

Humpback Whales • Gullah/Geechee Heritage • Clams Casino • Lessons Learned from Matthew

Coastwatch

NORTH CAROLINA SEA GRANT • WINTER • 2021 • ISSUE 4 • \$6.95

PODCASTING FROM THE COAST

*Student Journalists Give
Local Voices a Global Stage*



Winter 2021: New Plans and Partners for the New Year

North Carolina Sea Grant thrives through engagement with communities — research and extension collaborations, in-person exchanges, and hands-on field work. Of course, during the COVID pandemic, our projects have entailed a lot of virtual work. In recent months, our team and partners have begun to get back together safely for field excursions, on-site consultations, festivals, and small group meetings. The energy and enthusiasm involved with being back together is invigorating.

We can incorporate many aspects from our last 20 months of virtual engagement into future meetings and conferences, supporting greater accessibility to resources and information. This hybrid approach, pairing in-person engagement with virtual engagement, comes with a learning curve, but North Carolina Sea Grant was pleased to host this fall's Sea Grant Association hybrid meeting in Raleigh, which included representation from Sea Grant programs all across the nation.

The meeting's excitement about strengthening program connections was rejuvenating. Anticipated increases in federal resources for NOAA's state-based coastal programs, including Coastal Management, National Estuarine Research Reserve System, the U.S. Integrated Ocean Observing System, and National Marine Sanctuary Program — all with significant programs in our state and strong partnerships with North Carolina Sea Grant — provide an opportunity for North Carolina to enhance and expand community support for economic and environmental resilience. There continues to be great work to do together.

As you will read shortly, our partners also continue to inspire, engage, and educate. From budding student journalists giving coastal voices a global platform to ongoing efforts to preserve Gullah/Geechee land and culture to lessons from Hurricane Matthew five years out, these stories provide perspectives and considerations that encourage us to understand and engage coastal communities in new ways. How



Susan White

should we continue to expand our partnerships to work together to support state and local efforts to strengthen coastal communities and build capacity to prepare, respond, and recover from storms, pandemics, economic downturns, and other challenges?

In addition to our many collaborations and projects, North Carolina Sea Grant also looks to strengthen partnerships through our advisory board. We are excited to work with new and returning board members, who provide expertise and experience as we seek input on areas of investment in research, extension, and outreach.

In the last issue of *Coastwatch*, we welcomed Ricky Moore, Amanda Martin, James Hargrove, and Todd Miller to the board. We're also now pleased to be able to announce new members

Evan Ferguson, media coordinator at Cape Hatteras Secondary School; Sharon Harker, mayor of the Town of Beaufort; VeQuain Joyner, unit director of the New Bern Boys & Girls Club; and Haley Paas, Ph.D. student at the University of North Carolina at Chapel Hill and former joint fellow with the Albemarle-Pamlico National Estuary Partnership and North Carolina Sea Grant.

These advisors are critical to our program's relevance, and we look forward to working closely with our board — and other stakeholders and partners — as we move into a year of new strategic planning for 2024 to 2028.

In closing, we want to wish Julie Leibach, our team's stellar science writer and digital content specialist, a fond farewell as she begins a new position, taking her award-winning writing to new audiences.

And, as always, please feel free to email me with your ideas and feedback: smwhite3@ncsu.edu. Until then, Happy New Year!

— Susan White, Executive Director, North Carolina Sea Grant

IN THIS ISSUE

CONTRIBUTING WRITERS:

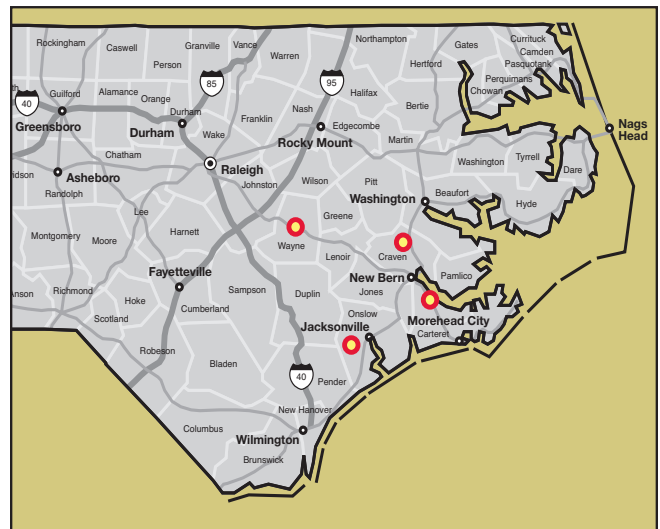
Scott Baker □ Lee Cannon □ Delandra Clark □ Corey Davis
Cameron DeChurch □ Jackie Jaffe □ Julie Leibach □ Vanda Lewis
Sara Mirabilio □ Katie Mosher □ Lauren D. Pharr □ Dave Shaw
Joyce Taylor □ Ambar Torres □ Susan White

CONTRIBUTING PHOTOGRAPHERS:

Michael Au □ Tyler Bell □ Rachel Bisesi □ Andrea Booher □ Lance Cheung
Herb Frazier □ P. Gemperline □ Paul Hosier □ Jorge Intriago □ Diedre Laird
Vanda Lewis □ Taiana Martinez □ Helen Penjam □ Joe Prusa □ Freda Pyron
Zach Rudisin □ Jonathan Shaw □ Samiris Suleiman-Orozco
Lorenzo Dow Turner □ Kelly Verdeck □ Roger Winstead □ and others

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Settings for the stories in this issue cover many locations in North Carolina, including these counties from east to west on the map: Carteret, Craven, Onslow, and Wayne.



A close-up photograph of a branch of an American beautyberry (Callicarpa americana) plant. The branch is covered in clusters of small, round, purple berries. The leaves are green and serrated. The background is dark and out of focus.

Coastwatch

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❑ *Front Cover:* Courtesy of NC State University.

❑ *Table of Contents:* American beautyberry, photographed by Paul Hosier.

Coastwatch

North Carolina Sea Grant • Winter • 2021 • Issue 4

Communications Director
North Carolina Sea Grant
Katie Mosher

Editor
Dave Shaw

Science Editor
Julie Leibach

Contributing Editors
Lee Cannon & Lauren D. Pharr

Assistant Editors
Nan Pincus & Carrie Clower

Designer
Linda Noble

Since 1970, North Carolina Sea Grant has aligned our goals with the National Sea Grant College Program. We provide research, education, and outreach to serve our state's coast and its communities.

Under executive director Susan White, our primary areas of emphasis include healthy coastal ecosystems, resilient communities and economies, sustainable fisheries and aquaculture, and environmental literacy and workforce development.

NOAA and the State of North Carolina fund our work. By forging enduring collaborations that bridge North Carolina's public and private universities with critical coastal needs, our program fuels discovery, learning, and real-world solutions.

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North Carolina Sea Grant
NC State University Box 8605
Raleigh, NC 27695-8605

North Carolina Sea Grant Coastal Offices:

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

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

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



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



P. Gempertine

THE NC KING TIDES PROJECT WANTS YOUR HELP

King tides are the highest and lowest tidal events of the year. These regular and predictable events occur when the sun, Earth, and moon are in alignment and the moon is at its closest point to the Earth.

The North Carolina King Tides Project is part of an international initiative to document extreme high tide events using photos. These photos can help visualize how “normal” high tides might look in the future due to sea-level rise, suggesting how rising seas will impact local

resources and community investments.

The images also contribute to a record of the present-day shoreline and can help track changes. The King Tides Project seeks photos both of tidal-related flooding and any flooding or high-water events.

— adapted by Lauren D. Pharr from information from the North Carolina King Tides Project

- **learn more and share photos:**
go.ncsu.edu/king-tides

REQUEST FOR PROPOSALS FOR THE CCRG PROGRAM

The Community Collaborative Research Grant Program is now open for proposals. This innovative program funds collaborative research that couples community knowledge and academic expertise in order to address priority coastal issues.

Proposals also should align with North Carolina Sea Grant and the North Carolina Water Resources Research Institute's vision for diversity, equity, inclusion, justice, and accessibility: go.ncsu.edu/DEIJA.

The deadline for proposals is February 4, 2022, at 5 p.m. Eastern.

Visit go.ncsu.edu/CCRG.

North Carolina Sea Grant and the North Carolina Water Resources Research Institute support the Community Collaborative Research Grant Program in partnership with the William R. Kenan Jr. Institute for Engineering, Technology, and Science. To read about a recent CCRG project, see this issue's “Podcasting a Wide Net.”

NEW PROJECTS SUPPORT SEAFOOD AND AQUACULTURE INDUSTRIES

North Carolina Sea Grant continues to help the seafood industry recover from the impacts of the COVID-19 pandemic through two new projects, one with a statewide focus and another with a national scope.

“We will develop and enhance direct-to-consumer marketing strategies to offset ongoing losses in the food-service sector, where a majority of seafood in 2020 was consumed before the pandemic,” says North Carolina Sea Grant coastal economics specialist Jane Harrison, who will head the statewide project. Sea Grant colleagues Barry Nash, Eric Herbst, and Scott Baker also will play key roles, as will partners from state agencies and organizations.

“Overall, our project will provide marketing assistance, training, and network building for North Carolina commercial fishers and marine aquaculture producers who are conducting direct marketing through tourism,” Harrison explains. “Building on the initial successes of the NC Oyster Trail and the *Visit North Carolina Farms* app, our team also will demonstrate ways to leverage tourism to increase public awareness and demand for North Carolina seafood.”

Annie Baggett at the NC Department of Agriculture and Consumer Services will work with seafood producers to expand use of the *Visit NC Farms* app, which helps consumers find retailers and seasonal events celebrating local food.

In addition, Ann Savage of NC State University Tourism Extension will help to further develop the NC Oyster Trail, a program that educates the public about the culinary options and ecosystem benefits of sustainable shellfish farming.

The North Carolina Coastal Federation will host a workshop to strengthen and build relationships between Oyster Trail members and tourism organizations. The workshop will coincide with the NC Oyster Summit in 2023.

North Carolina Sea Grant is also partnering on a national project with Maryland Sea Grant, the National Sea Grant Office, NOAA’s National Centers for Coastal Ocean Science (NCCOS), and others to support ecofriendly, successful, and equitable marine aquaculture.

North Carolina Sea Grant’s Eric Herbst will work with NCCOS aquaculture experts in Beaufort on marine spatial planning, regional workshops that focus on site selections for new aquaculture operations, and more.

“North Carolina Sea Grant already has strong working relationships with NCCOS partners working on aquaculture topics, such as through the recent update for the NC Oyster Blueprint and other committees,” Herbst says.

— Katie Mosher

- **NC Oyster Blueprint:** ncoysters.org
- **NC Oyster Trail:** ncoysters.org/oyster-trail
- **Visit North Carolina Farms app:** visitncfarmstoday.com



Tim Thomason

SEA GRANT AND SISTER PROGRAMS LAUNCH NEW DIVERSITY LIAISON POSITION

North Carolina Sea Grant, the North Carolina Water Resources Research Institute, and North Carolina Space Grant welcomed Tim Thomason aboard this fall as their inaugural DEJJA Liaison. Thomason will support the three teams’ joint commitment to diversity, equity, inclusion, justice, and accessibility by helping to diversify the applicant pools for the programs’ state and national funding opportunities.

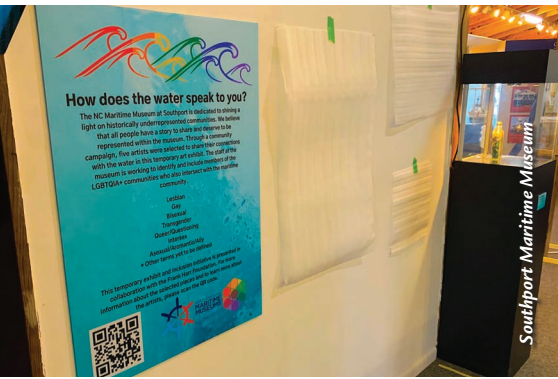
“I’m excited to be named as the first DEJJA liaison to both continue and amplify the joint diversity and inclusion commitments,” says Thomason, who also works for VF Corporation as the director of global inclusion, diversity, equity, and action. “There’s an incredible opportunity to further engage and connect diverse communities to funding opportunities, and I’m honored to support these efforts.”

Thomason, an MBA student at North Carolina A&T State University, also is executive director for Minority Game Changers, a nonprofit serving North Carolina by creating interactive and immersive STEM and professional development sessions for high school students from under-represented backgrounds.

“We recognize our programs’ unique position and responsibility to strengthen the pipeline to college and to professional life for students of all backgrounds and abilities,” says Christy Perrin, sustainable waters and communities coordinator for North Carolina Sea Grant and the Water Resources Research Institute, as well as a founding member of the programs’ joint DEJJA Committee. “Tim’s expertise will be critical in helping to fulfill this vision.”

— Dave Shaw

- **North Carolina Sea Grant’s DEJJA Vision:** go.ncsu.edu/DEJJA



SOUTHPORT MARITIME MUSEUM OFFERS LGBTQIA+ ART EXHIBIT

Port cities have always been a melting pot, but not all of the diverse voices within them have had a platform. For several months earlier this year, the North Carolina Maritime Museum at Southport showcased an exhibit that was designed to change that.

“How Does the Water Speak to You?” included watercolor and acrylic paintings, as well as digital and found-object artworks. These pieces shared a common connection: art with a maritime connection that was created by members of the lesbian, gay, bisexual, transgender, queer/questioning, intersex, asexual/aromantic/ally communities.

The Frank Harr Foundation, an LGBTQIA education and outreach organization based in Wilmington, helped identify artists in the community whose work had ties to the water.

