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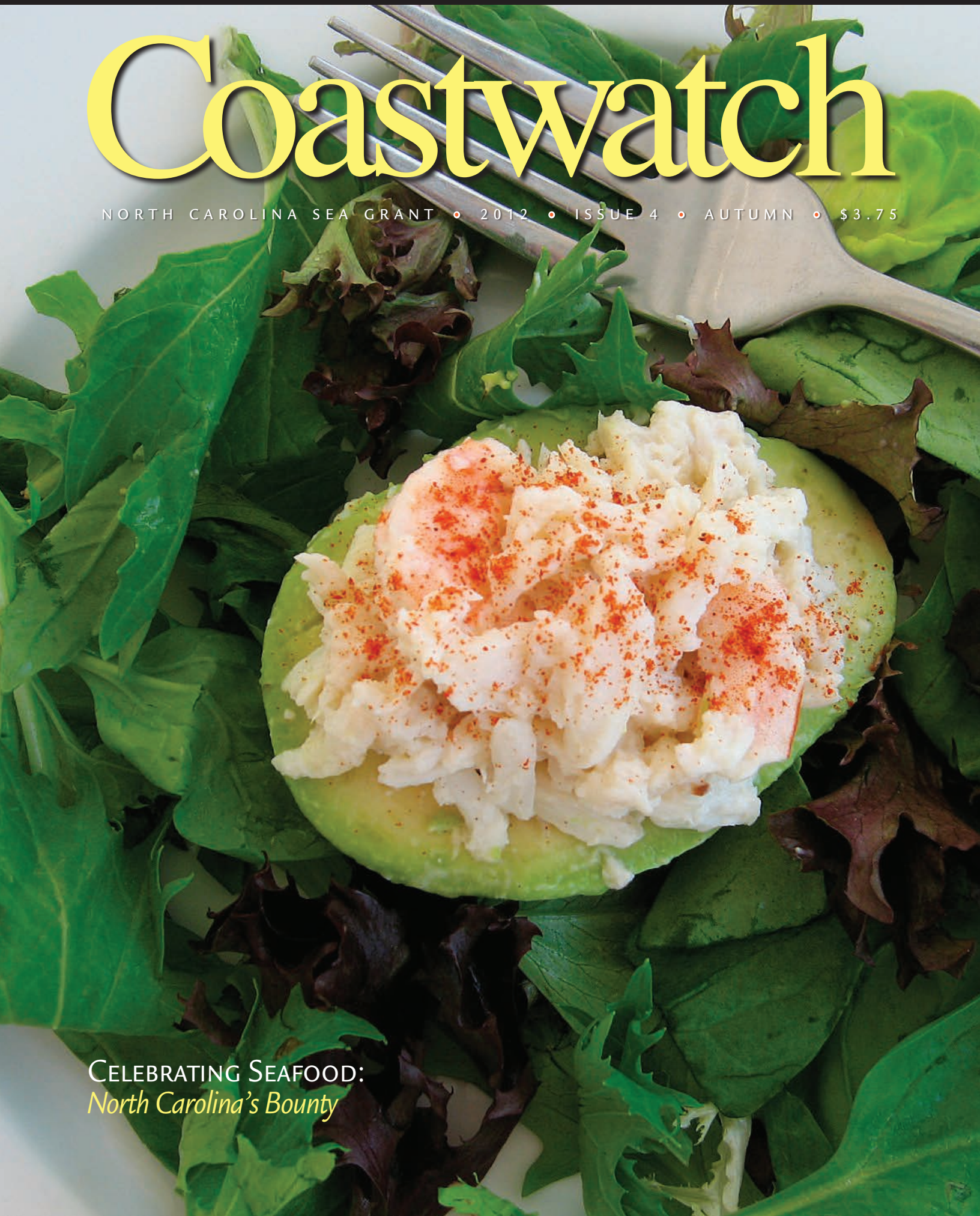
Coastwatch

NORTH CAROLINA SEA GRANT • 2012 • ISSUE 4 • AUTUMN • $3.75



Celebrating Seafood:
North Carolina's Bounty

Winds of Change

The Greek philosopher Heraclitus once said "Nothing endures but change." In recent years, change has been an enduring part of how North Carolina Sea Grant conducts its business and carries forth its mission of coastal research and outreach.

Sea Grant has explored and implemented new ways to efficiently identify, solicit, review, award and track new research opportunities and investigations that can have more immediate effects on the wise use of coastal resources. We have made several key changes in how researchers apply for awards that support their and their students' efforts, including Web-based submissions, tiered award levels, and special calls outside of the regular biennial cycle.

Since 2008, we have funded small fellowship grants for graduate students in maritime heritage studies, and also in studies that assist the state's Coastal Reserves Program in managing special state parcels and National Estuarine Research Reserves. Since 2010 alone, Sea Grant has awarded well over 25 "minigrants" for research or demonstration projects that address timely coastal resource questions or needs. The minigrant program initiative was labeled a national "best management practice" by a Sea Grant federal review team.

Lastly, we are in the midst of refining and implementing a software program to organize and streamline our research processes, from receiving preproposals, to collecting progress and final reports, and to describing outcomes and impacts.

In planning and evaluating what we do and how well we've reached program goals, there's been a sea change in our approach and activities. A new strategic plan, adopted in 2009, reflected input from stakeholders and aligned closely with the National Sea Grant plan. With great staff efforts, we've reported on progress toward those goals via a new and evolving federal reporting system, and also the North Carolina State University annual reporting mechanism.

Even while being actively driven and guided by that relatively recent plan, for the last eight months, we've been soliciting input and brainstorming in preparation for proposing a new 2013 to 2017 North Carolina Sea Grant strategic plan for federal approval.

As with all research and outreach programs, the biggest changes here have been within our staff foci and duties. Beginning in 2009, I've worn a "second hat," directing the Water Resources Research Institute of the University of North Carolina System, which also is based at NC State. Two other positions within Sea Grant's fiscal office have since added WRRI responsibilities to their Sea Grant work.

Also, our communications leader has carved out a portion of her work duties to assist NC State's Office of Research, Innovation and Economic Development to produce its fascinating and inspiring *Results* magazine. Our aquaculture specialist will spend part of his time formally serving as director of NC State's Marine Aquaculture Research Center in Smyrna. All of these staffing shifts and mergers not only attest to the overall excellence of Sea Grant staff, but also reveal Sea Grant as a marked example of the university taking bold steps for staff and cost efficiencies, while maintaining high standards of productivity.

Lastly, two other major changes will transpire before the end of the year. Our associate director and I both officially retire come December, presenting the opportunity for fresh thinking and further changes in how Sea Grant will continue in its mission. Final candidates for the director's job have been interviewed as of this writing, and we hope that the next issue of *Coastwatch* will introduce you to the new leadership of the program.

An anonymous sage has said, "To change and to change for the better are two different things." We believe that all the changes at Sea Grant, recent and forthcoming, will be for the better!

— Michael Voiland, Executive Director
North Carolina Sea Grant

IN THIS ISSUE

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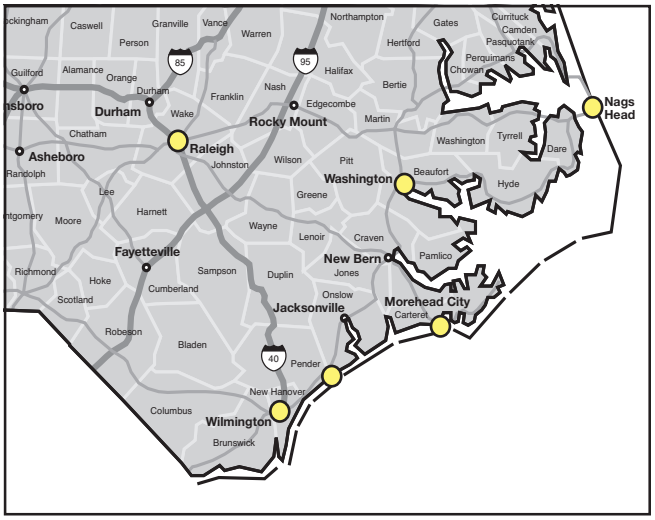

North Carolina's diverse coast offers countless interesting subjects. The map indicates story settings in this issue — including Beaufort, Carteret and Pender counties.

Coastwatch

FEATURES

Coastwatch

North Carolina Sea Grant • 2012 • Issue 4 • Autumn

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The North Carolina Sea Grant College Program is a federal/state program that promotes stewardship of coastal and marine resources through research and outreach. It joined the National Sea Grant College Network in 1970 as an institutional program. Six years later, it was designated a Sea Grant College. Today, North Carolina Sea Grant supports research projects, an extension program and a communications staff. Michael Voiland is executive director. The program is funded by the U.S. Department of Commerce's National Oceanic and Atmospheric Administration, and the state through the University of North Carolina.

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Cover photo of seafood-stuffed avocados by Vanda Lewis. Table of contents graphic based on photo of flower by Pam Smith. Printed on recycled paper.

Wings Over Water Festival Scheduled

The Wings Over Water Festival brings adventurers and nature lovers to the Outer Banks and Eastern North Carolina.

"Many come year after year to take advantage of new programs or to repeat their favorites," notes Sandy Semans, a member of the event's steering committee.

Set for Nov. 6 to 11, the festival is best known for its birding trips, where visitors get the chance to hike and view North Carolina's coastal birds, and snap memorable photos.

However, other facets of the event should not be overlooked. Festivalgoers can see wild animals that call coastal North Carolina home, such as the brown bear and the red wolf. Other adventures, such as kayaking at sunrise or sunset, also are options.

Participants can learn about history by visiting the Island Farm on Roanoke Island and Ocracoke Island, a favorite downtime spot of the infamous pirate, Blackbeard.

Find registration and fee information online at: *www.wingsoverwater.org.* — C.P.

2012 North Carolina Big Sweep Set

Volunteers with N.C. Big Sweep clean the land and waterways of North Carolina every October.

Over 10 million pounds of trash have been collected since 1987, when the program started as a North Carolina Sea Grant project. Last year, 16,212 volunteers collected 385,272 pounds of trash.

Sea Grant continues to tout the cause. "We are proud to support efforts to keep the state a beautiful place to live," says Katie Mosher, Sea Grant communications director.

This year, most counties will host events on Oct. 6. Dates may vary by county.

To learn more about Big Sweep or how to volunteer, visit: *www.ncbigsweep.org.* — C.P.

First Outer Banks Seafood Festival Planned

On Oct. 20, take your family and friends to the first Outer Banks Seafood Festival and experience the rich taste of the islands. The event will be held in Nags Head.

Participants will learn about the history and culture of the Outer Banks while enjoying tasty specialties from local restaurants.

Activities include storytelling, clam chowder-cooking lessons and food-eating contests. North Carolina Sea Grant consumer education products about seafood will be available in the Outer Banks Catch tent.

"Promoting and educating consumers about the advantage of requesting seasonal, local seafood has been a major focus of Sea Grant since the debut of Carteret Catch at the North Carolina Seafood Festival in 2005," notes Sara Mirabilio, Sea Grant fisheries specialist.

For directions and more information, visit: *www.outerbanksseafoodfestival.org.*

Read about the N.C. Seafood Festival in Morehead City on page 33. — C.P.

Courtesy Cycle North Carolina

Cycle North Carolina offers bicyclists the chance to see the state up close — from the mountains to the coast. The ride begins in Brevard with registration on Sept. 29 and ends at Carolina Beach on Oct. 6. The trip covers 490 miles. Learn more at: *cnc.ncsports.org/fallCNCRide*.


Spencer Rogers

2012 NC Building Code Adds Freeboard Requirements

LEFT: *A house under construction shows an example of freeboard.*

North Carolina's barrier islands are known for raised houses that allow for storm surge to flow underneath. Now, new homes in floodplains across the state will be required to have raised elevations higher than the minimum 100-year flood requirement in national regulations.

Since March 1, N.C. Residential Building Code amendments have called for a foot of "freeboard" for all new houses in the 112 communities under the Coastal Area Management Act.

Additional freeboard – a boating term used to describe the added elevation – requirements may be adopted by a community for new construction. This enables all insured buildings, including older buildings with lower floors, to qualify for flood insurance savings, explains Spencer Rogers, North Carolina Sea Grant's coastal construction and erosion specialist.

A few N.C. coastal communities already have adopted 3 feet of freeboard. About 46 percent of the coastal communities have adopted at least 2 feet of freeboard.

"Overall, three out of four coastal residents live in areas where communities have already adapted to 1 foot or more of increased water levels," notes Rogers, a member of the Science Panel on Coastal Hazards, which advises the N.C. Coastal Resources Commission.

"The national standard may sound safe, being exceeded on average only once in every 100 years. However, over the lifetime of an average house, the risk accumulates to about 50 percent," he adds.

"In contrast to the flood standard, the latest building codes are based on 700-year wind speeds, but few people on the coast question the existing design requirements for the hurricane winds. Building higher floor elevations adds a safety factor lacking from the national flood standards, for both coastal storm surges and inland-river flooding."

Most coastal property owners with a flood insurance policy qualify for lower premiums with community-adopted freeboard requirements.

"Individual building owners who are either required to add freeboard or, where not required, choose to add freeboard, can qualify for even larger annual premium discounts for each foot of freeboard the building has above the 100-year flood elevation," Rogers adds. "Discounts depend on the flood zone, increasing with higher risk." – K.M.

Hatchery Breeds Local Oysters

This fall, the University of North Carolina Wilmington Shellfish Research Hatchery will work with shellfish growers to field test North Carolina-sourced lines of eastern oyster.

Ami Wilbur, hatchery director, obtained broodstock from Crab Hole in Pamlico Sound, Hewletts Creek, Stump Sound and Lockwood's Folly, and produced four separate batches of seed oysters.

Aquaculturists – James Morris of Sea Level, Jay Styron of Cedar Island, Ron Sheffield of Hampstead, and Jim Swartzenberg of Jacksonville – will grow the North Carolina seed alongside Virginia seed that has been used by shellfish growers.

