




Sea Grant
S.C. Sea Grant Consortium
Science Serving
South Carolina's Coast

biennial report 2004-2006

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ON THE COVER: The northeast tip of Folly Island, S.C., at sunrise.
PHOTO/Wade Spees
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message from the director

n behalf of the S.C. Sea Grant Consortium's Board of Directors and staff, I am pleased to be able to share the results of the agency's programs and activities for the period 2004-2006.

Although South Carolina has one of the smallest populations in the country, its coastal region is experiencing unprecedented growth. People are attracted to the economic, recreational, and retirement opportunities the state's coastal and marine resources provide. But this growth is placing enormous pressures on our watersheds and estuaries, infrastructure, and quality of life. We still have opportunities based on sound science to minimize the anticipated impacts of this rapid growth. However, much of the scientific knowledge needed to make informed decisions must be generated and disseminated to those who will be making critical decisions affecting our future.

Since 1980, the S.C. Sea Grant Consortium has instituted a range of initiatives to improve our understanding of South Carolina's coastal and marine resources and our ability to manage them for long-term economic growth. The Consortium's research, education, extension, and communications program activities link government, industry, academia, coastal users, and the public together in a

mutual pursuit of a sustainable economy for South Carolina and an improved quality of life for South Carolinians and visitors. A state and regional leader in coastal and marine issues, the Consortium is a catalyst for action, working cooperatively with many other agencies and organizations.

The S.C. Sea Grant Consortium was created by the S.C. General Assembly as an independent, university-based state agency, which now consists of The Citadel, Clemson University, Coastal Carolina University, College of Charleston, Medical University of South Carolina, S.C. Department of Natural Resources, S.C. State University, and University of South Carolina. As a partnership of research institutions, the Consortium plays a unique role by supporting, consolidating, and strengthening the work of those involved with coastal and ocean issues in the state.

We hope you enjoy reading about the Consortium's programs and activities. If you have any questions or would like further information, please feel free to contact me at (843) 953-2078 or rick.devoe@scseagrant.org.



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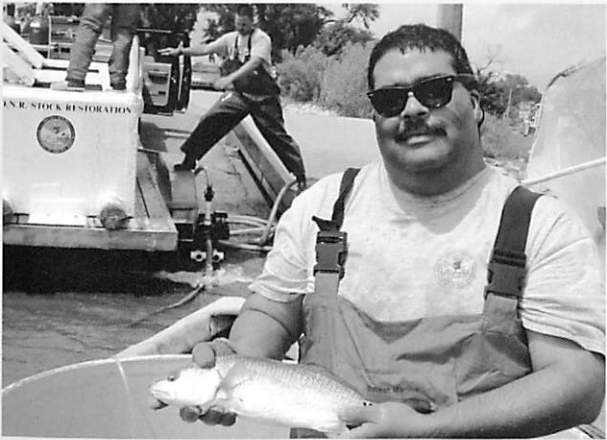
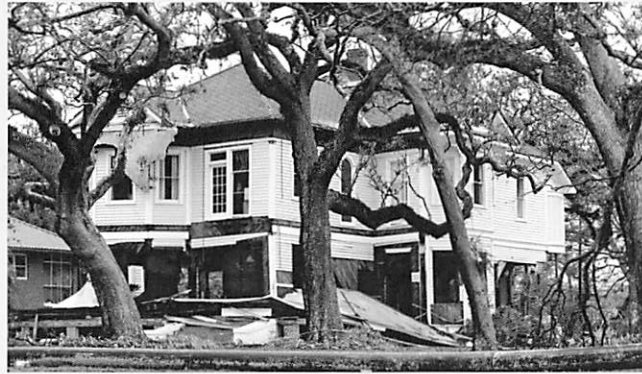
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• coastal ocean processes • coastal natural hazards • ecosystem dynamics • coastal growth and ecosystem effects •



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The Coastal Erosion Study

Beach erosion often seems mysterious. Why does a beach erode in one location while accreting—growing out—just a short distance down the shoreline? Because ocean waves—particularly their direction and intensity—can make all the difference. Waves frequently determine whether or not a beach is eroding or accreting.

S.C. Sea Grant Consortium scientist George Voulgaris of the University of South Carolina (USC) and his colleagues have been learning more about the processes that control sand movement on selected beaches in South Carolina.

The researchers are using computer models to simulate the waves, currents, and other coastal processes that shape the locations and amount of sand resources along the continental shelf. Once scientists develop the computer models to accurately portray physical conditions along the coast, then they can better predict erosion and other processes, and the potential sand sources for beach nourishment.

“Even the casual observer can see that sediment moves on the beach,” says Voulgaris, a physical oceanographer/geologist. “The numerical model work currently underway aims at understanding exactly when and under what combinations of waves and currents the sediment moves, plus the direction and quantities of the sediment that are transported. Only when we have this information will we be able to predict the location and rate of erosion or accretion along the coastline.”

Voulgaris' study is part of the South Carolina Coastal Erosion Study, which began in 1994, and is



a cooperative effort of the S.C. Sea Grant Consortium and the U.S. Geological Survey. Project information can be viewed at the Web site www.camelot.coastal.edu.

“The Coastal Erosion Study examines how the coast works as part of a larger system,” says Paul Gayes, director of the Burroughs and Chapin Center for Marine and Wetland Studies at Coastal Carolina University. “The study is a regional, comprehensive assessment on various time scales that helps explain how the coastal system has evolved.”

Rising sea level over thousands of years drowned South Carolina's ancient river valleys and beaches, locking potentially valuable sources of sediment, including beach-quality sand, under water.

Now, scientists are identifying where these ancient channels and beaches are located on the inner continental shelf from the North Carolina state line to

Winyah Bay. Finding ancient river valleys could make it easier and less expensive to locate high-quality sand, which could be used to nourish some of South Carolina's eroding beaches.

“Along much of the Grand Strand, we're starved for sediment,” says Gayes.

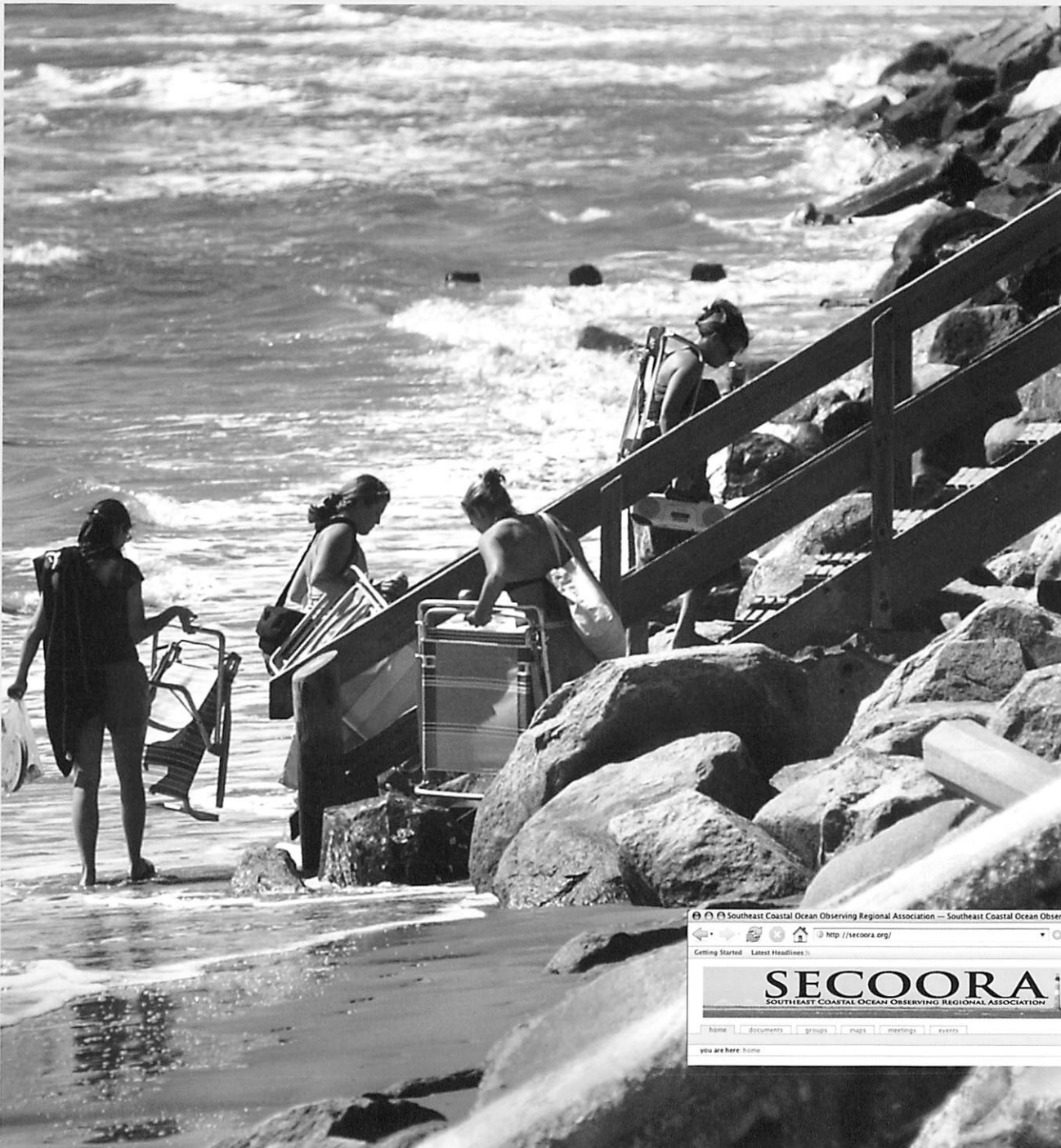
The study's first phase, completed in 1999, focused on a preliminary surveillance of the mid-section of coastal South Carolina.

