Autumn 2021: A Season of Variety and Opportunity

Autumn is not just a transition but also a season of contrasts within itself.

The start of a new school year brings excitement and adjustments. September marks the end of summer vacations, even if many people this year remained at home or nearby as the pandemic continues. Cooler days encourage walks to enjoy neighborhoods, park and our amazing beaches, and mark to watch and listen for birds in migration. No doubt Blain Simpson’s North Carolina: Land of Water, Land of Sky, which we excerpt in this issue, will inspire countless autumn days and longer sojourns into coastal environs. Autumn also is the peak of hurricane season, bringing memories of storms from our recent and deepest past, amid new preparations for stronger and more frequent storms with climate change.

The change in season also means an online gathering of our North Carolina Sea Grant Advisory Board. We have a great mix of people who meet with us twice a year — and connect with us throughout the year to offer perspectives on topics related to our research and outreach.

Our current chair is Michael Pahlke, director of the Institute for the Environment at the University of North Carolina at Chapel Hill and head of sustainability programs for the campus. Over the years Mike has worked with communities and agencies to better understand nitrogen cycling and coastal ecosystems and has mentored a cadre of future leaders.

We also have several new board members who offer a wide variety of expertise. Ricky Moore is owner and chef at Salbox Seafood Joint in Durham (and an author as well). Amanda Martin is the state’s chief resilience officer within NC Emergency Management. James Hargrove has a career in environmental science — that is evolving into a career in aquaculture as owner of Middle Sound Mariculture in Wilmington. Todd Miller is the founder and longtime leader of the N.C. Coastal Federation, based in Carteret County and with offices along the coast.

Variety is also a key element in this issue of Coastwatch. But there is an underlying theme, too: Sea Grant’s support of graduate students, fellows, and early-career researchers. Start with our “Tidings” section and you will find announcements about state and national policy fellowships, and we celebrate a new study from Sea Grant/Space Grant research fellow Melissa Martinez.

Our cover story on groundbreaking rip current forecasts has its roots in graduate work by Greg Dusek and his ongoing partnership with ocean rescue expert Dave Elder. Work by Carson Miller is featured in “Digging Up a Stormy Past,” a piece by Antonio Rodriguez of UNC’s Institute for Marine Science. Sienna Zaco, an undergraduate intern from UNC-Chapel Hill, helped local seafood businesses through a project with the N.C. Local Food Council, which we highlight in “New Links in the Sea-to-Table Chain.”

“In Currents,” Aaron Ramos of UNC-Wilmington writes about his research on invasive seaweed, research we funded with our joint fellowship with the N.C. Coastal Reserve and National Estuarine Research Reserve. Kara Yopak credits her UNCW students as coauthors on research we highlight in our “Science piece,” and “Hook, Line & Science” features several students as guest authors. Of course, we could not publish this magazine without the writing and editing of our science communication interns Lauren D. Peurr, Carrie Closer, and Nan Pincus.

“Tis also a season for finding opportunities for future projects. Check out opportunities on our news and funding pages at ncesagrant.org now and through the end of the year. And we are completing the process for our next set of two-year “core” research grants, so watch for news on those projects in early 2022.

As always, I’d appreciate your comments on our current work and ideas for the future. Please email me at snwhite@ncsu.edu.

— Susan White, Executive Director, North Carolina Sea Grant

IN THIS ISSUE

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This issue includes photographs from Coastal Studies Institute, Google Earth, Kill Devil Hills Council, Research Library of Oregon, NC State News, Pamlico Water Trail, UC Santa Cruz, UF/IFAS Nature Coast Biological Station, and VisitNC.com, as well as images available on ClimateGenetics.org, learning and from other sources.

Setting for the stories in this issue vary from many locations in North Carolina including Outer Banks, north to Cape Fear, Kill Devil Hills, Albemarle-Pamlico Peninsula, Harbors Island, and Montoaren Sound.

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| Front Cover: Fan on the Outer Banks, by Molly Shannon/Shutterstock
| Table of Contents: A sip of NC seafood, courtesy of Ray Meldert
NOAA and Sea Grant have announced 74 finalists for the 2022 class of the Sea Grant John A. Knauss Marine Policy Fellowship program, including four graduate students from North Carolina: Olivia Vill, Anderson Tran, Molly Bruce, and Colleen Baker.

The year-long fellowship honors John A. Knauss, a founder of the National Sea Grant program, NOAA administrator, and dean of the University of Rhode Island’s Graduate School of Oceanography.

“The Knauss Fellowship program offers talented students an opportunity to delve deeply into the work of their host offices, offering their expertise and unique perspectives that absolutely enhance much-needed research, education, and outreach,” says Susan White, executive director of North Carolina Sea Grant.

The 2022 Knauss Fellowship finalists from North Carolina have a wide array of research interests and experiences.

- Olivia Vill, a Ph.D. candidate at NC State University, works with multiple interdisciplinary teams on hazard mitigation and resilience research. Her current work uses environmental justice, leadership, and policy frameworks to assess communities’ ability to engage in recovery and mitigation, as well as to support improvements.
- Anderson Tran received his law degree from the University of North Carolina at Chapel Hill. After years in the natural sciences, he shifted his career to law to become more involved in policy decisions that affect fisheries and other coastal resources. “I hope to bring my merged scientific and legal training to help craft effective policy that will sustain our coastal resources to use and enjoy for generations to come,” Tran says.
- Molly Bruce earned law and master’s degrees from Duke University, where she focused on the interaction between water and climate. She has participated in clientele-centered representation and environmental policy design, as well as using research remotely sensed data from drones and satellites to monitor coastal ecosystems. “I am excited by the incredible opportunities I’ll have as a Knauss Fellow to learn about federal policy design and the nuances of representing national interests,” Bruce says.
- Colleen Baker holds a master’s degree from Duke University in environmental management, with a focus on coastal environmental management. Her research looks at small-scale fisheries and fisheries governance.

“I have spent a lot of time understanding management decisions and evaluating fisheries policies, but the Knauss Fellowship offers me the opportunity to be on the inside of decision-making and implementation,” Baker says. This year’s finalists join about 90 from North Carolina who have served during the four-decade history of the Knauss Fellowship.

NOAA and Sea Grant Select New Knauss Fellows

Cothron Joins Sea Grant to Support a Resilient NC

Cayla Cothron recently joined North Carolina Sea Grant’s team as a climate resilience extension associate. “Cayla brings an impressive track record of working with communities as a public and private sector planner,” says Frank López, North Carolina Sea Grant’s extension director.

“Sea Grant serves a unique role in building relationships and facilitating discussions with communities,” says Cothron.

Cothron will connect with community members and natural resource managers, working alongside Lopez, as well as North Carolina Sea Grant’s coastal resilience specialist, Sarah Speigler, and coastal construction and erosion specialist, Spencer Rogers.

Cayla Cothron also will work directly with students, fellows, researchers, and other stakeholders. In particular, she will collaborate with the North Carolina Sentinel Sea Programs partners along the N.C. coast.

North Carolina is “positioned to have rapid change due to climate change,“ Cothron says, adding that this requires planning in order to mitigate damage. For instance, she already has identified a project to help a coastal community improve its climate risk communication.

“We look forward to Cayla continuing our program’s commitment to helping coastal communities consider the immediate and longer-term impacts that they face from our changing climate,” López says.

- Cayla Cothron: gc.eo@nctc.gov
- Carrie Glover

Do Ghost Forests Perpetuate Global Warming?

New research from Melinda Martinez, a joint fellow with North Carolina Sea Grant and NOAA’s Office of Sea Grant in 2019, has determined that standing dead trees in coastal wetland “ghost forests” are emitting greenhouse gases.

Martinez and NC State University’s Marcelo Ardón measured the quantity and type of greenhouse gas emissions from dead pine and bald cypress snags in five ghost forests on the Albemarle-Pamlico Peninsula. They found that the snags increased emissions of the overall ecosystem by about 25%.

“Even though these standing dead trees are not emitting as much as the soils, they’re still emitting something, and they definitely need to be accounted for,” says Martinez, who recently completed her Ph.D. at NC State and now serves as a Mendenhall Fellow with the U.S. Geological Survey.

Researchers have been tracking ghost forests on the Albemarle-Pamlico Peninsula, terrain that formed due to sea level rise. Previous studies have projected that salinity from rising seas and more frequent flooding will further stress coastal ecosystems in the Southeast.

“The temptation from forest to marsh from these disturbances is happening quickly, and it’s leaving behind many dead trees,” Martinez says. “We expect these ghost forests will continue to expand as the climate changes.”

- the full story gc.eo@nctc.gov
- Ghost Forests in Coastwatch gc.eo@nctc.gov

STUDY REVEALS FOUL PLAY FROM CLAVELINA OBLONGA

The invasive marine fouling species Clavelina oblonga reduces ecological diversity, according to a new research from the North Carolina Sea Grant and the National Science Foundation supported. Marine fouling species are invertebrate filter-feeding organisms, like barnacles and mussels, and they also include soft-bodied “tunicates,” like Clavelina oblonga. Tunicates use tubular openings to sip up and expel water.

