC, JOSEPH SMITH; PHOTO, DANIEL STRAIN / MDSG

On the Patuxent River, according to a 2014 report produced by the Chesapeake Bay Program Office and the Center for Watershed Protection, marshes pulled out 35 percent of the nitrogen pollution and 81 percent of the phosphorus. Most of the water wasn't even running directly through the marshes. Yet the pollutants found their way there anyway.

Paradise for Birds, Dicey for Humans

Marshes protect the land from the sea and the sea from the land. But they have one more job: they protect wildlife from the sea, from the land, and from us.

"All of those other things are really valuable, and I would not dispute that for a second," says Lorie Staver, a plant biologist at the University of Maryland. "But in my mind, the wildlife value trumps almost everything else."

Staver has spent years studying marshes and trying to bring them back from decline. Her specialty is island marshes, which are especially valuable to wildlife because predators can't

access them without wings or a very good breaststroke. Currently she is a part of a vast project to design new marshes on Poplar Island, near the border of Maryland and Virginia. The island is being rebuilt using dredged sediment from approach channels to the Port of Baltimore. It's a difficult and precise process in which just a few millimeters of water could mean the difference between success and failure.

But it's worth it. Birds like rails, stilts, and saltmarsh sparrows might live in the wetlands year-round. Egrets, pelicans, and cranes might visit for hours or days and then leave. Teal, godwits, and geese might rely on them as a rest stop during migration. Terns, sandpipers, and ducks might lay eggs and raise their young on the marsh.

Hundreds of fish and invertebrate species might use the marsh as well. Tidal channels and marshes are crucial spawning, nursery, and feeding habitat for economically important Chesapeake Bay species, such as menhaden, blue crab, and oysters. Whether you have feathers, scales, or a hard outer shell, the marsh is the perfect place to raise a family.

But what's good for a bird or a fish is not always ideal for an ecologist. Marshes are not easy places to work in, as I learn on a hot day in early October when I ditch my kayak to wade in the water with Jessica MacGregor and Man Qi, researchers from Gedan's lab.

When I arrive, they're in the process of collecting seed heads to study how the wetlands are moving and what that means for the services they provide to society and nature alike. The seeds will help identify what plants are present, how healthy they are, how much inundation they can withstand, and how diverse the marsh is.

The migrating wetlands have begun to take over farm fields and backyards. Gedan would like to see some of these new marshes protected and allowed to grow.

"Watch your step," MacGregor warns me as she investigates a ratty flower on a cordgrass strand. "It looks like we are in the low marsh now," she says, referring to an area that floods daily with shallow, silty water.

A blue heron *at Blackwater. Many birds rely on marshes for habitat, food, and shelter from predators.* PHOTO, NICOLE LEHMING / MDSG

I am struck by how uniform the grasses are, almost like fields of wheat or sorghum. But the scientists tell me to look closer: it's a knee-high, dense forest of dozens of species, like black needlerush, bulrush, and invasive *Phragmites,* speckled with purplish saltmarsh aster.

MacGregor and Qi are eager to find samples of smooth cordgrass, a dominant Chesapeake marsh species, so we head deeper into the low marsh.

Water moves around marshes through dizzyingly complex channels that look like blood vessels or nerves from the sky. They're hard to see underfoot. While carefully picking my way along, I hear a yelp and a splash, as MacGregor steps into an especially deep rivulet.

"That was a bad one. Now I'm in the marsh — up to my hip," she laughs.

It takes some effort to pull her out of the sticky black mud, but it's not the first time MacGregor has been stuck.

Looking out across the flat marsh, I can see why so many birds live here. Any predator larger than a fox would be visible for miles and would get hopelessly mired in minutes. Raptors have nothing to perch on. Even humans, with our infinite capacity for clever new ways to travel, haven't found a good way to cross a marsh.

Heading back toward the cars, I notice a line of dead loblolly pines. The marsh here isn't in retreat, it's moving uphill. I suddenly remember something Baldwin said earlier: although wetlands conjure a doom and gloom scenario, they are actually very resilient.

The key to the survival of the Chesapeake tidal marsh — and all the services it provides — is helping it to adapt in time. For Baldwin, the marsh doesn't need protecting so much as room to migrate. Likewise, Staver believes that animals that depend on the marsh can survive if they have the time and space for adaptation.

"They can adjust to change at a certain pace, up to a certain threshold, and beyond that it's difficult to adjust quickly enough," she says.

