

Heroic Surfmen • Fishing for Food • Shrinking Sharks • Old Sheepshead Bones

# Coastwatch

NORTH CAROLINA SEA GRANT • SPRING • 2022 • ISSUE 1 • \$6.95



## WINGS OF CHANGE

*Birds of  
North Carolina  
in a Warming  
Climate*

## A Time for Planning and Moving Forward

Spring is a time of renewal and rejuvenation, and we here at North Carolina Sea Grant are well into a fresh season of excitement with new research investments in faculty and students across the state, new community partners, new fellows, new team members, and more. The cycle is always inspiring. You will learn more about new projects throughout this edition of the award-winning *Coastwatch* magazine.

Speaking of cycles, I'd like to single out two people on our team, one joining North Carolina Sea Grant, and the other a longtime veteran who is retiring.

First, we welcome Erika Young. Erika recently began serving as our new coastal and marine education specialist after teaching at the University of North Carolina Pembroke for 13 years. You soon will see her mark on the educational programming that links North Carolina Sea Grant's research and extension to formal and informal education across the state. You can read more about Erika in this issue, as well as here: [go.ncsu.edu/Erika-Young](http://go.ncsu.edu/Erika-Young).

Second: I'm in awe of the long-standing accomplishments of Spencer Rogers, our retiring coastal construction and erosion specialist. Recently, Spencer received North Carolina's Order of the Long Leaf Pine for his service and achievements on behalf of the state. Although he may be retired, Spencer is never one to slow down, and his work continues through his support on technical content for local and state coastal resource management. Our communications director, Katie Mosher, interviews Spencer in this issue to get his take on a four-decade history of change along coastal North Carolina, including how our state was one of the first to require the study of sea level rise.

Our spring issue also includes the story of the famous Pea Island Surfmen, an all African-American lifesaving crew who successfully carried out a heroic — and historic — rescue operation at night and



Susan White

during a hurricane. We take a look at recent research, too, that investigated the informal networks that stretch deeply into communities, binding people who fish for food with those in need. In addition, this issue explores how a new generation of scientists is studying the effects of climate change on North Carolina's birds. And we also provide "Four Big Takeaways from our Study of North Carolina's Seafood Industry." (There's much more as well.)

Many people look at spring as a time for assessing and organizing for the future — and indeed North Carolina Sea Grant is currently in the process of gathering input from our many partners about new and ongoing strategic areas for our program to support and lead for the next five years. Our approach to updating our strategic plan is to include

as many voices and partners that represent the diversity of challenges and opportunities our coastal communities and environments currently face and anticipate — and that we need to address in coming years.

Our current strategic plan, which we updated in 2020, is available here: [go.ncsu.edu/the-strategic-plan](http://go.ncsu.edu/the-strategic-plan). We'll share opportunities to provide input and advice on our next phase of planning, but I also encourage you to contact me directly with your ideas at [snwhite3@ncsu.edu](mailto:snwhite3@ncsu.edu).

In springtime, hope for the future can feel real. In our partnerships with you and communities across the state, this hope can continue to become reality through ongoing research, outreach, and educational opportunities that support our resilience.

— Susan White, Executive Director, North Carolina Sea Grant

P.S. Spring also brings another season of fish and shellfish for enjoyment. Recipes in every issue of *Coastwatch* and online at [MarinersMenu.org](http://MarinersMenu.org) can deliver tasty seasonal treats to your home!

## IN THIS ISSUE

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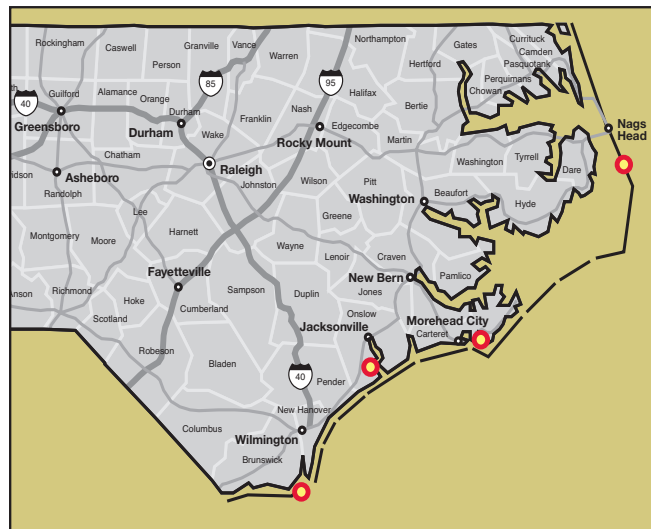
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Settings for the stories in this issue cover many locations in North Carolina, including these places from north to south on the map: Pea Island, Beaufort, Chadwick Bay, and Bald Head Island.



# Coastwatch

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□ Front Cover: Marae Lindquist West

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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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## COASTAL TIDINGS



Anne Smiley

Lauren Grimley

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### COASTAL RESILIENCE COMPETITION SELECTS WINNERS

A team of students from the University of North Carolina at Chapel Hill have won North Carolina Sea Grant's first Coastal Resilience Team Competition. The program will provide up to \$20,000 for the team to conduct their two-year project, which is designed to support more resilient habitats and communities on the North Carolina coastal plain.

Graduate students Anne Smiley, Lauren Grimley, and Helena Garcia, along with undergraduate Jacqueline Ruiz, will collaborate on "Incorporating Ecosystem Services into Flood-Resilience Planning in New Bern, North Carolina." Antonia Sebastian in the university's Department of Earth, Marine, and Environmental Sciences will direct the project.

"Flood resilience is a topic that spans the natural and social sciences," says Anne Smiley, graduate student lead for the project. "As the climate continues to change and floods become more frequent, we must develop strategies to increase community resilience. This is an exciting opportunity to collaborate with fellow students to address the topic of community flood resilience through a convergent lens. The team is excited to work together with the City of New Bern to translate this research to practice and maximize our impact in a region that prone to flood hazards."

The team plans to quantify how climate change and alterations to the natural

landscape influence ecosystems. In particular, they will look at flood-risk reduction and water-quality benefits, and they will assess the degree to which local plans support protection of the natural landscape.

"This research takes an integrated approach to resilience that makes a crucial connection between impacts of climate change and land-use and development patterns on ecosystems and the services they provide," says Cayla Cothron, climate resilience extension associate for North Carolina Sea Grant. "I'm hopeful that their work will generate invaluable information about how these factors are affecting natural systems and socially vulnerable populations and provide a framework for more holistic and equitable resilience planning that can help communities across NC that are increasingly dealing with these challenges."

The outcomes of this project will serve as the foundation for establishing a living lab in New Bern that links university researchers with local communities to facilitate collaboration on resiliency goals and climate mitigation research. In addition to presenting findings to the North Carolina Sea Grant Advisory Board, the team will share their results at conferences, in scientific journals, and through other media.

• **more funding opportunities:**  
[go.ncsu.edu/sea-grant-funding](http://go.ncsu.edu/sea-grant-funding)

— Lauren D. Pharr



### CURRITUCK SOUND COALITION PLANS FOR CLIMATE CHANGE

Audubon North Carolina and the Currituck Sound Coalition have announced a new Marsh Conservation Plan that identifies the complex web of threats facing Currituck Sound, offering a blueprint of how best to protect and restore it.

"The creation of the Marsh Conservation Plan was truly a collaborative effort by many partners," says Sarah Spiegler, coastal resilience specialist with North Carolina Sea Grant, one of the many partners on the coalition. "Continued coordination and collaboration will be crucial in protecting these special places in northeast North Carolina and throughout our coast."

The extensive freshwater marshes of Currituck Sound comprise a rare ecosystem and provide habitat to a wide variety of wildlife. These same wetlands also support human communities by filtering water, serving as a buffer against erosion and flooding, and supporting a thriving recreation economy.

Key strategies from the plan include conserving existing marshes, as well as identifying and protecting areas that could become wetlands in the future as seas rise and marshes migrate. The plan suggests prioritizing areas that both protect communities from flooding and create high quality wildlife habitat.

— from a news release by Audubon North Carolina

• **Marsh Conservation Plan:** [go.ncsu.edu/marsh-plan](http://go.ncsu.edu/marsh-plan)



Ashley Oliver

### NEW REEF FISHERIES FELLOW SERVES THE SOUTH ATLANTIC

Ashley Oliver has begun work as South Atlantic Reef Fish Extension and Communication Fellow, collaborating with South Atlantic Fishery Management Council and Sea Grant programs in the Southeast.

"I am very excited to connect with the fishermen in the southeastern region and spread valuable information on the best fishing practices that they can use," says Oliver, formerly a fisheries research technician at the University of Illinois. "I want to make a difference in the fishery, not only for the fish populations themselves but also help fishermen share their valuable knowledge with scientists and managers."

Scott Baker, fisheries specialist at North

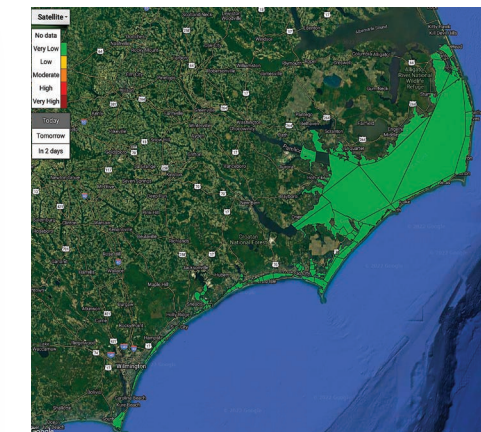
Carolina Sea Grant, notes Oliver is planning for offshore media tours and a science symposium. "She understands that stakeholders and managers have different perspectives, and effective science communication needs to be clear and relatable."

Mel Bell, chair of the South Atlantic Fishery Management Council, adds that as the number of fishers targeting offshore species continues to grow, so does the importance of best fishing practices to ensure the survival of fish that require release, such as red snapper.

"We're confident this fellowship will benefit the snapper grouper fishery in our region," Bell says.

— Nan Pincus

• **more:** [go.ncsu.edu/reef](http://go.ncsu.edu/reef)



### SHELLCAST APP PREDICTS LEASE CLOSURES

A team at NC State University has collaborated with NOAA partners, the N.C. Shellfish Growers Association, N.C. Division of Marine Fisheries, and others to create ShellCast, an app for predicting temporary shellfish lease closures.

The state issues lease closures when storm runoff pollutes coastal waters and potentially contaminates shellfish, which, in turn, could lead to human health concerns. Unlike standard weather apps, ShellCast provides growers with targeted information specific to a lease area.

"Temporary closures of shellfish harvest areas are a big challenge for many North Carolina shellfish growers and can have a big effect on inventory management, cash flow, and, ultimately, the bottom line," says Eric Herbst, North Carolina Sea Grant's coastal aquaculture specialist.

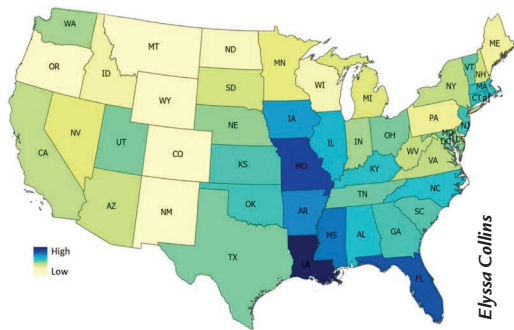
"Knowing the likelihood of a closure occurring in the immediate future can help drive decisions regarding resource and time allocation to mitigate or manage the effects of a pending closure on business," he adds.

The project began in 2020 under the direction of Natalie Nelson, who leads the Biosystem Analytics Lab at NC State. North Carolina Sea Grant, NC State's Biological and Agricultural Engineering department, and the Southeast Coastal Ocean Observing Regional Association all provided support.

"We're continuing to improve ShellCast in response to grower feedback," says Nelson.

— Carrie Clower

• **more:** [go.ncsu.edu/shellcast](http://go.ncsu.edu/shellcast)



Elyssa Collins

## Is FEMA UNDERESTIMATING FLOOD DAMAGE EXPOSURE?

New findings from North Carolina State University researchers suggest that recent flood maps from the Federal Emergency Management Agency do not capture the full extent of flood risk. North Carolina Sea Grant and U.S. Geological Survey Southeast Climate Adaptation Science Center supported the research.

The study found a high probability of flood damage — including monetary costs, human injury, and loss of life — for more than a million square miles of land across the United States over a 14-year period. That was 790,000 square miles more than the flood risk zones FEMA’s maps have identified.

“We’re seeing that there’s a lot of flood damage being reported outside of the 100-year floodplain,” said Elyssa Collins, a doctoral candidate in the NC State Center for Geospatial Analytics and the study’s lead author. “There are a lot of places that are susceptible to flooding, and because they’re outside the floodplain, that means they do not have to abide by insurance, building code, and land-use requirements that could help protect people and property.”

The team determined that the 30 most high-risk counties in the nation include North Carolina’s Dare, Hyde and Tyrrell.

— adapted from a story by Laura Oleniacz, NC State News

- **full study:** [go.ncsu.edu/flood-risk](https://go.ncsu.edu/flood-risk)
- **more on this team’s work:** [go.ncsu.edu/flood-map](https://go.ncsu.edu/flood-map)



Andrew Bone/CC-BY 2.0

## CHARGE UP ON THE COAST

Drivers of electric vehicles will find that escaping to the North Carolina coast is becoming more convenient.