Given the recent proliferation of C. oblonga on the coast, researchers with NC State’s Center for Marine Sciences and Technology in Morehead City wanted to explore the invasive’s impact.

David Eggigration and Kayla Christianion duplicated experiments performed 50 years ago in Beaufort. Along the docks, they observed submerged terra cotta plates and detected 22 different fouling species that settled on the plates.

They found that wherever C. oblonga settled, the species rapidly crowded out others. Even when cold weather and a hurricane removed C. oblonga, it quickly regrew, and again reduced diversity. “C. oblonga has only been here since 2015, but it seems to have no real natural predators, it crowds out native species, and it has a foothold,” Eggigration says. “We will have to monitor this species and be sure that it doesn’t impact my local shellfish industry.”

- the full study gc.eo@nctc.gov

— adapted from Tracey Poole’s NC State News story

Cayla Cothron joined North Carolina Sea Grant’s team as a climate resilience extension associate. “Cayla brings an impressive track record of working with communities as a public and private sector planner,” says Frank López, North Carolina Sea Grant’s extension director. “Sea Grant serves a unique role in building relationships and facilitating discussions with communities,” says Cothron. Cothron will connect with community members and natural resource managers, working alongside Lopez, as well as North Carolina Sea Grant’s coastal resilience specialist, Sarah Speigler, and coastal construction and erosion specialist, Spencer Rogers.

Cayla Cothron also will work directly with students, fellows, researchers, and other stakeholders. In particular, she will collaborate with the North Carolina Sentinel Sea Programs partners along the N.C. coast. North Carolina is “positioned to have rapid change due to climate change,” Cothron says, adding that this requires planning in order to mitigate damage. For instance, she already has identified a project to help a coastal community improve its climate risk communication.

“We look forward to Cayla continuing our program’s commitment to helping coastal communities consider the immediate and longer-term impacts that they face from our changing climate,” López says.

- Cayla Cothron: gc.eo@nctc.gov
- Carrie Glover

— adapted from Lauren Clason’s NC State News story

Marlind Martinez, former joint fellow with North Carolina Sea Grant and NC Space Grant.
** COMMUNITY PROJECTS EXPLORE SHARKS, OYSTERS, YOUTH TRAINING, AND MORE **

Shark new projects in North Carolina launch this year with support from the Community Collaborative Research Grant Program (CCRG). North Carolina Sea Grant administers the CCRG Program in partnership with the William R. Kenan Jr. Institute for Engineering, Technology and Science (KITES) and the N.C. Water Resources Research Institute (WRRI).

“The CCRG program expands its reach across North Carolina with the latest round of projects,” says John Pear, deputy director for North Carolina Sea Grant and WRRI. “The ongoing focus on local needs and use of local knowledge sets up these projects for success.”

- **New River Oyster Restoration**
  - Joel Fedrie of the University of North Carolina at Chapel Hill and Pat Donovan-Brandenberg of the City of Jacksonville will help identify where oyster restorations have succeeded on the New River to better plan future restoration efforts.

- **Youth Training and Conceptualizing Disaster**
  - Kathryn Stevenson of North Carolina State University and Veeramani Joyner of the Boys and Girls Club of the Coastal Plain will work in an underserved community to understand how K-12 students conceptualize disaster and to explore how to better engage community members in disaster resilience efforts.

- **Contaminants and Sharks**
  - Scott Belcher of North Carolina State University and Captain Charles Locke of F/V Salvation will work to compare contaminants present in four different shark species in the near-shores of North Carolina, as well as to determine whether mother sharks pass contaminants on to their offspring.

- **Wetlands and Wastewater**
  - East Carolina University’s Natasha Bell and Greenville Utilities Commission’s Jason Manning will work with a team of students to test a new hybrid constructed wetland at the Greenville Utilities Commission wastewater treatment plant.

- **Shoreline Erosion in Nags Head**
  - Radio Corpse with East Carolina University and Holly White with the Town of Nags Head will be working to provide the town with highly accurate shoreline erosion data to inform Nags Head’s new Shoreline Management Plan.

- **Endangered Freshwater Mussels**
  - Greenbloom Science Center’s Lindsey Zarecky and the N.C. Wildlife Resources Commission’s Rachel Hoch will create a new innovative visitor display at the Greenbloom Science Center, based on endangered freshwater mussel research, and also will develop a video about freshwater mussels.

- **The CCRG program provides stakeholders an opportunity to collaborate on community-related initiatives that address relevant problems and issues,” says Raj Narayan, associate director of KITES. “The CCRG continues to nurture the creativity and resilience of these communities and enables authentic partnerships focused on developing innovative approaches and solutions with beneficial outcomes and impact.”

**MORE:** go.ncsu.edu/oceans

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**NC SCIENCE POLICY FELLOWS BEGIN STATE GOVERNMENT ASSIGNMENTS **

Four new North Carolina STEM Policy Fellows recently began yearlong roles in high-level state government offices. The fellowship provides non-academic career opportunities for recent graduate students in science, technology, engineering, and math.

“Our incoming fellows will bring new perspectives and energy as they address policy challenges and opportunities on important issues,” says Susan White, North Carolina Sea Grant’s executive director.

This year’s fellowship class includes students from four North Carolina universities.

- Matthew Kollman, a doctoral candidate at NC State University, studies the chemistry of deriving sustainable products from renewable resources.
  - “As an NC STEM Policy Fellow, I look forward to working on a wide range of topics, while learning about and supporting advances in science and technology by innovative North Carolinians,” says Kollman, who will serve in the N.C. Department of Commerce Office of Science, Technology & Innovation.

- Emma Hughes graduated with a masters from Duke University’s Nicholas School of the Environment.
  - “I became interested in using my knowledge and skills to uplift the protection and preservation of natural and cultural resources during my time at Duke, and I’m excited to continue this type of work,” Hughes, who will serve with the N.C. Department of Natural and Cultural Resources Office of the Secretary.

- Rachael Wolff recently graduated with a master’s degree in city and regional planning from the University of North Carolina at Chapel Hill.
  - “As a storyteller at heart, whether through data or words, I think this fellowship will be a great opportunity to communicate the initiatives of the State Energy Office and transform science policy into meaningful action,” Wolff says of her new role in the N.C. Department of Environmental Quality.

- Stephanie Batast serves the past four years to pursue her Ph.D. in biochemistry at Wake Forest University.
  - “My current work in Wake Forest Innovation Quarter, a designated North Carolina Research Park, has shown me what can happen when research and innovation meet,” says Batast, who will serve with the North Carolina Biotechnology Center to support in-state innovation.

The 2021 NC STEM Policy Fellows also include professional development sessions in state government assignments.

**MORE:** go.ncsu.edu/sea-space
THIS WET AND WATER-LOVING LAND

BY BLAND SIMPSON

Excerpts from North Carolina: Land of Water, Land of Sky

Continued

Setting for a boyhood swim: sunrise at Kitty Hawk.
SWIMMING AT DAWN

Before sunrise on warm summer mornings at Kitty Hawk, my father would awaken my first cousin, Johnny and me, both of us not yet six, by shaking our feet, and we would come to quickly, put on our swimming trunks, and then follow him through the dunes, dew still on the sea oats and pennywort, down to the tide line of the Atlantic Ocean. Sometimes the glow from way out beyond the Gulf Stream clouds would be a deep red, other mornings it might be a faint yellow, with a promising fair-weather pink on the high clouds, nothing yet but the color of ash on the lower puffs closer to the sea. We would stand silently, just we three, for a few moments, till my father, a former Navy navigator, spoke in the voice of command, saying briskly, “All right, let’s go!” And in we went, over the sea-foam and into the surf after him, the plunges always shocking, as our warm bodies hit the frigid waters that had come all the way down to our cottage doorsteps from Labrador. Yet we knew by now what to expect, and to be immersed in those Labrador waters and in that moment with him were important it all was, for no one else was ever up and about.

The sea was ours, and we were the sea’s, and soon, after my father got us in to shore and, leaving us there, returned alone to the water, he swam forty or fifty yards out and then kept swimming parallel to the beach, the quarter mile up to the old fishing pier and back, and we went back up on the porch, found towels and dried off, and stood watching his progress, wondering and marveling over what strength it must take to do that, to be a man swimming powerfully in the sea, and dreaming of a year to come when we might do that too.

BEAUTIFUL BERTIE

Many years later, at the dedication of the North Carolina Coastal Land Trust’s 1,000-acre Salmon Creek gift to the people of North Carolina, I sat near the Town of Windsor’s Mayor James Hoggard and next to County Commissioner Ron Wesson, just 100 yards or so from the cypress-lined mouth of Salmon Creek into Albemarle Sound. In light-gray sweater and black slacks, my wife Ann as president stood and spoke happily as she presented the deed to this magical tract to North Carolina State Parks. “Now that much of Salmon Creek becomes a State of North Carolina natural area, we may forever find ways to connect people from all over the state, nation, and world — and especially people from right here in Bertie County and the surrounding area — with this precious landscape and with these precious waters.”