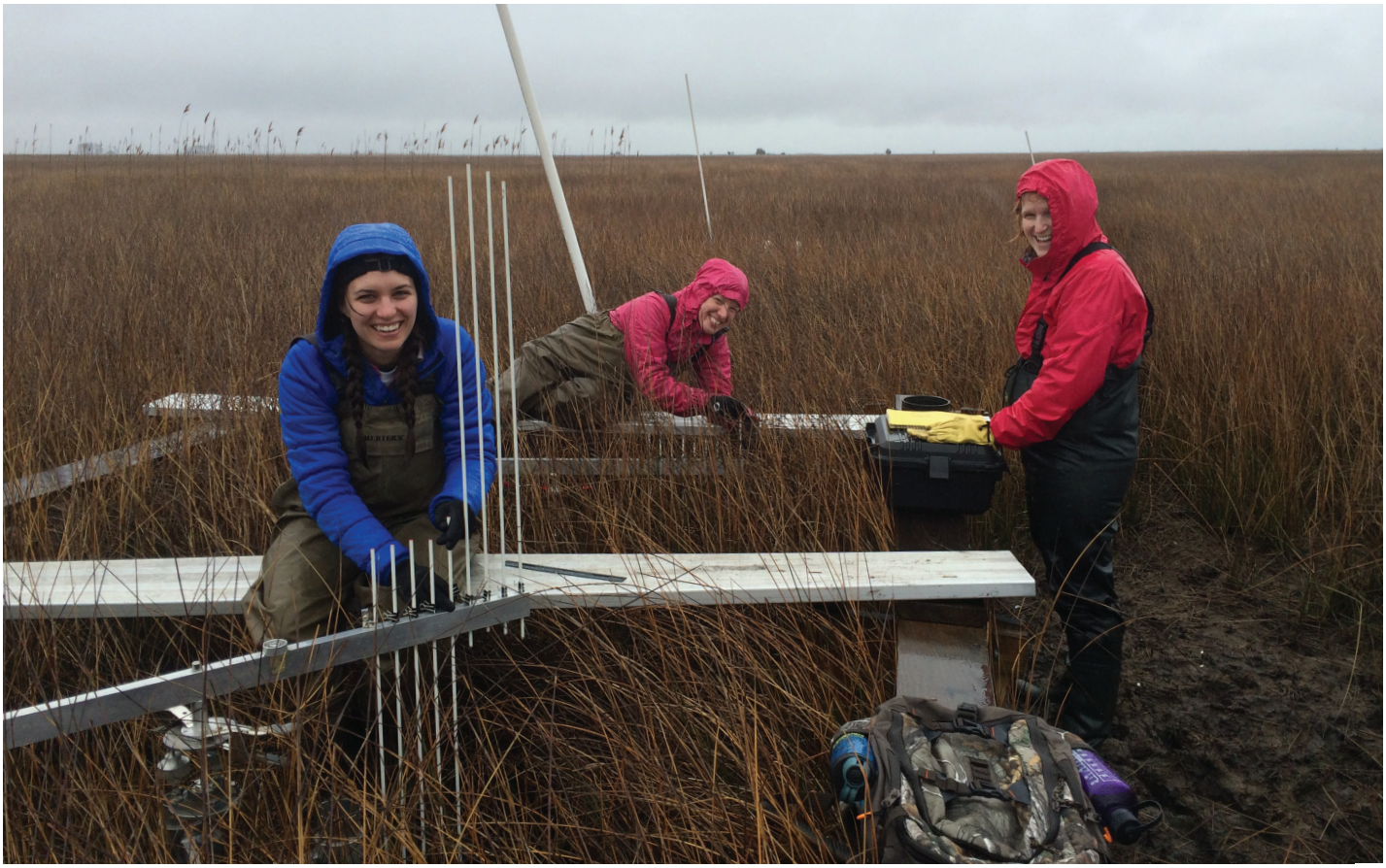
That's the fundamental question, not only for Chesapeake marshes but for all ecosystems in the line of fire for climate change. Can they adapt in time? Baldwin says the marshes seem to be pliant. Gedan agrees, but worries that humans might not be.

Another issue: Where will the marshes go when they move, and what will become of those places?

The best place for marshes to spread is farms — some a mile inland — abandoned because of the encroaching salt. But it's not clear when, if ever, those pioneer plants will turn fields into habitat. Gedan is studying this process and researching transition crops to protect the farmers, just as the marsh protects the shore.

Perhaps the radical changes in Chesapeake Bay marshes will be too much, and our grandchildren will never see sandpipers flitting in front of their kayaks. But perhaps the future won't be so bleak, and the marshes will change form, move, and find ways to survive. Perhaps, with just a little nudge from us, these soggy but crucial in-between places will persist for a while longer.

Erik Vance, a biologist, is a longtime science writer and the author, most recently, of Suggestible You.



We SET Our Sites on Collaboration

The Sentinel Cooperative Model

by Taryn Sudol

I guess you could say I came into this position cold. I started as the coordinator for the Chesapeake Bay Sentinel Site Cooperative (CBSSC) in January, relocating from my hometown of Orlando, Florida. It proved a dreary contrast: I saw rain, snow, and gray skies for my first few months traveling around the Chesapeake.

Fortunately the reception for my work was warmer. My job is to bring people and data together. The Chesapeake Bay is one of five National Oceanic and Atmospheric Administration (NOAA) Sentinel Site cooperatives in the United States. The other four are in North Carolina, the northern Gulf of Mexico, San Francisco, and Hawaii. Each location is a hot spot for ecological monitoring and illuminates the threat of sea level rise for the region. Here in the Chesapeake Bay, we are studying the effects of sea level rise on coastal ecosystems and communities across the Bay region. We use findings from the research and scientific data to inform planning and management decisions.

The Chesapeake Bay has seven sentinel sites in Virginia and Maryland, mostly on federal and state lands. Each site brings its own strengths, such as the efficacy of restoration approaches, conservation strategies for rare and endangered species, or the response of marshes to experimental manipulation that mimics human disturbances.

