Indigenous Americans • Post-Florence Power • Dune Restoration • Transplanting Lichen

Coastwatch

NORTH CAROLINA SEA GRANT • SPRING • 2019 • ISSUE 1 • $3.75

SEA TO TABLE
Restaurants Celebrate Coastal Cuisine

Rejuvenation and New Perspectives

Spring has sprung! Now is a time for rejuvenation, growth and anticipation for outdoor adventures that do not require three layers of warm clothing. I am ready to roll down along our coast this season and take advantage of all the opportunities available to us here in North Carolina.

Last autumn certainly was a difficult time for counties inland and along the coast as Hurricane Florence and Tropical Storm Michael beat a path across the state. These communities — the people residing and owning property there — are rebuilding together through a joint sensibility that this is, and will continue to be, home.

Impacts continue, but so, too, do stories of communities supporting each other. Also, individuals are working together and defining new and special bonds with each other, these places, and our relationships to them.

North Carolina Sea Grant also continues to partner with these communities. Our efforts include hands-on resources as well as science and policy applications to work toward near-term and long-term disaster resilience — supporting community capacity not only to identify the recovery and resiliency lessons that they have learned, but also to share those lessons among other communities and businesses coping with recent disasters.

Those lessons in particular apply to planning for the future, such as addressing infrastructure planning for transportation and housing, as well as other projects to strengthen rural resilience within North Carolina. We will continue to inform you of these ongoing investments.

Our hope is that you, too, will benefit as you notice recent changes along the coast as you explore the state's coastal history and current culture, getting to know new places and faces.

As you will read in this issue of *Coastwatch*, North Carolina's history is an amalgam of many perspectives. Malinda Maynor Lowery offers unique insights into her Lumbee tribe's first encounters with the English, a series of events that remain part of the Lumbee experience in dual indigenous and American roles. In addition, the North Carolina African American Heritage Commission is exploring the lesser-known history of Blackbeard's ship, the *Queen Anne's Revenge*. The ship had an entirely different identity as *La Concorde*, a slave-trading vessel, before the infamous pirate took possession of it.

Also, knowledge of past fisheries, fishing communities and environmental conditions helps explain current fishing interests and efforts in Sea Grant's new blog, "Hook, Line and Science," cleverly developed by our fisheries extension specialists. And you will learn the evolution of a plant's name — one that is dear to my heart through my own research. Yes, *Spartina* has taken on a new descriptor based on new knowledge.

As you plan ahead, consider an opportunity to learn more from experts across a range of topics during our upcoming North Carolina Coastal Conference in Wilmington on Nov. 19 and 20. North Carolina Sea Grant, along with the support of many partners, hosts this conference every other year as an opportunity to bring groups with different interests together and to highlight the positive impacts of our state's investments across the coast and in our coastal watersheds. The conference also provides a perfect setting to discuss future areas of focused support.

Please save the date and join us as we collectively engage with leaders across communities, academia, state and local government and nonprofit groups regarding progress and upcoming priorities for coastal communities, environment and economies. For more information, visit *ncseagrant.org*.

I am pleased to see so many of you have responded to our *Coastwatch* survey. It is an important way for our program to continue to respond to your interests and needs regarding information about our coast, state and North Carolina Sea Grant program. I appreciate your feedback, and if you have not yet responded, please take the time to do so now online at *go.ncsu.edu/CoastwatchSurvey*.

If you would like to reach out to me directly and share your thoughts, please feel free to do so at *snwhite3@ncsu.edu*.

I look forward to seeing you at the coast this spring!

— Susan White, Executive Director, North Carolina Sea Grant

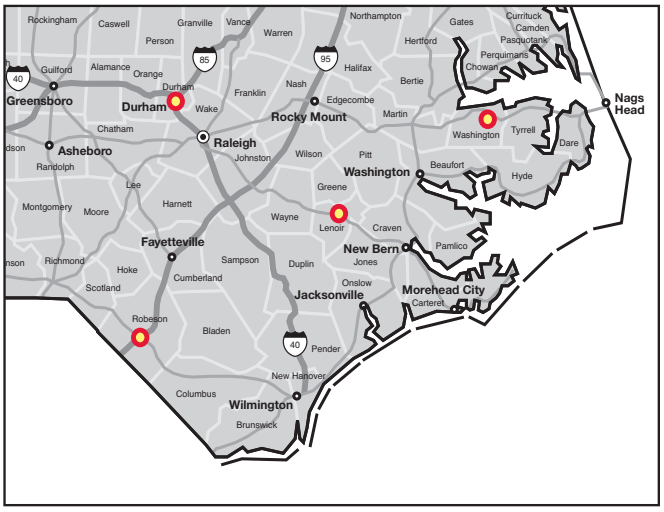
IN THIS ISSUE

CONTRIBUTING WRITERS:

Scott Baker ▫ Gordon Byrd ▫ Danielle Costantini
Caitlin Cunningham ▫ Paul E. Hosier ▫ Marisa Incremona
Alexey Katin ▫ Julie Leibach ▫ Malinda Maynor Lowery
Sara Mirabilio ▫ Katie Mosher ▫ David Nash ▫ Spencer Rogers
Dave Shaw ▫ Dee Stribling ▫ Katelyn Vause
Summer Walls ▫ Susan White

CONTRIBUTING PHOTOGRAPHERS:

Jessica Allen ▫ Chuck Bangley ▫ Ken Blevins ▫ Gordon Byrd
Vitaly Charny ▫ Gary Dincher ▫ Lisa Galizia ▫ Timothy L. Hale
Joi Henslee ▫ Jason Hollinger ▫ Paul E. Hosier ▫ Julie Leibach
Juli Leonard ▫ Forest Mason ▫ Linda Mathiasen ▫ Baxter Miller
Christopher Moore ▫ Paul Rudershausen ▫ Emily Scott ▫ Dee Stribling
▫ Casey Toth ▫ David Williams ▫ Freddy White ▫ Roger Winstead



North Carolina's diverse coast and inland terrain offer countless interesting subjects. The map indicates some of the story settings in this issue — including Durham, Lenoir, Robeson, and Washington counties.

Coastwatch

FEATURES

Front Cover: Chef Ricky Moore, photographed by Baxter Miller.
Table of Contents image based on photo of honeycomb oysters by Juli Leonard.

Coastwatch

North Carolina Sea Grant • Spring • 2019 • Issue 1

Editor
Katie Mosher

Managing Editor
Dave Shaw

Science Editor
Julie Leibach

Contributing Editors
Lee Cannon
Marisa Incremona
Danielle Costantini

Designer
Linda Noble

North Carolina Sea Grant is a federal/state partnership that promotes stewardship of marine, coastal and watershed resources through research and outreach. It joined the National Sea Grant College Network in 1970 as an institutional program. In 1976, it was designated a full Sea Grant College program. Today, North Carolina Sea Grant supports research projects, along with extension and communications teams. Susan White is executive director. The program is funded by the National Oceanic and Atmospheric Administration in the U.S. Department of Commerce, and by the state through the University of North Carolina.

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North Carolina Sea Grant Coastal Offices:

Coastal Studies Institute
Wanchese, NC • 252-475-3663

Center for Marine Sciences & Technology
Morehead City, NC • 252-222-6307

Center for Marine Science
Wilmington, NC • 910-962-2491

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Blackbeard's Queen Anne's Revenge *had an even more violent history as* La Concorde*, a slave-trading vessel.*

A Tale of Two Ships

A new project from the North Carolina African American Heritage Commission will explore the lesser-known history of a famous North Carolina shipwreck. While many know the *Queen Anne's Revenge* as Blackbeard's ship, it had an entirely different identity before the notorious pirate took possession of it.

La Concorde was a slave ship that sailed transatlantic routes from France to Africa and the Caribbean. From 1713 to 1717, the ship transported thousands of African men, women and children as part of the intercontinental slave trade.

A new project will comprise archaeological, archival and historical research of the ship, focusing on the period before Blackbeard commandeered it. Researchers also will create an educational framework to improve the interpretation of African American history in North Carolina. The Institute of Museum and Library Services, a federal grant program, is supporting the project.

"Our hope is that our research will further illuminate, for learners of all ages, one of North Carolina's African diaspora stories through this harrowing, yet significant, story of the transatlantic slave trade," says Michelle Lanier, project director. *— Danielle Costantini*

Blackbeard Among NC History Topics

Blackbeard rises again, this time in *This Day in North Carolina History*. The University of North Carolina Press released the book in time for the tricentennial anniversary of his death last year.

The day-by-day look at our state's culture offers entries that feature such topics as moonshine, Grandfather Mountain and Nina Simone. Fascinating stories range from sensational crimes to Mt. Olive Pickles to bluegrass, and entries include information about NASCAR, civil rights and more.

Ansley Herring Wegner of the North Carolina Office of Archives and History and Jeff Miles, formerly of the N.C. Department of Natural and Cultural Resources Marketing and Communications office, compiled the history. The book sprang from the popular blog of the same name, which has attracted thousands of readers since its inception six years ago.

Read more: *go.ncsu.edu/This-Day.* *— Summer Walls*

Susan White, executive director of North Carolina Sea Grant and new president-elect of the Sea Grant Association.

White Adds Role with Sea Grant Association

Susan White, executive director of North Carolina Sea Grant, is the new president-elect of the Sea Grant Association. Known as SGA, the organization includes representatives from the academic institutions in the network funded by the National Sea Grant College Program.

White will serve two years as president-elect, working closely with the current president, Fredrika Moser, director of Maryland Sea Grant. White will move to the top leadership position in 2021.

The SGA has multiple roles, including working closely with the National Sea Grant Office to coordinate activities and take the national program in new directions, as well as educating members of the U.S. Congress about Sea Grant's impactful support for communities, economies and ecosystems.

"I am looking forward to this opportunity to share the successes of the Sea Grant network, including some examples from here in North Carolina," notes White, who joined the North Carolina program in late 2012 and has been active in SGA committees and the board in recent years.

Previously director of NOAA's Hollings Marine Laboratory in Charleston, S.C., White earned a doctorate from the University of Georgia and a bachelor's degree from Duke University.

White also now serves as executive director for North Carolina's Water Resources Research Institute and Space Grant. Like Sea Grant, those programs have headquarters at NC State University and engage in targeted research, outreach and education projects to address critical issues in the state and the region.

— Katie Mosher

CitSci2019 to Raleigh

CitSci2019, an annual conference organized by the Citizen Science Association, will be held March 13 to 17 in Raleigh.

This year's theme, "Growing Our Family Tree," is a metaphor to describe the field's deep roots and broad branches. Speakers, workshops, poster sessions and field trips will address problem-driven citizen science, environmental justice and education.

Scott Baker, a North Carolina Sea Grant fisheries specialist, will give a presentation on Saturday, March 16, about the Citizen Science Program for the South Atlantic Fishery Management Council.

CitSci2019
GROWING OUR FAMILY TREE
Raleigh, NC | March 13-17

On-site registration is available, with options for members of the association, student rates and single-day passes. The event will take place primarily at the Raleigh Convention Center. For more information or to register: *citizenscience.org/association/conferences/citsci2019/.*

— Danielle Costantini

We Need Your Help: Loyal readers like you have helped make *Coastwatch* a success for more than 45 years. With your feedback on our reader survey, we'll be able to keep improving *Coastwatch* — and plan for the next 45 years.

Many Coastwatch readers already have sent in their surveys, which we included in the Autumn 2018 issue. If you haven't taken a few minutes to fill out yours, it's not too late.

You also can take the survey online if you prefer: *go.ncsu.edu/CoastwatchSurvey.*

All-Star Plant Guide

The Coastal Landscapes Initiative has published a handy new guide to native plants of North Carolina.

With full-color photographs and reader-friendly descriptions, the guide features 34 all-star species — plants that are native to the N.C. coastal region, visually attractive and versatile. Each profile offers information on unique traits and growing conditions, such as salt tolerance and soil requirements.

The guide includes color-coded sections on trees, shrubs, vines, grasses and flowering perennials, and it provides both common and scientific names, as well as a list of references. A companion brochure gives quick highlights of the same 34 plants, along with identifying photographs.

"We hope our guides provide professionals and coastal property owners confidence that these are solid choices for our landscapes and worthy of a place in the market," says Gloria Putnam, North Carolina Sea Grant's coastal resources and communities specialist and a member of the initiative.

The multi-partner effort addresses landscaping at every stage of the process, from planning and design to installation and management. Partners come from the public and private sectors and draw on a range of N.C. coastal expertise.

Free versions of the landscaping guide and companion brochure are available for download at *go.ncsu.edu/CoastalLandscapes.*

— Julie Leibach & Summer Walls

Danielle Lawson

Teaching Climate Change

Researchers on a new North Carolina Sea Grant-funded project have determined that intergenerational learning — teaching and influencing family members across generations — may be a key to encouraging adults to take action on climate change.

Danielle Lawson and her colleagues found that children who have a firm understanding of climate change are equipped to navigate ideological barriers in order to address the issue — and they also encourage their parents to get involved.

"Children have the potential to be great climate change communicators," says Lawson. "Not only do they interact with the topic of climate change unimpeded by things like political orientation, but they also share a unique relationship with the adults in their lives that is unlike the typical adult-adult relationship."

Lawson is part of the Environmental Education Lab at NC State, led by Kathryn Stevenson. The project team also found that child-to-parent intergenerational learning occurs when kids frame climate change as a local issue and when schoolwork encourages parental participation.

Lawson says there are numerous examples of children already fighting climate change and its effects, including the landmark case of 21 students in Oregon suing the federal government for climate inaction.

Global Environmental Change published Lawson's initial results: *go.ncsu.edu/climatechange.* — *Katelyn Vause*

Are Oystercatchers in Decline?

Due to continuing coastal threats to the American oystercatcher — and because the bird's small population had been in decline until recently — the North Carolina Wildlife Resources Commission has classified the species of "greatest conservation need." To better understand if the oystercatcher population is imperiled, a North Carolina Sea Grant study looked at a key indicator of species stability: the ratio of males to females.

"For a monogamous breeder like the oystercatcher, the number of available male-female pairs is critical," says Shilo K. Felton, a recent doctoral graduate in fisheries, wildlife and conservation biology from NC State University. "Many models assume an even ratio of breeding males to females, but this assumption can lead to misleading projections of population growth or extinction."

Natural resource managers rely on accurate estimates of population status and growth when making decisions to conserve species of interest.

"Skewed male-female ratios are common in avian species," Felton says. "We wanted to know if North Carolina's American oystercatcher population likewise had an uneven ratio."

Felton and Audubon North Carolina colleague Lindsay M. Addison combed through feather samples that Theodore R. Simon's lab at NC State had collected from over 600 oystercatchers during a 13-year period. In turn, a lab at the University of Porto in Portugal then sexed the samples.

A North Carolina Sea Grant-funded study looked at whether the American oystercatcher population is stable or dwindling.

Samples indicated even female-male ratios for both juveniles and breeding adults in all but one year.

The study also revealed additional insights about oystercatchers.

"Through capture and recapture analyses we also found that sex, hatch site and breeding site all influenced survival," Felton says. "In addition, the effects of each varied with life stage."

Overall, Felton and Addison say their results suggest oystercatchers may remain part of the state's ecosystems for years to come, as long as the various habitats the species requires are available. — *Dave Shaw*

Seeking Teacher Input on Mariculture Lesson Plans

Teachers, are you interested in test-driving lesson plans on marine aquaculture?

Developed through a grant from the National Oceanic and Atmospheric Administration, the 10 lessons include an introduction to marine aquaculture, or mariculture, as well as classroom activities on topics like environmental impacts, production methods and business perspectives.

Students who learn about mariculture gain exposure to new career avenues.

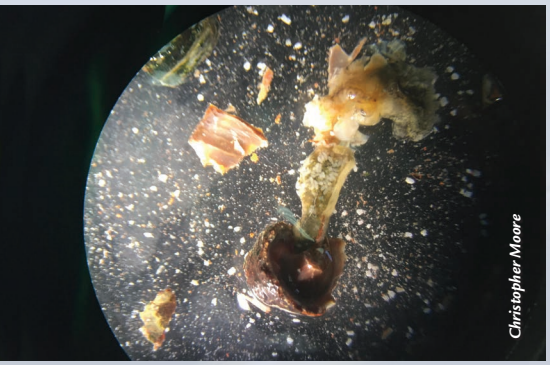
"We have worked with a team of science, agriculture and vocational teachers on the coast to develop these educational resources. The lessons now are ready to be tested in the classroom," explains North Carolina Sea Grant marine education specialist Terri Kirby Hathaway.

The team also included North Carolina Sea Grant coastal economics specialist Jane Harrison and science writer Julie Leibach, as well as Swansboro High School science teacher Amy Sauls.

"Initially we had a small team of top-notch teachers who gave input to the creative process. Now it is time to have educators field-test to make sure the lessons run smoothly and are effective," Sauls says. "It is important as a next step to ensure the lessons are useful to teachers in the future."

Teachers who would like to pilot the lessons and provide feedback for improvement should contact Hathaway at *tkhathaw@ncsu.edu* or 252-475-5486.

The final lesson plans will be available in time for the 2019-2020 school year.



A snail infected with larval trematodes. Centered under the lens, they resemble grains of rice.

Partnering with Parasites

Can parasites serve as indicators of biodiversity in marine ecosystems? Christopher Moore, a 2018 North Carolina Coastal Research Fellow and a doctoral student in marine ecology at East Carolina University, is exploring this question at the Rachel Carson National Estuarine Research Reserve in Beaufort.

