

Seafood Lovers • Migrating Marshes • Coastal Landscaping • Ancient Forests

Coastwatch

NORTH CAROLINA SEA GRANT • AUTUMN • 2019 • ISSUE 3 • \$3.75

Revisiting Floyd 20 Years Later
Survivors' Firsthand Accounts from 1999

Season-to-Season Successes

Summer was wonderfully busy here at North Carolina Sea Grant: kicking off new research awards, announcing new student and faculty funding opportunities to keep us moving forward, and expanding our team's collaborations with communities across the coast and the state.

In this issue, you will learn more about our partnerships and the impacts from new collaborative projects. And you can follow all our news and blogs at NCseagrant.org. We just cannot fit all the great work of our partners and team into this magazine!

Recent months also brought changes in our extension team. Jessica Whitehead moved to new duties as the state's first chief resilience officer for the N.C. Office of Recovery and Resilience within the Division of Emergency Management. Also, Chuck Weirich is joining the National Sea Grant Office in Silver Spring, Maryland. There, he will coordinate national aquaculture programs.

I am so pleased to see our team members move into strong leadership roles at state and federal levels. We look forward to their new and expanded programs and audiences as they bring their research and outreach skills to new challenges. This fall, North Carolina Sea Grant will be recruiting for two extension positions, one in aquaculture and the other in coastal resilience, to continue the great progress that Chuck and Jess brought to our program.

North Carolina Sea Grant also is pleased to welcome a new advisory board member, Beaufort Mayor Everette "Rett" Newton. He brings not only a local government viewpoint, but also perspective from serving 28 years in the U.S. Air Force. He also has a research lens as a doctoral candidate at the Duke University Marine Laboratory, focusing on marine robotics and remote sensing.

This summer our team also had the pleasure of hosting a researcher and two undergraduate students from Florida A&M University for a 10-week Summer Research Team for Minority Serving Institutions program, funded by the U.S. Department of Homeland Security (DHS). NC State University's Department of Landscape Architecture co-hosted the visit. The DHS Coastal Resilience Center of Excellence at the University of North Carolina at Chapel Hill coordinated the program.

Social scientist Michelle Divil and her students, Tia Maxwell and Tenesha Washington, rapidly became part of our Sea Grant team. They developed and delivered a robust research project focused on perceptions of risk related to climate in Wilmington and Elizabeth City. We benefitted greatly from their research findings and engagement, including discussions regarding how to widen and strengthen recruitment and retention of underrepresented minorities in the sciences.

Their work culminated in a Washington, D.C. presentation of their findings to DHS. I anticipate welcoming them back to present additional findings during the North Carolina Coastal Conference this November. Working with Michelle, Tia and Tanesha reinforced North Carolina Sea Grant's ongoing commitments to actively expand our engagement and awareness of opportunities to improve programming in our grants work and in support of where we live, work and play.

And now, I am more than ready for this Fall season! Crisp mornings with lower humidity and the back-to-school thrills of students arriving on campuses — and back at elementary school, in my family's case. Students are excited to learn, connect with new people, and see how individually and collectively they can contribute to the success of something they find valuable.

For some, it may be an introduction to hands-on research. Others will be engaging in and finding a home within a new community, learning about historical influences, and expressing themselves through the arts. Opportunities for learning are endless. I find the start of new school year full of contagious energy that helps affirm and inform our work across the state.

Speaking of which, make plans now to join North Carolina Sea Grant and many leaders from local communities, state and federal agencies, academia and nonprofits for the 2019 N.C. Coastal Conference in Wilmington. All the details are here: go.ncsu.edu/coastal-conference

I look forward to our having a productive fall season with you all — and to seeing you in Wilmington in November. Meanwhile, if you have ideas or thoughts about the conference or our programs, please feel free to reach out to me directly: snwhite3@ncsu.edu.

— Susan White, Executive Director, North Carolina Sea Grant

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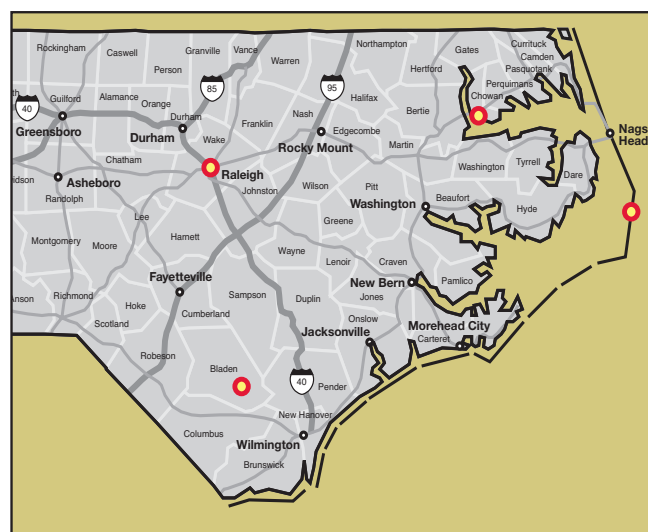
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*North Carolina's diverse coast and inland terrain offer countless interesting subjects.
The story settings in this issue including Bladen, Chowan, and other counties.*





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■ *Front Cover:* Hurricane Floyd, 1999, courtesy of NOAA

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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.

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C O A S T A L T I D I N G S

WHITEHEAD BECOMES FIRST NC CHIEF RESILIENCE OFFICER

In June, Jessica Whitehead began her new role as the first chief resilience officer for the N.C. Office of Recovery and Resiliency. For 11 years, she had served as the coastal communities hazards adaptation specialist for North Carolina Sea Grant.

"Hurricanes Matthew and Florence underscored that as North Carolina builds back, we need to find ways to build back smarter and stronger," says Whitehead, a nationally known expert on using science for adapting to coastal change.

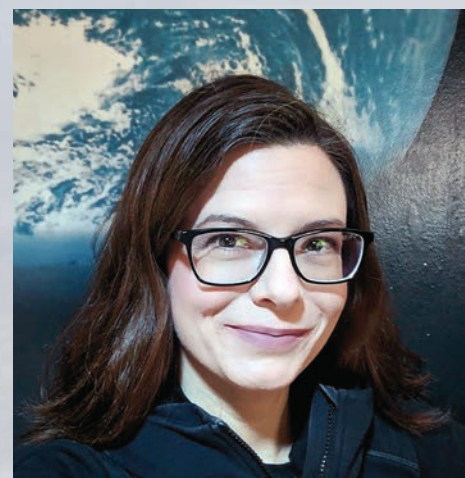
"We must improve North Carolina's resilience, and doing so now will be cheaper in the long run as weather events become more severe and our climate changes," she adds.

Susan White, North Carolina Sea Grant's executive director, notes that Whitehead has been encouraging communities over the last several years to identify current and expected hazards, including their causes and consequences.

"Those discussions have provided groundwork for plans now considered models in our coastal region and beyond," White says.

Whitehead works with deputy resilience officers Marlena Byrne and Amanda Martin to lead the state's initiative to help storm-impacted communities rebuild and adapt to future natural disasters and long-term climate change. The team will improve collaboration among governments, nonprofits, the private sector and academia, enhancing the resilience of communities and creating safe and affordable housing solutions.

Read more: go.ncsu.edu/resilience-chief



Jessica Whitehead

— Katie Mosher & Katelyn Vause

HURRICANE PREPARATION AND RECOVERY INFORMATION

With the heart of hurricane season approaching, North Carolina Sea Grant shares the following links to resources and information about disaster recovery and resilience:

- Coastal Hazards Information: go.ncsu.edu/coastal.hazards
- Hurricane Resource Portal: go.ncsu.edu/hurricane.resources
- Ready NC Portal: readync.org
- National Hurricane Center: nhc.noaa.gov/
- Community Assessment Using the Vulnerability and Consequences Adaptation Planning Scenarios Planning Tool (VCAPS): go.ncsu.edu/vcaps
- How the Town of Nags Head Used VCAPS: go.ncsu.edu/TheLongView
- Coastal Rivers Flood Mitigation: go.ncsu.edu/mitigation
- Checklist for Neighborhood Disaster Recovery: go.ncsu.edu/recovery.checklist
- Preparing Your Property: go.ncsu.edu/property
- The Emergency Supply Kit: go.ncsu.edu/kit
- Coastwatch Magazine on the 2018 Hurricane Season: go.ncsu.edu/2018.season

FEMALE SAND TIGERS LOVE SHIPWRECKS

A sand tiger shark swims over the SS Tarpon shipwreck.

Less than a year after the North Carolina Aquariums launched the *Spot A Shark USA* citizen science program, the initial findings could play a significant role in the protection of the sand tiger shark — a globally designated vulnerable species.

Divers submit both new and historical shark images to the *Spot A Shark USA* website, providing as much information about the image as possible. Based on those details, researchers map the locations of each shark.

“Six female sand tiger sharks were photographed and re-photographed at the same or nearby shipwrecks located off the

coast of North Carolina over a period of time ranging from a few months to six years,” says Avery Paxton, lead researcher for the project. “This indicates shipwrecks are potentially critical habitats for sand tiger sharks and worthy of further research.”

The citizen scientists’ photographs suggest that female sand tiger sharks exhibit “site fidelity” — that is, they return to the same locations over time. Such a photographic record can help to identify habitats that the imperiled species requires.

Read more: go.ncsu.edu/sandtigers.

— Katelyn Vause



Hurricane Florence approaches the East Coast.

CLIMATE CHANGE WORSENS COASTAL FLOODING

Research indicates that climate change is increasing major precipitation events in North Carolina, including hurricanes and tropical storms. Scientists analyzed a continuous data record dating back to 1898, determining that six of the seven highest precipitation events in the state during the last 120 years occurred within the last two decades.

Hans Paerl, a marine and environmental scientist at the University of North Carolina at Chapel Hill Institute of Marine Sciences, says that due to climate change the last 20 years of precipitation events have been “off the charts.”

“The price we’re paying is that we’re having to cope with increasing levels of catastrophic flooding,” says Paerl, lead author on the study. “Coastal watersheds are having to absorb more rain. Let’s go back to Hurricane Floyd in 1999, which flooded half of the coastal plain of North Carolina. Then, we had Hurricane Matthew in 2016. Just recently we had Hurricane Florence in 2018. These events are causing a huge amount of human suffering, economic and ecological damage.”

According to Paerl’s team, tropical systems today carry more moisture due to the warming climate. The probability of abnormally large flooding events like those from Floyd, Matthew and Florence occurring in such a short time period is 2%.

“The ocean is a huge reservoir that is absorbing heat and seeing more evaporation,” Paerl says. “With more evaporation comes more rainfall.”

North Carolina Sea Grant, the Water Resources Research Institute of the University of North Carolina and other partners supported the research.

Read the full study in *Scientific Reports*: go.ncsu.edu/more-flooding



Nesting near Rodanthe, this green sea turtle laid 151 eggs.

SEA TURTLES NEST ON NC BEACHES IN RECORD NUMBERS

Sea turtles came ashore in record numbers to nest on North Carolina’s beaches this year. Volunteers and researchers already had recorded well over 1,700 loggerhead nests along the coast by the end of July, breaking the 2016 record of 1,622 nests.

“We’re not entirely sure why this is such a big year, but perhaps it reflects the protections enacted a few decades ago, to protect nesting females and their incubating eggs on our beaches,” says Matthew Godfrey, a sea turtle biologist with the N.C. Wildlife Resources Commission.

He adds that South Carolina and Georgia also are experiencing record loggerhead nest numbers this year.

“Typically, a female will come up onto the beach at night and use her back flippers to dig a nest,” explains Dia Hitt, education curator with the North Carolina Aquarium on Roanoke Island. “Once the nest is dug, the female lays her eggs, and then she covers it back up and returns to the ocean.”

Hitt says each nest usually contains 100 to 120 eggs, with hatching starting in July and going as late as October.

Volunteer groups, such as the Ocean Isle Sea Turtle Protection Organization, watch over eggs, hatchlings and nesting mothers. Deb Allen, island coordinator for the group, says that everyone can help to protect sea turtles, especially from disorienting artificial light.

“We encourage everyone to practice *Lights Out — Sea Turtles Dig the Dark* from May to September,” she says.

Find a sea turtle group near you: seaturtle.org/nestdb/?view=1.

— Katelyn Vause



Outer Banks

NC FLOOD INSURANCE POLICYHOLDERS SAVED \$1.2 MILLION LAST YEAR

Wind-borne standards in the North Carolina Residential Building Code saved flood insurance policyholders in nine coastal communities over \$1.2 million during the past year.

The Community Rating System (CRS) — a program that helps foster floodplain management — reduces flood insurance premium rates for policyholders, enhances public safety, and reduces damages to property and public infrastructure. To encourage implementation of better building codes, the program's incentives rely on a local building code evaluation before they kick in.

"The insurance incentives encourage communities and individuals to adopt high storm-resistant standards," says Spencer Rogers, North Carolina Sea Grant's coastal construction and erosion specialist. "In this case, flood insurance incentives encourage building codes with higher wind standards. Communities that require higher CRS standards can qualify all flood insurance policies for the discounts."

Over a decade ago, Rogers collaborated with stakeholders in the building code and construction sectors to modify the code to accommodate wind-borne standards along the North Carolina coast.

Rogers says North Carolina Sea Grant's work on the updated standards meant that 18,242 policyholders in nine coastal N.C. communities paid less on their premiums over the past year alone — but such savings aren't new.

"This has saved property owners about \$10 million over the last decade."

— Dave Shaw

COASTAL TIDINGS

MARICULTURE COMES TO MORE CLASSROOMS

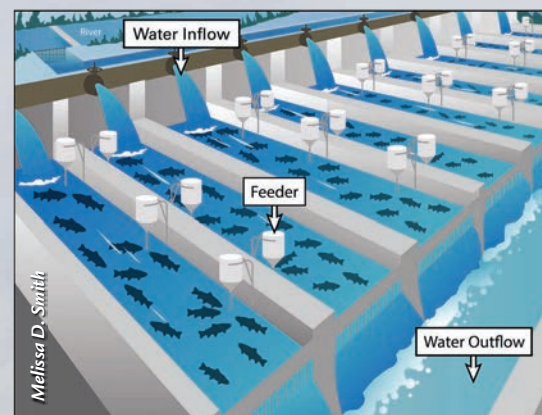
Marine aquaculture, or mariculture, is a growing industry in North Carolina — one that offers many career avenues. To help acquaint students with the field, North Carolina Sea Grant has produced a suite of mariculture lesson plans for use in high school science classrooms and Career and Technical Education programs.

The 10 lessons cover a variety of subjects. For example, one lesson delves into aquaculture's history, while another investigates different production methods. Most lessons entail either a hands-on activity, group collaboration, classroom presentation, or some combination.

"The range of information presented in these lesson plans makes them well suited for ninth-grade biology, Advanced Placement environmental science, and even agricultural education, among other courses," says Sea Grant coastal economist Jane Harrison, who has led the project. She and her team designed the lesson plans to provide a career pathway.

"I especially like the lessons that require the students to put themselves in the mindset of an aquaculture producer," she adds. For example, "if they were to grow oysters in the near-shore ocean, what are the required water quality conditions?"

Each resource builds off knowledge gained through earlier lessons, but teachers also can pick and choose to suit their curriculum.



A flow-through aquaculture system, or raceway.

The lesson-planning team also included high school science teacher Amy Sauls, Sea Grant marine education specialist Terri Kirby Hathaway, Sea Grant science writer Julie Leibach, Sea Grant marine aquaculture specialist Chuck Weirich, science illustrator Melissa Smith, graphic designer Kathy McKee, as well as beta-testers.

"We really appreciate the team of middle school and high school teachers that helped develop and field-test the lessons," Hathaway says. "We're looking for more teachers to pilot the lessons in their classrooms and help us improve these activities."