Featured artists, their works, and media included: Alexander Brooks, *Entangled*, watercolor; Robin Douglass, *Sailboats & Buoys*, driftwood, cloth and cork; Achilles Hack, *Patroclus and Achilles*, digital; Campbell Idol, *Hidden Identity*, acrylic; and Hannah Marley, *Small Treasure*, glass and found objects.

The North Carolina Maritime Museum at Southport is open Tuesday through Saturday, 9 a.m. to 5 p.m. Admission is free.

— adapted by Lauren D. Pharr from a media release from NC Department of Natural and Cultural Resources

• **More:** go.ncsu.edu/water-speaks



FORT FISHER SITE DEBUTS LUMBEE EXHIBIT

Earlier this year, the Fort Fisher State Historic Site launched “A Memory A People Could Not Forget: Lumbee Indians at Fort Fisher.”

Guest curated by the Museum of the Southeastern American Indian and the Lumbee Tribe of North Carolina, the Civil War exhibit was designed to portray the vital role played by Lumbee Indians — alongside free and enslaved African Americans — in building the fort’s massive earthworks. Faced with the reality of conscription and brutal working conditions, the Lumbee endured seemingly endless demands on their labor in building what came to be known as “The Gibraltar of the South.”

When Fort Fisher fell to Federal troops after an attack on January 15, 1865, its loss contributed significantly to the Confederacy’s defeat. Today, the Fort Fisher State Historic Site, located in Kure Beach, is part of the Division of State Historic Sites in the N.C. Department of Natural and Cultural Resources.

— adapted by Lauren D. Pharr from a press release from N.C. Department of Natural and Cultural Resources

• **Fort Fisher State Historic Site:** historicsites.nc.gov/all-sites/fort-fisher

SAVE THE DATE!

THE 2022 NORTH CAROLINA AQUACULTURE CONFERENCE RETURNS MARCH 10th THROUGH THE 12th.

The 34th annual NC Aquaculture Conference is planning to meet in person in New Bern in early March of 2022. Anyone with an interest in fish or shellfish farming is welcome to attend.

The conference brings together current and prospective fish farmers, scientists, the general public, and people in regulatory agencies to share information and ideas about aquaculture in our state.

All attendees also can enjoy an ongoing trade show, as well as the conference’s NC Cultured Seafood Festival, an “all you can eat” celebration.

Stay up to date at NCAquaculture.com and facebook.com/NCAquaculture.

NATIONAL FELLOWSHIP DEADLINES APPROACH

Knauss Fellowship winner Kayelyn Simmons.

Application periods for several national NOAA and Sea Grant fellowships are now open.

Sea Grant and NOAA recruit, retain, and prepare a diverse workforce, and proactively engage and serve the diverse populations of coastal communities. The opportunities below include fellowships in management, policy, and research that affect coastal ecosystems and benefit people of all backgrounds.

Applications for the **Coastal Management Fellowship and the Digital Coast Fellowship** are due **January 21, 2022**.

“These fellowships provide on-the-job opportunities in coastal resource management and policy, while also offering key expertise to state coastal zone management agencies and other key NOAA partners,” says John Fear, North Carolina Sea Grant deputy director.

Current and recent graduate students with degrees from colleges and universities in the state are eligible to apply. Information is available at go.ncsu.edu/coastal-fellows.

North Carolina Sea Grant also is accepting applications from doctoral students in the state for the **National Marine Fisheries – National Sea Grant Fellowship in Population and Ecosystem Dynamics and Marine Resource Economics**. The deadline is **January 27, 2022**.

“This joint fellowship not only provides hands-on research experience, but also it fosters a direct connection with NOAA,” says Fear.

Each fellow must work with a mentor from NOAA Fisheries. For more information, visit go.ncsu.edu/fisheries-fellow.

Last, the application period for the **John A. Knauss Marine Policy Fellowships** is open until **February 18, 2022**.

NOAA offers the prestigious fellowships through the National Sea Grant Office. The program places graduate students in Washington, D.C. to work on federal policies and processes that affect ocean, coastal, and Great Lakes issues.

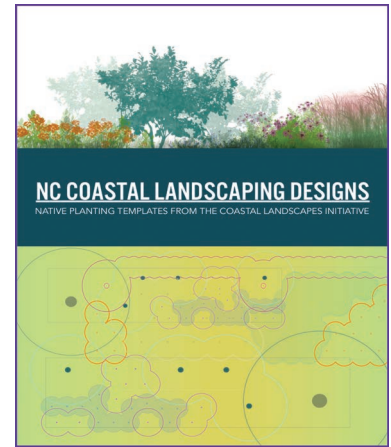
“We are honored to nominate strong North Carolina students for this opportunity every year,” says Fear. “Current and past fellows cite this vital professional experience in marine policy as a key influence on career paths in science, policy, communications, and other fields.”

To learn more about Knauss Fellowships, visit go.ncsu.edu/Knauss-fellow.

For more information about applying in North Carolina for any of the above fellowships, contact John Fear at jmfear@ncsu.edu.

— Katie Mosher & Dave Shaw

- **More funding opportunities:** go.ncsu.edu/sea-grant-funding



COASTAL LANDSCAPING DESIGN TEMPLATES WIN AWARD

A set of 10 design templates from the Coastal Landscapes Initiative has won an APEX Award for Excellence. These templates feature plants native to coastal North Carolina, explaining which species work well together and how to arrange them.

“We wanted to help people who are interested in sustainable coastal landscaping but don’t know where to begin,” says project manager Gloria Putnam, North Carolina Sea Grant’s coastal resources and communities specialist.

Each design provides ideal site conditions, a planting blueprint, seasonal bloom or berry color, an illustration of the plantings at maturity, and maintenance tips. Designs are adaptable for different lot configurations and also include alternative plant choices.

Native plant experts and design professionals helped create the templates, which the Coastal Landscapes Initiative published to encourage nature-enhancing landscaping. Key partners included the North Carolina Aquariums at Pine Knoll Shores and Roanoke Island and Coastal Roots Garden Design.

The full guide is available at go.ncsu.edu/CLI-designs.

Printed packets are also available by emailing Gloria Putnam at gfpuntam@ncsu.edu, by inquiring at your closest NC Cooperative Extension office, or contacting a North Carolina Sea Grant office in Wanchese, Wilmington, or Morehead City.

— Julie Leibach

- **Coastal Landscapes Initiative:** go.ncsu.edu/CoastalLandscapes





Student Journalists Offer Coastal Voices on
Climate Change to a Worldwide Audience

PODCASTING A WIDE NET

BY LEE CANNON

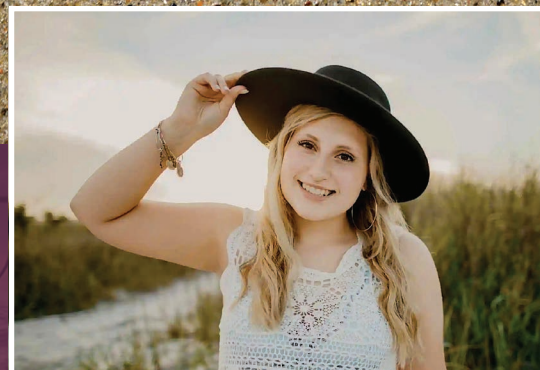
Under expert tutelage, students interviewed fishers, farmers, ecologists, veterinarians, aquarium staff, and town mayors.



What We Can Do to Save Our Beaches

from the podcast by Hollyn Petrock, Jacksonville

The sea levels rising have a major effect on our climate in Onslow County and many things surrounding it. With the sea levels rising comes eroded beaches, flooding through the lowlands, and changes to the nature surrounding us. Many people don't notice the problems and impact that the sea level rise has because the beach, for them, is a place to play or somewhere



to relax and vacation. Little do they know, it could be gone in the next 30 years. Then what?

High waves, more storms, and climate change are washing our beach away at nearly 3.4 mm each year!... The beach to me has never seemed so small. I remember going as a little girl every year since I was a baby, building sandcastles, swimming in the water, and lying down tanning by the shoreline. Now that may not be possible for any grandchildren that I have.



Tyler Bell/NC-CC-BY-2.0

Small Animal Conservation in Coastal NC

from the podcast by Nyaira Danley, Jacksonville

Kelli Applegate, a wildlife scientist, gave some insight into how climate affects wildlife, too. One thing she



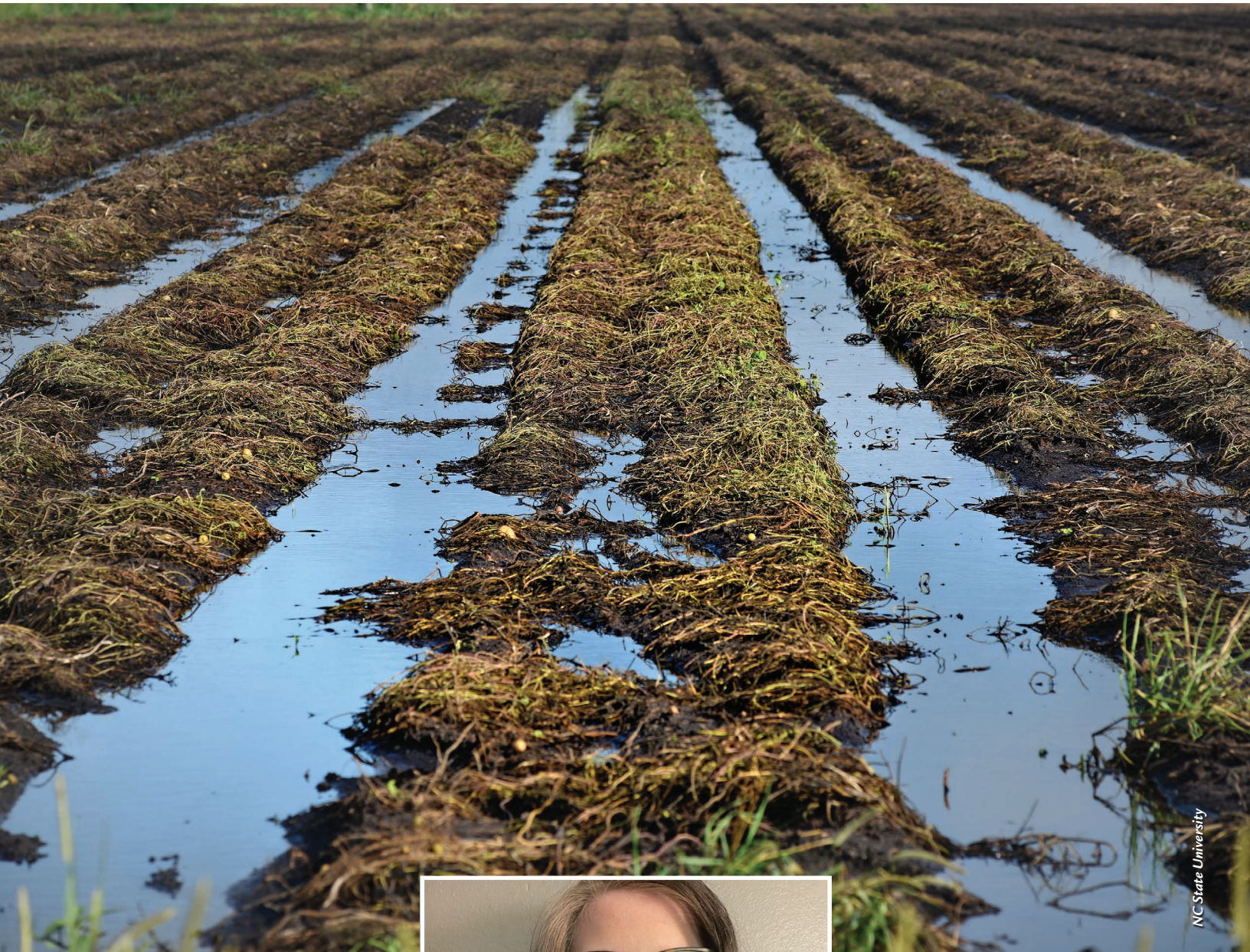
said that I found really interesting was that teenagers are the main key to helping our environment, and she has a great point. The youth of this era are going to have to take care of us in the future so it's very important that we learn that we need to take care of the place we live in.

"Hi. I'm Hollyn Petrock. I'm 15 years old and live in Jacksonville, North Carolina. This is 'Climate Stories, Youth Report,' a podcast by Coastal Youth Media and NC Health News, exploring how climate change is shaping our neighbors' lives in unexpected ways. I'm your host. This podcast is produced by eight youth producers living in rural, coastal North Carolina. Our region is one of the earliest places in the U.S. to be impacted by climate change. After training with professional North Carolina journalists, we embarked as reporters ourselves."

This is *Youth Climate Voices*, a series of podcasts that is the fruit of a whole village's labors — including contributions from high school students and teachers, journalists, multi-media storytellers, subject-matter experts, and other supporters who saw the promise of the project.

"It was such an honor to be selected for it," Hollyn Petrock says of being chosen to narrate the introduction and conclusion of each podcast. "I was a little nervous at first, but once I got the hang of it, I felt pretty confident."

Continued



NC State University

How Will the Climate Crisis Change Farming?

from the podcast by
Brianna Leduc, Whiteville

I think as a 17-year-old, talking about [climate change] more has made me think of how I could shed light onto it, so people with different views can have a civil conversation about it. When I talk with my dad about it, he is not as convinced that climate change is as urgent of a topic as I see it. He thinks



it's been overblown, but I look forward to having more discussion with him on the topic, because I plan to study it more.

Whether it's because of the farmers around me or my environmental science class or other youth voices, I think we are going to be dealing with climate change for a long time in the future. We just need to talk about it more.

Petrock was far from a seasoned student journalist when the program began. “I had never really thought about journalism before the project started,” she says. “It 100 percent made me interested in it, so much so I could see myself actually doing it as a career.”