Portions of the Reserve have been recently restored after significant shoreline erosion, and Moore and his colleagues are determining whether some restoration methods are more effective at enhancing biodiversity over time, particularly for fish, birds and reptiles.

Parasites provide clues that reveal if their host organisms are present in the same habitat. Because many parasites are highly specialized and require multiple hosts, parasites represent links between organisms in an ecosystem.

By sampling for parasites in easily-collected hosts like eastern mudsnails, researchers can infer the number and types of additional hosts present in the habitat, based on the species of parasite they find and the combination of hosts that each species requires. For example, an abundance of larval trematodes like *Gynaecotyla adunca* indicates that shorebirds, their final hosts, are also living in these restored sites.

"By harnessing the multiplicity of links that parasites form in an ecosystem, we can use parasite diversity as a tool to inform and guide restoration projects," Moore says. North Carolina Sea Grant and the N.C. Coastal Reserve fund his fellowship.

Preliminary data show that habitat complexity enhances overall biodiversity, as both host and parasite diversity are higher in areas with natural marsh.

Read more: *go.ncsu.edu/parasitepartners.*

— Summer Walls

Knauss Fellows Head to D.C.

Four Knauss Marine Policy Fellowship finalists from North Carolina are serving a year in the federal executive and legislative branches in Washington, D.C. Alicia M. Cheripka, Jill Hamilton, Chrissy Hayes and William Thaxton started their placements in February. Funded by the National Sea Grant College Program, the fellowship honors John A. Knauss, a Sea Grant founder and former dean of the University of Rhode Island's Graduate School of Oceanography. The new fellows focus on policies and processes that affect ocean, coastal and Great Lakes issues.

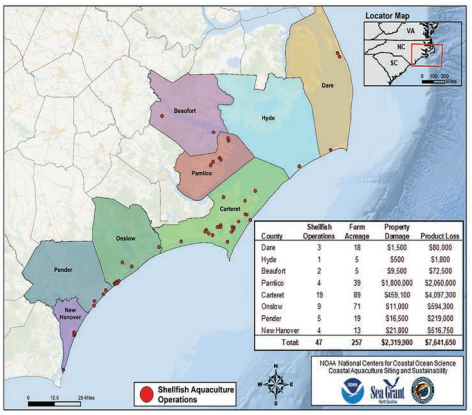
Cheripka earned a master's degree in marine biology from the University of North Carolina Wilmington. Her thesis project included creating a model to determine how various marine protected area network configurations affect species. She will work as an international liaison for the National Oceanic and Atmospheric Administration's (NOAA) Ocean Acidification Program.

Hamilton received a master's degree in environmental management from Duke University, concentrating in coastal environmental management. Her thesis explored international aid for small-scale fisheries and considered how future aid efforts could align with the United Nations Sustainable Development Goals. Hamilton will serve in the U.S. Department of State's Office of Marine Conservation.

Hayes also earned a master's degree in environmental management from Duke, concentrating in coastal environmental management. Her studies focused on the performance of small-scale fisheries development. Hayes will serve in the NOAA Office of International Affairs.

Thaxton completed his master's degree in biology at East Carolina University. He explored the effects of climate variability on several commercially important marine fishes in Beaufort Inlet. Thaxton will focus on ocean and natural resource policy in the office of U.S. Senator Brian Schatz from Hawaii.

— Marisa Incremona & Summer Walls



County	Shellfish Operations	Farm Acreage	Property Damage	Product Loss
Dare	3	18	$1,500	$80,000
Hyde	1	5	$500	$1,800
Beaufort	2	5	$9,500	$72,500
Pamlico	4	39	$1,800,000	$2,060,000
Carteret	19	89	$459,100	$4,097,300
Onslow	9	71	$11,000	$594,300
Pender	5	19	$16,500	$219,000
New Hanover	4	13	$21,800	$516,750
Total:	47	257	$2,319,900	$7,641,650

NCDA&CS, NCDMF and NOAA

Updated N.C. figures reveal millions in property loss and equipment damage to the industry.

Shellfish Aquaculture Hit Hard

Updated tallies show Hurricane Florence and Tropical Storm Michael in 2018 brought combined damages of nearly $10 million to North Carolina's shellfish aquaculture industry, with significant impacts to facilities, gear and crops.

The tallies are from ongoing surveys conducted by North Carolina Sea Grant, with partners at the N.C. Department of Agriculture and Consumer Services (NCDA&CS), N.C. Division of Marine Fisheries (NCDMF), and the National Oceanic and Atmospheric Administration (NOAA).

Hurricane Florence brought record-setting rain, causing a flush of fresh water into estuaries — and into shellfish farms. That inflow reduced salinity and dissolved oxygen levels, leaving poor conditions for growing oysters and clams. Powerful waves and storm surge also had severe impacts on shellfish hatcheries and nursery operations.

Michael, which was a hurricane when it made landfall in Florida, still had tropical storm force winds when it came through North Carolina.

"All 47 farms that reported had significant damage, and a few farms had catastrophic losses," says Chuck Weirich, North Carolina Sea Grant's marine aquaculture specialist.

Weirich worked first-hand with growers to gather damage estimates using a web-based form developed by NCDA&CS. The NOAA team then assessed the data and mapped the extent of loss in specific counties.

Pamlico County had the highest dollar losses, with $1.8 million in property damage and $2.06 million in lost product.

— Summer Walls

FROM SEA TO TABLE TO YOU

FARM-TO-TABLE HAS BEEN HAVING A MOMENT — BUT NOW "SEA-TO-TABLE" IS, TOO.

DANIELLE COSTANTINI

Continued

For chefs Bill Hartley and James Clark of Postal Seafood Company, cooking local seafood like wild Swansboro clams "has always been a way of doing things."

Forest Mason

Casey Toth/The News and Observer

Jail Leonard/The News and Observer

"When I opened up Saltbox, I wasn't trying to be trendy," chef Ricky Moore says. A small walk-up counter, Saltbox Seafood Joint quickly became recognized as one of the top places to get fresh seafood in the Triangle.

Now with two locations in Durham, the restaurant has gained local and national acclaim for its use of North Carolina seafood and traditional recipes. Growing up in New Bern, Moore was raised on local flavors that he brings to his customers.

With the restaurant scene flourishing in the Raleigh/Durham/Chapel Hill area — also known as the Triangle — more establishments are taking advantage of the bounty of seafood products from our coast.

North Carolina boasts over 300 miles of oceanfront and thousands of miles of estuary shorelines, ready access to water flush with coastal resources like shrimp, crab, flounder and oysters.

"It makes sense," says chef Matt Kelly of Saint James Seafood, in Durham. "We have this big, giant, beautiful coastline with pristine waters, and we have fishermen who need to sell fish."

But at restaurants inland, finding North Carolina seafood can be difficult at times. To get fresh N.C. seafood to the Triangle "has been very challenging logistically," Kelly says.

It's often more cost-effective for N.C. restaurants to get their products from distributors who source seafood from outside the state. This has led many restaurants to carry non-native salmon or cod.

Locals Seafood

ABOVE: *Chef Matt Kelly, shown here in front of Saint James, says strong relationships with fishermen and distributors have helped keep his restaurant stocked with fresh ingredients.* BELOW: *These Albemarle Sound fishermen catch blue crabs, establishing the first link in the supply chain for Locals Seafood, a prominent distributor serving the Triangle.*

"There are several barriers to getting North Carolina seafood to inland markets," explains Barry Nash, North Carolina Sea Grant's seafood technology and marketing specialist.

According to Nash, varied factors — the lack of labor; harvest regulations restricting the supply of coastal products; low capacity to process local products into ready-to-cook products; and underdeveloped supply chains — have limited the amount of N.C. seafood available inland.

THE NEW WAVE

Yet, despite the obstacles, North Carolina seafood is becoming more common away from the coast. Inland restaurants featuring native seafood have not just been surviving, but thriving — catching the eyes of restaurant-goers and food critics alike.

"National market research indicates people prefer locally grown or harvested foods over imports when given a choice," Nash says. In the Triangle, the increase in N.C. seafood may be related to the growing restaurant scene inspired by the area's rapid population growth, or by local chefs investing in their community. It could also be related to the farm-to-table movement and growth of local farmers markets.

Regardless, the sea-to-table movement shined in the Raleigh *News & Observer*'s ranking of the best new restaurants of 2018. Ricky Moore of

Locals Seafood

Forest Mason

Juli Leonard/The News and Observer

"As a chef, you have conviction in your craft, and my goal is to give the freshest local ingredients while also focusing on the local economy," he says. His restaurant explores traditional and innovative seafood recipes. "The first thing I think of is not business. I think of creating something special to share with someone, to sell to

ABOVE: *To bring the catch from the coast inland, Locals Seafood keeps it fresh by putting it on ice.* BELOW: *The menu at Postal Fish Company changes frequently, so that fish like beeliner are available without delay. To ensure freshness, chef-owners James Clark (shown) and Bill Hartley use seafood only from North Carolina, South Carolina and Virginia.*

Saltbox Seafood Joint, Matt Kelly at Saint James Seafood, and chefs James Clark and Bill Hartley of Pittsboro's Postal Fish Company elevated their three seafood restaurants into the top-10 list. A fourth, Postmaster — with chef Chris Lopez at the helm — had drawn recognition previously for its use of "market catch" fish.

The *N&O* also named Saint James the best seafood restaurant in the Triangle and gave it an honorable mention for best restaurant overall for 2018.

For Clark, sea-to-table has "always been a way of doing things." Postal Fish Company utilizes seafood from only North Carolina, South Carolina and Virginia. This choice is partially due to Clark's upbringing in Elizabeth City and his early-career experiences working with commercial fishermen in South Carolina. There, he learned the benefits of using seafood off the docks, particularly underutilized species.

"My philosophy is to try and get the best quality fish as local as I can get it," he says.

At Saint James, Kelly takes a similar approach.

someone, and it really starts there."

Outside of strictly seafood-serving restaurants, others are taking advantage of North Carolina's coastal resources by featuring a "fresh catch" or "catch of the day" option.

"We take pride in sourcing locally whenever we can," says Lopez, the chef at Postmaster, which opened in 2017 in Cary. Postmaster's menu changes seasonally to maximize the elements of a dish the restaurant can source locally.

"There are such great purveyors of local seafood that is it hard to want to

Continued

get it from anywhere else," Lopez says. "For the sake of quality of product and being able to trace where it is coming from, it's the obvious choice."

BRINGING IT HOME

Assisting these chefs in their mission are distributors like Locals Seafood. Owners Lin Peterson and Ryan Speckman first started selling shrimp out of a cooler on the side of the road. Now, their business has evolved into a multifaceted approach that brings seafood from the coast to the piedmont.

"The supply chain is structured to move seafood up north to markets such as Boston, not towards the west — inland," says Brendon Greene, who works for the distributor. "Restaurants in the Triangle look to us to bridge the gap between here and the coast."

Locals boasts an impressive list of customers totaling over 50 restaurant clients, including Postmaster, Saltbox and Postal. By working directly with fishermen and fish houses and making three to four trips a week to the coast, the distributor regularly has fresh seafood available to sell to restaurants, grocery stores and the public.

Forging and maintaining relationships with fishing communities and Triangle customers is vital. "We are always working with chefs and are in communication with them, because our product changes," Greene says. Weather, season and ocean conditions are all factors that could affect the daily or weekly catch.

When interacting with customers at the farmers market and their new site that includes a restaurant at the Transfer Company Food Hall, Locals helps people understand their products make a difference.

"It's constant education," Greene says. "We try to take something that these customers may not have seen before and compare it to something they are more accustomed to."

Aside from local distributors, chefs also use personal connections to get the best products, which means working with fishermen who make their living hours away.

"Chefs are out there making relationships with their farmers," says Postal Fish Company's Clark. "They should be out there making relationships with their fish farmers, too."

Clark and business partner Hartley drive down to the coast as regularly as they can. There, the duo will meet with fishermen to see what they are bringing in. They also work closely

Chef Ricky Moore of Saltbox Seafood Joint says feasting on local seafood ought to be an everyday occasion. Starting as a simple walk-up counter, Saltbox has recently expanded to a second, sit-down location.

Chef Chris Lopez at Postmaster has high standards for the food he serves, which is why he often uses local N.C. seafood in recipes like honeycomb oysters.

with suppliers like Salty Catch, with commercial fisherman Steve Goodwin transporting his catch himself to Pittsboro.

NAME RECOGNITION

After getting the seafood to the Triangle, a second challenge arises. When customers see the names of North Carolina fish on the menu, they aren't always familiar with them. Many people prefer fish commonly found on menus like salmon, which aren't native to the N.C. coast.

"We're just not a salmon or a cod place," Clark says. "They don't swim in our waters."

Saint James's Kelly agrees. "When you buy local fish, I can't always give you a standard cut of flounder."

Grouper, triggerfish, sheepshead and cape shark are just a few of the species seasonally available on our coast. But put them on the menu, and some customers may be cautious.

As Moore discovered at Saltbox, at first glance, people aren't always open to these fish. If consumers grow up eating a certain kind of fish — or no fish at all — trying something new can be difficult.

"There's a level of cultural conditioning at play," he explains. "I knew it would take time to inspire and influence people to try some different things."

Moore, Lopez, Kelly and Clark all stress transparency, honesty and direct communication with their customers.

"When we have a unique fish on the menu, we try to compare it to a commonly known fish, so people have a jumping-off point," Lopez says. This familiarity can help Postmaster customers "comfortably step out of their comfort zones." Sheepshead, for example, has a similar flavor profile to catfish or mahi-mahi, which all have a light to moderate flavor.

Having wait staff who are familiar with the products also helps.

"They have to go out there and sell it," Clark says. With this in mind, he trains his staff to be prepared to answer any questions that may come their way about the seafood they are serving.

Saint James employs a similar strategy. "Our staff is educated to explain to someone what the fish is and make the guest comfortable," Kelly says. "When you have high quality and have done the time, you have trust. People come here to try something different."

A slow and steady approach to building trust now allows Moore to offer lesser-known species of native fish on a daily basis.

"I have a standard menu, but also a 'try me' kind of dish, which is literally, 'Try this fish!'" he says. "Customers must trust you. If you are bringing them something out of their norms, they have to have trust."

Lopez says Postmaster includes some nontraditional species and seasonally changes their menu. They create their recipes around the seafood that is available, using the flavor profile, size and texture of the fish.

"With our customer base, we can put any fish on the menu, as long as it tastes good," he says.

But are appetites actually growing for local seafood?

Despite the challenges North Carolina seafood may present, customers are buying what these chefs are selling. Other successful N.C. chefs — like Ashley Christensen, Vivian Howard and Jason Smith — have embraced using local products and seafood on their menu to great acclaim.

Sea Grant's Nash also has seen hints of increased acceptance of local fish. "Consumer research conducted by Sea Grant with cultured sturgeon, lionfish and cape shark indicates that people are hungry — some pun intended — for unfamiliar marine species," Nash says.

For Moore's part, he wants to make eating North Carolina seafood as normal as possible.

"It's an everyday thing for these fishermen to get fish and provide this food," he says. "I want to make this an everyday occasion to eat their food."

Return

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of the Dunes

The Science of the Post-Florence Recovery

SPENCER ROGERS AND DAVID NASH
WITH ILLUSTRATIONS BY DAVID WILLIAMS

Dunes on the beach at Emerald Isle.

Dune walkover, Topsail Beach.

Months after Hurricane Florence made landfall on Wrightsville Beach, much of eastern North Carolina is still in recovery. Although Florence's ocean storm surge was lower than some previous hurricanes', the tropical system sat on the shoreline for an extended period of time, bringing significant flooding from record rainfall and estuarine storm surge.

As spring arrives, some oceanfront stretches still show signs of Florence, like extensive dune and beach erosion, and damaged or newly replaced walkways and dune crossovers.

The destruction evokes images of some of the worst hurricanes North Carolina saw in the 1990s. Almost exactly 22 years before Florence, Hurricane Fran made landfall near Cape Fear. In 1996, Hurricane Bertha already had damaged many of the dunes from Cape Fear to Topsail Island, with Bogue Banks and Brunswick suffering moderate dune erosion but minimal building damage.

In much of the primary impact area, Fran then overtopped and eroded many of the dunes that had remained. The combination of the 1996 storms was worse than Florence on the oceanfront, but the restoration of the dunes after the 2018 hurricane season will entail a similar slow process.

Spencer Rogers, North Carolina Sea Grant's coastal construction and erosion specialist, says that storm-induced erosion can seem alarming, but North Carolina's beaches already have started the process of restoration.

"It's not obvious that much of the sand lost from the beach and dunes is still in the nearshore waters and likely will return to the shoreline," Rogers explains. "Even though a significant portion of sand had been moved offshore during Florence, post-storm waves almost immediately began moving it back to the beach."

However, he adds, it is difficult to predict when the dunes will have made a full recovery.

"Recovery of the lower beach usually takes months to a couple years," Rogers says. "Recovery of the taller dunes by natural processes can take a few years to a decade, depending on the severity of the storm damage."

Although expensive, beach nourishment — bringing in sand to plant dunes or to widen the beach artificially — can speed up the process. Understanding the erosion and recovery processes of dunes, as the authors explain here, can inform decisions on many aspects of post-hurricane recovery.

by Katelyn Vause

• How the Beach Works

To understand the dunes, we first must understand how the beach works.