The second phase, begun in 2000, involved studies of the northern portion of the South Carolina coast, examining the behavior of the beach environment in short- and long-time periods.

Using geophysical surveys and repeated beach profiles, and developing and applying innovative technologies such as high-resolution sonar imagery, the scientific team is aiming to establish a “sand budget” for the coastal region.

Scientists involved in the project represent Coastal Carolina University, College of Charleston, Clemson University, University of South Carolina, Skidaway Institute of Oceanography, Georgia Southern University, Scripps Institute of Oceanography, and State University of West Georgia.

Additional institutional partners include the U.S. Geological Survey, S.C. Department of Health and Environmental Control-Office of Ocean and Coastal Resource Management, Mineral Management Services of the U.S. Department of the Interior, Offices of the State Geologist in South Carolina and Georgia, S.C. Department of Natural Resources Marine Resources Division, and Georgia Department of Natural Resources.



OPPOSITE: Scientists deploy an instrument to measure water flow and sediment transport near the seabed. PHOTO/University of South Carolina ABOVE: Erosion hotspots, like this one before renourishment on Folly Beach, remain a problem for beachgoers. PHOTO/Wade Spees

Group to continue coordinating ocean observations in the Southeast

Scientists are tapping into meteorological and oceanographic information gathered and integrated in new ways from the Southeast Atlantic coastal ocean. Using instruments on moored buoys, platforms, drifters, and onshore radar systems, scientists are partnering to collect and examine data from across the region.

The S.C. Sea Grant Consortium was awarded \$1.14 million over three years from the NOAA Coastal Services Center to expand its efforts in coordinating the development of the Southeast Coastal Ocean Observing Regional Association (SECOORA).

SECOORA's scope is the coastal and ocean environment from North Carolina through Florida. It is one of 11 regional associations spanning the country established to organize regional effort in support of the U.S. Integrated Ocean Observing System (IOOS).

Through a network of observations, IOOS systematically acquires and disseminates data and information on the past, present, and future status of the oceans and U.S. coastal waters. More information can be found at www.secoora.org and www.ocean.us.



Study saves resource agencies and communities money

Localities and government agencies are relying on Coastal Erosion Study data to save money on crucial infrastructure projects that protect public health and stabilize beaches.

The Beach Erosion and Resource Monitoring (BERM) Program is a component of the Consortium's Coastal Erosion Study, and was funded by the U.S. Geological Survey's Coastal and Marine Geology Program and the S.C. Department of Environmental Control-Office of Ocean and Coastal Resource Management (SCDHEC-OCRM). The BERM Program measures beach "profiles" at 400 sites along the South Carolina coast to determine the nature of and rate at which the shoreline is changing. BERM data provide yearly surveys of shoreline and shelf cross-sections.

These profiles help scientists and public officials understand the historical changes across the entire beach system, capturing conditions at various points in time.

BERM is the primary source of information used by SCDHEC-OCRM to generate its annual "State of the Beaches" report to the citizens of South Carolina.

The City of North Myrtle Beach, moreover, has used BERM data to find the best locations to install stormwater pipelines and outfalls along its coastline.

Kevin Blayton, public-works director for North Myrtle Beach, has used BERM data to understand where to locate stormwater outfalls offshore.



These outfalls must be located far enough from land, in relatively stable environments, so that discharges would not circulate back onto the beach and affect water quality. In the past, the city would have hired a design consultant and surveyors to profile the ocean floor and the beach at a cost of about \$50,000 for each outfall location.

Instead, Blayton and his staff downloaded BERM data from the Coastal Erosion Study's Web site at

Coastal Carolina University. BERM data indicated suitable locations offshore for outfalls. North Myrtle Beach today discharges stormwater via buried pipelines to outflow locations 1,250 feet to 1,400 feet seaward from mean high water. The city has already built four outfalls and plans to build seven or eight more in other coastal locations, in each case relying on BERM data, according to Blayton. The city's total savings is expected to be \$550,000 to \$600,000.

North Myrtle Beach also uses BERM data to help comply with monitoring of beach-nourishment projects. This information allows Blayton and his staff to generate its own beach profiles, which are required by the city every year under a U.S. Army Corps of Engineers beach-nourishment project maintenance agreement.

To meet its contract obligation as the project sponsor, the city must assess the beach's condition and generate a maintenance report. Now city engineers can create this report in-house rather than hire consultants, which saves the city \$100,000 to \$125,000 a year, according to Blayton. The City of Myrtle Beach and Horry County (for Arcadia Shores and Surfside Beach/Garden City) similarly use BERM data to generate annual maintenance reports for nourishment projects.

In fact, every major beach nourishment project in South Carolina over the past 10 years has depended on BERM data and other Coastal Erosion Study information. Major federal, state, and private nourishment projects include those at North Myrtle Beach, Myrtle Beach, Garden City/Surfside Beach, Huntington Beach State Park, Pawley's Island, DeBordieu Island, Folly Beach, and Hunting Island.



OPPOSITE, UPPER LEFT: S.C. Sea Grant researchers set up instruments for a geographic-positioning system beach-erosion survey. PHOTO/Coastal Carolina University OPPOSITE, LOWER LEFT: Decades ago, groins—hard structures perpendicular to the shoreline—were built in an effort to control erosion. But groins can starve sand from downdrift beaches. Now communities prefer to use beach nourishment in their attempts to control erosion. PHOTO/Wade Spees ABOVE: This tripod is outfitted with underwater computers and battery packs, which control acoustic instruments used to measure water flow and sediment processes near the ocean floor. PHOTO/University of South Carolina

coastal natural hazards

Coastal/Inland Flood Observation and Warning (CI-FLOW) project

The S.C. Sea Grant Consortium and its partners, the National Sea Grant Office, North Carolina Sea Grant, the NOAA National Weather Service, and the NOAA National Severe Storms Laboratory are leading a regional project, CI-FLOW (Coastal/Inland Flood Observation and Warning), to pilot a new flood detection and monitoring system. Test results are being used in conjunction with National Weather Service flood tools to improve flash flood detection and warning capabilities.

CI-FLOW is also being integrated by N.C. State University researchers into a storm-surge model to provide more accurate inputs from riverine flooding, and is being shared with Sea Grant programs in the Gulf of Mexico for flood applications there. For more information, go to www.nssl.noaa.gov/projects/ciflow.

HazNet web site and Hurricane Katrina portal

In 2005, in the immediate aftermath of hurricanes Katrina and Rita, the S.C. Sea Grant Consortium and the Sea Grant network responded to the needs of the affected communities by creating a Katrina/Rita web portal on the Sea Grant Hazards Theme Team Web site HazNet (www.haznet.org). Since these 2005 hurricanes, the HazNet Web site has been accessed by more than 60,000 individuals and has recorded more than 250,000 hits.



Measuring impacts of hurricane winds on coastal homes

How powerfully would a major hurricane's winds strike your home near the coast—or homes like yours?

Scientists can't say for certain, because there have been few directly measured data on wind speeds and forces at ground level. Even when wind speed data are available, they've been limited to occasional estimates of gusts and sustained wind speeds gathered somewhere far away from affected buildings.

Now this is changing. Building on long-term studies, Sea Grant scientists from South Carolina and Florida instrumented 44 southeastern coastal homes with special wind-pressure and wind-speed devices, including four in South Carolina.

Six instrumented homes in Florida were hit by the hurricanes during the 2004 season. For the first time, researchers were able to collect full-scale wind-load data for houses struck by hurricanes.