Lessons are available online at go.ncsu.edu/MaricultureLessons. If you're interested in providing feedback on a lesson, email Hathaway at terri_hathaway@ncsu.edu. —Julie Leibach

REGISTER NOW FOR 2019 NC COASTAL CONFERENCE

North Carolina Sea Grant again will host the North Carolina Coastal Conference, taking place November 19 and 20 at the Hotel Ballantyne on the Cape Fear River in downtown Wilmington.

"We're looking forward to a variety of participants and topics related to our coastal ecosystems and economies," says Susan White, North Carolina Sea Grant's executive director. "Partners around the state are helping residents respond to, recover from and anticipate urgent and long-term coastal challenges."

Drawing upon the success of similar conferences in 2015 and 2017, the sessions will include a wide range of important issues relevant to North Carolina, such as weather, storms and climate; community and ecosystem health; fisheries and aquaculture; and planning and eco-

nomics. Topics are expected to range from science and education to arts and humanities, and can incorporate both research and outreach.

During this interdisciplinary conference, experts will bring together diverse perspectives on panels, poster presentations, networking events, special opening and closing programming, and more.

Early registration rates are available through noon on October 18.

Sponsorship opportunities also are available at four levels of support. For more information on sponsorships, contact Katie Mosher, communications director, at kmosher@ncsu.edu or 919-515-9069.

Read more and register: go.ncsu.edu/CoastalConference. —Katie Mosher

CAN FISH ADAPT TO POLLUTANTS IN THE CAPE FEAR?

The Cape Fear River provides a habitat for killifish.

New research is exploring how fish tolerate living in severely contaminated ecosystems. With support from a North Carolina Sea Grant/Water Resources Research Institute Graduate Student Research Fellowship, Casey Lindberg is studying Atlantic killifish — a small, common marsh fish in the Cape Fear River Basin.

Lindberg, a recent Ph.D. graduate from Duke University, says high levels of human activity along the Cape Fear have led to designations of several regions as “Superfund sites,” polluted areas that require a long-term response to address hazardous contaminants.

Such contaminants include creosote, a complex mixture created from coal tar and used primarily in wood preservation processes. The primary chemical components of creosote, polycyclic aromatic hydrocarbons (PAHs), can persist in aquatic environments for decades.

Lindberg says, however, that creosote-contaminated habitats support populations of Atlantic killifish. But she wondered what

would happen to the fish if she introduced an additional environmental stressor *at the same time*.

For her study, she captured killifish from creosote-contaminated water and also exposed them to environmental hypoxia — a common low-oxygen condition.

“There were very interesting, albeit unpredictable, interactions between PAHs and hypoxia during exposures,” Lindberg says. “For example, killifish exposed both to PAHs and hypoxia were unable to hatch as well as those exposed to either stressor alone. In one population of killifish, the co-exposure caused such severe effects that none of the embryos hatched at all.”

Lindberg says researchers should look at multiple stressors simultaneously to identify the most susceptible species and stages of development.

Read more: go.ncsu.edu/stressors.

— Dave Shaw

WAVE TANKS SHOW STORM SURGE

Visitors to Jennette’s Pier Aquarium in Nags Head and MarineQuest at the University of North Carolina Wilmington are seeing storm surge impacts — on demand and on a small scale.

Wave tanks at the two locations, funded by North Carolina Sea Grant, reveal how the beach responds during storms as well as during daily tidal changes. Staff members use the tanks for K-12 education demonstrations throughout the year, and for summer camps at MarineQuest.

Spencer Rogers, North Carolina Sea Grant’s coastal construction and erosion specialist, designed and built the tanks, basing the motors and controls on a similar wave tank at the University of Delaware. UNCW Machine Shop staff fabricated and welded parts for the project.

“The tanks can produce up to a three-inch wave and are intended to be an active model for how the beach works,” Rogers says.

“The beaches are changing all the time, but students don’t always realize that. These tanks show how beach features adjust with variations in factors such as wave height, storm surge and sand grain size.”

Read more: uncw.edu/marinequest/ and ncaquariums.com/Jennettes-Pier.

— Katelyn Vause



Jarek Tuszyński/CC-BY-SA-3.0

Minigrants have funded research on jellyfish blooms and a wide array of other projects.

MINIGRANTS ENCOURAGE PILOT TESTING IDEAS

North Carolina Sea Grant has reopened its Minigrant Program, which often has allowed researchers to pilot-test new lines of inquiry.

“Our minigrants usually lead to great returns on investment, with recipients often able to leverage funding and expand their Sea Grant-funded work into larger studies,” says John Fear, North Carolina Sea Grant’s deputy director. “These projects have a great tradition of supporting student research — and of creating meaningful impacts.”

In the past, minigrants have fueled research on a wide variety of topics, including studies on jellyfish blooms, shipwreck site preservation, and the stability of the oystercatcher population.

North Carolina Sea Grant processes minigrant applications on a rolling basis, as they are received online. Grant requests must be less than \$10,000, which is double the previous award limit for an individual project. Proposals must support the program’s strategic plan.

Interested applicants should contact John Fear at jmfear@ncsu.edu or 919-515-9104.

Learn more: go.ncsu.edu/minigrants.

— Katelyn Vause

*Many North Carolina seafood lovers
still enjoy cooking their favorite
dishes in their own kitchens —
but where is the North Carolina
seafood market headed?
The answer is complicated.*





A Fish for All Occasions

Soccer moms with grocery bags brimming with Hamburger Helper and Ramen noodles. Millennials who scoop ready-to-eat meals and gulp them down on the move. Fitness fanatics intent on fueling the Body Temple with healthy, pure, protein-rich diets. Aficionados of high cuisine, lovers of the dining experience, and the chefs who prepare their meals with flair. Husbands, wives, retirees in aprons — a pinch of spice always between thumb and forefinger — whose cooking remains a lifelong labor of love.

Is it possible for local seafood to satisfy these and the many other sorts of guzzlers, diners and devourers that shape the contemporary American food scene?

DAVE SHAW

A QUEST FOR THE HEART OF THE LOCAL SEAFOOD LOVER

“Consumer research has shown that with today’s busy lifestyles people are searching for freshly prepared food options that are convenient to prepare and eat anywhere, especially at home,” says Barry Nash, North Carolina Sea Grant’s seafood marketing specialist. “But does this really apply to the local seafood market — and, if so, what does it mean for our state’s seafood producers and retailers?”

To find out, Nash went to the self-proclaimed fastest distributor of local seafood in the Raleigh-Durham-Chapel Hill area. Locals Seafood Company only sources its fish from points within a three-hour drive of the Triangle.

While apt for its simplicity, the Locals name alone doesn’t evoke an unmistakable element

Continued

of efficiency — until, that is, you do business with them. The company has developed such a smooth-running supply chain from coastal North Carolina that Triangle restaurateurs can have fish on your plate within 24 hours of that same fish swimming in the Atlantic.

“That’s about a third of the turnaround time of our quickest competitors,” says Locals co-founder Ryan Speckman. “Freshness and quality are the main reasons local chefs rely on us for seafood.”

Nash says North Carolina’s seafood comes with built-in consumer appeal.

“There’s an obvious functional aspect to eating local seafood,” he says. “Consumers equate quick turnaround, from sea to table, with freshness. Plus, North Carolinians can support local producers — and get the highest quality cuts.”

Locals Seafood is booming. Less than a decade ago, Speckman and college buddy Lin Peterson started the enterprise by selling Stumpy Point shrimp out of a tailgate cooler on the side of the highway. Today, not only is Locals supplying more than four dozen chefs across the Triangle, Speckman and Peterson’s company additionally stocks a dozen grocers and regularly provides foodies with homegrown choices at farmer’s markets.

They also serve their own retail customers at Locals Oyster Bar and Seafood Market, an airy, hip, even trendy space in the Transfer Company Food Hall in downtown Raleigh. There, a massive floor fan rumbles on summer days, evoking a dockside restaurant, while customers devour authentic offerings from chef Eric Montagne, whose father taught him to fish in the south Florida seaways.

In search of the highest quality product, Locals’ seafood lovers can experience the difference between Woccocon and Slash Creek oysters, for instance, as well as enjoy much more from a wide sampling of both well-known and underappreciated



J. Barry Nash



L. W. Yang/CCBY 2.0

TOP: Locals Oyster Bar and Seafood Market serves up authentic offerings.

BOTTOM: Global demand is increasing for seafood — like this item from Mr. Pizza in Seoul.

fish. In many ways, the company is helping to maintain the state’s seafood as a vibrant niche market.

Nash says the North Carolina seafood market is brimming with potential, yet certain to face ongoing challenges.

“There’s a growing, global demand for seafood,” Nash explains. “But there’s also a finite supply of local products, an aging population of the fishing fleet, and quotas designed to keep fisheries sustainable, limiting catch sizes. It’s never been more important to identify exactly what

consumers want.”

What do these challenges mean for Locals Seafood?

“We may need to change things,” Speckman says. “If we want to maintain our mission, we have to know how we can we squeeze every penny out of the local seafood market.”

To do that, diagnosing available market opportunities is critical — which is how Speckman, Peterson and Nash came to join forces on a quest for the heart of the North Carolina seafood consumer.



VisitNC.com

An online survey revealed that seafood lovers in North Carolina enjoy oysters the most.

THE BUSINESS OWNER'S FIRST COMMANDMENT

Speckman and Peterson have avoided the pitfalls of a classic cautionary tale — a story that starts with a young entrepreneur setting in motion what seems like an exceptional business plan. The company operates on an efficient model. The projected profit margins are solid. The owner invests liberally in clever advertising

and publicity, and the PR generates an explosion of awareness. Thousands of people, in fact, learn about the company, its slogan and its products. And then it promptly goes out of business.

The problem, Nash says, is that many businesses don't actually identify their core customers in order to learn what those consumers actually want, or how to meet their expectations and desires.

"The money and time it takes to actually understand your consumer base — their tastes and demands — is considerable," he explains. "Most producers and retailers don't have the resources to do this."

Which means many new businesses end up suffering the wrath of the market.

Even Speckman — who has taught himself how to navigate numerous hoops and hurdles while shepherding Locals from that single roadside cooler to a successful business — says the company has tried a clunker of an idea or two.

"Home delivery," he says, in a tone that doesn't need an eye roll. "We ended up spending a lot of time getting from point A to point B. There was always some guy who only wanted a half-pound of shrimp delivered, and he was always the farthest away."

Nash says that determining how best to meet customers' needs and expectations is crucial, but it's only one aspect of market research.

"In order to stay relevant, businesses must know how — and why — consumer desires change."

According to Nash, consumer research already has outlined the broader story of the contemporary American food scene. Because we lead such busy lives, we're apt to devour pre-prepared, impulse-driven products of convenience. We prefer fresh, transportable meals, with minimally-processed ingredients and without artificial preservatives. Bold flavors and "handcrafted" quality characterize the most successful new product launches of the last few years.

In addition, people increasingly want fresh, natural foods with greater nutritional value, which, many consumers believe, will help prevent or alleviate even serious health conditions. Over time, consumers have become more trusting of niche food brands from local and regional businesses, as opposed to impersonal and distant national chains or international conglomerates.

Continued

In fact, when choosing their foods, people today tend to swoon over fresh, locally sourced, high-protein ingredients. Protein-rich, low-fat marine animals — laden with heartbeat-regulating, blood pressure-lowering omega-3 fatty acids — seem a perfect place for health-conscious foodies to invest their trust.

But these trends and preferences don't fully explain the complexities of the North Carolina seafood consumer base.

"North Carolina Sea Grant can help fill in the gaps in market research," Nash says. "Right now, for instance, roughly three-quarters of seafood is consumed in restaurants. But what does that really *mean* for seafood producers and retailers in our state? Ryan, Lin and I wanted to learn what, exactly, North Carolina seafood consumers want to eat — and how they want to prepare it."

Nash and Locals collaborated to design focus groups and online surveys that would elicit a fuller portrait of the seafood company's consumer base and the North Carolina seafood market at large. Their specific questions asked why people shopped at Locals, why they ate seafood, which seafoods were favorites, and which typically lesser known species they were familiar with.

Their questions also went deeper, seeking to uncover how seafood fit within consumer expectations and understandings of cooking itself. They probed consumer interests in meal kits — prepared meal components that seafood lovers could assemble and cook at home. Additionally, they asked if consumers would make use of ready-to-eat or heat-and-serve seafood, for which occasions they would consider using either, if they preferred refrigerated or frozen seafood meals, and even if they preferred particular kinds of packaging.

Nash and Speckman teamed for a Raleigh focus group, and Ann Simpson, then executive director of North Carolina Catch, led another in Chapel Hill. The online survey drew responses



North Carolina seafood consumers present a diverse and educated palate.

from 318 customers, nearly all residing in the Triangle.

With this information in hand, they could begin to create a profile of North Carolina seafood lovers.

TO COOK OR NOT TO COOK

"First, we learned a lot about what was working," says Speckman. "The research confirmed we have loyal and trusting customers."

Nash says the company's relationship with its customers, in fact, would be the envy of any business.

"It was abundantly clear from the focus groups," says Nash. "People really trust Locals Seafood Company. Customers see the staff as knowledgeable and reliable when helping them make their selections."

That trust goes a long way, especially given Locals' dedication to freshness and quality, which means

bringing any available and appetizing species — even if lesser known — to market when timeliness dictates. This approach, however, can require some adventurousness on the part of the consumer.

Most focus group participants were equal to the challenge, collectively reporting they were familiar with a wide array of species: amberjack, black drum, bluefish, cape shark, croaker, king mackerel, mullet, pink snapper, sheepshead, white grunt, and white perch.

But, far more importantly, they said they were willing to try anything *if Locals Seafood was offering it*.

The online survey revealed other key information, too, including consumers' top three seafood favorites: oysters, clams and pink snapper. Participants also mentioned many other species they enjoyed from



Locals Seafood supplies four dozen restaurants in the Triangle area.

the North Carolina coast, including bass, crab, cobia, flounder, grouper, hogfish, mahi mahi, monk fish, octopus, pompano, scallops, shrimp, squid, Spanish mackerel, spots, swordfish, tilefish, triggerfish and tuna.

Lovers of North Carolina seafood, then, present a diverse and educated palate, for which Locals certainly deserves its share of the credit. Of course, credit also goes to the state's long heritage of seafood cooking and consumption.

But where is the North Carolina seafood market headed?

Here, the answer becomes complicated, because it relies on consumers' attitudes about the process of cooking seafood, how and why they cook, and when they prefer to take shortcuts from traditional cooking.

First, focus group discussions quickly confirmed that seafood certainly isn't only for people who enjoy dining out. The home kitchen, in fact, is alive and well. These consumers unequivocally indicated that they enjoy cooking seafood, although some noted they have less time than they want for it.

The online survey also revealed seafood's regular presence in kitchens across the Triangle. Forty-five percent of respondents said they cook seafood at home during a typical week, and nearly 36% indicated they do so twice weekly. Almost 1 in 10 reported they cook seafood at home three times a week.

Because they value cooking with fresh ingredients, seafood lovers in the focus groups seemed more reluctant than online respondents to use any kind of prepared product in their kitchens, except for pre-made crab cakes or fish cakes — and only then if they could cook them at home.

Many people, however, were open to additional ideas that could enrich the cooking experience.

"We did learn a lot about what would make people's lives easier," Speckman says. "To start with, everybody wants recipes."

The staff at Locals also knew about this need first-hand from their fish market patrons. "A lot of people come to the market asking for recipes," says Sarah Grace Smith, who oversees marketing for the company. "Because of that, we have a lot of recipes available on our website."

In addition, both the online survey and the focus groups found that consumers want to use soup stocks and seasoning blends, with the focus groups additionally indicating a desire for marinades and vinaigrettes.

"The goal of the focus group consumers clearly is to enhance the seafood cooking experience, without watering it down," Nash says. "The online survey showed us that people would purchase enhancements to use any day of the week, with some exceptions for preparing meals for the holidays or special occasions."

Consumers also expressed interest in meal kits that contain prepared ingredients, primarily to use during weekdays. In fact, 62% of the people who took the online survey indicated they would buy meal kits, although the product had much more appeal for consumers under age 65.