AFTER FLORENCE

“Young people are interested in storytelling these days,” says Rose Hoban, who founded North Carolina Health News, the online newspaper dedicated to health, healthcare, and health policy news. Hoban originally conceived Youth Climate Voices to focus on teens in smaller communities. “These kids don’t see as many opportunities as kids in big cities do, so they are really excited.”

After Hurricane Florence, Hoban discovered a Working Narratives/Coastal Youth Media project called “Storm Stories,” which highlighted North Carolinians’ responses to the storm.

She also saw a need for more general reporting from the coast — and student reporters offered a solution.

With initial support from the Local News Lab, a partnership was born. The core training team consisted of Hoban, Anne Blythe — also with North Carolina Health News — and Sarah Sloan of Working Narratives/Coastal Youth Media.

Through workshops, Hoban taught the students reporting skills. Blythe, also a journalist, helped the students shape their own story ideas, coached them through how to find people to interview, then helped the students pull everything together.

“The students in these workshops never fail to impress me,” says Blythe. “They are enthusiastic, curious, creative, and bring a youthful and fresh perspective.”

Sloan, a documentary producer based in Morehead City, helped the students not only with their stories, but also with the technology involved. She often trains people in coastal communities to tell their stories using video, photography, and podcasting, so she had experience guiding people through the process.

“We use the community media-making model,” Sloan explains, “where the teacher is the student is the teacher.” Her work, she adds, develops leadership skills in communities and helps forge strong community bonds, because people come to understand where they live better.

Midway through the Youth Climate Voices project, once they had a model they liked, the team received a key boost from the Community

Collaborative Research Grant Program. North Carolina Sea Grant, the Water Resources Research Institute, and the Kenan Institute for Engineering, Technology, and Science (KIETS) offer the CCRG program to strengthen research and outreach partnerships between communities and universities.

“The focus on engaging youth voices is a compelling way to build capacity at the local level for the pressing environmental issues that these students face now and in the future,” says John Fear, deputy director of North Carolina’s Sea Grant and the Water Resources Research Institute.

KIETS associate director Raj Narayan says the project is a good fit with his institute’s goals.

“The Youth Climate Voices project is a really wonderful collaboration, amplifying the voices of young climate leaders as they investigate the impacts of climate change in areas of interest personally meaningful to them,” Narayan says. “Their stories were very informative and well done. KIETS is very focused on the topic of climate change, and we remain grateful to support these diverse voices, as they share their insightful stories about the impacts of climate change within their communities.”

PODCASTING IN A PANDEMIC

Each time the Youth Climate Voices team opened the program for recruitment, it filled quickly, proving to Hoban, Blythe, and Sloan they were onto something.

The team aimed to attract students from coastal counties, like Carteret, Onslow, and Craven. The COVID-19 pandemic precluded in-person workshops, though, and it also sent the North Carolina Health News office into overdrive. This could have blighted Youth Climate Voices for a season, or for good — but instead of postponing or abandoning the project, the team adopted a fully online format.

“COVID took away the opportunity to do live workshops,” says Hoban, “but it did make the workshops more accessible to the students.” Many of the students they wanted to reach live in rural areas, which would have presented difficulties for in-person engagement anyway. However, the age of video conferencing means that many remote students had just as much access as students in the heart of the cities.

During the online sessions, the team led the students through training on the art of the interview, introducing them to common questions and showing them different interview styles.

Continued



Michael Aw/CC-BY-2.0

Humans and Sharks: Closer Together

from the podcast by
Isabella Avila, Hampstead

If you listen to those who know these magnificent creatures the best, you'll realize sharks keep order and balance in the ocean, and quite frankly sharks aren't out to attack humans.



There are theories that shark encounters with humans are happening more frequently due to climate change. Climate change is causing sharks and their prey to migrate to new waters as the oceans warm. That sometimes means sharks are coming closer to shore, looking for food. We might be swimming, surfing, or riding the waves when the sharks see something they are curious about and move in to find out what we are.

“The students were very engaged,” Hoban says, adding that they came up with excellent questions.

Guest speakers discussed elements of journalism and the students’ individual interests — and Aranzazu Lascrain, assistant university director of the Southeast Climate Adaptation Science Center, became a crowd favorite. With a broad background in environmental conservation and resource planning, she served as the climate expert for the students as they looked for the signs of climate change in their home communities.

From the impact on air quality of burning trash in rural areas to the stresses more frequent hurricanes and rain events put on horses’ hooves, students discovered the fingerprints of climate change everywhere. They interviewed relatives, neighbors, and friends, as well as local experts like farmers, fishers, ecologists, veterinarians, aquarium staff, and town mayors.

North Carolina Health News features the podcasts online as “impacts on animals,” “impacts on food and farming,” and “the past, present, and

Continued



VisitNC.com

Who Knew Climate Change Has an Impact on Horses' Hooves?

from the podcast by
Cassidy Carr, New Bern

After it rains, it is natural for the ground to become wet. But after a while, the ground dries up. However, after bigger storms, the ground can take a few or more days to dry up. For horses, who spend their lives outside, it is obvious their feet would be wet after it has rained.

I spoke to Holly Hyatt, a farm owner and friend who had been



around horses since she was a little girl. She told me all the ways they prepare their horses for stronger weather; the horses need to be moved to the middle of the field away from structures or trees that could fall over. But what I found interesting, was that

the horses' hooves can suffer with extreme weather changes.

"Really wet environments are not good for the horses' hooves. They have hard hooves, but if they stay in water, just like our skin, they become soft. So then they become sensitive to rocks or hard surfaces," Hyatt said.



NC State University

The Soil in My Garden

*from the podcast by
Ariel Shipman, Tabor City*

My grandmother always told me, "When you think about rain, you think about water, and how it's great for the plants." In reality, the acid levels from the rain usually don't benefit the plants unless the pH levels in the soil are low.



The acid gets into the rain as a result of pollution. Power plants, especially those that use coal for firing, create smog, which is acidic. When the rain comes, it washes that acid out of the air, creating something called acid rain. This makes the soil acidic.... When the soil is too acidic, there are nutrients in the soil, but the plants can't use those nutrients.

future of climate change.” They also are available on every major podcast platform, with the potential for a global reach.

“What they produced in just days is wide-ranging, far-reaching and, quite frankly, work that wowed us,” Blythe wrote in the introduction to the series. “We’ve compiled those essays and podcasts with hopes that their important voices will lend new depth and perception to an issue that will have great impact on their lives.”

SHARKS, HORSES HOOVES, AND ACID RAIN

Isabella Avila, one of the students who took part in the workshops, chose to talk about sharks. After interviewing her father, who is a diver, and two local shark experts, she realized sharks are crucial to their ocean environments and not the crazed man-eaters depicted in film.

“That was the coolest part of the whole project,” she says, “that transformation from one mindset to another.”

Since she finished her podcast, she has received praise from quarters she had not expected.

“My creative writing teacher shared it with the whole staff,” she says. “I didn’t know until my guidance counselor came up to me and said she had listened to my podcast. She said she had changed her mind about sharks because of it. That feels good, knowing that I was able to change even just one person’s mind!”

Cassidy Carr, a New Bern high school student who took part in the workshops, began with more of an interest in the visual side of storytelling.

“One of my teachers heard about this project and told me about it because she knew I’m a fan of photography,” Carr says. “My favorite lesson was listening to a photographer talk about the best ways to get a good picture.”

The project was not only a chance to further develop her skills with a camera, she adds, but also a way to explore other facets of storytelling. She also hit upon one of the most unexpected climate change impacts the student group discovered: the damage to horses’ hooves.

“My friend has horses,” she says, “and I remembered her once telling me that she had to evacuate with her horses to New York to avoid one of the hurricanes, because of the risk to the horses and their hooves.”

Ariel Shipman, a high school student in Tabor City, heard about Youth Climate Voices from her broadcasting teacher, who said it would be a great way to use her writing skills.

Shipman says the workshops were informative — and very interactive. “They made us come out of our shells,” she explains. “I gained new social skills, writing skills, and creative skills. I think, in a way, this made me more open to speaking up about new things I’ve come up with.”

With glowing reviews from the students, Hoban and team are hoping to continue the Youth Climate Voices program, with more podcasts from students all over the coast. Witnessing the students grow has provided all the motivation the team needs, as they watch these youth take on new challenges, connect with mentors, and visualize themselves on career paths they never considered before.

As Shipman discovered, “Our imaginations are broader than we think.” 🗨️

- Youth Climate Voices is available through several podcast platforms and at go.ncsu.edu/nc-health-news-YCV or shoresides.org/show/coastal-youth-media-project.
- Community Collaborative Research Grants go.ncsu.edu/CCRG
- North Carolina Health News northcarolinahealthnews.org
- Working Narratives: workingnarratives.org
- Kenan Institute for Engineering, Technology, and Science kenan.ncsu.edu
- Water Resources Research Institute wri.ncsu.edu
- North Carolina Sea Grant ncseagrant.ncsu.edu

Lee Cannon is a communication specialist for the Water Resources Research Institute, NC Space Grant, and North Carolina Sea Grant. Her Zoom calls occasionally feature guest appearances by her 10-month-old son.

BY LAUREN D. PHARR

CONSERVING

“Gullah/Geechee communities are typically found in areas where there are remnants of rice, indigo, and cotton. The culture is unique in that because of the seclusion found in those areas, people have been able to retain many West African traditions that aren’t found as often in other African American communities. The Gullah/Geechee people have been able to hold on to their roots.”

— COURTNEY MCGILL, PROGRAM SPECIALIST AT THE UNIVERSITY OF GEORGIA’S MARINE EXTENSION AND GEORGIA SEA GRANT, AND A MEMBER OF THE GULLAH/GEECHEE COMMUNITY

Queen Quet leads a movement to retain and reclaim Gullah/Geechee land.





A CULTURE

Land Development, Climate Change, and the Gullah/Geechee Nation

The Albemarle-Pamlico Sound region and communities southward along the Atlantic coast are home to millions of people — including nearly 500,000 residents of the Gullah/Geechee Nation, who inhabit a 500-mile stretch between Jacksonville, North Carolina, and Jacksonville, Florida.

The South Carolina coast sits at the heart of this terrain and is one of the most popular tourist destinations in the region. Nearly 7.3 million visitors flocked to the Charleston area in 2018 alone (an indicator of its pre-pandemic popularity), pushing the economic impact of the region's tourism to a record \$8 billion that year. Hilton Head Island, one of South Carolina's award-winning tourist destinations, itself typically attracts about 2.5 million visitors a year.

The Southeast coast also serves as an important foundation for the Gullah/Geechee Nation, whose people, over the years, have seen aspects of their culture vanish. With the increase in tourism comes more development of land, which, in turn, has displaced many important practices and beliefs of the Gullah/Geechee community.

The Gullah/Geechee Nation is also experiencing the heavy impacts of climate change on its waterways. The ocean traditionally has provided many resources and has brought the community food security.

As the effects of global warming and development both severely test the resiliency of the Gullah/Geechee people, is it possible to preserve this important nation and its culture? And, if so, how?

**“DISYA WHO WEBE!”:
LANGUAGE, FOOD, AND ART**

The Gullah/Geechee people are the descendants of Africans enslaved on multiple cotton plantations, known as the “Sea Islands,” located off the coast of South Carolina and southward into Georgia and Florida. Over time, enslaved Africans of different tribes and regions met and intermingled, leading to the emergence of the “Gullah” people.

The dialects they spoke among themselves created a place to uphold African culture, despite the conditions of slavery, and ultimately led to the creation of their own

language, “Geechee” — a creole language specific to the coastal areas of North Carolina, South Carolina, Georgia, and Florida. According to the Gullah/Geechee Heritage Corridor, in fact, Geechee is the only distinct African creole language in the United States that has influenced traditional vocabulary and speech patterns in the South.

The history of the Gullah/Geechee is truly unique.

Courtney McGill, program specialist at the University of Georgia's Marine Extension and Georgia Sea Grant, is a member of the Gullah/Geechee community. When she was a child, her mother married a 9th-generation Sapelo Island descendant, and her family moved to the island, off the coast of Georgia.

“Gullah/Geechee communities are typically found in areas where there are remnants of rice, indigo, and cotton,” McGill says. “The culture is unique in that because of the seclusion found in those areas, people have been able to retain many West African traditions that aren't found as often in other African American communities. The Gullah/Geechee people have been able to hold on to their roots.”

Gullah/Geechee ancestors brought African cultural traditions in music, food, and art. Most of their arts and crafts are products designed for daily living, such as cast nets for fishing, basket weaving for agriculture, and textile arts for clothing and warmth.

McGill says the traditional diet of the Gullah/Geechee consists of vegetables, fruits, and seafood — including okra, peas, berries, watermelon, shrimp, crabs, and fish.

“I have so many rich memories of seine net fishing with the entire community and having large fish fry cookouts with the catch of the day, learning how to make sweet grass baskets, listening to ‘griots,’ such as the late Cornelia Walker Bailey's storytellings, and attending church, where we would participate in call and response worship services,” she recalls. “It is important for this culture to persevere, so that we maintain these connections to our ancestors and our history.”

Marquetta Goodwine, also known as Queen Quet, is founder of the Gullah/Geechee Sea Island Coalition and the first elected Chieftess of the Gullah/Geechee Nation. She says that North Carolina Sea Grant's “Quality Counts: A Consumer's Guide to Selecting North Carolina Seafood” has helped the Gullah/Geechee become more aware about seafood safety today.

“It was great to have that little guide,” she says. “A person who was living or visiting the area knew what was safe to eat.”



Gullah/Geechee arts and crafts often have practical applications and include cast nets for fishing, textile arts for clothing and warmth, and renowned sweet grass baskets like the one Vera Manigault weaves here.