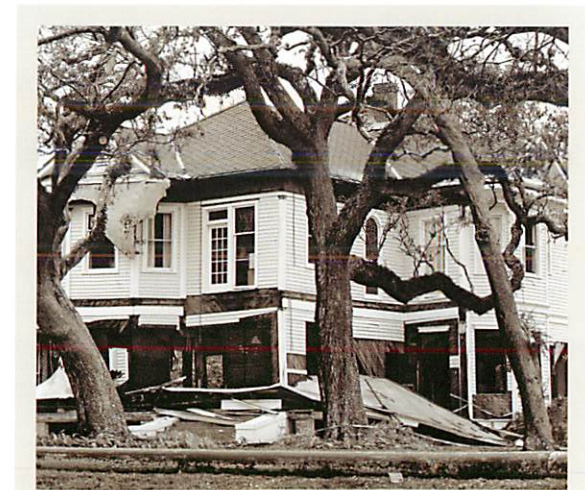
With these measurements, engineers can correlate hurricane winds during particular storms and the damage to specific buildings and types of construction. Moreover, this information can be used in evaluating wind-tunnel simulations.

S.C. Sea Grant Consortium researcher David O. Prevatt, a Clemson University engineer, and his students have built 1:50 scale models of single-family homes at the university's Wind Load Test Facility.

The researchers instrumented the models to measure the distribution of wind-induced roof pressures. The researchers then compared the roof pressures from the six Florida houses hit by 2004 hurricanes with the results of 1:50 scale models tested in the wind tunnel.

At the Wind Load Test Facility, researchers are also comparing wind pressures on various kinds of architectural features and roof shapes, learning more about which ones are less likely to be damaged by hurricanes.

Results benefit homeowners, developers, and builders by providing information that could result in more reliable roof structural designs. Information also benefits the insurance industry as it evaluates the adequacy of current building code provisions and construction practices in new and retrofitted homes. More information can be found at www.clemson.edu/ce/research.





*OPPOSITE: This home, 200 yards from the Mississippi coast, survived Katrina's storm surge because its first occupied floor was raised, preserving the elevated living area. PHOTO/Wade Spees
ABOVE: New Orleans native and preservationist Stephanie Bruno inspects a house that Hurricane Katrina knocked off its foundation. PHOTO/Wade Spees*

Terrapins are sensitive markers for mercury

Diamondback terrapin turtles (*Malaclemys terrapin*) provide an accurate measuring stick for mercury concentrations in coastal waters.

S.C. Sea Grant Consortium researcher David Owens of the College of Charleston and his colleagues have recently tested total mercury levels in diamondback terrapins from South Carolina waters and one location in Georgia.

The study shows that “diamondback terrapins could be used as a suitable sentinel species for assessing mercury contamination of estuarine systems,” writes lead author Gaëlle Blanvillain, a research associate at the College of Charleston Grice Marine Laboratory, in a research article published in the journal *Environmental Toxicology and Chemistry*.

Blanvillain is collaborating with Owens and colleagues at the National Institute of Standards and Technology and the S.C. Department of Natural Resources.

This study could be just the first of many to examine the terrapins as sentinels of environmental contaminants. “A lot of other scientists are asking about the terrapins and our study,” says Owens. “Now they want to look for other contaminants in the terrapins.”

The diamondback terrapin is a “real homebody,” an attribute that helps make the animal an effective

indicator, says Owens. “We’ve been looking for a higher vertebrate that’s indicative of its habitat, and this animal stays in one place. We can be fairly certain that if we take one out of the Ashley River, for example, that it’s been living there for years.”

With populations stretching from Texas to Massachusetts, diamondback terrapins produce an external keratin layer in their scutes. Scutes, a part of the terrapin’s shell, are similar to a human fingernail in chemical composition. Mercury levels in the scutes signal a terrapin’s exposure to mercury.

In a collaborative effort between the natural resources departments of South Carolina and Georgia, blood and keratin samples were collected from male and female terrapins located



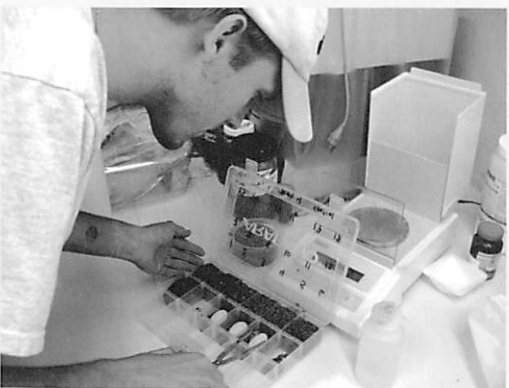
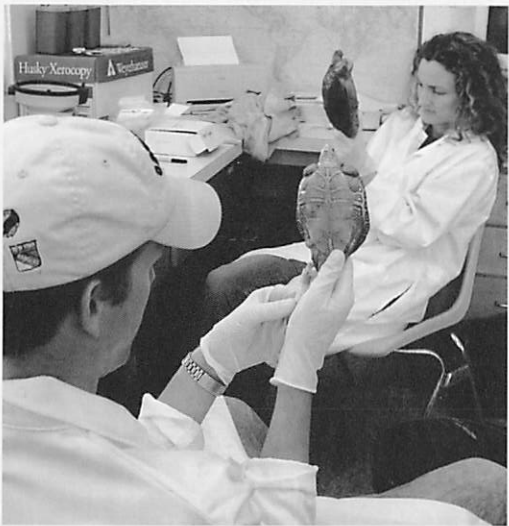
at five sites along their respective coasts. These sites were designated specifically for their proximity to known mercury sources such as fossil-fuel-generating plants and paper and steel mills.

Owens and his team have been developing techniques to accurately estimate the bio-accumulation levels of mercury in diamondback terrapins.

Past studies have shown that the amount of mercury found within a terrapin’s blood and keratin could be used to reconstruct a history of the animal’s mercury exposure. Mercury found within blood represents a recent uptake of mercury over a period of a few days. By contrast, mercury deposition within the keratin of scutes represents exposure within the past few weeks to months.

The researchers are determining the amount of mercury that terrapins accumulate at various sites and during different times of the year, how mercury moves throughout the animal’s body, and if a non-lethal form of testing is an accurate reflection of mercury exposure. The scientists also want to understand mercury’s physiological impacts—the behavioral and reproductive impacts of mercury exposure on terrapins.

The levels of mercury found in South Carolina terrapins are not unusually high, Owens’ research shows. But the larger females do have significantly higher levels than the males. Perhaps this is because females prey on larger periwinkle snails (*Littoraria irrorata*) than males do, and larger periwinkles have significantly higher mercury levels.



Scientists capture terrapins from the estuary (upper left), draw blood samples from the reptiles (center left), and test the samples (lower left) for total mercury levels. Principal investigator David Owens and research associate Gaëlle Blanvillain check a female terrapin with ultrasound technology to determine if it is pregnant. Pregnancy affects the outcomes of blood tests, so researchers do not use pregnant animals in this study. PHOTOS/OPPOSITE: Wade Spees ABOVE LEFT, CENTER, BOTTOM: College of Charleston ABOVE: Wade Spees

Rice fields provide water-quality benefits

A unique habitat is disappearing on the South Carolina coast, one of the last of its kind along the entire eastern seaboard. Remnant rice fields with breached dikes, valuable for wildlife and water quality, have been changing from open-water environments to swamp forests. In breached fields, this change is occurring at various rates in every river basin in coastal South Carolina.

The early-stage, open-water environments provide habitat diversity for birds and fish. Only eight open-water, breached fields (50 percent or more open water) remain in South Carolina—all on the Cooper River.

“These are special places,” says S.C. Sea Grant Consortium researcher B.J. Kelley, a retired biologist from The Citadel. “We need to take a hard look at whether these habitats should be allowed to disappear.”

For generations before the Civil War, landowners used slaves to clear cypress forests along the coastal rivers of the Southeast and build extensive dikes to control flooding of rice fields. Planters drained or irrigated these fields to kill weeds and encourage rice to germinate. After the Civil War, the lowcountry rice industry faded, and landowners eventually abandoned the impoundments.

When many dikes broke, sediments deposited by tidewaters raised field bottoms, triggering the plant succession process. In 1985, a portion of the



Cooper River flow was diverted to the Santee River, and average water levels dropped farther, encouraging more rapid growth of plants and trees. Approximately 50 percent of the open-water habitat on the Cooper has progressed to later stages since 1985.

Vegetation continues to grow in remnant fields in the river basins of coastal South Carolina, altering their ecology and potentially their water quality. S.C. Sea Grant Consortium researcher Daniel Tufford, a University of South Carolina biologist, and Kelley studied the processes and effects of the changes on the plant communities.

Tufford has examined the degree to which various successional stages affect dissolved oxygen levels

in the upper Cooper River. The scientists chose three fields representative of various stages of ecological succession. One field comprises predominately submerged aquatic plants. A second field is predominately intertidal, its plants submerged only at high tide. And the third is an intermediate stage between those two, shallow subtidal with floating leaf plants.