For travelers heading to Wilmington along I-40, the Mad Boar Restaurant & Pub in Wallace hosts several DC fast chargers. For Teslas, there are eight Supercharger stalls, and for other electric vehicles, Four County EMC provides a ChargePoint station.

Visitors to North Carolina’s Crystal Coast will find two stations available for guests at the Atlantis Lodge. In North Topsail Beach, Hampton Inn Sneads Ferry offers a publicly accessible charging station, thanks to Jones-Onslow EMC.

For beachgoers on Ocean Isle, Holden Beach, and Emerald Isle, Brunswick Electric

and Carteret-Craven Electric Cooperative have installed charging stations just minutes from the sand.

Halfway down Hatteras Island, motorists will find a ChargePoint DC fast charger, installed by Cape Hatteras Electric Cooperative near the Avon Fishing Pier.

“We have drivers coming from all over the country,” says Laura Ertle, director of public relations and marketing at Cape Hatteras Electric Cooperative. “We’ve also seen an increase in the variety of vehicles that are charging. . . everything from hybrid minivans to high-end, all-electric vehicles from Audi, Porsche, and BMW.”

— from a story by Jacob Bolin and Jonathan Susser, courtesy of Carolina Country

## NEW EDUCATION SPECIALIST JOINS SEA GRANT

Erika Young is North Carolina Sea Grant’s new coastal and marine education specialist.

Young taught at the University of North Carolina Pembroke for 13 years, where she served as a mentor through the Research Initiative for Scientific Enhancement. She also engaged communities in science education through the Morehead Planetarium, the NC Science Festival, and Boys and Girls Clubs.

“I often visit local schools in underprivileged counties to talk to K-12 students about STEM fields,” Young says. “I grew up in Robeson County and understand how important it is to have a connection with your audience.”

Young says that as a Native American undergraduate she was unaware of career opportunities — until a summer herpetology study set her path.

“I collected local frogs and tadpoles from ponds to study pigmentation and camouflage,” she recalls.

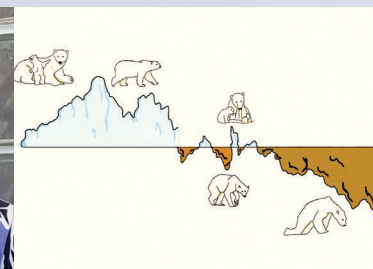
The experience led to more opportunities for research, then a master’s degree at Western Carolina University and a doctorate at UNC Chapel Hill, where she focused on aquatic ecology.

“I am super excited to be a part of North Carolina Sea Grant,” she says. “I look forward to developing relationships with our various stakeholders and continuing stewardship for our coasts.”

- **more about Erika Young:** [go.ncsu.edu/Erika-Young](https://go.ncsu.edu/Erika-Young)



Erika Young



Winning art by Bucky Matthews

## STUDENTS EARN CLIMATE ART HONORS

The NC Climate Education Network hosted a contest for visual art based on 30-year climate graphs and data, and K-12 students across the state submitted entries last fall.

The three winners, one each from elementary, middle, and high school, are Hansithi Teluguntla at Fuller Elementary, Jonah Risner at New Century Middle School, and Bucky Matthews at Haywood Early College.

Contest submissions are now closed, but the NC Climate Education Network will continue to accept submissions through 2022 to display on its website.

The network provides educational materials and support for educators to enhance their curriculums, with an emphasis on climate issues and awareness, as well as connecting scientists, researchers, and educators. North Carolina Sea Grant was among the first partners.

— from a news release by NC DEQ

- **submit artwork here:** [arccg.is/1yDvnK1](https://arccg.is/1yDvnK1)



New research finds that a small rise in temperature in the Atlantic is likely to increase the natural mortality rate of many marine fishes. A team of scientists examined archived life history data from 100 fish species common on the Scotian Shelf, part of the coastal Atlantic Ocean between the Labrador Current to the north and the warm waters of the Gulf Stream to the south.

Using computer modeling, the research team explored how a predicted 10% decrease in maximum size of adult fish due to global warming would affect natural mortality rates. Their findings suggest that most bony fish species in the study will realize a 10.5% higher rate of natural mortality with a 1.8° Fahrenheit rise in ocean temperature.

Modeling also predicted smaller-bodied fish species will experience greater increases in natural mortality than larger-bodied species. The researchers identified several fish species at “high” or “very high” risk, including many popular with recreational and commercial fishers: swordfish, spiny dogfish, Atlantic cod, greater amberjack, and summer flounder, among 32 others.

Thanks to this research, scientists now have a simple approach to examine how natural mortality rates — and, thus, long-term population viability — might change with small increases in ocean temperature.

- [HookLineScience.com](https://HookLineScience.com)

## Tangled in Trash: A Reporting Tool for Wildlife

NOAA Marine Debris Program | North Carolina, South Carolina, Georgia

Anyone can join!



## NEW “TANGLED IN TRASH” APP RELIES ON GRASSROOTS REPORTING

The first reporting tool designed to document when and where marine debris harms animals in the Carolinas and Georgia is now available. The “Tangled in Trash” app relies on information from anyone who finds wildlife entangled or injured in marine debris and trash.

“We’re eager for people to begin documenting what they’re seeing in North Carolina and across the region,” says Gloria Putnam, North Carolina Sea Grant’s coastal resources and communities specialist, and a member of the team who provided input for the app.

Kelly Thorvalson, conservation programs manager for South Carolina Aquarium and coordinator for the project, says Tangled in Trash will collect several types of key information.

“More than 200 species of wildlife have been documented as being affected by marine debris but interactions are not well understood,” explains Thorvalson. “This tool will house reported wildlife and marine debris interactions to help users, researchers, wildlife responders and others identify critical trends and concerns and strategize actionable solutions.”

The Wildlife and Habitat Impacts Working Group, part of the NOAA-facilitated Southeast Marine Debris Action Plan, offered insight and feedback on Tangled in Trash. The app uses Anecdota, an online platform available from the MDI Biological Laboratory.

The NOAA Marine Debris Program and National Marine Sanctuary Foundation funded the project.

— Dave Shaw

- **download the app:** [go.ncsu.edu/tangled](https://go.ncsu.edu/tangled)



The Pea Island  
Surfmen Prove  
Themselves on  
a Heroic Night

# FIRST WAVE

BY BRIDGETTE A. LACY

LEFT: After Richard Etheridge led an all African American lifesaving crew at Pea Island on a daring rescue in 1896, for the next six decades African American commanders served at the station. Here, a Pea Island crewman stands watch, ca. 1942.

FSA/Office of War Information

After a 393-ton schooner ran aground off Pea Island at night during a hurricane, Richard Etheridge (left) and his surfmen began rescue operations that lasted until 1:00 a.m.



U.S. Coast Guard

**W**hen Richard Etheridge peered out of the tower of the Pea Island Lifesaving Station that he commanded, he could hardly see for the blinding hurricane.

That Sunday night in October 1896 was going to be cold and long. Strong northeast winds whipped around the station on the northern shore of Hatteras Island.

Etheridge, a Dare County native and a Civil War veteran, was the first Black person to be appointed Keeper of a U.S. Lifesaving Service station, and he was the first of a line of Black commanders at the Pea Island Station that lasted more than six decades.

This particular Sunday night, he and his all-Black crew were not going to win any medals, but their heroics would be etched in history.

Caught in the storm was the *E.S. Newman*, a 393-ton schooner, captained by S.A. Gardiner, en route from Providence, Rhode Island, to Norfolk, Virginia. Gardiner was traveling with eight other people, including his wife and 3-year-old child.

The three-masted schooner ran into the hurricane, which ripped its sails away and blew the vessel 100 miles off course, into seas that were the responsibility of Etheridge and his team.

Surfman Theodore Meekins scanned the turbulent waters from the Pea Island watch tower, where he was on duty from dusk to 9 p.m. The darkness, the blowing sand, and the raging storm made it hard to see, but Meekins caught a flicker of light to the south of the lifesaving post.

The surfman set off a flare. If there was a sinking vessel on the Atlantic Ocean, Meekins wanted to signal the crew that they had been spotted.

**“You have to go out, but you do not have to come back.”**

The U.S. Lifesaving Service was established in 1848 to provide rescue services to all of America’s coasts. The service merged with the U.S. Cutter service in 1915 to form the U.S. Coast Guard.

The lifesavers’ unofficial motto was *You have to go out, but you do not have to come back.*

*Continued*

Richard Etheridge, who grew up on the water in Dare County, came to the Lifesaving Service with some command experience already. He had served in the Civil War as a Buffalo Soldier — the first Black cavalry regiment in the U.S. military.

After the 1864 Chaffin's Farm fight near Petersburg, Virginia, Etheridge was promoted to sergeant. The skirmish led to the capture of Richmond, the Confederacy's capital.

When white Union Army soldiers cheated Etheridge and other African American soldiers of their rations and mistreated their families, Etheridge didn't let the offenses pass. He wrote to General Oliver O. Howard, the commissioner of the Freedmen's Bureau in Washington, DC.: "Our families have no protection, the white soldiers break into our houses, act as they please, steal our chickens, rob our gardens, and if anyone defends themselves against them, they are taken to the guard house."

### Where Others Failed

After the war, Etheridge returned to Nags Head Township, married, and resumed his life as a fisherman and a surfman.

In 1879, Pea Island's all-white crew, as many Lifesaving Stations had in that era, came under scrutiny for not responding to a British vessel in distress, which contributed to the deaths of 17 crew and passengers aboard. Lieutenant Charles F. Shoemaker, the officer who investigated the tragedy, recommended to the superintendent that Etheridge be given the position of Keeper, after the previous crew was dismissed.

Etheridge had a reputation as one of the best surfmen on the coast. He had worked at the Bodie Island and Oregon Inlet lifesaving stations as a surfman — though not in the top leadership position of Keeper.

In 1880, following Shoemaker's recommendation, Etheridge became the first Black Keeper of a U.S. Lifesaving Service station, bringing together the all-Black Pea Island lifesavers, who individually were some of the best surfmen on the Atlantic Coast.

At the time, there were 18 stations in North Carolina and 179 in the United States. For the nearly 70 years that followed, Pea Island would be manned by all-Black crews. Etheridge and his men inspired a generation of Black men to join the Coast Guard.

### The Well-Prepared, Sharp-Eyed Leader

Etheridge's station consisted of seven surfmen, including himself. Each surfman had a number, a rank. If something happened to the Keeper, the No. 1 surfman was next in line.

At "checkerboarded" stations, those that were integrated, Black surfmen generally were numbers five and six, and performed menial duties, including cooking.

Etheridge understood the burden of being the first Black man to hold such a respected position and made sure that no one could question the ability of his crew. He was a sharp-eyed leader who kept a clean station, drilled his men constantly, and kept his equipment in good working condition. Inspectors consistently mentioned his station was one of the finest on the coast.

Etheridge was well-prepared for his role. He had grown up listening to the crash of the ocean, when Dare County was an isolated stretch of land and fishing was its chief industry. So as a boy he learned to fish and respect the power of the water.

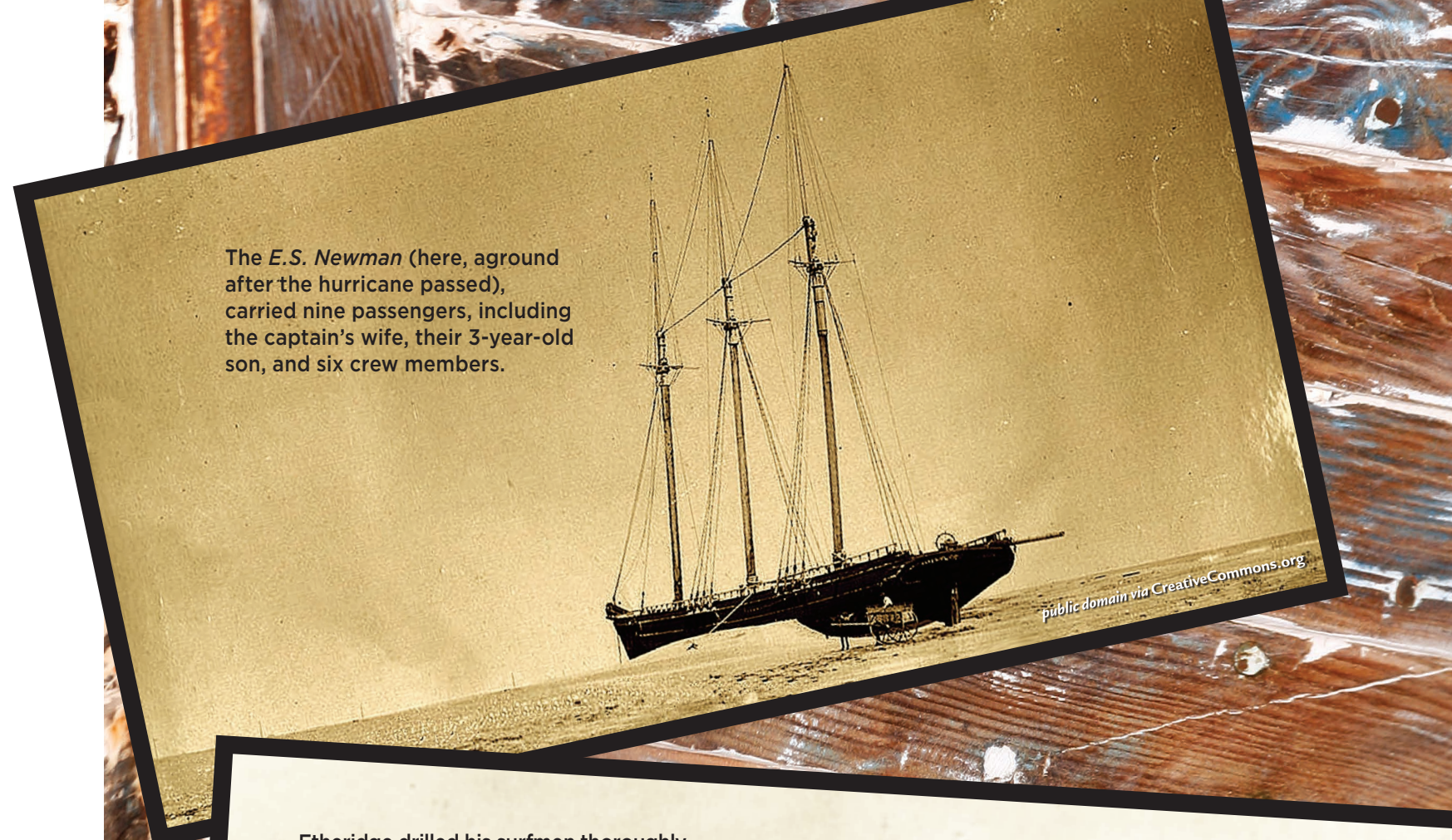
As a man, Etheridge was as much a disciplinarian with himself as he was with his surfmen. He was in good shape when he was appointed, reportedly "of strong and robust physique, intelligent, and able to read and write sufficiently well to keep the journal of the station."