VANISHING LAND

Back in the 1900s, land on some of the Sea Islands where Gullah/Geechee ancestors were once enslaved — including Cumberland, Jekyll, and Sapelo — became either resort locations or reserves for natural resources. This was the precursor to modern-day conflicts over resort development.

Surviving members of the community have taken many measures to help maintain and protect their culture, holding onto

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Diedre Laird / NPS

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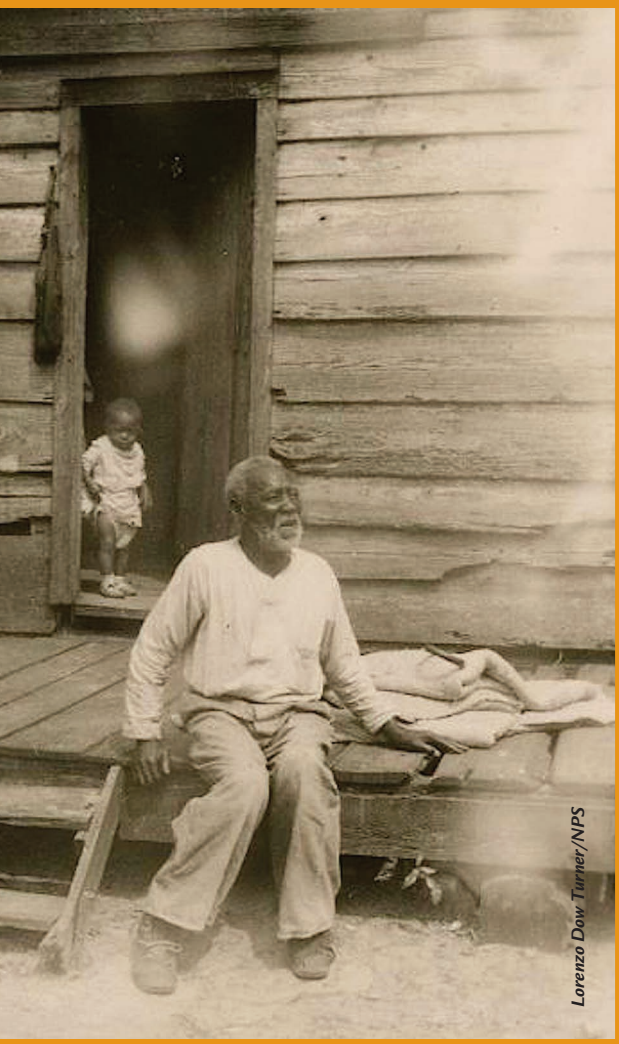


Boone Hall Plantation in Charleston County, South Carolina, offers visitors a Gullah drumming performance. Enslaved ancestors of the Gullah/Geechee brought African cultural traditions in food, art, and music to the Americas.



Gullah/Ceechee Sea Island Coalition Alkebulan Archive

Queen Quet carries heirloom seeds necessary to sustain the community's traditional agrarian practices.



Lorenzo Dow Turner/NPS

A Gullah/Geechee family on one of the Sea Islands off the coast of South Carolina or Georgia, ca. 1932.

the traditions that their African ancestors brought to America, as well as legally obtaining and staying on the isolated former plantation lands where their ancestors were enslaved.

The Gullah/Geechee initially bought their lands during the Civil War. By communally owning land passed down generation to generation — also known as “heirs’ property” — Gullah/Geechee people became the first group of African descent in North America to own land *en masse*.

Over the years, though, threats to Gullah/Geechee land ownership have brought drastic changes through both an abundance of continuous land development and legal loopholes.

“Folks come in with bulldozers,” said Queen Quet to *Vice News* in a 2016 interview. “And the first thing we see is that they want to dig up what we’ve already had for all these generations. And then they want to build something that’s apathetical to our culture.”

In South Carolina, construction contributed roughly \$12.6 billion of the state’s GDP in 2019. More specifically, private *nonresidential* spending in South Carolina totaled \$5.5 billion.

Hilton Head Island was one of the first elite vacation spots, and according to media reports its development has forced out about 300 Gullah/Geechee families. Land development, including a mixture of golf courses and resorts, has caused such a dramatic displacement of Gullah/Geechee communities, in fact, that one news account stated that burial grounds of Gullah/Geechee ancestors now make up the backyards of million-dollar condominiums.

Initially, heirs’ property arrangements helped to keep extended family properties from development, but over the years, developers have found legal openings, thanks to arcane property law.

“The history of Hilton Head and current Gullah communities reminds me of the concept of ‘highest and best use’ in real estate,” says Jane Harrison, North Carolina Sea Grant’s coastal economics specialist. “Property is appraised with a price that represents what the highest bidder will pay, regardless of the current occupants. People are displaced who do not have the financial capital or power to remain in a place. This process leads to a loss of culture and scattering of traditional communities.”

Overbuilding in the Gullah/Geechee community also has blocked important fishing access points to waterways, and some fishermen end up having to go out on foot, instead of on their boats, to catch blue crab or shrimp.

Quet says access points are essential in order for Gullah/Geechee people to

engage coastal areas and to protect them for future generations. Gullah/Geechee culture doesn’t make use of docks, instead making use of landings, but she adds that docks are proliferating along the coast.

“Furthermore, the shading from docks creates a situation where species that may depend on direct sunlight are not receiving it,” she explains. “And as a result, aquatic life who depend on those species will migrate away.”

Natural hazards exacerbate the situation.

“If a tropical storm or a hurricane tears a part the dock, the leftover debris enters the water,” she says. “The people who wanted the private dock end up not wanting to take responsibility of cleaning it out of the water. As humans, we all have a responsibility to protect these waterways.”

Additionally, the Gullah/Geechee Nation has been fighting a 10-year legal action for access to fish along the coast from North Carolina to Florida, ensuring that each state has Gullah/Geechee subsistence rights and laws in place.

However, in South Carolina, conflicts continue to arise among commercial fishers, the state’s Department of Natural Resources, and Gullah/Geechee fishing families, while in Georgia and Florida, the Environmental Defense Fund’s listening sessions in Brunswick and Fernandina documented and discussed broader concerns of African American fishermen, highlighting great overhead costs, diminishing waterfront access, overfishing, and the price of fuel.

RISING SEAS AND CLIMATE CHANGE

“We teach our children the same traditional ways to go out in the water, and the same traditional ways to live from the land, only when things are in season,” says Queen Quet.

Yet, 2019 brought record-breaking temperatures that marked North Carolina’s warmest year on record, and the *North Carolina Climate Report* projects a continued increase for the state in temperatures, precipitation, storms, floods, droughts, wildfires, and sea level rise.

Meanwhile, climatologists predict that for our neighbors to the south in

Continued

Charleston, flooding from tidal flows and rain will become more frequent over the next 30 years. Further south, according to UGA Marine Extension and Georgia Sea Grant, scientists expect coastal Georgia to experience at least six inches of sea level rise within the next 50 years as a result of the changing climate. Florida Sea Grant says sea levels will have risen in 2040 up to a foot above 2000's levels.

Climate change also brings concerns about water quality; warmer waters can contribute to decreased oxygen levels in rivers and estuaries, which, in turn, will affect Gullah/Geechee resources, such as fish, oyster beds, and other seafood. Moreover, pollutants that have entered waterways from factories also bring health risks for the Gullah/Geechee's subsistence fishing families.

In addition, as more intense hurricanes and stronger storm surges become more frequent, the Federal Emergency Management Agency (FEMA) frequently has denied disaster assistance to Gullah/Geechee landowners. A 2017 U.S. Department of Agriculture study found that FEMA turned down claims for approximately 20,000 heirs' property owners following Hurricanes Katrina and Rita because the Gullah/Geechee reportedly were not able to show clear titles to their land. After Hurricane Matthew in 2016 left many structures damaged, most of the 18,000 assistance claims that FEMA denied in South Carolina counties also involved heirs' property.

Storms of all sizes, in fact, bring stressors to the Gullah/Geechee community. Flooding can impact fall crops, and even rains and winds that don't originate with tropical systems can damage what little infrastructure the Gullah/Geechee rely on.

The decision often comes down to choices about what's affordable to fix. Is it, for example, the leak in the roof or the leak in the boat? Both are crucial to Gullah/Geechee survival.

Another step the Gullah/Geechee are taking in preserving their culture is educating their youth on the impacts of climate change. "The Gullah/Geechee Fishing Association always seeks to engage the youth so that they can pass

down traditional knowledge, all while incorporating current scientific information concerning climate change," explains Queen Quet.

"It is important for youth, particularly in the Gullah/Geechee community to know how to thrive and survive on the land in order to sustain the culture. In the future, this will help and empower them when it comes to avoiding economical displacement."

PRESERVING THE HISTORY OF GULLAH/GEECHEE

The Gullah Geechee Cultural Heritage Corridor is a Natural Heritage Area designed to preserve, share, and educate. The Corridor offers public meetings four times a year, hosts educational programs, and engages with public and private entities on projects and collaborations.

New partnerships with the Gullah Geechee Heritage Corridor promote and enhance tourism development opportunities associated with Gullah/Geechee culture and history. For instance, UGA Marine Extension has been working with the Corridor as well as Gullah/Geechee community leaders on developing better marketing to create and provide different tourism opportunities in Georgia to share the Gullah/Geechee heritage.

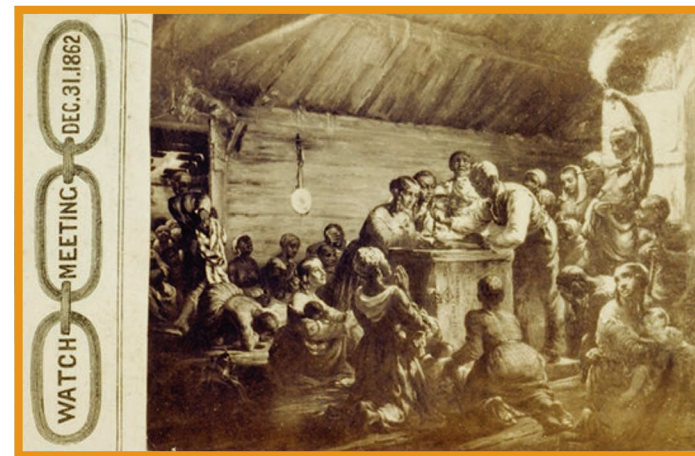
Bryan Fluech, associate marine extension director at Georgia Sea Grant, oversees the project. "Although the project is in its beginning stages," he says, "as an extension agent, a huge part of this whole process has been building internal trust and connections with the community."

Recently, the Gullah Geechee Chamber of Commerce in Beaufort, South Carolina, also received NOAA support to establish a Gullah/Geechee Seafood Trail, with designs on expanding it throughout the entire Corridor. The project will include extension and program directors from South Carolina Sea Grant Consortium, as well as other partner groups.

Although the Gullah/Geechee Nation faces many threats, continuing initiatives and

partnerships can help sustain and preserve its culture and history. In addition, the Gullah/Geechee's deep connections to the coast have made this community extremely durable.

"We know in the other world, there's this word called 'adaptation,'" says Queen Quet. "That word doesn't exist in the Gullah Language. There's this word called 'resiliency.' Doesn't exist in the Gullah Language. But we are resilient people who had to adapt to whatever the situation is that's coming against us." 🌍



Read More:

Gullah Geechee Cultural Heritage Corridor Commission

- gullahgeecheecorridor.org

Gullah Geechee Chamber of Commerce

- gullahgeecheechamber.org

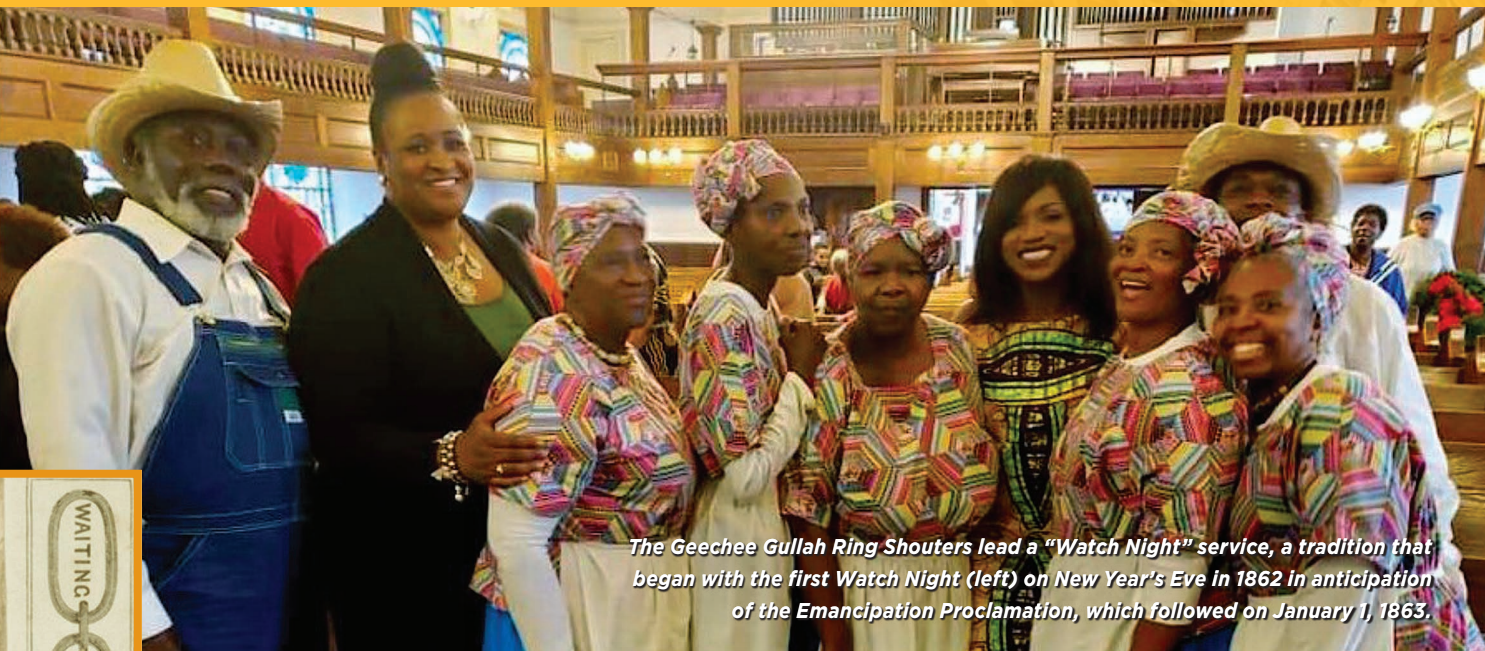
Gullah/Geechee Nation

- gullahgeecheenation.com

Quality Counts: A Consumer's Guide to Selecting North Carolina Seafood

- go.ncsu.edu/quality-counts

Lauren D. Pharr, a Ph.D. student in Fisheries, Wildlife, and Conservation Biology at NC State University, also is a science communicator with North Carolina Sea Grant, a Southeast Climate Adaptation Science Center Global Change Fellow, and winner of NC State's Forestry and Environmental Resources Fellowship for Excellence in Graduate Education.