“During the day, the submerged plants are photosynthesizing and they’re releasing that oxygen into the water,” says Tufford. “And if the tide is going out at that time, then all of that high-oxygen water is going out into the river.” At night, the submerged-vegetation field’s “oxygen-production machine is shut down because there’s no sunlight, and submerged plants use up more oxygen through respiration than they produce.”

In total, the submerged-vegetation field has a potentially positive effect on water quality, providing a net source of oxygen to the river. By contrast, the two remnant fields with shallow subtidal and intertidal vegetation provide a neutral net oxygen effect to the river. “At low tide their green stems and leaves are always above water, and the oxygen produced goes out into the air,” Tufford says.

Submerged-vegetation fields, meanwhile, provide important habitat for wading birds, waterfowl, and fish. Previous Consortium studies showed that submerged vegetation absorbs nitrogen and phosphorus. Such open-water rice fields that are owned by state agencies also provide places for the public to fish and hunt. Yet these particular ecosystems are becoming increasingly rare as they evolve into swamp forests.



OPPOSITE: A rice "trunk," or dike, used to raise or lower water levels in fields. PHOTO/University of South Carolina
 ABOVE: Biologist Joe Kelley (left) uses a geographic-positioning system to find his location and a metric survey rod to measure the depth of aquatic plants in a former rice field on the Cooper River. In the image in upper right, two stages of plant succession are shown. The taller vegetation is a later stage and is what the entire former field will look like in the future. Researchers (lower right) are setting up water-quality and water-level sampling equipment. PHOTOS/ABOVE: Wade Spees
 RIGHT TOP, BOTTOM: University of South Carolina



ecosystem dynamics

Progress made on invasive species

Invasive plant and animal species pose a direct threat to South Carolina in sectors as varied as agriculture and tourism. The Consortium's Sea Grant Extension Program is addressing the threat of invasive species in coastal forests and wetlands as well as on the beaches that support our tourism economy.

Co-chaired by Jack Whetstone of the Consortium's Sea Grant Extension Program, the Winyah Bay Focus Area Task Force, with representatives of Clemson University, The Nature Conservancy, S.C. Department of Natural Resources, University of South Carolina, U.S. Fish and Wildlife Service, and private industry and landowners, was formed to address the threat of invasive plant species in the area of the north central S.C. coast.

The task force identified five major invasive species: common reed, beach *Vitex*, giant reed, alligatorweed, and water hyacinth. *Phragmites* was also identified as an invasive species in South Carolina.

The task force is a partnership; it identifies and targets invasive plant species, applies for and receives grant support (public and private), develops action/management plans, and conducts demonstrations and symposia. These efforts have resulted in the development of two additional species-specific task forces, and the adoption of ordinances by several beachfront communities. For more information, visit www.beachvitex.org.

Gut-check reveals no relationship between snails and salt-marsh die-offs

During severe droughts, blue-crab populations in U.S. southeastern estuaries have historically fallen significantly. Some researchers have hypothesized that when numbers of blue crabs collapse in an estuary, this process can drive a "trophic cascade" that eventually destroys salt-marsh plants.

The cascade begins with the blue crab (*Callinectes sapidus*), a predator of periwinkle snails (*Littoraria irrorata*). These snails, in turn, feed on common cordgrass (*Spartina alterniflora*). Everyone agrees on these points.

But Brian Silliman, an ecologist at Brown University, has argued that an exploding population of periwinkle snails can graze such large amounts of cordgrass that the animals have contributed to massive marsh die-offs along southeastern U.S. coastlines.

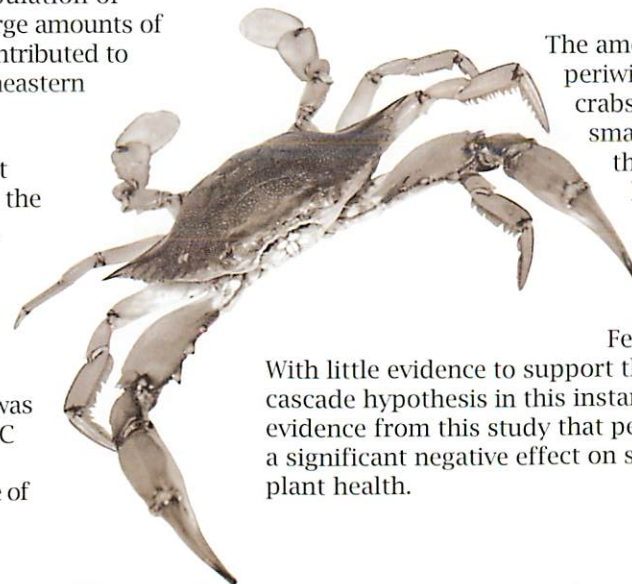
S.C. Sea Grant Consortium scientist Robert Feller, a marine biologist at the University of South Carolina (USC), tested this "trophic-cascade" hypothesis in the North Inlet-Winyah Bay National Estuarine Research Reserve.

Under Feller's direction, the study was performed by Michael Long as a USC Master of Science research project in biological sciences, with the assistance of

several undergraduate students. The scientists wanted to learn more about the relationship between blue-crab populations and one of their prey, periwinkles. If these snails proliferate in the absence of an important predator, do the snails, in turn, consume far more cordgrass, leading to salt-marsh die-offs?

The scientists studied whether blue crabs consume a significant number of periwinkle snails in a short period of time. Feller estimated blue-crab abundance in North Inlet, measured how long blue crabs can retain periwinkle parts in their guts, and estimated the number of periwinkle snails that could be ingested on a daily basis by blue crabs.

Based on visual and immunological analysis of wild-caught blue-crab gut contents, Feller found that the proportion of blue crabs containing identifiable solid parts (opercula, shells) or solubilized proteins from periwinkle snails was low during all summer times of collection.



The amount of periwinkles that blue crabs consume is small, so the effect that the crabs have on periwinkle populations must be minuscule, Feller concluded.

With little evidence to support the trophic-cascade hypothesis in this instance, there is no evidence from this study that periwinkles have a significant negative effect on salt-marsh plant health.



OPPOSITE: A blue crab, *Callinectes sapidus*. PHOTO/S.C. Sea Grant Consortium ABOVE: A periwinkle snail feeds on the common cordgrass plant. PHOTO/Wade Spees ABOVE RIGHT: Stormwater detention pond on Kiawah Island, S.C. PHOTO/S.C. Sea Grant Consortium



Reducing nonpoint source pollution in stormwater detention ponds

Stormwater ponds are the preferred method of controlling stormwater runoff in residential and commercial developments. But stormwater ponds can also be effective collectors of nutrients and other contaminants that pour off lawns and streets during heavy rains.

S.C. Sea Grant Consortium researcher Susan Wilde, of the S.C. Department of Natural Resources and USC, and her colleagues are studying brackish stormwater ponds on Kiawah Island to test methods for controlling nutrient pollution in these water bodies.

The scientists intensively sampled six Kiawah stormwater ponds and found moderate to high amounts of nutrients there. In each pond studied, elevated nutrient levels are feeding harmful algal blooms, which persist at all times of year, according to Wilde. These blooms have implications for adjacent estuaries. The ponds are tidally influenced and therefore linked to surrounding waterways.

coastal growth and ecosystem effects

Tying coastal land-use change to ecosystem health

Although the southeastern U.S. presently has one of the smallest coastal populations in the country, the region is experiencing unprecedented growth. This growth is placing enormous pressure on coastal resources. The opportunity for managing growth still remains; unfortunately, science-based information linking land-use change to environmental condition is limited.

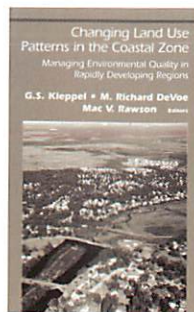
The overall goal of the Land Use-Coastal Ecosystem Study (www.lu-ces.org), funded by the NOAA Coastal Ocean Program and administered by the Consortium, has been to generate science-based information that integrates changes in land-use patterns with effects on hydrodynamics, transport processes, and ecosystem function to assist in planning for sustainable coastal land-use and resource management.

LU-CES data and knowledge have been integrated through the use of a Geographic Information System, statistical tools, and conceptual and numerical models. These tools are being developed to quantify linkages and provide practical information to facilitate decision-making on the potential effects of population growth and associated development on coastal resources and marine ecosystems.

Results of these analyses will contribute to (1) the qualitative prediction of impacts by identifying key processes and system interfaces, (2) conceptual models of linkages between the habitats and ecosystems in the coastal region of South Carolina and the southeast U.S., and (3) the definition of what spatial scale management may have the highest probability of minimizing or avoiding such impacts.