Ocean waves dominate the beach. Waves absorb energy from the wind. Stronger winds and larger storms create larger waves. That energy is transmitted across the water surface by the waves to the coast where the waves break, unleashing that energy on the beach.

Wave forces are very misleading. Most people avoid hurricane winds of 125 miles per hour. Yet the force of a single 1.5-foot breaking wave on a solid, vertical wall is at least three times more powerful than the winds of a major hurricane. Fortunately, our relatively thin bodies let the water forces go around us, allowing people to play in the surf.

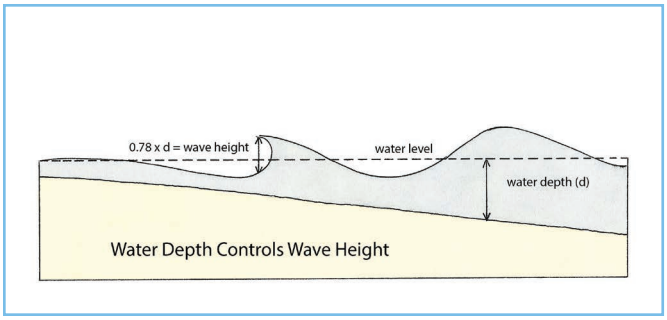
The most important protective feature of the beach and dune system is the submerged offshore slope. As a wave moves into shallower water, friction-like factors internally affect the wave form, slowing the base of the wave but having less effect on the crest or top of the wave. The decreasing depth causes the wave to increase in height, slow in speed and become much steeper. At some point, the crest of the wave is moving too fast for the bottom of the wave form to keep up. Then the wave becomes unstable and breaks, dissipating part of its energy before reforming into a smaller wave.

This depth-induced breaking is a relatively predictable wave phenomenon that can be measured on any beach or reproduced in the laboratory wave tank. This description assumes the wave will break when the water depth is roughly equal to the wave height. More precisely, the waves break when the wave height — crest to trough distance — is about 78 percent of the water depth (*Figure A*).

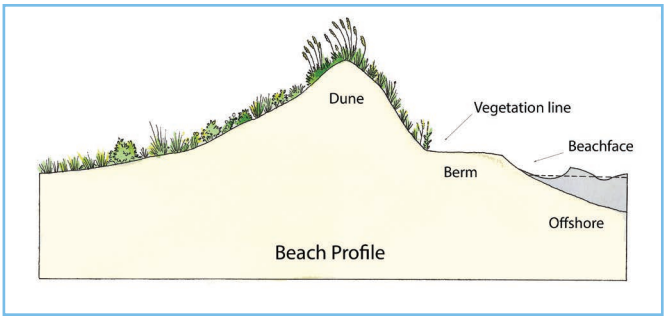
The offshore slope protects the beach and any coastal development from the largest waves. By the time the waves reach buildings on the shoreline, they are usually smaller than 6 feet, even in a hurricane.

The shape of the beach is no accident

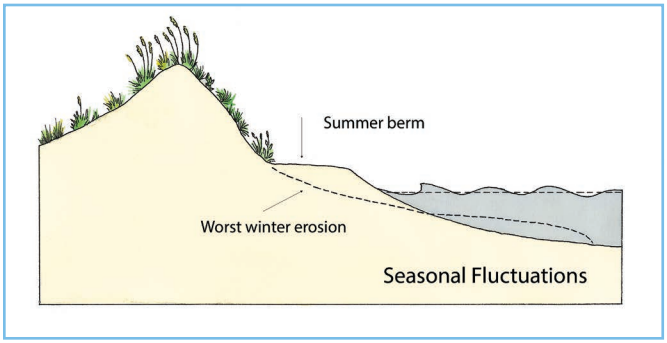
Adapted and updated from The Dune Book, *reprinted in 2016 by North Carolina Sea Grant:* go.ncsu.edu/TheDuneBook



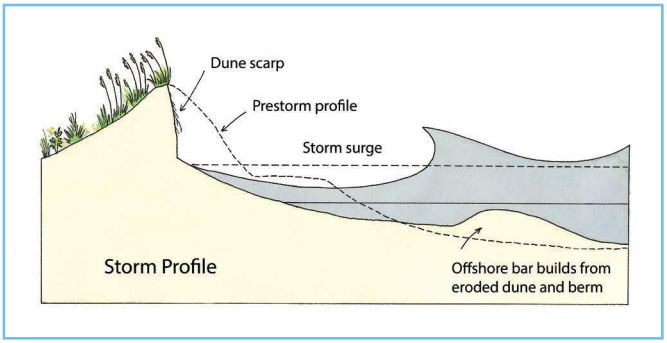
• **FIGURE A.** *Shallow water causes waves to break.*



• **FIGURE B.** *Beach components.*



• **FIGURE C.** *Seasonal changes in wave height and storm frequency cause seasonal fluctuations in the berm.*



• **FIGURE D.** *A single severe storm or hurricane causes "storm-induced erosion."*

(*Figure B*). The primary factors that affect the beach shape on most days include: the wave height during the last week or so; the water level, including astronomical tide conditions and recent storm surges; and the grain size of the sand.

Higher waves shift sand from the berm into deeper water, flattening the beachface. Smaller waves move sand back to the berm and steepen the beachface. When higher astronomical tides or small storm surges raise the water level, smaller waves can cause as much erosion as larger waves at normal water levels.

On any individual beach, the grain size distributions are relatively constant — but they can vary significantly from beach to beach. Fine sands result in flatter beaches. Coarse sand results in a steeper beachface.

If ocean conditions were ever constant, the shape of the beach would approach a relatively constant or equilibrium shape. In nature, wave height and water level are constantly changing. Adjustments in beach shape are critical in providing storm protection for coastal development.

• Erosion

Beaches are products of erosion. To make the best dune management decisions, it is critical to understand what type or types of erosion are occurring. Building dunes and planting vegetation can be very effective in treating some types of erosion but totally ineffective for others.

Varying weather and storm patterns that reoccur every year cause seasonal fluctuations in the beach width. Between late fall and early spring, a series of "northeasters" occurs across the North Carolina coast. These massive offshore storms cause larger waves and small storm surges that — at least on east-facing beaches — erode the berm. Although no single storm may be particularly noteworthy, they come frequently enough that the berm does not have time to recover during the periods of smaller waves that occur between storms. In contrast, the summer season has fewer and smaller storms, and the berm is usually wider than during late fall to early spring.

On a typical North Carolina beach, the waterline moves about 75 to 100 feet every year due to seasonal fluctuations. Seasonal fluctuations also cause dramatic changes in the elevation of the beach. When most beaches are at the widest, usually in the summer, you can stand at the seaward edge of the berm at the top of the beachface, and the beach elevation under your feet typically had been 6 to 8 feet lower following the worst storms of the previous year (*Figure C*).

As long as the sand returns for the summer, no one usually worries about the few days when the berm disappears and waves cut to the vegetation line. However, understanding the seasonal loss helps homeowners determine where dune building is likely to be successful.

On the other hand, storm-induced erosion is caused during infrequent, but very severe storms, including the worst hurricanes. Large waves are accompanied by a rise in water level or storm surge.

The breaking waves create currents along the bottom that move sand from the visible beach to submerged areas farther offshore (*Figure D*). The average slope of the beach is flattened, spreading

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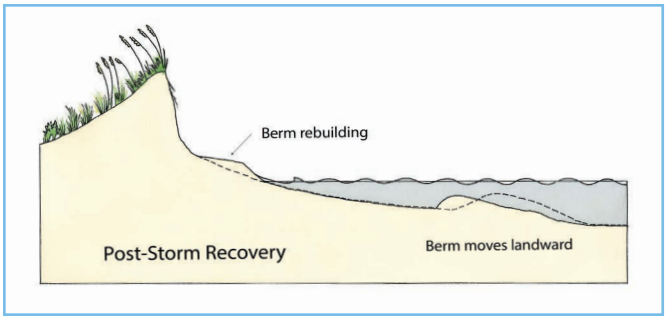
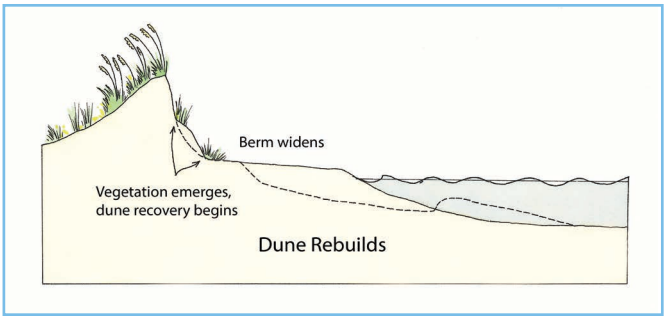
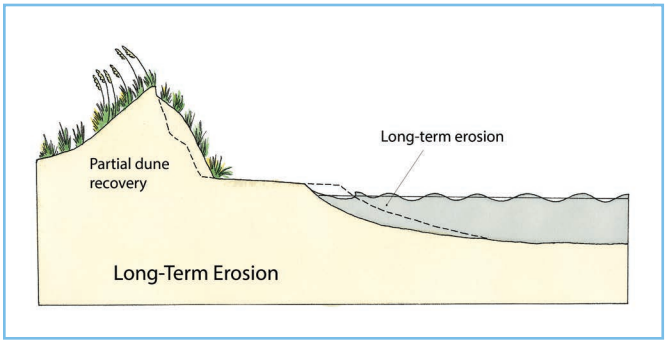


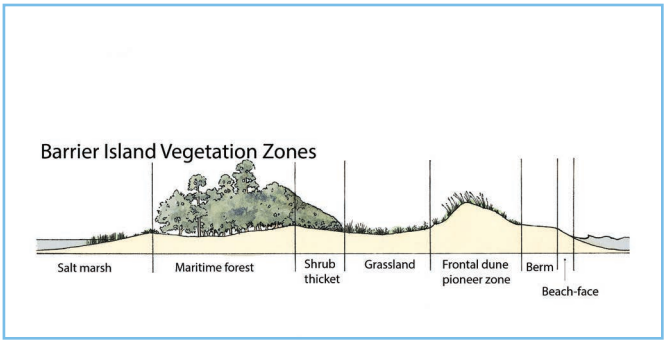
• **FIGURE E.** *Berm recovery begins immediately after a severe storm.*



• **FIGURE F.** *Berm recovery is complete as dune recovery begins.*



• **FIGURE G.** *Post-storm berm and dune recovery is complete, but long-term erosion deficits move the berm and dune farther landward.*



• **FIGURE H.** *Salt spray and blowing sand are the two main factors contributing to the zonation of plant species across the barrier island.*

out the incoming breaking waves. Initially the berm is eroded, but since the conditions are much worse than the typical annual storm, erosion occurs in the dunes.

As with seasonal fluctuations, the overall beach slope tends to flatten by moving sand in the upper beach to shallow water just offshore. As the storm begins, relatively deep water extends to the shoreline, allowing large waves to reach the berm and causing rapid erosion. As more sand is moved offshore, the depth gets shallower, forcing the waves to break farther offshore and gradually slowing the erosion.

Storm waves frequently form offshore sand bars. As the waves move into shallower water, currents moving in opposite directions are created along the bottom. Sand is pushed toward the crest of the bar from both directions. The larger the waves, the larger the bar and the farther offshore it forms. Many beaches have one or more rows of offshore bars all year. In those areas, the storm moves the bars farther offshore as sand erodes from the berm and dune, increasing the bar's size.

Conveniently, the bars, with their sand-efficient shapes, cause the waves to break. As the storm continues, the bar builds in height above the original depths. Thus, the water depth over the bar is reduced by the sand supplied by the upper beach. Because water depth controls the wave height, as the bar height builds, even smaller waves are forced to break on the growing bar. Wave heights reaching the upper beach are diminished. Smaller waves result in a slower rate of erosion. The bars act as an increasing filter for the largest waves.

Like the seasonal fluctuations, the storm moves the sand toward an equilibrium — a beach shape that after some period of time experiences little additional erosion. Even in the middle of a hurricane, the beach still moves toward a stable shape.

A principal benefit for anyone living near the shoreline is that the dune acts as a storage reservoir for sand that is made available during infrequent but severe storms. The larger the dune, the more time it takes to be eroded by the waves, and the more protection it provides to areas farther landward. If the dunes are large enough, the waves and storm surge are prevented from washing across a barrier island. Flooding may still occur from the backside of the island but not directly from the ocean. Even if the dune is breached and the shoreline is overwashed, the sand stored in the dunes and eroded by the storm reduces the incoming wave heights compared to areas without dunes.

Both natural and man-made dunes provide significant protection from storm-induced erosion.

• Post-Storm Beach Recovery

If the offshore sand transport was a one-way path, ocean shorelines would disappear extremely rapidly. Fortunately, most of the sand eroded from the berm and dune moves only a short distance offshore. As the waves and storm surge subside, the beach shape is again out of equilibrium. However, this time the offshore is too shallow. The smaller waves

on the post-storm beach shape induce currents along the bottom that push sand back toward the shoreline.

Initially, the bar crest begins to move landward, and the berm begins to reform (*Figure E*). Eventually, the lost sand is pushed back into a new and wider berm. With more time, the dune recovery begins (*Figure F*).

Dunes provide protection against storms but don't prevent long-term erosion.

The berm is a feature of the post-storm recovery during average waves and tides. Returning sand is pushed up the beachface, where the water percolates into the surface, depositing the sand it carries. At high tide, daily wave runup pushes sand to its maximum elevation, resulting in a flat berm (*Figure G*).

Water and the waves control the berm and offshore area, but dunes are features of the wind, making use of those areas not regularly rearranged by the waves. As the wind speed increases, the sand starts to move. The threshold on a particular beach depends on the grain size and composition of the sand. The finer and lighter the sand, the lower the wind speed necessary to move it. That is why dunes tend to have finer grain sizes than wave-dominated parts of the beach.

The sand must be transported to a relatively stable location of beach, landward of the seasonal fluctuations. Finally, to form a dune, there must be some barrier to slow the wind speed below the threshold needed to move the sand; dune vegetation becomes very important.

When a dune plant traps sand, it stimulates growth through the accumulating sand that would kill many other plants, ensuring that the plant remains a continuing sand trap for building the dune elevation. Sand fences and other wind barriers trap sand in the same way, but these barriers are unable to expand with the dune like vegetation does.

The time required for the onshore and offshore movement of sand depends on the severity of the storm. A hurricane may cause severe dune erosion in as little as a few hours, but the sand may take several years to get back to the berm. The slow dune recovery by the wind may take as much as a decade following the worst storms. However, most of the sand eventually returns.

In the simplest terms, sand stored in the dunes buys time and protection from the worst storms. The bigger the reservoir of sand, the more time it takes for the waves to consume the dune. By carefully encouraging larger and properly placed dunes, the storm protection can be improved for more landward, natural and man-made features on your beach.

• Dune Vegetation

Only a few species of plants can adapt to the dunes closest to the ocean and beach, where high levels of salt spray, continuous winds, large amounts of wind-blown sand, and other environmental factors continuously impact these "pioneer zone" species. Coastal dune plants must be able to survive in soils that are low in nutrients and moisture and have extreme fluctuations in temperature and ocean overwash. Dune species thrive in this harsh environment because they are highly adapted to tolerate the extreme conditions.

Vegetation aids in forming the dune and plays an important role in the coastal dune ecosystem. Plants trap blowing sand, causing the formation of sand dunes and the stabilization of barrier island soils. As the dune field grows, multiple dunes line the beach, providing habitat for animals, birds, amphibians and reptiles.

Salt spray and blowing sand are the two main factors contributing to the zonation of plant species across the barrier island (*Figure H*). When waves break on the ocean shoreline, salt spray is tossed into the air in high concentrations. Regular onshore winds push the spray inland, coating everything in its path. The highest salt concentrations occur on the beach, gradually decreasing with distance. Dune plants tolerate the highest levels of salt spray and even an occasional overwash by sea water.

Most plants have a low tolerance for burial over their stems and roots. In contrast, dune plants thrive on wind-blown sand deposits, and collect sparse nutrients from the incoming sand, stimulating growth and reproduction. The harsh conditions in the pioneer zone allow the dune vegetation to grow without competition from less tolerant plants.