The Geechee Gullah Ring Shouters lead a “Watch Night” service, a tradition that began with the first Watch Night (left) on New Year’s Eve in 1862 in anticipation of the Emancipation Proclamation, which followed on January 1, 1863.

WAITING FOR THE HOUR.



Through “Weeping Time” ceremonies like this, the Gullah/Geechee preserve the history of an infamous 2-day slave auction — the largest ever in Georgia — when a wealthy owner split apart families and friends during a torrential downpour, all to cover his gambling debts.



FIVE LESSONS FROM

The eel17/CC-SA-4.0 International



BY COREY DAVIS

YEARS LATER, LEARNED MATTHEW

TORRENTIAL INLAND FLOODING FROM THE
2016 HURRICANE WAS A WAKEUP CALL,
SPARKING STATE INVESTMENT IN
COORDINATED RESILIENCE EFFORTS.

Continued

IN THE AFTERMATH OF HURRICANE MATTHEW, GREENVILLE,
NORTH CAROLINA, NEAR PITT-GREENVILLE AIRPORT.

“THE LESSON WAS THAT EVEN THOUGH YOU JUST HAD THE BIG ONE, IT DOESN’T MEAN THERE ISN’T ANOTHER BIG ONE COMING SOON.”

— RICK NEUHERZ, SERVICE HYDROLOGIST AT NWS WILMINGTON

This past October marked the anniversary of one of North Carolina’s most destructive weather events. Five years ago, Hurricane Matthew brushed our coastline but still caused incredible inland impacts, including significant freshwater flooding that broke records set by Hurricane Floyd 17 years earlier.

Matthew was a bellwether. In 2018, Hurricane Florence set new rainfall and flooding records as it inundated communities still recovering from Matthew.

Climate and infrastructure specialists who experienced Matthew and its impacts first-hand have been reflecting on the past half-decade. The lessons learned from that storm have kick-started initiatives to improve resilience in eastern North Carolina.

HURRICANE TRACK AND INTENSITY DON’T TELL THE FULL STORY

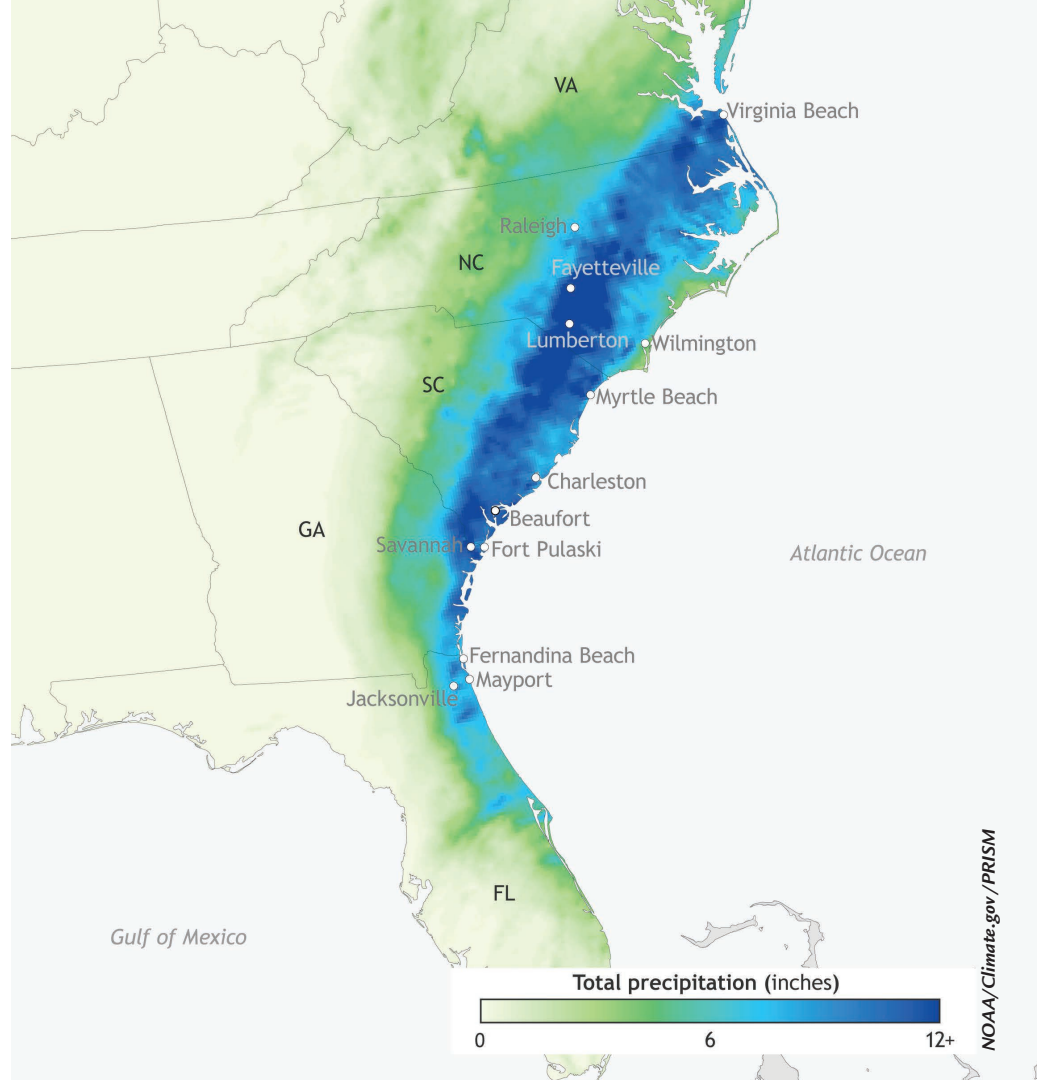
As Matthew churned northward across the Bahamas at Category-4 strength, some model forecasts showed the storm looping out to sea before doubling back toward the Southeast coastline.

Ultimately it avoided such an unusual path. But its actual track and evolution still complicated the National Weather Service’s messaging efforts. As storm behavior changed, expected precipitation totals for eastern North Carolina shifted.

“We convey that uncertainty in our briefings to emergency management and the media, but getting the message about the uncertainty to the public is a challenge,” says Rick Neuherz, service hydrologist at NWS Wilmington.

Despite weakening to a Category 1 and remaining mostly off the North Carolina coast, Matthew dumped a foot of rain in areas up to 100 miles inland.

“Matthew was a great example of why we



DESPITE WEAKENING TO A CATEGORY-1 STORM AND REMAINING MOSTLY OFF THE NORTH CAROLINA COAST, MATTHEW DUMPED A FOOT OF RAIN IN AREAS UP TO 100 MILES INLAND.

have to constantly reiterate in our messaging to not focus on the skinny black line on the forecast map and understand that the forecast cone is not an impact cone,” says Steve Pfaff, warning coordination meteorologist at NWS Wilmington.

Even after the rain ended, Matthew posed a meteorological threat. A period of strong winds on the back edge of the storm knocked down trees and power lines in the rain-weakened ground, leading to more hazards.

For anyone following the weather radar, those heavy winds would have seemed unlikely as precipitation waned. For that reason, Pfaff says, “we had to issue several messages to advise that the situation was not improving, and in fact winds were going to be worse at the end of the event.”

The lingering storm impacts — far from Matthew’s center, and hours after the rain had stopped — revealed the importance of communicating potential hurricane havoc.





Lance Cheung/USDA

OF THE 29 DEATHS ATTRIBUTED TO MATTHEW IN NORTH CAROLINA, 24 WERE DUE TO DROWNING, ALL IN FRESH WATER. A WEEK AFTER THE HURRICANE, FLOODWATERS STILL OVERWHELMED AREAS OF ROBESON COUNTY.

INLAND AND URBAN FLOODING DEMANDS MORE ATTENTION

On September 29, 2016, as Matthew had just reached hurricane strength 1,500 miles to our south, a long-lived thunderstorm dropped up to 10.5 inches of rain over Cumberland County. That deluge caused the Cape Fear River and its branches to surge, with excess water breaching the river banks and cascading into downtown Fayetteville, Fort Bragg, and surrounding communities.

During Matthew's rendezvous with North Carolina, it dropped an additional 14 inches of rain on the same areas, sending the Cape Fear rising once again. During an 11-day stretch, the Little River at Manchester twice eclipsed its long-standing high-water mark from 1945.

At least 17 dam failures were reported in North Carolina after Matthew, according to the *News & Observer*, and 13 of those were in the Cape Fear basin after those back-to-back heavy rain events.

Meteorologists at NWS Raleigh, who

issued forecasts and warnings for some of the hardest-hit areas along the Cape Fear and Neuse rivers, weren't surprised by Matthew's inland and urban flooding impacts. However, late changes in the forecasts, combined with a lack of historical flood events in those areas, still caught some people off guard.

"The news and the public focuses so much on the dunes and the surf zone, but in this case, so much of the damage and death happened inland," says Jonathan Blaes, meteorologist-in-charge at NWS Raleigh. By contrast, "there were no flooding fatalities in a county in North Carolina that touches saltwater," he says.

Of the 29 deaths attributed to the storm in North Carolina, 24 were due to drowning, all in fresh water. Those fast-rising and deadly inland flood waters in some ways changed how the NWS responds to, and crafts messages about, hurricanes and their impacts.

"Matthew was one of the steps in realizing things we needed to do" from a service perspective, says Barrett Smith, senior service hydrologist at NWS Raleigh.

For example, Matthew motivated local NWS offices to start sending meteorologists to inland areas such as Cumberland County, where they provide on-site expertise and updated forecast information to local officials. The idea is to help those communities prepare for potential threats like dam failures.

Greater coordination between the NWS, local municipalities, and partners — including N.C. Emergency Management, the U.S. Army Corps of Engineers, and others — was tested during Florence in 2018.

"Groups huddled to discuss hot-spot locations that would experience flooding, areas that may require evacuation, and [positioning of] resources in anticipation of major impacts that would affect life and property," says Diana Thomas, a meteorologist and planner with N.C. Emergency Management.

On a larger scale, after Matthew, the National Hurricane Center changed how it crafts messages about hurricane impacts on its website. "It used to focus mostly on the wind

Continued



Jonathan Shaw/NC Army National Guard

field and the track. Now on those web pages, rainfall is promoted more,” Blaes says.

In addition, the NWS launched the National Water Model, which can predict streamflow levels and velocities using high-resolution forecasts.

The local support that the NWS is now providing, along with enhanced models, is designed to increase awareness of, and preparedness for, the often rapid onset of inland flooding — especially in places that had never experienced such impacts prior to Matthew.

OUR INFRASTRUCTURE WAS DUE FOR AN UPGRADE

Some of the most unbelievable scenes during Matthew were stretches of major highways and interstates completely under water, effectively turned into new river branches by the overwhelming flood waters. Many local roads also became impassable.

The scale of Matthew’s infrastructure impacts presented a major response and recovery challenge for the North Carolina Department of Transportation (DOT), which manages roadways across the state.

“That single storm had the most pipe washouts of any that DOT has dealt with,” says Stephen Morgan, state hydraulics engineer.

In total, 728 drainage pipes were washed out during Matthew and more than 2,100 roads required repairs, according to a report published by the U.S. Geological Survey.

Rising flood waters in Fayetteville and Lumberton eventually reached the travel lanes of Interstate 95, closing a 60-mile stretch of the



DURING AND AFTER MATTHEW, STRETCHES OF MAJOR HIGHWAYS AND INTERSTATES WERE COMPLETELY UNDER WATER, AND MANY LOCAL ROADS WERE IMPASSABLE, IMPERILING RESIDENTS AND INFLECTING HARDSHIPS.

road for the weekend after Matthew, with some sections shut down for as many as 10 days.

Flooding on the interstate in Lumberton created a much larger problem in that area. As water spilled over the raised road and through a railway underpass, it inundated the city and created what at the time was the worst flood in Lumberton’s history, Morgan says.

“The same thing happened with Floyd. A lot of places flooded that hadn’t flooded before, especially in vulnerable and less-affluent communities,” he says.

Part of the DOT’s response to Matthew entailed organizational and technological improvements. Those efforts began with better tracking the department’s equipment across

the state, including the replacements for those washed-out pipes.

“The way we report, collect, and share that information has changed tremendously,” says Andy Jordan, the state hydraulics operations engineer. “The number of eyes on our current inventory has improved since Matthew. We know what we have on the ground, and we know what we have in our yards.”