Magical? A fair call, in terms of the confluence of cultures that has happened here: A former Indian village, Mettaquem, sat in this place; Lost Colonists, some if not all, may have sought shelter here after abandoning Roanoke Island in the late 1580s, and archaeologists led by the First Colony Foundation are literally digging into that matter; and Nathaniel Batts lived in his trading post here in the mid-1600s (a “rude and desperate man,” presumably Quaker George Fox called him). Two centuries afterward, a massive Capehart family herring fishery anchored itself hereabouts.

Just a short way up the shoreline from Salmon Creek lay Bertie County’s nearly brand-new beach, nicknamed “Tall Glass of Water,” and Ron Wesson — who as the African American chair of the Bertie County Commission had signed the deed for it — spoke to me later with real pride and emotion about this first ever public swimming access in Bertie for all people.

He himself (a Dun and Bradstreet executive who worked all over the world before retiring back home) had not been able to learn to swim here in his own then-segregated home county, so his mother, a schoolteacher for forty-two years, had driven Ron and his cousins over to Rocky Mount to kill and to the Tar River every weekend till the boys old enough. When the county held the May 2019 grand opening of this Bertie beach, featuring food, games, and swimming, Ron recalled 900 people showing up and one scene in particular: “This touches my heart — one little lad was in the water and he says, ‘Commissioner, thank you for letting us come to play at your beach!’ and I said, ‘This is your beach, and as you grow up, you have to take care of it!’”

HARKERS ISLANDER

In one man’s life, the heartiness, the fearlessness, and the confident self-reliance of Harkers Island people could clearly be seen. Exploring North Carolina host Tom Earnhardt, who had a cottage on the island’s southeast shore for over forty years, from which he could boat down the Darn to Lookout Bight and fish for red drum and false albacre alike, has told me much about his across-the-street neighbor Donald Willis, an American hero then and now.

Once when Donald was a boy of only nine, his mother woke him in the middle of the night. She was a bit tall of the island’s midwives, and she said urgently: “Mrs. — is going to lose her baby and she might die herself — you’ve got to go to Beaufort and get the doctor.” Back then, with no bridge to the mainland, water was the only way. So Donald went down to the dock, mid-Island, south shore, to the family’s small sailing skiff — “First, I had to break the ice off the sail,” he recollected for Tom — and called west across the mouth of North River in the dark.

Up Taylor’s Creek he sailed on, to Beaufort Fisheries, where he docked. When he rang the bell on the waterside dock, the night watchman soon appeared, a .38 pistol on his hip. “What’re you doing here?” asked the watchman, who then heard Donald’s story, the need of the people. "This is our beach, and as you grow up, you have to take care of it!

Continued
“OK,” said the chief. “You’re a deaf-mute, and you’re going to France.”

In France, Donald Wills worked with the French Resistance, indeed feigning as a deaf-mute on fishing boats off the French coast in the face of Nazi patrols, taking soundings with a lead line, triangulating with church steeples, making faint pencil notes on the blade of an oar, and then, when pulling up alongside another fishing boat, holding that oar out and using it to get in close, effectively handing that oar to one of its men, who would file with the Resistance this crucial look-of-shore-from-sea information, Donald getting an imperceptibly different oar in return, one with its blade sanded—a clean slate, as it were—ready for more key nautical inscriptions.

This was March 1944, before D-Day that June.
Drawing on lifeguard expertise and artificial intelligence, researchers are improving rip current forecasting for beachgoers nationwide.

Lifeguard observations from Kill Devil Hills were used to develop a new national rip current forecast model.
Several years ago in late September, Bob Schiffer rode his bike to the beach at Kill Devil Hills for a dip in the ocean, as he often did. Before heading to the water, he hung up his backpack on a pole with a waving red flag — a no-swimming alert indicating hazardous surf conditions. His plan was to repeatedly propel himself, porpoise-style, through shallow water, then backstroke to where he had started as part of a strength-building exercise he had practiced numerous times.

The sea was turbulent that day, with waves breaking in all directions, recalls Schiffer, who at the time lived on the Outer Banks. He had barely begun his routine when he suddenly discovered that he was nowhere close to the beach. “It happened as if I were on an express train,” he says, and “I realized I was in a rip” — that is, a narrow current of water flowing away from shore.

As a teenager growing up in New York City, Schiffer served as a beach lifeguard. He knew the common safety protocol: If you’re caught in a rip current, try to break free by swimming parallel to shore. Otherwise, float and call for help.

The churning water made swimming futile. Spying bystanders in the distance, Schiffer yelled for someone to call 911. Then he tried to relax, turning the face of his watch away from sight so he wouldn’t dwell on the time.

About 40 minutes later, help came splashing toward him. David Elder, lifeguard and supervisor of Kill Devil Hills Ocean Rescue, had received the distress call and arrived with a torpedo-shaped float. Schiffer grabbed hold and together they kicked back to shore.

The next day, the two ran into each other at a local café. Schiffer remembers wearing a rain slicker and that Elder pointed to its off-white interior, noting, “That’s the color of your complexion when I came to see you.” In the ocean, treading water at what seemed like 50 yards from shore, Schiffer wasn’t aware of how drained he’d become.

Rip currents are the leading cause of death on surf beaches worldwide. Preliminary data collected by the National Weather Service suggests that in 2020, 65 rip-current related fatalities occurred in the United States and Puerto Rico. But that number doesn’t reflect unreported or undocumented drownings. (In this article, “drowning” implies fatality.)

Given that the majority of drownings occur on unguarded beaches or outside of regular beach patrol times, the actual U.S. death rate could be more than 100 a year, according to U.S. Lifesaving Association (USLA) executive director Chris Brewster and colleagues, reporting in Natural Hazards and Earth System Sciences in 2019.

This public safety threat has driven researchers to devise ways to predict hazardous rips. Until recently, efforts centered on a tool first pioneered in the 1990s, which National Weather Service forecasters have tailored to their locales. Just this past spring, the National Oceanic and Atmospheric Administration officially launched a new model designed to provide more precise and timely forecasts than ever before.

The tool combines lifeguard observations of rip currents and rescue reports with artificial intelligence to deliver an hourly forecast up to six days out for many U.S. coastlines — including in Hawaii, Puerto Rico, and Guam. Greg Dusek, NOAA senior scientist and project lead, says that with additional refining, forecasts will be available for the entire continental U.S., and even the Great Lakes, “hopefully not too far down the future.”

Ultimately, researchers aspire to warn swimmers of rip currents on their specific stretch of shore — in real time.

“WADING IN

Back in the early 2000s, lifeguard David Elder was becoming increasingly frustrated with the number of rip-related close calls and fatalities. He thought that the only way to warn beachgoers was by adding a warning system directly to the beach. He proposed a push button that was to be placed on the beach and would light up whenever a rip current was detected on the beach. The push button was to be available for the public to use and would be connected to a computer system that could detect a rip current and would alert the lifeguard. The push button would be connected to an acoustic system that would be able to detect rip currents and would alert the lifeguard. The push button would be connected to an acoustic system that would be able to detect rip currents and would alert the lifeguard.

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that his team was encountering. He wondered if there was a way to improve rip current forecasting, particularly for the sake of people on unguarded beaches.

“What I realized was the problem that we were experiencing was a lack of knowledge and an inability of the average patron to be able to understand what a rip current was,” says Elder, who has over 30 years of lifeguarding experience, and whose team has advanced certification from the USLA. “We need to inform them about [rips] in a more timely manner,” he adds — before they set foot on the sand.

Rip currents occur along beaches with breaking waves, including some Great Lakes shorelines. But their mere existence doesn’t spell danger. “What’s going on under the water, in the surf, is changing so fast and is so hard to measure.”

— MELISSA MOULTON

Rip currents occur on surf beaches around the globe. The rocky structure at the bottom of the frame likely contributed to this rip, photographed in Australia and distinguishable by a swelling sediment plume.
formation. For instance, channel rips can occur when a break between sandbars or reefs creates a conduit for water flowing back out to sea.

But capturing data on a constantly shifting sea floor is difficult, to say the least. “What’s going on under the water, in the surf, is changing so fast and [is] so hard to measure,” says Moulton, the coastal physical oceanographer.

“What I realized was the problem that we were experiencing was a lack of knowledge and an inability of the average patron to be able to understand what a rip current was.”

— DAVID ELDER

When Dusek and his doctoral advisor, Harvey Seim of UNC-Chapel Hill, first described the model in 2013 in the Journal of Coastal Research, they noted a 67% improvement over the old forecasting method for Kill Devil Hills. Since then, Dusek says, “pretty much everywhere we test, we see an improvement with the new approach, with obviously the added benefit [that] we’re not just giving you one value for today; we’re giving you much more information going much further into the future.”

“It’s really the first time we’ve had sophisticated numerical model guidance for rip currents that goes out that far and for that many beaches,” adds Mark Willis, Wilmington’s meteorologist in charge.

From a planning perspective, advance warning is crucial to emergency managers. Case in point: This past August, the University of North Carolina Wilmington was hosting an event on Wrightsville Beach, and the school’s emergency manager was concerned about the rip current risk.