Marc Turano, North Carolina Sea Grant mariculture and blue crab specialist, is assisting.

These studies are a first step in developing lines that the team hopes will show improved growth and survival for North Carolina aquaculture. The work is funded by the N.C. Blue Crab and Shellfish Research Program, which is administered by Sea Grant. – S.B.S.


Stephanie Clavez

ABOVE: Maleclemys terrapin *is a "species of concern" in North Carolina.*

2012 FRG Awards Announced

The North Carolina Fishery Resource Grant Program has selected six new projects in 2012. North Carolina Sea Grant administers the program, which is funded by the N.C. General Assembly.

Capt. Dale Britt of Morehead City and Jeff Buckel of North Carolina State University are looking at discard mortality of dolphinfish, also known as mahi-mahi.

Capt. Aaron Kelley from Kill Devil Hills and Roger Rulifson of East Carolina University are using ear-bone chemistry to assess if striped bass likely came from resident or oceangoing mothers.

Capt. Tom Roller of Beaufort, Rulifson of ECU and Philip Kemp of Carteret Community College are assessing the diet of spiny dogfish. Data will be useful in stock assessments by estimating mortality due to spiny dogfish predation.

Capt. Jeff Wolfe of Wilmington, Amanda Southwood Williard of the University of North Carolina Wilmington and Wendy Cluse with the N.C. Aquarium at Pine Knoll Shores are studying the distribution of diamondback terrapins in Bogue Sound. They will assess the impacts of bycatch-reduction devices on terrapin and crab catches.

Willy Phillips of Columbia are testing the feasibility of smoked soft-shell crab as an additional market for North Carolina's blue crab. He will collaborate with Barry Nash, Sea Grant seafood technologist and marketing specialist.

Robert Farnell of Hubert and Wade Watanabe of UNCW are assessing the salt marsh plant, *Salicornia*, for bioremediation of aquaculture waste.

To learn more about the FRG awards, see the news section at: *www.ncseagrant.org.* – S.B.S.

Mirabilio Receives Conservation Award

Sara Mirabilio

Sara Mirabilio, North Carolina Sea Grant fisheries specialist, was recognized with the 2011 N.C. Natural Resources Scientist of the Year award. The Governor's Conservation Achievement Awards program, administered by the N.C. Wildlife Federation, recognizes individuals and organizations that have exhibited a commitment to conservation in North Carolina.

Mirabilio is cited for her devotion to sound science and solid research that provide invaluable data for enhancing North Carolina's coastal and marine environment.

"What really sets Sara apart is her commitment not only to the resources, but to the people, families and communities of coastal North Carolina. She is respected at the same high level by both the scientific community and the coastal constituents that she serves as a Sea Grant specialist," explains Jack Thigpen, Sea Grant extension director.

Mirabilio's innovative research on turtle excluder devices in the offshore flounder fishery is providing data that will protect threatened and endangered sea turtles, as well as help to increase targeted catch profitability for North Carolina's fishing families.

In addition, she works with the Saltwater Connections resource team, a community development project funded by the N.C. Rural Center, to strengthen 21 unincorporated communities in Dare, Hyde and Carteret counties.

She also particpates in the Day at the Docks celebration in Hatteras Village and mentors a seafood marketing youth team at the Cape Hatteras Secondary School of Coastal Studies.

For a complete list of recipients, visit: *ncwf.org/awards*. — E.L.

Pam Smith

Smith Recognized with APEX Honors

Pam Smith, a contributing writer for *Coastwatch*, received a 2012 APEX Award for Publication Excellence in feature writing.

She was recognized for her article titled "Citizen Science Bolsters Oyster Restoration Efforts" in the Spring 2011 issue of *Coastwatch*.

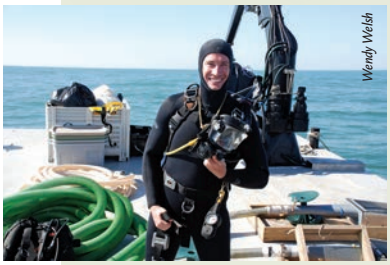
"Pam has an eye — and an ear — for detail that brings her features to life," says Katie Mosher, North Carolina Sea Grant communications director. "She truly enjoys sharing stories that reveal citizen participation in coastal science."

Although she retired from Sea Grant in 2005, Smith continues to write for *Coastwatch* and edit Sea Grant-related projects.

APEX Awards are based on excellence in graphic design, editorial content and the ability to achieve overall communications excellence. In 2012, more than 3,300 submissions were received, with 1,027 Awards of Excellence and 100 APEX Grand Awards presented.

To read Smith's article or to learn more about *Coastwatch*, go to: *www.nccoastwatch.org*.

Several other Sea Grant programs from across the country also are among winners. For a complete list, visit: *www.apexawards.com*. — E.L.



TOP: *Daniel Brown aboard the 17th century Swedish warship,* Vasa. BOTTOM: *Thomas Horn prepares for a dive.*

Maritime Fellows Selected

The North Carolina Sea Grant/East Carolina University joint Maritime Heritage Fellowship program announces two fellows for 2012.

Daniel Brown is investigating the early 17th century wooden ship remains of a wreck in Corolla. The ship's origin is unknown.

"Funds received from the fellowship will allow me to conduct further lab research that may provide better answers as to how old the wreck is and where it came from," Brown comments.

Thomas Horn is studying the corrosion rate of an iron-hulled shipwreck, the *USS Huron*, which sank off the coast of Nags Head in 1877. The data will be included in local and international efforts related to ferrous corrosion in a marine environment.

"People find maritime heritage and underwater science fascinating. I am pleased to play a small part in managing an important cultural resource here in North Carolina," Horn explains.

Sara Mirabilio, Sea Grant fisheries specialist, co-manages the fellowship with Bradley Rodgers at ECU. "These two maritime archaeologists will produce valuable inventories and evaluations of coastal shipwrecks, as well as crucial data on how to mitigate the effects of climate that threatens hundreds of archaeological sites along the North Carolina coast," notes Mirabilio.

Read more about the Maritime Heritage Fellowship at: *www.ncseagrant.org/s/maritime.*

— S.B.S.

CORRECTIONS

In our last issue, we misidentified the owner of Kitty Hawk Kites on page 8. His name is John Harris. Also, the sun is 27 million times larger than the moon. Our comparison on page 30 was incorrect.

Training Future Coastal Managers

Nicole Carlozo

Laura Flessner

Nicole Carlozo and Laura Flessner recently began two-year appointments with the Coastal Management Fellowship Program, sponsored by the National Oceanic and Atmospheric Administration's Coastal Services Center.

Carlozo will work for the Maryland Chesapeake and Coastal Program in Annapolis. She will integrate water quality and coastal resources into a marine spatial plan for the restoration and conservation of Maryland's Chesapeake and Atlantic Coastal bays.

"This project will contribute to the revitalization of the Chesapeake Bay's fisheries and wildlife habitats," she says. "Using shellfish to filter and meet water-quality goals is a very novel and out-of-the-box idea that I'm thrilled to be working on, especially since it involves watermen and other stakeholders."

Carlozo has a master of environmental management and a certificate of geospatial analysis from Duke University. She holds bachelor's degrees in biology and English from St. Mary's College of Maryland in St. Mary's City.

Flessner, funded by the Association of State Flood Plain Managers and The Nature Conservancy, will integrate watershed and coastal strategies that support disaster risk reduction and adaptation solutions to enhance community resilience. She will be based in TNC's offices in Seattle.

"As a coastal resident myself, I appreciate the value of proactive and adaptive decision making when dealing with potential coastal hazards. Programs like this can help coastal managers make more ecologically and socioeconomically sustainable decisions to help prolong the health of our coastlines," she notes.

Flessner received her master's degree in environmental studies and a certification in geographic information systems from the University of North Carolina Wilmington. She has a bachelor of fine arts in design with a psychology minor from the Virginia Polytechnic Institute and State University in Blacksburg.

"We hope the experience will provide them with valuable skills on how to develop comprehensive programs to manage and balance competing uses of, and impacts to, coastal resources," says Sara Mirabilio, fisheries specialist at North Carolina Sea Grant.

Mirabilio is the fellowship program contact for North Carolina applicants. Sea Grant recommends finalists from a state applicant pool for the national selection process. For more information about the Coastal Management Program, visit: *www.csc.noaa.gov/cms/fellows.html*.

— S.M.

Mike Orbach and Lisa Schiavinato

Orbach Earns Honor from Coastal Society

Mike Orbach, former director of the Duke Marine Laboratory and a current member of the National Sea Grant Advisory Board, has received The Coastal Society's Outstanding Service Award.

"The TCS Board of Directors honors Mike with this award for his outstanding service to the field of coastal resource management. His exemplary work and influence has been noted at the local, state, federal and international levels," says current society president Lisa Schiavinato.

"Mike also has shown strong dedication as a mentor to students and young professionals. Mike is a true asset to the profession," she notes. Schiavinato also serves as North Carolina Sea Grant's law, planning and community development specialist.

Orbach has long service to the international organization, including as society president from 1996 to 1998.

The honor was announced at the society's June conference in Miami, which Orbach was unable to attend. Schiavinato recently presented him the award at the Marine Lab.

Orbach is a member of the marine affairs and policy faculty in Duke's Nicholas School of the Environment.

— K.M.

Scott Baker

Baker Garners Regional SG Award

Scott Baker, North Carolina Sea Grant fisheries specialist, was selected to receive the 2012 South Atlantic Sea Grant Regional Outreach Award.

He was recognized for suggesting a study that resulted in Community Supported Fisheries, or CSFs, and other promising business models. The project has improved sustainable incomes for fishermen, while educating consumers about local seafood and the traditions of fishing communities.

"Scott has been a leader in developing innovative methods for North Carolina fishing families to market their wild-caught products. His ideas and concepts are making a difference, not only here in our state, but around the country as well," says Jack Thigpen, Sea Grant extension director.

Baker first envisioned a direct-marketing arrangement for local seafood, similar to Community Supported Agriculture. He helped guide a project that was supported by the N.C. Fishery Resource Grant Program, which is funded by the N.C. General Assembly and administered by Sea Grant. This work was featured in the Winter 2010 issue of *Coastwatch*.

Communities in Alaska, California, Connecticut, Maine, Massachusetts, New Hampshire, New York, South Carolina, Australia, and Canada have embraced the CSF model.

Every two years, each of the six Sea Grant regions sponsors outreach awards. The South Atlantic region covers North and South Carolina, Georgia, Florida and Puerto Rico. Baker moved to the national competition, with the overall winner being announced in September.

— E.L.

BY SHARON SETTLAGE

THE MULTITALENTED OYSTER

"Imagine what it'd do if it had a brain."

Jack Spruill ponders oyster spat's propensity to settle on the unlit side of surfaces. When the mature shellfish detects a shadow passing, it rapidly closes up. But the oyster does not have a true brain — just one or two aggregates of nerve cells located near the hinge region.

Spruill, vice president of PenderWatch and Conservancy, experiments with growing oysters on all kinds of surfaces — not for eating, but for the environmental services they provide, such as water filtration.

He revels in describing "spat by the millions, just looking for a place to settle." He makes necklace-like strings of old oyster shells and suspends them in the water below his dock. Before long, a sphere of oysters has formed around the recycled shells. Each ball supports dozens of living oysters and other wildlife, such as tiny crabs and grass shrimp that find homes in the crevices.

He and other volunteers with PenderWatch also are active in creating living reefs along shorelines using recycled oyster shells. The living reefs are placed just offshore of marshes where they provide spawning and nursery area for blue crab, shrimp and clams. Finfish use oyster reefs as refuge and nursery.

While fish flourishing around an oyster reef is an obvious benefit to ecosystems, a more subtle way that oyster reefs improve habitat is through nitrogen recycling, or converting nitrogen waste products into atmospheric nitrogen.

In a North Carolina Sea Grant study, Michael Piehler and graduate student Ashley Smyth at the University of North Carolina at Chapel Hill found that unseen organisms also flourish around oyster reefs. These microbes — that live in and on the sediment associated with the shellfish — are active in recycling nitrogen.

Nitrogen is the most abundant gas in the air we breathe and the gas generally is inert. Nitrogen can be a problem when it's in the concentrated form of fertilizer or nitric oxide. In the past 100 years, humans have dramatically

Continued

A thriving community co-exists with oysters on a sanctuary in Pamlico Sound.

Pelle Holmlund

Clockwise from top left: *Michael Piehler examines an oyster reef in Bogue Sound.* • *Piehler's lab equipment measures nitrogen processing.* • *Ashley Smyth collects sediment cores for nitrogen measurements.* • *Oysters close their shells with a squirt as Jack Spruill pulls them out of the water.*

altered the nitrogen landscape. Nitric oxide occurs in the exhaust of internal combustion engines. If fertilizers are applied in excess for farming and residential use, they may cause problems in nearby waters.

There was a time when bioavailable nitrogen was locked in a cycle, much like the water cycle. Active nitrogen was not created except by an occasional lightning strike. Fertilizer came from manure or nitrogen-fixing crops such as peas. In the early 1900s, the Haber process established a method for chemically converting inactive nitrogen gas to ammonia, which can be converted to nitrates for fertilizers. A 2008 *Nature* paper estimates that almost one-half of the world's population depends on synthetic nitrogen-based fertilizer to enrich crop soils.

However, too much fertilizer in lakes, rivers or sounds can encourage harmful algal blooms, which smother and kill underwater vegetation and fish as the algae die and decompose, depleting the water of oxygen. Low oxygen is partially responsible for crab "jubilees." It causes the blue crabs to crawl out of the water to the joy of harvesters. The crabs actually are seeking air because their water has become hypoxic.

Welcome the oyster. Oysters — from small-scale oyster gardens or under-dock cages to larger natural or man-made reefs — feed on potentially harmful algae and other microorganisms, purifying the water in more ways than one.

Oysters and Economics

North Carolina has an offset trading program that gives credit for nitrogen removal, among other nutrients. Based on the current payment value, Piehler and Smyth sought to quantify the work of oysters in nitrogen recycling. In work published in the journal, *Ecosphere*, they established that reefs trap and recycle nitrogen. They put the nitrogen-recycling value of an acre of reef at $3,000 per year compared to $400 per year for a mudflat.