The DOT has also partnered with N.C. Emergency Management to identify flood-prone roads using GIS software and to outline mitigation strategies in river basin studies of the Lumber, Neuse, and Tar rivers.

In addition, construction will begin next year on I-95 in Lumberton to reduce



NWS Wilmington



NASA

CROP AND LIVESTOCK LOSSES IN-STATE FROM MATTHEW WERE ESTIMATED AT \$400 MILLION. FLOODING CARRIED RUNOFF AND SEDIMENT INTO TRIBUTARIES, RIVERS, AND THE ATLANTIC.

the likelihood of significant roadway closures during future storms.

“When those designs are completed and constructed by 2026, we will have raised I-95 high enough to maintain its mobility and connectivity during a storm like Florence,” says Matt Lauffer, assistant state hydraulics engineer.

As Hurricane Matthew reminded us, keeping people and goods moving around the state is crucial to public safety and people’s livelihoods.

FLOODING ON FARMS CAN TURN FEASTS TO FAMINES

Hurricanes can be a blessing and a curse for North Carolina’s agricultural industry. In some areas, rainfall from tropical systems makes up nearly a fifth of the average warm-season precipitation. However, years without sufficient moisture can lead to punishing droughts that destroy crops.

But farming also suffers when a season’s worth of rain falls in less than a week, as

happened with Hurricane Matthew. The storm’s October arrival effectively wiped out many crops in eastern North Carolina just before the harvest.

“The biggest impact that I can remember is the loss of whatever crops were in the field,” said Dalton Dockery, the Columbus County extension director for NC Cooperative Extension. “We still had crops like sweet potatoes, soybeans, cotton in the ground, and had just begun harvesting peanuts.”

Summer had already been wet, thanks to soil-saturating rain from tropical storms Hermine and Julia. The additional water from Matthew had few places to go but fields and barns.

“Down east, it’s so flat and low and level that we’re talking a foot to 18 inches of water is all it took to get inundated,” says Richard Goforth, a specialized area poultry agent with N.C. Cooperative Extension.

In total, crop and livestock losses in the state due to Matthew were estimated at \$400 million, according to the N.C. Department of Agriculture and Consumer Services. That included 1.8 million chickens killed by the flooding.

Like Floyd, Matthew exposed the vulnerabilities of low-lying farms, and their potential impacts to the surrounding environment. Floyd caused 50 livestock wastewater lagoons to flood; six were breached, according to the Natural Hazards Center at the University of Colorado, sending a surge of sludge into nearby waterways.

In response, the state bought out 42 hog farms and decommissioned 103 lagoons located in floodplains, a move supported by the state’s then Clean Water Management Trust Fund.

That effort helped lessen the damage during Matthew. Case in point: Flooding was limited to six lagoons and two breaches, both on a hog farm in Greene County, according to the N.C. Department of Environmental Quality.

Not all eligible farms receive buyouts. For those that remain, hurricane flooding during harvest time will continue to pose a problem.

MATTHEW WAS A SIGN OF STORMS TO COME

The wait for Matthew’s meteorological successor didn’t take 500 years, 50 years, or even 17 years.

Only two years later, Florence dumped more than twice the rain seen with Matthew

Continued



Tech. Sgt. Jorge Intriago/U.S. Air National Guard

FROM RAIN TO RIVER CRESTS TO COSTS, BROKEN RECORD AFTER BROKEN RECORD, AND BIG ONE AFTER BIG ONE, FLOODING HURRICANES IN NORTH CAROLINA ARE THE NEW NORMAL.

and broke the record as the worst flood event in our state’s history. Its estimated \$17 billion in damage was more than triple Matthew’s \$4.8 billion bill.

That Floyd, Matthew, and Florence caused devastating inland flooding within a 20-year span comes as a shock to some weather forecasters.

“I was confident after Matthew I’d see no more huge floods like that one in my career, but after Florence I no longer have that confidence,” says Neuherz of NWS Wilmington. “The lesson was that even though you just had the big one, it doesn’t mean there isn’t another big one coming soon.”

From rain to river crests to costs, broken record after broken record, and big one after big one, flooding hurricanes in North Carolina are the new normal.

The North Carolina Climate Science Report, which summarizes changes in our climate and their impacts statewide, notes that tropical storms are getting wetter, which is increasing the likelihood of inland flooding.

Lessons learned from Matthew have helped inform the NCDOT’s flood resilience feasibility study for interstates 40 and 95. Its findings are already being implemented into design plans, such as bridges built with extra clearance to withstand a 100-year flood event.

The state is exploring how agriculture can better weather hurricane flooding as well. As reported by the Coastal Review, the General

Assembly approved legislation last year to implement flood control measures such as stream restoration and wetlands enhancement on working lands.

Indeed, a statewide 2017 greenhouse gas emissions study found that farms and forests offset 25% of North Carolina’s current greenhouse gas emissions, or more than twice the average rate of other states.

Matthew also inspired agencies and communities across the state to work together more closely.

“Matthew required a whole community approach to recovery,” says Thomas of N.C. Emergency Management. “The magnitude of the need required federal, state, local, private sector, and nonprofit agencies to develop creative solutions to recovery and communication following large disasters.”

Evidence of those collaborations includes the State Disaster Recovery Task Force, which advises state agencies on recovery and resilience measures related to infrastructure, agriculture, and public health. North Carolina Emergency Management also developed a state hurricane guide pamphlet to provide safety and preparation tips to homeowners, farmers, and business owners.

Five years after Matthew, parts of eastern North Carolina are still recovering financially, structurally, and emotionally. With a greater investment in coordinated resilience measures,

hopefully North Carolinians will be more prepared for, and capable of bouncing back, from hurricane disasters.

“To go visit a place after it floods is heart-wrenching,” says Blaes from NWS Raleigh. “The flood water, the mold, the slime, the mud is everywhere. It’s emotional and it lasts so long.”

Links to all sources and more information are available at go.ncsu.edu/lessons, where an earlier version of this article appears on the North Carolina State Climate Office’s “Climate Blog.”

NORTH CAROLINA SEA GRANT’S RESEARCH AND RESOURCES ON HURRICANES AND OTHER COASTAL HAZARDS

- go.ncsu.edu/coastal-hazards

COASTWATCH ON HURRICANES

- go.ncsu.edu/coastwatch-hurricanes

Corey Davis works for the North Carolina State Climate Office as assistant state climatologist. With state climatologist Kathie Dello, he co-authored “Inside the Greenhouse: North Carolina’s Hottest Year on Record” for the Summer 2020 issue: go.ncsu.edu/greenhouse.

Hurricane Noise, Live Weigh-Ins, and Wind Farms

The Latest Science for Anglers

CURATED BY SCOTT BAKER AND SARA MIRABILIO,
FISHERIES SPECIALISTS WITH NORTH CAROLINA SEA GRANT

HOW DO HURRICANES AFFECT CORAL REEF FISH?

Underwater sounds can provide important clues about the ecological health of a reef fish community.

by Sara Mirabilio, fisheries specialist with North Carolina Sea Grant

The Atlantic hurricane season concluded on November 30.

These storms wreak havoc on marine ecosystems, destroying coral reefs, mixing

up the water column, redistributing bottom sediments, and increasing pollution through stormwater runoff. Hurricanes also cause fish to evacuate nearshore estuaries and coastal ocean environments for deeper water.

- *Research Need*

One of the most common ways to assess the impact of a disturbance on a population or community of fish is to look at changes in the diversity and numbers of fish in a location.

Sound, however, also is a driving force of

ecological function. Whether fish are capturing prey, avoiding predators, listening for weather changes, or communicating with other species, they rely on sound as a critical component of normal function.

Thus, the underwater “soundscape” — the collective sounds from marine life and naturally occurring events (such as breaking waves) — is important to study and understand, especially if and when the soundscape fluctuates. In fact, changes to a marine environment’s

Continued

soundscape from human causes or natural causes (like hurricanes) can directly impact overall ecological health and the well-being of individual species.

But, not much is known about storm impacts on coral reef soundscapes.

- *What did they study?*

Sea Grant Knauss fellow Kayelyn Simmons and her colleagues examined the impacts of Hurricane Irma on the soundscape at two reef sites within the Florida Keys National Marine Sanctuary. Hydrophones recorded the underwater sound levels at the reefs in the months leading up to Irma, during the hurricane, and after the storm passed.

Generally, sound production by reef fishes varies between daytime and nighttime. From the hydrophone data, the scientists were able to differentiate the noise patterns of different species in the soundscape to assess whether the hurricane disrupted this pattern.

- *What did they find?*

The team observed that, on short time scales, daily patterns in the coral reef soundscape were resilient, despite “acoustic energy” (sound waves traveling through the water) during the storm and despite changes in environmental conditions resulting from hurricane damage.

Before the storm, the soundscape included a distinct daily, low-frequency pattern from sound-producing fish (including sea basses, groupers, snappers, drums, and grunts). During the twilight periods, there was increased high-frequency sound from snapping shrimp. In the weeks following the storm, the sound patterns produced by the fish were similar to those before, and the high-frequency noise associated with snapping shrimp showed only a small shift.

- *Anything else?*

As the storm passed, the cumulative acoustic energy near the seabed was comparable to a small vessel operating continuously overhead for 1 to 2 weeks, depending on the study site.

The extent to which a coral reef soundscape recovers from a hurricane may depend on characteristics of the reef, such as its structural complexity or the relative abundance of certain species — as well as characteristics of the storm itself, such as wind speed, direction, and duration.

DO OFFSHORE WIND FARMS AFFECT RECREATIONAL FISHING?

Yes — but maybe not like you’d think they would.

by Lauren D. Pharr, science communicator with North Carolina Sea Grant, and a Southeast Climate Adaptation Science Center Global Change Fellow

Offshore Wind Farms (OWFs) have emerged as the most common form of marine renewable energy generation. In fact, the U.S. has 16 active offshore wind farms covering over 1.7 million acres along the Atlantic coast.

Although interests in renewable energy has grown along with the expansion of OWFs, concerns from coastal communities, as well as from commercial fishers and recreationalists, also have increased. Recreational anglers, in particular, sometimes target fish in specific locations, which could cause potential conflicts with OWFs.

Therefore, understanding attitudes and behaviors of anglers towards OWFs has the potential to inform ocean management and avoid conflicts.

- *Research Need*

There have been few studies to assess the impact of OWFs on recreational anglers. Little research has attempted to document angler behavior or to understand their motivations and the factors that affect their satisfaction with fishing trips to OWFs.

Rhode Island’s Block Island Wind Farm (BIWF), which in 2016 was the nation’s first OWF to open, provided an opportunity for researchers to assess the impact of an OWF on anglers’ experiences.

- *What did they study?*

To begin understanding interactions

between OWFs and recreational anglers, researchers assessed the impacts of the Block Island Wind Farm through a combination of research methods. Initial interviews with anglers informed questions for a survey, and survey results then guided the team as it conducted follow-up interviews.

- *What did they find?*

Initial interviews took place in 2018 and had 19 participants; follow up interviews took place in 2019, which included 12 of the same participants. Charter operators, marina and tackle shop owners, private anglers, and spear fishers were among the participants.

Data from the surveys confirmed that anglers, specifically those who fished at the wind farm, strongly believe that the wind farm has benefited fishing. They also value the wind farm’s purpose of generating “green” energy. However, some anglers also reported their concerns about increased crowding at the OWF, which they feared could lead to future restrictions on fishing access.

- *Anything else?*

The foundations of the turbines on the BIWF provides structure throughout the water column. As a result, some anglers described the turbines as “growing food” for fish, noting that the structure creates water flow that “tosses the little bait [fish] around.” Anglers reported that this brought more recreationally popular species — such as black sea bass, fluke, and scup — to the BIWF site.

Additionally, the BIWF can give anglers the opportunity to see or catch new species not normally found in the region.

- *So what?*

Results from this study suggest that OWFs do not conflict with angling. Instead, anglers view BIWF as an enhanced fishing destination. The research team recommends future study of ocean-goers to inform managing issues (like crowding and access) — and to consider the benefits of nearshore OWFs for anglers and other stakeholders.

Continued

Some anglers reported the off-shore wind turbines were “growing food” for fish, noting that each structure creates water flow that “tosses the little bait around.”



WHAT HAPPENS TO RED DRUM AND SPOTTED SEATROUT AFTER LIVE WEIGH-INS AT TOURNAMENTS?

Red drum are slower to leave the area after release, and fewer die after tournaments than spotted sea trout.

by Scott Baker, fisheries specialist with North Carolina Sea Grant

- **Research Need**

Catch-and-release fishing is an ideal way to enjoy the sport while reducing pressure on popular fish stocks. Red drum and spotted sea trout are two of the most popular fish among saltwater anglers — and they're also the focus of many saltwater fishing tournaments.

Some tournaments have adopted the live weigh-in format, where anglers must bring in fish alive. After anglers catch fish, they transport them to the tournament headquarters, where officials measure and weigh the catch, ultimately to release the fish back into the surrounding waters to be caught another day.

We know that a large percentage of red drum and spotted sea trout survive catch and release during recreational fishing — but what about survival after the tournament weigh-in process? If they do survive, how long do they hang around the tournament site, and then where do they go?

- **What did they study?**

Scientists worked with fishers and organizers of the 2016, 2017, and 2018 Alabama Deep Sea Fishing Rodeo to track the survival rates and movements of live red drum and spotted sea trout after live weigh-ins. They documented the condition of the fish and where anglers caught them (when known), as well as length and weight. Scientists also implanted both an electronic acoustic tag and used an external streamer tag to aid in following the fate and location of each fish after release.

- **What did they find?**

The combination of tags allowed the research team to build a computer model to

determine whether fish lived or died within a 3-day window after the tournament weigh-in.