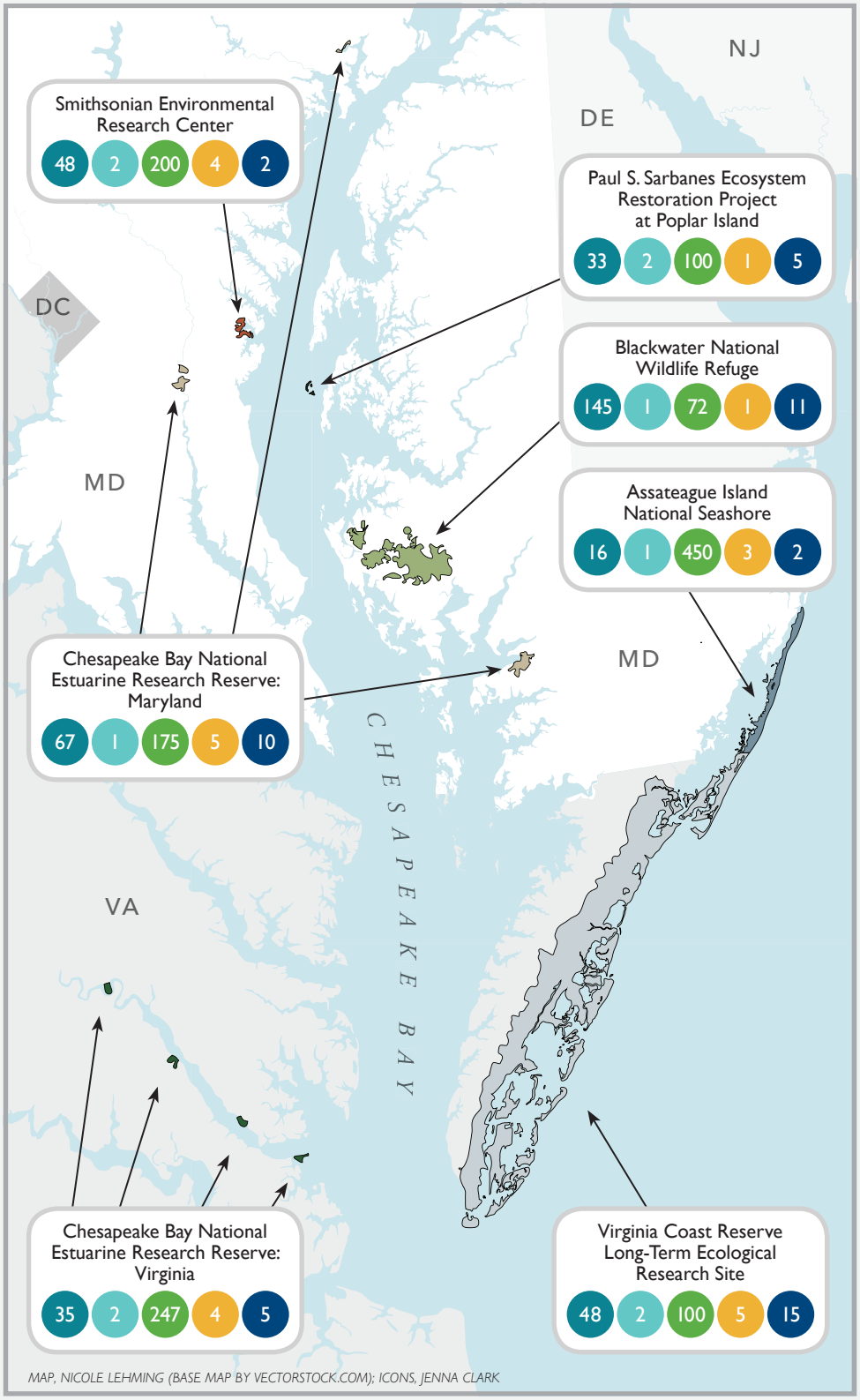
They are deemed "sentinel" because they each conduct a suite of long-term, local observations for their marsh ecosystems that include meteorological data, water quality, vegetation sampling, surface elevation tables, and water levels. Affiliated partners may collect a subset of this data or lead similar research that feeds into the cooperative's goals. The management

Researchers take SET measurements *at the Chesapeake Bay National Estuarine Research Reserve in Maryland, one of seven CBSSC sentinel sites.* PHOTO, SARAH WILKINS

Chesapeake Bay Sentinel Sites

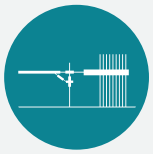
Sentinel sites around the Bay share a mission to improve planning and management decisions by providing the best data derived from local observation.

The map shows general locations of the seven sites. Each collects information about the marsh's health, includes surface elevation tables, meteorological data, vegetation sampling, water levels, and water quality. The numbers indicate number of monitoring instruments at each site.



MAP, NICOLE LEHMING (BASE MAP BY VECTORSTOCK.COM); ICONS, JENNA CLARK

MONITORING INSTRUMENTS



Surface Elevation Tables
Mechanical devices to measure small surface elevation changes that show how coastal marshes respond to sea level rise.

Meteorological Data
Real-time weather stations measure temperature, precipitation, wind speed and direction, relative humidity, and barometric pressure. This data reveals estuarine circulation, plant productivity, and storm frequency and intensity.

Vegetation Sampling
Plant traits, such as height, percent cover, stem density, and biomass within sampling plots, indicate how wetland vegetation responds to changing sea levels.

Water Levels
Sea level rise manifests differently along the coast. Water level monitoring stations continually measure the depth of water, providing a long-term data set.

Water Quality
The chemistry and levels of pollution cause ecosystem changes. Water monitoring stations check temperature, total suspended solids, dissolved oxygen, pH conductivity, chlorophyll, and nitrogen.

team includes stakeholders who make use of the data for land use decisions or community outreach.

Because scientists monitor so closely, the sentinel sites are a good indicator of the marsh's health. Networks of marshes are crucial across the Eastern Shore. They provide habitat, protect communities from flooding, and increase biodiversity. The data can help predict how other marshes might be faring.

The CBSSC has narrowed its focus to sea level rise impacts on marsh persistence, given the breadth and depth of research occurring here, as well as its rising threats.

As of 2010, the Bay had approximately 282,291 acres of marshes; the Chesapeake Bay Program aims to reestablish another 85,000 acres by 2025.