The Pea Island surfmen patrolled the beach from sundown to sunup. One of Etheridge's surfmen would carry a lantern as he walked north to Oregon Inlet and another surfman would walk south to the New Inlet station. The men would exchange badges with men from the other stations, then return to their outpost.

Etheridge logged the numbered badges, which served as proof that his men walked their patrol area. His journal entries, made four times a day, also included how many boats or vessels passed in a given day and the weather conditions.

As the men walked the 3 1/2 miles out and back, they would be looking for flares in the darkness and listening for the sound of ripping sails. They were also searching for debris that might indicate a ship in trouble.

*Continued*

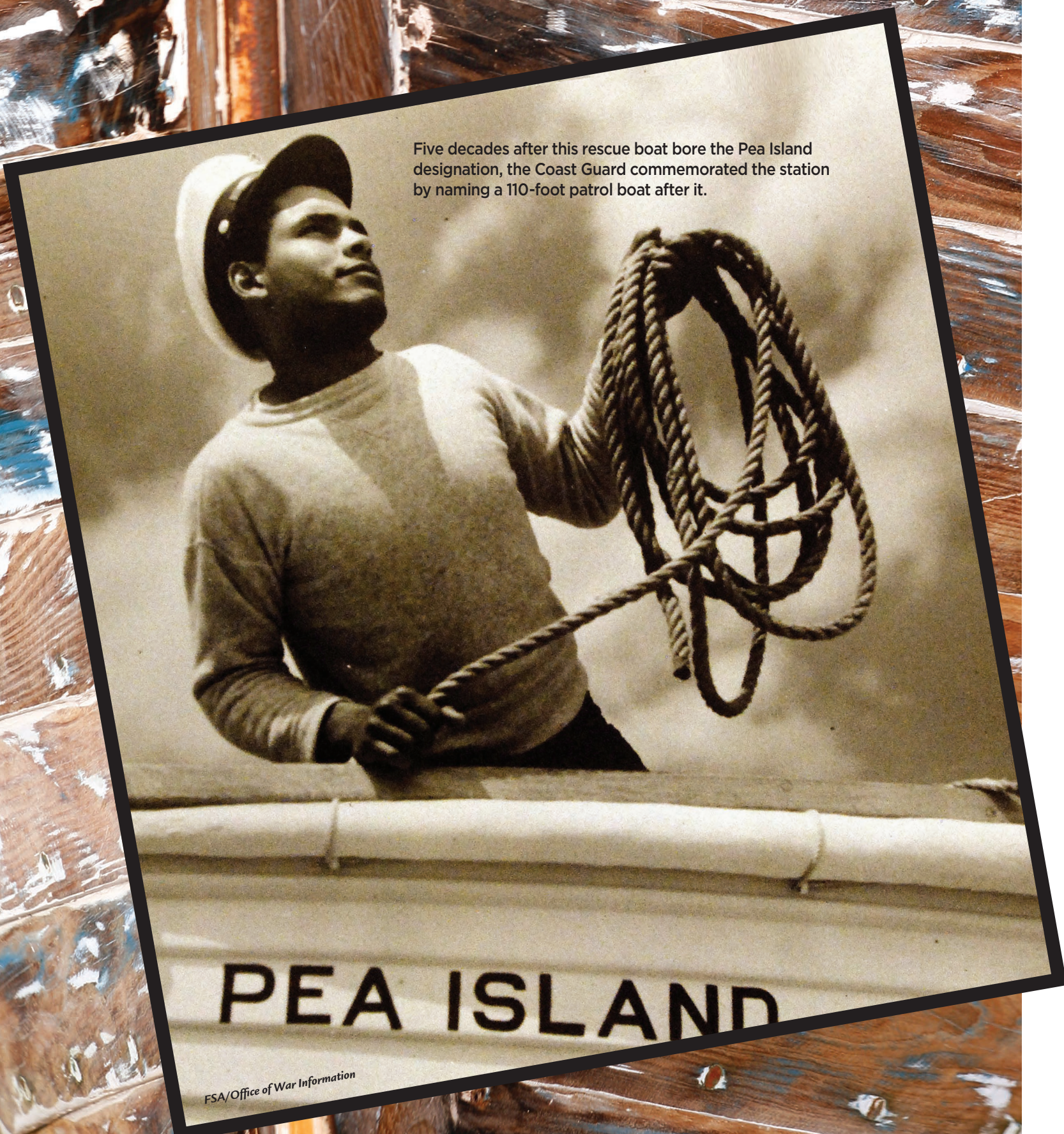


The *E.S. Newman* (here, aground after the hurricane passed), carried nine passengers, including the captain's wife, their 3-year-old son, and six crew members.



Etheridge drilled his surfmen thoroughly (here) so that no one would question their ability.

NPS/Cape Hatteras National Seashore



Five decades after this rescue boat bore the Pea Island designation, the Coast Guard commemorated the station by naming a 110-foot patrol boat after it.

PEA ISLAND

FSA/Office of War Information

### “The voice of gladden hearts”

On the stormy night of October 11, 1896, the weather was so bad that Keeper Etheridge had to suspend foot patrols. In the station log, he recorded that the weather at sunrise was “fresh N.E. gale, Stormy” and at noon “fresh, N. Hurricane, Stormy.”

Meekins was on watch in the station’s tower, and when he saw what he thought was a distress signal, Etheridge’s log recounts, he “immediately answered” with a flare. Summoned by Meekins, Etheridge “burned a red rocket, which was answered again with a red torch light. Then it became an evident fact that some vessel was stranded on the beach.”

“The keeper,” Etheridge records, “at once mustered the crew and with the team [of] a pair of good mules started to the scene of disaster with the hand cart and driving cart.”

One of the carts contained a small cannon that would shoot a line across to the wreck. If the vessel was further out in the ocean, the lifesavers would row a boat to it and rescue people as best they could.

But this night, Etheridge wrote, “It seemed impossible under such unfavorable circumstances to render any assistance.” They found the schooner “well upon the beach, with head sails all blown away, cabin stove in, and its effects greatly demolished, yawl boat [lifeboat] lost.” Raging waters thwarted every attempt

to get a line on the *Newman* from shore.

So, Etheridge decided to tie heavy lines to his strongest surfmen and “let them go down through the surf as near the side of the vessel as possible.” Meanwhile, the other surfmen held on tightly to the lines attached to the men.

When the surfmen got close to the wrecked vessel, the *Newman* crew threw out a ladder, and “each survivor with a line around their body with great difficulty was carried back on the beach.”

The surfmen repeated the ritual until all nine people on the ship were off.

Etheridge wrote in the Pea Island station that night, “The voice of gladden hearts greeted the arrival of the station crew.”

It had taken his men until 1 a.m. to rescue all nine people on the ship.

Etheridge remained keeper at Pea Island Station until his death in 1900. He and his family are buried on the grounds of the North Carolina Aquarium on Roanoke Island, land the family once owned.

In homage to the all-Black lifesaving crews, the Coast Guard named a 110-foot patrol boat after them. *The Pea Island*, christened in 1992, was based in Mayport, Florida, where it served as a border patrol vehicle. 🗿

### More about the U.S. Lifesaving Service

- [go.ncsu.edu/lifesavers](https://go.ncsu.edu/lifesavers)

This story appears courtesy of the African American Experience of Northeast North Carolina, a six-county collaboration that inspires exploration and appreciation of dozens of sites in one of America’s most history-rich corridors. This self-guided discovery begins at [NCBlackHeritageTour.com](https://NCBlackHeritageTour.com) and connects dozens of points of interest and African American influence across a region that includes the Outer Banks, the legendary Dismal Swamp, and some of the state’s earliest riverfront communities in Elizabeth City, Hertford, and Edenton.

Bridgette A. Lacy, a feature and food writer, is the author of *Sunday Dinner*, a “Savor the South” cookbook from UNC Press and a finalist for the Pat Conroy Cookbook Prize from the Southern Independent Booksellers Alliance.

- [go.ncsu.edu/Sunday-Dinner](https://go.ncsu.edu/Sunday-Dinner)





BY LAUREN D. PHARR

# WINGS OF CHANGE

THE IMPACTS OF A WARMING CLIMATE  
ON BIRDS OF NORTH CAROLINA

SHILO FELTON PREPARES TO MONITOR AND DOCUMENT  
OYSTERCATCHERS ON CAPE HATTERAS NATIONAL SEASHORE,  
WHILE ONE OF HER STUDY'S SUBJECTS LOOKS ON.

Tracy Bornemann/NC State



Over the last four centuries, nine bird species have gone extinct. The ivory-billed woodpecker — the third largest species of woodpecker in the world — is among the most recent, only officially declared extinct this past September by the U.S. Fish and Wildlife Service.

The reasons why certain bird populations become threatened or extinct can vary. Habitat loss through development, natural disasters like hurricanes, and hunting and poaching all can contribute.

*THE REASONS WHY CERTAIN BIRD POPULATIONS BECOME THREATENED OR EXTINCT CAN VARY. HABITAT LOSS THROUGH DEVELOPMENT, NATURAL DISASTERS LIKE HURRICANES, AND HUNTING AND POACHING ALL CAN CONTRIBUTE.*

Yet, one of the prominent current challenges for bird species is global warming.

About 389 species of birds are at risk of extinction from climate change. In fact, according to the National Audubon Society, extinction will threaten about two-thirds of America's bird species if temperatures rise by 5.4°F before 2100. Scientists predict that within only three decades, 126 endangered birds worldwide will lose more than 50% of their current habitat due to climate change; by 2080, 188 bird species could face the same plight, including 170 that live in North Carolina.

Birds are critical to their ecosystems, so much so that they serve as important “indicator species,” meaning that their presence provides scientists with valuable information on other environmental conditions. As a Ph.D. student



Britta Muiznieks/NPS

SHILO FELTON (LEFT) IS ONE OF A GROWING GROUP OF YOUNG SCIENTISTS DEDICATED TO STUDYING HOW CLIMATE CHANGE AFFECTS NORTH CAROLINA'S BIRDS.

at NC State University and a Southeast Climate Adaptation Science Center Global Change Fellow, I am one of a growing group of scientists in North Carolina dedicated to studying how climate change affects various bird species — from American oystercatchers to red-cockaded woodpeckers.

**COASTAL THREATS TO AMERICAN OYSTERCATCHERS**

Human-driven activity has a large influence on the health of coastal ecosystems. Many shorebird populations continue to face increasing challenges as rising sea levels and



Boston Dang

MARAE LINDQUIST WEST EXTRACTS A MARSH SPARROW FROM A MIST NET.

growing human populations constrain their breeding habitats.

“Shorebird communities are particularly vulnerable to such influences, due to their long migrations, niche specialization, vulnerable nest locations, and use of sandy beach habitats,” says Shilo Felton, field manager for Audubon’s Clean Energy Initiative. “For a great majority of the species which will be subjected to the environmental effects of a changing climate, we know very little about how these changes will influence them.”

Populations of the American

oystercatcher, a large shorebird with a long narrow orange bill, black head, and brown back and tail, had been in decline until recently, although the International Union for Conservation of Nature has now classified their populations of “least concern.” As a Ph.D. student at North Carolina State University, with funding from North Carolina Sea Grant, Felton studied the key indicator of oystercatcher population stability: the ratio of males to females.

“For a monogamous breeder like the oystercatcher, the number of available male-female pairs is critical,” says Felton, a former

Global Change Fellow with the Southeast Climate Adaptation Science Center. “Many models assume an even ratio of breeding males to females, but this assumption can lead to misleading projections of population growth or extinction.”

Natural resource managers rely on accurate estimates of population status and growth when making decisions to conserve species. A previous study by Felton and her research partners suggested nearly stable oystercatcher populations in North Carolina, but prior research also has shown that the

*Continued*



Paul Plischka

A LEAST TERN FROM THE SOUTH WRIGHTSVILLE BEACH COLONY DEMONSTRATES THERMOREGULATING BEHAVIORS THAT RESEARCHER ROBERT SNOWDEN RECORDED.