Estimates of the survival rates of both species fell within the documented range of recreational catch-and-release rates. Specifically, 6.1% of red drum died after weigh-ins, much lower than 30.6% of spotted seatrout that died.

Neither red drum nor spotted seatrout lingered in large numbers at the weigh-in site after release. Most spotted seatrout dispersed from the area within 2 weeks, but red drum took almost 5 weeks to disperse similarly. By the end of the 8-week sampling period, almost all fish had relocated from the weigh-in site.

- **Anything else?**

Although researchers didn't account for

summertime water temperatures in their model, warmer waters could have negatively impacted the survival of both species.

Increasing angler education on proper live-well practices could further increase fish survival, especially in the summer.

- **So what?**

Based on the data obtained in this study, the research team suggests that red drum and spotted seatrout tournament organizers should consider moving to live-release events only and hold them outside of summer conditions whenever practical. 📌

read the full studies and more at HookLineScience.com



Florida Fish and Wildlife/CC BY-ND 2.0



Andrea Booher/FEMA

Events in the aftermath of Hurricane Katrina are part of what informed Delandra Clark's interest in environmental engineering.

My Passion for Environmental Engineering

BY DELANDRA CLARK

CAREER GUIDES OFFER MURKY EXPLANATIONS ABOUT WHAT ENVIRONMENTAL ENGINEERS DO.

I recall the skeptical look on my mother's face when I recited the typical job description: "I'll use science to solve environmental problems." Her puckered brow suggested she heard, "I'll hug trees for a living."

Ripples of doubt about my chosen major began seeping into my own mind in 2019 when, as a college junior, I sat down one early morning at 1 a.m. to register for spring classes. A quick survey of my peers in a GroupMe chat confirmed my suspicion: They also struggled to craft clear definitions of environmental engineering. "I tell people we work with wastewater," texted one classmate. Another sent a meme of a caped superhero wrangling spreadsheets.

Looking around the deserted library, I popped the last chocolate-covered espresso bean into my mouth and wondered, "Why did I ever decide to pursue this degree when, clearly, I have no idea what I'm doing?"

Eventually I started remembering my connections to the natural environment.

My father was a heavy equipment operator for Local 3, the largest construction trade union in the United States. He worked in waterways across the country dredging rivers, building levees, and creating drainage canals. Flood control solutions like these protect lives and property by forcibly directing flow away from certain locations and towards others.

But when those measures fail, the results can be catastrophic, resulting in disasters such as the bursting levees in New Orleans after Hurricane Katrina, or lesser-known — but still highly destructive — flooding events, such as in rural areas of North Carolina.

Over the years, I have learned that brute-force flood control systems are no longer adequate. Those structures are frequently mangled by the water they were meant to hold back.

I have since realized that my passion is being part of an engineering

Continued



FEMA

Flood control solutions protect lives and property, but if such measures fail, the results can be catastrophic — like when this levee burst in New Orleans after Katrina.

movement that designs nature-based, resilient infrastructure that protects people and maintains community.

Real-world experience helped convince me.

PERSONAL PERSPECTIVES

In 2020, the summer before my senior year, I began working with North Carolina Sea Grant on a study investigating how natural infrastructure can help farming communities in eastern North Carolina manage the risk of flooding across the Coastal Plain.

I was a communications intern and wrote a narrative script for a video highlighting the research team’s collaborative efforts, which focused on Wayne County. As I interviewed engineers, economists, biologists, and designers, I realized that each specialist had a personal connection to the project. I began to see resilience in a different light.

“We can’t wait another 50 years to be proactive,” Michelle Lovejoy, executive director of the NC Foundation for Soil & Water Conservation, told me. Lovejoy coordinates the community outreach events for the project.

She shared a story about driving through Pender County one

night in 2019, six months after Hurricane Florence caused mass flooding in the area. Miles of darkened homes suggested the community had all but vanished. Lovejoy wondered if residents would ever be able to return to their farm family way of life.

“It’s one thing to lose your home,” she said, “It’s another thing to be uprooted and never be able to come back to the place you know, the place you love, the place you live, the place your ancestors lived.”

RESILIENCE REDEFINED

During this project I often ruminated on the fate of Glen Christina, a family friend of mine. He lived his whole life in New Orleans. Even after Hurricane Katrina flooded his house in 2005 and displaced his family and friends, he couldn’t bring himself to leave the one place where all his memories had been made.

Several years after Katrina made landfall, I received a call from the Orleans Parish coroner. Glen had died alone in his dilapidated home from an untreated abscessed tooth. Someone needed to claim his body to avoid a potter’s field burial (an unidentified grave), and I was on the list of Glen’s most recent cell phone contacts.

Back then, I was convinced that if Glen had been able to repair his damaged home in a timely manner, he'd still be alive. When the weather was wet or cold, he had spent so much time trying to find a safe shelter that he couldn't focus on other aspects of health — like making dentist appointments.

Talking with experts during my internship has brought me new perspective on Glen's situation. The hurricane had not only destroyed his roof but his social network. Friends who would have checked in on him or offered a ride had moved on to other states.

I've learned that resilience isn't just about protecting the built

environment. It's about safeguarding health, transportation, and commerce. It's about empowering people to support their communities before and after disasters occur.

"Knowing we are going to continue to get hurricanes," Lovejoy says, "we have to live smarter. It's about being proactive instead of reactive."

GAINING KNOWLEDGE

More and more, communities are considering expanding their resilience strategy to include natural infrastructure. As leader of a North Carolina Sea Grant effort on natural infrastructure and flood mitigation, water resources engineer Barbara Doll is examining how implementing practices like wetland restoration, reforestation, and water farming on private lands can lessen flooding while providing financial benefits to people living in rural areas. (Water farming entails using natural landscapes to store water during floods.) Ultimately, it's up to local landowners and farmers to decide if these practices are sustainable and make sense for them economically.

As many of my professors have told me, an environmental engineer must be familiar with several disciplines: chemistry, biology, mapping, statistics, soil science, and lots of math. I completed a seemingly endless list of mandatory courses, not really knowing how it all connected. My internship helped me understand. I have been building a scientific foundation so that I can help guide sustainable development.

Communities have greater capacity to weather disasters if they're given access to necessary scientific information about their risks and vulnerabilities. My role as an environmental engineer will be to equip people with knowledge they need to explore options and advocate for solutions. 🌱

MORE ON NORTH CAROLINA SEA GRANT'S FLOOD MITIGATION WORK

- go.ncsu.edu/floods

Delandra Clark served as a communications intern for a project on natural infrastructure and flood mitigation in eastern North Carolina before graduating in May from NC State University with a bachelor's degree in environmental engineering.



Zach Rudisim/CC-SA-4.0 International

Pender County's AME Church bore the highwater marks inside and outside, long after Florence had brought mass flooding to the area.



Joe Prusa/NC Division of Parks and Recreation

Red buckeye is one of six featured plants in a new video series.

Native Plant Picks

A NEW VIDEO SERIES HIGHLIGHTS BEAUTIFUL – AND ECOFRIENDLY – NC PLANTS.

BY JULIE LEIBACH

THE COASTAL LANDSCAPES INITIATIVE HAS RELEASED THE FIRST SIX VIDEOS IN A SERIES FEATURING NATIVE NORTH CAROLINA PLANTS.

Each video focuses on the plant’s main attributes and growing requirements, such as pollinator attraction and drought tolerance.

“We chose species that are ideal for a variety of coastal landscapes,” says project lead Gloria Putnam, North Carolina Sea Grant’s coastal resources and communities specialist. “We hope that these videos will inspire home gardeners and professional landscapers alike to purchase these species at local nurseries and incorporate them into their plantings.”

Three debut videos on goldenrods, rudbeckia species, and southern live oak join earlier releases from this fall, which feature:

- Red buckeye, a small tree with tubular scarlet flowers;
- American beautyberry, an understory shrub with stunning purple fruits; and
- Sweet pepperbush, a deciduous shrub with aromatic white flowers.

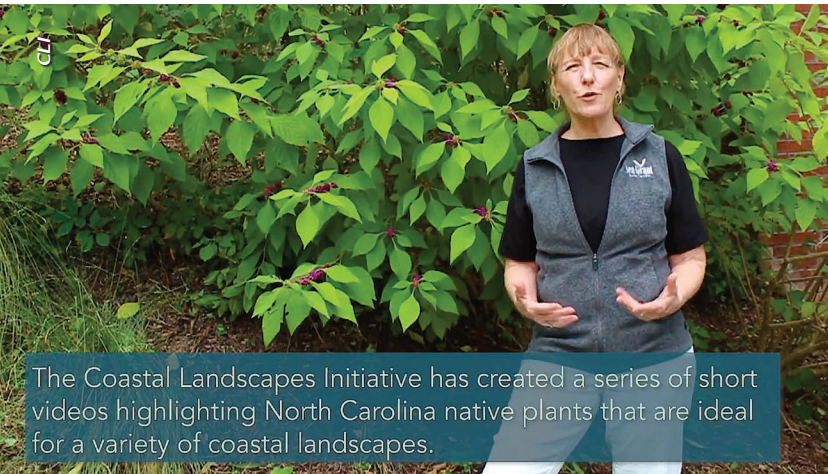
Upcoming videos in the “Native Plant Pick” series will profile more shrubs

and trees, as well as flowering perennial and grass species.

“Our team narrowed down a long list of potential plants to a dozen that stood out for a few key reasons, including their versatility, attractiveness, and wildlife benefits,” says horticulturist Kathy Mitchell of Coastal Roots Garden Design. “The series really does have something for everyone.”

The videos add to a growing number of free resources from the Coastal Landscapes Initiative, a North Carolina-based effort to create landscapes that are beautiful, maintainable, cost-efficient, and environmentally beneficial. Other CLI offerings include a set of 10 landscaping design templates, as well as a handy booklet and brochure featuring 34 native plants that flourish along the N.C. coast. Those products are available in print as well as online.

“CLI members want to help people choose plants that are naturally adapted to thrive in the harsh conditions of the coast — the strong sun and wind, the dry, sandy soil, and the salty air and water,” Putnam says. “By incorporating native plants into your landscaping, you can enhance local ecosystems while cutting maintenance costs.” 🌱



The Coastal Landscapes Initiative has created a series of short videos highlighting North Carolina native plants that are ideal for a variety of coastal landscapes.

The CLI's Gloria Putnam says using native plants makes for eco-friendly landscaping.

An overview of the Native Plant Pick series, plus the first six videos, are available on North Carolina Sea Grant's YouTube channel at:

- [youtube.com/user/NCSeaGrant](https://www.youtube.com/user/NCSeaGrant)

More coastal landscaping resources also are available at:

- go.ncsu.edu/CoastalLandscapes

The Native Plant Pick video team also includes horticulturist Rachel Veal of the N.C. Aquarium on Roanoke Island; consumer horticulture extension agent Emilee Morrison, of NC Cooperative Extension in Onslow County; conservation horticulturist Freda Pyron of the N.C. Aquarium at Pine Knoll Shores; Charley Winterbauer, co-chair of the Southeast Coast Chapter of the N.C. Native Plant Society; and North Carolina Sea Grant science writer Julie Leibach. Sea Grant's Scott Baker produced the videos with assistance from videographer Shane Moore.



American beautyberry, an understory shrub with stunning purple fruits.



Helen Penning/CC-BY-2.0 (edited)

Cigars and cigarette butts comprise almost a third of all reported items of marine debris.

NC MARINE DEBRIS BY THE NUMBERS

REPORTED TRASH IN OUR STATE TOTALS OVER ONE-HALF MILLION ITEMS —
AND THERE'S REASON TO BELIEVE THE ACTUAL TOTAL IS HIGHER.

BY JACKIE JAFFE AND CAMERON DECHURCH

PLEASURABLE ACTIVITIES LIKE FISHING OR EATING A PICNIC LUNCH CAN HAVE UNINTENDED CONSEQUENCES FOR MARINE ECOSYSTEMS, ANIMALS, AND EVEN HUMAN BEINGS. Whether it's a fishing line left behind or a plastic bag that accidentally flew away, our small actions can negatively impact the earth for thousands of years.

Marine debris has become one of the biggest environmental threats to the planet, with plastic comprising the bulk of this problem — and it's not just sea turtles that are hurt by floating debris disguised as delicious jellyfish. When the fish we eat have ingested microplastics, we might ingest these harmful substances, too.

As DukeEngage interns partnering with “North Carolina Marine Debris Action Plan”

organizations, we conducted a research project that examined North Carolina cleanup and observation reports from NOAA's Marine Debris Tracker App and the Ocean Conservancy.

When we looked at the numbers from 2016 to 2021, we learned that our state's marine debris included 552,957 collected or observed items from reporting counties.

Eleven of North Carolina's 20 coastal counties reported almost three-quarters of this

trash; the other nine coastal counties did not submit clean-up reports. All told, the statewide total of over one-half million items came from only 59 reporting counties (out of North

Carolina’s 100 counties), *underrepresenting* the amount of trash in the state’s environment.

Diving deeper into the statistics shows that cigars and cigarette butts are the most

prominent kinds of marine debris in North Carolina, nearly one-third of the total number of items of trash reported. This isn’t a surprise; tobacco waste is the most commonly reported litter worldwide. Once in the environment, cigarette butts release chemicals, including arsenic, which are harmful to marine life.

After analyzing data on the composition of marine debris, we found plastic to be the most common substance, comprising 71% of the items collected. This includes water and soda bottles, grocery bags, utensils, and anything else manufactured with that difficult-to-decompose material.