Combining the old and new rip forecasting approaches, “we were able to say with a higher level of confidence, yes, there’s a moderate risk of rip currents for New Hanover County — in particular, Wrightsville Beach today — and we think that the rip probabilities will be highest during the morning,” Pfaff says.

The rip model currently uses an approximation for bathymetry: specifically, it considers whether a big storm occurred several days prior to a given forecast. “From our research data we saw that, following a storm — you know, a pretty large wave event — the shape of the bottom would end up being pretty favorable to rip currents,” Dusek says.

Nor does the model yet account for the influence of structures, such as groins, jetties, and piers, which can promote rip currents as incoming waves deflect. Such structures can also influence how sediment moves and thereby affect bathymetry.

Dusek also plans to further improve the model using data beyond lifeguard observations: “Even though lifeguards are really good at doing this, there’s going to be different interpretations depending on where you are,” he says, “so a lifeguard in Kill Devil Hills, North Carolina, is probably going to see the beach differently than a lifeguard in San Diego, California.” Plus, most beaches don’t have guards, so many nearshore nuances go unobserved.

Dusek and colleagues think surf webcams — internet-connected cameras attached to stationary structures like piers — could provide missing data. The idea is that a camera would capture video of the surf, and a computer would analyze the imagery for tell-tale signs of dangerous rips. Positive identifications would then be used to enhance the rip current model.

Alex Pang of UC Santa Cruz is developing that technology using a process called machine learning; the team is testing its capability using footage from a regional array of webcams operated by the Southeast Coastal Ocean Observing Regional Association.

Dusek and Pang’s ultimate goal is to enable beachgoers to detect rip currents in real time. They envision docking stations located on elevated locations, such as piers and beach access points, where beachgoers can dock their smartphones to detect rip currents in real time. They envision docking stations located on elevated locations, such as piers and beach access points, where

ON THE HORIZON

Despite years refining his model, Dusek acknowledges that “there’s still a lot of work to do.” One important limitation is the tool’s treatment of bathymetry, a critical factor in rip current formation. For instance, channel rips can occur when a break between sandbars or reefs creates a conduit for water flowing back out to sea.

But capturing data on a constantly shifting sea floor is difficult, to say the least. “What’s going on under the water, in the surf, is changing so fast and [is] so hard to measure,” says Moulton, the coastal physical oceanographer.

C  o  n  t  i  n  u  e  d
BY THE NUMBERS

Anyone can get caught in a rip current. The map above “highlights the need to talk about rip currents not only within coastal areas, but also in cities well inland, across the country,” says Victoria Oliva, a meteorologist with the NWS Forecast Office in Wilmington. “Whether someone lives in Greensboro, North Carolina, or Kentucky, if they ever visit a beach, they need to be aware of rip currents — what they are and how to stay safe.”

The Wilmington office provided the rip current-related statistics below. The data applies to North and South Carolina and extends from 2000 through July 31, 2021, except where noted.

- Known rip current deaths: 172 (141 males, 25 females, 6 whose gender was undocumented).
- Men ages 41 through 50 comprised the majority of male fatalities; women ages 31 through 40 constituted the majority of female fatalities.
- Most drownings occurred between noon and 5 p.m.
- 51% of deaths involved people visiting from outside North and South Carolina.
- Since 2010, 27% of fatalities have been considered “bystanders,” or people who entered the water in an attempt to rescue someone else in distress.
- In 2020, 11 known rip current drownings occurred.

GETTING THE MESSAGE

The rip current that Bob Schiffer survived in Kill Devil Hills wasn’t his last. This past June, he and his daughter and grandson were playing in the surf at Ocean City, Maryland, when he discovered that he was again caught in a rip.

The prospect of drowning in front of loved ones filled Schiffer with anxiety, and he began frantically swimming. “Years of training and experience were erased by a flash of emotion,” he says.

Schiffer’s family escaped to shore, where his daughter immediately sought help. Once again, a lifeguard pulled him out of the water, shaken but unscathed.

In retrospect, Schiffer says he overlooked certain realities that likely contributed to the close call: He’s older, he hadn’t been in the ocean in a while, and, having once been a competitive swimmer, he fancied himself somewhat invincible.

Not everyone will experience such an epiphany. An enhanced rip current forecast is one step to saving more lives, but a prediction is only as good as the messaging around it. In that regard, building public awareness “has a long way to go,” says Pfaff.

Elder agrees. “How do you tell a 55-year-old male and a 19-year-old kid the same message? And where do you tell them that, and how do you say it?”

“This is something I’m passionate about,” Elder adds, “because I can see the faces in front of me, right now, who should have known this stuff and who will never get a chance to.”

For Schiffer’s part, he’s changing his ways. “I’m accustomed to swimming alone, and was accustomed to swimming early before the beach opened,” he says. “I’ve now made a pact with my children, my daughters, that Grandpa will no longer do that, that I will abide by all of the reasonable standards.”

VISITORS CAN POSITION THEIR PHONES, OPEN AN APP, AND TAKE STEADY FOOTAGE OF THE SHORELINE IN FRONT OF THEM. THE APP WOULD THEN REVEAL DANGEROUS RIPS WITH A VIRTUAL OVERLAY MARKING THEIR PATH, SIMILAR TO INSTAGRAM FILTERS THAT STICK “WHISKERS AND FUNNY NOSES OVER SOMEONE’S SELFIE,” PANG SAYS.

Pfaff says the concept is promising. Seeing a rip current illuminate on your phone “has a sense of realness to it,” he notes. “As far as an educational tool, I think that’s amazing.”

Red flags signal no swimming because of hazardous surf conditions.

Robert Alford/Shutterstock

HOMETOWNS OF NC & SC RIP CURRENT VICTIMS (2000-2020)
DIGGING UP A STORMY PAST

Sediment samples hundreds of years old offer insight into how hurricanes and nor’easters can affect landward migration of salt marshes.

Continued

Aerial view of a North Carolina salt marsh fringing the upland forest. At the boundary, notice the dead and dying trees. This ghost forest is evidence of salt marsh transgression. Clockwise from the boat, researchers include Joshua Himmelstein, Antonio Rodriguez, Naomi Niece, Yasamin Sharifi, and Molly Bost.
Salt marshes are extensive along the estuaries and sounds of North Carolina, where they connect tidal upland forests with shallow coastal waters. These important ecosystems provide refuge for fish, improve water quality, sequester carbon dioxide from the atmosphere, and help control shoreline erosion and flooding during storms.

Salt marsh area is declining globally and locally, largely due to human impacts, such as conversion of habitat into developments and navigation channels. However, new salt marsh is forming in some places where sea level rise has inundated upland forest. These locations have become intertidal, with salty soils, and are ideal for marsh colonization.

Landward expansion of salt marshes, called transgression, can offset some of the ongoing losses. The rate of salt marsh transgression is directly related to the slope of the upland forest surface and the rate of sea level rise. Low upland slopes and high rates of sea level rise promote rapid salt marsh transgression.

Parsing the various factors that influence transgression can help scientists to more accurately project salt marsh coverage under different climate change scenarios. Improved understanding can also inform management practices related to construction along the landward edge of salt marshes. For our study, we wanted to know if major storms like hurricanes and nor’easters contribute to salt marsh transgression. Storms are commonly associated with elevated water levels (albeit temporarily), and they deliver salt to upland soils. They also can cause inlets to form through barrier islands, thereby increasing the connection between ocean and estuary, resulting in higher tides over the marsh.

We decided to look back in time to see how past storms have affected salt marsh movement along coastal North Carolina. As part of her master’s thesis project at the University of North Carolina at Chapel Hill’s Institute of Marine Sciences, graduate student Carson Miller measured rates of salt marsh transgression during a stormy period from about 1400 to 1675 C.E. During that 275-year stretch, the number of inlets through the Outer Banks was greater than it is today, stemming from an increase in nor’easter activity and associated beach erosion, surge, and overwash, according to research published by colleagues at East Carolina University. Greater storminess during that time period wasn’t restricted to North Carolina — it characterized the entire western North Atlantic.

To reconstruct rates of salt marsh transgression, we collected sediment samples, called cores, from salt marshes that fringe bays and tidal creeks, also contributed to contributions from sea level rise, changes in storminess also modulate salt marsh transgression rates. This finding is important because both storminess and the rate of sea level rise are projected to increase in the future. As development along the landward edge of salt marsh continues, will the area of this essential habitat be maintained or lost?

The rate of salt marsh migration into upland coastal areas is increasing in the future. Salt marshes at two different sites migrated 2 and 10 times faster, on average, during the 1400–1675 stormy period than the non-stormy period that followed. Sea level rise was less than 1 millimeter a year during both time spans.

We also looked at transgression post 1865 — after the Industrial Revolution — when sea level rise had increased nearly three-fold, to 2.4 millimeters a year. Salt marsh transgression occurred on average 7 times faster than it did during the previous non-stormy period.