Robert Snowden

THIS LEAST TERN NEST INCLUDES A RECENTLY HATCHED CHICK — AND ONE OF ROBERT SNOWDEN'S "ARTIFICIAL EGG DATA LOGGERS."

number of breeding pairs in certain protected areas decreased by almost 50 percent in the past decade.

Felton and Audubon North Carolina colleague Lindsay M. Addison combed through feather samples collected from over 600 oystercatchers during a 13-year period. In turn, a lab at the University of Porto in Portugal determined the sex of the birds from the samples.

“Through capture and recapture

analyses, preliminary results indicated even female-male ratios for both juveniles and breeding adults in all but one year,” reports Felton. “We also found that sex, hatch site, and breeding site all influenced survival, and the effects of each varied with life stage.”

Overall, Felton says their initial results suggest oystercatchers may remain part of the state’s ecosystems for years to come, as long as the various habitats the species requires are available.

Human recreation, development, and pollution also continue to impact the species’ habitat, though. When Felton observed the effects of off-road vehicle use on oystercatcher populations, for instance, her findings suggested that decreasing the presence of vehicles might allow oystercatcher parents to invest less time and energy on defensive behaviors and more on nest attendance.

In her current position with the National

gets is up to us, and I’m grateful to be in a position with Audubon that helps me work toward solutions.”

**MARSH SPARROWS AND RISING SEAS**

Salt marshes — coastal grasslands regularly flooded by seawater — filter nutrients and reduce the impact of coastal storms by absorbing wave energy. They act as buffers for our coastlines and provide habitat for both aquatic and avian species.

Saltmarsh sparrows and a similar species, seaside sparrows, are tidal marsh obligates, meaning that they spend their entire lives in tidal marsh ecosystems. The saltmarsh sparrow, a medium-sized orange, brown, and tan bird with a fairly large bill, lives along the East Coast. The seaside sparrow lives in tidal marshes along the East Coast, as well as in the Gulf of Mexico.

**SALTMARSH SPARROWS AND A SIMILAR SPECIES, SEASIDE SPARROWS, ARE TIDAL MARSH OBLIGATES, MEANING THAT THEY SPEND THEIR ENTIRE LIVES IN TIDAL MARSH ECOSYSTEMS.**

Both populations of sparrows are at risk, and soon the saltmarsh sparrow could become an endangered species. In fact, saltmarsh sparrow populations have declined by 9% annually since 1998 due to climate change and other human-influenced impacts.

“If habitat declines or is degraded, it can lead to population declines for the species that depend on that habitat, especially like saltmarsh and seaside

Global Change Fellow has informed her understanding of avian interactions with renewable energy under a changing climate. “My experience as a Climate Change Fellow has given me a helpful perspective about the importance of addressing climate change to protect birds,” she says. “It’s not some far off, abstract threat. How bad it

Audubon Society, Felton is responsible for promoting best practices for offshore wind projects nationally, as well as onshore wind and solar projects throughout the Mississippi and Atlantic flyways, in order to advance clean energy in a way that minimizes impacts on birds.

Her own research and experience as a

*Continued*

sparrows,” says Marae Lindquist West, a Ph.D. candidate at UNC Wilmington and a NOAA Margaret A. Davidson Fellow.

West studies the effects of sea-level rise on the sparrows at five sites in North Carolina: Rachel Carson Reserve, Hammocks Beach State Park, Masonboro Island, Bald Head State Natural Area, and Bird Island. By gathering data about tides, elevation, and sea-level rise, and then modeling habitat changes at low, moderate, and high levels of sea-level rise through the year 2060, she can predict what will happen to tidal marsh habitat and how it might affect saltmarsh and seaside sparrows. This information will help the U.S. Fish and Wildlife Service in particular, when it decides in 2024 about whether to list the saltmarsh sparrow as “endangered” or “threatened.”

West and her team actively flush the birds into the nets, extract them, and take body measurements. The team also attaches radio tags to a subset of sparrows in order to track their movements through the marsh, gathering data to help understand the sparrows’ home range and habitat use, as well as to determine the overall population density of the species.

**WEST AND HER TEAM ACTIVELY FLUSH THE BIRDS INTO THE NETS, EXTRACT THEM, AND TAKE BODY MEASUREMENTS.**

West’s team will continue to collect data to determine how rising sea levels will impact marshes, which typically adapt to sea-level rise by moving inland to higher ground.

“We need to plan ahead for the impacts of sea level rise on marsh bird habitat — and



Christopher Moorman

THE AUTHOR INVESTIGATES A RED-COCKADED WOODPECKER’S CAVITY TREE.

right now we’re not doing that,” says West, formerly a joint fellow with North Carolina Sea Grant and N.C. Sentinel Site Cooperative. “For populations at both study sites, our models show that without marsh mitigation, winter habitat will decrease a lot by 2060.”

West says sea level rise is accelerating, and such modeling can help inform where to

implement specific management strategies for sparrows — and for other species.

“Where are those marshes going to go?” she asks. “Where do you put your resources? Do you put them into buying land? Do you try to conserve the marsh by building it up some more? These are the kind of questions we are trying to help managers answer.”



Lauren D. Pharr

AN ADULT RED-COCKADED WOODPECKER VISITS ITS HOME CAVITY.

**LEAST TERNS AND RISING TEMPERATURES**

The N.C. Wildlife Resources Commission lists least terns as a species of

“special concern.” With a breeding season lasting from early May to late July, these birds need and prefer nice sandy beaches and will nest nearby one another. In fact, they

make their nests, which typically contain two or three eggs, right on the open sand, preferring to avoid potential predators in the vegetation during the three-week incubation period.

While a graduate student at UNC Wilmington in Ray Danner’s lab and as a joint North Carolina Sea Grant and N.C. Coastal Reserve’s Coastal Research Fellow, Robert Snowden studied how temperature affects least tern behavior and ecology on Masonboro Island and at other coastal sites around Wilmington. Specifically, Snowden focused on how the terns coped with the thermal challenges of their breeding environment during incubation.

“I’ve always been interested in the impacts of climate change on avian ecology, particularly with seabirds,” he explains. “And a lot of research focuses on its indirect effects — like changes in habitat or food availability. But it’s also valuable to understand how birds will respond directly to changes in the thermal environment.”

During his study, from May to July Snowden observed around 50 nest sites at different times of the day and recorded the behaviors of least terns under various environmental conditions.

Snowden says he tracked a lot of different behaviors at the nest, including “how often they would stand up and elevate themselves above the eggs — called ‘shading’ — and how often they would open up their wings, which helped to circulate air flow.”

He and his collaborators were able to analyze his observational data and determine the best predictors of certain behaviors at certain temperatures. At lower temperatures, least terns would stand above the nest and spread their wings. At higher temperatures,

*Continued*

least terns engaged in gaping — opening their bills — and tongue fluttering, which is more energetically expensive. While unable to avoid the direct heat from the sun during incubation, these behaviors helped them to stay cool.

Now currently serving as the Creamer's Field Migration Station project director at the Alaska Songbird Institute, Snowden says there is still much more work to do when it comes to climate change and understanding behaviors that indicate when and how coastal birds are thermoregulating.

"Although a lot of these behaviors have been documented before in other birds, we wanted to quantify and try to find these environmental temperature thresholds in which we would see certain behaviors," he says. "Just trying to predict what certain behaviors you would expect at certain temperatures is something that could be used to forecast the effects of climate change going forward."

## PINE FORESTS, HURRICANES, AND RED-COCKADED WOODPECKERS

Under the direction of Caren Cooper and Christopher Moorman in NC State's Department of Forestry and Environmental Resources, my own research addresses the potential impacts of climate change on the federally endangered red-cockaded woodpecker.

The "RCW," for short, is endemic to the longleaf pine ecosystem. It is the only species of woodpecker to excavate cavities for nesting in *living*, old growth pine trees, a process that can take several years.

An almost complete loss of habitat has been responsible for the species' population decline. The longleaf pine provides essential resources for RCW cavities and foraging, but

this tree itself is now an endangered species. Once covering an estimated 59 to 91 million acres, today, due to logging, longleaf forests cover only 3 million acres. Though still listed as endangered, RCW populations have continued to increase thanks to successful management of the longleaf pine ecosystem through frequent prescribed burning, as well as the construction of both artificial drilled cavities and insertions of nest boxes in living pine trees by forest managers.

The research-based *North Carolina Climate Report* projects a continued increase in temperatures, precipitation, storms, floods, droughts, wildfires, and sea level rise, much of which places the longleaf pine ecosystem at greater risk, particularly trees along the coast. As a result, 63 out of 124 known RCW populations are vulnerable to hurricanes, according to the U.S. Fish and Wildlife Service, with 56 of those populations having low or very low ability to withstand environmental or demographic changes.

As the leading expert on this species, Jeffrey Walters, a conservation biologist at Virginia Tech (and a member of the team advising my research), explained in a WRAL news report, "There's probably been more significant damage to the woodpecker populations in the last three years than in the previous 50. There was one big storm in 1989 that did a lot of damage, but there's been multiple, major impacts in the last few years."

Because the process of cavity construction can take years, it is difficult for RCWs to move to a new forest, which increases their dependence on existing old-growth forest territory, even as it shrinks.

In addition, longer rainy and dry seasons make it more difficult to effectively manage RCW habitats, particularly by means of prescribed burns, which keep hardwoods

from replacing the longleaf pines. But, if large storms continue to knock over cavity trees and if longleaf pines then can't replenish, the RCW population will be decimated.

Additionally, over the past two years, RCW populations in the Sandhills, Fort Bragg, and coastal Florida have been experiencing a "brood reduction," a decrease in the numbers of nestlings, which usually occurs due to a lack of natural resources.

We continue to develop many hypotheses about why RCWs are experiencing brood reduction, including factors related to climate change, like the timing of the arrival of certain food sources and overcrowding of RCWs in some areas. As an avian ecologist, I'm testing multiple research questions about RCWs and accessing a 40-year high-quality data set, along with additional data I will be collecting, in search of answers that will inform better outcomes for this species.

By studying both the direct and indirect effects of climate change on the animal kingdom, a rising generation of new scientists has the opportunity to make new discoveries — findings that managers and others can use to inform conservation efforts. Many of my peers and I have made this our career, and we will continue to work hard to understand how avian species are reacting to rapid changes. 🌱

*While pursuing her masters and Ph.D. degrees at NC State University, Lauren D. Pharr has served as a Southeast Climate Adaptation Science Center Global Change Fellow, a science communicator with North Carolina Sea Grant, and an editorial advisory board member for The Wildlife Society's magazine, The Wildlife Professional. She also has won NC State's Forestry and Environmental Resources Fellowship for Excellence in Graduate Education.*



Melissa McCarty/NCWRC

THE AUTHOR VISITS THE FIELD OFTEN FOR HER RESEARCH — AND TO GO BIRDING.

## MORE

SHILO K. FELTON AND AMERICAN OYSTERCATCHERS

• [go.ncsu.edu/oystercatcher](https://go.ncsu.edu/oystercatcher)

MARAE LINQUIST WEST AND MARSH SPARROWS

• [go.ncsu.edu/sparrows](https://go.ncsu.edu/sparrows)

ROBERT SNOWDEN AND LEAST TERNS

• [go.ncsu.edu/terns](https://go.ncsu.edu/terns)

LAUREN D. PHARR ON HER OWN RED-COCKADED WOODPECKER RESEARCH

• [go.ncsu.edu/RCWs](https://go.ncsu.edu/RCWs)

THE SOUTHEAST CLIMATE ADAPTATION SCIENCE CENTER

• [go.ncsu.edu/secasc](https://go.ncsu.edu/secasc)

NORTH CAROLINA SEA GRANT AND N.C. COASTAL RESERVE'S COASTAL RESEARCH FELLOWSHIP

• [go.ncsu.edu/reservefellowship](https://go.ncsu.edu/reservefellowship)

THE NORTH CAROLINA SEA GRANT/NORTH CAROLINA SENTINEL SITE COOPERATIVE JOINT FELLOWSHIP

• [go.ncsu.edu/sentinel](https://go.ncsu.edu/sentinel)

## NORTH CAROLINA BIRD ATLAS

One in four birds have been lost since 1970 nationwide, with some of these losses most likely resulting from the effects of climate change. *The NC Bird Atlas* is a statewide community science project to map birds during the breeding and wintering seasons. The project gathers essential information from volunteers, using systematic surveys of an entire region about the current and future distribution and abundance of North Carolina's birds, in order to help prevent species from inaccurately being listed as endangered or instinct.

more about *The NC Bird Atlas*

• [go.ncsu.edu/BirdAtlas](https://go.ncsu.edu/BirdAtlas)

By Nan Pincus

# FISHING FOR AND FINDING CONNECTION FOOD

Public fishing is popular across North Carolina, including in New Hanover County (here).



At places like these two sites in Beaufort, fishing is far more than a pastime.

***“I donate most of the fish I catch. A couple of my friends’ moms who can’t work — they’re disabled and stuff like that. I’ll clean fish and take it to them or just take them a Ziploc bag slammed full of fish.”***

We often think of fishers in two distinct groups. There are the commercial fishers, hauling in the finfish that lands on dinner tables in North Carolina and beyond. Then there are the recreational fishers who steer their boats towards fish-filled, sun-drenched spots.