"Excessive nitrogen loading to our estuaries and coastal regions is clearly a high-priority issue. Understanding the contribution that oyster reefs, seagrass beds and salt marshes can make to limiting the bioavailable nitrogen in these systems has value for both ecosystem science and ecosystem management," Piehler comments about the work.

Piehler's lab at the Institute of Marine Sciences, or IMS, in Morehead City specializes in nitrogen dynamics of estuarine systems. Piehler and Smyth studied nitrogen removal in the estuarine system along the southern shoreline of Bogue Sound. Their groundbreaking research leveraged a National Science Foundation grant. Included on the grant are scientists from Florida, Georgia and Massachusetts. Sea Grant previously funded one of the researchers, Jonathan Grabowski, now at Northeastern University in Massachusetts.

Smyth and Piehler sampled the sediments from mudflats, submerged aquatic vegetation, marshes and oyster reefs. They took 2.5-by 7-inch cores of material back to the lab and incubated the specimens in an environmental chamber. They then measured the amount of nitrogen gas emitted by the cores.

Samples with higher amounts of active microbes would be expected to release more nitrogen gas.

The team found that among all the habitats sampled, the sediments around oyster reefs exhibited the highest rates of denitrification or conversion of active nitrogen to inert nitrogen gas. Based on the Bogue Sound landscape, they estimate that oyster reef sediments remove 25 percent more nitrogen than intertidal sediments without oysters.

Smyth and Piehler call the oyster reefs "hot spots for biogeochemical cycling." This is because as the oysters filter feed, they absorb nitrogen for growth and reproduction, plus they excrete material

that microbes colonize. The microbes process the ammonium in the excreta into inert forms that do not cause negative effects.

Their work indicates that at present, the marsh, aquatic vegetation, mudflats and oysters of the Bogue Sound estuarine system are able to process the current input of nitrogen. As described in their report, this explains the high-quality water of Bogue Sound.

"This work has opened our eyes to the services played by oysters and oyster reefs in promoting denitrification. They show that the denitrification service is far more valuable in economic terms than even the habitat provision service. Hence, Piehler has publicized an entirely new motivation for oyster reef restoration and treating oysters as a habitat of value," says Charles "Pete" Peterson, an expert in reef dynamics at IMS and vice chair of the N.C. Environmental Management Commission.

Too Few Oysters

Oysters have long been a staple of the state's tidal creeks and estuaries. Native American feasts are indicated by piles of shells, or middens, at old settlements.

At one time, reefs were so thick in the Mid-Atlantic sounds that they interfered with boat traffic. Researchers Hunter Lenihan and Peterson previously published that oyster reef heights in the Neuse River estuary decreased from 6 to 8 feet in 1868 to only 1 to 3 feet in 1993.

In North Carolina, oyster harvests have been in decline from a record high of 1.8 million bushels in 1902 to a record low of about 57,000 in the early 1990s, with an increase to 150,000 bushels in 2011. Oysters are listed as a "species of concern" by the N.C. Division of Marine Fisheries, or DMF.

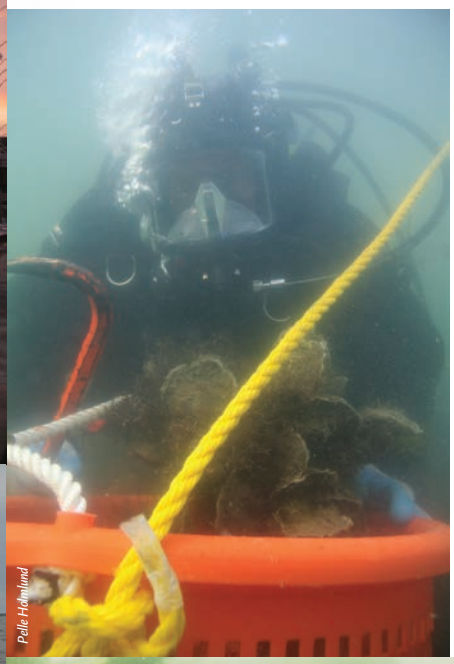
To help overcome the depletion in oysters, DMF is planting them on a large scale. Oysters prefer to settle and grow on oyster shell, but they will grow on a number of stable substances such as lime-rich marl, which sometimes is used by the DMF to create oyster sanctuaries.

Oyster sanctuaries also support fishing grounds that are targeted by anglers because of the bottom habitat created. A UNC-CH study by Joel Fodrie and Grabowski found commercially important fish species, such as menhaden and croaker, were more abundant in oyster reefs relative to mudflats in the Rachel Carson National Estuarine Research Reserve. This study was supported by a 2010 N.C. Fishery Resource Grant, which is administered by Sea Grant.

Separate research conducted in Pamlico Sound by David Eggleston at North Carolina State University, Brian Efland of Sea Grant and others set out to document whether marl attracted oyster settlement and if fisherman would

Continued


David Eggleston


Pelle Holmlund


Courtesy NC State


Pelle Holmlund


Courtesy N.C. Coastal Federation


Gayle Plaia

Clockwise from top left: *Brian Efland interviews an angler about fishing near oyster sanctuaries.* • *A diver collects samples from an oyster sanctuary.* • *An oyster toadfish makes his home on a sanctuary.* • *David Eggleston's team measures juvenile Atlantic sharpnose sharks found at the reef.* • *Oyster shells with spat indicate a healthy reef.* • *Eggleston conducts research on oyster reefs.*

Courtesy N.C. DMF


Brian Efland


Courtesy N.C. DMF


Courtesy N.C. Coastal Federation


Courtesy N.C. DMF

Clockwise from top left: *Find oyster shell recycling sites online.* • *Piles of marl are visible beneath a fishing boat.* • *Volunteers build an oyster reef sill.* • *Recycled oyster shells are distributed near Lockwood Folly River.* • *Trucks collect shells from a recycling site in Wake County.*

find more fish on marl-based sanctuaries than sandy bottom. Their work was part of a $5 million Federal Recovery Act grant administered by the N.C. Coastal Federation in cooperation with DMF and others.

Efland conducted interviews with fishers who "thought the project was a good idea and a good use of taxpayers dollars." He also conducted aerial surveys of the reefs to determine if fishing was concentrated there. The team estimated the added value of oyster restoration to recreational fisheries could be as high as $367,000 per year in 2011.

Eggleston says that the "timing was perfect as the marl boulders were put out in the winter." This is because, in early summer when the larvae are looking for a place to settle, the substrate is relatively clean. "We saw record numbers of settlement on the boulders."

However, they found that boring sponges are able to naturally drill into marl and may cause oyster mortality because of toxins. Now in a new FRG-funded study, Eggleston is looking at alternative substrates, such as concrete and granite, to create oyster sanctuaries.

The earlier study documented that oysters multiply on the reefs, along with a surprise — stone crabs, which do not normally occur as far north as the reefs they sampled. Stone crabs, which previously were found only south of Cape Lookout, have expanded their range north to include the sound near Cape Hatteras.

"Stone crab densities were just as high as in areas of the Florida Panhandle that are the population center of stone crabs," Eggleston notes. "Some of the highest densities in the states for stone crabs are now in the Pamlico Sound," he adds. However, Eggleston's data indicate that stone crabs are not a major concern for predation on oyster reefs.

Katherine Pierson, Eggleston's graduate student, received a master's degree for her part in studying the fish species attracted to the reefs. Using fish traps or gillnets, the team found that the relative abundance and number of fish species was higher on oyster reefs. They found fish that are important to the North Carolina coastal fisheries, including Atlantic croaker, black sea bass and blue fish.

Don't Chuck your Shucks

DMF also is constructing oyster reefs with recycled shells. The program, started in 2003, serves the dual purpose of keeping the shells out of landfills and also creating more reefs for both oyster fishermen and anglers.

In 2006, DMF created a dedicated oyster shell recycling position. Sabrina Varnam, now known as the "oyster queen," became recycling coordinator and got the ball rolling. Starting with a total of only 700 bushels recycled in 2003, the program has increased to 27,000 bushels recycled in 2011.

Varnam coordinates with volunteers, restaurants and landfills. She even arranges for private carriers to pick up shells from high-volume restaurants, such as the 42nd Street Oyster Bar and Grill in Raleigh.

Restaurants contribute more than one-half of the recycled shells. "Recycling's for everybody's benefit. The oysters filter the water and keep our water clean. It benefits our operation and the oyster industry," says Brad Hurley, owner of the Raleigh restaurant.

Landfills see the benefits of recycling too. "It's a great reuse of the shell and it closes the loop. Folks can take their shells right back to where they got them and they are processed back to the waterways," comments Sam Hawes, New Hanover County landfill manager.

Shells are stockpiled first in landfills before they are loaded with a front-end loader onto 18-wheelers for transport to one of the several collection sites near the sounds, where they are later transferred onto a barge for planting.

On the barge, a worker sprays the shells into the water with a high-pressure hose. Sites are selected for their likelihood to accumulate juvenile oysters, or spat. Unlike the oyster sanctuaries, these sites are

open to oyster harvest, so that we may see more North Carolina oysters on our plates in the future.

Varnam continues efforts to publicize her mission. She is creating a video and brochures with funds from the N.C. Coastal Recreational Fishing License program. That project includes Sea Grant as a partner. The funding reflects the benefits of oyster reefs for recreational anglers.

"Everyone can benefit from this program and I think that's why it's been so successful. Whether you love to eat oysters, harvest oysters, if you're a restaurant owner, you love to fish or whether you're concerned with water quality or shoreline erosion, everybody feels like it's one of the best state programs out there," Varnam says.

Shells in Bags

Similarly, living shorelines constructed with bags of oyster shells attract live oysters that filter water and provide habitat. The Coastal Federation lists 25 sites along the state's coast where it has assisted private and public properties create such shorelines. A permit is required from the N.C. Division of Coastal Management for their installation.

PenderWatch also collects oyster shells and creates reefs near Hampstead. Spruill and other volunteers monitor the reefs. The group hopes that the reefs will help to stabilize shorelines. Varied research continues to determine how and where the oyster-based living shorelines may provide estuarine erosion control.

As the federation's Ted Wilgis decribes, the reefs consist of oyster bags stacked like firewood in a long pyramidal shape 50 to 100 feet long. "The oyster larvae swimming around in the summer are looking for some place to land and attach. The oyster shells are that natural hard substrate," says Wilgis, who also worked on Sea Grant research while a graduate student at UNC Wilmington.

The larvae help create the living reef. "Along with the oyster larvae come all the small fish, shrimp and crab, blennys, gobis and all different kind of mudcrabs that make the reef function along with the oysters. Once you see that, you start to see a lot of other fish coming in feeding on these guys, or fish like gag grouper using the reef for temporary refuge as it hides there in its juvenile stage," Wilgis explains.

Wilson Bay is another place that uses bagged oysters. Before 1998, the bay was an unpleasant 100-acre receptacle for treated sewage in Jacksonville. Oysters proved their value in an experiment in the bay to test their capacity to purify water. Now it is a pristine park, and a site for children to play and study ecology.

"Oysters are phenomenal," says Jay Levine, an NC State researcher who facilitated the cleanup. He describes the bags of oysters placed in the bay as "whole communities of life."

He continues, "A microcommunity develops on every one of those oysters, including bacteria, protozoa, small crustaceans and annelids that serve as a food resource for fish. You wind up with small juvenile fry and fish that come in and make use of those resources you're providing with those oysters. It's helping support the fish community."

Learn about oyster shell recycling via the N.C. Division of Marine Fisheries website at: portal.ncdenr.org/web/mf *and search for shell recycling.*

Watch for a future Coastwatch *story on living shorelines and other estuarine shoreline research.*

Above: *Shellfish gardening under a dock can optimize oyster growth.*

OYSTERS UNDER DOCKS

The under-dock program promotes raising oysters under docks in waters open to oyster harvests. Under-dock permits are required and obtained through the N.C. Division of Marine Fisheries.

The permitting process includes reading an informative manual and test created by Steve Rebach, North Carolina Sea Grant's associate director. Much of the information comes from studies by Jim Swartzenberg, who conducted numerous Fishery Resource Grant projects to evaluate off-bottom culture of oysters, Rebach says.

New participants may choose to join the Shellfish Gardeners of North Carolina and attend one of their workshops. Participants start with cages, which are actually plastic sleeves containing 1,000 seed oysters, that growers float under their docks. As the oysters grow, the gardeners transfer them to bigger cages.

According to John Zimmerman, president of the group, oysters can mature in as little as nine months instead of the usual three years that a wild oyster may require.

Just like vegetable gardening, there is work involved. Crabs, algae or sea squirts may invade and hamper growth. However, if everything goes right, the 1,000 seed oysters can be counted on to mature into about 800 oysters, Zimmerman says.

The proud gardener could have a harvest of about five bushels — enough for a crowd!

Find out more about the under-dock program by going to the N.C. Division of Marine Fisheries website at: portal.ncdenr.org/web/mf *and searching for under dock.*

Check the Shellfish Gardeners of North Carolina website at: www.oysters-cleanwater.info.

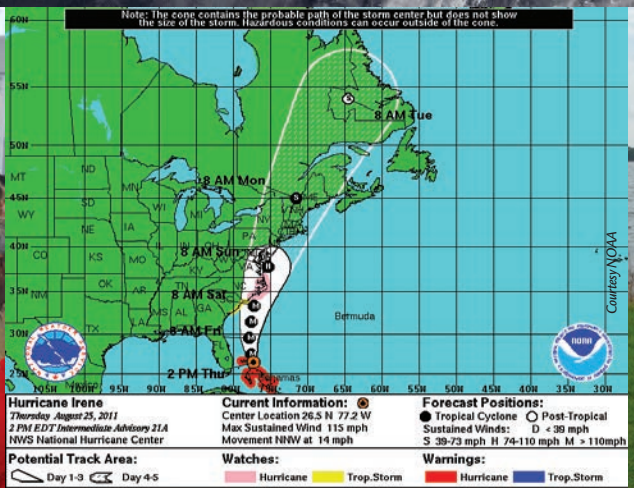
STORM PRACTICES:

Lessons Learned from Hurricane Irene

By Michelle Covi

Courtesy NOAA

Michelle Covi



Courtesy NOAA

Even Ann Keyes learned a lesson from Hurricane Irene about the importance of reliable communications and being prepared for the worst.