The value of cooking fresh seafood varies according to who is responding and how. In contrast to focus group consumers, a majority of the online participants — across all age groups — said they would purchase heat-and-serve seafood products and that they would use them during the workweek, when time was at a premium.

And what about the absolutely easiest products to put on the table at home — those foods you don't even have to heat up?

"Many people do want an option for scoop-and-serve seafood," says Speckman.

Although it might seem like blasphemy in a state with a heritage of pan-seared sheephead and shad roe with bacon, this finding from the online survey obviously reflects the realities of contemporary life. A majority of consumers, especially within the 24-to-44 age range, will buy pre-cooked, ready-to-serve products. About half said they would eat them during the week and half on the weekend — meaning, of course, that on any day of the week a sizable portion of the seafood consumer base in the study will eat scoop-and-serve meals.

The research revealed other important tidbits, too. Focus group responses implied a potential market segment for smoked North Carolina seafood, for instance. Consumers also noted it was critical for prepared seafood products to include detailed instructions that would deliver a consistent outcome. Focus groups additionally emphasized that prepared portion sizes should accommodate the appetites of one to four people.

But the inescapable, overarching conclusion of the survey and focus

Continued

groups, which has implications for what to sell and how to sell it, is that consumers of local seafood do not all place the same value on cooking. These consumers include traditional cooking purists, as well as people who want enriched or augmented cooking experiences and other consumers willing to trade cooking for convenience.

Generally speaking, the online survey suggests that consumers do trend younger as convenience increases from meal kits to heat-and-serve to scoop-and-serve meals. But local seafood lovers likely do not comprise completely separate groups. A single consumer might belong to each of the groups at different times, depending on the day of the week, type of product and the occasion.

WHAT WORKS AND WHAT DOESN'T

Speckman has helped to build Locals Seafood in no small part because the risks associated with change scare him far less than with keeping the status quo.

"When we first started this business, I thought we were going to be selling all of our seafood online," he says. "But we evolved naturally into a predominately wholesale distributor. We allowed the demand to drive our growth and development."

With new insights about the market, Locals is reflecting that adaptability again.

"We want to have different seafood products for each category of consumer," Speckman says. While the company remains committed to bridging the sea-to-table gap with fresh North Carolina catches, Locals Oyster Bar and Seafood Market now offers fish stock and prepared foods that include shrimp salad, smoked fish dip and a ceviche. All still rely on quality North Carolina seafood, while also meeting consumer needs for enriching and pre-made products.

"I've also wanted to offer products that people could assemble at home with some easy instructions," Speckman



Jared Kay/VisitNC.com

Regardless of what local consumers can afford and where they can afford to eat it, North Carolinians likely will continue to covet quality seafood.

adds. Always the innovator, he says Locals is even developing a sushi-grade product that chefs and retail consumers will be able to use in raw dishes.

To Nash, the company's multi-pronged approach makes sense. While Locals continues to respond to North Carolina seafood consumers' wide-ranging tastes, the company also is positioning itself to deal with changes in the economy.

"We clearly found there are still consumers who enjoy preparing seafood at home, and that many other people also will use fresh products that facilitate home cooking without fully replacing the cooking process," Nash says. "If the economy goes bad, out of necessity many more seafood-loving restaurant-goers may retreat to their own kitchens to cook. Locals can address their tastes."

Regardless of what local consumers can afford and where they can afford to eat it, North Carolinians likely will continue to covet quality seafood, and Locals Seafood likely will

find an avenue to satisfy their desires.

"Over the years, we've never really pigeon-holed ourselves," Speckman says. "We just always knew we wanted to bring a North Carolina product as fresh as possible to consumers and let them dictate what works and what doesn't." 🍤

The Community Collaborative Research Grant program supported this project. North Carolina Sea Grant administers the program in partnership with NC State's William R. Kenan Jr. Institute for Engineering, Technology and Science, and with the N.C. Water Resources Research Institute. go.ncsu.edu/CCRGprogram

- **More about North Carolina's Sea-to-Table movement**
go.ncsu.edu/Sea-to-Table
- **Information and resources for seafood lovers**
go.ncsu.edu/seafood-info
- **More about Locals Seafood**
LocalsSeafood.com



Rob Amberg ©2000

Raymond and Eunice English stand in the community of Northeast, North Carolina, with all of their earthly possessions.

The Great Deluge

A CHRONICLE OF THE AFTERMATH OF HURRICANE FLOYD

as told to Charles D. Thompson Jr. • with photographs by Rob Amberg

*This fall marks the 20th anniversary of Hurricane Floyd.
We look back at the infamous night the water rose and the days that followed —
as survivors originally told the story in 1999.*

In the last 20 years, flooding from hurricanes Floyd, Matthew and Florence — as well as other tropical systems — has devastated North Carolina. When the first of these storms, Floyd, made landfall on September 16, 1999, at that time it was North Carolina's worst natural disaster.

Floyd left 52 North Carolinians dead, a half-million without power, and 48,000 in shelters. Rising waters forced police and the military to perform 1,500 home evacuations. The storm flooded out 24 wastewater treatment plants and destroyed seven dams. Millions of livestock perished. Damage totaled several billion dollars statewide, including well over \$500 million in lost crops, and 66 counties were declared disaster areas.

The swelling of the Cape Fear, Neuse and surrounding river basins transformed the geography and terrain of much of North Carolina. It also changed forever the people who endured it and left behind innumerable stories.

Three months after Floyd, historian Charles D. Thompson Jr. and photographer Rob Amberg visited flood-damaged North Carolina communities to record eyewitness interviews about the hurricane and its aftermath. Survivors in communities like Tick Bite, Northeast, White Stocking and Grifton recounted Floyd and the long days that followed it. This is their chronicle of The Great Deluge.

Continued



Rob Amberg ©2000

The winds of Hurricane Floyd felled numerous ancient trees as the storm passed over terrain already drenched, but the real damage came from floodwaters that rose two to three days after the winds subsided.

“I walked out to the corner and walked over to where the bridge was at and just looked at the water to see how it was coming along. I’m saying to myself, ‘It’s not doing anything; we’re going to be alright.’ So I came back and went to bed.”

—WALTER DAVIS JR., ADMINISTRATOR AT THE CASWELL CENTER
GRIFTON, NORTH CAROLINA

“And the water was just trickling across the road. And I said, ‘Well, it’s about to peak out. This don’t come this high.’ And we came on home and went to bed.”

—AARON CAVENAUGH, TURKEY FARMER
NORTHEAST, NORTH CAROLINA

“We’re blessed because when that flood came through here, I tell you what, it was just as pretty as it could be that Thursday. Sun was shining and it was warm... That night we went to bed, the lights were off... About the time we got to bed good, there were lights flashing to the window and the water was up just that quick. We hurried up and got our clothes on and got out and stepped in the water, right there to the doorstep. Just that quick.”

—WALTER DAVIS SR., RETIRED DUPONT EMPLOYEE
GRIFTON, NORTH CAROLINA

“I didn’t know what was going on, so I got my flashlight. I walked out to see what was going on. I stepped out on the back porch, and water came up to... to my knees. And that woke me up. I got in high gear. And I already had an overnight bag packed... I just grabbed it, threw it in my truck and got out. Got out. It was something. It was unbelievable. I just did not realize how quick that water had rose like that.”

—WALTER DAVIS JR., ADMINISTRATOR AT THE CASWELL CENTER
GRIFTON, NORTH CAROLINA

“We were putting deeds and files in a trash bag and tying them up.”

—JENNY CAVENAUGH, TURKEY FARMER AND ANTIQUE DEALER
NORTHEAST, NORTH CAROLINA

“The water was coming. I don’t know what kind of force it was, but it was terrible. The water was just rolling like there was pressure behind it. I just haven’t ever seen water do like that before. I was thinking that after we had gotten out — I said to myself, ‘The force that was behind that water; it might just wash the house down.’”

—WALTER DAVIS SR., RETIRED DUPONT EMPLOYEE
GRIFTON, NORTH CAROLINA



LEFT: When Andy Cavanaugh's father left his home after midnight in chest-high waters, he felt something stinging his legs as he walked.

His flashlight illuminated masses of fire ants surviving the floodwaters by clinging together.

RIGHT: In the remains of their living room, Billy King remembers the night he and his wife left home — in a boat.

"I felt like that I was a refugee or something because we were all — I mean I went out with my gown, a shoe of one color on each foot, and my pocketbook. That's all... It came quick... You're talking about a foot of water that afternoon to chest deep on a 6-foot man by 8 o'clock."

—JENNY CAVENAUGH, TURKEY FARMER AND ANTIQUE DEALER
NORTHEAST, NORTH CAROLINA

"We were behind one another praying to get out of that water."

—WALTER DAVIS SR., RETIRED DUPONT EMPLOYEE
GRIFTON, NORTH CAROLINA

"It looked like an ocean. I never. It just got me. It looked just like an ocean."

—WALTER DAVIS JR., ADMINISTRATOR AT THE CASWELL CENTER
GRIFTON, NORTH CAROLINA

"Our fire department — I think they did an excellent job of getting people out. They worked around the clock, you know, until they got everybody out."

—JENNY CAVENAUGH, TURKEY FARMER AND ANTIQUE DEALER
NORTHEAST, NORTH CAROLINA

"The only way we got through it: They had a big fire truck. And what it does, it was in front of the cars; and it would sort of wave the water off with the cars coming behind. It was making a path for us."

—WALTER DAVIS JR., ADMINISTRATOR AT THE CASWELL CENTER
GRIFTON, NORTH CAROLINA

"When Aaron came out from the river house he was rescued. Some boys went down and got him with a boat."

—JENNY CAVENAUGH, TURKEY FARMER AND ANTIQUE DEALER
NORTHEAST, NORTH CAROLINA

"We heard that [our community] was quarantined, and then we heard it wasn't quarantined. And then we heard that they advised you not to go back. And then we heard, wait until the water goes down and you can go back."

—AVA CAVENAUGH, REGISTERED NURSE
NORTHEAST, NORTH CAROLINA

"The next morning I had to go check the farm, the turkeys, which they were all dead when I got there. And the water probably had come up at least 5 foot during the night, drowned all the turkeys, flooded the antiques. It was just more than we expected. We didn't just — disbelief. We didn't believe that, but it did happen."

—AARON CAVENAUGH, TURKEY FARMER
NORTHEAST, NORTH CAROLINA

"Right sickening to be out there and to float them animals out and shoot your goats to keep them from drowning. I mean, it was terrible. I'd shoot a goat and cry. Shoot a goat and cry."

—JIM CONNORS, HOG FARMER
NEAR HOLLY SHELTER CREEK, NORTH CAROLINA

"He was an Amish horse. He was a saddle-bred horse. A good buggy horse... And he was in water probably up to his knees, and we just hooked a lead line to him. And we were in the boat and we just led him all the way... for about probably five miles to a higher ground where he was safe."

—AARON CAVENAUGH, TURKEY FARMER
NORTHEAST, NORTH CAROLINA

Continued



LEFT: Renee Lee, her children, and others from her community of White Stocking survey her grandmother's home.

Renee's own mobile home was a total loss, and her grandmother moved into a FEMA trailer.

RIGHT: As this family rebuilds from the brick shell that was once their home, water supplies from outside their community help meet basic needs.



"It was like everywhere that I went there was devastation. The house was devastated... And we didn't see anybody. We'd see our friends and our neighbors all along the road. But nobody had time to stop and say, 'How are you? Do you need anything?'"

—JENNY CAVENAUGH, TURKEY FARMER AND ANTIQUE DEALER
NORTHEAST, NORTH CAROLINA

"I was wrestling two-hundred-pound feed bags and chest waders going from building to building. Then I had my johnboat with a generator in it and a submersible pump, and I was dropping it over the side filling feeders up to the water."

—JIM CONNORS, HOG FARMER
NEAR HOLLY SHELTER CREEK, NORTH CAROLINA

"When I first got in the air to [fly over] what happened, my first feelings were of disbelief... Hog waste is this particular color of pink, it looks like Pepto Bismol — I hate to use that name because I don't want the company to get a bad rap — but it looks that color, and you could see it running off into the river. You could follow it down from where the floodwaters were right on down to the river. We flew over the junkyards and we could see these huge plumes of oil and gas and antifreeze and different chemicals washing out of the junkyards, and there's lots of junkyards in the flood plain. We could see these fuel storage areas for farms and industry had gotten hit and you could see these oil drums leaking, just tremendous amounts of fuel down the river. And then even from farm houses and things you could see the chemicals coming out of the barns, you know, where the waters had gotten inside. You could see dogs on top of the roof of a car. All you could see was the top of the roof of the car and you could see a dog there. You'd see people standing on the porches of their houses, the house completely surrounded by water, no way to get in and out, and sitting on a rocking chair on the porch, rocking back and forth. But that's the kind of thing we saw: pollution, people's pain, the loss of property. I mean it was a terrible sight."

—RICK DOVE, RETIRED NEUSE RIVER KEEPER FOR THE
NEUSE RIVER FOUNDATION, NEW BERN, NORTH CAROLINA

"I hadn't had any taste for fish... because a friend of mine, he lived over in Pitt County, and he said when he went on his porch with his boots on, he could see fish going across his porch."

—WALTER DAVIS SR., RETIRED DUPONT EMPLOYEE
GRIFTON, NORTH CAROLINA

"In the beginning there was nothing... We had 60,000 dead turkeys... Every bit of income we had, every business, everything we owned was under water... There was no time to go stand in line to see if Salvation Army would help you or the Red Cross could help you. It was needless to go for food stamps."

—JENNY CAVENAUGH, TURKEY FARMER AND ANTIQUE DEALER
NORTHEAST, NORTH CAROLINA

"When you came back, it wasn't like people could just come and stay. You had a two-hour time limit. They had the National Guard patrolling and you got your little ticket and everything. And if your time limit was up, they came looking for you."

—WALTER DAVIS JR., ADMINISTRATOR AT THE CASWELL CENTER
GRIFTON, NORTH CAROLINA

"I was here thinking that I could save our floors and walls. So I was trying to dry them out with the dehumidifiers. And I was trying to spray Clorox on everything."

—JENNY CAVENAUGH, TURKEY FARMER AND ANTIQUE DEALER
NORTHEAST, NORTH CAROLINA

"They said throw away all your plastic stuff, your paper stuff, your wooden things that got contaminated. Throw away everything except maybe something like stainless steel that you could bleach."

—AVA CAVENAUGH, REGISTERED NURSE
NORTHEAST, NORTH CAROLINA



Floodwaters covered homes, farms and businesses for more than a week, transforming thousands of lives.

The electrical pole on the right preserves the high-water marks of two infamous hurricanes, recording Floyd's flooding at over twice the height of Fran's.

"In the beginning there were times when churches would come by. I know Pinhook Church or Oakdale Church — I think it was Oakdale Church came by one day and it was around lunchtime. They stopped in our driveway. It was two ladies. And they had brought us some paper towels and things from their church. And I was so glad because I hadn't had time to go get any. And out she brought some potted meat. And Aaron said, 'Well I just want some potted meat.' I mean anything that you could just pop the top on a can. That's what we ate... Even church groups from out in Wallace came. Ladies would come in the afternoon after their prayer service. They would come and wash dishes with me for an hour or two hours, three hours. And when they'd come in, I'd just say, 'Go pick a section. Here's some gloves. Here's a tub. Pick a section and just wash what you want to wash.' And they acted like they had fun doing it."

—JENNY CAVENAUGH, TURKEY FARMER AND ANTIQUE DEALER
NORTHEAST, NORTH CAROLINA

"I thought that FEMA was going to help us, and I signed up with FEMA to start with, but I didn't ever hear anything."

—WALTER DAVIS SR., RETIRED DUPONT EMPLOYEE
GRIFTON, NORTH CAROLINA

"When I got to my father's, 40 head were there [to help clean out the house]. And there were all my pictures and slides and stuff. And they were just chucking them. There wasn't much I could do... strangers taking that stuff out. Then they tell you that they're going to go to your house to do the same thing. And by the way, the wrecker man is here to haul your cars off... There was busloads of people helping everywhere. I mean, it was like a war zone."