Yet there is a third category: people who must fish for food for themselves, their families, and their friends.

“Not everyone with a rod and reel is just fishing for fun,” says Scott Baker, fisheries specialist at North Carolina Sea Grant. “For some people, the stakes can be much higher.”

With funding from North Carolina Sea Grant, Duke University’s Grant D. Murray and Lisa Campbell studied fishing for food in public spaces, such as the Newport

River Pier and its former across-the-channel neighbor, the Grayden Paul Drawbridge.

Their research found that those who fish for food support each other by sharing both bait and catch, but away from these gathering areas, they mostly don’t know each other. Around a third of these anglers are women. They are more racially diverse than the population immediately surrounding the piers, and they are of all ages but disproportionately over the age of 50. They could survive without their catch, but they’d be worse off for it.

Through ethnographic methods such as interviews and observations, Campbell and Murray discovered that this third category of fishing is a resilient and impactful



One in seven North Carolinians face hunger, and people who fish for food often feed the elderly, people with disabilities, and children. Carteret County, North Carolina.

group. Fishing for food is both a practice and a network, extending into the community like piers into the water, connecting the ocean’s resources to kitchen tables along the coast and inland.

#### **From the Water’s Edge to the Heart of the Community**

One in seven North Carolinians face hunger, and for children that reality is even bleaker, with one in five children enduring food insecurity, according to Feeding America. While we often don’t see the hunger behind closed doors, North Carolina has the tenth highest food insecurity rate in the country; nearly 590,000 households in the state do not have enough food each day.

Fishing for food is one way people combat food insecurity in their communities.

“We help feed the people in North River,” said one participant in Campbell and Murray’s research, referring to

a community about 10 miles away from the study sites. “Like, we’ll take them all the fish. I donate most of the fish I catch. A couple of my friends’ moms who can’t work — they’re disabled and stuff like that. I’ll clean fish and take it to them or just take them a Ziploc bag slammed full of fish.”

People who fish for food often feed the elderly, people with disabilities, and children. In fact, more than a third of the 74 Carteret County participants in the study said that they share their catch with children.

“One of the things we learned was how meaningful it was for people to share the fish that they were catching,” explains Murray, a marine social scientist in Duke University’s Nicholas School of the Environment. “Some of those fish ended up in fish fries, church dinners, and other events where people were coming together to share and eat seafood.”

*Continued*



*Interpersonal and informal networks can provide local, healthy food to people who need it — as long as public fishing remains accessible.*

These interpersonal and informal networks provide local, healthy food to people who need it — as long as public fishing remains accessible.

Campbell and Murray conducted their research from June to November in 2018, before and after Hurricane Florence made landfall that September. Not surprisingly, the storm's damage to piers and waterways affected over 70% of the study participants' ability to fish, as well as how much they could catch.

#### Healthy Hearts and Minds

The nourishing power of fishing for food also carries implications for public health.

Previous studies by the National Institute of Health and other organizations have shown that access to fresh or healthy foods is correlated with a decreased rate of diet-related chronic diseases, such as obesity, diabetes,

heart disease, and cancer. This link is especially important in some underserved and under-represented communities; African Americans and people living in poverty or rural areas, for instance, are less likely to eat fresh or healthy foods.

The benefit of eating fresh-caught fish wasn't news to study participants.

"I like the taste," said one respondent. "And it is healthy. Healthiest meat I eat."

Another participant described how eating fish is part of how he manages diabetes under the recommendations of his doctor. "Fish have a lot of protein," he said, "and that's what they tell me I need."

The practice of fishing for food also improves mental well-being. Many study participants described stress relief and socialization, among other positive effects on their emotional health.



*Fishing has always been about far more than the catch.*

"This is pretty much therapy," said one study participant. "I come down, I catch a fish, I feel."

Campbell, a marine social scientist at Duke, says such benefits are critical to the fishing-for-food community. "I was surprised by the extent to which various aspects of well-being are at stake for people, including mental health," she says.

Murray says that there's still plenty to uncover about how seafood that isn't part of the formal economy nevertheless does powerful work feeding communities and forging connections.

"This kind of informal economy is something we want to learn even more about," he says. "It's an important example of how seafood that never enters a market feeds and brings people together."

As Murray and Campbell's research shows, fishing for food is about far more than the catch. 🌊

Duke graduate students Cass Neiman, Alexie Rudman, and 2020 Knauss Fellow Margaret Chory contributed to this research, including leading the interviews.

- **the full study:** [go.ncsu.edu/food-study](https://go.ncsu.edu/food-study)
- **about Grant Murray:** [go.ncsu.edu/Grant-Murray](https://go.ncsu.edu/Grant-Murray)
- **about Lisa Campbell:** [go.ncsu.edu/Lisa-Campbell](https://go.ncsu.edu/Lisa-Campbell)
- **Margaret Chory on fishing for food: "Interviews as Catalysts for Change":** [go.ncsu.edu/chory-interviews](https://go.ncsu.edu/chory-interviews)
- **more research on fishing:** [HookLineScience.com](https://HookLineScience.com)

Nan Pincus is a science communicator with North Carolina Sea Grant and is pursuing a master of science in technical communications at NC State. She earned a master of arts in teaching from Duke University, where she received the Steve Unruhe Award for Social Justice.





UNCW Coastal Plant Ecology Lab

# Are Warming Seas Affecting How Blue Crabs Escape Predators?

RESEARCH FROM THE UNC WILMINGTON COASTAL PLANT ECOLOGY LAB

**B**LUE CRABS ARE A VITAL COMPONENT OF OUR COASTAL MARINE ECOSYSTEMS, SUPPORTING ONE OF THE MOST IMPORTANT FISHERIES IN NORTH CAROLINA. THESE CRABS ALSO ACT AS BOTH PREDATOR AND PREY IN COASTAL HABITATS.

Along much of the North Carolina coast, seagrasses are a critical habitat for juvenile blue crabs, providing a refuge from predators and a protected foraging location. As a result, seagrass habitats directly help sustain this economically important fishery as adult blue crab abundances are directly related to the abundance and survivorship of juveniles.

However, warming sea temperatures are altering the composition of seagrass communities within North Carolina — a phase shift in dominant seagrass species from temperate eelgrass meadows to tropical shoal grass meadows. These seagrass species differ in form and structure, and their beds differ in complexity. Thus, this shift could alter predation rates and how much juvenile blue crabs within this region utilize these habitats,

which, in turn, has significant implications for the blue crab fishery. To address how this change in dominant seagrass habitats might impact blue crabs, our team at UNC Wilmington is conducting field surveys through 2022 in Topsail Sound and Chadwick Bay to assess the relative abundance of juvenile blue crabs. To sample juvenile blue crabs, we're using throw traps, sweep nets, and lightweight trawls in eelgrass, shoal grass, and unvegetated habitats.

In addition, to further understand the potential impacts of changing seagrass habitats, we're examining differences in predation on blue crabs in eelgrass, shoal grass, and unvegetated areas by conducting tethering experiments, in which we restrain the prey and document what happens. These experiments will provide important information on potential differences in quality between the two seagrass habitats and between vegetated and unvegetated habitats.

In the lab, we also will study juvenile blue crab behaviors when a predator is present and absent, offering additional insight about how they utilize the two seagrass species. We then can compare patterns from the habitat choice

experiments to our field sampling of the relative abundance of juvenile crabs that utilize eelgrass and shoal grass.

Understanding how warming seas affect juvenile blue crabs by altering critical nursery habitats will provide essential information to fisheries management, which, in turn, can benefit both recreational and commercial fishermen within North Carolina. 📍

*The UNC Wilmington Coastal Plant Ecology Lab works to understand the effects of environmental stressors on large-scale physiological processes, such as plant development and reproduction within seagrass populations, and to communicate these results to resource agencies and policymakers charged with their management. North Carolina Sea Grant has supported research from the lab on blue crabs from 2020 to 2022.*

More about The UNCW Coastal Plant Ecology Lab  
• [jarvislab.weebly.com](http://jarvislab.weebly.com)

Funding opportunities from North Carolina Sea Grant  
• [go.ncsu.edu/sea-grant-funding](http://go.ncsu.edu/sea-grant-funding)

Contributors to this story include UNCW's George Easterly, Martin Posey, Troy Alphin, Jessie Jarvis, and Mike Wheeler.



Robert Carmichael/NOAA's Battle of the Atlantic Expedition

# Deepwater Fish and Shipwrecks, Lionfish DNA, and Ancient Sheephead Bones

*The Latest Science for Anglers*

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

**WHICH FISH LOVE DEEPWATER SHIPWRECKS? Video and laser imaging identified fish by species — and even revealed where on shipwrecks fish liked to hang out.**

Some experienced offshore bottom fishers can read a depth finder display like a good book and identify individual fish species from shapes that most others would refer to as “something big down there.” Unfortunately, fishers never really know what is down there until they see it on video or catch it themselves.

But are times changing?

• **Research Need**

The waters off the coast of North Carolina are home to many shipwrecks that have accumulated over the past several hundred years. These structures hold cultural and historical significance, as well as important habitat for marine life. Shipwrecks are often

the destination for offshore fishers and divers, because these structures can serve as fish havens.

A team of NOAA archaeologists captured on video and with detailed laser-generated imagery the remains of two World War II shipwrecks sunk during the Battle of the Atlantic in 1942. The ships, a German U-boat, *U-576* (above), and a Nicaraguan freighter, *SS Bluefields*, are located relatively close together about 30 miles offshore in 660 feet of water — deeper than the range of most fishers and divers.

When ecologists learned about the availability of the video and imagery, they were interested in using the data to see which kinds of fish frequent these remote, deep-water shipwrecks and where exactly on the wrecks these fish seem to congregate.

Inquiring fishers want to know as well.

• **What did they study?**

A research team utilized two manned

submersibles equipped with advanced video and laser scanning equipment to create high-definition video and three-dimensional imagery of the two deep water shipwrecks.

The submersibles made several passes alongside each shipwreck to collect video and create 3-D profile images. From the ecological data collected, the scientists were able to count and identify the fish and their locations relative to each shipwreck.

• **What did they find?**

The shipwrecks hosted several fish species that live close to the ocean floor, including snowy grouper and yellow-edge grouper, among others. Other notable species included wreckfish, Conger eel, and Darwin's slimehead.

On both shipwrecks, fish concentrated around high-relief shipwreck features. For example, on the U-boat, this included the

*Continued*



Scientists found evidence of lionfish much farther inland than they expected.

NOAA

conning tower, the deck gun, and the bow. A similar pattern of fish behavior has been reported around rocky hard-bottom reefs.

While the research team did not have access to water current data, fish location data suggests that fish are congregating on what appeared to be the upstream side of each shipwreck. Previous work on shallower shipwrecks on the U.S. continental shelf indicates that this pattern may be common.

• *Anything else?*

The authors note that the study site is the only naval battlefield of World War II on the U.S. East Coast where both the target (the SS *Bluefields*) and the aggressor (*U-576*) sank in the same vicinity.

• *So what?*

The success of the joint archaeological-ecological mission has opened the door to additional collaborative ventures, which unmanned underwater vehicles potentially could carry out.

— Summary by Scott Baker, adapted in part from an original article by Heidi Swanson

**IS IT POSSIBLE TO DETECT LIONFISH BY ANALYZING ENVIRONMENTAL DNA?**

*A new study suggests that invasive lionfish have spread into unexpected areas.*

• *Research Need*

Lionfish are highly invasive species that are resistant to many forms of population

management. While they are known to have established populations in South Atlantic and Gulf of Mexico ecosystems, the fish's pervasiveness was unknown for shallow, inshore, riverine, and estuarine locations along the Gulf.

Environmental DNA — also known as eDNA — is DNA that an organism sheds into the environment. Analysis of eDNA from water and other environmental sources is a relatively new method to determine the presence and prevalence of invasive species. Prior to this research, though, environmental DNA had not been yet used to detect lionfish invasions, which have become a persistent problem in the Southeast.

What if scientists could sample water to determine whether lionfish are present without actually seeing the lionfish?

• *What did they study?*

Researchers collected water samples in four river estuaries along the northern Gulf of Mexico: the Mobile River Delta, Perdido River and Bay, Escambia River and Bay, and Blackwater River and Bay. They used 44 sites total across these four estuaries and collected samples in all four seasons. After storing the water samples in dark, cool places, the team then extracted the DNA and analyzed the data.

• *What did they find?*

Researchers found evidence of lionfish in all four sites and in all four seasons of the year.

The team detected the highest numbers of lionfish in July, across locations. Occupancy modeling, a statistical analysis method used to determine the true presence of a species at

a site, suggested that the environmental DNA is likely underrepresenting the true number of lionfish at these sites.

In addition, lionfish were present farther inland than previously assumed — with eDNA detected as far as 23 miles inland from the northern Gulf of Mexico.

• *So what?*

Lionfish are an invasive species that indiscriminately feed on other fish in their environment and already have impacted offshore fish, including some popular snappers and groupers.

As this study shows, lionfish also exist in shallow, inshore, riverine, and estuarine locations along the Gulf of Mexico, which means they might also pose a threat to native estuarine fish and invertebrate species, such as shrimp and crabs.

— Summary by Nan Pincus

**WHAT CAN SCIENTISTS LEARN FROM ANCIENT SHEEPSHEAD BONES?**

*Sheepshead bones recovered from historical sites reveal large-scale changes in population, as well as the forces driving these changes.*

• *Research Need*

Fisheries managers are developing more nuanced management strategies that take into account the dynamic interactions among ecosystems and humans.