"Have a Plan C for your Plan B," advises the Washington County emergency management director who has 25 years of experience under her belt. During the storm, Keyes' Internet connection went down and her pre-tested air cards — devices that give users mobile Internet access using their cellular data service — did not work.

"I relied on good relationships with my partners, so that I could get into the store and get new cards," she recalls.

Keyes shared her Irene experiences with more than 150 other emergency managers, meteorologists, public information officers, emergency responders and university researchers at the third annual N.C. Division of Emergency Management-East Carolina University Hurricane workshop, co-sponsored by North Carolina Sea Grant. The May event highlighted the role of emergency communications and the lessons learned from Hurricane Irene in 2011.

The hurricane taught North Carolina emergency managers and their communities the importance of accurate and detailed communications before, during and after the storm. They depend upon early forecasting from the National Weather Service, or NWS, and clear communications to residents and visitors to make sure that people are able to evacuate vulnerable areas.

The National Hurricane Center found that effective communications are just as important as the development of accurate weather models in forecasting hurricanes. Improved strategies include using maps and graphics, and collaborating closely with news media to inform the public.

Many people had not expected that Irene, a Category 1 storm when it made landfall, would do so much damage. During the storm, areas of Hyde County, which includes Ocracoke Island, experienced a 7-foot storm surge, major flooding and sustained high winds for hours. Eighteen homes were destroyed, and 803 residences and businesses were affected.

However, the hardest part has been rebuilding. "Most people did not expect the recovery process to take as long as it did. It is like switching from a sprint to an endurance race," says Justin Gibbs, Hyde County's director of emergency services, who also attended the workshop.

AT LEFT: A NOAA satellite image captures the landfall of Hurricane Irene at 7.30 a.m. EDT, Aug. 27, 2011, near Cape Lookout. BELOW, LEFT TO RIGHT: Participants attend a panel discussion at the 2012 Hurricane Workshop. • The National Weather Service issued this Hurricane Irene track forecast graphic two days before landfall. • Hurricane Irene destroyed homes and public structures. • A home in Washington County is flooded in the aftermath of Hurricane Irene.


Craig Sullivan


Courtesy NWS

FORECASTING IRENE

The impacts of Hurricane Irene, especially in areas surrounding the Pamlico Sound, surprised many people. Sustained high winds and major flooding from storm surge caused greater damage than most people anticipated. NWS forecasts were accurate but people still were caught off guard.

"People just did not think that the impacts from a Category 1 would have been so substantial," says John Cole, warning meteorologist with the NWS in Newport/Morehead City.

Although meteorologists correctly forecasted the track and rainfall amounts for the hurricane, people reported that they had no idea that the flooding problems would be so severe. Was this because the experts or the news media were not doing a good job at conveying potential risk? Or were people overly optimistic that they would not be personally affected by severe storms?

To understand the public perception of the threats posed by Hurricane Irene and find out how people responded to the weather forecasts, the NWS held public meetings in some of the communities hardest hit by the storm. At December meetings in Dare, Pamlico and Beaufort counties, participants were surveyed about their experiences and perceptions.

In addition, Rich Bandy, lead meteorologist at the NWS Newport/Morehead City office, presented comparisons of the forecasts for wind, inland flooding and storm surge with observations during and after the storm.

Meteorologists forecasted a low threat of tornadoes. However, there were three confirmed tornadoes in the state. The strongest, near Columbia, had maximum winds of 130 mph and caused severe local damage.

Wind impacts were projected to be extreme, with possible sustained winds of 115 mph for much of the coastal area. In actuality, "there were gusts of 90 to 100 mph in the corridor where the eye made landfall," Bandy notes.

In comparing the forecast of inland flooding with actual rainfall impacts, Bandy says that the predictions "were

Continued


Chris Jackson

Courtesy Twitter

Courtesy Facebook

pretty close." Although Irene dropped about the same amount of rainfall as Hurricane Floyd in 1999, river flooding was not as significant because of low water levels prior to the storm.

Four days before landfall, researchers from the Coastal and Inland Flooding Observation and Warning project, or CI-FLOW, began running models, and making river-flooding and storm-surge inundation predictions for the area. The experimental system was developed after Hurricanes Dennis and Floyd to improve real-time water level predictions prior to and during tropical storm events.

The modelers and forecasters were pleased with the results from CI-FLOW. The model forecasted maximum water levels in the Tar-Pamlico and Neuse river basins, which came within 1 foot of the observed water levels in the selected test sites. The NWS forecasters had access to CI-FLOW to evaluate how well the system represented the interaction between storm-surge, sound and river water, and its impact on the coast.

Jack Thigpen, Sea Grant extension director, notes, "Although CI-FLOW is experimental and not a replacement for the standard forecasting models traditionally used by the forecasters, it adds another source of information to help the experienced forecaster make better predictions and reduce potential for loss of life and property damage."

Coastal flooding due to storm surge in many areas was catastrophic and unanticipated by the public. The NWS forecast 18 hours prior to landfall was for extreme coastal flooding, meaning 8 feet or more of water above ground level, in parts of Carteret, Pamlico, Beaufort and Hyde counties. Other areas — including the entire barrier island chain north of Cape Lookout, and the Pamlico and Neuse river areas — were warned of high storm surge, with an expected 5 to 7 feet of flooding.

After the storm, measurements showed that about 4 to 6 feet of storm surge occurred above the ground level in areas of the Pamlico River. In the Neuse River, similar surge levels were measured, although some local areas had as much as 8 feet of water.

The forecast of coastal flooding due to storm surge was close to the observed levels but many residents were still unprepared.

NWS is improving forecasting, and striving to provide the public and emergency managers with better accuracy and longer lead time for emergency preparations. However, getting people to evacuate often is difficult. The experts focus on communicating danger with graphics, but even that information might not get people to leave.

"What we cannot convey with our warning maps is what it really means to stay behind," Bandy notes. "It is not just still water. There are waves and it is extremely dangerous."

WARNINGS IN 140 CHARACTERS

Many municipalities across the state are using Twitter, Facebook and other social media to expand their communications. Hurricane Irene was the first time several counties used these new communication tools for emergency management.

Donna Kain, faculty member in the technical and professional communications program at ECU, surveyed emergency managers about social media. She found that 55 percent are using social media and another 24 percent are likely to start using it in the near future.

"Social media has been adopted by larger county emergency management departments," says Kain, who participated in a Sea Grant-funded study on risk perceptions and emergency communication effectiveness in coastal zones. "Most of the departments prepare the messages themselves, in addition to their other duties."

Roberta Thuman, Town of Nags Head's public information officer, spent Hurricane Irene in the emergency operation center listening in on calls from people who wanted to be rescued during the storm. This was the first emergency in which she was using Twitter to provide information to the public about the storm and the conditions in the area.

"I was the person sending out the tweets and I had to keep my emotions in check," Thuman says. She started tweeting before the hurricane — and her Twitter followers grew exponentially during the storm. She was grateful that many of her posts were re-tweeted, especially ones that alerted people to rising waters and recommended staying inside.

In New Hanover County, emergency manager Warren Lee finds that social media is a good way to reach out to young people. The county uses Facebook, Twitter, Flickr and YouTube, in addition to traditional media such as newspapers or television.

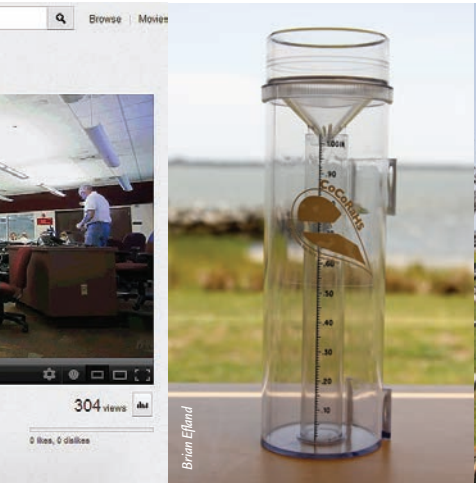
"During Irene we had a 300 percent increase in Facebook followers with over 76,000 views and 204 tweets. In addition, we produced six YouTube videos showing the activities of the county's Emergency Operations Center," Lee says.

While social media is a way to reach people who do not rely on traditional media, adoption has been slow because many municipalities do not allow employees to access the sites on work computers. One of the lessons from Irene for emergency communicators has been that policies need to be developed about the use of social media, including how it will be staffed when a crisis occurs.

"The immediacy of Twitter and other social media is wonderful, but it is also a big challenge. You have to keep that in mind," Thuman says.

HYPERLOCAL INFORMATION

Traditional news media, particularly television news, played an important role during Hurricane Irene. Local and national media turned to emergency managers and the NWS for information, but getting the local information people need often is challenging.



LEFT TO RIGHT: National Hurricane Center's Bill Read answers questions from the media at the Hurricane Workshop. • During Irene, Roberta Thuman, Nags Head public information officer, connected with residents through Twitter. • New Hanover County Emergency Management used YouTube to inform the public during the hurricane. • Volunteers with the CoCoRaHS weather-observing program use a high-capacity rain gauge. • Irene left behind swaths of destruction.

Irene showed emergency communicators the power of social media to share real-time and precise information. Social media plays an important role in filling the gaps for local information and offers an outlet for the news media to reach additional audiences.

Skip Waters, chief meteorologist at WCTI-TV, never had a desire to communicate via social media. With Hurricane Irene, he has seen its value. "The stuff that really resonates for people is the hyperlocal," he says.

Hyperlocal is very specific in both location and time. It is the kind of information that Waters has from driving around his region, 19,000 miles each year — and the kind of knowledge that helps when using social media. There is value in "knowing every little landmark, every little store, every store that used to be there, every place that has a good cheeseburger," he says.

During Irene, Travis Morton, the news station's intern, adapted Waters' on-air weather reports and descriptions to Facebook and Twitter to increase their communications reach. Tweeting or creating Facebook posts also can allow people to share what they are experiencing in their neighborhoods. For example, comments from viewers via social media provided verification of storm impacts, often in real time.

However, some of the biggest communications challenges occurred during the recovery, when many communities were without power for extended periods. Because of the hurricane, Waters says that the station evolved from just sharing information to understanding how people without power were getting much of their weather information through the station's social media outlet via smart phones or other devices.

One viewer was thankful for the social media updates during the storm when she was without power for three hours. "Travis was my hero," she told Waters.

VOLUNTEER WEATHER OBSERVING

Local information is sometimes difficult for the forecasters to obtain with limited numbers of weather stations around the state. That is where the Community Collaborative Rain, Hail and Snow Network, also known as CoCoRaHS, comes in. It is a volunteer weather-observing program that trains citizens to collect precipitation data and send it daily to the NWS.

"It is a good way for folks to get involved," notes Brian Efland, coastal business specialist with Sea Grant, who is helping recruit volunteers. "Some counties in the region do not have any observers, so Sea Grant has funded 36 rain gauges for volunteers in rural locations along the coast."

To be involved, participants must have a high-capacity, 4-inch diameter rain gauge and register with the CoCoRaHS website. Then each morning, the volunteer empties the rain gauge and records the amount of precipitation through the website.

During storms like Hurricane Irene, the CoCoRaHS volunteers provide detailed data that become part of tropical storm statements for NWS. Rainfall amounts also are incorporated into CI-FLOW and other models to help improve rainfall forecasting.

"One of the pluses is that the rain gauges do not rely on electricity, so they are great for storm totals and fill in the gaps between automated gauges. The CoCoRaHS network was also critical in ground truthing a new radar system put into place by the NWS just prior to Hurricane Irene," says David Glenn, state coordinator for the project and NWS meteorologist.

NO 'JUSTA' STORM

Bill Read, recently retired director of the National Hurricane Center, spent his 35-year career studying hurricanes. One of his most recent efforts has been the Hurricane Forecast Improvement project, a 10-year program that began in 2009. While forecasts of the hurricane track have improved greatly, forecasts of intensity have not.

Irene was an example of how difficult it is to predict hurricane strength and speed. "A lesson learned from Irene is one I have seen in many storms. Even a good forecast has uncertainty. Getting locked into specific times and locations, especially before 48 hours, can cause misunderstanding," Read says.

Hurricane Irene reminded meteorologists and emergency managers that there is no "justa" tropical storm or "justa" Category 1 hurricane. Each storm is different. In a severe thunderstorm, 60-mph winds may last seconds or minutes, but in a tropical storm the size of Irene, these winds can last hours.

"If I could rewrite history, I would not have any kind of scale," Read remarks, referring to the categories used for hurricanes. "Mother Nature is a continuum."

- *Information on hurricane preparedness is available at:* readync.org *and* www.ncdhhs.gov/hurricanes. *Many county and town websites also have good resources.*
- *For research on weather preparedness see:* www.ecu.edu/riskcomm.
- *See a video describing the Coastal and Inland Flooding Observation and Warning Project at:* www.nssl.noaa.gov/projects/ciflow.
- *Find out if you are at risk for flooding at:* www.ncfloodmaps.com.
- *To volunteer to be a CoCoRaHS observer in North Carolina, contact David Glenn at:* david.glenn@noaa.gov. *In the coastal region, contact Brian Efland at:* brian_efland@ncsu.edu. *For more on CoCoRaHS, visit:* www.cocorahs.org.

COUNTING FISH: TESTING SHIPBOARD VIDEO MONITORING

BY E-CHING LEE

"THE OCEAN IS JUST LIKE THE SERENGETI," says Reece Hair, a snapper grouper fisherman based in South Carolina. "Just got water over the top of it."

But that water can obscure a lot of data. Just ask the South Atlantic Fishery Management Council. It is working to collect sufficient information on the snapper grouper fishery in the region to set and update fishing regulations.