Inland from the shoreline and behind the shelter of the dunes, the conditions moderate to allow a wider variety of moderately tolerant grasses, shrubs and trees, resulting in distinctive plant zones forming across barrier islands — from the ocean to the estuary. The older dune ridges are farthest from wind-blown sand and salt spray. Plant species with less

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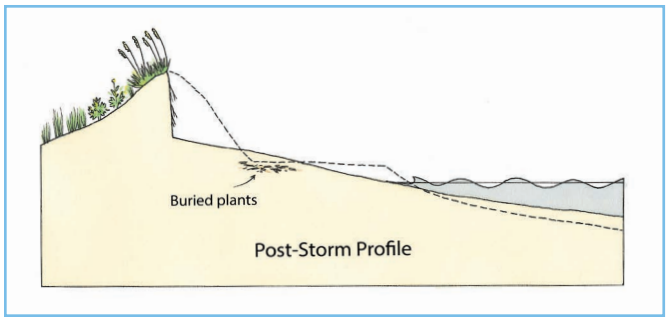
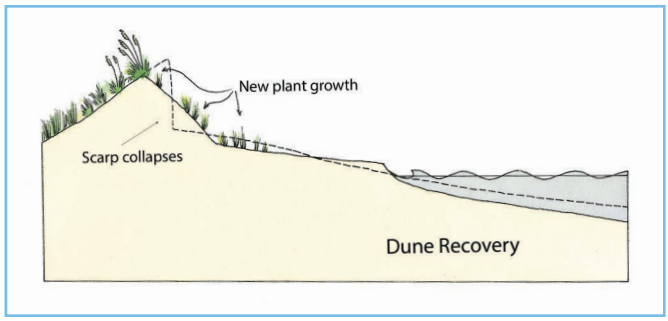
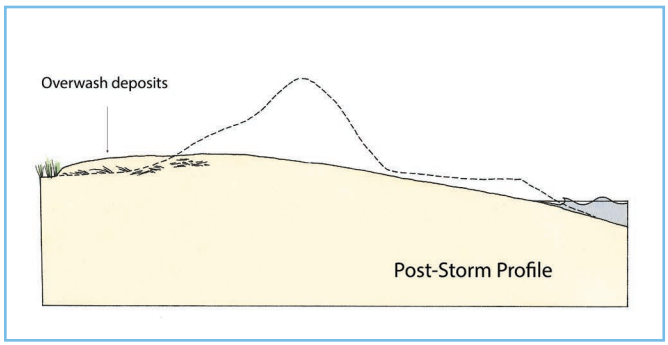
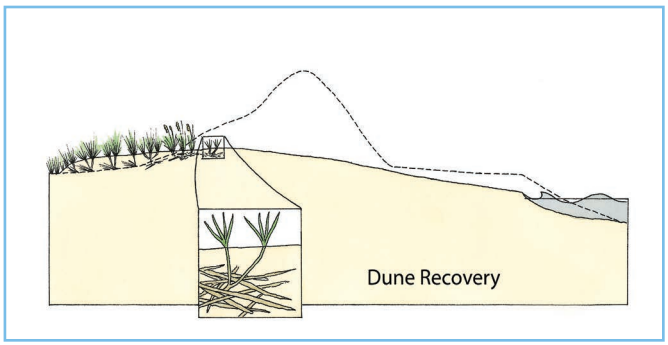




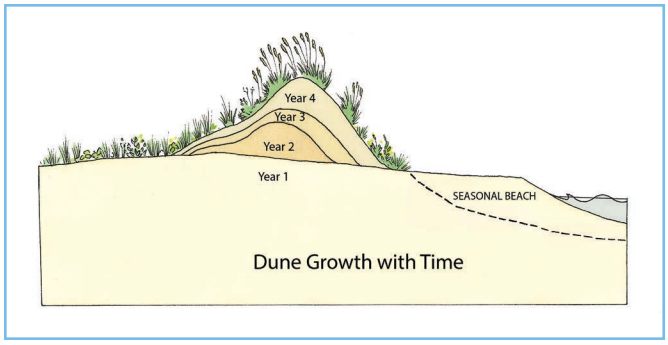
• **FIGURE I (left) and FIGURE J (right).** *Surviving plants slide off the face of the eroded dune as the scarp dries and collapses, where plants take root.*





• **FIGURE K (left) and FIGURE L (right).** *After a storm flattens the dune and overwash deposits bury the vegetation, some plants grow through the deposits and initiate dune recovery.*

tolerance for salt spray and other adverse conditions may thrive in the back dune zone, where other plants and dune ridges block the sand and salt spray carried by the wind.



• **FIGURE M.** *Dune width and height increase each season in a seaward direction toward the source of blowing sand. Vegetation and the height of the dune prevent sand from reaching the landward side of the dune.*

• Climate and Native Species

Climate is the primary factor limiting the geographic range of pioneer zone coastal plant species. Along the mid-Atlantic coast, the dunes between the Chesapeake Bay and Cape Lookout are the approximate transition zone for several species. For example, sea oats prefer the warmer climate found south of this area and appear to be limited in their northern range by cold temperatures. American beachgrass is the dominant pioneer zone species north of the transition zone, tending to die back when stressed by the hot, dry conditions found farther south. Both species are excellent sand trappers and dune stabilizers. Each species should be utilized in the climate regions where it is best adapted.

While the native geographical range of a coastal species may extend for hundreds of miles along the coastline, plants from one end of the native range may not adapt well at the other end of their native habitat. For example, research has demonstrated that the genetic makeup of sea oats — which influences the plant's hardiness, vigor, seed production, temperature tolerance, growth rate and reproduction — differs from one population to another.

Since local plants take years to evolve, they are usually best adapted to the climate where they were first grown. For example, South Florida sea oats do not adapt as well in the cooler climate of North Carolina as they do in Florida, and American beachgrass from New Jersey is not well suited to North Carolina's warmer climate. Therefore, whenever possible, it is always best to obtain dune plants grown from seeds or parent material originating within a 100-mile radius of the beach where they will be planted. Often, however, the need for plants after the worst storms overwhelms local supply capacity, making it necessary to buy stock from farther away.

Whether patching the frontal dune adjacent to a beach cottage or planting several miles of a beach nourishment project, the primary goal is likely to be

the same: to trap and stabilize the blowing sand so that it will repair or enhance the storm protection that dunes provide.

Coastal dune plantings also help build new ecosystems. This is best accomplished by using native indigenous species adapted to the pioneer zone. It is widely accepted that species diversity lends stability to an ecosystem. The difference between environmental restoration and landscape gardening is an important distinction when planning coastal dune revegetation projects, which should include several pioneer zone species.

Native grasses and broadleaf plants stabilize pristine dune ecosystems, such as those found on the Cape Lookout National Seashore. Unfortunately, the dunes and plants in developed areas along the North Carolina coast are often destroyed by human impacts.

Planting three or more of the pioneer zone species in a dune revegetation project will increase the long-term stabilization of the blowing sand and help the ecosystem recover more quickly. Once the foundation of the pioneer zone species is established, other annual and perennial plants adapted to the dune environment will establish naturally. As the dune system stabilizes and provides food and shelter, birds, animals and reptiles will return to the recreated habitat.

• The Role of Vegetation in Natural Dune Recovery

Dune recovery following a storm usually evolves in several ways, depending on the remaining topography and severity of the storm. During typical seasonal fluctuations in the berm width, the seaward edge of the vegetation sends rhizomes a few feet into the back edge of the berm during the growing season, only to get pruned during the season's worst erosion.

In severe storms — where the dune is not overtopped but a significant volume of sand is removed from the dune — vegetation recovery is usually initiated at one of the three points where remaining vegetation may survive (*Figure I* and *Figure J*).

The most severe storms may leave remnants of surviving vegetation near the old vegetation line, initiating the most seaward pioneer plants in the next growing season. The near vertical erosion scarp is highly unstable. In the days to weeks following the storm, the moist sand in the scarp dries, and the scarp gradually collapses, becoming a flatter, more stable slope.

As the scarp collapses, vegetation from the top of the dune is carried with it. Some of the vegetation survives the slide to the toe of the dune, initiating the recovery over the new slope. Remaining vegetation at the top starts the recovery from above. Therefore, on high dunes, vegetation recovery following storms can begin at three locations: surviving plants on the dune top; plants sliding seaward with the collapsing scarp colonizing the toe of the dune; and sometimes, the old vegetation line, if the erosion isn't too deep.

On shorelines where the dunes are low and over-topped by the waves, a storm can flatten everything (*Figure K* and *Figure L*). The old vegetation line and the dune are eroded, and the vegetation is lost. The waves push overwash sand farther inland, behind the original dune. Farther back, the overwash deposits stop, and the original grasses remain exposed.

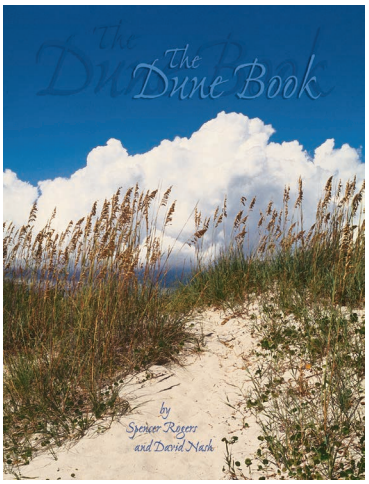
Dune vegetation has the ability to survive varying depths of burial by overwash. Although the plants seem to disappear following a storm, they can pop up out of nowhere at the beginning of the next growing season and initiate the dune recovery. Buried too deep, the vegetation will not survive, and recovery must start farther landward.

Dune plants colonize bare sand primarily by spreading rhizomes or runners from a parent plant. Storms can leave debris deposits or wrack lines that contain a few viable seeds or plant remnants and help jumpstart the dune recovery.

The densest clumps of vegetation trap the most sand and are stimulated to grow denser and spread even faster. As the dune grows in height and vegetation density, the area farther landward begins to be affected. By trapping most of the sand in the first dense vegetation, the sand supply to more inland areas is reduced. As the seaward dune height increases, dunes farther landward lose their sand supply and become more sheltered from the wind speeds necessary to deliver the sand.

Over time, most dune growth — in both width and height — occurs in the seaward direction (*Figure M*). During each season, the seaward edge of the dune grows farther seaward, followed by the rising dune crest. In contrast, the landward side of the dune captures very little sand.

In this way, dunes grow from landward to seaward. However, at some point the seaward growth is halted when the vegetation line reaches the landward limit of seasonal berm fluctuations. As the slope of the dune face steepens, future increases in dune height slow considerably. Understanding the way that dunes grow in width and height — and their effect on the growth of more landward dunes — is critical in applying the dune and vegetation management strategies.



The Dune Book *includes information on dune management strategies, tips for planting each of the five pioneer zone species, and more:* go.ncsu.edu/TheDuneBook

In the Face

How Electric Co-ops Worked around the Clock to Get their Communities Back Online

GORDON BYRD

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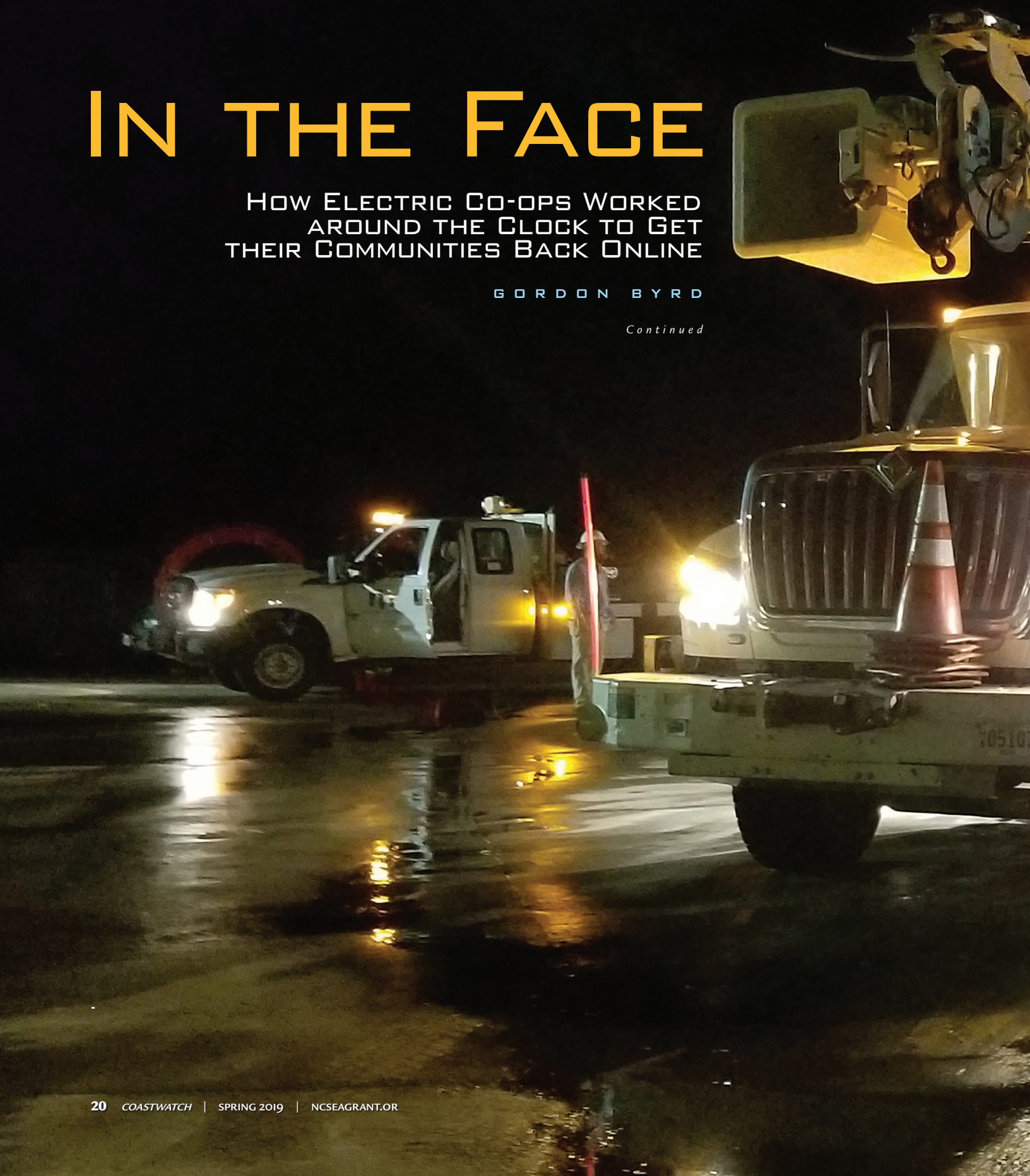


# of Florence

Lisa Gallizia

Florence made landfall near Wrightsville Beach on Friday, Sept. 14, as a massive and deadly storm. Electric co-ops serving southeastern counties — in particular Brunswick Electric, Carteret-Craven Electric Cooperative, Four County EMC (Electric Membership Corporation), Jones-Onslow EMC, Lumbee River EMC, South River EMC, Tideland EMC and Tri-County EMC — bore the brunt of the initial impact. But the storm's trajectory would affect thousands farther inland in the coming days, causing flooding across much of the state. Peak electric co-op outages hit a record high of more than 300,000 — nearly one-third of all co-op members in North Carolina.

But at the co-ops faced with Florence's force, a steeled determination met the furious winds.

"We knew we needed to have the strongest response possible," said Don Hughes, CEO and general manager of Brunswick Electric. "We were ready."

At Lumbee River EMC, employees like contract services coordinator Derek Owens made arrangements weeks in advance for the crews coming in from other electric co-ops.

"We brought in co-op crews from Ohio, Tennessee and Alabama, besides the North Carolina trucks," Owens said. Other affected co-ops also received assistance from Illinois, Florida and Georgia co-ops, as well as help from North Carolina co-ops unaffected by the storm.

Owens arrived before dawn the day before Florence made landfall with enough clothing for the week. While his contractors had hotel rooms, Owens slept on a cot next to his desk. Before the storm hit, finding accommodations was difficult, but the real challenge began after the storm.

DRY SOCKS AND BIRD-DOGGING

As Florence churned down the coast into South Carolina, storm surge, winds and flooding proved devastating. Carteret-Craven Electric Cooperative lost power across its entire system. Brunswick Electric outages neared 100 percent. Such dire circumstances called for all hands on deck.

"People who do certain jobs under normal circumstances get assigned much different roles during emergencies like this because they are essential," said Carteret-Craven Electric Cooperative communications director Lisa Galizia. "At times like this, what matters is lodging visiting crews, keeping everyone fed, getting supplies out and 'bird-dogging' for line crews unfamiliar with your territory. We're constantly keeping track of where the crews are and how many meals they need so we can run them out to them."

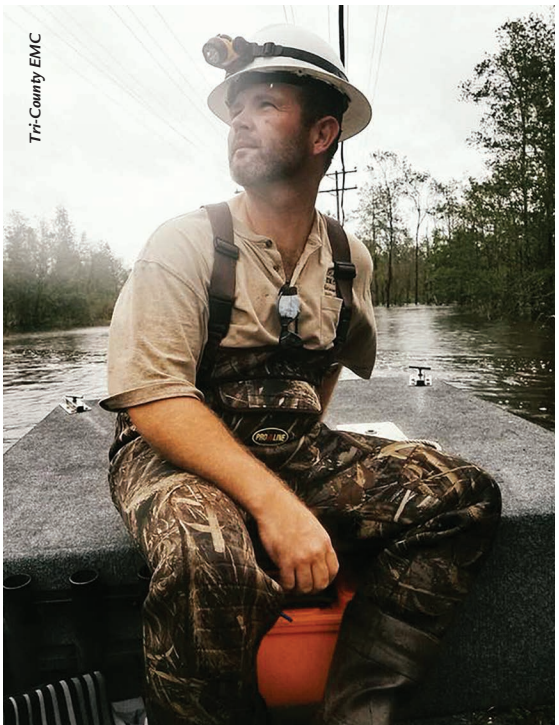
To keep the hundreds of line crew workers

CLOCKWISE FROM ABOVE: • Tideland EMC office personnel prepared meals for 130 power restoration team members. • Lineman Billy Katalinic made his way through flooded waters to repair a span of wire near the Maple Hill community in Pender County. • Post-Florence flooding in Pembroke. • After making storm preparations, Jones-Onslow EMC crews gathered for a final briefing as Hurricane Florence approached. • Daniel Hood, first-class lineman for Tri-County EMC, patrolled lines during Hurricane Florence restoration.

"In the Face of Florence" first appeared in *Carolina Country*.


Gordon Byrd


Linda Mathiasen


Tri-County EMC

operational, it took a Herculean effort to keep them fed and well-equipped, including washing layers of required clothing.

"Nothing can keep these guys from doing the job they're trained to do, but clean, dry socks do help," said Brunswick Electric manager of operations Josh Winslow.