LU-CES State-of-Knowledge (SOK) reports were prepared by scientific teams that summarize the current literature on issues and topics related to land use and ecosystem health. Information contained in the LU-CES SOK reports has been summarized in a synthesis document, which provides an integrated statement of what is currently known about the relationship between land-use activities and the condition of marine resources in the inner South Atlantic Bight region for technical and lay audiences.

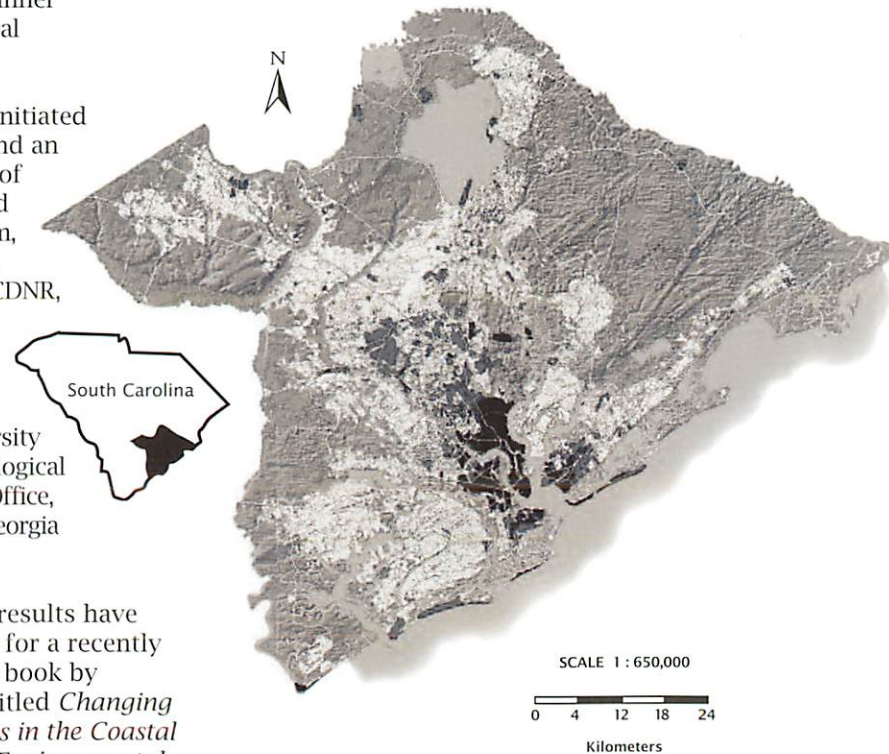
A full-scale field research effort was initiated in July 2000 by five research teams and an education/outreach team, consisting of more than 35 scientists, students, and staff from the S.C. Sea Grant Consortium, State University of New York-Albany, Marine Resources Research Institute-SCDNR, University of South Carolina, Clemson University, NOAA/NOS Charleston Laboratory, Skidaway Institute of Oceanography, University of Georgia, Georgia Institute of Technology, University of Massachusetts-Dartmouth, U.S. Geological Survey, Beaufort County (S.C.) Planning Office, S.C. Sea Grant Extension Program, and Georgia Sea Grant College Program.



LU-CES research results have formed the basis for a recently published (2006) book by Springer-Verlag titled *Changing Land-Use Patterns in the Coastal Zone: Managing Environmental Quality in Rapidly Growing Regions*, edited by G.S. Kleppel, M. Richard DeVoe, and Mac V. Rawson; to date, almost 1,000 copies of the book have been sold.

Predicted Urban Growth by Year 2030 in Charleston Area, South Carolina

Integrated GIS-Based Prediction
Clemson University



- Urban 1973 (70 square miles)
- Urban 1994 (180 square miles)
- Urban 2030 (618 square miles)
- Non-Urban

Computer model illustrates rapid coastal growth

Nearly one million new residents will likely move to South Carolina over the next 20 years, and much of this growth will occur in the lowcountry. Jeffrey Allen, director of the S.C. Water Resources Center at Clemson University's Strom Thurmond Institute of Government and Public Affairs, and his colleagues have studied the implications of dramatic growth with a Geographic Information System computer program.

In an examination of development trends in the Charleston metropolitan region, Allen and his team found that future urban growth would probably exhibit a pattern typical of urban sprawl. As the urban area sprawls, population density and housing density decrease, and this spreading out requires additional roads, bridges, water and sewer lines, and other infrastructure.

Charleston-area leaders were startled when Allen's team projected that the region's urban land area could expand more than 10-fold by 2030. The model developed by the Clemson team showed land in the Charleston area had been converted from rural to urban uses from 1973-1994 at a rate six times higher than the rate of population growth. View the model at www.strom.clemson.edu/index.html.

The growth model was later to be expanded to include the entire eight-county coastal region with funding provided by NOAA. Growth models are now being generated for other regions of South Carolina.

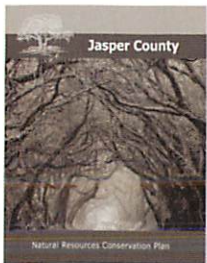


ABOVE: Road building in recent years has opened vast new tracts near coasts for development. PHOTO/Wade Spees

Coastal community program helps communities plan for future

Migration of newcomers to the South Carolina coast has spawned rapid development across the coastal landscape, increasing sprawl, converting forested areas, and increasing stormwater runoff, all affecting coastal health. Some community leaders say that local land-use planning isn't keeping up with such rapid development.

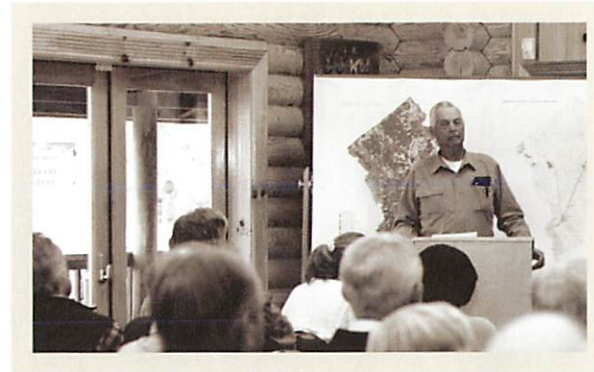
Over the past two years, April Turner of the S.C. Sea Grant Extension Program has offered educational presentations and workshops, publications, and Internet resources that help local officials and citizen groups understand how best to take a comprehensive approach to couple land-use planning and natural-resource management.



This program provides advice and assistance to coastal communities for use in developing and updating comprehensive land-use plans consistent with environmental health and resource conservation.

As part of an EPA Smart Growth pilot project implemented through the S.C. Sea Grant Extension's

Coastal Community Program, a series of stakeholder workshops were held in Jasper County to promote the use of natural resource-based planning. The workshops helped educate local decision-makers and landowners about innovative quality growth policies, tools, and strategies for natural resource conservation, and provided a forum for gathering input about the county's conservation concerns and issues. Together, this information was applied by county leaders to determine priorities and policies for



natural resource conservation, which culminated in the development of the Jasper County Natural Resource Conservation Plan.

The Plan evolved as a result of the efforts of more than 100 stakeholders, representing local and regional government officials and staff, state and federal resource agencies, nonprofit conservation organizations, local businesses, private landowners, and concerned citizens.

The Plan has been submitted to Jasper County staff and County Council for integration into the Natural Resource Element of the county's Comprehensive Land-Use Plan, which is currently under revision.

S.C. Coastal Community Initiative grants program

The overwhelming majority of land-use decisions are made at the local level. Local leaders, though, are facing increased pressure to accommodate rapid growth and development. Now, many officials recognize that they need more information about how

various kinds of growth can affect water quality and other coastal resources.

The Consortium's S.C. Coastal Community Initiative has created a small-grants program, which helps local governments develop and implement "quality growth" land-management policies and practices. Proposals are solicited from coastal municipalities and counties to participate and recipients of the award received a \$2,500 grant to help leverage further support and funding.

Since 2004, the recipients of grant awards have been coastal communities within Colleton County and Horry County, and the Town of Sullivan's Island. To date, the communities participating in the grants initiative have leveraged more than \$47,000 from other sources.

Recipients of these mini-grant awards have addressed a variety of issues related to land use. For example, Colleton County developed a master trails plan that will provide a low-impact alternative transportation system connecting open spaces for pedestrians and cyclists, while providing public access to the natural resources of the ACE (Ashepoo, Combahee, and Edisto rivers) Basin, one of the largest undeveloped estuaries on the East Coast.

Horry County compiled a countywide open space inventory of all protected open space and undeveloped, unprotected parcels. This inventory, in conjunction with modeling efforts, will be used to establish a decision-making framework to analyze land-use alternatives and impacts associated with the county's open space.

The Town of Sullivan's Island is conducting a study of the "conservation zone" along the island's entire beachfront. The town will develop a management plan and an educational campaign to foster stewardship of this dune and maritime forest ecosystem.