—ANDY CAVENAUGH, FLOWER FARMER
NORTHEAST, NORTH CAROLINA

"The FEMA inspector that came here — very arrogant, rude. He was not interested. And I think our \$2,855.10 showed that. He was not interested in us at all. He came from California, a very rude man... And he punched some numbers on a little handheld computer... I had the same amount of water that I know another lady had. She got \$9,000 and I got \$2,855. I'm glad the lady got the money. There's not a problem with that at all. But I know we weren't paid enough even to make it safe and livable... FEMA and they said we could save everything. Well we couldn't... The walls were spongy."

—JENNY CAVENAUGH, TURKEY FARMER AND ANTIQUE DEALER
NORTHEAST, NORTH CAROLINA

Continued



LEFT: Elder Bert Picket says he hasn't seen trauma like this since Vietnam. Floodwaters swept away cherished pictures of buddies who died in the war.
RIGHT: A family in the White Stocking area finds a way to wash clothes, despite having no home.



"I'll tell you the truth: the flood is no worse than this rigmarole, red tape what you go through afterwards."

—FRANK CAVENAUGH, RETIRED FARMER
NORTHEAST, NORTH CAROLINA

"One Sunday we come riding by here and we seen a brand new Jeep parked up in our yard. We thought it was somebody else come to help... We was coming back from the Red Cross and pulled in here. And [the people with the Jeep] were loading up our stainless steel. They were stealing. Had all my stainless steel cookware loaded up and all my children's toys loaded up."

—AVA CAVENAUGH, REGISTERED NURSE
NORTHEAST, NORTH CAROLINA

"The whole thing brings out the good and the bad in people. This gentleman gave me \$50 right out of his pocket. Told me I needed it. And I don't even know who he was."

—ANDY CAVENAUGH, FLOWER FARMER
NORTHEAST, NORTH CAROLINA

"He came to the door and he said, 'I'm with the North Carolina Department of Revenue.' And I said, 'Well, son, I think I mailed my sales tax and paid all my taxes.' And he said, 'Well I didn't come to collect.' And I said, 'Well, what can I help you with?' And he said — and by then I had invited him in — and he said, 'I've come to help you.' And I said, 'You've come to help me?' And he said, 'Yes, ma'am... Anything that you want cleaned up pertaining to this flood.' They were good help, too."

—JENNY CAVENAUGH, TURKEY FARMER AND ANTIQUE DEALER
NORTHEAST, NORTH CAROLINA

"Never thought I would meet anyone from Pennsylvania. This group came down here and worked like Turks to serve me — who has nothing."

—KATHLEEN BRATTEN, FAMILY CARETAKER
TICK BITE, NORTH CAROLINA

"The governor, on ABC News — I'll never forget it as I sat there, and I just sat there in disbelief for about 10 minutes after I heard him make this statement — but he had the president by his side... He threw his arms open and he looked around to all these people, including this one little kid who the camera focused on afterwards, and he said, 'There wasn't anything that we could do to prepare for this.' And I think Governor Hunt's a pretty good fella, and I'm not mad with him or anything, but that was a dumb statement. Because there is a lot we could have done to prepare for this."

—RICK DOVE, RETIRED NEUSE RIVER KEEPER
FOR THE NEUSE RIVER FOUNDATION,
NEW BERN, NORTH CAROLINA

"The Salvation Army truck would come through our community. And they would stop and they would have like a box lunch with a drink... But that hot meal when they would pass it out that window, I never ate anything that was bad that came off that truck. Everything that we ate was delicious."

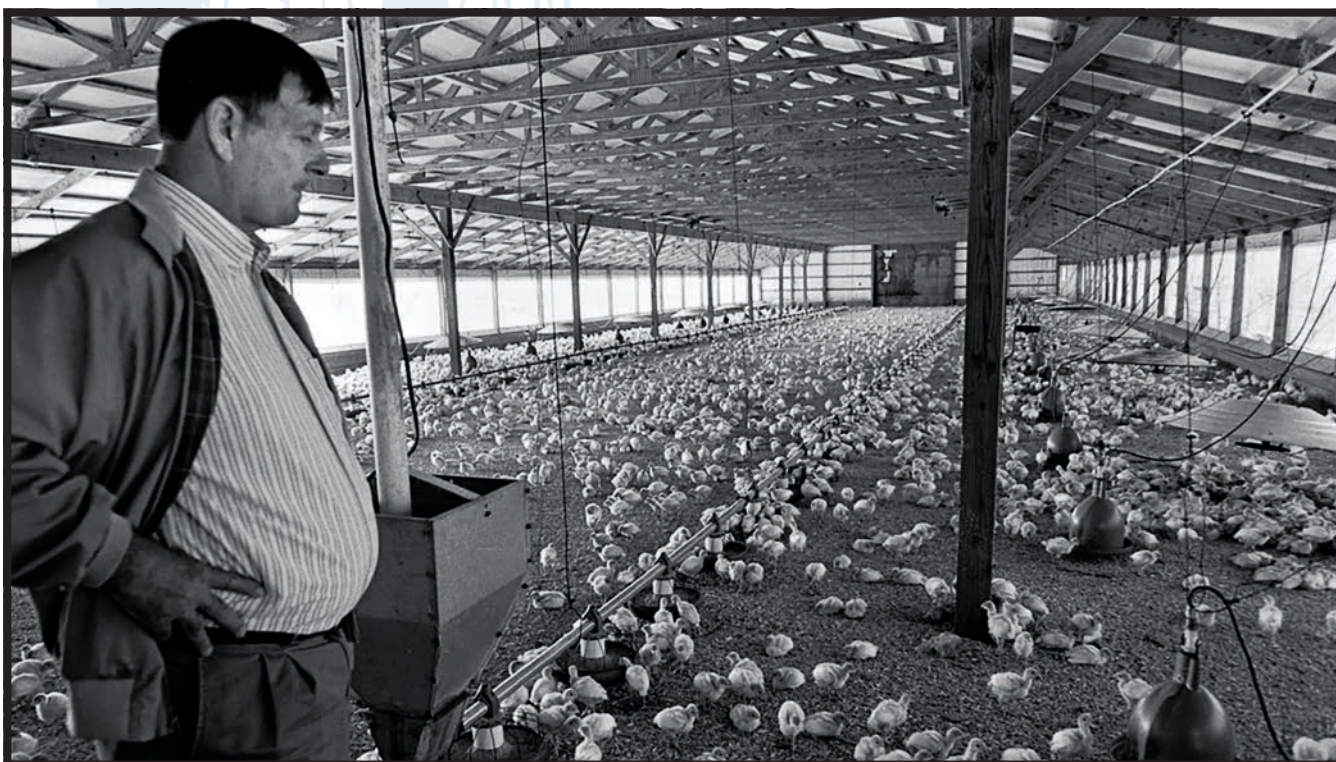
—JENNY CAVENAUGH, TURKEY FARMER AND ANTIQUE DEALER
NORTHEAST, NORTH CAROLINA

"It's hard to stand in line and wait for somebody to tell you, 'You can have this, and you can't have this.' And you've worked all your life, and you've always been the one to give."

—ELDER BERT PICKET, PASTOR OF MOUNT PLEASANT
ALL SAINTS PENTECOSTAL HOLINESS CHURCH
WALLACE, NORTH CAROLINA

"Hands have been the biggest asset that anybody — if you've ever been flooded, hands are what a person needs. They need financial stuff, too. But in the very beginning — those hands. You don't even know what you need financially but you know you need hands, because your mind is working so much faster than your hands can keep up."

—JENNY CAVENAUGH, TURKEY FARMER AND ANTIQUE DEALER
NORTHEAST, NORTH CAROLINA



Rob Amberg ©2000

Aaron Cavanaugh describes an eerie silence as the floodwaters covered his barns and drowned tens of thousands of turkeys just weeks before Thanksgiving. For him and his wife Jenny, this was their first batch of new turkeys since Floyd.

“We have joined an organization here in the county called SOC. And that stands for ‘Strengthening Our Communities.’ And we want to know the situation... When money comes to the county we will be able to... distribute it to the people that really has a need.”

—ELBERTA HUDSON, ASSISTANT PASTOR OF WHITE STOCKING A.M.E. ZION CHURCH, WHITE STOCKING, NORTH CAROLINA

“Governor Hunt, when he got his money, the governor’s relief fund, he sent out checks. And you went down and you signed your name up and he gave everybody the same amount... I got 300-and-some dollars the first time, a hundred-and-some dollars the second time and \$308 the last time... Jim Graham, our commissioner of agriculture, took up a farmers’ disaster relief fund. And he said that every dollar would be given to the farmers. And I know that we did receive money from Mr. Graham, and we greatly appreciate it. I wrote him a thank-you note.”

—JENNY CAVENAUGH, TURKEY FARMER AND ANTIQUE DEALER NORTHEAST, NORTH CAROLINA

“The flood has brought some good changes because I think once — well now when you meet people that you know now, a lot of times people would see you and wouldn’t say anything, just — they know you but they wouldn’t go out of their way to say something to you. But now I think it’s more united again. Everybody... we’re glad to see each other... Everybody’s on the same playing field... Brought us all down to the same level.”

—WALTER DAVIS SR., RETIRED DUPONT EMPLOYEE GRIFTON, NORTH CAROLINA

“This was in fact a 50-year rain event that caused a 500-year flood event. And to understand what’s happened here, is in the last 50 years in order to develop all over this state, eastern North Carolina in particular, we have changed the landscape. We’ve put Mother Nature out of balance. I guarantee you when this storm rolled in here this time with this rain, Mother Nature didn’t recognize this place... We have filled the wetlands as if they were trash... We filled them to build shopping centers. We cut down the forests to build shopping centers and schools. In doing that we’ve let the sediments go down to the river to shallow the river... So when Mother Nature rolled in here this time with this rain, there was no holding capacity. It all ran right to the river... Mother Nature couldn’t deal with it except by pushing it over her banks as she did. And I don’t think we should be surprised about that.”

—RICK DOVE, RETIRED NEUSE RIVER KEEPER FOR THE NEUSE RIVER FOUNDATION NEW BERN, NORTH CAROLINA

These interviews and some of the photographs appeared in different form in Southern Cultures, volume 7, number 3. © Center for the Study of the American South. Used by permission of the publisher: uncpres.org. A portion of the content also previously appeared in the January/February 2001 NC Crossroads, a publication of the North Carolina Humanities Council.

“The Great Deluge” draws from interviews from the Southern Oral History Program. Founded in 1973 by historian Jacquelyn Hall, the SOHP is part of the UNC Center for the Study of the American South. The SOHP Collection in UNC’s Wilson Library, more than 6,000 interviews strong, is one of the nation’s most valuable oral history archives. 📖



RIVER OF TIME

THE STUNNING OLD-GROWTH FOREST IN THE THREE SISTERS SWAMP

JACK H O R A N

North Carolina's famous Black River holds living bald cypresses that were saplings before Rome was an empire. After finding trees over 2,000 years old, researchers say the river might even nourish bald cypresses that sprouted three millennia ago.

C o n t i n u e d



Charlie Peek/The Nature Conservancy



Jack Horan

Julie Moore, formerly of the N.C. Natural Heritage Program, and David Stahle, University of Arkansas, rest their canoe next to the 2,624-year-old tree. Stahle believes there are multiple 2,000-plus-year-old trees in the swamp.

THE RHYTHM OF TIME

stretches back 2,000 years through the ancient bald cypress trees in Three Sisters Swamp along the Black River in southeastern North Carolina.

New research shows the swamp holds some of the oldest trees in the world. Two bald cypress have been documented to be at least 2,624 years old and 2,088 years old, ascertained by counting their annual growth rings and through radiocarbon analysis.

The venerable trees were alive centuries before the advent of Christianity and the English language. David Stahle, a researcher in the department of geosciences at the University of Arkansas, cored the trunks and established

the ages of the two trees. He believes even older trees may grow in the swamp and along the river.

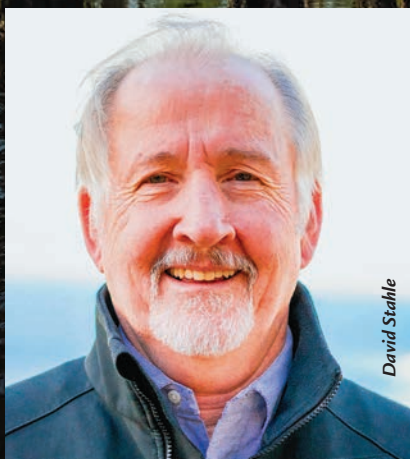
“There are surely multiple trees over 2,000 years old at Black River,” Stahle says. “It’s my belief there are some approaching, if not exceeding, 3,000 years old.”

The Black River has been known, for three decades, for the oldest trees on the East Coast. The previous oldest documented tree in the swamp is a bald cypress sampled in 1988 by Stahle and his colleagues. Called “Methuselah,” after the Biblical character who lived for 969 years, the tree was determined to have been growing in 364 A.D., making it about 1,700 years old. But the two 2,000-plus-year-old trees

exceed the Methuselah tree in age by nearly 1,000 years.

Stahle’s new findings were published in May in the peer-reviewed journal *Environmental Research Communications*. On the day of publication, he joined staffers from The Nature Conservancy of North Carolina and members of the media in Three Sisters Swamp to view the 2,624-year-old tree by canoe and kayak. In December, The Nature Conservancy bought 319 acres encompassing Three Sisters Swamp and adjoining uplands in Bladen County.

About 25 people paddled a half mile, zig-zagging through the sloughs and channels. At a designated area, Stahle stopped paddling, faced



David Stahle



Researcher David Stahle (inset) says the Three Sisters Swamp is home to “one of the greatest old-growth forests left in the world.”

the group and pointed to the surrounding trees with huge buttresses, often gnarled trunks and missing upper limbs shorn off from centuries of storms. The tallest stood 90 feet high.

“YOU’RE IN MILLENNIUM-AGE TREES. THE ENTIRE STREAM, PRETTY MUCH, IS LINED WITH AN ANCIENT FOREST. THIS IS ONE OF THE GREATEST OLD-GROWTH FORESTS LEFT IN THE WORLD.”

— David Stahle

“You’re in millennium-age trees,” he said. “The entire stream, pretty much, is lined with an ancient forest. This is one of the greatest old-growth forests left in the world.”

Stahle and his canoe companion, Julie Moore, former N.C. Natural Heritage Program botanist and an advocate for protecting the

Continued

OLDEST-KNOWN INDIVIDUAL TREE FOR EACH SPECIES

TREE	AGE IN YEARS	LOCATION
1. Great Basin bristlecone pine	4,900	Nevada
2. Alerce	3,622	Chile
3. Giant sequoia *	3,266	California
4. Sierra juniper **	2,675	California
5. Bald cypress	2,624	North Carolina

This list shows the five oldest tree-ring dated, sexually reproducing trees reported for each species worldwide.

* Died 1915-18 when it was cut.

** Died about 1165 AD and found in 1994, according to the Oxford Tree-Ring Laboratory web site.

Sources: Rocky Mountain Tree-Ring Research in Fort Collins and David Stahle, University of Arkansas.



Charlie Peek/The Nature Conservancy

According to David Stahle, the Black River's ancient bald cypresses could include "some approaching, if not exceeding, 3,000 years old."

trees, then paddled a few more yards. They parked beside the tree that everyone wanted to photograph: the 2,624-year-old bald cypress. Dark green moss covered its lower trunk; alligator weed sprouted in the onyx-colored water around it. Ironically, the tree, with a weathered but straight bole, didn't look as elderly as some of its knobbly neighbors.

Stahle and a team from Arkansas accidentally discovered the extreme longevity of the Black River trees in the 1980s as part of a study to reconstruct the historical climate of the

Southeast. They took corings from trunks and measured the width of individual tree rings. Tree rings are wide in wet years, signifying growth; rings are narrow in dry years with less growth.