Brunswick Electric employees rose to the occasion to ferry more than 450 pounds of wet, soiled clothing to a boarded-up local laundromat when their own washers and dryers couldn't handle the demand. Tideland EMC office personnel took over the kitchen at YMCA Camp Seafarer in Arapahoe for meal preparation to feed linemen and tree trimmers. CEO Paul Spruill's duties included transporting crews in a school bus to their sleeping quarters at the camp. At Lumbee River EMC, consumer accounting specialist Meta Deese fed crews from a food truck, no easy feat with so many shortages in the region.

LIVES ON HOLD

Working around the clock to support power restoration efforts can be especially difficult for those employees affected by the storm themselves. Many left family members at home, hearing reports of power outages and damage to their own homes while staying focused on tasks at hand.

Guadalupe Torres, one of Lumbee River EMC's Spanish-speaking call center workers, lives with her granddaughter with special needs and grandniece. They used a generator to run feeding and breathing machines until power could return six days after the storm struck. Meanwhile, Torres worked from 7 a.m. to 11 p.m., sleeping in her office while not on the phone. She provided reassurance to distressed members who called looking for answers.

"One man can only do so much. But a team, now that's another story," said Brunswick Electric line technician Robert Cartrette, discussing work to restore power throughout his own community. "It's not about numbers, not addresses, but people. People we know — our neighbors."

Though Florence's impacts persist, many co-op members had power restored quickly and were able to get on with their lives and recovery. Within a week, hundreds of thousands of outages had been reduced to 12,700, which were also soon restored. With restoration work complete, co-op employees were able to return home, assess damage and begin to move on.

"Several of our employees suffered losses and real hardships during the storm, but continued to put service to others before self," said Brunswick Electric marketing communications supervisor Heather Holbrook. "We were all focused on doing our jobs during the storm, and part of that focus included supporting our crews with everything they needed — even an encouraging note tied to their clean laundry. The little things matter."

Hiding in Plain Sight

Along the Mid-Atlantic coastal plain, northeastern North Carolina stands out as a hotspot for lichen biodiversity.

BY JULIE LEIBACH

On a crisp, sunny morning in December, two rubber-booted figures are slogging their way through swampland north of Creswell, Washington County. One clasps a blue plastic ruler while the other scribbles on a makeshift notepad fashioned from a cardboard peppermint patty box.

They're investigating the trunks of certain trees, looking for particular patches of lichen — oft-overlooked organisms that are more like mini-ecosystems, teeming with life.

"Okay, so which ones are we missing here?" asks Jessica Allen, carrying the ruler.

"Twelve is gone," replies her colleague, James Lendemer, referring to a spot on a red maple where a lichen apparently should have been.

Allen and Lendemer are lichenologists at Eastern Washington University and the New York Botanical Garden, respectively. They're here today, calf-deep in murky water, to check on the progress of a pilot study they began in late 2017. Their aim is to see how lichens are surviving after being removed from one location in the swamp, called Bull Neck, and transplanted onto trees at this site, about two miles away.

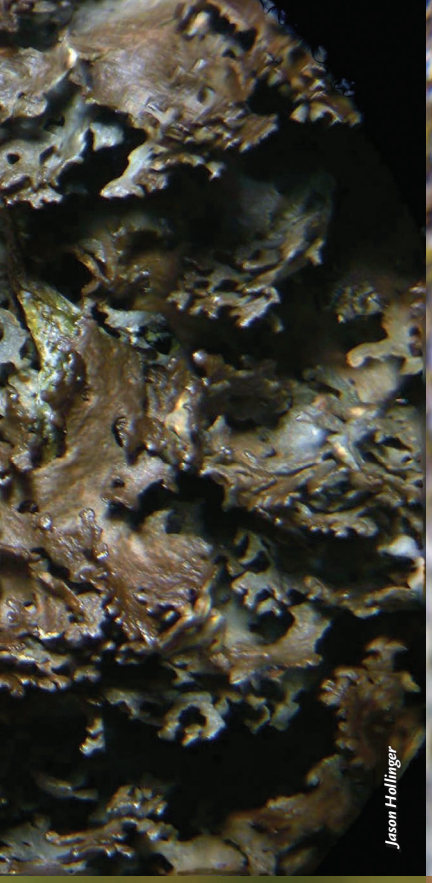
"We were going for quantity, and we were going for diversity," Allen says. All told, the duo transplanted more than 400 samples, representing about 100 lichen species — the most diverse lichen transplantation to date, she says.

The whole process took three days. Using wood chisels and a hammer, Allen and Lendemer extracted swatches of lichen-laden bark from select trees and placed them into pillowcases. Then they toted the samples down a dirt road to the new location. Using a staple gun or silicon sealant, they stuck the lichens onto trees in orderly columns. In some cases, the trees were the same species as those that the lichens had originally grown on. Other times, the team selected new species.

"Our question was, will [the lichens] live? And then, will they grow off of these bark fragments onto the tree?" Allen explains. A transplant that creeps onto its new surface signifies that the species might be able to survive in that environment.

Continued

• TOP LEFT: The foliose lichen *Sticta deyana* is nearly endemic to mature inland swamp forests of the hotspot. Otherwise, it's known from a single mature hardwood forest in Alabama.
• TOP RIGHT: Jessica Allen and James Lendemer call this crustose lichen "American sunrise," for its orange fruiting



Jason Hollinger

Jessica Allen

Vitaly Charny/CC BY-SA 4.0 creativecommons.org

Jason Hollinger/CC BY-SA 4.0, creativecommons.org

BODIES, OR SEXUAL STRUCTURES. FOUND IN THE HOTSPOT, ITS SPECIES NAME IS *BRIGANTIAEA LEUCOXANTHA*. • BOTTOM LEFT: THE BLACK TENDRILS ON THIS FOLIOSE LICHEN, *PARMOTREMA PERFORATUM*, ARE CILIA, AND ARE THOUGHT TO FUNCTION AS DEW CATCHERS. IT'S POSSIBLE THAT THEY ALSO HELP THE LICHEN LATCH ONTO A SUBSTRATE IF IT BREAKS OFF, LICHENOLOGIST JAMES LENDEMER SAYS. • BOTTOM RIGHT: THE FRUTICOSE LICHEN *USNEA STRIGOSA* IS SUSCEPTIBLE TO AIR POLLUTION AND WON'T THRIVE IN CITY ENVIRONMENTS. IT GROWS ON THE CANOPY BRANCHES OF TREES, AND YOU MIGHT SPY IT ON FALLEN BRANCHES ALONG TRAILS.

Allen and Lendemer are interested in transplantation as a potential method of N.C. lichen conservation in the face of rising seas. As it turns out, areas in and near North Carolina's Albemarle-Pamlico peninsula host the core ranges of many Mid-Atlantic coastal plain lichen species. Helping these organisms migrate inland could be one way to rescue them from habitat eventually lost to saltwater inundation, according to the researchers.

Indeed, there's growing evidence that the sea is rising faster north of Cape Hatteras than it is to the south, according to a 2015 report prepared by the N.C. Coastal Resources Commission's Science Panel.

As Allen puts it, "if you really needed to rescue hundreds of species — hundreds of individuals — could you do that? What success rate could you expect?"

TOP: The lichen transplantation site is located near Deep Creek, which feeds into Bull Neck Bay. BOTTOM: Lichenologists James Lendemer, left, and Jessica Allen are conducting a pilot study to see how well N.C. coastal plain lichens fare after being transplanted to new surroundings.

LICHEN 101

To fully appreciate these unassuming organisms, a little lichenology is useful.

While lichens might bring to mind primitive plants like mosses, they aren't plants at all. At its very essence, a lichen consists of a fungus coexisting symbiotically with algae or photosynthetic bacteria called cyanobacteria — and sometimes with both. The resultant organism looks "completely different from the two constituent parts," Lendemer says.

The fungus benefits from the union by absorbing sugars produced by the algae or cyanobacteria through photosynthesis. In turn, the fungus provides shelter from extreme conditions, such as drought and intense sunlight.

"They have a lot to teach us about how different organisms can live in close association," says Scott LaGreca, the collections manager of lichens at the Duke University Herbarium. Duke researchers are exploring how lichen symbionts communicate with each other.

Lichens are classified by their primary fungal component. That fungus largely influences the form a given lichen takes, which, generally speaking, ranges from flat and leafy (foliose), to shrubby (fruticose), to crusty (crustose).

But there's much more to lichens than their main characters. They're small worlds unto themselves, brimming with tiny organisms such as mites, nematodes, tardigrades — also known as water bears — and plenty more fungi and bacteria, Allen explains.

"It's like a community of people living in a co-op," Lendemer says.

What roles those other dwellers play in the lichen community is an active field of study. For instance, work led by researchers in Austria suggests that bacteria contained within a species known as the lung lichen could help it absorb nutrients and resist pathogens, among other functions.

Unlike plants, lichens have no roots. They instead absorb various essential nutrients and moisture from their surroundings, directly through their outer layer, called the cortex.

Nor do lichens sport a protective waxy coating. As a result, they can't keep airborne pollutants out of their tissues, and most species are sensitive to air pollution. "Lichens are really useful as environmental indicators," LaGreca says.

Lichens perform ecosystem services as well. For instance, "they're one of the most important natural fertilizers of forests," Allen says. "Lichens with cyanobacteria contribute kilograms of nitrogen to those systems." They also absorb carbon dioxide from the atmosphere in order to photosynthesize, producing oxygen in the process.

All lichens need a substrate to grow on, and some are not picky about it, Allen says. While sampling in Maryland, for example, "we found an entire couch somebody had dumped into a swamp, and it was 100 percent covered in lichen," she recalls. "It was absolutely incredible. We collected like 10 species off of it."

The unique lichen lifestyle has enabled these organisms to adapt to myriad niches. In fact, Allen says, "lichen occur in every single terrestrial habitat on the planet."

A spider nestles inconspicuously next to the foliose lichen *Punctelia rudecta* and on top of a crustose species in the genus *Pertusaria*, both found in the hotspot.

A COASTAL GEM

North America's "crown jewel" of lichens is the Southern Appalachian Mountains, Lendemer says. But as it turns out, the Albemarle-Pamlico peninsula and nearby areas offer their own lichen trove.

In 2012, Allen, Lendemer and colleagues began inventorying lichen along the Mid-Atlantic coastal plain, stretching from New Jersey into Georgia. During the project, it became clear that North Carolina harbored much higher levels of lichen diversity than expected, concentrated in forested wetlands along the Alligator River.

"The sheer number of individuals is fantastic. Trees just coated in lichens, and [lichens] falling out of the trees and on the ground everywhere. It's wonderful," Allen sighs rhapsodically.

Allen and Lendemer first characterized this bevy of lichen in the journal *BioScience* in 2014. Two years and more sampling later, Lendemer and colleagues published an extensive review of the hotspot, which essentially includes the N.C. counties of Currituck, Dare, Hyde, Tyrrell and Washington, along with a portion of Camden.

Of approximately 5,000 samples collected from about 50 sites in the region, the richest biodiversity occurred in low-lying swamp forests, followed by maritime forests, the researchers reported in the journal *Castanea*. In total, the samples represented more than 380 taxa — several of which were new to science. The overwhelming majority were crustose lichens.

"This place hosts some of the last large populations of species that we either now find nowhere else, or [that] are now extremely rare other places when they were once more widespread in the past," Lendemer says.

Meanwhile, nearly a quarter of the samples were represented by only one specimen, suggesting that many species are rare even to the hotspot.

Two species appeared to be endemic to the area, including *Albemarlea pamlicoensis*, collected from Bull Neck Swamp, which is managed by NC State University's College of Natural Resources. To the naked eye, the species appears as inconspicuously small, reddish-brown dots. But "it's very distinctive microscopically," Lendemer assures.

Uncoincidentally, the hotspot encompasses the largest remaining contiguous protected natural areas in the Mid-Atlantic Coastal Plain from southern New Jersey to southern South Carolina, according to the researchers. Alligator National Wildlife Refuge and Pocosin Lakes National Wildlife Refuge make up the bulk of this haven.

In those wetlands unmarred by development or agriculture, "you actually see mature forest," Lendemer says. "It's just a landscape that exists nowhere else. It's totally unique. It's like vast, endless, flat swamps. I mean, for lack of a better way of describing it, they're beautiful."

And lichen like pristine habitat.

"It's just exactly the sort of place you'd expect to find high diversity — long ecological continuity, places that haven't been disturbed, and places that have relatively clean air," says Rebecca Yahr, a lichenologist at the Royal Botanical Garden Edinburgh, who has collected lichen along North Carolina's coastal plain.

The extensive swamp habitats likely also provide coastal plain lichens with an abundance of "microhabitats" — that is, tiny ecological niches — in which to thrive. For instance, the topography of tree bark, wind shear, humidity and shadiness are all factors that can influence which lichens settle where.

"When you're the size of a quarter, that stuff's huge," says Yahr, who was not part of the hotspot research. "All of those little, tiny microhabitats [are] where the diversity is generated."

But another factor also likely plays into the lichen variety observed in the coastal plain. Cape Hatteras marks the dividing line between two biogeographic regions.

In other words, "we're at the southern extent of the northern species range, and at the northern extent of the southern species range," explains Terri Kirby Hathaway, a marine education specialist with North Carolina Sea Grant. For instance, along the N.C. coast you can find both spiny lobster — a tropical species — and Maine lobster, as well as northern and southern bayberry.

Where lichen territory is concerned, Allen supports the idea of converging distributions. "They really meet the edges of their ranges right there in this particular region."

Continued

JAMES LENDEMER WAS EXCITED TO SEE THAT A TRANSPLANT OF THE FOLIOSE LICHEN *LOBARIA RAVENELII* — VISIBLE HERE AS DARKER GREEN — HAD CREEPED ONTO ITS SUBSTRATE.

SIGNS OF HOPE

A look at the National Oceanic and Atmospheric Administration's Sea Level Rise Viewer, which draws on data from NOAA tide gauges, suggests that the sea could rise around Duck, in Dare County, by as much as 3.5 feet by 2050.

Already forests in the Albemarle-Pamlico peninsula are succumbing to saltwater intrusion, and Allen and Lendemer worry about the future of North Carolina's coastal lichens. For many species, this hotspot is a last bastion.

As a conservation measure, transplanting lichen must be strategic.

"If you move them into a place where the habitat is markedly different, then they'll suffer. If you move them into a place where there's terrible air pollution, then they die," Yahr says. Identifying suitable new habitat and managing it properly is crucial, she says.

Allen agrees. "Really, what we need to be doing now is preparing, so like planting and preserving land inland so the forest can start to mature somewhat so these species can move," she says.

Back in Bull Neck Swamp, Lendemer is getting anxious to see if a transplant of a relatively rare cyanobacterial lichen removed from an evergreen tree has established on a deciduous red maple.

Known by the rather unappealing common name Ravenel's lung lichen (*Lobaria ravenelii*), "it's one of the prettiest lichens around," Allen attests.

Examining the tree, Lendemer is at first crestfallen. A large smear of silicon sealant suggests that the transplant has bit the dust, so to speak.

"Although, look!" Lendemer suddenly exclaims.

Upon closer inspection, it's apparent that the dark green, leafy lichen isn't entirely gone. In fact, a portion has migrated onto the maple bark.

"Oh, it attached!" Allen replies. "And it grew more!"

"It really did grow onto the substrate," Lendemer says. "That's amazing."

The new growth is a little ray of hope for the researchers, who anticipate that their project will take another year or two to complete.

"We transplanted common species and rare species," Lendemer says. "And so, when the rare ones are actually growing onto the substrate, that's really promising for us. Okay, maybe not everything is going to work, but maybe if we have to focus in on the rare species, this method might work for them."

THE NATURE TRAIL AT PINE ISLAND AUDUBON SANCTUARY

Want to see coastal N.C. lichen but don't care to tromp through a swamp?

Try the Nature Trail at Pine Island Audubon Sanctuary in the Outer Banks. The public path is 2.5 miles one way, and courses between Duck and Corolla. In terms of habitat, "it's primarily maritime forest or maritime shrub" dominated by live oak, says Robbie Fearn, sanctuary director and a former partner on a Community Collaborative Research Grant project, supported by North Carolina Sea Grant in partnership with NC State's William R. Kenan Jr. Institute for Engineering, Technology and Science.

Walking along Audubon's nature trail, "you see these sort of mappy patches all over the limbs of the live oaks," Fearn says, while the limb tips appear fuzzy with other lichen species.

Lichenologist James Lendemer of the New York Botanical Garden has surveyed Pine Island Audubon Sanctuary as part of a larger lichen inventory. "It's a really nice typical assemblage of the lichens you would see in a maritime forest on the Outer Banks," he says.

Fearn's liking for lichen stems from hiking trips he took as a teen through the Appalachians, where lichens coated mountain-top balds like abstract paintings. "To me," he says, a lichen "is just like this fascinating little world of wonder that we'll walk past as if it was nothing."

Pine Island Audubon Sanctuary is generally closed to the public, but the trail is open to everyone from dawn to dusk, 365 days a year. Park at the Pine Island Racquet and Fitness Center on N.C. 12 for easiest access. Learn more at pineisland.audubon.org/visit/landing/nature-trail.

Wingina, Wanchese and Manteo

A Lumbee Perspective on the Lost Colony

MALINDA MAYNOR LOWERY

The Lumber River winds into and out of the heart of Lumbee land.