Whitley "Whit" Saumweber, *former program manager for the NOAA Estuarine Reserves Division, holds the GPS section of an RTK Base-Rover system to collect elevation data at Sweet Hall Marsh, one of the long-term transects of the Chesapeake Bay National Estuarine Research Reserve's Sentinel Site.*
PHOTO, SCOTT B. LERBERG / VIMS

Marshes produce a suite of ecological services, including improved water quality, flood reduction through wave attenuation, and erosion protection. They also provide essential nursery habitat for commercial fisheries and habitat for other wildlife. The Chesapeake Bay region, however, has the second highest rate of sea level rise in the continental United States, after the Gulf of Mexico.

These wetlands are systematically complex, where numerous inputs (sediment supply, topographic setting, nutrient levels, vegetation type, and herbivory) can lead to uncertain outputs. If sea level becomes too high, marshes will drown. But some marshes can adapt or be restored. Instead of focusing on the particulars of a single site, the cooperative approach considers different types of marshes, broadening our assessment of the Bay's overall wetland longevity.

I completed an MS in conservation biology and sustainable development at the University of Maryland, so the terrain was not completely unfamiliar to me. But in the Chesapeake Bay region, you can drive a couple of hours and be in a different world. I traveled to marshy expanses on Maryland's Eastern Shore, restored marsh sites on Poplar Island near Tilghman Island, and research laboratories at the Virginia Institute of Marine Science at Gloucester Point. The road trip offered a way to learn about the geography and the people, with the hope of gathering the science and assembling the scientists for collaboration.

Bringing scientists and managers together can make a world of difference, even if it's just to ask, "Hey, is everyone else's cordgrass looking particularly ginormous after our rainy summer?"

Sometimes, the inquiry is more specific. At Jug Bay Wetlands Sanctuary in southern Maryland, biologists realized that the physical platform where they had installed their water level sensor was unstable. The function of the sensor is to measure and calculate the standard elevation for a tide, which then determines mean high water, mean sea level rise, and other measurements. Because the sensor was moving, how could they take an accurate measurement?

The biologists shared their error and discovered that this problem could be systematic at CBSSC and other sites. As a result, the National Estuarine Research Reserves now monitor and document whether the appropriate infrastructure and leveling protocols are in place. We are able to ensure that our platform is secure so that our numbers are reliable.

The cooperative members have been collaborating for years — and it's taken all that time to build trust and camaraderie. Their best intentions to work together on new, larger-scale projects can easily get passed by, given the demands of field schedules. It takes time to reach consensus on what scientific questions to ask, what procedures to follow, and how individual research aligns with these joint efforts.

One common data collection element among the sentinel sites is surface elevation tables (SETs). These portable devices have nine movable pins attached to a metal arm; the arm locks into a permanent benchmark installed deep into the surface of the marsh. (The table moves; the benchmark does not.) Each year, the same scientist lowers the pins to the marsh surface and measures the height of the pin above the metal arm. Compared against the benchmark, measurements of pin height tells us precisely whether the marsh is rising or sinking over time. Tracking this elevation change is a core indicator for how a marsh can withstand sea level rise. It's a race of millimeters on a decadal time scale.

It made sense for us to list the SETs at each sentinel site and the geographical characteristics at each SET sampling station. As it turns out, there are more than 400 SETs nestled in Chesapeake Bay marshes. As the coordinator, I worked closely with each site to compile their SET locations and key characteristics (e.g., salinity regime, vegetation community, installation date, sampling frequency) for each of the SET inventories.

The CBSSC scientists updated their SET inventories in a database and agreed to share this information with members and the public. This was a huge deal: researchers are protective of their data, and they don't want their hard work to go unrecognized or their results to be misconstrued. Those years of building trust weren't for nothing; members encouraged other members. As some sites moved forward, others followed.

Leadership, baby steps, and a stroke of good fortune have gone a long way. A newly hired NOAA geographic information systems specialist turned this list into an interactive map, now live and accessible to the public (www.chesapeakebayssc.org/maps). We believe it is the first of its kind.

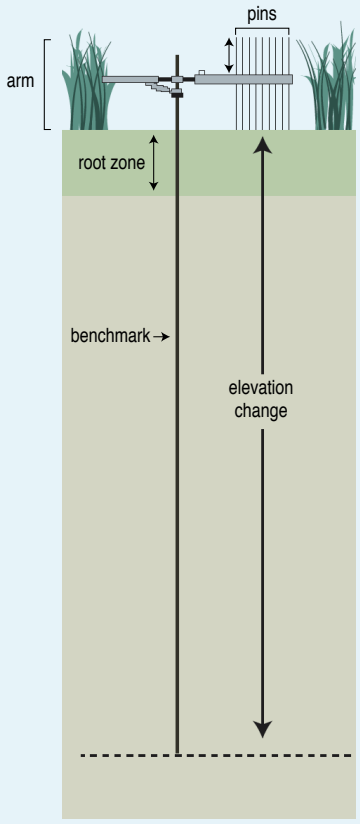
Our 400 SETS of data can tell us, for example, whether a marsh is degrading. Scientists have established that a degraded marsh cannot support the typical amount of wildlife when it starts falling apart and eroding. As a result, habitat and recreation uses are lost, and proximal communities are placed at greater flood risk.

We can slow marsh degradation if we can identify and implement proper restoration. Alternatively, we may learn that a particular marsh is facing insurmountable threats and that our resources could be more effective if used elsewhere.

When we have a network of information, we strengthen and expand our research. With everyone at the table, we also see where we need to invest more research or resources. With strong data, we can make predictions and set priorities. The sentinel sites are able to speak for the Chesapeake Bay as a whole. Working together leads to new insights — it just requires coordination and cooperation.

— *sudol@mdsg.umd.edu*

Taryn Sudol is the CBSSC coordinator; her position is funded by the National Sea Grant Office and National Ocean Service.