The annual ring-growth history taken from the Black River trees and others in Virginia have recorded extended wet and dry years over the centuries. The history includes long-term droughts that likely impacted English settlements on Roanoke Island in 1587 and Jamestown in 1607, according to the study.

"IF WE COULD REALLY PROVE THERE ARE INDIVIDUAL LIVING TREES THAT ARE 2,000 YEARS OLD. . . THAT INFORMATION COULD HELP ADVANCE CONSERVATION OF THE TREES ALONG THE BLACK RIVER." — David Stahle

In 2018, Stahle said he agreed to core the two 2,000-year-old trees and count their growth rings to raise awareness of the unique

stand of ancient trees 45 miles northwest of Wilmington. “If we could really prove there are individual living trees that are 2,000 years old. . . that information could help advance conservation of the trees along the Black River.”

Angie Carl, a Nature Conservancy staffer who oversees Three Sisters Swamp, guided Stahle to the two aged cypresses, which were well into their prime before the Roman Empire was established.

Three Sisters Swamp, about a mile long and a half-mile wide, holds the greatest concentration of ancient trees on the Black River. The Methuselah tree lives here as well. Stahle said bald cypress grow very slowly in the acidic, low-nutrient waters of the Black.

The finding of the 2,624-year-old tree elevated bald cypress into fifth place for longevity among all sexually reproducing tree species on Earth. The oldest species on record is a Great Basin bristlecone pine; one in Nevada has been dated at 4,900 years, according to a list compiled by Rocky Mountain Tree-Ring Research in Fort Collins, Colorado.

The Black River trees have survived deluges and droughts, hail and hurricanes. They also have escaped logging over the years, likely because many are partly hollow and wouldn’t have made good lumber, Stahle said.

The Three Sisters Swamp trees, owned by The Nature Conservancy, aren’t in danger of being logged. The conservation group has protected more than 16,000 acres through ownership and easements along the Black, a tributary of the Cape Fear River, safeguarding other cypress as well.

To preserve and showcase the trees, the N.C. Parks and Recreation Division in 2017 proposed a state park along the Black. Opposition arose from some residents. The proposal was “dropped by the legislature due to lack of community support,” parks spokeswoman Katie Hall said by e-mail. “If the community changes their opinions and comes to be supportive about it, we could revisit the possibility.”

Stahle’s study concluded the Black River potentially holds more 2,000-plus-year-old trees: “Because we have cored and dated only 110 bald cypresses at this site, a small fraction of the tens of thousands of trees still present in

these wetlands, there could be several additional individual bald cypress over 2,000 years old along the approximately 66-mile reach of the Black River.”

The future of the ancient trees — particularly those in private ownership — is uncertain. Altogether, the study says, the old-growth cypresses along the Black “remain threatened by logging, water pollution and sea-level rise” and that thousands of acres

“with high-quality ancient forests remain to be protected.”

Without permanent protection, Stahle says, the primeval but privately-owned trees “could become garden mulch.”

An earlier version of this story appeared in the Charlotte Observer and the Raleigh News and Observer. The National Science Foundation has supported the research of Stahle and his colleagues.



A no-fee Wildlife Resources Commission boat ramp is among several points of access to the Three Sisters Swamp on the Black River.

HOW TO SEE THE ANCIENT BALD CYPRESS

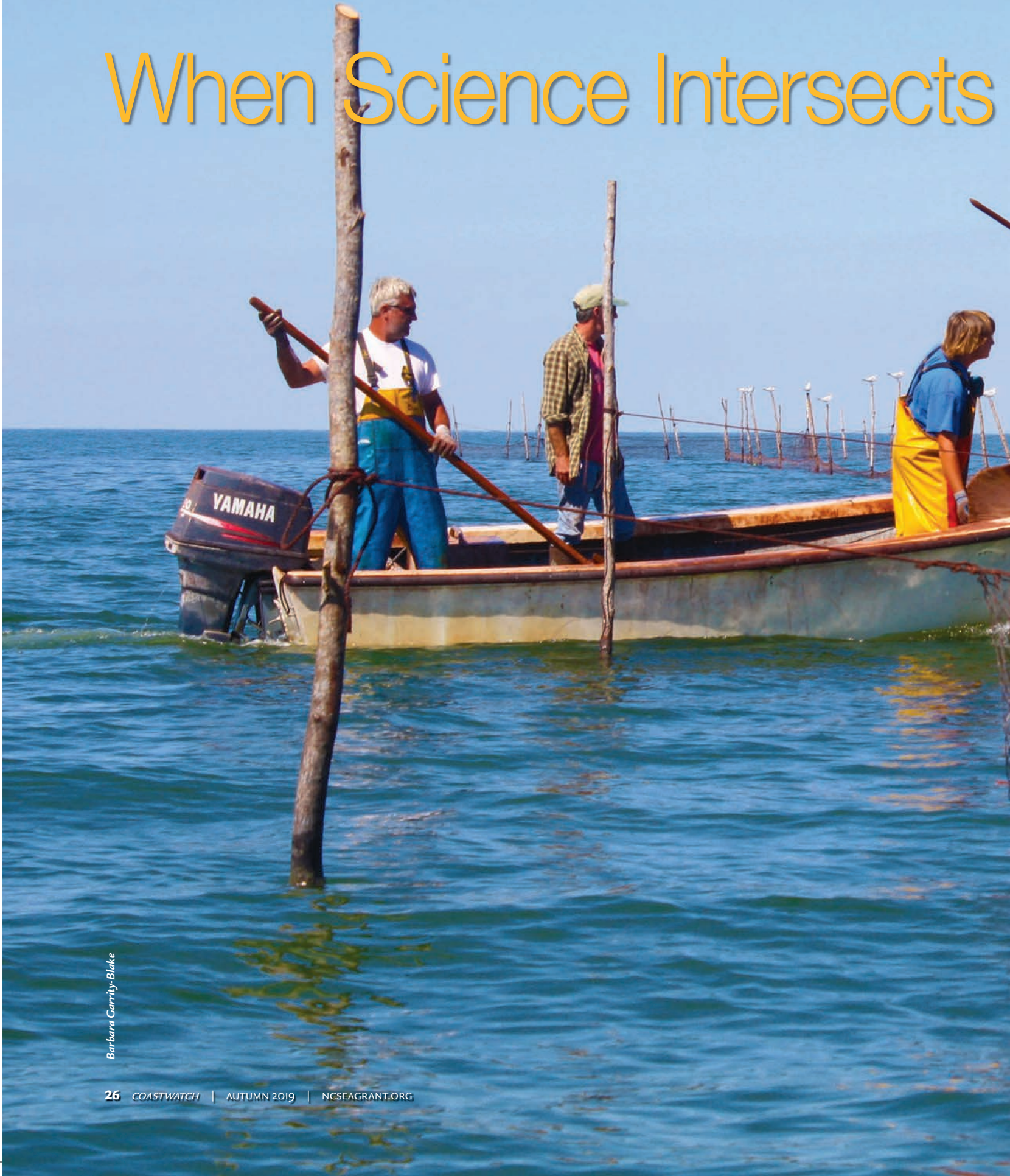
Want to see the ancient bald cypress? Three Sisters Swamp lies between the State Road 1550 bridge and the N.C. 53 bridge on the Black River in Bladen County. Only canoes and kayaks can maneuver through the swamp.

For a 9.5-mile float to Three Sisters Swamp, begin at Henry’s Landing, a private landing 1.5 miles downriver from the State Road 1550 bridge. Launch fee is \$5 per canoe or kayak.

It’s 5 miles to the upper end of the swamp, 0.5 miles through the swamp, and 4 miles to a private landing at the N.C. 53 bridge. The fee there is \$3 per boat. Another 1.7 miles downriver is a no-fee Wildlife Resources Commission boat ramp.

Paddlers unfamiliar with the swamp should go with an experienced group or an outfitter; there are no marked trails. Minimum river flow for paddling through the swamp without having to drag canoes or kayaks over sand bars is 500 cubic feet per second, measured at the upstream U.S. Geological Survey gauge at Tomahawk.

When Science Intersects



Barbara Garrity-Blake



DANIELLE COSTANTINI

with Local Expertise

New Collaborations on Healthy Ecosystems and Community Resilience

After last year's hurricane season, new Community Collaboration Research Grant projects include a study of how the seafood industry is facing both chronic pressure and acute events.

Five new partnerships are tackling pressing issues, with the help of funding from the North Carolina Community Collaborative Research Grant Program. Topics include water quality treatment in wetlands; algal blooms and cyanobacteria; and community resilience in the face of natural disasters.

Now in its fourth year, the program known as CCRG leverages support from the William R. Kenan Jr. Institute for Engineering, Technology and Science (KIETS) at North Carolina State University with funding from North Carolina Sea Grant and North Carolina's Water Resources Research Institute (WRRI).

Each project is required to take a collaborative research approach that couples local knowledge from the community with expertise of academic partners. This combination encourages creative problem-solving related to coastal

and water-related challenges that N.C. communities face.

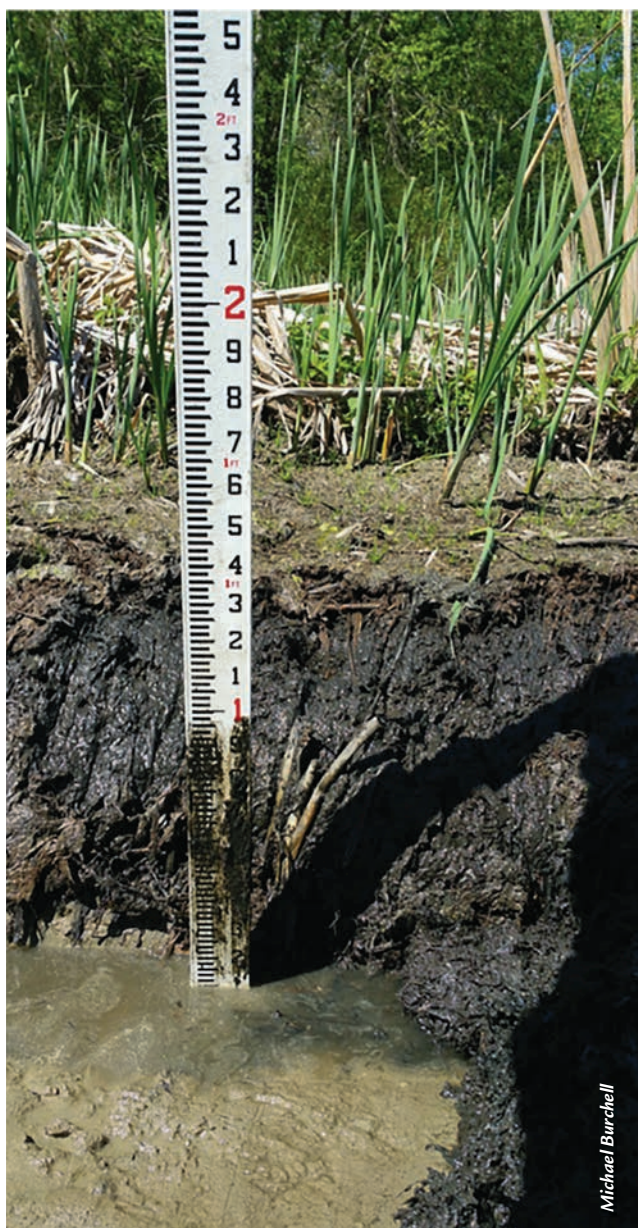
"We are excited to continue to bring together new sets of researchers and community partners," says Susan White, executive director for Sea Grant and WRRI.

Raj Narayan, KIETS' associate director, adds that the new projects reflect innovative and impactful partnerships, similar to successful leveraging through the CCRG program in recent years.

"The projects selected for CCRG support in 2019 continue to connect and bring together experts from higher education institutions, local community stakeholders, businesses, nonprofits and government organizations to work collaboratively for the benefit of North Carolina."

With the addition of WRRI, the CCRG program is now statewide. The new projects and their respective partners include:

Continued



Michael Burchell



Astrid Schmetzer

- **LEFT:** New research is testing two methods to improve constructed wetland efficiency.
- **RIGHT:** Scientists are exploring whether cyanotoxins accumulate within common fish and blue crab in the Chowan River — and if consumers face any risk of exposure.

Improving Wetland Treatment

Michael Burchell and Brock Kamrath of North Carolina State University; Fred Summers of North Carolina Rural Water Association; with Kim Greenwood and Bobby Sisk of the Town of Walnut Cove.

The research team working on “Detritus Removal and Enhanced Aeration to Improve Water Quality Treatment and Extend the Useful Life of Constructed Wetlands in North Carolina” seeks to improve constructed wetlands used for wastewater treatment.

“There is adequate guidance about how to build them, but almost none about how to restart wetlands after they get older so they can continue to provide efficient treatment of wastewater,” says Michael Burchell, an engineer at NC State.

Over time, levels of plant biomass increase in wetlands. As that biomass begins to break down, the total nitrogen in the water increases. Building off ongoing work from a WRRRI grant, and an

earlier Sea Grant project, the current study is testing two methods to improve constructed wetland efficiency and limit the causes and effects of increased nitrogen.

“If our techniques are successful, not only will the town benefit, but the work also has enormous implications for our ability to educate wastewater treatment operators in North Carolina and outside of our state about how to keep constructed wetlands performing efficiently.”

— MICHAEL BURCHELL

“If our techniques are successful, not only will the town benefit, but the work also has enormous implications for our ability to educate wastewater treatment operators in North Carolina and outside of our state about how to keep constructed wetlands performing efficiently,” Burchell says.



Courtesy of Colleen Karl

• **ABOVE:** Colleen Karl, of the Chowan Edenton Environmental Group, says her community has many questions about the resurgence of blue-green algal blooms.

“We have cleaned out an entire wetland cell — and our preliminary water quality measurements indicate that the water coming out of the rehabilitated wetland cell is much cleaner.”

Transferring of Toxins

Astrid Schnetzer of North Carolina State University; Charlton Godwin and Jill Paxson of the North Carolina Department of Environmental Quality; Gloria Putnam of North Carolina Sea Grant; with Colleen Karl of Chowan Edenton Environmental Group.

Harmful algal blooms, such as those caused by cyanobacteria and the toxins they produce, in water systems are a growing threat for local communities, government agencies and public utilities. This year, the N.C. Department of Environmental Quality has already issued multiple warnings for the public and pets to avoid blooms in northeast North Carolina, including in the

Albemarle Sound and Chowan River.

When present, algal blooms may affect drinking water, tourism and wildlife suitability. Of particular concern is their impact when ingested by humans through seafood.

“Cyanotoxins can be passed through the food web and affect humans who consume contaminated fish or crab.”

— ASTRID SCHNETZER

“Cyanotoxins can be passed through the food web and affect humans who consume contaminated fish or crab,” explains Astrid Schnetzer, marine ecologist at NC State University.

“This project will allow a thorough examination on whether cyanotoxins are accumulated within common fish and blue crab in the Chowan River and, by that, show if there is a risk of toxin exposure for consumers,” Schnetzer says.

The study, called “Food Web Transfer of Cyanobacterial Toxins in the Chowan River and Western Albemarle Sound,” will provide a baseline for potential food web impacts from cyanotoxins. “The aim is to provide information that can help establish if monitoring of certain animal species is needed, and if so, what type of toxins need to be considered,” Schnetzer adds.

The Chowan Edenton Environmental Group has been active in community science projects in the region, including regarding the blooms.

Understanding Algal Blooms

Nathan Hall of University of North Carolina at Chapel Hill; Colleen Karl of Chowan Edenton Environmental Group; the Albemarle-Pamlico National Estuary Program; with the Town of Edenton.

“Our community has many questions about the resurgence of blue-green algal blooms in the Chowan River,” says Colleen Karl, of the Chowan Edenton Environmental Group.