Gary Dincher/CC BY-SA 2.0 creativecommons.org

In the winter of 1865, the bleakest of his life, George Lowry stood on the steps of the Robeson County courthouse. He had just emerged from an inquest into the murders of his two sons. He was 67 years old, born following an American Revolution. The county coroner had identified the Confederate soldier responsible for his sons' deaths at the inquest, but the killer remained at large. The sheriff refused to arrest him.

Consumed with the iniquity of these events, Lowry unchained a spontaneous, unrestrained history lesson, describing his people's conception not in the sin of slavery but in the virtue of freedom: "We have always been the friends of white men. We were a free people long before the white men came to our land. Our tribe was always free. They lived in Roanoke in Virginia. When the English came to Roanoke, our tribe treated them kindly. One of our tribe went to England in an English ship and saw that great country."[1]

In his story of his people's origins, Lowry emphasized the Lumbees' freedom, their hospitality and reciprocity with English newcomers, and the journey from their original homeland, Roanoke, where these virtues were nourished. Lowry sought to strike a blow against death by pointing out the betrayal of at least one of these virtues, friendship with whites.

George Lowry's view may not be the only version of Lumbee origins, but it nevertheless gives us a legitimate starting place from which to piece the documentary record together. That process begins with an understanding that the Lumbees' homeland is larger than Robeson County. Many of the Lumbees' ancestors came from places as far north as the James River in Virginia, south as the Santee River in South Carolina, east as the Atlantic Ocean, and west as the Great Pee Dee and Catawba rivers. That territory may not belong to them today, but it produced them nonetheless. "Roanoke" is neither the beginning nor the end of this tale of journeys, a tale that belongs to Indians in the southern United States in particular and to Americans generally.

Governor John White returned from England three years after Virginia Dare's birth and found "Croatoan" carved on a tree, signaling that the settlers had taken refuge with White's enemies — people he had brutally attacked. He memorialized the scene himself in the painting above. The Virginia Dare Monument commemorates Dare's birth and baptism in 1587.

Today we understand the word "race" to mean members of a group who share certain physical traits and a common culture, allowing for possible differences in customs and attitudes, as northerners are different from southerners in the United States. But before the settlers came, Indians in North and South Carolina and Virginia were enormously

Excerpted from "We Have Always Been a Free People: Encountering Europeans," the first chapter in *The Lumbee Indians: An American Struggle*, by Malinda Maynor Lowery. Copyright © 2018 by Malinda Maynor Lowery. Used by permission of the University of North Carolina Press. www.uncpress.org

different from each other, physically and otherwise. Even so, they had much in common — all valued family, and many placed heavy emphasis on the power of women to determine belonging and make political decisions, including tracing a family's descent from the mother's line or from the lines of both parents equally, rather than only from the father's.[2]

In the 1580s, when Sir Walter Raleigh's soldiers and settlers ventured into North America, they landed at the place the Algonquian speakers called Roanoke, named after people who make things smooth or polish things, possibly referring to the shell beads that a select group of skilled artists produced. Despite their intentions to subdue land held by savages, the English found themselves having to play by the rules of this place, just as the Indians did.

Nothing was inevitable about the conquest that unfolded, and epidemic-inducing germs did not do all of the work. Violence, slavery, unchecked English immigration — all were the results of decisions to aggressively seize land owned by others. The earliest colonists were scientists, soldiers, diplomats, and pirates who had honed their skills in wars against the indigenous people of Ireland and against the Spanish Armada. Raleigh and his soldiers largely considered their efforts in North America to parallel their colonization of Ireland, and they believed that the Irish and the Indians in the Americas possessed the same savage qualities. But unlike with the Irish, Raleigh ordered his soldiers to treat the native inhabitants of this new world kindly, to learn everything they could about the people whose land the English wanted to claim.[3]

Roanoke Indians and the English found that they had a lot in common. When an Indian emissary met the English ships commanded by Arthur Barlowe in July 1584, things went so well that Wingina, a *werowance* (principal leader) of Roanoke and other villages, decided to try to adopt the strangers. They both loved to trade, and they each offered items that they believed the other would value. The English offered ornamental things: metal serving dishes, mirrors, and beads. Indians gave the sailors food, hosted dinner parties, showed the English how to bathe properly, and volunteered protection against their enemies.

Barlowe and his men did not ruffle the Indians of the Roanoke region. For centuries, the Indians had dealt with strangers in one of two ways: by making war on them or by making family of them. Waging war on the Raleigh expedition was unnecessary — none of Barlowe's men had attacked them, and these new strangers did not appear to be a threat but simply seemed scared and weak. Further, Barlowe arrived at an opportune time. Wingina had been engaged in a bitter and deadly war with Indian enemies, the Pomeioocs, who lived on the Neuse River. A few years earlier, the Pomeioocs and their allies escalated the war by killing thirty Secotan warriors at a peace conference. Making the English enemies was unnecessary, but making them kin was desirable.[4]

"We have always been the friends of white men. We were a free people long before the white men came to our land. Our tribe was always free. They lived in Roanoke in Virginia. When the English came to Roanoke, our tribe treated them kindly. One of our tribe went to England in an English ship and saw that great country." — George Lowry

Wingina was looking for new allies with unique *montoac* (power), and the English seemed like good candidates. Their ships were useless, but the cannons and guns were a form of *montoac* that could defeat the Pomeioocs. When Barlowe decided to leave, Wingina sent two of his allies back to England with him, men named Wanchese (of Roanoke) and Manteo (of Croatoan). Neither men were "chiefs," as the story has been told; instead, Manteo's mother was the principal leader of Croatoan, and Wanchese was a warrior from Roanoke. Wingina counted both men, and their villages, as kin. Their assignment was to cross over into English culture and bring back as much intelligence as possible about these strangers who might become useful allies.[5]

The two men stayed at Sir Walter Raleigh's mansion in London, learning English and teaching Algonquian to a scientist named Thomas Hariot. In six months they had learned enough to interpret both languages. They created an orthography of their Algonquian language and translated it into English, a document that became the foundation of a written form of an American Indian language. The bottom of this document bore a phrase written in the signs of Algonquian: "King Manteo did this." Undoubtedly Manteo and Wanchese saw savagery in English culture: filth, disease, and noise; men who hoarded wealth; women whose husbands completely controlled them. One woman defied that cultural norm in England: Queen Elizabeth. Manteo would have seen his own mother treated with the same deference that Raleigh gave Elizabeth.[6]

Manteo and Wanchese returned home in 1585, accompanied by a force of 600 Englishmen — half of them soldiers — and their weapons. This time, Raleigh was not just exploring; he was creating an "outpost of empire." He intended to establish and fortify a site in Virginia to prevent the Spanish from gaining any ground there. He thought he had secured Wingina's friendship and Manteo's and Wanchese's loyalty. He did not think to ask their permission.[7]

After they landed, the commander of the 1585 expedition, Ralph Lane, began to believe that Wingina was going to betray the English's weak colony to Indians farther west. Lane's men ambushed and destroyed Manteo's village of Croatoan, killing Wingina and impaling his head on a stake. Then, in the midst of a hurricane (probably something that he had never experienced), Lane fled the Carolina coast with the pirate Sir Francis Drake, who picked him up after pillaging Spanish settlements in Florida.

Drake had captured several hundred Africans and Indians in his raids, and it is possible he left them on the Outer Banks when he picked up Lane's men. One scholar calls these people the "first and almost entirely forgotten 'Lost Colony.'"[8] A few weeks later, another small group of soldiers landed as reinforcements; they did not get the message that Lane had fled in despair. Wanchese destroyed that group in short order, not only exercising political vengeance but enhancing his own *montoac*; he showed his allies and his enemies that he was more powerful than Wingina and could do what Wingina would not.

In the meantime, Manteo seemed to secure his kinship ties with the English: He was increasingly fluent in the language, and he wore English clothes (at least when the English record keepers saw him). Lane's men did not kill him

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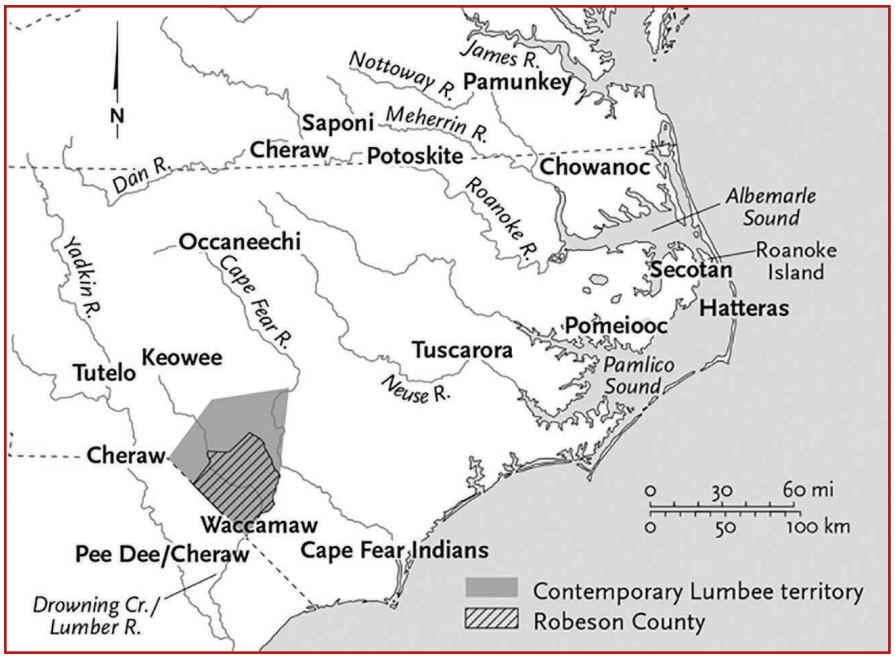

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Many of the Lumbees' ancestors came from places as far north as the James River in Virginia, south as the Santee River in South Carolina, east as the Atlantic Ocean, and west as the Great Pee Dee and Catawba rivers.

in the massacre at Croatoan, and he boarded Drake's ship with Lane and left for England. Whether he escaped in despair at the massacre of his kinfolk or left intending to continue his diplomatic mission, we do not know.[9]

But he did come back home. Two years later, in July 1587, Manteo returned, this time with a mixed crew, not just of explorers but of women, children, and farmers, all led by Governor John White. White was an artist, not a soldier. He knew of Lane's expedition and wanted to repair relations; he needed Manteo to do so. When Croatoan warriors saw White's English ship approach, they readied their arrows, having no reason to think that this bunch wanted to do anything but kill them, as Lane had done. Indeed, although White said he sailed to Croatoan with Manteo seeking to renew friendships, he still ordered his soldiers to disembark with their guns drawn. The warriors began to retreat at the shoreline, but Manteo called out to them. They stopped and greeted Manteo and the English, cooked them a meal, and proceeded to talk about what it would take for the two groups to be friends again. If White was as intelligent an observer as Manteo, he would have recognized that calling on the ties of kinship and alliance advanced him toward his goal.[10]

But White was still ambivalent; when the Croatoan *werowance* asked for a gift to seal their friendship, White refused, saying that English fury fell only on those who offended them and that English friends need not worry. Perhaps White did not know that Ralph Lane had killed innocent people, people who had thought of the English as friends. Indeed, White ended that day's talks assuring the Croatoan *werowance* that the English would receive Indians again in friendship and forget all wrongs. White had gotten it backwards: Manteo's people had been wronged, not the English. To no one's surprise, except perhaps White's, no Indian leaders came to "receive" English "friendship."[11]

White waited seven days and then set himself on a course surprisingly similar to Lane's. He decided to attack Wanchese, who had massacred the English soldiers who had arrived immediately after Lane left. On the morning of the attack, Manteo went with White's soldiers. His reasons remain obscure; White says he was a guide, implying that he endorsed the English mission and wanted to help and that his alliance had been transferred to the English. I imagine Manteo had his own goals: Killing Wanchese would show Indian leaders, including their enemies inland, that Manteo had English power at his disposal. But in return, Manteo had to accept the demon consequences of English power, a lesson he learned that very day.[12]

Instead of killing Wanchese and his men, White and Manteo mistakenly attacked Croatoan villagers. These were Manteo's own people, and they had posed no threat. After the smoke cleared, the English took all the food at the settlement and some of the survivors, including the wife and child of Croatoan's *werowance*. A few days later, the English conferred a title upon Manteo, "Lord of Roanoke," in exchange for his "faithful service," and they baptized Manteo in the waters off of Roanoke. Perhaps he believed that allying himself with the power of the English God would assuage his anguish, that he could be forgiven. Perhaps he believed that the English God could protect him from the kind of vengeance that Wanchese had exercised on the Englishmen who paid for Lane's sins. In any case, White did not turn on him, as Lane had turned on Wingina.[13]

The English could have negotiated permission instead of courting animosity, but the arrogance of Ralph Lane and the ignorance of John White precluded common sense. Innocent people suffered as a result, both English and Indian. Five days after Manteo's baptism, John White's daughter, Eleanor Dare, gave birth to a girl and gave her the English name for her new home, Virginia. Her parents could hardly have

LEFT: The commander of the 1585 expedition, Ralph Lane, fled the Carolina coast with the pirate Sir Francis Drake, who picked him up after pillaging Spanish settlements in Florida, part of Drake's 1585-1586 transatlantic travels. RIGHT: White's map of the East Coast from Chesapeake Bay to Cape Lookout, ca. 1590.

imagined worse circumstances for their little girl. Under the haze of cultural superiority, the leaders of this expedition had alienated the only people who could help the settlers survive. Undoubtedly frightened at the prospect of how the Indians would respond to the killings, the English families demanded that White return to England to get more supplies. White, it seemed, had permanently damaged any prospect of friendship with the Indians, except possibly Manteo. Hoping it would be a short trip, he agreed.

White did not return until almost three years to the day after Virginia Dare's birth. Unlike the previous ventures, when Indians had welcomed the English, no one came to the shore this time. White found the word "Croatoan" carved on a tree, signaling that the settlers had taken refuge with White's enemies, people he had brutally attacked. By that time, Virginia Dare likely spoke Algonquian; perhaps her grandchildren never knew that she had been English. Her parents and their fellow colonists may have repeated the mistakes that led to Lane's and White's departures — explorer John Smith reported that Chief Powhatan, Pocahontas's father, had killed them. However, the Indians of Roanoke, Croatoan, Secotan, and other villages had no reason to make enemies of the colonists; instead, they probably made them kin.[14]

The colonists did not disappear any more than Manteo's Croatoan people had vanished. The man who recorded George Lowry's history lesson on the steps of the Robeson County courthouse, Hamilton McMillan, believed that Indians from Croatoan adopted the desperate English settlers and that their descendants settled on Drowning Creek, later called the Lumber River. McMillan pointed to English surnames in the list of colonists ("Lowry" was not among them) and found parallel names among Robeson County Indians. While some of the surnames, such as Sampson, Brooks, and Berry, are unquestionable matches, most of the similar names are found as much in the English population as in the Lumbee population.

Further, we have no evidence that American Indians regarded English surnames as more special than any other kind of name; it is difficult to imagine that a group of Indians who took in foreign refugees would have changed their naming practices to accommodate these newcomers and then maintained them for over 200 years.[15]

McMillan also cited the writings of North Carolina's surveyor general, John Lawson, who visited the island of Croatoan 12 decades after the English left Roanoke and found people there who called themselves Hatteras Indians. To Lawson, they appeared to possess English ancestry; some of them had gray eyes, and they told him how several of their ancestors "were white people" and "talked in a book." Lawson did not record English names among the Hatteras, nor did he say that their culture possessed English characteristics.[16]

If the Hatteras Indians were not "pure-blooded" Indians, Lawson never discussed it, but such a category never would have occurred to him. At the time, the purpose of English colonization was to acquire Indian land; the mix of European with Indian culture was not significant to Lawson — the use and ownership of places was.

Hundreds of articles, books, plays, poems, a National Park, and a tourist economy in the town of Manteo, North Carolina, have been devoted to the story of these few dozen "lost" English colonists. Stephen B. Weeks, a

Continued

respected North Carolina historian, called their fate "the tragedy of American colonization."[17] Weeks wrote that if McMillan's theory of Lumbee origins is rejected, "then the critic must explain in some other way the origin of a people which, after the lapse of 300 years, show the characteristics, speak the language, and possess the family names of the second English colony planted in the western world."[18]

"When English people landed in Roanoke we were friendly, for our tribe was always friendly to white men. We took the English to live with us." — George Lowry

But there are many more plausible reasons for Lumbees' similarity to Europeans other than their possible connection to the Lost Colony. First among them is that Indian people — like any others — change, borrow, and transform what they find useful, including languages, stories, food, materials, and religions. Far less is written in tribute to this process or to the Indians who continued to maintain power in that region for more than a century after these events unfolded. Of course, Indian people remembered, but their stories went largely unrecorded until Hamilton McMillan wrote down George Lowry's eulogy for his murdered sons.

Almost 300 years after the English colony disappeared, George Lowry spoke of these events that prompted change, with the very specific intention of shaming the newcomers whom his ancestors had befriended but who had betrayed Indian people. That winter day, Lowry continued his origin story on the steps of the Robeson County courthouse: "When English people landed in Roanoke we were friendly, for our tribe was always friendly to white men. We took the English to live with us. There is the white man's blood in these veins as well as that of the Indian. In order to be great like the English, we took the white man's language and religion, for our people were told they would prosper if they would take white men's laws."[19]

The Lumbee story is about what it means to be indigenous and American. Here, three Lumbee girls sing at a U.S. Army event honoring the tribe for its contributions to the nation.