Measuring marsh change

A surface elevation table (SET) measures relative elevation change of wetland sediments. It consists of the following sections:

Benchmark
A permanent pipe or rod deep (3–25m) in the ground serves as a stable reference point for comparing changes in pin height.

Arm
A metal attachment fixed to the benchmark holds nine movable pins.

Pins
Lightweight, fiberglass rods measure change.

Root zone
The growth or decay of plants influences changes in wetland elevation.

Once or twice a year, scientists lower the pins to the marsh surface to measure the height above the metal arm. If the pin height increases, the marsh bed is rising; if it decreases, the marsh is losing elevation.

ADAPTED FROM GRAPHIC BY DONALD CAHOON / PATUXENT WILDLIFE RESEARCH CENTER

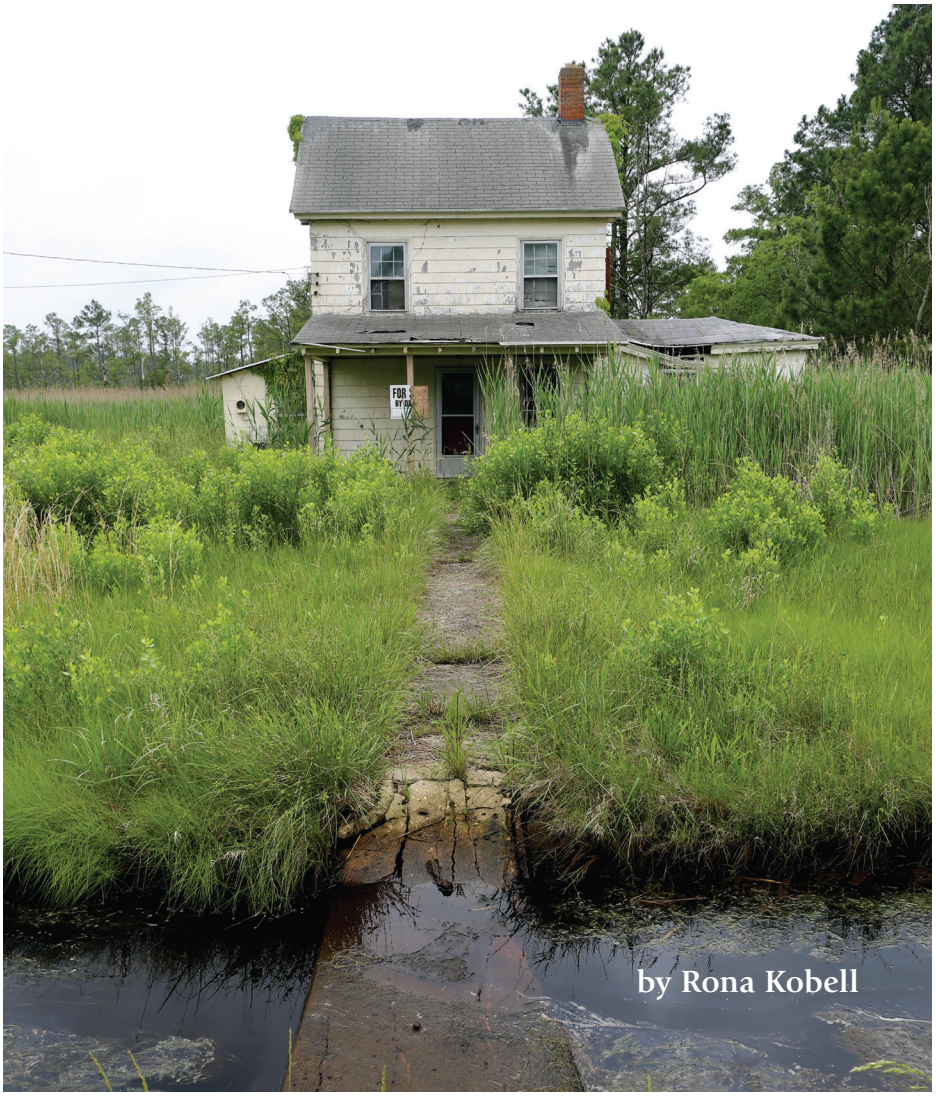
MARSH RESILIENCE SUMMIT
February 5–6, 2019

In February, the Chesapeake Bay Sentinel Site Cooperative (CBSSC) and partners will host the first Marsh Resilience Summit. Land managers, local government planners, engineering consultants, land conservancies, waterfowl enthusiasts, and others need to understand marsh dynamics and learn how to protect and restore Bay marshes, especially under changing climate conditions. About 200 researchers and practitioners will present current research and discuss priorities. CBSSC will identify research gaps, create partnerships, and develop tools for marsh management.

www.chesapeakebayssc.org/marsh-summit

Churches Take On Climate Change

Eastern Shore congregations emerge as a focal point on flooding and erosion



by Rona Kobell

As an environmental anthropologist at the University of Maryland, Michael Paolisso had studied the effects of climate change and sea level rise on the Eastern Shore. And he knew how communities prone to flooding, erosion, and land subsidence were struggling.

But as a part-time resident of Deal Island, all he had to do was take a short walk around his neighborhood to see proof that these things were happening.

Along the rural Somerset County peninsula, which includes about 1,000 people across four towns, water pooled on roadways and around houses, wetland plants were overtaking yards, and high ground was becoming marsh. With no mayor or central island government, residents were left to their own devices to address these challenges.

Understanding that Deal Islanders would be more resilient if they had greater engagement with decision makers and researchers, Paolisso helped form the Deal Island Peninsula Project. The initiative uses collaborative learning to build a social network linking community residents, University of Maryland scientists, and state and county officials. Collaborative learning is essentially a process that brings together stakeholders who don't always connect so they can learn from each other.