OPPOSITE: Gordon Wells, chairman of the Jasper Soil and Water Conservation District, welcomes participants to the Jasper County Natural Resource Conservation Plan stakeholder workshop. ABOVE: Municipal government staff and council members learn about coastal S.C. population growth projections and the state of scientific knowledge on land-use impacts during one of three Coastal Community workshops. The forum provided the opportunity for productive interactions between local community officials and natural resource agency personnel. BOTH PHOTOS/ S.C. Sea Grant Extension Program

Coastal Waccamaw Stormwater Education Consortium

The S.C. Sea Grant Consortium has partnered with Clemson Extension, Coastal Carolina University's Waccamaw Watershed Academy, the North Inlet-Winyah Bay National Estuarine Research Reserve Coastal Training Program, the Waccamaw Riverkeeper, and Murrell's Inlet 2007, to form the Coastal Waccamaw Stormwater Education Consortium (CWSEC).

Using a regional/watershed approach to maximize the efficiency of stormwater education efforts, the CWSEC provides education and outreach guidance for MS4 (municipal separate stormwater sewer systems) communities in Horry and Georgetown counties. Through the development of a comprehensive stormwater education plan, CWSEC members help designated communities meet the public outreach component of the National Pollutant Discharge Elimination System Phase II permit requirements.

Capitalizing on local training resources, the CWSEC, including Dan Hitchcock, the Consortium's former environmental quality

specialist, has provided a variety of program tools, including stormwater management workshop presentations, mapping activities to "get to know your watershed," demonstration projects (e.g., rain garden installation and other stormwater management practices), and public service announcements (radio, print, television spots) to deliver information to the public.

In 2005 and 2006, the CWSEC delivered stormwater education workshops to three MS4 communities: the Town of Surfside Beach, Georgetown County, and Horry County. These workshops were based on the Nonpoint Education for Municipal Officials (NEMO) format, with emphasis on better development site design, stormwater pond issues, and Low Impact Development (LID) strategies. Rain garden demonstration sites were constructed at the Town Hall of Surfside Beach and in Conway at Coastal Carolina University's Burroughs and Chapin Center for Marine and Wetland Studies. An associated workshop was delivered at the Town of Surfside Beach rain garden site. For more information, visit www.northinlet.sc.edu/training/stormwater_education.

Stocking contributes to restoration program for red drum

Stocking red drum (*Sciaenops ocellatus*) in estuaries is proving to be part of an effective management strategy to help restore South Carolina's most popular coastal recreational fish species.

High fishing pressure in the past has substantially decreased the abundance of red drum throughout its range. In 2001, the South Carolina legislature passed more stringent fishing regulations to help the population recover.

Unfortunately, regulations alone might not be enough to bring red drum back in significant numbers for many years.

With support from the S.C. Sea Grant Consortium, as well as from other agencies, actual field trials have been initiated to evaluate the impacts of various stock enhancement approaches to rebuild red drum populations.

Scientists are spawning wild adults in captivity and releasing offspring in a number of estuaries throughout South Carolina. The results to date have been positive, and releasing small juveniles into the wild could become an effective management tool when coupled with traditional fishery management techniques.

S.C. Sea Grant Consortium researcher Ted Smith, a retired senior scientist from the Marine Resources Research Institute (MRRI) of the S.C. Department of Natural Resources, and his colleagues have been studying various techniques of restocking wild populations of red drum. Mike Denson, a MRRI marine scientist, is now leading the project.



In the Consortium-funded effort, the researchers spawned and stocked about 2.4 million red drum in Murrells Inlet during 2002-2005. For its size, Murrells Inlet is the most intensely fished area in coastal South Carolina and was selected due to this high fishing pressure.

"We wanted to see if we could increase the red drum population in an estuary that has a high fishing pressure," said Smith. "Murrells Inlet appears to have had a much higher population of red drum than it does today."

Although this project is being conducted in one coastal community—Murrells Inlet—it has generated information critical to support coast-wide restoration efforts of one of the state's most important recreational fishes.

A primary focus of the work in Murrells Inlet has been to evaluate the relationship between size of the released fish to population contribution and abundance. During 2002 to 2005, fish in different size-classes, ranging from about ¾ inch to 6 inches in length, were stocked.

Using genetic techniques, researchers have examined fish of the 2002-2004 year classes. From the 2002 year class, 9.2 percent were stocked. For the 2003 year class, 5.7 percent were found to be of stocked origin.

Not all fish for the 2004 year class have been examined, but to date 27 percent are stocked fish. Such data clearly indicate that stocked fish do survive and can be a substantial component of the population, said Smith.

During the project's initial years, researchers marked stocked fish by immersing them in an antibiotic bath. This process stained fish ear bones, so the animals could be identified after release. Evaluation of stocking success was based on collection of fish heads from legal-size fish donated by cooperating anglers. The ear bones were removed, dried, and sectioned.

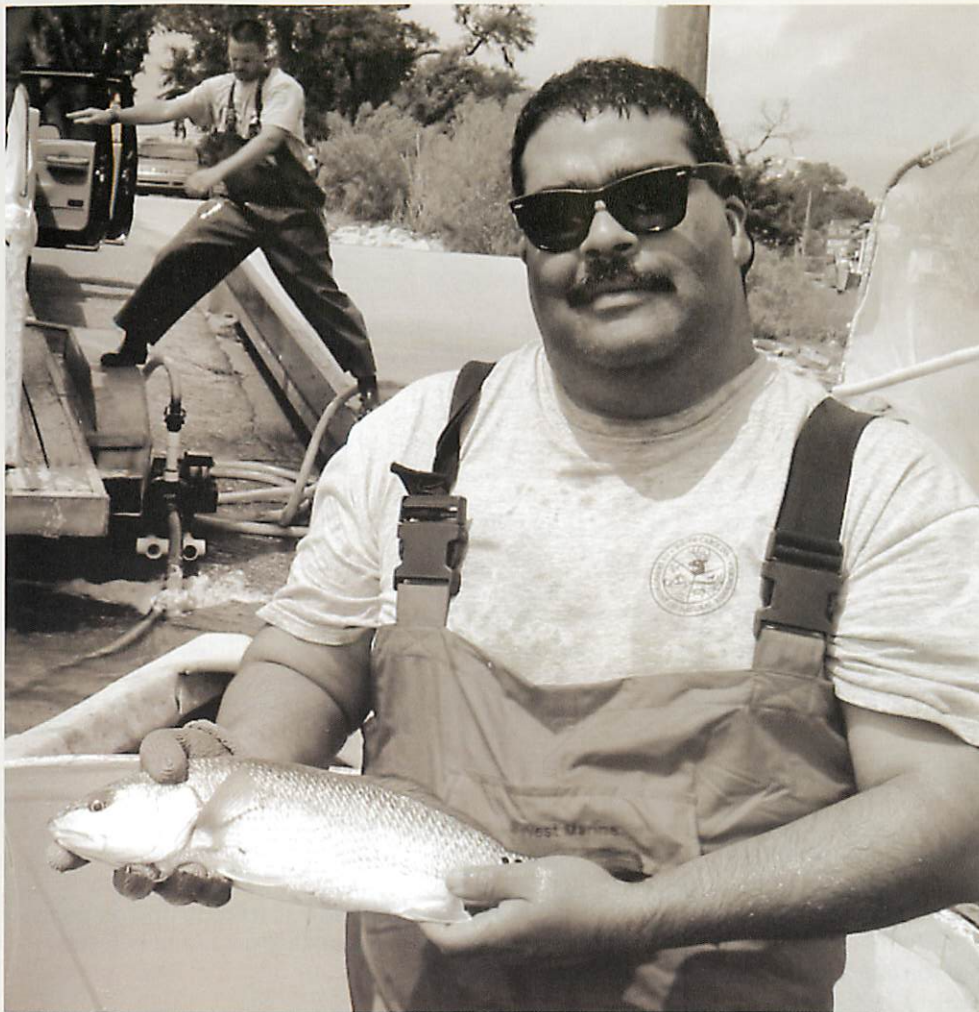
When viewed under a microscope equipped with UV light, a faint yellowish ring indicated that the fish had been stocked. But this technique has practical limitations.

Researchers have increasing difficulty reading the fluorescent ring on the ear bone as the fish grows. Also, more than a year is required before the fish is large enough to be legally harvested and then the fish must be sacrificed to obtain the ear bone.

Now, scientists can test the animals genetically, a more accurate and precise tool. Years of study, partly funded by the Consortium, led to a genetic identification technique for red drum. "The genetic approach is the tracking tool of choice now," said Smith.