"We just don't have the resources to have that accurate picture of what's actually happening on the water," acknowledges Brian Cheuvront, the council's fisheries economist.

"Having more accurate estimates of catch and bycatch could actually help fishermen in the long run," he continues.

Currently, the SAFMC requires fishermen in the snapper grouper fishery to self-report information in logbooks. Human observers are occasionally placed on a handful of boats to record data, but there are no dedicated funds for an observer program for the fishery.

Some snapper grouper permit holders, including Phil Conklin from South Carolina and Charlie Phillips from Georgia, asked Sea Grant fisheries specialists Scott Baker from North Carolina and Amber Von Harten from South Carolina to conduct a study to determine if electronic video monitoring could be a cost-effective and efficient alternative to those two methods.

"In theory, it doesn't seem to be as intrusive as having an observer on your boat, and management could essentially turn it on and off when needed," Baker notes. "It collects a wealth of information that hopefully could be used to benefit the industry."

Kenny Fex from North Carolina and Mark Mahefka from South Carolina joined Hair, Conklin and Phillips on the project. For logistical purposes, this study involved vessels in the northern half of the SAFMC jurisdiction and did not include Florida.

Their work was supported by a National Oceanic and Atmospheric Administration Cooperative Research Program Grant. This program encourages collaboration in research between scientists and fishermen, requiring that anglers be part of the data-collection process.

JUST ANOTHER TOOL

SNAPPER GROUPER PERMIT HOLDERS ARE required to keep logbooks for each trip. The information is used to document fishing effort and the catch that is landed, which can be verified when the vessel unloads.

However, there currently is no way to validate the number of discarded fish reported in logbooks because this happens at sea. Furthermore, the data can be inaccurate if the records are completed at the end of a trip, long after fishing is complete. According to Baker, for these reasons, scientists are sometimes hesitant to use the data other than to determine fishing effort and landed catch.

Funding from the same cooperative research program allows scientists to put observers on a handful of boats, providing a wealth of information.

"Human observers are considered the gold standard in terms of what's happening out there because it's an independent voice," Baker says. But at a cost of more than $1,300 per day at sea per observer, it quickly adds up to a "crazy amount of money." At that price, the observer program is not scalable to the entire fleet.

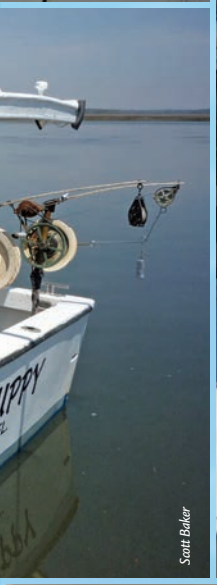
Still, funding for observers is very limited and is not guaranteed from year to year. Also, adding another person to these small fishing boats is often a challenge.

Enter electronic video monitoring, or EM.

Continued

Clockwise from top left: *The electronic video monitoring control box, screen and keyboard are installed in the wheelhouse.* ○ *Boats from the snapper grouper fleet dock in Southport.* ○ *Scott Baker installs EM wiring in a vessel wheelhouse.* ○ *Amber Von Harten, Kim Astle and Kenneth Fex prepare cameras for installation.* ○ *The system shows live images from four cameras.* ○ *EM cameras are mounted on the vessel so that the reels are in view.* ○ *Bandit reels are named for their resemblance to casinos' one-armed slot machines.*


Scott Baker

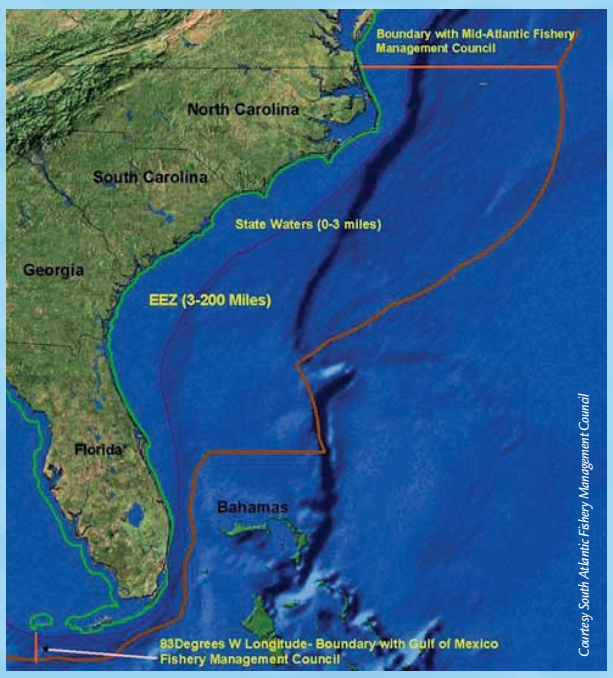

Scott Baker


Scott Baker

Scott Baker


Amber Von Harten


Scott Baker



Above: *The SAFMC is responsible for fish stocks within federal waters from Cape Hatteras to Key West, Fla., including the snapper grouper complex.* Right, top: *Fish caught during the study included, clockwise from top left, red grouper, red snapper, vermilion snapper and red porgy.* Right, bottom: *The camera views show a stationary vessel that is not fishing.*

"EM has the potential to improve the existing knowledge of the snapper grouper complex since it records not only fish that are landed, but also species that are released due to regulations or because they do not have marketable value," explains Jack McGovern, project monitor and NOAA fisheries biologist.

Baker and Von Harten theorized that EM would cost less than observers, be more reliable than self-reported logbooks, and not place an additional burden on the fishermen. The Canadian Department of Fisheries and Oceans currently uses this method to validate self-reported data from fishermen. Also, EM can be deployed in instances where safety or space limitations prevent a human observer from being present.

McGovern notes that EM could fill in critical missing information about discards within the fishery. "There is a need to characterize the entire catch of commercial fishermen, not just what is landed. The magnitude and composition of bycatch is not well known. Information from EM has the potential to enhance that knowledge," he says.

The Sea Grant specialists wanted to assess EM's price tag. "We couldn't really understand that until we figured out how these boats fished, how the cameras worked on the boats, how much of the data can be analyzed accurately, and how to hone down the handling practices of the fish on board to capture that data that you need," Von Harten notes.

Another goal was to determine if EM could bridge the informational quality and quantity gap between observers' data and fishermen's logbooks.

"From a larger perspective, this study is: Can we collect the same level of information that they're collecting but at a reduced cost and reduced hassle to human observers?" Baker explains. Available research states that this is possible, depending on the fishery, he adds.

SETTING UP

FOR THE STUDY, BAKER AND VON HARTEN worked with boats that use vertical hook-and-line reels, known as bandit gear. These electric or hydraulic reels are so nicknamed because of their resemblance to casinos' one-armed bandit slot machines.

"They are fast, mobile vessels that can quickly traverse to the fishing grounds and have large enough fish holds to stay out for an extended period of time," Von Harten explains. These boats are configured so that the reels are positioned to fish off the port, starboard and stern of the vessel, allowing fishermen to use three or more reels at once.

The team contracted with Archipelago Marine Research Ltd. for equipment and services to carry out a pilot study on six boats.

"It's a complex fishery to monitor," recalls Howard McElderry, Archipelago's head of fishery monitoring technologies. "We had done some work with the vertical longline fishery before but not a lot, and certainly not as complicated as the South Atlantic."

However, these very issues made the work interesting. "Just the vast number of species and the speed at which the fish are coming up from a variety of points on the boat — that presented quite a unique challenge for us in terms of being able to capture all this fishing activity accurately and completely," points out Adam Batty, the Archipelago project manager.

Each boat had four cameras, a sensor to turn on the cameras when a reel moved, a GPS device and a control box. The fixed cameras were pre-focused such that all fishing activity on the back deck could be recorded.

The system recorded video streams on hard drives, and once those were full, Baker and Von Harten replaced them. Then Baker sent the drives to Archipelago to analyze for species caught and fishing effort, among other details.

In addition, the fisheries specialists provided local tech support, going to service the equipment after trips or when there were problems. They did a lot of tweaking to adjust the EM devices for the individual boats and for how the anglers fished — fast, in tight spaces, on long trips that could last up to two weeks, and often in rough seas.

By the close of the study, the pair had picked up some new skills. "We really felt like we were handymen by the end of the project after troubleshooting problems with the equipment and using our toolboxes to fix and tweak adjustments on camera lenses and hardware," Von Harten jokes.

ANALYZING THE DATA

THE FISHERMEN TOOK 93 TRIPS DURING THE eight-month study with EM systems onboard. An independent observer went out on five of those trips, and his records were compared with the data that were collected by the EM systems. Baker and Von Harten also created a special project logbook for fishermen to record catch and effort details to compare with the EM data.

The researchers found that EM and observer data matched well for overall fish count, but fish counts recorded by fishermen varied in levels of agreement to EM. Some fishermen were better at data collection than others.

"The project also demonstrated that there was the potential to obtain information on species identification and length of discarded fish," McGovern says.

"The hard part was breaking down the identity of those species that may come across the camera, including the ones that are discarded," Baker says. "As you can imagine, a lot of them look very similar." For example, some common species such as vermilion snapper were easily identified, while others such as black sea bass were harder to distinguish.

Furthermore, reviewers had to contend with the different fishing styles and the speed at which the anglers fished. Often, very little time

elapsed between the end of one fishing event and the beginning of another. That made it difficult to come to a consensus on how to define a single fishing event, which would be necessary if EM is to be further explored for this fishery.

"Time is money to them," Von Harten explains. "The faster they can discard the fish that they're not going to keep or get the fish on board that they are going to keep, it makes all the difference."

Data analysis — mainly the time spent identifying and counting fish — turned out to be the most expensive part of the project.

"A lot of the costs are actually going to be in coming up with a plan to figure out how you're going to analyze and use that information," Baker says. "You've got to figure out which information is important for you to use."

Without that plan in place, the EM system "could just be an expensive piece of equipment on your boat," he adds.

"Nonetheless, the data will be there," counters the council's Cheuvront, "which is something we've never had before."

LOOKING AHEAD

FEX, THE SOLE NORTH CAROLINA FISHERMAN in the project, has praise for the pilot study. "The good thing about it is that it's true science," he explains. "And it made me realize the amount of discards and things like that." However, he has reservations about deploying the system across the entire snapper grouper fleet, mostly because of cost.

In fact, Baker and Von Harten recommend that with tweaking, EM has the potential to augment, rather than replace, existing data collection programs. One possible use of EM is as an audit system to verify a portion of the fishermen's logbook data.

And even though EM was effective in collecting data, "there's certainly a big learning curve that needs to be incorporated for this to be effective," Baker acknowledges.

"Putting technology on a boat isn't something you just do and forget about. You have to actively work with it," Archipelago's Batty concurs. "Very often it affects the way catch is handled, places where discarding occurs, all those sort of things. So it becomes a bigger method."

However, others are learning from these lessons. When the Ocean Conservancy started a similar pilot study in the Gulf of Mexico for reef fish, Baker was invited to share advice and lessons learned.

"Scott's knowledge of the challenges in maintaining equipment and traveling to multiple sites helped us prepare for the amount of work that would realistically be needed to successfully complete the tasks. Scott also shared guidance on the qualifications we should look for in an observer," says Kristy Tavano, the coordinator for the Gulf project.

"The work that we did with Sea Grant really helped us to know what we were up against and plan a little bit better for the installations," adds Batty, who also is managing the Gulf project for Archipelago. In addition, he used some of the video feed from Baker's study to familiarize his technicians with the type of fishery they would encounter.

Although Von Harten doesn't see the EM system being deployed on all boats in the fleet, she suggests there could be a potential follow-on project in the snapper grouper fishery.

"If there was a small segment of the fleet that wanted to do more pilot testing of the equipment to really hone down on how this could effectively work on their boats, I think that would probably be the next step," she suggests.

But even though he agrees that the EM technology is very useful, Cheuvront has several caveats.

"For this to work, we need to get the buy-in from the fishermen and we need to get the resources from management to actually deploy the technology," he cautions, citing the need to have funding to support the EM work.

"The link between deploying the gear and its use in management has to happen very rapidly or it's going to lose whatever support it has from the fishermen," Cheuvront advises.

To learn more about the snapper grouper complex and its related management plan, go to: www.safmc.net *and click on Fishery Management Plans in the Quick Links box. Then search for snapper grouper.*

Electronic Video Monitoring Survey

Scott Baker and Amber Von Harten recently surveyed 773 snapper grouper permit holders on electronic video monitoring research. Fifteen percent, or 116 people, responded.

Responses were grouped according to coastal region. Fifty-four percent of permit holders responding from North and South Carolina, and Georgia were supportive of additional testing of EM systems. However, 75 percent of the Florida respondents were opposed.

When asked if a third-party data review method such as EM might be considered as a tool to validate self-reported logbook records, more than 60 percent in each group were opposed to the concept.

Likewise, when asked if they would support the adoption of standardized fish-handling guidelines to improve the video-review process if EM was to be further evaluated, more than 75 percent of respondents were not in favor.

"WE WANT OUR REGION TO BE THE DESTINATION, NOT JUST A STOP ALONG THE WAY."

Courtesy Tar-Pam Guide Service

By Pam Smith

PEOPLE FIRST TOURISM: Connecting with Nature's Bounty

If your idea of connecting with nature involves encountering lions and wildebeests on safari in exotic lands, stop reading now.

On the other hand, read on if you opt to connect with *people* whose tourism ventures embrace the natural environment — ecology, culture and history — of places a bit off well-worn paths.

Researchers at North Carolina State University's Department of Parks, Recreation and Tourism Management developed People First Tourism to boost the number of rural tourism entrepreneurs — and enhance rural economies.

"Many coastal communities are in transition from traditional agriculture economies to something very different. Few long-term, well-paying jobs come with gentrification trends. We designed People First Tourism to assist individuals interested in being involved in nature-based tourism enterprises," explains Duarte Morais, NC State faculty member, and the project's designer and coordinator. Morais' team includes doctoral candidates Chantell LaPan and Yuchen Mao.