The study highlights that, in addition to contributions from sea level rise, changes in storminess also modulate salt marsh transgression rates. This finding is important because both storminess and the rate of sea level rise are projected to increase in the future. As development along the landward edge of salt marsh continues, will the area of this essential habitat be maintained or lost?

To figure out that time period, we aged blades of grass stuck in the marsh peat. We used the times that salt marsh first colonized a given core to estimate the age of that site. The age of the marsh peat represented when marsh grass first appeared in the upland area. To figure out that time period, we aged blades of grass stuck in the marsh peat using a tool called carbon-14 dating.

Using the times that salt marsh first colonized upland areas and the distances between the cores, we could calculate rates of salt marsh transgression.

We found that salt marshes at two different sites migrated 2 and 10 times faster, on average, during the 1400–1675 stormy period than the non-stormy period that followed. Sea level rise was less than 1 millimeter a year during both time spans.

As development along the landward edge of salt marsh continues, will the area of this essential habitat be maintained or lost?

In a given core sample, we identified the transition between upland forest peat and marsh peat by the absence of organisms found in brackish water typical of salt marsh habitat. The layer of marsh peat that had accumulated over time atop layers of upland forest peat. As a rule of thumb, the closer a core’s location was to the forest, the less marsh peat there was in the sample, and the more recently the marsh had migrated to that area.

In a given core sample, we identified the transition between upland forest peat and marsh peat by the absence of organisms found in brackish water typical of salt marsh habitat.
New Links in the Sea-to-Table Chain

THE NORTH CAROLINA LOCAL FOOD COUNCIL RESPONDS IN THE PANDEMIC’S DARKEST HOUR

BY SUSAN WEST
The North Carolina Local Food Council supports the 35 food councils that serve counties and towns across the state. Food councils bring stakeholders together to build resilient food systems that improve access to healthy food, protect natural resources, and support economic development.

Representatives from 21 member organizations and three regional councils serve on the Council. “It’s unique in that not all states have a formal way for the different organizations working on food systems to collaborate and share information and resources,” says Angel Cruz, the Council’s coordinator and the academic and extension initiatives manager with the Center for Environmental Farming Systems at North Carolina State University.

The Council’s focus immediately transitioned to helping food producers adapt to the loss of food service industry revenue streams and remain viable during the pandemic, and to helping get food to food banks and the people who needed it,” says Nash, who serves as Council chair.

When food producers quickly lost wholesale markets in spring of 2020, the North Carolina Local Food Council was prepared to act. The study surveyed commercial fishermen in states from Maine through North Carolina and found that two-fifths of the fishermen did not go fishing for portions of the March-to-June 2020 timeframe due to market disruptions tied to the pandemic. Nearly all the fishermen who did continue to fish reported a decline in income compared to previous years.

In fact, NOAA Fisheries reported an overall 23% decrease in landings revenue for species in the Southeast during the first six months of 2020 compared to 2019. Black sea bass revenue fell by 65% and dolphinfish (“mahi-mahi”) by 53%, declines that reflected closings of “white tablecloth” restaurants, where both species are popular.

Incorporating direct sales to consumers into business models helped soften the blow for local seafood producers and farmers when wholesale demand slowed. “People were already looking for local foods because often local foods are healthier and fresher than food from other states and other countries,” Nash says. “But the popularity of online sales and home delivery programs accelerated with the pandemic.”

Local food producers often can adjust to market changes faster than national food systems because they usually have less volume of product to move, shorter supply chains, and serve smaller areas. However, not all small business owners have the technological skill to develop a strong online marketing presence and reach new customers.

To help address that challenge, the North Carolina Local Food Council created a student intern program called Remote Internship to Support Enterprises for Local Foods (RISE), which North Carolina Sea Grant co-sponsored. The project paired seven paid college students skilled in digital technology with local food producers, farmers markets, and food hubs to develop websites, videos, newsletters, and social media posts.

“The internet allows producers to create a brand, tell their story, and directly connect with customers on a personal level,” says Sienna Zuco, a student intern from the University of North Carolina at Chapel Hill. In addition to working with several local seafood companies to help build websites designed to meet marketing goals, Zuco created tutorials so clients can update product information, add blog posts, and make other changes as their businesses grow. After graduating in December, Zuco began working as a communications assistant for the Council.

Susan Hill, co-founder of Down East Mariculture in Williston, wanted to improve an existing website to attract more online traffic and feature stories about the history of the business and the town. “Sienna and the RISE project helped us take our website to the next level and tell our story,” Hill says.

In Englehart, Diamond Shoal Shrimp Company did not have a website, and co-owner Patrice Clarke was looking for a way to promote shrimp cakes, the company’s new product. “Our shrimp cakes meet what customers are looking for now,” she says. “They’re easy to order online and prepare at home, trends that took off with the pandemic and are likely to continue.”

Sea Grant plans to follow up with more clients in the seafood industry to evaluate the economic impact of the project and to identify any additional outreach that could help local producers adjust to digital platforms.

Nash and Cruz say much of the energy of the North Carolina Local Food Council lies in the networking opportunities it fosters. Nash points to a new grant that will add seafood producers and farmers to the state legislature in 2021.
that change by sharing data.” Cruz explains, “but I think we helped create cold storage facilities in the state. “That’s not something the storage facilities in food pantry parking lots. refrigerated delivery trucks, idled by the pandemic, became cold food charities with Sysco Corporation, and the company’s the Council heard about,” she says. Council members connected cold storage space for perishable goods.

consumers with local farms. Nash explains. “Serving on the Council has allowed me to connect with other people working on direct marketing projects and discuss how we can raise the visibility of seafood producers.” Cruz recalls that in some areas the amount of food going to food pantries and banks increased by up to 300% when restaurants, school cafeterias, and other food service industries closed or operated at reduced capacity under stay-at-home orders. However, many charitable organizations lacked adequate cold storage space for perishable goods.

That was one of the pinch points, one of the challenges, the Council heard about,” she says. Council members connected food charities with Sysco Corporation, and the company’s refrigerated delivery trucks, idled by the pandemic, became cold storage facilities in food pantry parking lots. Now there are initiatives underway to permanently increase cold storage facilities in the state. “That’s not something the Council directly did,” Cruz explains, “but I think we helped create that change by sharing data.”

The Council’s website is a resource for information on local food and local food councils. Comprehensive guides to North Carolina’s oysters, strawberries, and shrimp point consumers to local sources and feature videos, profiles of local food producers, and recipes, including many from Mariner’s Menu, Sea Grant’s guide to preparing seafood dishes.

Consumers can also read stories about “food champions,” people going the extra distance to promote local foods, like chef Ricky Moore, known for the use of North Carolina seafood at his restaurant, the Saltbox Seafood Joint in Durham.

Cruz says that Council members gained valuable experience after addressing critical food system vulnerabilities tied to the pandemic. “In the future, I think we will continue to be involved in different ways, including finding long-term solutions to making our food system more resilient and more prepared for future pandemics, climate change, and other challenges,” she says.

Nash notes that the U.S. became a net importer of food in 2005, and has remained one since — which is why the North Carolina Local Food Council will always be a crucial resource for groups that want to build or strengthen local food economies.

“We have the graying of the commercial fishing fleet and of farmers too, and we need to show younger people that these businesses can be profitable,” he says. “Otherwise, we are going to lose access to local foods.”

With shorter supply chains and less volume to move, local food producers often adjust to market changes faster than national systems. 

NORTH CAROLINA SEA GRANT’S SEAFOOD CONSUMER AWARENESS CAMPAIGN

In addition to collaborating with the North Carolina Local Seafood Council during the pandemic, North Carolina Sea Grant immediately began an award-winning public service campaign. Not only did the campaign highlight existing and new avenues for consumers to purchase the state’s seafood, it also provided strategies and tips to consumers for both seafood preparation and preserving freshness.

These initiatives supported the state’s seafood industry during a dire economic period and provided valuable resources for consumers and businesses:

• How to Freeze NC Seafood,” the cover story from the summer 2020 issue of Coastwatch, touted alternative strategies for seafood consumers, highlighting how to preserve and prepare fresh seafood. This also appeared as part of the online Currents series.

• Consumer surveys indicated a widespread desire for seafood recipes, which we provided online through the Mariner’s Menu site, as well as a regular feature online and in print in every 2020 issue of Coastwatch. North Carolina Sea Grant partners, such as the National Marine Fisheries Service, regularly used and promoted these recipes. In addition, Carteret County News Times featured Mariner’s Menu recipes in a calendar that the paper published in December 2020. Visit go.ncsu.edu/seafood-primer.

• Leveraging the popularity of Mariner’s Menu, in 2020 North Carolina Sea Grant also developed 13 Mariner’s Menu posters, which news media in turn published in newspaper food sections around the state, including outlets in Dare County at the coast and Chatham County in the piedmont, as well as 919 magazine in Raleigh. Visit go.ncsu.edu/black-menu-poster.

• In print and online, North Carolina Sea Grant also published the 2020 “Seafood Availability Posters,” which highlight dozens of species and their availability by month and by region of the North Carolina coast. These posters represented a fresh update to information consumers have relied on for years as the popular series has evolved since the 1970s. Coastwatch also carried the posters. Visit go.ncsu.edu/seafood-availability.