Genetic identification allows researchers to know exactly which groups of fish are contributing to the population. "We can release fish from different genetic families of different sizes at different times, and then we can monitor their progress throughout the population," says Wallace Jenkins, MRRI marine biologist and co-investigator of the Sea Grant project.

Further, the fish doesn't have to be sacrificed to determine its origin—a small fin clip will do.



Allan Hazel, a S.C. Department of Natural Resources biologist (top), holds a large juvenile red drum to be released into Murrells Inlet. Biologists transport large juveniles to be released (pg.22 and lower left) into the estuary. They also release small juveniles (lower right). Scientists are studying how various fish sizes affect population contribution and abundance. ALL PHOTOS/S.C. Department of Natural Resources

Potential shift in fishery management studied

For decades, U.S. fisheries were managed with scant attention paid to their habitats. Most regional fishery councils primarily focused on fisheries themselves, recommending catch limits and allocating catches.

But, in recent years, many scientists have called for a new fishery-management approach that emphasizes habitat protection and ecosystem-based management approaches.

The U.S. Commission on Ocean Policy's 2004 report strongly endorsed this approach. Regional fishery management councils are now developing new strategies of ecosystem-based management such as Essential Fish Habitat implementation.

These trends point to a dramatic shift in policy, but no one has fully analyzed the legal and regulatory challenges that could arise from such changes—until now.

S.C. Sea Grant Consortium researcher Kim Diana Connolly, a law professor at the University of South Carolina (USC), is studying existing federal laws that address ecosystem-based management to evaluate the concept and identify potential pitfalls that can be avoided in the future.

"We're barreling ahead," said Connolly, "but there are lessons we need to learn first."

Connolly is also assessing lawmaking and regulations associated with the Endangered Species Act and the Marine Mammal Protection Act, both of which have mandated ecosystem considerations.

She is also analyzing legislative histories to learn what Congress intended in regard to ecosystem concepts in each law. And she is examining their regulatory histories and implementations.

"What did Congress have in mind?" Connolly asks. "How have the agencies implemented the laws? How do these regulations translate into things that people have to do every day?"

Connolly will review and assess current approaches to ecosystem-based fishery management such as Essential Fish Habitat implementation. She hopes to develop regulatory approaches for ecosystem-based fishery management.

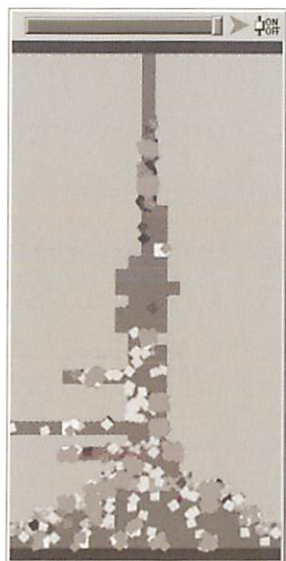
F. James Cumberland, also of USC, will write a summary report for commercial and recreational fishermen, nonprofit organizations, fishery councils, and citizens.

Blue crabs sensitive to one-two punch of warmer and saltier waters during droughts

South Carolina's blue crab (*Callinectes sapidus*), which supports a \$5-million-dollar commercial fishery, is susceptible to water pollution, winter freezes, habitat destruction, tropical storms, and fishing pressure.

But the state's blue crabs are especially sensitive to a one-two punch of warmer water and higher salinity during severe droughts, according to S.C. Sea Grant Consortium researchers Michael Childress, a Clemson University biologist, and Elizabeth Wenner, a marine scientist at the S.C. Department of Natural Resources.

"Temperature and salinity combine to cause increased mortality," said Childress. "When there is less precipitation, there is less fresh water into the estuaries, and the river flow is slower and picks up more heat." Blue crabs are likeliest to die in their younger stages during temperature and salinity extremes, perhaps because the animals are molting more frequently and are



Mouth of Ashley River (Model)



more vulnerable to predation and increases in abundance of parasites.

Weeks	49
year	4
Crabs	2845
Dead	14791
Trapped	189

Childress and Wenner discovered this cause of blue crab mortality through an innovative computer model they developed to study the fishery in South Carolina. The computer model, available at www.clemson.edu/SCBCRABS, is enhancing researchers' knowledge of complex interactions among various habitats and life stages of the blue crab.

On salt?
 Off salt?
 On temp?
 Off temp?
 On oxy?
 Off oxy?
 On nat-m...
 Off nat-m...
 On dense?
 Off dense?

The model simulates individual blue crabs through time as they occupy various habitats and encounter changing environmental conditions in the Ashley River near Charleston.

initial-number-crabs	3 X 1000
births	10 larvae / fem
immigration	10 larvae / wk
number-traps	25 trap lines
trapping-probability	0.25

In this way, the model simulates the dynamics of the entire blue crab population in the river.

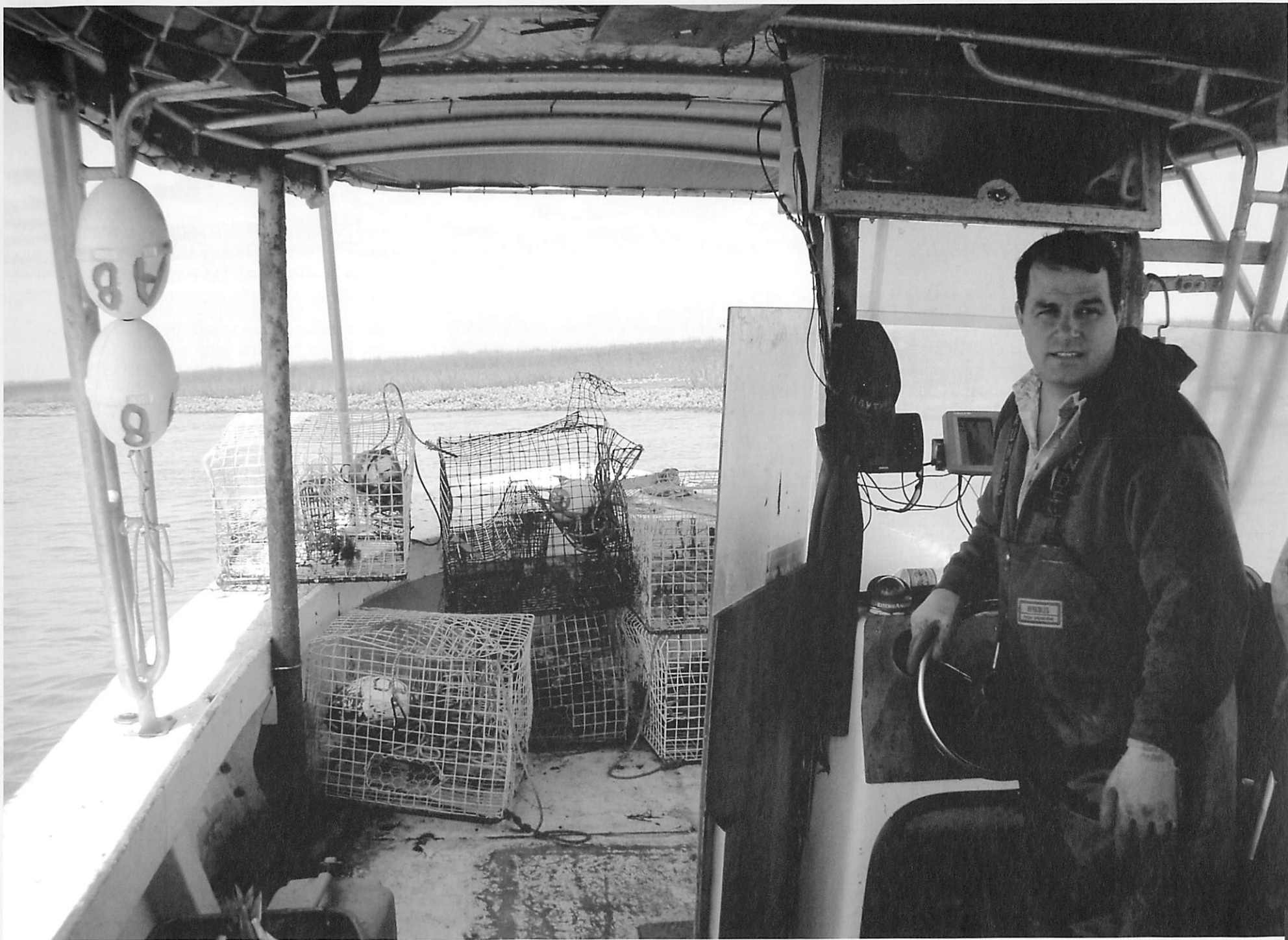
The model can be used to quantify the effects of various management techniques on blue crab populations. Blue crabs have multiple life stages in various habitats from salt-marsh creeks to open ocean waters.