She is part of a team working on “Using Citizen Science to Understand Nutrient Limitation of Algal Blooms on the Chowan River: Filling Critical Data Gaps and Promoting Community Engagement” to respond to these concerns. Already this year, state officials have issued warnings to avoid contact with algal blooms in northeast North Carolina.

Continued

The new project aims to determine the nutrient status in Edenton Bay of cyanobacteria blooms, which can degrade waters for wildlife, recreation and tourism.

The collaborators also hope to engage and educate the local community about the effects of eutrophication in their own lives. “We are excited to share this work with our community to spark more enthusiasm for doing science in our backyard,” Karl adds.

The team plans to launch a website to coordinate a citizen-science effort. That effort will include examination of a series of microscopic images of cyanobacteria in order to understand the role of nitrogen fixation in promoting cyanobacteria blooms in ecosystems where nitrogen is limited.

The partners for this project and a second group of CCRG collaborators provided a combined outreach event in Edenton in August to share preliminary results with community members and local leaders.

Determining Community Networks

Lisa Campbell and Liz DeMattia of Duke University; Karen Willis Amspacher of Core Sound Waterfowl Museum and Heritage Center; with Rett Newton of the Town of Beaufort.

Hurricane Florence, which hit North Carolina in September 2018, illustrated the importance of community efforts before, during and after a storm. Preparedness in each of these three phases is critical to long-term community resilience, particularly in small, rural communities like those found in eastern Carteret County.

The “Connecting for Resilience: Understanding Community Networks and Their Role in Disaster Preparedness and Response” project aims to understand how communities mobilize in the face of disaster using social networks.

“With a better understanding of the social networks that were most important to various groups within the community — before, during and after Hurricane Florence — we can work with communities and elected officials to plan for future events.”

— LISA CAMPBELL



Barbara Garrity-Blake

Lance Cheung/USDA

• **ABOVE:** After Florence's impact, “Connecting for Resilience” aims to understand how communities mobilize by using social networks.

“With a better understanding of the social networks that were most important to various groups within the community — before, during and after Hurricane Florence — we can work with communities and elected officials to plan for future events,” says Duke University’s Lisa Campbell.

Researchers, including the community partners, are analyzing diverse organizations that serve varied needs. The goal is to see how they are connected to, and cooperate with, other organizations, individuals and groups.

“This collaborative project gives us a chance to mobilize academic research in direct service of the communities of eastern Carteret County,” Campbell says.



- **ABOVE:** After Florence and Michael, researchers are conducting a much needed inventory of fish houses to see if the level of domestic seafood-packing capacity in North Carolina has changed.

Assessing the Damage

Barbara Garrity-Blake of Duke University; Susan West of Hatteras Island; with Sara Mirabilio and Scott Baker of North Carolina Sea Grant.

An active 2018 hurricane season took its toll on coastal North Carolina, causing an estimated \$17 billion in damage to the seafood industry, with many of the impacts still unknown. The team collaborating on “In the Wake of the Storms: Working Waterfronts and Access in Coastal North Carolina” is working to determine the damage to North Carolina’s working waterfront and public access sites.

“Given the devastation wrought by Hurricanes Florence and Michael, we will consider how an industry already grappling with chronic pressures responds to acute events.”

— BARBARA GARRITY-BLAKE

“Given the devastation wrought by Hurricanes Florence and Michael, we will consider how an industry already grappling with chronic pressures responds to acute events,” says Barbara Garrity-

Blake, a cultural anthropologist at the Duke University Marine Lab.

Already facing long-term challenges — such as competition from imported seafood, changes in access to resources and a loss of working waterfronts — coastal communities have added rebuilding their way of life. As part of the damage assessment of these storms, “our team will build on previous inventories of water-dependent fish houses to see if the level of domestic seafood-packing capacity in the state has changed,” Garrity-Blake says.

Preliminary results show that fish house owners and fishermen closely monitor official storm forecasts and also rely on local knowledge and experience to anticipate impacts, explains Susan West of Hatteras Island, who is part of the survey team. “They also understand how a subtle shift in direction or speed can dramatically alter the impact. ‘Prepare for the worst, pray for the best’ was something we heard,” West notes, citing written storm preparations lists developed by some businesses.

Initial results — including impacts to the fishing fleets, ecosystem changes, and damage to docks and processing facilities — are on the agenda for Day at the Docks on Hatteras Island in September. 📍

Working with Nature

*A new guide offers plant suggestions for sustainable
— and beautiful — coastal landscaping.*

Design by John Ring; photo by Paul E. Hosier, Seacoast Plants of the Carolinas



IF YOU'VE EVER MOWED A LAWN, WEEDED A GARDEN OR STRUGGLED WITH SPRINKLERS, YOU KNOW HOW MUCH MAINTENANCE A YARD REQUIRES. But there are approaches that not only simplify yard upkeep — they offer environmental benefits and storm protection, too.

The Coastal Landscapes Initiative, or CLI, is a collaborative effort to address landscaping at every stage of the process, from planning and design to installation and management. Partners — including members of North Carolina Sea Grant — come from the public and private sectors and draw on a range of expertise. The ultimate goal is to foster coastal landscapes that are beautiful, functional, manageable and environmentally friendly.

North Carolina Sea Grant has published a new guide to help property owners interested in adopting nature-enhancing landscaping practices. The booklet features 34 species that stand out as all-stars — they're native to the region, visually attractive and versatile.

"We've had requests for the native plant guides from coastal nursery managers and master gardeners, as well as novice garden enthusiasts," says Sea Grant coastal economist Jane Harrison, who led the landscaping guide project. "A resident of Elizabeth City told me she simply likes red flowers. I suggested she plant coral honeysuckle to line her fence."

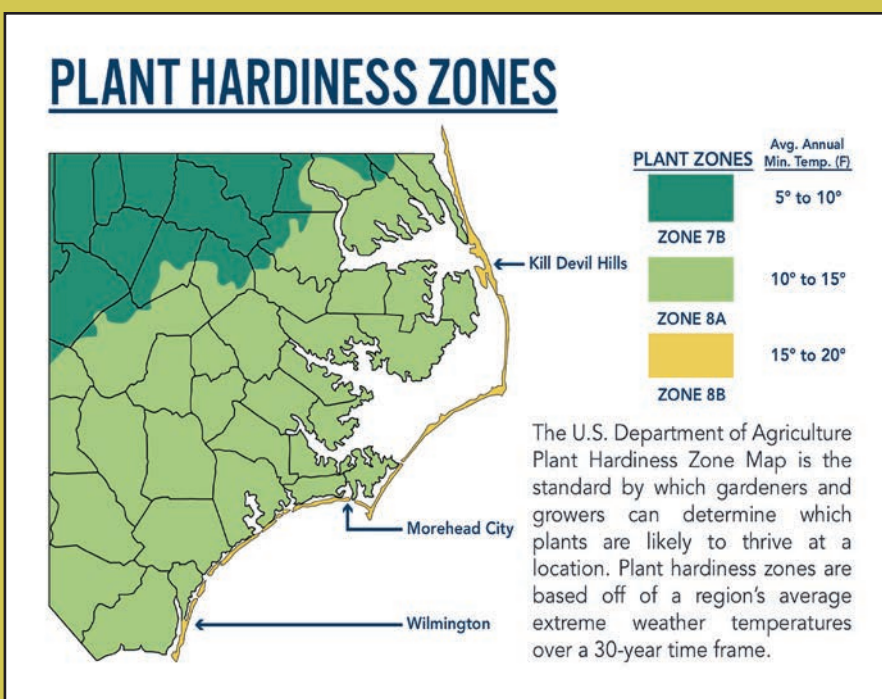
"The guides offer something for everyone," Harrison adds. "Whether you want to attract butterflies to your yard, plant storm-ready trees, or avoid excessive irrigation or fertilizer, these plant choices will help you get there."

Just this summer, the guide earned an award for publication excellence from the annual Apex Awards, a national competition that recognizes achievements in print and digital media.

The following pages offer examples of what you'll find in this resource. For more information, and to order copies of the guide or a companion brochure, go to go.ncsu.edu/CoastalLandscapes.

— Julie Leibach

Graphic by John Ring



EASTERN RED CEDAR

JUNIPERUS VIRGINIANA

- **Highlights:** Attracts birds & butterflies, pest-resistant, wildlife habitat
- **Light Exposure:** Full sun to part shade
- **Soil:** Dry to moist
- **Height & Width:** H: 30'-40' W: 10'-20'
- **Form:** Upright & densely pyramidal
- **Salt Tolerance:** Moderate
- **Zone:** 2-9

Katja Schulz/CC BY 2.0

A dense, fast-growing, evergreen conifer with scale-like foliage found in forests or disturbed areas in fields and pastures and along fence rows. Its bark peels off in thin, shreddy strips that are collected by birds as nesting material. Female trees produce bluish, berry-like cones that ripen in autumn and provide nourishment for songbirds and small mammals. Eastern red cedar also provides winter cover to wildlife and is the larval host of the juniper hairstreak butterfly. Its aromatic heartwood is commonly used for cedar chests. Suitable as a windscreen or buffer, this tough tree also boasts the best drought resistance of any conifer native to the eastern U.S. A smaller relative, the southern coastal red cedar (variety *silicicola*), found near ocean dunes, is significantly more tolerant of salt spray. *Silicicola* is harder to find in nurseries, however, apart from the "Brodie" cultivar.



plantsforpermaculture/CC BY 2.0



Nicholas A. Tonelli/CC BY 2.0

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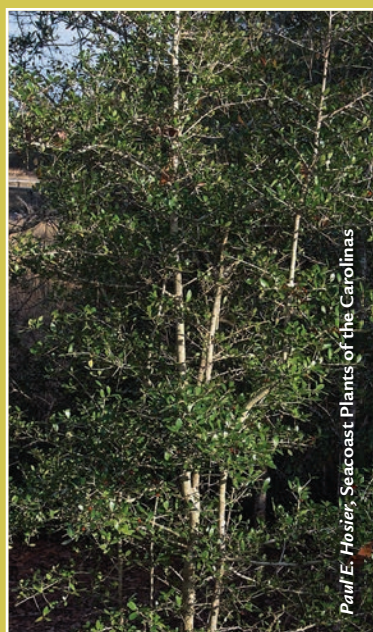
YAUAPON HOLLY

ILEX VOMITORIA

- **Highlights:** Attracts birds & butterflies, pest-resistant
- **Light Exposure:** Full sun to part shade
- **Soil:** Dry to wet
- **Height & Width:** H: 10'-20' W: 8'-12'
- **Form:** Upright & multi-stemmed
- **Salt Tolerance:** High
- **Zone:** 7-9

Paul E. Hosier, Seacoast Plants of the Carolinas

An evergreen shrub or small tree native to sandy woods, brackish and tidal marsh shorelines, dunes, maritime forests and shrub thickets. Plants are either male or female. On pollinated female plants, small, white, fragrant flowers give way to red berries that provide sustenance to songbirds and small mammals.



Paul E. Hosier, Seacoast Plants of the Carolinas



Paul E. Hosier, Seacoast Plants of the Carolinas

Though toxic to humans, the bright fruit adds pizzazz to holiday decor. Yaupon holly is the source of a concentrated drink that Native Americans made to reportedly cleanse the body, hence its scientific name. Browned and dried leaves can also be steeped in hot water to brew a caffeinated tea. This species has been known to tolerate flooded conditions for extended periods of time.

CORAL HONEYSUCKLE

LONICERA SEMPERVIRENS

- **Highlights:** Attracts birds & butterflies, drought-tolerant, pollinator-friendly
- **Light Exposure:** Full sun
- **Soil:** Moist
- **Height & Width:** H: 15'-20' W: 10'-12'
- **Bloom Time:** Spring to summer
- **Salt Tolerance:** Moderate
- **Zone:** 6-8

Dave Gavani/CC BY-NC-SA 2.0



Ronnie Pitman/CC BY-NC-SA 2.0



Bob Girtowski/CC BY-NC-SA 2.0

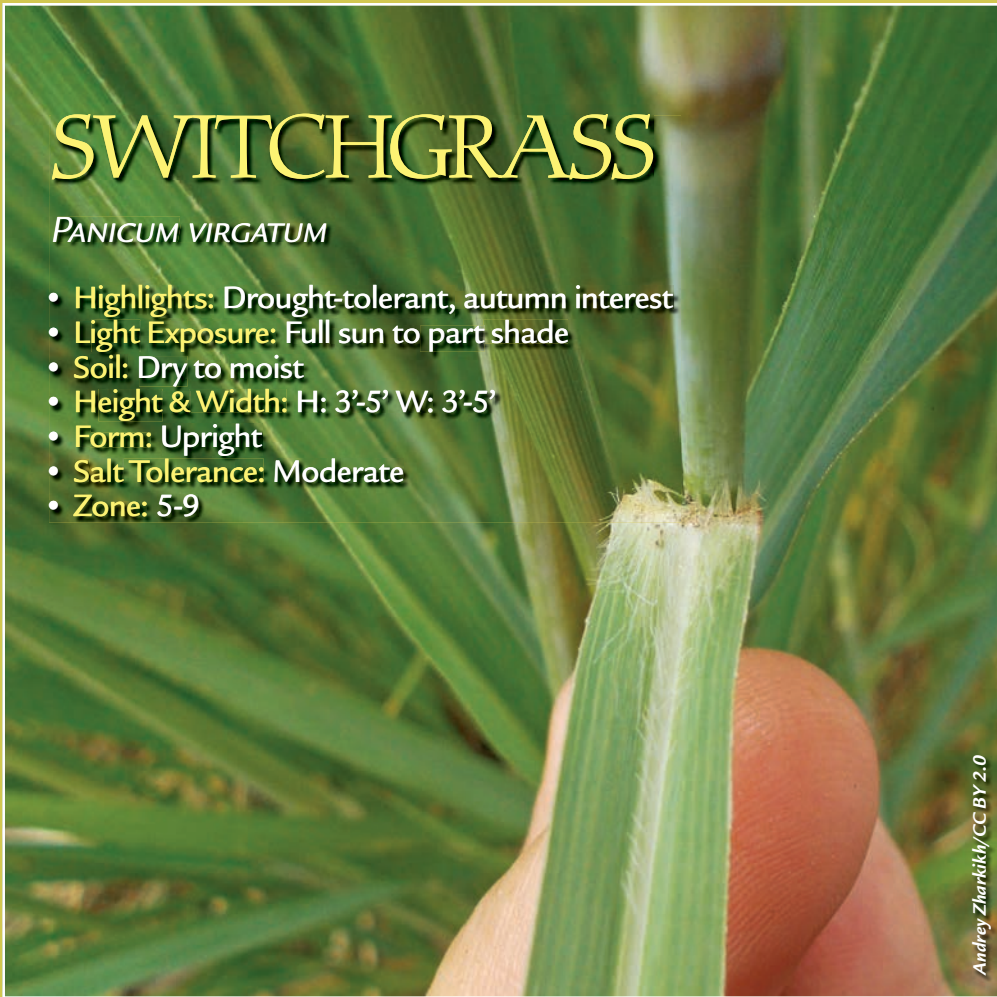
A fast-growing, woody, semi-evergreen vine that twines along the margins of maritime forests and maritime shrub thickets. One of the showiest of the vining honeysuckles, it dons long, tubular flowers that range from coral-red to orange-red and that may be lined with yellow. Coral honeysuckle is a larval host to the hummingbird clearwing moth. Various songbirds — including cedar waxwings, catbirds and cardinals — feed on its round, red berries, and hummingbirds seek its nectar. Unlike its invasive relative Japanese honeysuckle, coral honeysuckle is not aggressive. It blooms both in the spring and in autumn.