Sheepshead are a major component of both commercial and recreational fisheries

along the southeastern U.S. coast and the Gulf of Mexico. In contrast to some popular species that have been exploited for a relatively short period of time, there is evidence that sheepshead in the Gulf of Mexico have been highly sought-after for hundreds of years.

We know this because scientists have found piles of sheepshead bones at historical sites along the Gulf of Mexico coast. Some of the largest historical sites, in fact, are in and around New Orleans.

By utilizing these old bones, scientists might be able to begin to understand how

species like sheepshead respond to long-term changes in fisheries practices.

• *What did they study?*

Scientists recovered sheepshead bones from five historical sites dating from 1720 to 1910 BCE and from one earlier site dating from 450 to 130 BCE. The study area encompassing these sites contains a wide range of habitats used by sheepshead.

The research team used bone size as a proxy for fish size and looked at chemical signatures — specifically carbon and nitrogen

isotope ratios — in the bones to reconstruct prehistoric diet. As bones grow, their compositions reflect dietary intake and mobility.

• *What did they find?*

Overall, results showed a steady decrease in average standard length of sheepshead through time, indicating a long-term trend of declining size of sheepshead consumed in New Orleans.

Analyses showed a pattern of decreasing sheepshead average standard length from the 1720s to 1840s, followed by an increase in average estimated standard length in the 1840s to 1860s, and then a return to consistently decreasing standard lengths from 1870 to 1910.

The decrease in average size from 1720 to the 1840s suggests long-term, negative impacts from fishing on sheepshead populations in the study area. The increase in size during the 1840s to 1860s suggests that fishers had begun to tap into new, previously un(der)fished sheepshead populations. But starting in 1870, average size declined again through 1910, likely indicating overfishing of the newly targeted sheepshead population.

Analyses of archaeological sheepshead specimens also produced a wide range of bone compositions that indicates sheepshead consumed in New Orleans were sourced from a broad range of brackish and marine habitats. This provides more support for the theory above.

• *What else did they find?*

Recovered bone fishhooks and possible net mesh gauges and net weights from past archaeological sites in the area indicate that indigenous peoples before European arrival used hook-and-line and net-based fishing methods.

• *So what?*

The research findings show that sheepshead populations in the Gulf of Mexico are particularly vulnerable to overharvesting. Despite their highly adaptable behavior, sheepshead populations were not able to cope with sustained fishing pressure.

The decreases found in average fish catch size are a well-documented response to overfishing and may have resulted from use of size-selective gear like gill netting, and from removing larger fish from the population. This, in turn, can promote genetic selection for fish that reach sexual maturity at a smaller size, which therefore can contribute to overall decreased fish sizes.

— Summary by Lauren D. Pharr

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A Florida boy with a fresh sheepshead catch, ca. 1910.

State Library and Archives of Florida



Commercial boats docked alongside a retailer in Brunswick County.

NC State University

# Four Big Takeaways from our Study of North Carolina's Seafood Industry

BY JANE HARRISON

**N**ORTH CAROLINA SEA GRANT LED RESEARCH LAST YEAR THAT EVALUATED THE IMPACT OF COMMERCIAL FISHERIES ON LOCAL ECONOMIES AND ON THE STATE OVERALL. OUR TEAM CONDUCTED AN ECONOMIC IMPACT ANALYSIS AND CONSUMER DEMAND SURVEY TO INFORM OUR RESULTS. HERE'S WHAT WE FOUND.

## #1. OUR SEAFOOD INDUSTRY MAKES A BIG SPLASH.

North Carolina's wild-caught commercial seafood industry provides nearly \$300 million in economic impact and 5,500 jobs in the state. From harvesting along the coast, seafood preparation and wholesaling, and the retail and restaurant sectors, the seafood industry makes a significant economic splash.

	<i>Economic Impact</i>	<i>People Employed</i>
Commercial Fishing	\$155.3M	2,660
Seafood Preparation and Processing	\$14.4M	210
Fish Markets and Retailers	\$80.3M	1,616
Seafood Restaurants	\$47.3M	1,043
<b>Total</b>	<b>\$297.3M</b>	<b>5,528</b>

Surprisingly, the largest economic impact by geographic area is away from the coast (\$130.6 million), where inland fish markets and restaurants play a significant role in the state's seafood economy. The north coast of the state has the next largest economic impact (\$78.6 million), followed by the central coast (\$57.5 million) and the southern coast (\$30.3 million).

"Total economic impact includes direct, indirect, and induced impacts," says Eric Edwards, the NC State University economist who

led the economic impact analysis. "Direct impacts are the dollars first earned by a fisherman. Indirect impacts are the money from those seafood earnings spent by the fisherman, for example, at their local boat repair manufacturer. Induced impacts are the boat repair guy's wages that further circulate into the state's economy, perhaps at the grocery store or spent on monthly rent payments."

## #2. CONSUMER DEMAND IS STRONG FOR N.C. SEAFOOD

As part of our research, we conducted a survey of 1,600 North Carolina residents to determine both their current consumption of seafood and the potential demand for North Carolina seafood.

Survey respondents had a positive perception of N.C. and U.S. seafood, with confidence in seafood safety protocols and in fishers following rules that conserve fishery resources. Respondents also believe

their purchases should support the livelihoods of fishers.

State residents reported preferences for seafood like shrimp and flounder from North Carolina and from U.S. sources over foreign products — which may result in a price premium in certain markets. In fact, seafood origin had a stronger influence on consumers' willingness to pay for seafood than "wild-caught" or "sustainably-caught" labels, although these attributes also mattered to respondents, especially as these attributes accumulated.

## #3. PROMOTING LOCAL SEAFOOD PAYS OFF

Price is still a prime factor affecting purchasing decisions, thus sellers of domestic seafood should cultivate a promotion strategy that tells customers why their product is worth buying. The commercial industry has opportunities to increase its market share through targeted

*Continued*



Justin Kase Conder/NC Oyster Trail

The NC Oyster Trail promotes a variety of seafood businesses that sell oysters and other products, as well as fostering ecotourism through visits to shellfish farms.

marketing, home-preparation guidance, and prepared-seafood meals.

Many consumers care where their food comes from. Being transparent about the origin of seafood is critical to attracting and retaining customers who want to support North Carolina seafood businesses. Promotion should inform potential customers why North Carolina seafood is worth buying and where they can purchase it.

Since 1995, the North Carolina Department of Agriculture & Consumer Services has supported the *Got to be NC Seafood* program, which raises consumer awareness of the businesses that produce and sell wild-caught and cultured marine and freshwater species. Between 2005 and 2012, five local-seafood educational initiatives along the coast also began helping to raise public awareness of North Carolina seafood and commercial fishing: Brunswick Catch, Carteret Catch, North Carolina Catch, Ocracoke Fresh, and Outer Banks Catch.

In 2019, Always NC Fresh was launched with funding provided by the North Carolina Commercial Fishing Resource Fund. In 2020, North Carolina Sea Grant and partners established the NC Oyster Trail, which promotes a variety of seafood businesses that sell oysters and other products, as well as fostering ecotourism through visits to shellfish farms.

While all of these efforts have helped to generate consumers and strengthen the sea-to-table chain, according to North Carolina Sea Grant seafood marketing specialist Barry Nash, “A deficit of recurring funds and paid, professional staff among all of the coastal-seafood brands has made long-term seafood marketing challenging.”

Given the resource limitations of the various marketing programs, the commercial fishing industry might consider which programs can serve as leaders to promote North Carolina seafood and the state’s commercial fishing industry to consumers statewide. The industry also needs to determine how to fund and proactively manage its branding on an annual basis.

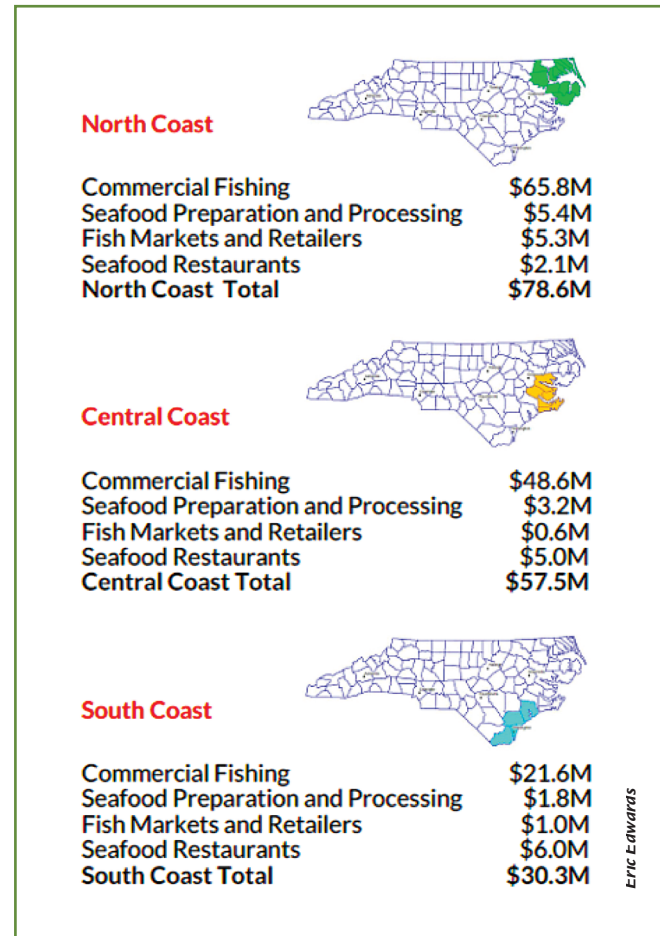
#### #4. A NIMBLE SEAFOOD INDUSTRY CAN CAPITALIZE ON EVERY FISH

With significant consumer demand for N.C. seafood, supply is not always available. Additional processing, cold-storage aggregation facilities, and centralized distribution centers are infrastructure investment opportunities that could add significant value to the industry. As is, the commercial seafood industry suffers from fragmented and underdeveloped supply chains moving west from the coast to markets further inland. (Visit [go.ncsu.edu/Seafood-Supply-Chain](http://go.ncsu.edu/Seafood-Supply-Chain) to learn more.)

Regulatory limits on fisheries also reduce supply, which requires a nimble seafood industry to capitalize on every fish sold. Value-added seafood meals, product enhancements, and home preparation guidance are opportunities to earn more revenue. When cooking seafood at home, 72% of survey respondents were interested in recipes, 48% in blended seasonings, 36% in seasoned breading, 30% in pre-made marinades, 27% in pre-portioned and marinated raw fillets, and 17% in seafood stocks.

The convenience of purchasing and preparing food is important to consumers across all demographics. North Carolina Sea Grant’s popular print and online seafood guide, *Mariner’s Menu*, includes a free web archive of recipes and home-preparation tips. These recipes all use commercial fish species native to our state. Visit [MarinersMenu.org](http://MarinersMenu.org).

To read the full reports from our study of North Carolina’s seafood industry, visit [go.ncsu.edu/NCSeafoodDemand](http://go.ncsu.edu/NCSeafoodDemand).



The N.C. seafood industry’s largest economic impact by geographic area is away from the coast, largely due to inland fish markets and restaurants. The north coast of the state has the next biggest impact, followed by the central coast and southern coast.

*North Carolina Sea Grant’s Jane Harrison and Barry Nash led this seafood economics research with partners at four universities. The team also included Eric Edwards (NC State University), Chris Dumas (UNC Wilmington), Sara Sutherland (Duke University), and John Whitehead (Appalachian State University). The N.C. Commercial Fishing Resource Fund Grant Program, which is jointly overseen by the N.C. Marine Fisheries Commission’s Commercial Resource Fund Committee and the Funding Committee for the N.C. Commercial Fishing Resource Fund, provided funding for the research.*

#### MORE

North Carolina Sea Grant’s seafood consumer awareness campaign

- [go.ncsu.edu/seafood-campaign](http://go.ncsu.edu/seafood-campaign)
- Coastwatch on “New Links in the Sea-to-Table Chain”
- [go.ncsu.edu/chain](http://go.ncsu.edu/chain)

*Jane Harrison is North Carolina Sea Grant’s coastal economics specialist. She collaborates with community planners and leaders, private industry, and residents to safeguard natural resources and advance sustainable economic activity.*



# Are Sharks Getting Smaller?

AROUND CAPE LOOKOUT OVER THE LAST 50 YEARS, THE ANSWER FOR MANY SPECIES IS YES.

BY JOEL FODRIE

**S**HARKS ARE IMPORTANT PREDATORS IN MARINE FOOD WEBS, BUT THEIR NUMBERS ARE THOUGHT TO HAVE BEEN SIGNIFICANTLY ALTERED BY FISHING AND OTHER HUMAN IMPACTS, POTENTIALLY DISRUPTING COASTAL ECOSYSTEMS.

#### WHAT WE STUDIED

Many anglers note that small sharks currently appear quite abundant, but there are few rigorous analyses of trends in shark sizes over time, due to the relative rarity of long-term survey data on these highly migratory and hard-to-sample fishes. Therefore, we wanted to explore whether shark sizes along the North Carolina coast have changed over time, leveraging one of the longest-running shark surveys in the world.