It's a win-win situation, according to Jack Thigpen, North Carolina Sea Grant extension director.

"Tourists are eager to get in touch with the natural environment. Local folks are the ones who are most vested in the ecology, history and culture of any given locale. So it makes sense to help provide the tools that can lead to new economic opportunities for individuals and communities," Thigpen explains.

Sea Grant provided seed money to help Morais and his research team conduct fieldwork in rural communities in the Inner Banks region to gain an understanding of the challenges fledgling entrepreneurs face.

"These are places that tourists now typically pass through en route to Outer Banks attractions," Morais points out.

But Morais hopes to change that by building a strong People First Tourism network to attract visitors to the region. The Inner Banks, a term describing coastal plain counties around the Albemarle-Pamlico estuarine system, has untapped potential for natural resource-based tourism, he asserts.

At community meetings hosted by his team, prospective entrepreneurs learn about services available through local community colleges, county Cooperative Extension offices, regional economic development centers, established tourism organizations and natural resource management agencies.

LEVERAGING RESOURCES

Lentz Stow, executive director of Beaufort County Community College's Small Business Center, is a People First Tourism advocate.

"I see this as a way to bring ideas and concepts together to help produce new entrepreneurs. The bottom line is job creation through micro-entrepreneurship," Stow says. "It may mean an additional income stream to supplement the household income."

Small business centers at community colleges across the state offer a series of how-to seminars, from writing business plans to recordkeeping and reporting taxes, Stow points out.

"Cash flow and cost factors are what it's all about. We teach new entrepreneurs to keep score and win the game," he says, noting that his program builds upon the basics.

People First Tourism's efforts to promote the Inner Banks as a tourism destination are a definite plus.

"We have impoverished pockets in scattered river towns between I-95 and the ocean. Many are struggling and have hurdles, but also have assets in their pristine natural resources. However, many communities don't have the money needed to advertise and market those assets and few state or local dollars to develop infrastructure," Stow says.

That's where People First Tourism networking can pay off by leveraging resources of a large university like NC State, small business centers, community colleges, faculty know-how, and students who bring energy and ideas into play.

Advertising via websites and social media could help package the region's nature-based tourism assets and services, Stow adds.

Continued

LEFT: Capt. Richard Andrews helps Will Briley hoist a topwater striper from the Pamlico River.

It's what he calls "the logic of generosity."


Pam Smith

Pam Smith


Chantell LaPan


Courtesy Washington-Beaufort Tourism

THIS PAGE, CLOCKWISE FROM TOP: Capt. Richard Andrews, who operates his Tar-Pam Guide Service from Washington, wants to make the Inner Banks a tourist destination. • Cast off from Pungo Creek Marina in Belhaven to connect with nature. • Duarte Morais explains People First Tourism at an informational meeting for folks in Washington and Beaufort counties. • Andrews can find fish year-round in the region.

"People First Tourism can provide the window for a view of Inner Banks," he explains, citing a desire that the estuarine region earn recognition similar to the national identity for the Outer Banks.

Most towns east of I-95 include or border bodies of water. "Those water resources — and the rich history surrounding them — could become the connecting element for marketing the Inner Banks as a tourism destination," Stow notes.

STAYING TO PLAY

To be sure, Inner Banks towns, such as Bath, Columbia or Washington, give travelers a reason to stop — to eat lunch, visit folk art galleries, or walk through history along a picturesque waterfront — while en route to the Outer Banks.

But People First Tourism entrepreneurs want tourists to come, explore and *stay* in the Inner Banks region.

"We want our region to be the destination, not just a stop along the way," says Capt. Richard Andrews, who wants people to know the Inner Banks are "open for business year-round."

Andrews, who owns and operates Tar-Pam Guide Service out of Washington, participated in People First Tourism workshops in Beaufort County in early 2012. He was impressed with the idea of building a support network for micro-entrepreneurs.

"I thought it was a way to learn and do more to expand my own business, to encourage others, and to share resources for marketing the Inner Banks as a tourism destination," Andrews explains. "I definitely want to be part of an initiative that promotes our region."

He believes that collaboration and cooperation will mutually benefit fledgling nature-based businesses. It's what he calls "the logic of generosity," a successful model he observed while working several seasons aboard charter fishing vessels out of Hatteras Village and Oregon Inlet Fishing Center.

"The charter boat captains support each other and work for the common good of the fleet. They radio each other when they find a good offshore fishing area as a way of spreading the wealth of shared resources. Spreading the wealth means spreading tourism dollars through the whole network," Andrews says.

It's about a high tide raising all boats. And, it's a model Andrews is emulating in the fourth year of his Inner Banks fishing operation. He shares information with other fishing guides, and recommends locally owned restaurants and bed-and-breakfast accommodations to encourage his clients to stay and play.

It seems that Andrews was destined to do what he loves best. Born and raised in Tarboro, Andrews began fishing in rivers, estuaries and offshore waters as a youngster. He says the day after he graduated from the University of North Carolina at Chapel Hill, he headed to the Outer Banks to fulfill his lifelong dream of working as a mate on an offshore charter boat.

Those experiences whetted his appetite to learn more about the coastal environment, leading to a master's degree in natural resources from NC State, where he focused on stream and wetland ecology.

Andrews brings that store of knowledge to bear as a fishing guide on the Pamlico, Pungo and Tar rivers, as well as the Pamlico and Albemarle sounds.

He can launch his boat at any site and travel to where the fish are running year-round. And, it helps that he understands the dynamics of rivers and estuaries, and how fish behave in response to stream dynamics and seasonal changes.

"What the old timers will tell you is that fish track food. Period. That's just about the

THE PAGE, CLOCKWISE FROM TOP: Edward Davis and Ben Davis stand in front of the 150-year-old Leggett Organics Farm homestead in Washington. • Ben Davis delights customer Resha Ryan with cut flowers from the farm. • Step into the rich history of the people and ecology of the region at the North Carolina Estuarium in Washington. • A sunflower thrives in the rich soil of Leggett Organics Farm.

most important thing you need to know," he says. "I have so much respect for the old timers who have generations of knowing how to read the waters passed down to them. I had to earn a couple of degrees to come to that basic knowledge. I am earning my stripes on the water. There is no substitute for being on the water."

While his business is all about "putting people on fish," there are no guarantees that the fish will take the bait. What Andrews can guarantee, though, is an opportunity to connect with nature and learn a bit about complex wind-driven tides and the dynamics of estuaries, as well as local wildlife, geology, traditions and history.

"I love what I am doing and where I am doing it," he says. That doesn't mean his entrepreneurial spirit is quelled. He continues to build his client base with an Internet presence and Facebook postings. He also writes for several fishing publications, including *Fisherman's Post* and *Coastal Angler*.

Andrews' dream is to build a multi-faceted, nature-based enterprise that offers guided fishing trips, nature tours and hospitality at his own rustic, riverside lodge.

GROWING INTEREST

Ben Davis, Andrews' friend, shares an entrepreneurial spirit, a love for the region and a determination to make the Inner Banks a tourist destination.

The Leggett Farm, just outside of Washington, is the centerpiece of his long-term vision to establish a bed-and-breakfast on the homestead that has been in his family for more than 150 years. His organic farm would supply all the needs for guests, while continuing to provide top-notch organic food for the wider community.

For now, his People First Tourism focus is the Leggett Organics Farm operation he founded nearly a decade ago. This is his third season as part of the Community Supported Agriculture, or CSA, network. Members purchase shares prior to each growing season and are guaranteed a weekly box of organic vegetables or other farm products.

Members may come to the farm and pick their own produce, or pick up their weekly share at Greenville or Washington farmers' markets where Davis sells his products.

Visitors to the Leggett Organics Farm website can watch the crops grow, and learn about the latest activities and offerings. A resident chef posts images of staff-tested recipes that feature the current season's crops.

Leggett Organics Farm also offers farm tours, festivals and other social events on the farm for the CSA members. The public also is encouraged to "tour and taste."

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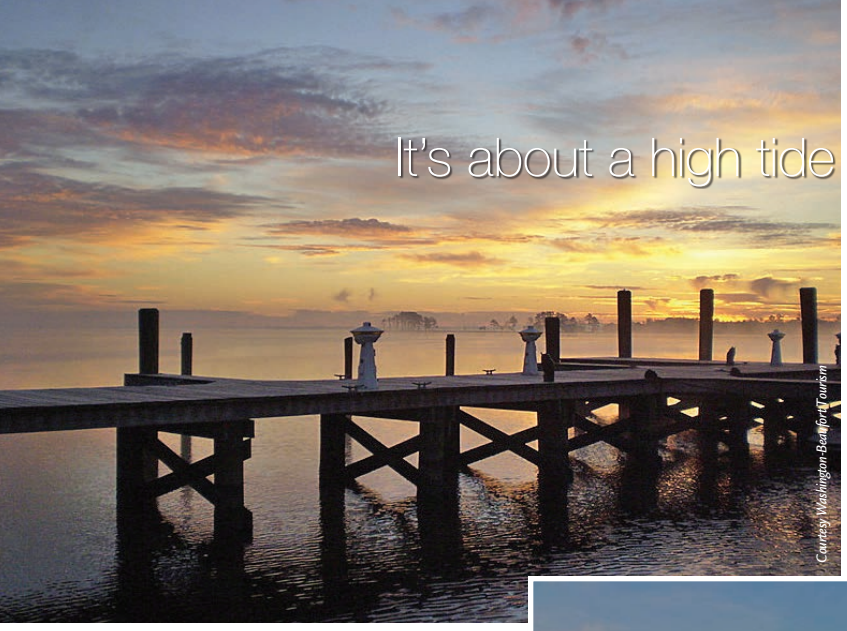


CLOCKWISE FROM TOP: Sunset at Bayside Marina in Belhaven provides a perfect ending to a day on the river. • Capt. Bob Boulden points out Inner Banks beauty along the Tar and Pamlico rivers aboard *Miss Bea.*

"They are ways to develop knowledge of how their food is grown," Davis says. "And what visitors learn is that we are doing 1950s-era farming. We don't own huge tractors, and the fertilizer comes courtesy of chickens and cows."

A UNC-Chapel Hill alumnus, Davis founded, owns and operates an environmental consulting firm.

"That's my day job," he jokes. "But I had an opportunity to come back to the farm about 15 years ago and began farming conventionally as a hobby. When the chemicals made me sick, I decided, 'No more.' Since then, I have invested in converting the entire acreage to strictly organic methods."

To earn U.S. Department of Agriculture Organic Certification, farmers must meet rigid standards and be recertified annually, Davis explains.

He started organic farming on a small scale, growing for friends and family members. The operation now yields seasonal crops of a variety of greens, root vegetables, herbs, corn, peppers, eggplants, squash, melons and even cut flowers, as well as 10 acres of collards.

His dad, semi-retired pediatrician Edward Davis, is adding a new dimension to the farm's offerings. He is tending four beehives near the edge of planted rows of crops. It will be a couple of years before they can harvest honey. In the meantime, the elder Davis is overseeing a new brood of chickens that one day will provide organic eggs.

Heirloom tomatoes are always in demand, says the younger Davis. He recalls an earlier season of planting about 100 varieties of heirloom tomatoes to test what worked best in the local climate and what best suited the locals' taste buds. He's whittled the selection down to about 50 varieties. This year, his favorite is the Sungold cherry tomato that Davis claims actually tastes like the sun.

"Organic farming produces food that is safe to eat, free of harmful chemicals. And, importantly, fresh organic food just tastes better," Davis says.

As part of the People First Tourism project, Davis hopes to expand his role in the farm-to-table movement by helping to develop a network of organic farms in Beaufort County that supply fresh produce to local restaurants.

CONNECTING THE DOTS

"We planted seeds of interest that are beginning to germinate into a network of fledgling enterprises that are part of our pilot phase," People First Tourism's Morais says.

"We want to put them in the marketplace well prepared to meet the challenges of a small business. It's important to know how to negotiate the maze of business plans, credit, licensing, liabilities and marketing," he adds.

"Our newly launched People First Tourism website is designed to look and feel like other tourism reservation sites. It allows tourists to research and make reservations with rural tourism entrepreneurs who have, thus far, been difficult to find and contact," Morais explains.

For now, the site provides profiles and contact information of about 20 participating entrepreneurs. Along with Andrews and Davis, the site features fellow Beaufort County entrepreneur Capt. Bob Boulden. He owns Miss Bea Charters, a service that offers nature cruises on the Tar and Pamlico rivers, and the picturesque creeks that provide habitat for myriad wildlife in the water and on the shore.

An economic innovation grant from the N.C. Rural Center is enabling Morais to expand the project to rural counties beyond the Inner Banks. He envisions adding as many as 100 to 200 entrepreneurs to the network from across the state.

"We expect the People First Tourism website to become a prime resource for tourists interested in connecting with North Carolina's people and natural resources. The project stands to improve the tourist appeal of North Carolina, to enable the self-reliance of numerous entrepreneurs, and to increase appreciation for the state's rich natural resources," Morais concludes.

For more information, visit People First Tourism at: www.peoplefirsttourism.com.

Also, find Capt. Richard Andrews at: www.tarpamguide.com*; Ben Davis at:* www.leggettfarmorganics.com; *and Capt. Bob Boulden at*: www.missbeacharters.com.

North Carolina State University supports the Small Business and Technology Development Center at: www.sbtdc.org. *The N.C. Community College System runs the N.C. Small Business Center Network at:* www.ncsbc.net.

Courtesy N.C. Museum of Natural Sciences

Above: *Visitors to the N.C. Museum of Natural Sciences admire a model of a megalodon jaw.* Below: *Specimens sit on display in the Nature Research Center.*

Courtesy N.C. Museum of Natural Sciences

North Carolina's Coastal Treasures

BY CHELSEA PIERCE

ANTHONY STEPPED OFF THE SCHOOL BUS. HE RAISED HIS HEAD TO VIEW THE NORTH CAROLINA MUSEUM OF NATURAL SCIENCES. HIS SCIENCE CLASS WITH MRS. BAKER WAS ABOUT TO DISCOVER MORE ABOUT THE COAST.