Continued

SWITCHGRASS

PANICUM VIRGATUM

- **Highlights:** Drought-tolerant, autumn interest
- **Light Exposure:** Full sun to part shade
- **Soil:** Dry to moist
- **Height & Width:** H: 3'-5' W: 3'-5'
- **Form:** Upright
- **Salt Tolerance:** Moderate
- **Zone:** 5-9



Andrey Zharkikh/CC BY 2.0



Paul E. Hosier, Seacoast Plants of the Carolinas



Fores and Kim Starr/CC BY 2.0



Andrey Zharkikh/CC BY 2.0

A fast-growing, perennial grass common in many coastal dune and marsh environments, as well as in tallgrass prairie. Its stems don pink-tinged flower clusters that are wind-pollinated. Autumn color often reveals reddish-purple streaks. Switchgrass is a boon to wildlife: A variety of wetland birds and songbirds eat its seeds; it offers nesting sites and cover for small mammals; and it is a larval host of various species of skipper butterfly. Switchgrass' ornamental appeal and ability to thrive in poor soils makes it suitable for any coastal landscape.

SPOTTED HORSEMINT

MONARDA PUNCTATA

- **Highlights:** Attracts birds & butterflies, drought-tolerant, pollinator-friendly
- **Light Exposure:** Full sun to part shade
- **Soil:** Dry to moist
- **Height & Width:** H: 2'-3' W: 2'-3'
- **Bloom Time:** Summer to autumn
- **Salt Tolerance:** Moderate
- **Zone:** 3-8

John Brandauer/CC BY-NC-ND 2.0

A short-lived perennial with aromatic leaves found in dunes and dry, sandy woods and fields. Purple dots speckle its pale yellow flowers, which emerge in mid-summer and grow in



Aaron Carlson/CC BY-SA 2.0

tight whorls at the top of the plant. Attractive lavender, pink or white leaf-like structures called bracts encircle the captivating blooms. The nectar and pollen attract hummingbirds, butterflies, honey bees, bumblebees, miner bees and plasterer bees. Spotted horsemint contains an essential oil called thymol, used as an antiseptic in some mouthwashes, and Native Americans drank tea made from its leaves to treat colds, fever and flu. Also known as bee balm, this plant is well-suited to various types of gardens, including cottage, container, herb and butterfly gardens. It is unpalatable to deer, rabbits and other herbivores. 🌱



Eleanor/CC BY-NC 2.0



Oceanana Fishing Pier, Atlantic Beach.

Life and Death for Dolphinfinh, Roaming Red Drum, Triggering Triggerfish, and Summer Vacation for Striped Bass

BY SCOTT BAKER AND SARA MIRABILIO

The latest science for anglers

DOES IT MAKE A DIFFERENCE WHERE THE HOOK LODGES?

For dolphinfinh, a hook embedded in the roof of the mouth or in the jaw could mean the difference between life and death.

- *Research Need*

Dolphinfinh (*Coryphaena hippurus*) continue to be one of the top-ranked recreational fisheries in numbers caught within the U.S. south Atlantic. For multiple reasons, including ethical angling, bag limits and size, fishermen in this region often release dolphinfinh after capture.

Does this fish survive hook trauma?

Post-release mortality for the species is unknown, which can lead to uncertainty in assessing the health of the fishery.

- *What did they study?*

Hooking location is the most important contributor to post-release mortality, according

to reviews of catch-and-release studies across species. A total of 42 dolphinfish carcasses were collected along the waterfront in Morehead City, North Carolina, from May to July of 2016 and 2017. Researchers determined hooking locations by observing wounds or hooks left in place. They used gross necropsy — a surgical examination of the dead body — as well as CT scans to assess the extent of injuries to soft tissues and bone.

- *What did they find?*

Dolphinfish likely experience higher mortality when hooked in the roof of the mouth than when hooked in the jaw. In 75% of roof-hooked fish, the injuries would have resulted in long-term visual impairment — and sight-feeding is critical to dolphinfish survival.

- *What else did they find?*

Some injuries that gross necropsy revealed, including optic nerve damage, were not detectable on CT scans. But, overall, CT and gross necropsy diagnoses agreed nearly 80% of the time. Given the agreement between approaches, researchers could use time-saving CT scanning as a first approach to identify severely injured fish.

- *Anything else?*

In light of these findings, dolphinfish hooked in the eye or roof of the mouth may

have a lower chance of survival if released, compared to fish hooked in the jaw.

Full study: go.ncsu.edu/hooking

— Summary by Sara Mirabilio

CAN NC'S OFFICIAL SALTWATER FISH SURVIVE IN THE MEDITERRANEAN?

A Facebook group identified a red drum caught off the coast of Italy.

- *Research Need*

North Carolina designated the red drum, *Sciaenops ocellatus*, as its state saltwater fish in 1971. (The state freshwater fish is the brook trout, *Salvelinus fontinalis*, designated in 2005). Common to the Atlantic coast from Maine to northern Mexico, red drum thrive in North Carolina waters, preying on crustaceans and finfish. Because these predators are large and mobile, red drum are an important component of coastal food webs — and a popular target for saltwater anglers.

But commercial aquaculture facilities, both in the United States and other countries, also have grown red drum for some time. Most cultivation of red drum outside of the United States is for human consumption.

What would happen if any of these red drum were to escape or were released into ecosystems outside of the species' native range?

Would they survive?

Non-native species have the potential to alter natural ecosystems. In the southeastern United States, we certainly know all too well about lionfish.

- *What did they study?*

On April 17, 2016, a local commercial fisherman landed an unusual fish in his trammel net in the estuarine waters of southern Sicily, Italy. A concerned person noticed the fish in the day's catch and then posted a picture of it to an Italian fisheries Facebook group to seek an identification.

- *What did they find?*

By referring to common features outlined in published North American fisheries field guides — such as body shape, color pattern and a distinctive dark circle with pale edges near the fish's tail — the group identified the specimen as a red drum. It was the first red drum reported in Italian waters and only the second documented in the Mediterranean Sea. The single fish was among typical estuarine species of the region in the same catch, but, unfortunately, no one preserved the red drum for further examination beyond the photo.

- *What else did they find?*

Based on the known size of the fish tote in the Facebook photo, the red drum was 25 to 27 inches long.

- *Anything else?*

The investigators can only speculate about how the non-native found its way into the wild off the Italian coast. However, the size of the fish coincides with those from an aquaculture facility in southern Italy that started culturing red drum in 2013. Likewise, red drum are regularly farmed in Israel, across the Mediterranean Sea.

Full study: go.ncsu.edu/red-drum

— Summary by Scott Baker



Steve Hillebrand/U.S. Fish and Wildlife Service

Red drum, North Carolina's officially designated state saltwater fish.

Continued

DO HURRICANES AFFECT FISH IN DEEP WATER?

Tropical systems cause gray triggerfish to evacuate.

• Research Need

Hurricanes wreak havoc on coastal marine ecosystems. They destroy coral reefs, mix up the water column, redistribute bottom sediments and increase pollution through stormwater runoff.

Hurricanes also can cause fish to evacuate nearshore estuaries and coastal ocean environments for deeper water. Nobody has previously studied whether storms influence fish in deeper water, but most people have assumed these fish remain generally unaffected.

• What did they study?

Researchers at the NOAA Beaufort Laboratory in North Carolina and a colleague at the Naval Postgraduate School affixed transmitters to 30 gray triggerfish, a commercially and recreationally important oceanic species that dwell in rocky reef habitats in the southeast United States. The team tracked these fish in an area off North Carolina during September 2017 as two hurricanes, José and Maria, moved along the coast.

• What did they find?

Surprisingly, as each storm approached, most of the gray triggerfish quickly evacuated the 120-foot-deep study area for even deeper water, and those few fish that remained in the study area swam much faster than normal. After the passing of each storm, many of the gray triggerfish returned to the study area within a couple of days and resumed normal swimming behavior.

• What else did they find?

Previous studies have indicated that falling barometric pressure, increased runoff or a change in water temperature are primary cues that fish use to determine storms are



Triggerfish, tagged for research.

approaching. Here, though, gray triggerfish evacuated the study area one to two days in advance of hurricanes, long before any changes in barometric pressure or water temperature occurred.

But why?

The research team determined that as surface waves increased in size from each approaching storm, energy from those large waves transferred to the bottom, sloshing water on the seafloor. Only waves from the largest storms can transfer enough energy to cause this sloshing at a depth of 120 feet.

It appears that the sloshing of bottom water, or the related fluctuating water pressure from sloshing, was the cue to which gray triggerfish responded.

Full study: go.ncsu.edu/triggerfish

— Summary by Kyle Shertzer and Nate Bachelier

WHERE DO LARGE NC STRIPED BASS SPEND THEIR SUMMERS?

In the northeast United States — and they don't waste time getting there.

• Research Need

The Roanoke River in North Carolina

represents an important spawning habitat for striped bass. Anglers flock to the river each year to target this charismatic species.

Fisheries scientists understand the basic migration patterns of striped bass. Simply put, adult fish spawn in the river and feed in the ocean. What is much less certain is where the fish go specifically, how fast they travel, and if and when they return to the same place to spawn. Changes in water temperature may trigger these migrations, or other factors could be at play.

Having a better understanding of the species' fine-scale movements throughout the year can help managers to craft specific regulations at the local level, as well as to identify essential fish habitat on the broader ecosystem level.

• What did they study?

Scientists from NC State University telemetry-tagged and released 17 female and two male large Roanoke River striped bass, 29.5 to 45.0 inches long, during the springs of 2011 and 2012. The investigators tracked fish movements in near-real time with an expansive network of 480 acoustic receivers throughout the U.S. south Atlantic east coast, including North Carolina

waters. Multiple researchers, institutions and organizations own the receivers and collaborated on the study, sharing data whenever a new tagged fish entered the array.

- *What did they find?*

All fish survived tagging and rapidly left the Roanoke River after spawning.

Four fish likely migrated into the ocean, and fishermen later caught two other fish in coastal Massachusetts waters and in the Albemarle Sound; 11 of the 13 remaining fish, all females, headed great distances to northern ocean waters offshore from New Jersey to Massachusetts, where they spent their summers before returning to the

Roanoke River to spawn the following year.

The two males, which also happened to be the smallest tagged fish, left the river after spawning but appeared to remain in offshore North Carolina waters before returning to spawn the following spring.

- *What else did they find?*

No tagged fish left the spawning grounds until river temperatures reached at least 64.5°F.

Fish journeyed from the Roanoke River around May, spent June to September in northern ocean waters, and then started swimming south again in October to arrive in the Roanoke River by the following spring. The

return trip in the second year of the study began three weeks later, likely due to cooler ocean temperatures than the year before.

- *Anything else?*

The striped bass on average covered about 27 miles per day. Larger fish tended to swim at faster rates than smaller fish. For example, the largest striped bass in the study, a 49.5-inch female, traveled from the Roanoke River spawning grounds to New Jersey — a distance of 521 miles — in 10 days.

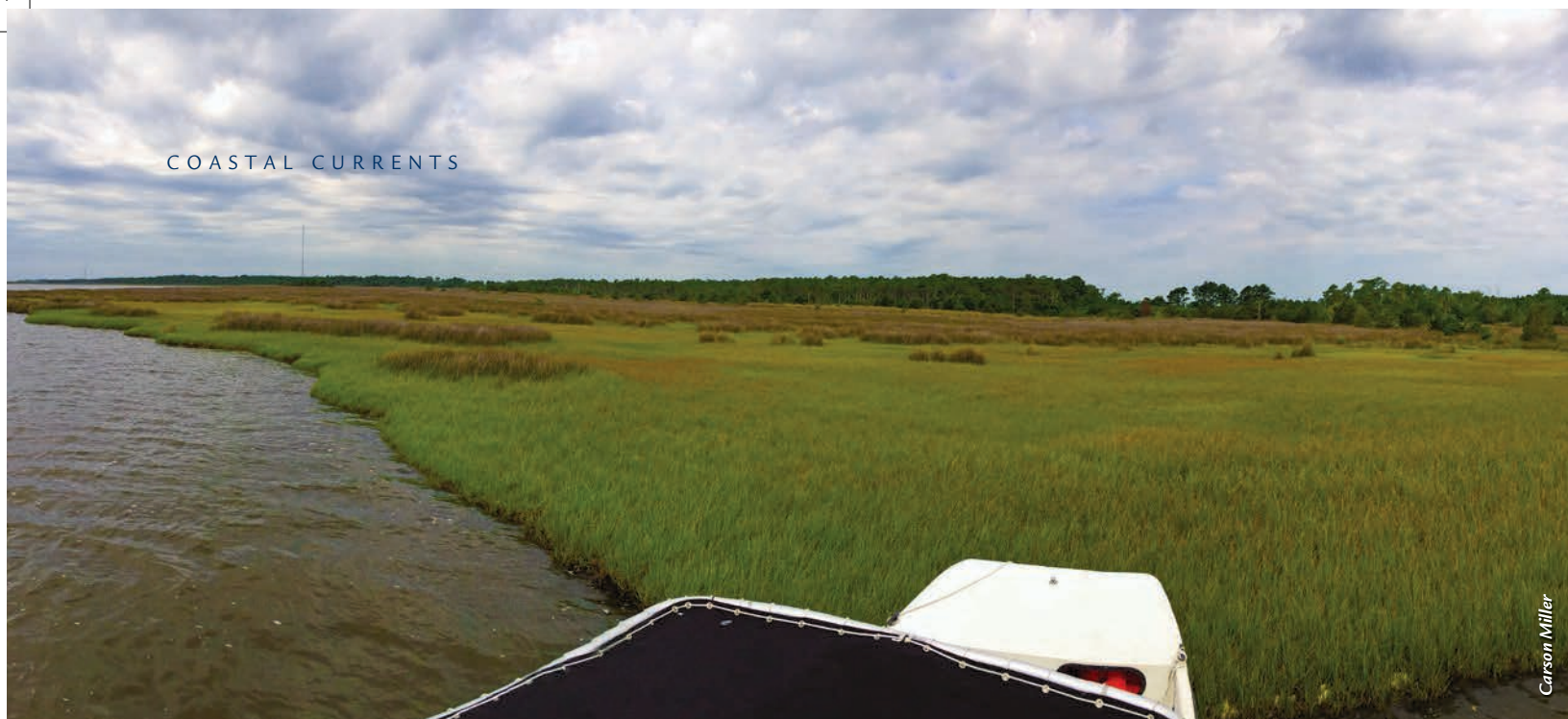
Full study: go.ncsu.edu/stripped-bass

— Summary compiled by Scott Baker

Visit HookLineScience.com



Roanoke River, Halifax County, North Carolina.



Scarps at Shallotte and Newport, as well as ramps at Cedar Island (here) and Hobucken, already have provided sites for a new study of how marshland migrates.

Migrating Marshes Reveal Sea Level Rise and Human Activity

BY CARSON MILLER

North Carolina Sea Grant currently supports a core research project to reveal how salt marshes migrate over time. Antonio Rodriguez, a coastal geologist at the University of North Carolina at Chapel Hill Institute of Marine Sciences, is collecting data at 40 coastal sites in the state. His team will share the results with scientists, coastal managers and restoration practitioners, as well as develop educational materials for grades 6 to 12. Carson Miller, a graduate student in marine sciences at UNC-Chapel Hill, works with the team and provided this update.

ACROSS THE ENTIRE NORTH CAROLINA COAST, LOCALS AND TRANSPLANTS ARE ITCHING TO MOVE CLOSER AND CLOSER TO THE WATER. DRAWN TO THE ICONIC COASTAL VIEWS, MARITIME ACTIVITIES AND LOWER REAL ESTATE PRICES, MORE PEOPLE ARE DEVELOPING PROPERTY ALONG THE SALTMARSH-UPLAND FOREST BOUNDARY. This boundary resides where the marsh meets the tree line. Because it is both economically and environmentally important, we must understand how this boundary moves.

The saltmarsh that fronts the upland forest boundary is crucial for many reasons:

water purification, erosion control and coastal protection, fish habitats, and recreation — as well as carbon sequestration, the process that removes carbon dioxide from the air.

Globally, however, saltmarsh area is declining. Marshes face both natural and human stressors on seaward and landward edges, also known as “coastal squeeze.”