• Last year, enhanced webspace and a new print and online brochure touting farmed shellfish and promoted the availability of shellfish from North Carolina farmers. This broadened availability helps supplement the otherwise more limited seasonality of shellfish caught during wild harvests. Visit go.ncsu.edu/oyster-time.

• For the first time in 2020, “A Primer on North Carolina’s Seafood” offered webspace that provides information on North Carolina fisheries, consumer safety and health tips, strategies for seafood preparation, cultural resources, and more. Visit go.ncsu.edu/seafood-primer.

• Throughout the pandemic, North Carolina Sea Grant social media feeds also regularly emphasized and amplified key seafood consumer awareness campaign messages and themes, as well as a wide array of new and existing resources (for example, through “#FishyFriday”). Visit @SeaGrantNC and facebook.com/ncseagrant .

• From the start, “North Carolina Sea Grant’s COVID-19 Resource Hub” provided an immediate portal to resources for seafood consumers, marine science educators, and seafood industry owners and employees. Visit go.ncsu.edu/covid-hub.

In July, North Carolina Sea Grant’s Barry Nash, Katie Mosher, and Vanda Lewis received a Grand Award, top honors from the 2021 APEX Awards for Communication Excellence, for spearheading the Seafood Consumer Awareness Campaign.

READ MORE

• North Carolina Local Food Council: nclocalfoodcouncil.org

• RISE: nclocalfoodcouncil.org/rise-for-local-foods

• NC Shrimp Promotion: go.ncsu.edu/shrimp

• NC Oyster Promotion: go.ncsu.edu/oyster-time

• NC Strawberry Promotion: go.ncsu.edu/strawberries
INTERTIDAL MUDDY AREAS EXPOSED DURING LOW TIDE, ARE ACTUALLY QUITE COMMON IN NORTH CAROLINA’S ESTUARIES. Although they might not seem as scenic or picturesque as other coastal habitats, these intertidal mudflats are home to myriad invertebrates — species without a backbone — as well as to fish and seabird populations. These mudflats also support numerous fisheries, including the hard clam *Mercenaria mercenaria*. Hard clams are edible, filter-feeding bivalves that constitute the basis for a popular recreational and major commercial shellfishery in North Carolina that generates more than $3.7 million annually, according to the N.C. Division of Marine Fisheries.

Many of North Carolina’s mudflats are now also home to a new species — a black, stringy, disheveled-looking seaweed known as *Gracilaria vermiculophylla*. In fact, non-native *Gracilaria* has recently invaded almost every estuary in the southeastern United States, from Georgia to Maryland, and it appears *Gracilaria* is here to stay.

When *Gracilaria* invades, it forms complex micro-habitats in these intertidal areas that previously were largely devoid of vegetated structure. Because predators — such as whelks, seabirds, stingrays, and blue crabs — play a major role in controlling populations of benthic (bottom-dwelling) invertebrates on intertidal mudflats, *Gracilaria* could provide benthic prey with a refuge from predators. This could potentially modify predator-prey interactions on invaded mudflats, with important implications for the production of hard clams in North Carolina estuaries.

Understanding the distribution and impacts of invasive and non-native species on coastal ecosystems is a pressing management issue. Aaron’s previous research, as well as past Coastal Research Fellows’, has suggested that these impacts are likely context-dependent and not always negative.

— BRANDON PUCKETT, RESEARCH COORDINATOR AT THE NC COASTAL RESERVE

Aaron Ramus received the 2020 Coastal Research Fellowship, which North Carolina Sea Grant and the N.C. Coastal Reserve and National Estuaries Research Reserve Program sponsor jointly. Ramus, a Ph.D. candidate at the University of North Carolina Wilmington, studies the ecological impacts of *Gracilaria* in estuaries in the Southeast. He received his master’s in marine biology from UNC Wilmington and his bachelor’s in biology from the University of North Carolina at Chapel Hill.

NEW RESEARCH REVEALS THE IMPACT OF THE INVASIVE SEAWEED *GRACILARIA* ON HARD CLAMS AND OTHER INTERTIDAL BOTTOM-DWELLERS.

BY AARON RAMUS

Aaron Ramus conducted research on intertidal mudflats in the Masonboro Island National Estuarine Research Reserve to find out.
Coastal Research Fellow Aaron Ramus on the mudflats in the Masonboro Island National Estuarine Research Reserve.

Intertidal mudflats in four of the reserves—all of which are along the central and southern portion of the state’s coast. Ultimately, I developed a web-based interactive map of Gracilaria’s distribution and abundance to assist managers in their endeavors.

Second, I examined the indirect effects of Gracilaria on predator-prey interactions and on other aspects of the benthic community, including the production of hard clams, by conducting an experiment on intertidal mudflats in the Masonboro Island National Estuarine Research Reserve. My experiment manipulated the presence of Gracilaria and predators simultaneously in experimental plots by either manually removing Gracilaria or using cages to exclude predators.

After two months, I sampled the plots using sediment cores to collect smaller invertebrates and juvenile hard clams and by digging with a clam rake to recover adult hard clams. The results showed:
- Gracilaria strongly and positively affects the overall abundance and diversity of the benthic community.
- Predator exclusion had a negligible effect on the benthic community. The natural mortality of juvenile hard clams (as well as other benthic invertebrates) is very high, independent of whether predators are excluded.
- Most importantly, neither predator exclusion nor the presence of Gracilaria significantly influenced the production of hard clams.

These findings suggest that Gracilaria’s overall impact on the ecosystem falls somewhere between positive and neutral. It would appear that invasive Gracilaria is neither “good” nor “bad” for this estuarine shellfishery and is simply a new feature of North Carolina’s mudflats. Consequently, taking management actions to eradicate this invasive seaweed might not be necessary to preserve the health of our state’s hard clam fishery.

Watch a video about Aaron Ramus’s research on non-native Gracilaria. go.ncsu.edu/invaders

View an interactive map of Gracilaria’s distribution and abundance. go.ncsu.edu/the-map

As the pandemic continues to affect K-12 learning models, several thousand North Carolina teachers, students, and families already have accessed the free Watershed Wisdom Online Lesson Plan.

Watershed Wisdom provides a thorough introduction to the value of water and of maintaining healthy watershed ecosystems. The lesson plan includes guidance for elementary school teachers and a wide range of activities for North Carolina students. In addition, a companion lesson plan is available for middle and high school teachers.

THE WATERSHED WISDOM LESSON PLAN
FREE RESOURCES FOR K-12 EDUCATORS TO ENRICH ONLINE AND IN-PERSON LEARNING
BY CHRISTY PERRIN

Christy Perrin serves as sustainable waters and communities coordinator for North Carolina Sea Grant and the N.C. Water Resources Research Institute. She helps run the statewide N.C. Watershed Stewardship Network (WSN) in partnership with N.C. Division of Water Resources.

Perrin, Paula Edelson of PBS North Carolina, and Lauren Daniel of N.C. Division of Water Resources Water Education led a WSN team that recently won a national APEX Grand Award for Publication Excellence for The Watershed Wisdom Lesson Plan.
“Learning from Home Guide” highlights activities that teachers can assign online to accommodate remote learning across the state.

We designed Watershed Wisdom to support North Carolina teachers by providing them with an easily accessible lesson plan that meets required N.C. Essential Standards. We created it to get students outdoors, empower them, teach them about their local watersheds, and prompt student-parent interactions with the concepts at home.

Our PBS North Carolina partners helped us to achieve this and more. They led development of Watershed Wisdom, including a completely interactive online component, “Ways of Watersheds.” The lesson plan makes a wide range of tools available, from videos to maps to interviewing activities.

Portions of the lesson plan are below. Watershed Wisdom is available in full at no cost by opening a free Learning Media account at go.ncsu.edu/wisdom.

THE WATERSHED WISDOM LESSON PLAN

OVERVIEW

As is the case in many states, North Carolina has suffered its share of flooding, and its citizens have coped with fairly significant periods of drought and polluted waterways. With environmental issues such as extreme weather events on the rise, everyone — and especially students — should understand that water is a natural resource that needs to be valued and protected.

Designed for alignment with North Carolina 4th-grade and 5th-grade science standards but appropriate for all students regardless of age and location, Watershed Wisdom is a blended lesson that combines interactive components with hands-on projects. With enough content to fill two full weeks of class time, the lesson begins with a host of activities to introduce students to the topic, including River Avengers (available at go.ncsu.edu/river), a short animation featuring four youngsters who pose an inquiry to the class: What ideas do students have to keep the river near their school safe and clean?

The rest of the lesson helps students gain the knowledge they will need to solve that inquiry through creative design-thinking tasks, group events, an interactive map activity provided by the EPA’s EnviroAtlas website, and other rich content that serves not only to educate students about water but to inspire them to take action to protect this valuable resource.

Time allotment: Seven to 10 class periods for the entire lesson plan. Each activity takes a class period or less.