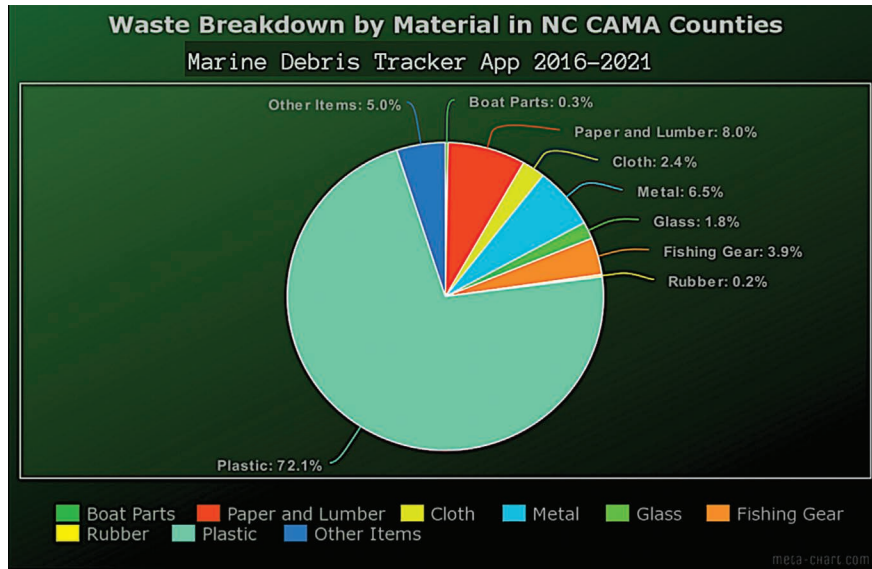
Plastic bottles, in particular, can take 450 years to break down, depending on various estimates. Because they didn’t exist before the 1940s, every plastic water bottle that consumers haven’t properly recycled or disposed of still exists in the environment today.

The “North Carolina Marine Debris Action Plan” highlights concrete steps businesses and governments can take to reduce marine debris. If the food industry implemented marine debris reduction strategies, for example, like swapping single-use plastics for reusable alternatives, the environment would directly benefit. The political sphere also can spark environmental change through public policies that address and prevent marine debris. 🌱

THE NORTH CAROLINA MARINE DEBRIS ACTION PLAN

- go.ncsu.edu/marine-action-plan

Jackie Jaffe and Cameron DeChurch, students at Duke University, served as DukeEngage interns for the “North Carolina Marine Debris Action Plan.” Partners on the Duke University Marine Lab’s DukeEngage N.C. Marine Debris Assessment project include North Carolina Sea Grant, U.S. Fish and Wildlife Service, N.C. Coastal Federation, Jennette’s Pier, and the North Carolina Coastal Reserve and National Estuarine Research Reserve System.



Rachel Bisess

From 2016 to 2021, the Marine Tracker App recorded 33,794 items of debris in the 20 N.C. counties subject to the Coastal Area Management Act, unique legislation designed to better protect the marine environment. Organized cleanups can help address the problem.



NOAA Fisheries

How Do Humpback Whales Behave Around Busy Atlantic Seaports?

RESEARCH REVEALS WHAT HAPPENS WHEN HUMPBACK WHALES AND BOATS OF ALL SIZES FREQUENT THE SAME HIGH-TRAFFIC AREAS.

BY SCOTT BAKER

HUMPBACK WHALES LIVE IN ALL OCEANS OF THE WORLD, INCLUDING THE ATLANTIC COAST, WHERE SOME MAKE REGULAR LONG-DISTANCE MIGRATIONS NORTH AND SOUTH. This charismatic species gets its name, of course, because of the large hump on its back. A favorite of whale-watchers, these animals jump partly out of the water and slap the surface with their pectoral fins.

In U.S. waters, both the Endangered Species Act and the Marine Mammal Protection Act protect humpback whales. However, these whales must ply the same waters as transatlantic cargo ships, military vessels, commercial and recreational fishing vessels, and pleasure boats. Not surprisingly, threats to humpback whales include vessel strikes, entanglement in fishing gear, and other forms of harassment from vessels.

On the U.S. Atlantic coast, researchers believe the waters in and around the mouth of the Chesapeake Bay are important feeding grounds for humpback whales. Yet, the mouth of the Chesapeake Bay also hosts the Port of Virginia,

the sixth busiest seaport in the world, and Naval Station Norfolk, the largest naval base in the world.

Scientists used satellite tags to track the movements and behavior of humpback whales within the high-traffic region of the Chesapeake Bay seaport from December of 2015 to February of 2017. In all, tags transmitted data for 35 humpbacks for an average of almost 14 days.

The research team then used the tagging data to construct a computer model to understand how whales behaved in local waters.

They found that all of the tagged humpback whales spent some time in the high-traffic shipping lanes near the seaport and mouth of the Chesapeake Bay. In fact, almost one-quarter of all tagged data came from within the high-traffic areas.

The team also determined that humpback whales spent 82% of their time foraging for food while in the proximity of the mouth of the Chesapeake Bay.

In addition, nine of the 106 humpback whales identified as part of this study showed evidence of propeller strikes.

Together, these results demonstrate that humpback whales spend a substantial amount of time in and around the high-traffic areas of busy seaports during the winter months. Although seasonal speed-reduction measures are in place for larger vessels along the Atlantic coast while humpback whales actively migrate through these waters, the scientists behind this study suggest that broadening the geographic range of such restrictions is a worthwhile consideration that could minimize possible interactions between humpbacks and vessels. 🌐

READ THE FULL STUDY:

Satellite Telemetry Reveals Spatial Overlap Between Vessel High-Traffic Areas and Humpback Whales (Megaptera novaeangliae) Near the Mouth of the Chesapeake Bay

• go.ncsu.edu/humpbacks

This story originally appeared on HookLineScience.com

Scott Baker is a fisheries specialist with North Carolina Sea Grant.



Samirra Saiferman-Oroza

What's the Status of American Eels in North Carolina's Tidal Creeks?

SCIENTISTS LOOKED AT WHETHER DEVELOPMENT ON TIDAL CREEK TERRAIN AFFECTED THE SURVIVAL RATE OF YELLOW-PHASE AMERICAN EELS.

BY AMBAR TORRES

AERICAN EELS SUPPORT RECREATIONAL AND COMMERCIAL FISHERIES IN THE EASTERN UNITED STATES AND ARE ONE OF THE MOST MYSTERIOUS CREATURES IN OUR WATERS. They are a “catadromous” species, which means they spend their larval stages in ocean environments and their juvenile and adult stages between coastal and freshwater environments. Because they move freely between these environments, they potentially are a resilient species.

But in recent years, the perceived health of the species — and the perceived health of the tidal creek habitat of juvenile eels — has been on the decline.

While habitat loss, poor water quality, and overfishing might all play a role in the decline of the American eel population, determining which factors actually contribute to fewer numbers of American eels is much more challenging.

Given that little is known about American

eels in coastal estuaries, tidal creeks present an interesting landscape to explore the link between habitat and juvenile eel abundance and survival rates. From 2015 to 2019, scientists from North Carolina State University studied how development along tidal creeks affected the catch, survival, and mortality rates of yellow-phase American eels.

The research team trapped and tagged 68 yellow-phase American eels and then recaptured eels at eight weeks to estimate catch rates in tidal creeks in Carteret County, North Carolina. The team also used watershed runoff and saltwater marsh cover as indicators of development in this region.

They found that survival of the eels is low in comparison to other locations along coastal habitats on the Atlantic. These low survival rates might be due to natural causes or fishing mortality in this region, but this needs further study.

Eels caught for this study were between 6 and 18 inches long. Catch rates were higher in the spring and lower in the winter.

Development along tidal creeks did not appear to reduce yellow-phase American eel catch rates. In fact, culverts even had a positive effect on the catch rates. However, this does not rule out possible adverse effects that large-scale development might have on the survival of yellow-phase American eels. 📌

READ THE FULL STUDY:

Survival and Habitat of Yellow-Phase American Eels in North Carolina Tidal Creeks

• go.ncsu.edu/american-eel

This story originally appeared on HookLineScience.com

North Carolina Sea Grant partially funded this project.

Ambar Torres is pursuing a master of science in fisheries, wildlife, and conservation biology at NC State. Her research addresses population demographics and climate change implications for the American eel in tropical streams.



Vanda Lewis

Clams Casino



Vanda Lewis

Flounder Fillets with Parmesan Stuffing

Clams Casino, Cornbread-Oyster Dressing, Sautéed Striped Bass with Garlic-Basil Butter, and More

BY VANDA LEWIS AND JOYCE TAYLOR

MARINER'S MENU, NORTH CAROLINA SEA GRANT'S POPULAR ONLINE SEAFOOD GUIDE, FEATURES BLOGGER AND PHOTOGRAPHER VANDA LEWIS'S PICTURES WITH HUNDREDS OF RECIPES THE LATE JOYCE TAYLOR DEVELOPED. ENJOY THESE SAVORY SPECIALS OVER THE HOLIDAYS AND DURING THE NEW YEAR.

CLAMS CASINO

- 24 littleneck clams, shucked and drained
- 24 1-inch pieces of bacon (about 3 slices)
- 2/3 cup of green onions, thinly sliced, including tops
- 1/2 teaspoon of black pepper, freshly ground
- 1/2 teaspoon of thyme
- 2 teaspoons of fresh lemon juice
- 1/8 teaspoon of Tabasco sauce
- 2 tablespoons of dry bread crumbs
- 1/4 cup of dry bread crumbs

In a medium saucepan, cook bacon until it's lightly browned.

Remove and reserve. Remove all but 4 tablespoons of bacon grease. Stir in the green onions. Add pepper, thyme, lemon juice, Tabasco, and 2 tablespoons of crumbs. Mix well. Remove from heat.

Place clams shells on the bed of rock salt in a sheet pan. Place each clam on a half shell. Spoon the sauce evenly over the clams. Sprinkle each with crumbs. Place bacon pieces on top.

Bake at 475° F until browned and liquid is absorbed (about 8 to 10 minutes).

FLOUNDER FILLETS WITH PARMESAN STUFFING

- 6 small flounder fillets, skinless
- salt
- black pepper, freshly ground
- 2 tablespoons of butter, melted

Prepare the *Parmesan Stuffing* (below), and set it aside.

Sprinkle fillets with salt and pepper. Roll them up, lapping small end over larger, leaving space in the middle for stuffing.

Place the rolled fillets in a greased muffin tin. Spoon the *Parmesan Stuffing* into the center of each. Baste the tops with melted butter, and



Vanda Lewis

Cornbread-Oyster Dressing

bake at 450° F until stuffing is lightly browned and fish flakes easily with a fork (about 20 minutes).

Parmesan Stuffing

- 2 tablespoons of butter
- 1/2 cup of onion, chopped
- 1/2 cup of celery, chopped
- 1 1/2 cups of fresh bread crumbs
- 1/2 cup of cheese, freshly grated
- 1/4 teaspoon of salt
- 1/4 teaspoon of black pepper, freshly ground
- 3/4 teaspoon of fresh basil, chopped

Melt the butter in a medium skillet over medium heat. Sauté the onion and celery until soft. Remove from heat. Combine with crumbs, Parmesan, salt, pepper, and basil.

CORNBREAD-OYSTER DRESSING

- 2 cups of oysters, drained, liquid reserved
- 3 tablespoons of butter
- 3/4 cup of onion, chopped
- 3/4 cup of celery, chopped
- 1/2 teaspoon of salt
- 1/4 teaspoon of black pepper, freshly ground
- 2 cups of cornbread, crumbled
- 2 cups of soft bread crumbs
- 1 tablespoon of dried parsley
- 3/4 teaspoon of dried sage
- 2 eggs, beaten

Preheat the oven to 400° F. Cook the *Cornbread* (below), and set it aside.

Lower the oven temperature to 350° F.

Melt the butter in a medium saucepan. Lightly sauté the onion and celery. Add salt and pepper.

In a large bowl, combine the *Cornbread* and crumbs. Add sautéed vegetables, parsley, sage, and eggs. Add the oysters and toss lightly.



Vanda Lewis

Sautéed Striped Bass with Garlic-Basil Butter

Add reserved oyster liquid until the dressing is moist but not packed.

Place it in a shallow, greased baking pan and bake, uncovered, at 350° F until done through and crusty outside (about 30 to 40 minutes).

Cornbread

- 1 cup of self-rising yellow cornmeal
- 1 cup of milk
- 1 egg

Mix the cornmeal, milk, and egg, and pour it into a shallow, greased pan. Bake at 400° F until brown (about 30 minutes).

SAUTÉED STRIPED BASS WITH GARLIC-BASIL BUTTER

- 1 1/2 pounds of striped bass fillets, skinless, cut into serving-size pieces
- 1 tablespoon of butter, melted
- 1 tablespoon of oil
- salt
- black pepper, freshly ground

Prepare the *Garlic-Basil Butter* (below), and set aside.

Pat the fish dry with paper towels. Season with salt and pepper.

In a large nonstick skillet, melt the butter with oil over medium-high heat.

Place the fish in the skillet and cook for about 6 minutes. Gently turn the fish over and cook about 1 to 2 minutes longer, or until done.

Serve with *Garlic-Basil Butter*.

Garlic-Basil Butter

- 1/2 cup of butter, softened
- 1 teaspoon of garlic, pressed
- 1 teaspoon of fresh basil, minced
- 1 teaspoon of fresh lemon juice
- 1/8 teaspoon of salt

In a small bowl, combine the butter, garlic, basil, lemon juice, and salt. Serve with warm fish. 🍴

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North Carolina Sea Grant
North Carolina State University
Box 8605
Raleigh, NC 27695-8605

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The annual conference for the North Carolina Water Resources Research Institute returns March 23 and 24. This hybrid event will take place in-person and online.

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Learn more about this Spring's conference at go.ncsu.edu/2022-conference.

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