Normally, a saltmarsh can move freely and offset stressors that cause erosion, such as sea level rise, storms and boat wakes on the estuarine edge. However, when humans develop the upland boundary, marshes no longer have the ability move landward (“transgression”), leading to coastal squeeze.

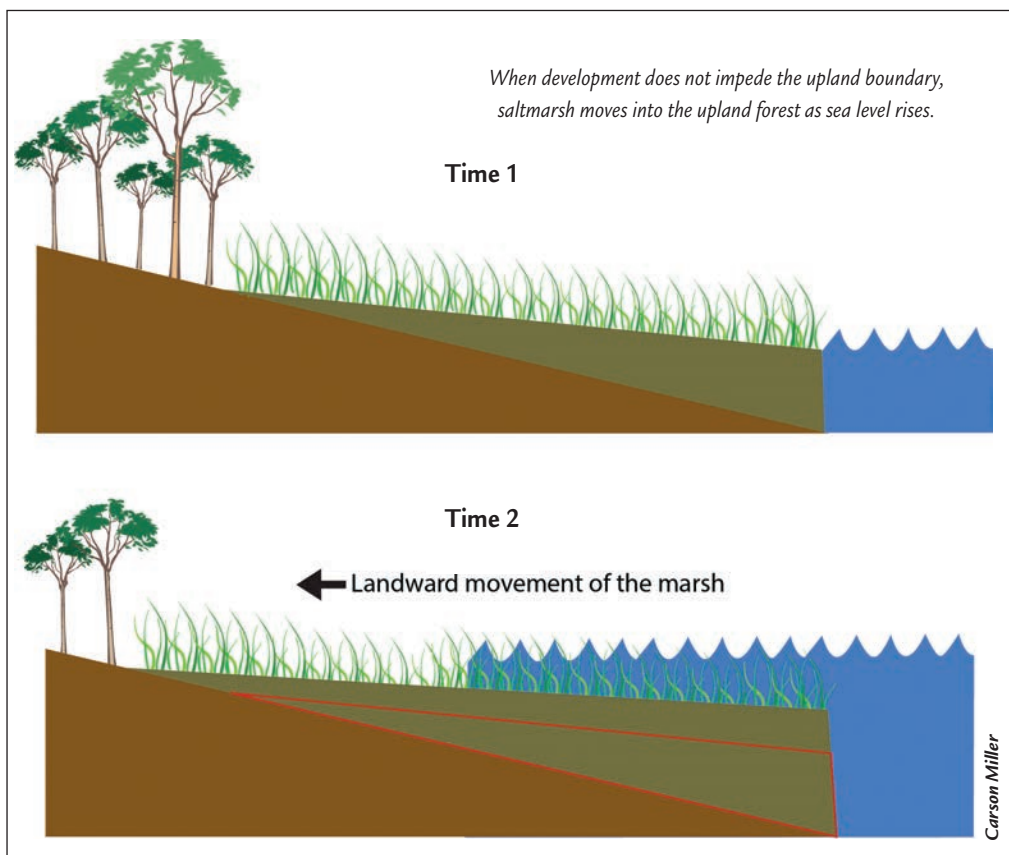
Many studies show that sea level rise drives saltmarsh transgression. Water levels

fluctuate in saltmarshes daily through tides, but if you raise the total water level through sea level rise, the saltmarsh starts encroaching on the upland forest. As the saltmarsh moves landward, the upland forest begins to die, leaving a ghost forest behind.

This model explains what happens when the slope between the saltmarsh and upland is gradual, or “ramped,” but what happens when the boundary is a scarp — steeper and more abrupt?

Over the past year, our lab has been sampling sites across ramped and scarped upland gradients in North Carolina. The ultimate goal is to better understand how sea level influences saltmarsh transgression.

We’ve taken sediment cores at four



different sites: scarps at Shallotte and Newport and ramps at Cedar Island and Hobucken. After we took core transects — a series of cores perpendicular to the marsh shoreline — we brought the cores back to the lab, cut them in half and examined them.

At the gradual ramp sites, we found sediment in the cores that was indicative of transgression due to sea level rise. Although we expected to find this, we're still working to understand the nuanced relationship between transgression and sea level rise.

We weren't expecting to find "regressive" (seaward-moving) marsh that fronted the steep scarped boundaries — but cores at both scarp sites indeed showed regression.

We radiocarbon-dated our marshes as "modern," meaning they formed after 1950. We then focused on the Newport site and determined a massive increase in marsh area between 1964 and 1975. In the watershed, a project to grow and cultivate trees had begun in 1964, which increased suspended sediment in the estuary and promoted marsh growth. After 1975, marsh growth slowed and remained relatively stable.

So, what does this all mean for saltmarsh management? Should these marshes be protected or left to erode, returning the coast to a natural state? Without the additional sediment from human activity, after all, these marshes wouldn't normally have formed as they did.

Despite limited resources, managers need to identify the ecosystem benefits most important for an area when considering which saltmarsh should receive protection from wave erosion. Managing older marshes — which have been providing ecosystem services for thousands of years and contain rich carbon stocks — might be a better use of resources. On the other hand, new marshes offer other ecosystem services, such as fishing sites, but will most likely require erosion-control structures to succeed.

In any case, because it's nearly impossible to know the age of a saltmarsh from its surface, cores that sample the entire marsh thickness are important when deciding how best to conserve these fragile habitats. 🌱

More about North Carolina Sea Grant's core research funding: go.ncsu.edu/core-funding.



Carson Miller cuts sediment cores in half to get a look at marsh history.



Courtesy of Alireza Gharagozlou

Alireza Gharagozlou surveys the beach near Hatteras after Hurricane Florence.

XBeach Model Predicts Storm Impacts on Beaches and Dunes

BY ALIREZA GHARAGOZLOU

Alireza Gharagozlou is a doctoral student in the Department of Civil, Construction, and Environmental Engineering at NC State University. He studies how to connect predictions of beach and dune erosion to community-wide flooding, and he serves with Casey Dietrich on NC State's Coastal and Computational Hydraulics Team. North Carolina Sea Grant has supported their work.

DURING STORMS, STRONG WAVES AND CURRENTS CAN ERODE BEACHES AND DUNES AND CREATE LOW-LYING AREAS VULNERABLE TO FLOODING. WE USE FIELD SURVEYS AND A COMPUTER MODEL CALLED XBEACH TO PREDICT THIS EROSION, AS WELL AS TO UNDERSTAND ITS INTERACTIONS WITH STORM-DRIVEN FLOODING OF LARGER REGIONS.

Computer models allow us to see how storm surge and waves impact the beach over time, and which locations are vulnerable to large-scale damage. Good predictions of such storm impacts help emergency managers take better-informed measures to protect coastal areas. Understanding vulnerabilities also instructs highway access design and residential area planning.

We used the XBeach computer model on more than 18 miles of Hatteras Island between Avon and Rodanthe to explore how to connect erosion predictions to larger areas. Could XBeach cover more of the island, yet still provide good erosion predictions at beach and dune scales? And how could we connect erosion predictions to other models for storm surge and flooding?

USING HURRICANE ISABEL AS A TEST CASE

Hurricane Isabel made landfall on Sept. 18, 2003, on the Outer Banks with Category 2 wind speeds, 8-meter-high waves, and a storm surge 2 meters above mean sea level. The hurricane devastated the region, causing flooding, dune erosion and overwash at many locations along the barrier islands.

Although Isabel occurred more than 15 years ago, the storm provides a great test case for the model because of available observations of coastal erosion. High-resolution datasets depict beach and dune topography two days before and three days after the storm made landfall. These datasets tell us a lot about the storm's effects on erosion in Hatteras Island. The largest erosion event was the creation of the "Isabel Inlet," which was 500 meters wide and remained open for more than a month.

Significant erosion also occurred all over the island. Storm surge and high waves washed away the dune, pushed the sand back into infrastructure and closed highway NC 12. Between the towns of Avon and Rodanthe, more than 20 major erosion and overwash events resulted in sand deposits extending 80 to 200 meters from the shoreline. At Buxton and Frisco, the storm deposited sand inland 400 to 500 meters from the shoreline. Residential communities at Rodanthe experienced severe storm impacts that included damage to the main road and buildings.

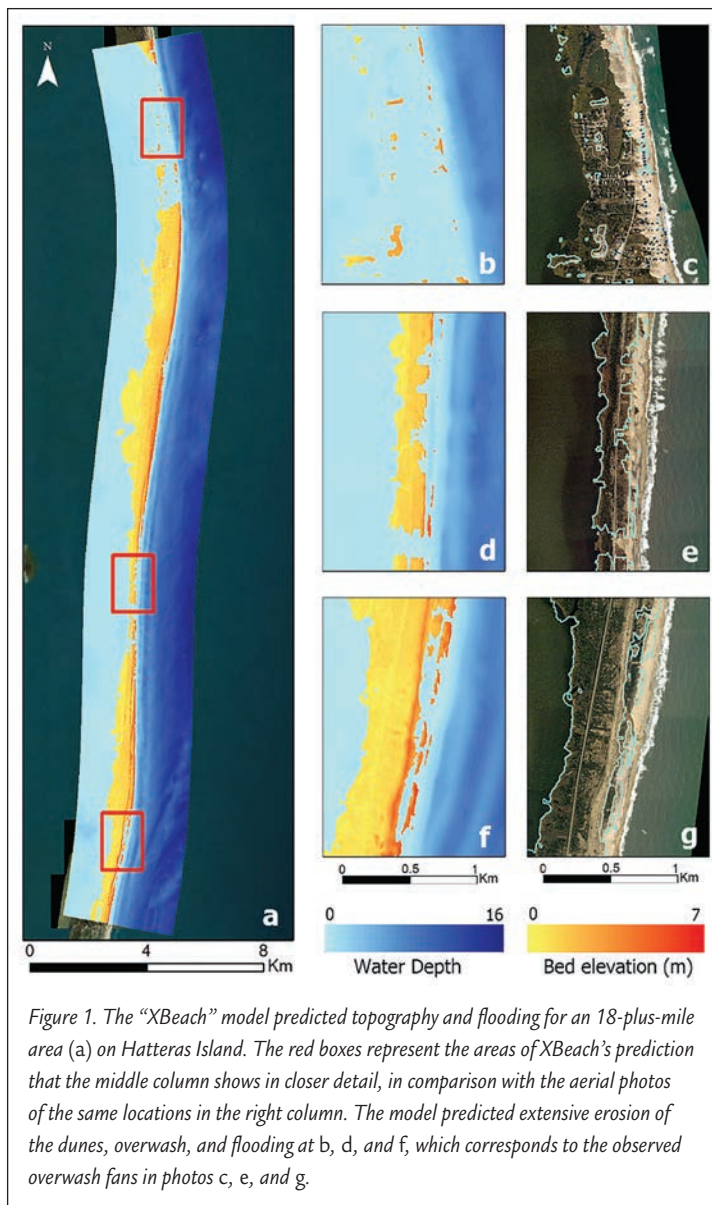


Figure 1. The "XBeach" model predicted topography and flooding for an 18-plus-mile area (a) on Hatteras Island. The red boxes represent the areas of XBeach's prediction that the middle column shows in closer detail, in comparison with the aerial photos of the same locations in the right column. The model predicted extensive erosion of the dunes, overwash, and flooding at b, d, and f, which corresponds to the observed overwash fans in photos c, e, and g.

HOW DID XBEACH MODELING PERFORM?

To explore XBeach's performance, we applied it to the 30-kilometer stretch of Hatteras Island from Avon to Rodanthe. The model captured major dune erosion events during Isabel very well.

For example, aerial photos taken after Isabel showed a closure incident to the south of Salvo, where sand covered the road (Figure 1). XBeach "predicted" the dune erosion and flooding at the same location. The model also predicted the elevation change in the dune crest and the amount of beach erosion with accuracy that was very close to post-storm observations.

Such predictions were very encouraging. They told us how the storm surge cut through the dunes, and where and when those events had happened. These findings allow us to use the model confidently for future storms to estimate impacts before landfall.

In addition, larger storm surge and flooding forecast systems can

incorporate information from such models. Scientists and researchers run large-scale models like ADCIRC to predict flooding and water levels along the coast, but such models neglect erosion and breach events.

However, by connecting XBeach to ADCIRC, we can improve the flooding prediction. In our ongoing work, we are tightening these connections.

FIELD OBSERVATIONS OF EROSION AFTER FLORENCE

Hurricane Florence impacted coastal North Carolina in September 2018. The storm made landfall near Wrightsville Beach and caused considerable dune erosion and flooding.

After the storm, I participated in a field survey that NC State University's Beth Sciaudone led. We surveyed beaches at locations where we could observe major erosion events. The elevation of these points was measured from the dune to the shoreline with a Real Time Kinematic GPS device.

This survey information can help us evaluate the erosion volume and assess

the extent of storm impacts on the beach. It tells us where the dune system prevented flooding and where the beach was vulnerable and eroded.

These findings also can be fed into numerical computer models to improve prediction accuracy. Similar to how the detailed surveys with Isabel helped our previous modeling study, these new surveys during Florence will help to validate the performance of the model in capturing coastal processes. 🌐

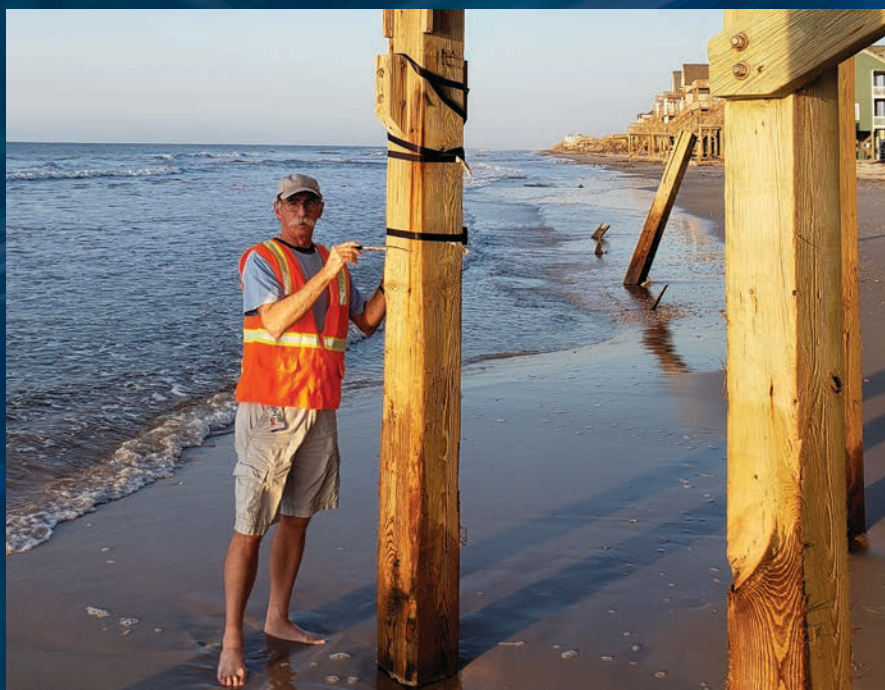
RESOURCES:

- North Carolina Sea Grant's core research funding: go.ncsu.edu/core-funding
- NC State's Coastal and Computational Hydraulics Team: ccht.ccee.ncsu.edu
- About XBeach: oss.deltares.nl/web/xbeach/
- About ADCIRC: cera.coastalrisk.live



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SEA GRANT'S SPENCER ROGERS NETS AWARD FOR EXCELLENCE

NC State University has honored Spencer Rogers with a 2019 Award for Excellence. Rogers, coastal construction and erosion specialist for North Carolina Sea Grant, joined 11 other winners of the highest annual honor for non-faculty staff at the university.

The prize is the latest in a collection stretching across his mantle. The 40-year Sea Grant expert also has garnered special recognition from the National Oceanic and Atmospheric Administration and the National Sea Grant Network, as well as earning other awards.

Learn more about Spencer Rogers and the 2019 Awards for Excellence:
go.ncsu.edu/RogersAward.

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