Anthony had moved from Colorado, so he was excited to learn about the beach. Today, he was going to find out about his classmates' favorite place to visit.

"Alright class," Mrs. Baker began, "Ready to go? Stay together!"

She opened one of the glass double doors. Anthony and his classmates filed in.

The first thing Anthony noticed was the biggest teeth he had ever seen. Next to it was a sign that read North Carolina Natural Treasures. Anthony stood in awe as his other classmates roamed about the gallery. He didn't know a part of an animal could be so huge.

He pointed to it with interest and asked his teacher, "What is that?"

Mrs. Baker smiled at him and said, "That's a model of the jaw of the white shark's ancestor. They are most often called **megalodon** and they grew to be very large."

Anthony made his way over to read the description.

"Megalodon grew to be 42 feet long!" Anthony exclaimed.

"Wow, that's a little bit longer than our bus outside," Maria, Anthony's classmate, added.

"Good job, Maria!" Mrs. Baker added. "Comparing the measurements to something you see daily is a good way to get an idea of a creature's size."

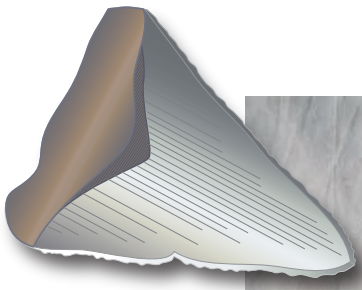
Anthony was excited to learn more about animals. He walked around the displays until he found the **eastern box turtle**. The turtle's eyes intrigued him.

"Its eyes are so red!" Anthony exclaimed.

A museum volunteer noticed Anthony's interest and walked over to him to explain.

"Well," the volunteer began, "the males have bright red eyes, like this particular box turtle. The females have brown or yellow eyes."

"How long do box turtles live?" Anthony asked.



"Typically 60 to 80 years. Sometimes, they can live more than 100 years," the museum volunteer replied.

"Wow! That's a long time," Anthony said.

"It is quite amazing," the volunteer agreed. "Another interesting fact is that all their shells have different patterns. Each one is unique. They also are found across the entire state."

"Thanks for telling me," Anthony replied. He had no idea how interesting turtles could be.

The volunteer smiled and said, "You are very welcome. Remember, you can always find more information about box turtles in your local library. It is the state reptile."

Anthony nodded. His library card would certainly get more use now that he had discovered the megalodon and box turtle. He couldn't wait to learn more about them.

Anthony smiled back and then followed his classmates to the next area of the museum, Coastal North Carolina.

Courtesy N.C. Museum of Natural Sciences

Courtesy N.C. Museum of Natural Sciences


Courtesy N.C. Museum of Natural Sciences

Clockwise from top left: *Fossilized shark tooth.* • *Vince Schneider holds the fossilized teeth of the white shark's ancestor.* • *In the Naturalist Center, Jerry Reynolds examines an octopus and pencil urchins.* • *Margined sea star.* • *Male box turtle.* • *A museum intern shows a young visitor the skull of a black bear.*

Illustrations by Charlotte Ingram for North Carolina's Amazing Coast

COASTAL NORTH CAROLINA

Anthony noticed a tall and dry-looking plant next to the sign labeled Salt Marshes. Mrs. Baker walked over to Anthony and told him the plant is officially called *Spartina*, but is commonly referred to as **smooth cordgrass**.

"It looks so different from the grass in my yard," Anthony stated.

"It is actually a plant that can grow to 8 feet and it stabilizes the soil it grows from with its matted roots," Mrs. Baker noted. "When *Spartina* dies, it becomes detritus, which serves as food for many salt marsh species."

"What's that?" Maria questioned as she pointed to the salt marsh model. The exhibit also showed a U-shape under the mud with a tube-like creature inside the U.

"That's a **lugworm**, young lady," said a museum visitor. "They burrow under the mud in salt marshes. When the tide goes out, if you ever see a depression in the sand with coils of mud nearby, that's likely a lugworm."

"The coiled mud is the waste that their body doesn't need," Mrs. Baker added.

Anthony listened closely. He would be sure to look for the depression in the mud once he went to a soundside beach.

Mrs. Baker thanked the visitor for helping. Then the class moved to the second floor of the museum.

DISCOVERY ROOM

Mrs. Baker led the class to the Discovery Room and everyone waited in line to enter. Anthony was anxious to see what this room had to offer. Finally, it was his turn.

Anthony walked to a corner of displays in the room. He saw a creature that had five limbs. Maria walked over and picked up the peculiar animal.

"It's called a sea star, Anthony," Maria said.

"Sea star? What does it do?" Anthony asked.

"I'm not sure," Maria responded, "but it feels rough." Maria made a dissatisfied face as she examined the star.

Norman, another classmate, came over and said, "That's because it's all dried out. I see those when I go to the beach. They are very squishy."

Mrs. Baker overheard the conversation between her students. She knelt down and turned over the sea star in Maria's hands. "This is a **margined sea star**. Its tube feet are pointed and perfect for sticking in the sand. It uses its feet like poles to help it move."

All three students felt the bottom of the sea star. Then, Mrs. Baker turned the sea star back over. "See this circle on top? That is where water enters to help it move."

Norman grabbed a book from the shelf about sea stars and started to search for margined sea stars. "This also says that margined sea stars are one of the fastest types of sea stars!" he exclaimed.

"Impressive research skills, Norman," Mrs. Baker noted. "Using books as a resource is helpful, isn't it?" All three students nodded.

Anthony turned to see that his other classmates were looking at pull-out drawers with the help of a museum volunteer. Anthony decided to join them. To his delight, the box was full of information on sharks and it also included shark teeth.

"I get to touch the teeth?" Anthony asked.

"You certainly do," the museum staff member replied.

Anthony felt excitement as he reached for the megalodon tooth. He was thrilled to touch

Continued

- Above: *Visitors to the Naturalist Center use the magic table to learn more about the barred owl.*
- Right: *Barred owls are found in forests near water bodies throughout the state.*

something that belonged to such a powerful creature. It was smooth, but rough in some areas. The museum volunteer told him that was because the tooth was fossilized and it was millions of years old.

"What does fossilized mean?" Norman asked as he joined them.

"Fossilization occurs when something is covered in sediment for years. A tooth that fell to the ocean floor could have become covered by sediments and deprived of oxygen. Over a long period of time, minerals from the sediment eventually replaced the minerals in the teeth," the volunteer explained.

"That's awesome!" Norman replied with enthusiasm.

"Fossils of megalodon teeth are often found in fossil deposits in eastern North Carolina because the land was under water when the megalodon lived," the volunteer added. "And divers also find them off our coast."

Anthony imagined finding a megalodon tooth of his own.

"Time for lunch!" Mrs. Baker interjected.

"Good. I could eat as much as a megalodon," Norman added.

NATURALIST CENTER

After lunch, it was time to leave the main part of the museum. The class walked over to the Nature Research Center.

The class traveled to the second floor and entered the Naturalist Center. Once the students had watched a short video on how to take care of specimens in the room, Anthony was ready to look around.

A volunteer helped him with what was called a "magic table," which was a touchscreen that showed pictures and descriptions of the animals.

"You can choose any animal with a tag," the volunteer told him.

Anthony chose what he considered the most beautiful animal he had ever seen. The tag on its talon read **barred owl**. He carefully lifted it from the shelf. He couldn't believe how soft it felt. The volunteer helped Anthony place the owl on the magic table.

The rest of Anthony's classmates and Mrs. Baker gathered around the magic table. Together, the class went through slides of information on the barred owl. Anthony learned that it could prey on animals as big as rabbits.

"It got its name from the bar-like feather pattern on its chest. It is what distinguishes it from other owls in North Carolina," the volunteer said.

"It's gorgeous," Maria stated.

Brandon, a museum curator, joined the group. "The sounds the barred owl makes are just as distinctive as their markings," he noted.

Anthony pressed the button for the next slide on the magic table and everyone heard the famous and distinctive "hoo-hoo-to-hoo-oo, hoo-hoo to wha-aa" of the barred owl.

"Some people say the hoot sounds like the owl is crying 'Who cooks for you? Who cooks for you all?' " Mrs. Baker added.

Anthony and his classmates listened with enthusiasm. They even mimicked the call.

"I've heard that sound before!" Norman exclaimed. "It came from the forest near my friend's house. He lives at the coast."

Maria pointed to the magic table and read from the display. "It says here that barred owls live in forests near bodies of water," she stated.

"Good observation and research skills Norman and Maria," Mrs. Baker said.

After, Brandon helped Anthony place the barred owl back on its shelf.

"Time to visit the museum store." Mrs. Baker said.

In the store, Anthony went straight to the book section, hoping to find a book on coastal animals and plants.

One day he would get the chance to visit the coast. Until then, Anthony intended to learn more about that fascinating place.

For more information on the North Carolina Museum of Natural Sciences and its Nature Research Center, visit: naturalsciences.org.

Find out more about North Carolina's coastal animals and plants from North Carolina's Amazing Coast, *which will be published in 2013.*

The Jones Awards for Excellence in Coastal and Marine Graduate Study recognize graduate students whose research "promises to contribute materially to the development of new or improved approaches to coastal or ocean management."

Awarding North Carolina Innovation

BY SHARON SETTLAGE

SIX NORTH CAROLINA GRADUATE STUDENTS ARE AMONG THE WINNERS OF THE 2012 WALTER B. JONES SR. AWARDS, ISSUED BY THE NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION. The Jones Awards for Excellence in Coastal and Marine Graduate Study recognize graduate students whose research "promises to contribute materially to the development of new or improved approaches to coastal or ocean management."

The Town of Plymouth also is among the winners of a 2012 Jones Award for Coastal and Ocean Resource Management. Plymouth was selected for excellence in local government, along with communities from Florida, California and Oregon.

The awards, presented every other year, honor "the people and organizations of America for their dedication and outstanding contributions in helping the nation maintain healthy coastal and ocean resources and balance the needs of these resources with human use."

• **1.** *Michelle Covi* • **2.** *Covi is outreach coordinator for RENCI.* • **3.** *Michelle Brodeur* • **4.** *Brodeur samples algae on an oyster reef.* • **5.** *Jennifer Cudney-Burch examines spiny dogfish.* • **6.** *Jennifer Cudney-Burch*

The national awards are named for Walter B. Jones, Sr., who represented North Carolina in the U.S. House of Representatives from 1966 to 1992.

STUDENT ACHIEVERS

Ten graduate student awards are given nationally every other year. North Carolina Sea Grant provided research funding for four of the six North Carolina winners in 2012. Also, three of the graduate students are doing research within N.C. National Estuarine Research Reserve sites.

"The high number of North Carolina graduate students among the winners speaks to the excellent quality of marine and coastal research being conducted in our state, as well as to the caliber of the students themselves," says Chris Brown, vice president for research

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and graduate education for the University of North Carolina System.

• **Michelle Brodeur** is a doctoral student with Joel Fodrie in the Coastal Fisheries Oceanography and Ecology laboratory at the University of North Carolina at Chapel Hill's Institute of Marine Sciences, or IMS. Previously a Sea Grant/N.C. National Estuarine Research Reserve fellow, she recently became a NOAA/NERRS fellow. Her research focuses on management of oyster reefs and how climate change will interact with stressors, such as eutrophication and nuisance algae. Brodeur's work on the effect of algal mats on intertidal oysters in the Rachel Carson Reserve site was featured in the Summer 2011 issue of *Coastwatch*. "Michelle has become an industry unto herself," Fodrie says, citing her expertise in the oyster reef ecosystem consisting of macroalgae, fishes and other animals.

"I really enjoy teaching the public about the habitats found in their backyards and hope to make my research — focusing on the processes that control where oyster reefs are found in the intertidal areas — accessible to the residents of North Carolina."

— Michelle Brodeur

• **Michelle Covi** is a doctoral candidate with Jennifer Brewer in the Coastal Resources Management program at East Carolina University. Covi also is outreach coordinator for the Renaissance Computing Institute's East Carolina University Engagement Center, or RENCI at ECU. She is working with Donna Kain of the Technical and Professional Communications program at ECU on a Sea Grant-funded project evaluating risk communication and perception of sea-level rise in northeastern North Carolina. She also worked with a Sea Grant team that collaborated with Plymouth leaders to establish a strategy for addressing recurring flooding problems in the town. For her doctoral research, she is studying sea-level rise risk perception, communication and policy making in North Carolina. She is cited for her abilities to relate to local residents and use advanced techniques to analyze interview data. Covi authored an article for the Spring 2012 issue of *Coastwatch* on the Town of Plymouth and another article in this issue on hurricane risk communication.

"This work would not be possible without the support of Sea Grant, the ECU Coastal Resources Management program, RENCI at ECU and my mentors. I am pleased that our work engaging with the rural communities in our region to prepare for sea-level rise has received this recognition."

— Michelle Covi

• **Jennifer Cudney-Burch** is a doctoral student with Roger Rulifson at the Institute for Coastal Science and Policy at ECU. She was previously a National Sea Grant Knauss Fellow in the Highly Migratory Species Management Division of NOAA's National Marine Fisheries Service. As a Knauss Fellow, she made a valuable connection between fishermen and policy makers. Her dissertation research addresses spiny dogfish management along the U.S. East Coast and Canada. Funded by the N.C. Fishery Resource Grant Program, Cudney-Burch's study of spiny dogfish migration resulted in a new paradigm in spiny dogfish management plans being recognized at national and international levels. An article in the Summer 2010 issue of *Coastwatch* highlighted her use of acoustics to track fish movement.

1. *Timothy Ellis* • **2.** *Ellis tags a spotted seatrout.* • **3.** *Rachel Gittman* • **4.** *Gittman measures the effectiveness of marsh sills.* • **5.** *Matthew McCarthy* • **6.** *McCarthy measures topography on Masonboro Island.* • **7.** *Brian Roth is mayor of Plymouth.* • **8.** *Plymouth is home to many tranquil scenes.*

"I am researching the migration and movement patterns of spiny dogfish in collaboration with the North Carolina Outer Banks fishing community. I think that working with the commercial fishermen was probably the best and most educational part of my graduate education to date."