We examined the sizes of 12 shark species

caught regularly during a nearly five-decade-long survey conducted in Onslow Bay, North Carolina, using standardized longline gear (200 baited hooks attached to a 1-mile main line, deployed biweekly). We evaluated trends for each species in average and maximum “fork length” (the distance from the snout to the fork in the tail).

#### WHAT WE FOUND

All 12 species were characterized by fish appearing smaller over time, ranging from decreases in maximum sizes by 10% for silky sharks to 35% for sandbar sharks.

Despite significant differences across species in life histories (for example, between tiger sharks and Atlantic sharpnose sharks) and harvest pressure (for example, between harvested blacknose and protected dusky), all shark types appear to be characterized by smaller individuals compared to sizes in previous decades.

Survey data also indicated that the overall numbers of 11 of the 12 shark species, Atlantic sharpnose as the exception, are lower now than in previous decades. This combination of fewer and smaller sharks in the coastal ocean has likely contributed to shifts in ecosystems and fisheries that we don’t fully understand. 🐠

#### THE FULL STUDY

“Size Changes Within a Southeast United States Coastal Shark Assemblage: 1975-2018”  
• [go.ncsu.edu/shark-study](http://go.ncsu.edu/shark-study)

*Joel Fodrie (above) is a professor with the Institute of Marine Sciences (IMS) and the Department of Earth, Marine, and Environmental Sciences at the University of North Carolina at Chapel Hill. Over the years, North Carolina Sea Grant often has supported his work, including several projects on oyster restoration and aquaculture. Carolina Power and Light (from 1975-1985) and IMS have supported this research on shark abundance and size.*



• Crab Cakes with Fresh Lime



• Sautéed Tuna Steaks with Tarragon

# Crab Cakes with Fresh Lime, Sautéed Tuna Steaks with Tarragon, and More

BY VANDA LEWIS AND JOYCE TAYLOR

**M**ARINER'S MENU, NORTH CAROLINA SEA GRANT'S POPULAR ONLINE SEAFOOD GUIDE, FEATURES BLOGGER AND PHOTOGRAPHER VANDA LEWIS'S PICTURES WITH HUNDREDS OF RECIPES THAT JOYCE TAYLOR DEVELOPED. ENJOY THESE SPRING TREATS — AND VISIT [MARINERSMENU.ORG](http://MARINERSMENU.ORG) FOR MORE.

## CRAB CAKES WITH FRESH LIME

- 1 pound backfin crabmeat
- 1 egg, beaten
- 1/2 cup mayonnaise
- 1/4 teaspoon Tabasco sauce
- 1 1/2 tablespoons fresh lime juice
- 1/4 teaspoon salt
- 1/8 teaspoon cayenne pepper
- 1 1/2 tablespoons fresh cilantro, chopped
- 1 cup French breadcrumbs
- 1 cup French breadcrumbs for coating
- 2 tablespoons canola oil
- 2 tablespoons butter
- lime wedges for garnish

In a medium bowl, combine egg, mayonnaise, Tabasco, lime juice, salt, cayenne, and cilantro.

Blend in bread crumbs. Gently blend in crabmeat, being careful not to break the meat apart.

Shape into 6 patties or 8 cakes. Coat lightly with 1 cup of bread crumbs.

Heat oil and butter in a skillet to 375° F. Add the crab cakes to the skillet, and cook until golden brown, about 4 to 5 minutes per side. Drain on paper towels.

Garnish with lime wedges.

## SAUTÉED TUNA STEAKS WITH TARRAGON

- 4 tuna steaks, each about 1-inch thick
- 2/3 cup dry white wine
- 1 tablespoon fresh tarragon, finely chopped or 1 teaspoon dried
- salt
- black pepper, fresh ground
- 1/4 cup butter

In a small bowl, mix the wine and tarragon. Lightly salt and pepper the fish. Melt the butter in a large skillet and heat. Add the steaks and

cook about 5 to 6 minutes per side or until done. Spoon tarragon wine over the steaks as they cook. Place the fish on a serving platter, and pour the remaining wine mix over them.

## HERBED MEDITERRANEAN SNAPPER

- 1 1/2 pounds snapper fillets (or other white fillets)
- 1/4 cup olive oil
- 1/2 teaspoon garlic, pressed
- 4 tablespoons fresh basil, chopped
- 1/4 teaspoon salt
- 1 teaspoon paprika
- 3/4 teaspoon ground cumin
- 1/2 teaspoon ground turmeric
- 1/4 teaspoon black pepper, freshly ground
- salt

Preheat the oven to 450° F.

In a small bowl, combine olive oil, garlic, basil, 1/4 teaspoon of salt, paprika, cumin, turmeric, and pepper.

Lightly salt the fish. Place the fish in a lightly greased baking dish. Brush the mixture over the fish. Bake at 450° F until done, about 10 to 12 minutes.

## COQUILLES ST. JACQUES

- 1 pound bay scallops (or sea scallops, quartered)
- 1/2 cup dry white wine
- 1/2 cup water
- 4 tablespoons green onion, minced
- 1 bay leaf
- 1 sprig of parsley
- 1 teaspoon salt
- 2 tablespoons butter
- 1/2 cup mushrooms, chopped
- 3 tablespoons flour
- 2/3 cup heavy cream
- 2 teaspoons fresh lemon juice
- 1/4 teaspoon white pepper, freshly ground
- 1/3 cup Swiss cheese, freshly grated
- 1/4 cup soft bread crumbs

Place the rack in the top third of the oven, and preheat the broiler.

Place the wine, water, onion, bay leaf, parsley, and salt in a large saucepan. Bring to a boil, lower heat, and simmer for 5 minutes. Add the scallops. Return to a simmer, and cook until the scallops are done, about 5 or 6 minutes. Remove the scallops with a slotted spoon,



• Herbed Mediterranean Snapper



• Coquilles St. Jacques

then set them aside. Remove the bay leaf and parsley, then reserve the cooking liquid.

In a small bowl, combine the cheese and breadcrumbs. Set aside.

In a small saucepan, melt the butter over medium heat. Sauté the mushrooms until tender, about 5 minutes. Blend in the flour. Add the cream slowly, stirring constantly. Add the cooking liquid. Continue to cook until it is thickened and smooth. Stir in the lemon juice

and pepper. Thin with more cream, if needed.

Add the scallops in the cream sauce. Place the scallop cream sauce in four individual shells or ramekins. Sprinkle with the bread crumb mixture. Broil about 4 inches from heat until bubbly and lightly browned, about 5 minutes. 🍴

**For hundreds of free seafood recipes, visit [MarinersMenu.org](http://MarinersMenu.org).**



Catastrophic flooding across NC Highway 12 on Ocracoke Island after Hurricane Dorian in 2019.

NCDOT

# Coastal Change in North Carolina

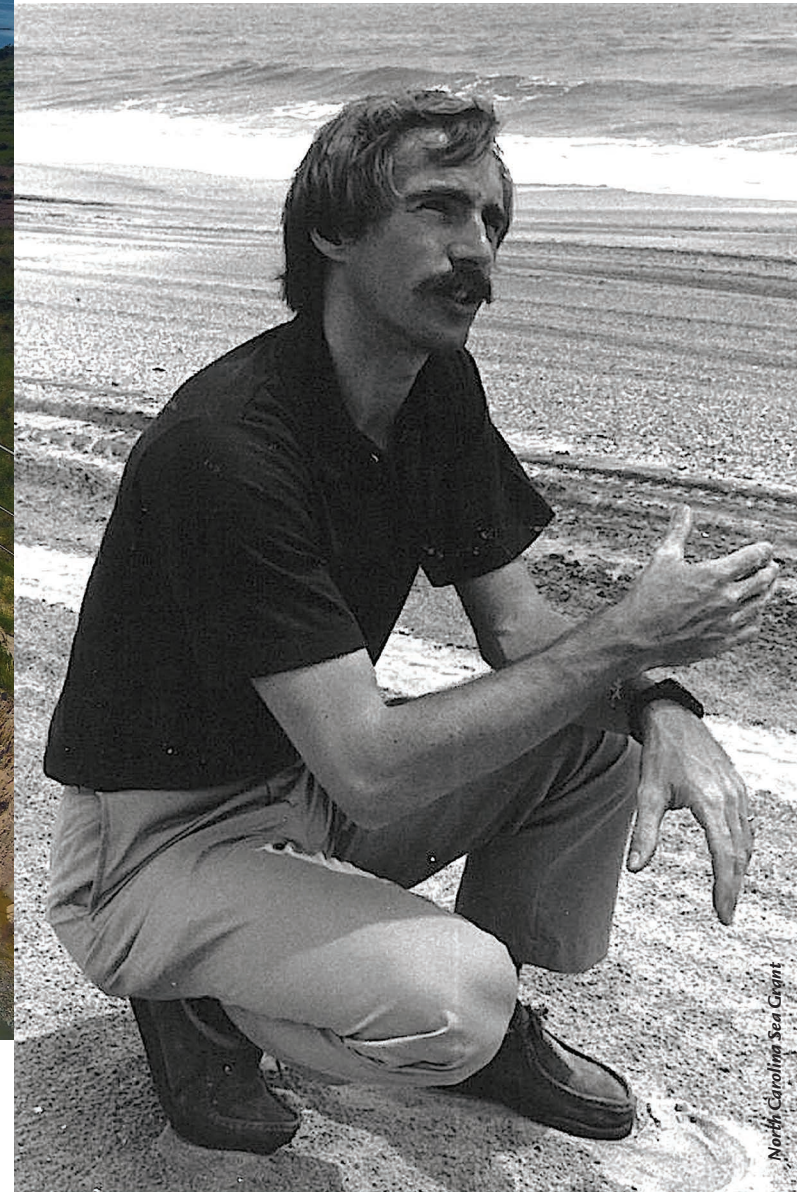
AN INTERVIEW WITH SPENCER ROGERS, COASTAL CONSTRUCTION AND EROSION SPECIALIST

*I've always been passionate about conveying good science and consistent science to the people who can put it into use.*

— SPENCER ROGERS

IN 1978, WHEN SPENCER ROGERS BECAME ONE OF NORTH CAROLINA SEA GRANT'S EARLY EXTENSION SPECIALISTS, THE FIRST REGULATIONS FOR THE N.C. COASTAL AREA MANAGEMENT ACT WERE STARTING TO TAKE EFFECT. FOR MORE THAN FOUR DECADES, HE WOULD USE HIS COASTAL ENGINEERING AND GEOLOGY TRAINING, AS WELL AS HIS EXPERIENCE, TO ADDRESS HURRICANE-RESISTANT BUILDING CONSTRUCTION,

SHORELINE EROSION, GREEN CONSTRUCTION, COASTAL MANAGEMENT, AND MORE. THE STATE'S ORDER OF THE LONG LEAF PINE AND THE NATIONAL SEA GRANT NETWORK, AMONG OTHERS, HAVE HONORED HIS WORK. BEFORE HE RETIRED IN FEBRUARY, HE SPOKE WITH KATIE MOSHER, NORTH CAROLINA SEA GRANT'S COMMUNICATIONS DIRECTOR, ABOUT COASTAL HAZARDS AND RESILIENCE — AND WHAT HE ANTICIPATES FOR THE FUTURE.



North Carolina Sea Grant

*In the 1970s, Rogers conducted the initial erosion study that informed oceanfront setbacks in the state. A decade later he helped start a committee that looked at building code requirements and recommended increasing the depth of pilings, among other changes. Today, raised homes are prevalent along the coast.*

**Katie Mosher: You have served on the state's Science Panel on Coastal Hazards, and sea level rise has been an issue in recent decades. What has been the longer-term purpose of the panel's work?**

**Spencer Rogers:** One of the science panel's most important efforts has been the sea level rise study in 2010. I was one of many who worked on that study — a particularly challenging topic because of the uncertainty of what impact climate change and sea level rise will have at different scales. Not only are there future climate issues, there also has been a historical increase over our own lifetimes.

The sea level rise report made clear that historically it has been increasing. The group of experts assembled by the panel agreed that an acceleration in the future is certain to occur. That acceleration has been

slower to see in North Carolina than has been recorded in other parts of the United States or elsewhere.

The response at the time by the N.C. General Assembly was to ban the report from being implemented. But the report predictions were never intended to be implemented as a regulatory tool. It was always a planning document. So, the prohibition that was established really didn't prohibit anything that was actually going to be done.

Ironically, while the report was referenced by the Colbert Report on national television, North Carolina did not get credit from Colbert or others that we were one of the first states to actually require sea level to be studied.

The panel provided an update in 2015. That report process was a critical turning point in our understanding that sea level was not a constant. It never has been and never will be. We're actually at the point where the methods that we used in the last report — to observe sea level rise changes and to project them into the future — are relatively routine. Now, in an extreme event, they can monitor in real time or near real time and report what water levels are doing in most of the coastal rivers and streams and major bays. That level of ongoing data was encouraged by, and I think the result of, our sea level report.

*Note: In February, the N.C. Coastal Resources Commission determined it will ask the Science Panel for shorter annual updates on sea level rise to identify new research or forecasts. The panel may also prioritize related items or topics for additional study.*

**Are there related issues that North Carolina officials and residents need to consider?**

The land is changing as well as the sea level is changing at the same time. So, the question for the science panel becomes: *Can stations in the NC Flood Inundation Mapping and Alert Network, known as FIMAN, be used to identify sea level rise?* I suspect the answer to that probably is: *Not yet; but maybe in the future, particularly if the data review and archiving is improved.*

There's a second key question: *Can the state provide better measures of land subsidence?* The first sea level rise study said that parts of North Carolina are subsiding. The second study in 2015 said that you can divide that into four segments. The northeast quadrant is what's subsiding the most in North Carolina. So that makes local sea level rise the fastest in those parts of the state.