Lowry, in his grief, glossed over the decisions that Indian people had made that led to English-Indian alliances. He emphasized how the Lumbees' ancestors changed, borrowing English worldviews (through language and religion) that suited Indians' determination to survive. But cultural change was a two-way process; both sides had to adapt. He knew he could not do justice to the whole story, not on that day when he wanted to expose the injustice of his people's circumstances.

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1 Hamilton McMillan, *Sir Walter Raleigh's Lost Colony: An Historical Sketch of the Attempts of Sir Walter Raleigh to Establish a Colony in Virginia, with the Traditions of an Indian Tribe in North Carolina. Indicating the Fate of the Colony of Englishmen Left on Roanoke Island in 1587,* in O. M. McPherson, *Report on Condition and Tribal Rights of the Indians of Robeson and Adjoining Counties of North Carolina, 63rd Cong., 3rd sess. (5 January 1915), S. Doc. 677, 50* (hereafter cited as McPherson Report).

2 The best resource to understand the diversity of Indigenous groups in the southeastern United States is Raymond Fogelson, ed., *Southeast, vol. 14 of Handbook of North American Indians, series ed. William Sturtevant (Washington, D.C.: Smithsonian Institution, 2004);* within that volume see Jason Baird Jackson and Raymond D. Fogelson, "Introduction," 1–13; Blair A. Rudes, Thomas J. Blumer, and J. Alan May, "Catawba and Neighboring Groups," 301–18; and Raymond J. Demallie, "Tutelo and Neighboring Groups, 286–300."

3 Michael Oberg, *The Head in Edward Nugent's Hand: Roanoke's Forgotten Indians* (Philadelphia: University of Pennsylvania Press, 2008), 37; Colin G. Calloway, *White People, Indians, and Highlanders: Tribal Peoples and Colonial Encounters in Scotland and America* (New York: Oxford University Press, 2008), 34.

4 Oberg, 12, 32.

5 Oberg, 50–51.

6 Coll Thrush, *Indigenous London: Native Travelers at the Heart of Empire (New Haven,* Conn.: Yale University Press, 2016), 35–36; Oberg, *Head in Edward Nugent's Hand, 59–64;* see also David Beers Quinn, *Set Fair for Roanoke: Voyages and Colonies, 1584–1606* (Chapel Hill: University of North Carolina Press, 1985), 39–40.

7 Oberg, *Head in Edward Nugent's Hand, 57.*

8 Oberg, 102.

9 Oberg, 98–100, 101–2, 107–10; see also Thrush, *Indigenous London*, 59.

10 Oberg, *Head in Edward Nugent's Hand, 112–13, 116–17.*

11 Oberg, 118.

12 Oberg, 119–20.

13 Oberg, 120–22.

14 Oberg, 123–26; for a summary of theories on the Lost Colony's fate, see Helen Rountree, *Pocahontas's People: The Powhatan Indians of Virginia through Four Centuries* (Norman: University of Oklahoma Press, 1990), 21–24.

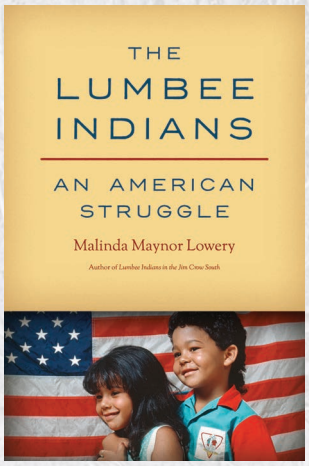
15 Hamilton McMillan, Sir Walter Raleigh's Lost Colony, in McPherson Report, 51–55.

16 Lawson, *New Voyage to Carolina*, 62.

17 Stephen B. Weeks, "The Lost Colony of Roanoke: Its Fate and Survival," reprinted from Papers of the American Historical Association, vol. 5 (New York: Knickerbocker Press, 1891), 22, https://digital.lib.ecu.edu/13444.

18 Weeks, 39.

19 Hamilton McMillan, Sir Walter Raleigh's Lost Colony, in McPherson Report, 50.



FROM THE COURTHOUSE STEPS TO CLIMATE CHANGE:

How Lumbee History Can Inform New Social and Environmental Dialogue

AT LEFT: Malinda Maynor Lowery

The Lumbee tribe remains the largest east of the Mississippi and among the largest in the United States, living on its original homelands and maintaining a distinct identity and sense of community. Malinda Maynor Lowery's *The Lumbee Indians: An American Struggle* weaves together the histories of indigenous peoples and Europeans in America. Lowery spoke to us about Lumbee history, what it means to be indigenous and American, and how the tribe's struggle for justice and self-determination is relevant today.

• Why did you write *The Lumbee Indians: An American Struggle*?

I really wanted to help people see how the Lumbees have created themselves as a nation that would mirror our understanding of how the U.S. has been created as a nation. I based the chapter *Coastwatch* excerpted on what I could know from the documentary record about the indigenous communities that coalesced to generate who the Lumbee people are today. George Lowry sprang forward as the only person we have on written record to tell a Lumbee origin story. In fact, his speech on the courthouse steps is also the one origin story from a Lumbee and not from somebody talking about us from the outside.

• Why is George Lowry's speech on the courthouse steps relevant today?

The relevance of that speech is still with us when we think about how native peoples are routinely silenced and erased. At the moment of the inquest about his murdered sons, George Lowry would not be silenced. And I think it's powerful — he's a beacon of understanding about what it means to not be silenced.

• How does Lumbee history inform what happened in Robeson County after Hurricanes Matthew and Florence?

The accumulation of those two catastrophic events is a kind of metaphor in some ways for colonialism: one bad thing after another. Fundamentally, indigenous people remain indigenous because they survive with a sense of themselves, as a political community, intact.

It's important for any policy response to fully incorporate input from the Lumbee community as political actors, not simply as "victim citizens." The Lumbee people have quite a number of resources to solve problems. That's our engagement with American identity: We're problem solvers.

When folks try to address emergency response or infrastructure issues, they can take advantage of the perspective and expertise of Lumbee people by virtue of their long-standing attachment to the land and how they value it. I think with Florence and Matthew it's pretty practical to ask: What do we know about the Lumber River? What do we know about how our land is situated there? What kind of ways do we have to rethink the hurricane as a phenomenon, because it's not just a coastal phenomenon?

We also have Lumbee hydrologists, engineers, politicians, accountants — all sorts of people whose expertise we can harness to address these problems. When no one takes advantage of that expertise, we're missing powerful resources to address crises.

• Will storms like Matthew and Florence ever diminish the Lumbee capacity to remain a community?

I feared that Matthew and Florence would cause widespread displacement — and not just of Lumbees, of course, but of many poor people in Robeson County. But what I feared didn't seem to come to pass to that degree. Whether you're Lumbee or not, if you were born and raised in Robeson County and you've lived there for several generations, the universal feeling that I've gotten from people is no, we're not going anywhere. We're just going to rebuild and try again and hope for better from the decision-makers who allocate the resources.

• How can a Lumbee perspective contribute to dialogue about climate change?

To those of us who aren't scientists, climate change and its destructive consequences seem inevitable and unavoidable. Lumbee knowledge of place and attachment to place tell us that nothing is inevitable.

Do we ignore opportunities to make policy changes or infrastructure changes? Do we ignore opportunities to mitigate impact or eliminate impact? The broader Lumbee history informs these questions. It says the consequences we face are generated by the qualities of our relationships. We have stayed where we are, and we have maintained our relationships to this place because we value the nature of the relationships themselves, and because we are willing to sacrifice for those relationships to maintain them and keep them alive. That type of choice values history and can inform whatever decisions are made about the future of our planet.

Malinda Maynor Lowery, a member of the Lumbee Tribe of North Carolina, is a historian and the director of the Center for the Study of the American South at UNC-Chapel Hill.


Roger Winstead

J Hooks, Warming Waters, and Favorite Reefs

SCOTT BAKER AND SARA MIRABILIO

Two fisheries specialists with more than 40 years of combined experience have launched the Hook, Line & Science *blog series for North Carolina Sea Grant. The following three blog posts, along with many others, are available at* HookLineScience.com.

CAN CIRCLE HOOKS COMPETE WITH J HOOKS?

One Hook Clearly Wins in N.C. Offshore Dead-Bait Troll Fishery

Almost one-half of North Carolina's 11 million pounds of marine recreational landings in 2017 came from three species: yellowfin tuna, dolphinfish and wahoo. Clearly, the act of hooking — and then successfully bringing the catch aboard — is important to saltwater anglers.

• *Research Need*

At the time of this study a few years ago, fisheries managers were unsure whether to require the use of circle hooks in offshore dead-bait troll fisheries. Some studies had found that circle hooks maintained catch rates but reduced rates of deep hooking for billfishes, compared with J hooks. If circle hooks were required, what impact would the requirement have on catch rates in these troll fisheries? Members of North Carolina's charter boat industry were eager to find out.

• *What did they study?*

Fisheries scientists partnered with charter and recreational fishermen to compare catch rates for circle hooks and J hooks for three common fish species in the N.C. offshore, dead-bait troll fishery: dolphinfish, yellowfin tuna and wahoo. Prior to testing, scientists and expert fishermen met at a planning workshop to determine the hooks and gears to be tested "side-by-side" on 75 trips. It was important for everyone to agree on the parameters, including selecting specific circle hooks that are comparable to the J hooks used in this fishery. The scientists then ran computer models to better understand how such factors as hook type, leader type, species, trip type, and wave height affected catch rates.

• *What did the results show?*

Generally, more fish were caught on J hooks than circle hooks. In fact, computer modeling suggests that fishermen can expect 65 percent greater catches of the three species with J hooks. The results confirm the general observation of the charter boat industry that J hooks perform better than circle hooks in this fishery.

• *What else did they find?*

While king mackerel were not a large proportion of the total catch in this study, the research team found that J hooks also were more effective than circle hooks in catching this species.

• *Anything else?*

As tackle manufacturers continue to introduce new hooks and terminal tackle, will these results hold? They certainly could. The planning workshop for the study generated many novel rigging and fishing techniques with circle hooks, but only the most promising were tested.

• *Reading*

For specific hook descriptions, fishing techniques and more: *go.ncsu.edu/CircleOrJHook*

From *Coastwatch*: "Hooks in the Gulf Stream: Captains and Scientists Reel in Data": *go.ncsu.edu/HooksInTheGulfStream*

See also: "Study Finds Circle Hooks Lower Catch Rate For Offshore Anglers": *go.ncsu.edu/LowerCatchRate*

Summary compiled by Scott Baker

WILL FISH MOVE AS THE ATLANTIC WARMS?

Warming Could Lead to Distribution Shifts for Popular Species

Sometimes it's difficult to see differences in fisheries populations when we look at data from season to season or year to year, because often differences are variable or small. Generally, the best insights come from examination of long-term data sets. Here is a great example of the utility of looking at data trends over a longer period.

• *Research Need*

The waters around the U.S. Northeast Continental Shelf have warmed considerably faster than the world's oceans as a whole, and this increase is expected to continue. Warming of ocean temperatures may ultimately change the distributions of many popular fish species, impacting both local fishing communities and possibly even major fishing ports. Having a better understanding of where fish might move as the ocean warms can help fishermen plan for the future.

• *What did they study?*

Scientists used a high-resolution global climate model and historical observations of species distribution from trawl surveys to estimate changes in thermal habitats. This study is important, because different fish prefer different habitats — and their preferences also are linked to a suitable water temperature at those habitats. The research focus was the U.S. Northeast Continental Shelf from the ports of Wanchese, North Carolina, to Portland, Maine.

More fish were caught on J hooks than circle hooks.

• *What did the results show?*

At the end of the 80-year model simulation period (or year 2093), ocean temperatures in the southern portion of the study area (nearest North Carolina) are forecast to increase by a projected 7.4°F (4.1 °C) on the surface and 9.0°F (5.0 °C) on the seafloor along the shelf. This will result in a probable northward shift for the majority of species' thermal habitats.

• *What else did they find?*

The anticipated increase in water temperature will impact

Continued

The smooth dogfish shows strong northern shifts under future warming predictions.

some species more than others. For example, projections suggest that butterfish and black sea bass will suffer moderate losses in preferred thermal habitat, whereas such species as summer flounder, striped bass and Atlantic croaker will experience significant increases.

• *Anything else?*

The Atlantic croaker and smooth dogfish also showed strong northern shifts under future warming predictions. All things being equal, North Carolina fishermen targeting these species in the future will have to travel farther to reach them.

• *Reading*

Full study: *go.ncsu.edu/Northward*

Summary compiled by Caitlin Cunningham and Scott Baker

DO ANGLERS PREFER ARTIFICIAL REEFS?

Patterns along the Gulf Coast Suggest Anglers Favor One Type of Reef

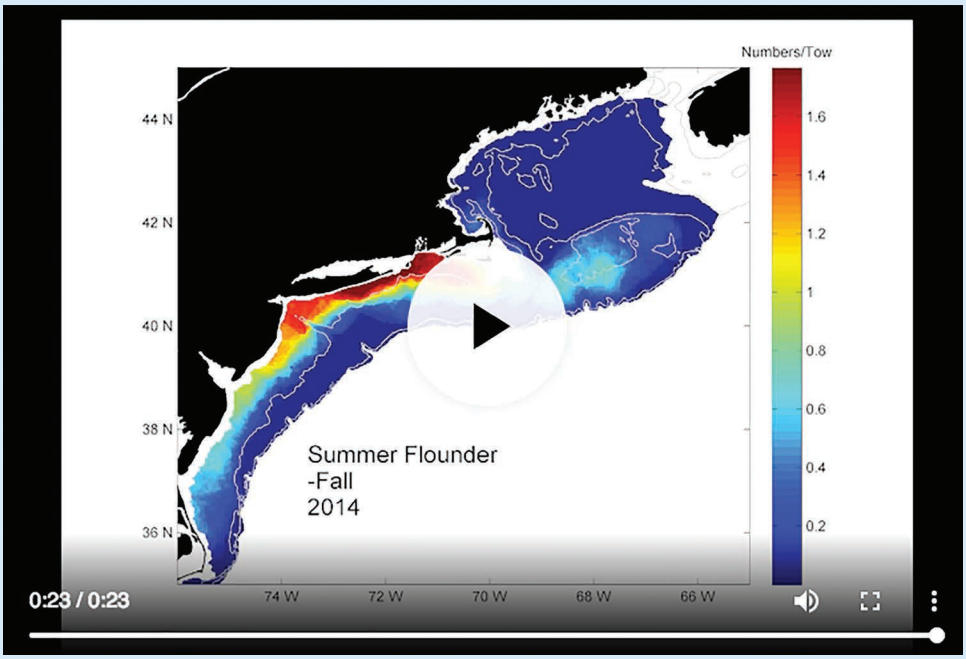
Have you ever been to one of your favorite fishing spots and found you were the only one in sight? Did you think either no one was fishing that day or few people knew about your spot? Or, maybe you pondered whether you were missing "the bite" somewhere else? What if there was a way to see how much boat traffic occurred at various fishing locations without actually being there in person to observe it?

• *Research Need*

Knowing if anglers prefer one reef type more than another can help stakeholders to assess the value of reefs for fishing and enjoyment and to characterize the economic impact of natural and man-made fish habitats.

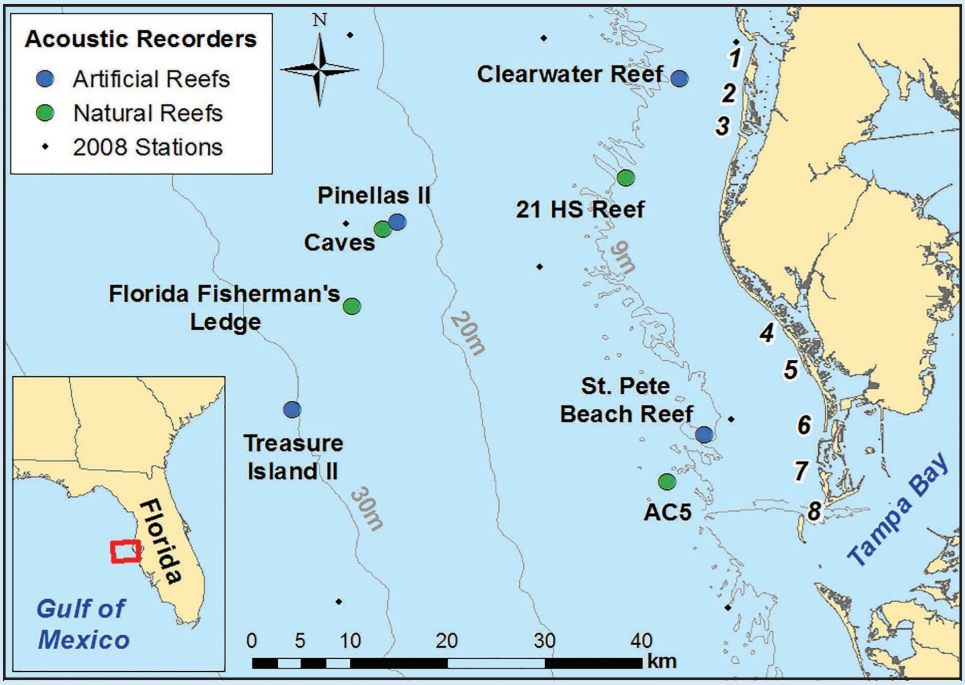
• *What did they study?*

To better understand where anglers



NOAA

Watch the NOAA Fisheries animation about how the distribution of summer flounder has changed along the East Coast from 1968 to 2014: go.ncsu.edu/NOAAvideo.