— Jennifer Cudney-Burch

• **Timothy Ellis** is a doctoral student with Jeffrey Buckel and Joseph Hightower in North Carolina State University's Fisheries, Wildlife and Conservation Biology program. His research, funded initially by FRG and later by the N.C. Coastal Recreational Fishing License Program, or CRFL, has resulted in significant contributions to the management of spotted sea trout. He is a scientific advisor on the N.C. Marine Fisheries Commission's fisheries management plan advisory committee for spotted seatrout. His research was featured in the Spring 2009 issue of *Coastwatch*, in articles in *The News & Observer* of Raleigh and several other publications. Ellis was previously an N.C. Division of Marine Fisheries/Sea Grant fellow with Buckel. He is cited for his outreach to the fishing community and state management agencies.


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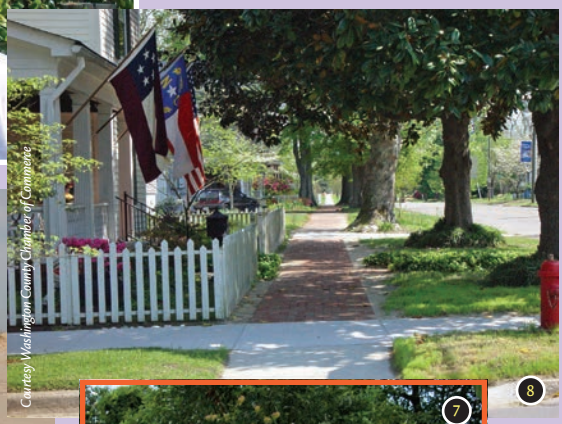
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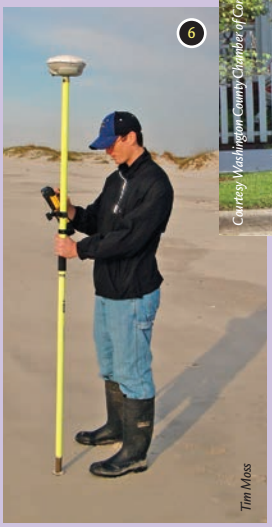

6
Tim Moss


7
Mary Anne Byers

"Being able to study difficult questions about a popular and important fishery in our state has been a very rewarding experience for me. It's nice to be recognized for my efforts and I hope this award signifies that I've been doing the right thing."

— Timothy Ellis

• **Rachel Gittman** is a doctoral student with Charles Peterson and John Bruno in the Curriculum for the Environment and Ecology of UNC's IMS. She has a NOAA/NERRS Graduate Research Fellowship to assess the ecological effects of shoreline stabilization on coastal resources, communities and habitats. Her work also is funded through a CRFL grant. Gittman is cited for her poise in environmental agency working groups and stakeholder meetings with citizens. Her work is helping advance the goals of the Coastal Zone Management Act by providing federal and state agencies with valuable data. Gittman was recently featured in an N.C. Coastal Federation article on the use of oyster shells as marsh sills.

I am evaluating the ability of alternative shoreline-stabilization techniques to maintain and enhance habitats. Shoreline stabilization using bulkheads and seawalls can degrade coastal habitats. Therefore, a better understanding of the success of other methods, such as marsh sills, is critical."

— Rachel Gittman

• **Matthew McCarthy** is pursuing a master's of marine science with Joanne Halls, director of the Spatial Analysis lab in the Department of Geography and Geology at the University of North Carolina Wilmington. His research involves evaluation of new satellite imagery products and their usefulness for assessing habitat change in the coastal habitats of Masonboro Island, which is part of the N.C. National Estuarine Research Reserve. McCarthy won the 2011 G. Herbert Stout Award for the most innovative student paper from the N.C. GIS Conference and also the Hydrographic Society of America's national 2012–13 scholarship. He is cited for undertaking a variety of new techniques that will result in a better understanding of the measurement of barrier island dynamics.

"I am excited that my results may improve and streamline future coastal habitat mapping efforts. I hope that the new methods will be adopted by coastal management organizations to better monitor our coasts with greater frequency and lower costs."

— Matthew McCarthy

THE TOWN OF PLYMOUTH

Sea Grant nominated Plymouth for its efforts to identify opportunities for economic growth while maintaining the environmental quality and diversity in the Lower Roanoke River Basin, which has been called the state's environmental "crown jewel."

"This is an incredible honor and recognition of our vision and journey in Plymouth. It reflects the enduring dedication and hard work of many great citizen volunteers, several outstanding community organizations and the leadership of our town officials," Mayor Brian Roth notes.

Roth adds that the town is blessed with an amazing river delta teaming with wildlife and spectacular beauty. "It is our responsibility to be the best stewards we can be of this great gift, while continuing to promote our local businesses and our community," he says.

The leaders of Plymouth seek to maintain the health of — and everyone's ability to appreciate — the Roanoke River. Citizens and visitors enjoy the walkable historic and business district, a kayak-launch point, and a series of camping areas. Plymouth is an integral part of North Carolina's birding and paddling trails, and hosts fishing tournaments and boat races.

The town also participated in the 2010 National Sea Grant Coastal Communities Climate Adaptation Initiative, part of a $1.2 million national program to help communities cope with short- and long-term impacts, from tropical storms to sea-level issues. Town leaders worked with Sea Grant extension specialists and researchers at RENCI to develop maps that predict areas prone to flooding.

"Plymouth is considered a national leader. Other communities are learning from Plymouth's efforts to identify immediate needs, survive storms and significant hurricanes, and be prepared into the future," Michael Voiland, Sea Grant executive director, comments.

The town's plan to cope with water rise was featured in the Spring 2012 issue of *Coastwatch*. □

See the full list of Jones Awards winners at: oceanservice.noaa.gov/programs/ocrm/jones-noaa-awards.html.

Read Facing the Future in Plymouth, NC: Preparing for Increased Flood Risks, *at:* ncseagrant.org/s/plymouth-rep.

Watch the Sea Grant online calendar at: www.ncseagrant.org *for an event to celebrate North Carolina's Jones Awards winners.*

Left to right: *N.C. Division of Marine Fisheries will reprise its popular clam-shucking demonstrations.* ∘ *Crab cake samples are ready for judging in the 2011 People's Choice competition.* ∘ *Audience judges*

Fish Ashore

SEAFOOD LOVERS, MAKE PLANS FOR A FUN WEEKEND AT THE COAST! The 26th Annual North Carolina Seafood Festival kicks off on Friday, Oct. 5, and continues through Sunday, Oct. 7, at the Morehead City Waterfront. The free festival offers seafood, live music and entertainment for the entire family. For more information and a schedule of events, visit: *www.ncseafoodfestival.org.*

This autumn, *Coastwatch* brings ashore an array of recipes from Joyce Taylor's *Mariner's Menu: 30 Years of Fresh Seafood Ideas*. We offer seafood-stuffed avocados, oysters and mushrooms, and a simply prepared tuna. These mouthwatering meals can be complimented with a warm loaf of bread and a seasonal salad.

Quality counts when preparing these dishes, so be sure to use fresh seafood from North Carolina's waters. For more information on selecting fish and shellfish, go to: *www.ncseagrant.org/seafood* or check the *Mariner's Menu* blog at: *marinersmenu.org.* The *Mariner's Menu* seafood resource book is available in bookstores. To order a copy from North Carolina Sea Grant, call 919/515-9101.

—V.L.

SEAFOOD-STUFFED AVOCADOS

- 1/2 pound backfin crabmeat
- 1/2 pound cooked small shrimp, peeled and deveined
- 3 tablespoons mayonnaise
- 3 tablespoons sour cream
- 1/4 teaspoon salt
- 1/4 teaspoon freshly ground white pepper
- 3 avocados, chilled
- paprika
- lettuce leaves

Carefully remove any shell or cartilage from crabmeat. In medium bowl, lightly toss crabmeat and shrimp. In small bowl, combine mayonnaise, sour cream, salt and pepper. Add to crab and shrimp. Mix gently but thoroughly. Chill for several hours.

When ready to serve, peel avocados and cut in half lengthwise. Pile centers with salad. Sprinkle with paprika. Place on lettuce leaves. Serves 6.

GRILLED TUNA WITH LIME BUTTER

- 4 tuna steaks, about 1 inch thick
- 1/4 cup vegetable oil
- salt
- freshly ground black pepper

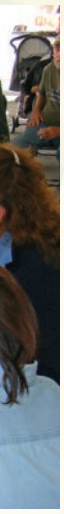
Prepare Lime Butter and set aside.

Brush steaks with oil on both sides. Sprinkle with salt and pepper. Grill about 4 inches from coals until done on one side, about 6 to 7 minutes. Turn and repeat on other side. Spread with Lime Butter. Serves 4.

Lime Butter:

- 3/4 cup margarine or butter, softened
- 3 tablespoons fresh lime juice
- 3 teaspoons lime zest

In small bowl, combine margarine, juice and lime zest. Set aside for flavors to blend. Serve over cooked steaks.



taste the finalists' crab cakes in last year's contest. • Chefs prepare dishes using local seafood and produce. • A plated course is ready for prime time. • Volunteers prepare samples for audience members.

OYSTERS AND MUSHROOMS AU GRATIN

- 1 pint standard oysters, liquor reserved
- 2 tablespoons margarine or butter
- 5 tablespoons flour
- 1/2 cup heavy cream
- 3/4 teaspoon salt
- 1/8 teaspoon paprika
- 1/4 teaspoon dry mustard
- 1/8 teaspoon freshly ground black pepper
- 1 cup sliced fresh mushrooms, sautéed in margarine or butter, drained
- 1 teaspoon fresh lemon juice
- 1 teaspoon Worcestershire sauce
- 1/2 cup fresh bread crumbs
- paprika

Drain and dry oysters. Melt margarine in medium saucepan over medium heat. Add flour and stir until blended. Slowly stir in 1/2 cup oyster liquor and cream. Add salt, paprika, mustard and pepper. Cook, stirring, until mixture comes to a boil and thickens. Reduce heat and add cooked mushrooms, lemon juice, Worcestershire and oysters. Heat, stirring until edges of oysters begin to curl, but do not boil. Place in 6 individual shells or ramekins. Sprinkle with bread crumbs and paprika.

Broil about 4 inches from heat until lightly browned, about 5 to 8 minutes. Serves 6.

Local Seafood Showcase Set for October

Cooking with the Chefs: A North Carolina Experience is back to tutor and tease taste buds at the Morehead City Waterfront. This program is part of the N.C. Seafood Festival, which runs from Oct. 5 to 7.

"The chefs program highlights commercial fishermen, local seafood and the coastal restaurants that serve North Carolina seafood to the public," says Barry Nash, North Carolina Sea Grant seafood technology and marketing specialist.

On Saturday, Oct. 6, watch area chefs prepare fresh, local seafood. On Sunday, Oct. 7, audience members can judge the second annual chef competition. The four local catch groups — Brunswick Catch, Carteret Catch, Ocracoke Fresh and Outer Banks Catch — will be represented.

"Cooking with the Chefs, which is entering its fifth year, has won two international awards within the past four years — one for Best Event and one for Best Educational Program — making it one of the Seafood Festival's top attractions," Nash adds. Sea Grant is a co-sponsor of this event.

In Sunday's "People's Choice" competition, area chefs will compete to prepare shrimp and grits. The contest is sponsored by the Seafood Festival and the N.C. Department of Agriculture and Consumer Services.

For more information, visit: *www.ncseafoodfestival.org.* — E.L.

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RALEIGH HOSTS #SCIWRI12

SCIENCEWRITERS2012

Science writers from around the nation and beyond will converge in North Carolina this fall. Headquartered in Raleigh, Science Writers 2012 will include events around the state, from Beaufort to Kannapolis.

The event, from Oct. 26 to 31, combines two meetings that draw reporters, producers, book authors, bloggers, multimedia experts and public information officers. The National Association of Science Writers will offer professional development sessions. The Council for the Advancement of Science Writing will host its New Horizons in Science briefings.

The Science Communicators of North Carolina are coordinating the hosting. Sponsors include North Carolina State University, the University of North Carolina at Chapel Hill and Duke University, along with other campuses, federal labs and independent research organizations. North Carolina Sea Grant, an early sponsor of the meeting, is coordinating the coastal field trip that is expected to fill quickly.

Rosalind Reid leads the CASW briefings. "When I began talking with local scientists, I found that many of them were delighted to be working in a collaborative environment that so celebrates science," she wrote recently.

"I was also struck by their determination to make their work useful to people. North Carolina is working hard to turn its research into products, technologies and jobs, and so you'll see much applied science on the New Horizons program," adds Reid, now at Harvard University and known in North Carolina for previous positions with NC State and Sigma Xi.

Students interested in volunteering for the any of the events should check the website, which also includes registration details, at: www.sciencewriters2012.org. Follow plans and the event on Twitter via #sciwri12.

— K.M.

SUBSCRIBE • Request *Coastwatch* or send it to a friend.

One year for $15, two years for $28 and three years for $42. Send checks to *Coastwatch*, North Carolina Sea Grant, NC State University, Box 8605, Raleigh, NC 27695-8605. Educators receive a discounted rate of $10 for the first year. For more information, call 919/515-9101 or email: *sandra_harris@ncsu.edu*.

DONATE • Make a contribution to the North Carolina Sea Grant Program Enhancement Fund.

Donations will go directly toward Sea Grant's capacity to offer educational outreach programs that address critical issues and opportunities along the state's shoreline. Make checks payable to "NC State Foundation" with North Carolina Sea Grant in the memo field. Send to: North Carolina Sea Grant, NC State University, Box 8605, Raleigh, NC 27695-8605. All donations to the fund are tax deductible as allowable by law.

CONNECT • Keep up with North Carolina Sea Grant.

Visit: *www.ncseagrant.org* for news and upcoming events. Become a "fan" at: *www.facebookcom/ncseagrant*. Read *Coastwatch* stories at: *www.nccoastwatch.org*. On Twitter, follow *@ncsg_katiem*.

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