Another resource that we identified to help determine changes to landforms is the N.C. Continuously Operating Reference Station, a network of the Global Navigation Satellite System. They're used by private surveyors, but they take position measurement in multiple ways every second or two — and have been doing that for years. So, they're essentially measuring local ground elevation changes compared to GPS satellites.

Can we use those stations to measure landform changes near the towers — and if so, how far from the towers? Can those numbers actually be applied to represent landform changes in coastal North Carolina? I think that the answers are still undefined. The science panel could probably put their resources to good use to determine if that data provides good measurements for landform changes, as a tool to improve our ability to measure local sea level.

*Continued*



Google Maps via NCDOT

Forty-two years ago, Rogers predicted that the dune on the south end of Topsail Island would keep moving — and that inlet has continued southward at about 90 feet per year, as this recent aerial image shows

**Many coastal communities also experience flooding that is not associated with a particular storm. Can you explain?**

When you get in the estuaries, those sunny day flooding events can become a significant nuisance — and will continue to get worse in the future as sea level rises. The science panel may look at best ways to describe to local officials and residents how they can use tidal data to determine the increasing frequency of these types of nuisance flooding.

If you plan mitigation — such as to raise a road or raise a house X number of feet — then you can predict how long that mitigation action will be effective. That's very important information for decision-makers at personal and community levels, and state levels. A case study could use gauges at the USS North Carolina battleship next to the Wilmington tide gauge. Another location could be Pivers Island in Carteret County, where two of the primary NOAA gauges are installed. We know the data exists at those sites. The question becomes: Can we use data so that nuisance flooding can be better predicted?

**You have noted that “Inlet Hazard Areas” are another success story for the panel, one that is still in process. What are they and why do they matter?**

By far the inlets are the most volatile shorelines in the state, both eroding and accreting. Inlets have some of the longer-term trends. Some inlets oscillate or have cycles. Some oscillations are on the order of three to five years. But others are oscillating over 40 or 50 years. One side of the inlet gains as the other side loses, but eventually the cycle reverses.

In 1978, one of the original inlet studies that was done in North Carolina looked at changes in the inlet shoreline between islands. Our new report looks more closely at inlet influence along the oceanfront of the barrier islands. Those hazard areas can extend for a mile or more beyond the inlet itself — and the inlet increases the variability by a factor of 10 to 100 over normal long-term erosion problems. Depending on the island, if you go a mile or more from each end of the ends, that can be quite a bit of the island.

The innovative Inlet Hazard Area identification methods that we developed and reported back in 2018 are now being reviewed and partially implemented by the N.C. Division of Coastal Management.

Speaking of inlets, the south end of Topsail Island is one of my better predictions. Forty-two years ago, I advised the Topsail Beach town manager at the time, Tony Caudill, that the dune would not stay in front of some buildings. He agreed and actually gave up on trying to protect the buildings — and instead built the dune to protect the road behind it. The road and the dune are still there.

Now they're building houses in the area. But that inlet has been moving south at about 90 feet per year for the last 80 years. That's the last of the migrating inlets in the state, and it appears that it may now be slowing down.

It's not surprising that we've lost a number of inlets in the southern part of the state over the last 10 or 20 years, because they're still adjusting to the construction of the intercostal waterway in the 1930s. The waterway entirely changed the circulation between the mainland tidal creeks and individual inlets to create a distribution system that could move water more effectively along the waterway to the larger inlets. It's had a major change on the smaller islands.

**Identifying building setbacks on the oceanfront areas of barrier islands was part of one of your early Sea Grant projects.**

One of the most useful tools in establishing oceanfront building setbacks is the local long-term erosion rate. The primary threat for things with long lifetimes, like buildings, is the chronic long-term erosion, not just short-term, or storm-induced erosion. With NC State colleagues, I was tasked by the N.C. Division of Coastal Management to update prior erosion shoreline studies that were done when the N.C. Coastal Area Management Act was coming on in the 1970s.

I conducted the initial erosion study that was used for oceanfront setbacks in the state. We were forced to use crude aerial photography analysis tools. I had a UNCW student in the dark room using a



Rogers attaches a wave gauge at North Topsail Beach.

photographic enlarger to compare shorelines, something the equipment was never intended to do, and nowhere near what's available today.

Now it's done by DCM's in-house GIS wizards. The setback lines are updated about every five years. The photographs for one of the update studies cost half a million dollars at the time. Now we can get much better photos from Google Earth for free.

**You often have spoken about how the most boring buildings are the most important.**

Some of the work that I found most interesting has been inspecting areas that have been hit by major hurricanes around the country. Going into these areas, everybody takes pictures of the broken houses. I do that, too, including some fairly spectacular collapses. Many more are less spectacular, but just as important to the individual property owners. What's been important to me is to look at the same areas for the buildings that survived.

The surviving buildings are relatively boring, and seldom get shown in news coverage. But they're always examples of successful buildings. Even as you get to the extremes of Hurricane Katrina, there were surviving buildings that managed such conditions with minimal damage or very tolerable damage.

Understanding what was successful is just as important as identifying

what is failing in these storms. In our work on Hurricane Ike [during which Rogers collaborated with national experts after the storm struck Texas], we moved from anecdotal observations — building by building, noting what was broken and what worked — to a community scale. We've gone from a handful of buildings on any individual report to almost 4,000 buildings after Ike.

To do that, you must have accurate reporting of conditions. That means using pre-deployed storm gauges — something that I have been involved with over the years and that has become standard practice now by the U.S. Geological Survey. We're confident that we know what happened in one profile of the Bolivar Peninsula in the middle of Ike, because we have a gauge on the Gulf of Mexico shoreline and one on the backside, with multiple buildings in between with varying levels of damage.

**What have you learned about storm surge and wave modeling?**

Sea Grant has supported a number of different studies to improve storm surge models overall. Hurricane Ike, again, allowed us to apply those models to the conditions in that particular storm, because we have gauges to confirm if the model was accurate or where it was accurate. In practice, our ability to predict the wave elevations near the Gulf of Mexico was very good — within a few inches. But the wave models were not as accurate across the peninsula so, there's still more work to do.

Our work with groups like USGS and others provides wave gauge transects across developed areas. Sooner or later, when these areas get hit, we'll have not just a gauge on the oceanfront and on the backside, with the estuary. Rather we will have a series of gauges. We've been deploying 10 gauges in transects from barrier islands' oceanfront to mainland communities that have flooding. That's what it's going to take to sort out better modeling for these areas during hurricane conditions.

**One response to storm surge and high-wind risk has been updates to the state building codes. What changes have occurred, and what do you anticipate going forward?**

In 1986, a committee that I helped get started looked at the 1960s-era building code requirements. Our recommendations — which increased the depth of pilings and the way buildings were constructed in North Carolina — were tested in Hurricane Fran and Floyd in the 1990s. They proved to be effective in the post-storm analysis. You see raised homes all along the coast now.

Looking at the future, by far the big wildcard is climate change and sea level rise, because of the uncertainty of predicting sea level rise. If climate change is at the intermediate, or, particularly, the higher ranges, anything we do for the lower ranges, would be wasted effort. If we go at it in the other direction to plan for the highest levels of sea level rise increase, that's basically abandoning large parts of the mainland and most of the barrier islands. Which end of the spectrum that local and state officials use will be important in my successor's career.

**You are a well-known expert on rip currents here and nationally. What have you learned?**

Rip currents are a major beach hazard — one of very few hazards on what's otherwise a relatively safe place for recreation. They are threats to

*Continued*



North Carolina Sea Grant

Rogers has used GPS-fitted drifters (like the one he holds here) to study the patterns of water flow in dangerous rip currents. “My grandkids,” he says, “will have a rip current warning magnet on their refrigerator.”

people, and they're very difficult to identify. We're losing lives, in North Carolina, nationally, and internationally.

We worked for many years with partners here in North Carolina, producing a whole series of warning posters and materials that evolved to better convey the risk to beach goers. Around 2004, we agreed to work with NOAA at the national level to help produce and update national products that could be used by any community as warning materials. Since then, North Carolina Sea Grant has helped partners produce warning information on signs and magnets, even on sunglasses and dog leashes. [See the inside back cover of this issue.]

There is an endless group of new beach-users coming to the coast. Many are coming from inland areas, with no concept of what a rip current is or what to do if you happen to get caught in one. I'm pleased that most of the communities in North Carolina are using some form of those signs, posted at hundreds of public walkways and lifeguard stands around the state, to convey the science of what rip currents are, and what to do if you get caught in one.

To be safe, the best strategy is still to swim parallel to shore, get out of the rip current absolutely, as soon as possible — and the U.S. Lifesaving Association and NOAA have used that for warning guidance.

My grandkids will have a rip current warning magnet on their refrigerator. Strong science communication and outreach will be needed. 📧

**NC FLOOD INUNDATION MAPPING AND ALERT NETWORK**

- [Fiman.nc.gov](http://Fiman.nc.gov)

**N.C. CONTINUOUSLY OPERATING REFERENCE STATION NETWORK OF GLOBAL NAVIGATIONAL SATELLITE SYSTEM**

- [ncsg.state.nc.us/pages/CORS-and-GNSS](http://ncsg.state.nc.us/pages/CORS-and-GNSS)

**ROGERS'S WORK ON RIP CURRENTS (AND OTHER RIP CURRENT MODELING EFFORTS)**

- [go.ncsu.edu/rip-current-models](http://go.ncsu.edu/rip-current-models)

**THE DUNE BOOK**

- [go.ncsu.edu/TheDuneBook](http://go.ncsu.edu/TheDuneBook)

**ROGERS ON COASTAL CONSTRUCTION AND INSURANCE OPTIONS**

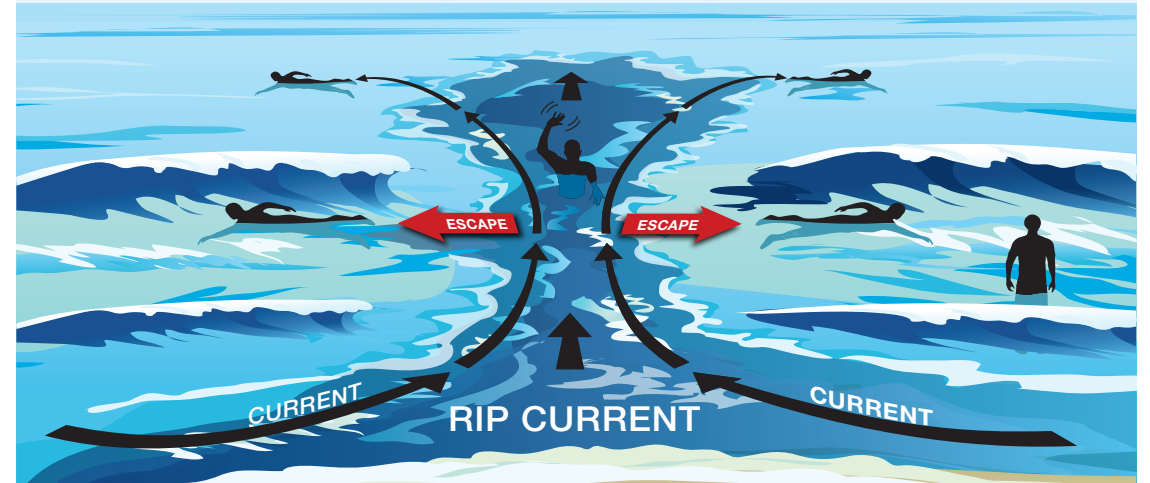
- [go.ncsu.edu/insurance-savings](http://go.ncsu.edu/insurance-savings)

*Katie Mosher has led the North Carolina Sea Grant communications team since 1998. During her tenure, she has been a writer, editor, mentor, and collaborator, including ongoing service on the national rip currents task force. An Ohio native, she initially came to Raleigh as a daily news journalist.*

Detach this page and stick it to your refrigerator at the beach house, post it on the back door of your coastal rental cottage, pack it in your beach bag, use it as a bookmark, or stow it with the suntan lotion and umbrellas.

# RIP CURRENTS

## Know your options



Rip currents are powerful currents of water moving away from shore. They can sweep even the strongest swimmer away from shore. If at all possible, swim near a lifeguard.

### IF CAUGHT IN A RIP CURRENT

- ◆ Relax, rip currents don't pull you under.
- ◆ Don't swim against the current.
- ◆ Swim out of the current, then to shore.
- ◆ If you can't escape, float or tread water.
- ◆ If you need help, yell or wave for assistance.

### SAFETY

- ◆ Know how to swim.
- ◆ Never swim alone.
- ◆ If in doubt, don't go out.
- ◆ Swim near a lifeguard.

More information about rip currents can be found at the following websites:

[weather.gov/safety/ripcurrent/](http://weather.gov/safety/ripcurrent/)  
[usla.org](http://usla.org)



### RIP CURRENTS: KNOW YOUR OPTIONS

North Carolina Sea Grant joins the National Weather Service, oceanfront communities, and other partners to highlight surf-zone safety throughout the year. Learn more, and find links to order signs and magnets at [ncseagrant.ncsu.edu/ripcurrents](http://ncseagrant.ncsu.edu/ripcurrents)





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