The Peninsula Project influenced the Maryland Department of Natural Resources to bring a shoreline and dune project to Deal Island to stabilize the land and prevent further erosion. The shoreline initiative is also helping the island connect with county and state officials who can assist with ditch management issues to prevent flooding.

"There is a cultural intersection of the environment, pollution, and flooding. You can't make sense of it without looking through that frame," Paolisso said as he drove by yet another house overtaken by marsh. "I would like to believe that the world could use a lot more stories about the last house standing, because it's never the last. And their history and heritage — *our* history and heritage — doesn't have to disappear while we watch Netflix."

Reaching beyond Deal

Encouraged by the progress with the Deal Island Peninsula Project, Paolisso and colleagues sought to expand the work to other coastal communities in similar straits. They weren't hard to find. Nationwide, coastal shoreline counties include 10 percent of the land but are home to 39 percent of the population. Coastal rural lands are home to 9.5 million people, and the Eastern Shore's population is close to 500,000; many of those are in unincorporated parts of counties. The communities may be small and lack a strong local government to advocate for help, according

Encroaching water *brings wetland plants to the doorstep of an abandoned house.*
PHOTO, EUDORA MIAO

to the Third National Climate Assessment of the U.S. Global Change Research Program.

The federal government, through NOAA and EPA, provides about $300,000 annually to the state to help communities with climate adaptation, but the money can only go to an incorporated entity, such as a county or town. Funds are awarded largely to put in place different processes for resilience, including mapping, modifying codes and ordinances, or supporting outreach efforts.

Additionally, Governor Larry Hogan has pledged $15 million for resilience planning to Maryland communities over five years — but those funds require legislative approval every year. Two years in, the state has supported about a dozen projects, most of them involving installation of living shorelines, including the one on Deal Island. Unlike federal grants, the state monies can go to nonprofit organizations, which, in turn, can consider projects that protect whole neighborhoods instead of one house at a time. Officials acknowledge that it's not always easy for small communities without mayors to know where the money is or how to apply for it.

But these communities do have important local institutions that can help connect them: their churches. Paolisso's research and life experience on Deal Island suggested the churches were central to how Shore communities operate.

Often, pastors are more than spiritual advisors; they are emergency contacts and disaster response crews, food pantries, and shelters. They support their communities in times of need but also are essential conduits for information sharing in areas where internet connections are spotty. Paolisso and his colleagues wondered if the churches could fill the resilience gap.

Last year, Paolisso and his team received a grant from the National Oceanic and Atmospheric Administration's Coastal and Ocean Climate Applications program for their project, "Linking Rural Decision Makers with Local Churches to Build Coastal Resilience to a Changing Climate." Maryland Sea Grant is a partner on the project, which Paolisso heads, along with anthropologists Christy Miller Hesed, project director, and Elizabeth Van Dolah, a postdoctoral researcher.

A collaborative learning approach is more than just bringing people together. It entails inviting residents of local communities into complex discussions about scientific concepts and demonstrating to them how different predictions of sea level rise may affect their landscapes and their lives. It involves bringing in experts from state and federal agencies to explain how they award grants for adaptation projects, what projects are eligible, and how to apply for funding. And it requires the commitment by community members to attend follow-up meetings with Paolisso's team over months — or years.

But for those who put in the effort, the process can empower communities to open channels of communication with scientists, government officials, and nonprofit agencies. If people know what to ask for and how to ask, they may get money for hazard mitigation plans, projects in the ground, and technical design advice.

Drawing on previous anthropological research that Paolisso, Miller Hesed, Van Dolah, and others have conducted on socioecological change, the project seeks to answer these questions: Can rural churches help to link county and state decision makers with rural communities? Is a collaborative learning approach effective in bringing together church leaders, local decision makers, and citizens to become more resilient? Will it help residents understand the challenges of climate change, the scientific underpinnings of the flooding and erosion they're seeing, and bring them closer to a community solution?

Participants include members of 12 churches, all but one of them Methodist; representatives from Wicomico Interfaith Partners; and elected officials and staff from Dorchester, Somerset, and Wicomico counties.

Paolisso and his colleagues have been meeting with these individuals over the past year to discuss their needs and determine how improved collaboration between churches and decision makers can help. At these meetings, scientists present concepts, maps, plans, and other aspects of sea level rise, climate change, and adaptation, with their messages tailored to a general audience. Participants receive information that is more substantive than what the local newspaper might publish and more accessible than scientific papers posted online. They are encouraged to provide feedback based on their own ideas of what's worked in the past.

Part of the project involves assessing what residents believe, where their information comes from, and how much faith they put in the science of what is happening on the ground. Interviews indicate that some participants understand the science underlying the changes and wish to learn more. Others maintain that the problem stems from erosion that has always battered the shorelines of these low-lying, marshy communities.

Regardless of their beliefs, the residents often agree on solutions: finding

funds to raise houses or neighborhoods, building protections, and maintaining the road network. Research wraps up next year, with a report and a film to be presented by mid-2019. At that time, project leaders will have a sense of how much the collaborative process helped the community to understand, prepare, and adapt for its changing future.

Putting Theory into Practice

At a meeting in August in Dorchester County, anthropologist Christy Miller Hesed led a discussion between officials — county emergency manager Anna Sierra and environmental planner Brian Soper — and congregants at New Revived United Methodist Church in Smithville about a problem: A marsh is encroaching on the church property. Water from the marsh threatens the church's cemetery. And the intruding water makes it impossible to dig graves during certain times of the year. It was an opportunity to put the collaborative learning approach into action.