Learning objectives:
- Students can define and describe the water cycle.
- Students can define and describe the watershed ecosystem.
- Students can discuss the threats watershed ecosystems face.
- Students can describe actions people can take to protect and promote watershed health.

SAMPLE: THE “WAYS OF WATERSHEDS” INTERACTIVE SESSION

Entertaining video segments and interactive components help define and describe the water cycle and watersheds, feature information on the importance of watershed management, and provide strategies on how best to take care of local watersheds.

Teaching Tips: go.ncsu.edu/the-tips

Support Materials for Students (and more): go.ncsu.edu/ways

SAMPLE: THE “WADDED WATERSHED” ACTIVITY

In this activity, students will use crumpled paper and markers to create model watersheds and track the flow of surface water across “land.”

Teacher Handout for Wadded Watershed: go.ncsu.edu/teacher-handout

Video Demonstration of Wadded Watershed: go.ncsu.edu/video-demo

“LEARNING FROM HOME” (THE EDUCATORS’ GUIDE)

Watershed Wisdom has several activities that are accessible at home via printed handouts and online interactive activities. Many of these lessons are perfect to assign through Google Classroom, Canvas, Sessez, or any other program to share assignments with your classroom.

Access the guide: go.ncsu.edu/guide

In addition to PBS North Carolina, North Carolina Sea Grant partnered on Watershed Wisdom with N.C. Division of Water Resources and with the North Carolina Watershed Stewardship Network’s K-12 team, which included NC Project Wet, the North Carolina Water Resources Research Institute, Town of Kill Devil Hills and City of Raleigh stormwater staff, and the Allamuchy-Pamela National Estuary Partnership. GSK also provided funding for the project.

Watch Krista Brinchek, science specialist at Alblot Creek Elementary, on the value of teaching elementary students about water and watersheds (video): go.ncsu.edu/Krista

The Watershed Wisdom Lesson Plan go.ncsu.edu/Wisdom

“Drought and polluted waterways. With environmental issues such as extreme weather events on the rise, everyone — and especially students — should understand that water is a natural resource that needs to be valued and protected.”

“Designed for alignment with North Carolina 4th-grade and 5th-grade science standards but appropriate for all students regardless of age and location, Watershed Wisdom is a blended lesson that combines interactive components with hands-on projects. With enough content to fill two full weeks of class time, the lesson begins with a host of activities to introduce students to the topic, including River Avengers (available at go.ncsu.edu/river), a short animation featuring four youngsters who pose an inquiry to the class: What ideas do students have to keep the river near their school safe and clean?”

“Time allotment: Seven to 10 class periods for the entire lesson plan. Each activity takes a class period or less.”
FALL FAVORITES

By Vanda Lewis and Joyce Taylor

MARINER’S MENU, NORTH CAROLINA SEAGRANT’S POPULAR ONLINE SEAFOOD GUIDE, FEATURES BLOGGER AND PHOTOGRAPHER VANDA LEWIS’S PICTURES WITH HUNDREDS OF RECIPES THE LATE JOYCE TAYLOR DEVELOPED. ENJOY THESE SAVORY SPECIALS THIS FALL.

CRAB-STUFFED BAKED POTATOES
- 2 cups of backfin crabmeat
- 4 medium baking potatoes
- 6 tablespoons of butter, melted
- 1/2 cup of light cream
- 1/4 cup of sour cream
- 1 cup of shredded mozzarella cheese
- 1/2 teaspoon of salt
- 1/4 teaspoon of white pepper, freshly ground
- 2 tablespoons of fresh parsley, chopped

Preheat the oven to 400° F.
Scrub the potatoes with a brush. Rub them lightly with canola oil.
Bake at 400° F until done, about 40 to 60 minutes.

When cool to the touch, cut the potatoes in half lengthwise. Carefully scoop out the pulp, leaving a firm shell about 1/4-inch thick. Combine pulp, margarine, cream, sour cream, cheese, salt, pepper, and parsley.
Then, gently stir in the crabmeat, being careful not to break apart the pieces. Stuff the shells with the mixture. Sprinkle it all lightly with paprika. Bake it at 400° F until heated through, about 15 minutes.

SMOKED FISH CHEDDAR SPREAD
- 2 cups of flaked smoked fish
- 8 ounces of cream cheese
- 1/2 cup of mayonnaise
- 1/4 teaspoon of salt
- 1/2 teaspoon of white pepper, freshly ground
- 1/4 teaspoon of cayenne pepper
- 1 1/2 teaspoons of fresh garlic, minced
- 1/3 cup of fresh chives, chopped
- 1 1/2 cups of medium cheddar cheese, grated
- crackers

In a medium bowl, combine the cream cheese, mayonnaise, salt, white pepper, cayenne, garlic, and chives. Gently blend in the fish and cheese, taking care not to break apart the flakes.
Chill thoroughly. Place in a serving bowl, and serve with assorted crackers.

FRIED STRIPED BASS WITH PARMESAN
- 1 1/2 pounds of striped bass fillets, skinless, cut into serving-size pieces
- 3/4 cup of flour
- 1/2 teaspoon of salt
- 1/4 teaspoon of black pepper, freshly ground
- 1/3 cup of Parmesan cheese, freshly grated
- 2 eggs
- 2 tablespoons of milk
- 1 cup of Panko crumbs
- 2 tablespoons of canola oil
- 2 tablespoons of butter

In a shallow dish, combine the flour, salt, pepper, and Parmesan. Beat the eggs and milk in another shallow dish.
Pat the fish dry. Dip it in the flour mixture, then in egg. Coat lightly with the Panko crumbs.
Heat the oil in a skillet to 375° F. Add the butter, and melt. Place the fish in the pan, and cook for about 4 minutes. Turn it, and repeat, cooking until done.

SPOTTED TROUT CHOWDER
- 1 1/2 pounds of spotted trout, skinless fillets, cut into 1-inch pieces
- 6 tablespoons of butter
- 3/4 cup of flour
- 1/2 teaspoon of salt
- 1/2 teaspoon of white pepper, freshly ground
- 1 cup of celery, chopped
- 1/4 teaspoon of cayenne pepper
- 1 1/2 cups of medium cheddar cheese, grated
- 1 1/2 cups of chicken broth
- 1/2 teaspoon of dried thyme leaves
- 1/2 teaspoon of salt
- 1/4 teaspoon of black pepper, freshly ground
- 1/4 teaspoon of white pepper, freshly ground
- 1 cup of heavy cream
- 1/4 cup of fresh parsley, chopped

In a large saucepan, melt the butter. Lightly sauté the onions, celery, carrots, and garlic. Stir in the flour gradually. Stir in the broth. Add thyme, salt, and pepper.
Simmer over low heat for 10 minutes or until thoroughly heated. Slowly stir in the cream. Add fish, and simmer until done, about 8 to 10 minutes. Garnish with fresh parsley.

For hundreds of free seafood recipes, visit MARINERSMENU.ORG
Over their lifetimes, some species occupy different environments and exhibit distinct life stages, known as “ontogenetic shifts.” The life histories of most sharks involve these ontogenetic shifts, which can include changes in habitat and diet, as well as behavioral changes at the onset of sexual maturity. In addition, fishes — including sharks — commonly experience indeterminate growth, whereby their bodies and organs grow throughout their lives. However, very little work has been done to explore changes in the shark brain across life stages, which could provide insights into both brain plasticity and evolutionary change.

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The ever-expanding brains of Atlantic Sharpnose Sharks

This shark’s brain never stops growing throughout its entire life, especially the regions responsible for motor control and sense of smell.

By Kara E. Yopak

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READ THE FULL STUDY:
“Ontogenetic Shifts in Brain Size and Brain Organization in the Atlantic Sharpnose Shark”
https://doi.org/10.1159/000511304

Kara E. Yopak, from the Department of Biology and Marine Biology at the University of North Carolina Wilmington, leads the “UNCW ZoMBiE Lab” (Zoological Morphology of the Brain and its Evolution). The lab focuses on the evolution of the brain within and across sharks and their relatives, particularly the ways in which variation in brain size, structure, and cellular composition across species can inform complex behaviors and sensory specialization.

FOLLOW:
@ProfSharkBrain and @YopakZoMBiELab

This story originally appeared on HookLineScience.com

Abeoce: The brain of an Atlantic sharpnose shark, showing the regions that process smell (olfactory bulbs) and motor control (cerebellum) across life stages, including adulthood (far right). Scale: The vertical bar to the right of the adult brain equals 2 cm. Images adapted from Laforest et al. (2019). All rights reserved. Below: The underside of a sharpnose shark, showing its mouth, jaw, and teeth.
Oyster Reefs, Self-Releasing Hooks, and the Mysterious Wanderings of Southern Flounder

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

DOES PROTECTING OYSTER REEF BENEFIT OTHER MARINE ORGANISMS?

Creating no-harvest zones on oyster reefs also helps the fish and crustaceans that live on the reefs, by Aman Raza, biology major at the University of Maryland, Baltimore County, and former intern at the Smithsonian Environmental Research Center in the Maryland, Baltimore County, and former intern at the Smithsonian Environmental Research Center.