Artificial and natural reef sites in the study.

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prefer to fish, researchers studied four pairs of artificial and natural reefs in the eastern Gulf of Mexico off western Florida, where a lot of artificial and natural reefs are in close proximity. Scientists calculated boat visitation rates for these reefs by first using underwater acoustic recorders to collect digital sound files for almost two years and then developing a computer program to automatically identify boat noise, separating that sound from any others present at the reef locations.

Once the boat engine sounds were isolated from all other background noises, the scientists developed a procedure to count individual boats at each reef site for each day of the study. With this information in hand, they compared visitation rates between natural reefs and nearby artificial reefs. They looked at two inshore and two offshore reef pairs.

• *What did the results show?*

In all four artificial-natural reef pairs, visitation rates were much higher at the artificial reef than at the natural reef. At the inshore locations, visitation rates at the artificial reefs were approximately 10 times higher than those at natural reefs. The difference in visitation rates between paired offshore locations was not as dramatic: only two times higher for the artificial reef in one pair and eight times higher for the artificial reef in the other pair.

During the study, visitation patterns were a bit sporadic for inshore locations, with peaks occurring in the warmer months, but fairly consistent across seasons for offshore locations.

• *What else did they find?*

The researchers thought that the increase in boat visitation patterns at artificial reefs was likely due to (1) actual or perceived increased quality of fishing and diving at these locations, and (2) lack of knowledge of the presence or location of nearby natural reefs.

• *Anything else?*

The research team documented that the background noise collected with the recorders was highly variable and made the automated detection process of boat noise difficult. Fine-tuning the detection process to better eliminate background noise or to better identify boat noise could make this type of study easier to replicate in other locations.

• *Reading*

Full study: *go.ncsu.edu/BoatVisitationRates*
Summary by Scott Baker

HookLineScience.com

DNA tests give a new scientific identity to a staple of coastal North Carolina — smooth cordgrass, shown here during winter season.

What's in a Name? A Lot, It Seems!

Can a coastal plant ecologist quell a minor social media uprising?

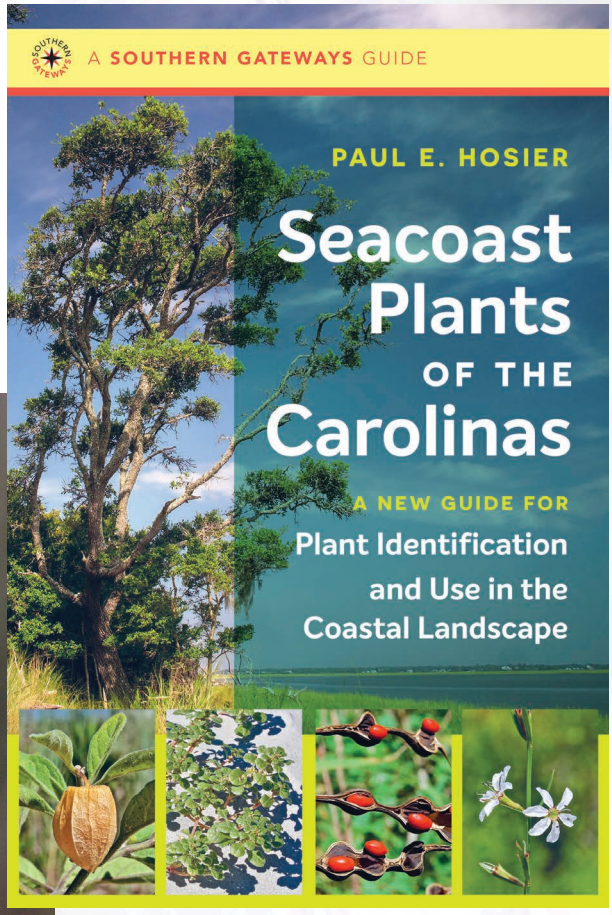
BY PAUL E. HOSIER

Paul E. Hosier is the author of Seacoast Plants of the Carolinas: A New Guide for Plant Identification and Use in the Coastal Landscape. *He also is professor emeritus of the Department of Biology and Marine Biology and former provost at the University of North Carolina Wilmington. Here, he explains what happened when new research necessitated renaming a favorite plant for many coastal scientists and residents alike.*

IN A PRESENTATION AT THE N.C. MUSEUM OF NATURAL SCIENCES NATURE RESEARCH CENTER IN RALEIGH, I CITED A NEW LATIN BINOMIAL, *SPOROBOLUS ALTERNIFLORUS*, FOR OUR WELL-KNOWN SMOOTH CORDGRASS, *SPARTINA ALTERNIFLORA*. ATTENDEES MET THE CITATION WITH EXPRESSIONS OF SURPRISE, ANGST, DISAPPOINTMENT, DISGUST AND DISBELIEF.

During their entire careers, some spanning 50 years or more, coastal ecology researchers have extolled the fundamental importance of several species representing the genus *Spartina* to coastal ecosystems in the Carolinas and, indeed, the entire U.S. Atlantic and Gulf coasts. Clearly, this new nomenclature is a major change in how we cite our cordgrasses. With a somewhat imperfect analogy, you probably would express similar responses if a childhood friend, Meg Jones — as she reached adulthood and married — preferred that she be called "Margaret Smith." She is, and

BELOW: *Smooth cordgrass assumes a new alias — and causes a ruckus.* RIGHT: Seacoast Plants of the Carolinas *was one of the early adopters of the new name for smooth cordgrass:* Sporobolus alterniflorus.



always will be, "Meg" to you.

Recent DNA-based phylogenetic studies of the grass subtribe *Sporobolinae* found that several well-known genera — including *Spartina* — were more appropriately placed in the genus *Sporobolus*, and following the rules established by taxonomists, the research necessitates that the genus *Spartina* be discarded (Peterson, et al., 2014a; Peterson, et al, 2014b).

The scientific community continually engages in taxonomic research, and results of individual studies are published as quickly as possible, usually within a few months to a few years following an investigation. Conversely, floras, books and other user-friendly expressions of taxonomic research are produced at a much slower rate. Decades may pass before new floras incorporating the changes established by taxonomic research appear in hard copy.

Note that the *Flora of the Southern and Mid-Atlantic States* (Weakley, 2015) now replaces the familiar *Manual of the Vascular Flora of the Carolinas* (Radford, et al., 1968) after a span of nearly 50 years. Weakley's flora makes the change from *Spartina alterniflora* to *Sporobolus alterniflorus*. *Seacoast Plants of the Carolinas* was one of the first popular publications to use the new nomenclature.

In perusing the *Flora of the Southern and Mid-Atlantic States*, readers will notice the *Spartina*-to-*Sporobolus* change is not the only recent change. *Ampleopsis arborea* is referred to as *Nekemias arborea*. *Polypodium polypodioides* is now *Pleopeltis michauxiana*. And today, *Chloris petraea* is *Eustachys petraea*. Changes to these and many other lesser-known plant names have gone all but unnoticed — but they represent, and are the expression of, our accumulated knowledge about the phylogenetic relationships among plants.

While our long-time friend will always be "Spartina" to coastal ecologists, new and future coastal scientists will be introduced to *Sporobolus*. They may know little or nothing of its past name, and *Sporobolus alterniflorus* will become one of their favorite plants! Over time, we, *Spartina*'s old friends, will come to understand and appreciate that the new plant name is based on our current understanding of its relationship to other plants.

Welcome, *Sporobolus*.

Paul Hosier's "Seacoast Plants of the Carolinas" talk on Jan. 9 was part of the Lunchtime Discovery Series, a partnership between the N.C. Office of Environmental Education and Public Affairs in the N.C. Department of Environmental Quality and the N.C. Museum of Natural Sciences. Watch it here: go.ncsu.edu/PaulHosier

More on Seacoast Plants of the Carolinas*: go.ncsu.edu/SeacoastPlants*

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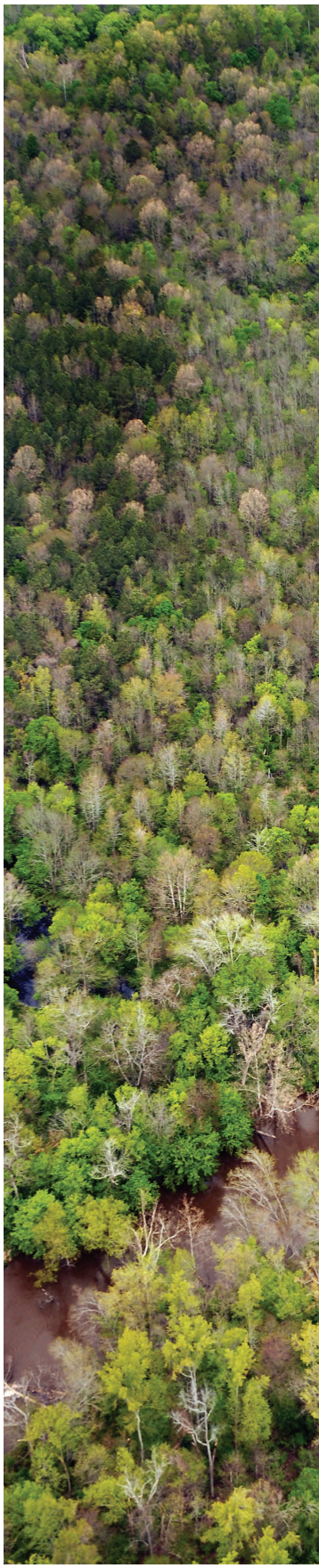
Ken Blevins/ Star-News




Roger Winstead/NC State Communications

Tropical Systems Disrupt Neuse River Oxygen Levels

BY ALEXEY KATIN

Last June, a team of researchers used an experimental model to forecast that hypoxia — low levels of dissolved oxygen — would be more severe than average in the Neuse River Estuary during midsummer 2018. Such predictive models are important, because hypoxia can lead to ecosystem stresses, including fish kills.

Daniel Obenour, an environmental engineer at NC State University, is collaborating with coastal ecologist Hans Paerl of the University of North Carolina at Chapel Hill's Institute of Marine Sciences on this North Carolina Sea Grant research project. When the team later assessed how well their experimental model had anticipated oxygen levels, they determined their forecast effectively matched observed conditions. They also found significant impacts on the estuary from Tropical Storm Chris and Hurricane Florence.

Alexey Katin is a doctoral student in civil engineering at NC State who works on the project.

TO EVALUATE THE PERFORMANCE OF OUR EXPERIMENTAL HYPOXIA FORECAST FOR THE NEUSE RIVER ESTUARY, WE COMPARED OUR FORECASTED BOTTOM-WATER DISSOLVED OXYGEN CONCENTRATIONS WITH OBSERVED VALUES.

We had forecasted severe hypoxic conditions for July and August, relative to long-term averages throughout the Neuse River Estuary. Note

Continued

Hurricanes and storms like Florence and Chris have disrupted the oxygen levels in the Neuse River Estuary. Here, post-Matthew Neuse River floodwaters surrounded Kinston.

the solid black line in Figure 1. In comparison, the average observed midsummer bottom-water dissolved oxygen concentrations, which the figure's dashed blue line represents, were higher than our forecasted estimate. Still, those observed levels were within the 90 percent prediction interval of our forecast. The prediction interval, which the figure's gray band indicates, expresses the uncertainty in the forecast due to unpredictable conditions.

However, the average dissolved oxygen levels would have been lower — and thus even closer to our forecasted values — if July measurements had not immediately followed an extreme weather event, Tropical Storm Chris. The storm mixed the water column of the estuary, temporarily elevating the bottom dissolved oxygen levels.

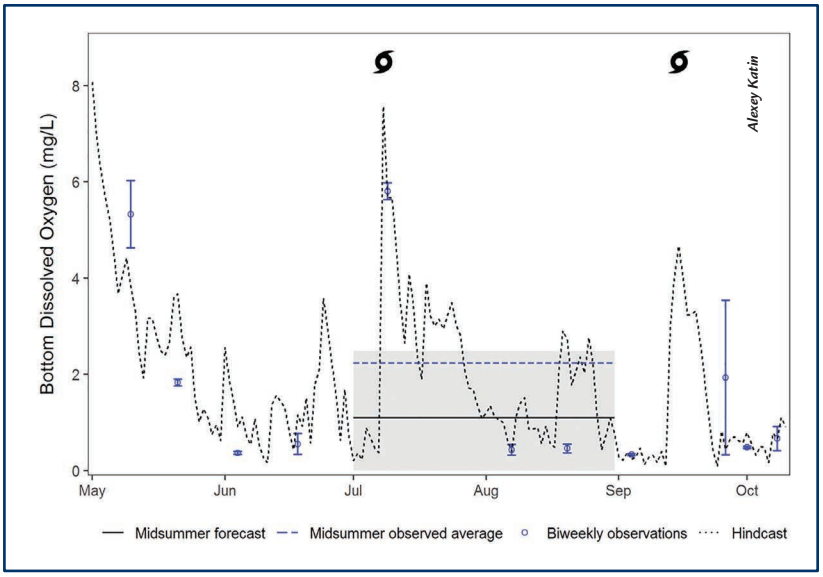


Figure 1. Observed and Predicted Bottom-Water Dissolved Oxygen for May to October 2018 for the Middle Segment of the Neuse River Estuary. *Storm symbols indicate when Chris and Florence struck the estuary.*

OBSERVED CONDITIONS IN THE NEUSE RIVER ESTUARY

The summer of 2018 was wet. From May through August, the mean Neuse River discharge — a measure of the volume of water flowing into the estuary — was twice as high as the historical average. These high flows deliver nutrients and promote water-column stratification, which leads to depletion of dissolved oxygen.

At the beginning of July, winds from Tropical Storm Chris mixed and oxygenated bottom waters throughout the estuary. Unfortunately, we have no observations of conditions in late July after this storm event, because the sampling cruise was canceled due to maintenance.

During the second half of July and the beginning of August, the estuary continued to receive substantial fresh water and nutrients from upstream. As a result, the whole estuary became severely hypoxic, with levels of bottom-water dissolved oxygen less than 1 milligram per liter during August. The absence of strong winds and precipitation that month maintained hypoxic conditions until the beginning of September, with fish kills reported in the Neuse River Estuary.

Flooding from the Neuse River near Kinston.

Observations following Hurricane Florence in late September and October indicated severe hypoxia continued into the fall.

THE HINDCAST: A LOOK BACK

In November, we reran our hypoxia simulation using observed daily data for May through October. Thus we reconstructed, or hindcasted, daily dissolved oxygen conditions in the estuary in order to evaluate the model. Note the dotted black line in Figure 1.

The hindcast indicated that the estuary was hypoxic, below 2 mg/L, about half the time during midsummer 2018. In addition, the hindcast captured elevated bottom-water dissolved oxygen levels from Tropical Storm Chris and Hurricane Florence. The hindcast also matched summer observations well, as shown by the blue points in Figure 1. In addition, the hindcast supported our forecasted midsummer hypoxic conditions in the estuary.

In short, the experimental model we used to predict oxygen levels this past summer shows great promise as a tool for future forecasts.

Read more about the causes of hypoxia and our work with experimental modeling:

- *Forecasting Hypoxia, Algal Blooms for the Neuse River Estuary:* go.ncsu.edu/Forecasting
- *Model Forecasts Severe Hypoxia through August in Neuse Estuary:* go.ncsu.edu/NewModel

Saturday Left Behind

BY DEE STRIBLING

Sound laps soft at waters edge, gentle waves touch morning's shore. Egret and heron with lifted legs watch for tiniest sand cloud stir and puff. Crab awakens peeking out, says the night was long and full of stars.

All peace reigns on this lost cove where hand-hewn oar washed up years ago. Remnants of fisherman's shack now tilt toward sound, expect boat's return. No fisherman hands now row, only island oaks tangle with briars and grass.

Distant sounds and diesel smells float across water calm and smooth. Wind pushes remnants of someone's Saturday wrapped in plastic sails. Tiny rafts of color, red from a kid's balloon, bits of line, die in tangled mess.

Gull pays slight attention as these gifts bob and pitch onto white linen shore. Scattered about they lie exposed, wait to be picked up and used again. Osprey cry stirs air, brings back the wind, buries all abandoned at tide's door.

Poem and pictures reprinted with author's permission from Down East Picture Book *(2017), as published by Horse & Buggy Press.* • *Photos by Dee Stribling*

Dee Stribling writes prose and poetry about how landscape and culture can shape communities. Currently Hillsborough's Poet Laureate, she is a North Carolina native with a doctorate in geography from the University of North Carolina at Chapel Hill. To learn more: *deestribling.com*.

North Carolina Sea Grant
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"This article, without beating you over the head with dire predictions, shows that local communities can — and should — start the planning process and that there are agencies out there that can help."

— NORTH CAROLINA ASSOCIATION OF GOVERNMENT INFORMATION OFFICERS

The ink had barely dried on Julie Leibach's "The Long View" before it won the NCAGIO's *Excellence in Communications Award in News Release/Feature Writing*. Her article chronicled a pioneering effort in Nags Head to address sea level rise — and adapt to it — in official town planning. No doubt her story was a major reason that the issue in which it appeared also earned runner-up for the annual award for print publications.

This is just the latest in *Coastwatch*'s long tradition of honors and awards. In case you missed it, you can read Leibach's prizewinner here: *go.NCSU.edu/TheLongView*.

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