Parishioners are mostly senior citizens in an African American community, where residents say many families are related and trace their history to the 1800s. They worry the marsh waters could flood their church. New Revived, which dates to 1925, is still intact, structurally, despite a partial flood during Tropical Storm Isabel.

Soper and Sierra reminded the group that the county can't offer money — only technical solutions and assistance to get permits approved.

"We are aware of what's happening, and we want to be involved," Sierra told the group. "Part of what we need is a strategic direction, because if you build a berm that keeps water out, it also keeps water in."

She added that whatever solution they choose, they have to be mindful that the past is not a guide for the future. County public works director Ryan White said his neighbors tell him, "It rains differently now." That rain, more frequent and heavy, brings more flooding to an already soggy peninsula.

Churches on the Eastern Shore *(opposite) grapple with sea level rise that threatens their buildings and cemeteries. Anthropologist Christy Miller Hesed and Michael Paolisso (right) have been working for years to build a resiliency network that includes leaders of faith, who gathered for a meeting in Dorchester County (above).* PHOTOS, (OPPOSITE) EUDORA MIAO, (ABOVE) CORINA PAOLISSO, (RIGHT) RONA KOBELL

"We are living climate change. We are living land subsidence. We are living vulnerability right now. Other counties have 20, 50, 100 years to plan for it — we're living it right now," Sierra added.

The goal at the Dorchester meeting was not to make a final decision but to examine and discuss options. Victoria Chanse, an associate professor of landscape and plant science at the University of Maryland and part of the collaborative team, presented design ideas for mitigating the marsh migration now and the effects of heavy rain in the future.

Joan Brooks, pastor of New Revived, said that whatever plan they choose, she'd need help implementing it. Sierra and Soper and other county officials responded that they would try to mobilize assistance.

After several hours, the group reached no conclusions about whether to build a berm or opt for a living shoreline approach. But many participants agreed it was valuable nonetheless. A few said that, while they'd met county officials years ago through a citizens' erosion group, they hadn't had an opportunity to connect in a direct way before these collaborations. They worried about their future and wanted to examine solutions. They understand the changing climate will bring more frequent flooding, and they want to be able to save what's special about their communities.

"Often, we feel like we're on the fringes, we're not part of things. But they brought us in, and it has been enlightening," said Roslyn Watts, a pastor and Dorchester resident who worries about flooding at Church Creek, where she lives, as well as at New Revived.

Nona Stanley, New Revived's lay leader, added: "I thought I should know what's going on, how things will be in the future. Of course, I'm not going to live to see it, but you hope that someone will continue to carry it on."

— *kobell@mdsg.umd.edu*

Meet the Extension Agent

JENNIFER DINDINGER

by Rona Kobell

Jennifer Dindinger, *an extension specialist on Maryland's Eastern Shore, helps communities secure grant funding for planting projects, infrastructure work, and other efforts to become more resilient.* PHOTO, NICOLE LEHMING / MDSG

But for a chance phone call, Jennifer Dindinger may not have found her way to the Eastern Shore.

Dindinger, a watershed restoration specialist for Maryland Sea Grant Extension, was working on her master's degree in environmental policy at Bard College in 2003. Her training included different modules — air, water, and forestry. Nothing was clicking with her as a career path — until she discovered the agriculture module. Growing up in suburban Connecticut, Dindinger didn't interact much with farmers. But something about the interconnection of water quality and soil, and actions taken on the land, moved her. "It was the rock that I needed," Dindinger said. "It just stuck."

She did a search for organizations working in both fields and stumbled upon the Harry R. Hughes Center for Agro-Ecology, based at the Wye Research and Education Center and part of the University of Maryland. In the spring, she cold-called them, as she had done to other places but without much luck.

As it turned out, Russ Brinsfield answered the phone. The center's director at the time did not typically answer the main line, but it was lunchtime and the receptionist was out, so this time he did.

She told him who she was and what she wanted to do — and secured a six-month internship for the summer and fall of 2003. The next year, she graduated with a degree in environmental policy, and the Hughes Center hired her full-time in 2004, first as a research assistant and then as the communications and outreach coordinator. That proved to be a good segue into a career in extension work.

In 2009 while still at Wye, she joined Maryland Sea Grant Extension and became a watershed restoration specialist on the Eastern Shore, where she works with local governments and groups on stormwater management.

Dindinger and her watershed restoration specialist colleagues participate in a partnership program between the University of Maryland Extension, Maryland Department of Natural Resources, and Maryland Sea Grant, which jointly support them.

She helped start the Watershed Stewards Academy (WSA) in Cecil County, which offers extensive training for individuals who want to learn to install small-scale, best stormwater-management practices in their communities. Some participants pursue careers in landscaping, while others hope to improve water quality close to home. The Cecil WSA, one of about a half dozen in Maryland, recently welcomed its third cohort.

Dindinger also helped the planner for the city of Cambridge win grants to finish installing stormwater controls on Maryland Avenue, a major thoroughfare through the historic district.

And she's pushed for restoration using native plants, too.

As a watershed specialist, she sometimes finds it hard to point to tangible results; so much of the work, Dindinger said, involves making connections and helping organizations secure this grant or that technical help. It can take years before those connections translate into work on the ground.

But if she had to pick a favorite project, she said, it might be the Trinity Parish rain garden in Church Creek, which she helped plan with the Nanticoke Watershed Alliance. Dindinger assisted a member of the Chesapeake Conservation Corps — a service organization for college graduates, who work with an environmental or science organization — with the garden design. Then she worked with a Girl Scout troop to paint rain barrels.

"We got to actually see the project go into the ground," she said. "We had to mark it off and do the planting."