Research Needs

- In the 19th century, the Chesapeake oyster fishery was the largest in the world. However, the number and types of fish in the bay has significantly decreased.

- Oysters have been the subject of extensive management efforts, but there are many gaps in our understanding of oyster reef ecosystems.

- We know oysters provide many ecological services, such as water filtration, nitrogen removal, and habitat for other species.

- To answer this question, I analyzed GoPro video footage of oyster reefs from three tributaries in the Chesapeake Bay: the James, Great Wicomico, and Choptank rivers. Each tributary had one reef that was actively harvested and a neighboring reef where harvesting was prohibited. After watching the videos, I compared the number and types of fish and crustaceans in oyster sanctuaries compared to harvested zones.

- What did I study?

- What did I find?

There was a higher abundance of fish and crustaceans, as well as higher diversity, on protected reefs compared to harvested reefs.

This study provides evidence that fish and crustacean species benefit from creating no-harvesting areas and highlights the importance of oyster reefs for healthy ecosystems.

Expanding this study to more sites could provide new data to help guide oyster reef management in the future.

- Anything else?

- The James River had a higher abundance and diversity of organisms compared to the other two sites.

- In addition, I was able to identify many different species of fish and crustaceans in the GoPro videos of the tributaries, including striped bass, summer flounder, and black sea bass, as well as blue crabs and grass shrimp.

- What’s more exciting is that some of these species, like striped bass and blue crabs, are federally managed. Spotting them in our videos is a good indicator that the species benefit from no-harvest zones.

- So what?

- Focusing our efforts on protecting valuable oyster reef habitat not only will benefit oysters but also the important fish and crab species that depend on them. As the demand for oysters increases and affects the oyster fishery, it is critical to understand how this might impact the broader ecosystem of the Chesapeake Bay.

- What did we find?

- The James River had a higher abundance of fish and crustacean species on harvested areas compared to harvested reefs.

- There was a higher abundance of fish and crustacean species, like striped bass, summer flounder, and black sea bass, as well as blue crabs and grass shrimp, in the Chesapeake Bay.

- There was a higher abundance and diversity of fish and crustacean species on harvested areas compared to harvested reefs.

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- What did we find?

On 150 spotted seatrout, we tested earlier field trials with bonefish on Palmyra Island, the species would “spit out” bite-shortened hooks once they were released in the water. The idea appeared promising and prompted the researchers at the Nature Coast Biological Station to begin more rigorous testing.

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- What did we study?

To our knowledge, these are the first assessments of hooks designed to self-release from fish and to fully eliminate fish handling. On 135 spotted seatrout, we tested whether standard, barbless, or bite-shortened hooks would allow anglers to reel in the popular coastal sport fish and then release the fish to self-release while still in the water.

- What did we find?

We found promising results for the bite-shortened modified hook, which enabled anglers to land 93% of hooked spotted seatrout and then release 87% of those fish without direct handling, shows promise.

Research Need

- Fishing practices and gears that minimize handling, hook injuries, and air exposure can considerably improve the chances for survival of released fish. In particular, efficient dehooking substantially reduces the physiological stress in fish that typically occurs during the landing and release process.

- Earlier field trials with bonefish on Palmyra Island found the species would “spit out” bite-shortened hooks once they were released toward the angler and the angler gave slack in the fishing line. The idea appeared promising and prompted the researchers at the Nature Coast Biological Station to begin more rigorous testing.

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 handling. In comparison, the self-release success rates were 47% using barbless hooks and 20% using standard, unmodified hooks.

We also found that smaller fish could be self-released without handling at higher rates. Length-regulated fisheries often protect smaller fish, and reducing mortality in these fish especially can help conserve resources.

- **So what?**
  
  A proven and effective self-releasing hook could have broad conservation and management applications in recreational fisheries as a means of minimizing or eliminating injuries and mortalities in catch-and-release fishing. Foreseeable uses of self-releasing hooks could include cases of restricted fishing in sensitive fishing areas, such as no-take aquatic protected areas or areas experiencing unsustainable fishing pressure. Further research with different lures, species, and anglers can inform conservation strategies.

**WHERE DO SOUTHERN FLOUNDER GO IN THE WINTER?**

Southern flounder move offshore to spawn, but their migration patterns might be more mysterious than we thought.

**Research Need**

Working with other U.S. South Atlantic states, the N.C. Division of Marine Fisheries recently concluded that not only is the state’s southern flounder population overfished but also that overfishing is still occurring. The poor status of the stock requires considerable reductions in harvest to allow rebuilding.

**Research Need**

**What did we study?**

We used pop-up satellite tags to estimate the offshore locations of southern flounder during the winter. In fall of 2020, we cooperated with fishermen to tag 100 fish captured at several inshore sites close to ocean inlets along the North Carolina coast.

**Data collected**

- Adult southern flounder leave estuaries for the ocean during the fall and spend the winter in offshore habitats, where they presumably spawn.
- Most southern flounder left the estuaries and went to the ocean. However, some fish remained in the estuary or stayed very close to the ocean shoreline.
- The offshore movements of southern flounder were not as extensive as we expected, with many fish still using nearshore habitats during the winter.

**Results**

- Most southern flounder that individual southern flounder might not spawn every year.
- Self-releasing hooks could have broad conservation and especially can help conserve resources.

**The Question**

Under what conditions do water snakes change their drinking and feeding behavior? Researchers hand-captured live specimens of banded and brown water snakes from creeks and swampy habitats in Alachua County, Florida. They maintained each snake in a cage, and, during a one-hour period each day, they provided access to a pool of tap water and food, which included live feeding fish.

The Answer

**All snakes drank freshwater when they experienced relatively small amounts of dehydration. Snakes that had access to food but not water readily ate while dehydrated, but stopped eating during prolonged dehydration.**

Overall, both freshwater and semi-marine species of water snakes are more sensitive to dehydration than other species of snakes.

**Do Water Snakes Get Thirsty?**

A RESEARCH TEAM ENTERS SWAMPY TERRAIN TO HAND-CAPTURE SNAKES AND MEASURE THE REPTILES’ SENSITIVITY TO DEHYDRATION.

**By Lauren D. Pharr**

According to the research team, by documenting the relationship between freshwater availability and feeding behavior in water snakes, it might be possible to better understand how these snakes and similar animals evolved.

**READ THE FULL STUDY:**

“Thirst and Drinking in North American Water snakes”

go.ncsu.edu/thirst

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

This story originally appeared on HookLineScience.com

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**Hook, Line & Science**

**What did we find?**

Most southern flounder left the estuaries and went to the ocean. However, some fish remained in the estuary or stayed very close to the ocean shoreline. The absence of offshore movements by these fish could be related to stress from capture and tagging or could mean that individual southern flounder might not spawn every year.

**Where do southern flounder move offshore to spawn, but their migration patterns might be more mysterious than we thought.**

**Research Need**

Working with other U.S. South Atlantic states, the N.C. Division of Marine Fisheries recently concluded that not only is the state’s southern flounder population overfished but also that overfishing is still occurring. The poor status of the stock requires considerable reductions in harvest to allow rebuilding.

**Research Need**

Determining how much these fish mix across states will help to better understand the impacts of present and future fishing practices, informing strategies to rebuild and sustain the stock.

Adult southern flounder leave estuaries for the ocean during the fall and spend the winter in offshore habitats, where they presumably spawn. As waters warm in spring, flounder in offshore habitats, where they presumably return to coastal and estuarine habitats, but conventional tagging data has shown that their return locations often are hundreds of miles away from their original tagging sites.

**More recent studies of flounder genetics and chemical tracers indicate a well-connected flounder population throughout the South Atlantic. But how does this happen? Are flounder from Florida estuaries spawning in the same offshore locations as fish from North Carolina? Or are flounder merely wandering back inshore in different states?**

**What did we study?**

We used pop-up satellite tags to estimate the offshore locations of southern flounder during the winter. In fall of 2020, we cooperated with fishermen to tag 100 fish captured at several inshore sites close to ocean inlets along the North Carolina coast.

We programmed the tags to pop off the hook and go to the surface and transmitted their locations via satellite.

**Summary**

- The research team also found that overfishing is still occurring. The poor status of the stock requires considerable reductions in harvest to allow rebuilding.
- Southern flounder move offshore to spawn, but their migration patterns might be more mysterious than we thought.
- The absence of offshore movements by these fish could be related to stress from capture and tagging or could mean that individual southern flounder might not spawn every year.
- The offshore movements of southern flounder were not as extensive as we expected, with many fish still using nearshore habitats during the winter.
- Self-releasing hooks could have broad conservation and especially can help conserve resources.

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Coastwatch
Nets New
State and
National
Honors

Over the summer, Coastwatch received new recognition for material that we published during the pandemic. The Science Communicators of North Carolina honored Julie Leibach and Dave Shaw for feature stories, and all four issues from last year earned the magazine another national APEX Award for Publication Excellence.

If you’re counting, that makes five honors for Leibach’s writing and 13 for the magazine overall in the last three years.

And all of Coastwatch’s award-winning content is free online.

go.ncsu.edu/Coastwatch-awards