Dindinger is not sure where she'd be if Brinsfield had not answered the phone. She's just glad he did. It's been an interesting career so far, with more good work to come.

"We [extension specialists] call ourselves the grease, the catalyst for things," she said. "We may not be the one wielding the shovel, but we help bring everyone together."

— *kobell@mdsg.umd.edu*

Suds, Scat, and Study

New research fellows get to work

Maryland Sea Grant has awarded two new fellowship research grants. Each fellow receives a $25,000 stipend, tuition allowance, and benefits for two years.

Ethan Hain

Most freshmen do not get involved immediately in research. But Ethan Hain was not most freshmen. While pursuing his degree in biochemistry, with a minor in mathematics, at St. Mary's College of Maryland, he worked in a lab during his second semester. His job was to scare zebrafish with a dot on a computer monitor to see if fluoxetine, a compound found in many antidepressants, affected their behavior. (Zebrafish are commonly used as a proxy for humans in experiments.) Hain's experiment showed that the antidepressant calmed the fish when they were startled. For the remainder of his undergraduate education, he focused on organic synthesis and genomic studies, but his work with zebrafish may have foreshadowed his current research.

The Ellicott City native is a doctoral student in chemical and biochemical engineering at the University of Maryland, Baltimore County. Standing by an oven with the scent of chicken scat may not seem like the most appealing prospect, but Hain was drawn to Professor Lee Blaney's scholarship and enthusiasm. He is developing fluorescence-based tools to screen for emerging contaminants of concern, including antibiotics, ultraviolet filters from sunscreen, and hormones. And he's teaming up with the Maryland Department of Natural Resources on its oyster survey and expanding his research to study effects of these contaminants on oysters.

Hain ended up in a place he did not expect to be, doing research he didn't expect to do. In doing so, he's able to fuse his love for sailing and swimming in the Chesapeake with his acumen for chemistry and lab work.

"Graduate school is not a sprint, it's a marathon — you should enjoy it," Hain said. "Otherwise, what's the point?"

—Alexandra Grayson

Ana Sosa

Ana Sosa was interested in microbes, from yeast in beer to microcommunities in the ocean. And she has experience working with both.

After receiving her degree in biotech engineering in 2014 from the Monterrey Institute of Technology and Higher Education in Mexico, Sosa began studying microbes at the Anheuser-Busch brewery in Mexico City.

"I wanted to learn about industrial biotechnological processes, and I thought that working for such a big international company would give me a platform to learn about business, marketing, manufacturing, and just about having an industry job in general," she said.

After a few years with Anheuser-Busch, Sosa wanted to further her education in marine microbiology. Born in Mexico City, Sosa moved to Baltimore to pursue her doctorate at the Institute of Marine and Environmental Technology. She researches microbial communities that live on microplastic particles floating in the Chesapeake Bay. Using small disks placed in the water, she collects these particles to study how microplastics and their hitchhikers might affect larger organisms.

When she first moved to Maryland, Sosa knew that crabs and oysters were important. After a few years here, she has learned that the Chesapeake "is a big part of the state's economy, providing jobs and other sources of income, not to mention the overall environmental importance of the ecosystem and its connection to other ecosystems."

—Ben Anderson

Maryland Sea Grant's research fellows
Ethan Hain (top) and Ana Sosa (above).
PHOTOS, COURTESY OF ETHAN HAIN AND ANA SOSA

Alexandra Grayson and Ben Anderson are this year's Maryland Sea Grant communications interns *(see page 20).*

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Introducing Maryland Sea Grant Interns

Each year Maryland Sea Grant's communications office hires one or two interns to assist us with social media, blogging, and articles for *Chesapeake Quarterly*. During their stay, we hope they hone their writing and communications skills and maybe even get inspired to pursue a career in marine science, environmental policy, or science communications. They work in our office and in the field; we also provide them with professional development opportunities.

This year we are thrilled to have Ben Anderson and Alexandra Grayson as our interns. (We also have two film interns from Morgan State University; see page 6.)

Ben is a senior at the University of Maryland, College Park, majoring in environmental science. A native of rural St. Mary's County, Ben has spent lots of time on the Bay, and last year he interned at the Chesapeake Bay Program. He expects to graduate in May 2019 and hopes to join the Peace Corps.

"Before I knew what I wanted to major in at college, I knew that I wanted to help people. The Peace Corps allows me to apply the knowledge and experience gained through my [environmental science] degree to the people and communities who need it most," he said.

Ben spends a lot of his time helping our staff with social media engagement. This is his second year at Sea Grant.

Alexandra is a first-year student at Howard University in Washington, D.C., and a member of the Freshman Leadership Academy there. She's pursuing a double major in political science and environmental studies.

Though new to Sea Grant, Alexandra is not new to environmental studies. During the summer, she worked at the Institute of Marine and Environmental Technology, at Baltimore's Inner Harbor, with Eric Schott, an associate research professor. She was a 2018 Hutton Scholar of the American Fisheries Society, part of the junior fisheries biology program that promotes diversity in science. Alexandra learned how to extract DNA and barcode the genetic characteristics of marine animals in the harbor. She also blogged about her experiences.

In addition, she has been a community organizer, an intern with the Baltimore Office of Sustainability, and an activist in the fight to ban Styrofoam and reduce the use of single-use plastic. The Catonsville native is currently working on a project on freshwater mussels for *Chesapeake Quarterly*.

— *kobell@mdsg.umd.edu*

Maryland Sea Grant's communications interns *Alexandra Grayson (top) and Ben Anderson (above) assist with writing and social media.* PHOTOS, (TOP) AMY PELISINSKY / UMCES, (ABOVE) COURTESY OF BEN ANDERSON