Changes in their environment can influence the degree to which blue crabs can survive and grow. The scientists have used the computer model to compare river conditions and blue crab populations during the 1999-2003 drought and the 1995-1998 non-drought period.

The good news is that South Carolina already has a network of habitats that protect blue crab populations during drought conditions. State regulations limit blue crab catches in upriver areas of South Carolina estuaries, where salinity levels are lower.

"During droughts," said Childress, "blue crab populations move upriver to reach fresh water beyond the legal catch area, where conditions are better for growth and survival. And then, after the drought is over, the blue crabs relocate farther downriver into the area where catches are allowed. Sustaining the catch regulations that provide these 'refuges' are a good way to protect populations longer-term."

Eventually, Childress and Wenner plan to expand the computer model to include other regions of the South Carolina coast, and the program will be made available for public use through a Web-based, user-controlled interface.



ABOVE: Jerry Gault, of Beaufort County, fishes for blue crab in his 26-foot boat. PHOTOS/OPPOSITE: S.C. Department of Natural Resources ABOVE: S.C. Sea Grant Extension Program

Constructed oyster reefs built a half-decade ago increasingly resemble natural reefs

Constructed oyster reefs in South Carolina are becoming more like their sisters, natural oyster reefs, in the diversity of species living there. Over time, constructed reefs offer habitat for an increasing number of species of worms, mussels, crustaceans, crabs, snails, and fish.

Still, a rich assemblage of creatures doesn't arrive right away on a constructed oyster reef. "You need four to five years to get a healthy reef with appropriate oyster densities and three-dimensional complexities," said S.C. Sea Grant Consortium researcher Loren Coen, senior scientist with the Marine Resources Research Institute at the S.C. Department of Natural Resources (SCDNR).

Coen and his colleagues at Coastal Carolina University and the College of Charleston, building upon long-term efforts supported in part by the Consortium, set out to answer fundamental questions about constructed and adjacent natural oyster reefs at sites near Charleston in Toler's Cove and Inlet Creek.

What should be the goal of an oyster restoration project? What characteristics make a constructed reef a success? How long does it take for the characteristics of a constructed reef and a natural reef to converge?

Scientists have traditionally built reefs with the aim of growing large commercial oysters (at least three



inches in most states, although South Carolina has no minimum size). It is generally viewed that if large numbers of harvestable (three inch) oysters are not produced, then restoration efforts have not been successful.

But Coen and his colleagues wanted to find out if a constructed reef could have significant habitat and water-quality benefits even if the reef contained relatively small oysters in large numbers.

The answer is yes. On many of South Carolina's constructed oyster reefs, diverse crab and mussel communities developed early even where relatively small oysters had become established. Mussels are also effective filterers, contributing to improved water quality. Coen and his colleagues often find that constructed reefs in South Carolina have mussel densities in the thousands per square meter.

The Sea Grant scientists also have been studying reef communities and oyster populations to find

consistent measuring sticks—known as metrics—to define successful restoration. That is, they are working on techniques of judging restoration projects that can be used in South Carolina and elsewhere.

However, comparing various constructed reefs in different locations is difficult because various scientists are building them with different goals, indicators of success, and techniques to collect data.

"We're hoping to get people to assess oyster restoration projects in a similar way," said Coen. "Today everybody collects data on restoration projects differently, and the data aren't comparable."

Coen and his colleagues found that counting dozens of species as a way to measure biodiversity would be an impractical method if used on other projects. Instead, the scientists counted populations of 11 selected species of crabs, bivalves, and a snail. These species are large, easy to identify, and representative of the diverse biological communities that occur on reefs in South Carolina.

Six years after construction, oyster size and number were still significantly greater on the natural reefs. However, species diversity on the two reef types is converging—becoming increasingly similar—over this time period. Large oysters, therefore, are not critical to have significant biodiversity and water quality benefits on constructed reefs.

The researchers are developing a Web page to disseminate project findings and related information. The page (www.coastal.edu/marine/sgoyster) will provide information on oyster reef restoration, site selection criteria, and related success benchmarks, along with links to other efforts.



Oyster restoration program receives national acclaim

Since beginning in Fall 2000, the S.C. Oyster Restoration and Enhancement (SCORE) program has engaged more than 2,000 volunteers in restoration activities, building 105 reefs at 28 sites along the South Carolina coast with partial support from the S.C. Sea Grant Consortium. SCORE is also coordinating a statewide program to recycle oyster shells and rebuild oyster reefs, which provide habitat for dozens of fish and shellfish species.

In recognition of immense success, SCORE (score.dnr.sc.gov) was recognized with two prestigious national awards for 2004. The Coastal America Partnership Award recognized the SCORE program's efforts to leverage skills and resources of federal, state, and local partners to restore critical oyster habitat.



OPPOSITE: Scientists are studying constructed oyster reefs in comparison to natural reefs as suitable habitats for species such as mussels, crabs, snails, and fish. ABOVE: S.C. Oyster Restoration and Enhancement (SCORE) program volunteers pour oyster shells into mesh bags during the 2005 Day of Caring sponsored by Trident United Way. Volunteers (lower left) from Dataw Island stand by filled shell bags ready to be made into an oyster reef near the island's golf course. Beaufort Marine Institute and the Boys and Girls Club of Bluffton (lower right) form a human chain to pass shell bags to the shoreline where they are laid in a grid, forming a reef footprint. Each reef is composed of 100 bags filled with 75 bushels of shell weighing approximately 1.5 tons. ALL PHOTOS/S.C. Department of Natural Resources

The Theodore M. Sperry Award, sponsored by the Society of Ecological Restoration International, acknowledges the SCORE program's innovative approaches to oyster habitat restoration. According to the society, award recipients are pioneers of the restoration movement, leading the way for other successful programs.

COASTeam drives discovery learning

For more than a decade, the S.C. Sea Grant Consortium has supported the College of Charleston's COASTeam Program, which trains teachers in discovery-learning techniques.

Leslie Sautter, a geologist at the College of Charleston, developed and directed COASTeam from 1994 until it was adopted in 2006 by the Center for Ocean Sciences Education Excellence-SouthEast (COSEE-SE), which is charged with promoting educational programs of excellence throughout the Southeast region.

Sautter offered COASTeam courses in marine-science education, providing science teachers with curriculum materials they can use in classrooms.

The program has been successful for two reasons. First, the resource materials used (a textbook and source books of many classroom-suitable, hands-on activities) have been written and compiled specifically for teachers in the Southeast. Second, the program emphasizes training collaborative teams of teacher facilitators from the same school, who subsequently train teachers.

COSEE-SE, funded by the National Science Foundation and NOAA, and managed by the S.C. Sea Grant Consortium, will extend COASTeam into selected schools in South Carolina and later into North Carolina and Georgia.

Center for Ocean Sciences Education Excellence-SouthEast advances ocean literacy

Scientists and educators need more chances to work together, inspiring young students and bringing ocean and aquatic sciences into K-12 classrooms. That's why the National Science Foundation created the Centers for Ocean Sciences Education Excellence (COSEE) nationwide.

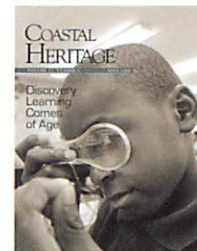
The COSEE network now comprises 11 centers across the United States, including COSEE SouthEast (COSEE-SE), which serves North Carolina, South Carolina, and Georgia, and is administered through S.C. Sea Grant Consortium. COSEE-SE fosters educator-scientist interactions through professional development, increases access and preparation of culturally diverse populations, promotes regional networking and collaboration, and supports the improvement of science education.

COSEE-SE staff coordinates several summer flagship programs: Ocean Sciences Leadership Institute, Coastal Legacy, and regionally distributed Ocean Awareness Day workshops. COSEE-SE also offers technology-oriented workshops, including the Massachusetts Institute of Technology Sea Perch, in which teachers build and use their own remotely operated vehicles, or ROVs, and the "Taking the Pulse of Our Coastal Ocean," in which teachers learn to access and use coastal ocean observing system information through the Web.

During 2004-2006, COSEE-SE engaged more than 500 teachers in workshops and reached more than 200 educators through conference presentations. More information is available at www.scseagrant.org/se-cosee.

Coastal Heritage Curriculum Connection

Four times a year, the Consortium writes and produces *Coastal Heritage*, its award-winning magazine that describes environmental, historical, technological, and cultural patterns of change along the South Carolina coast.

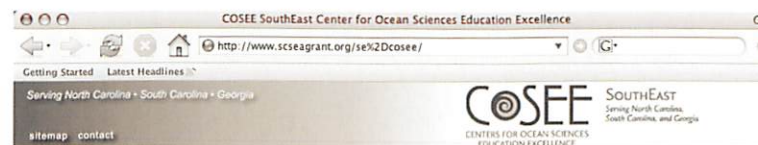


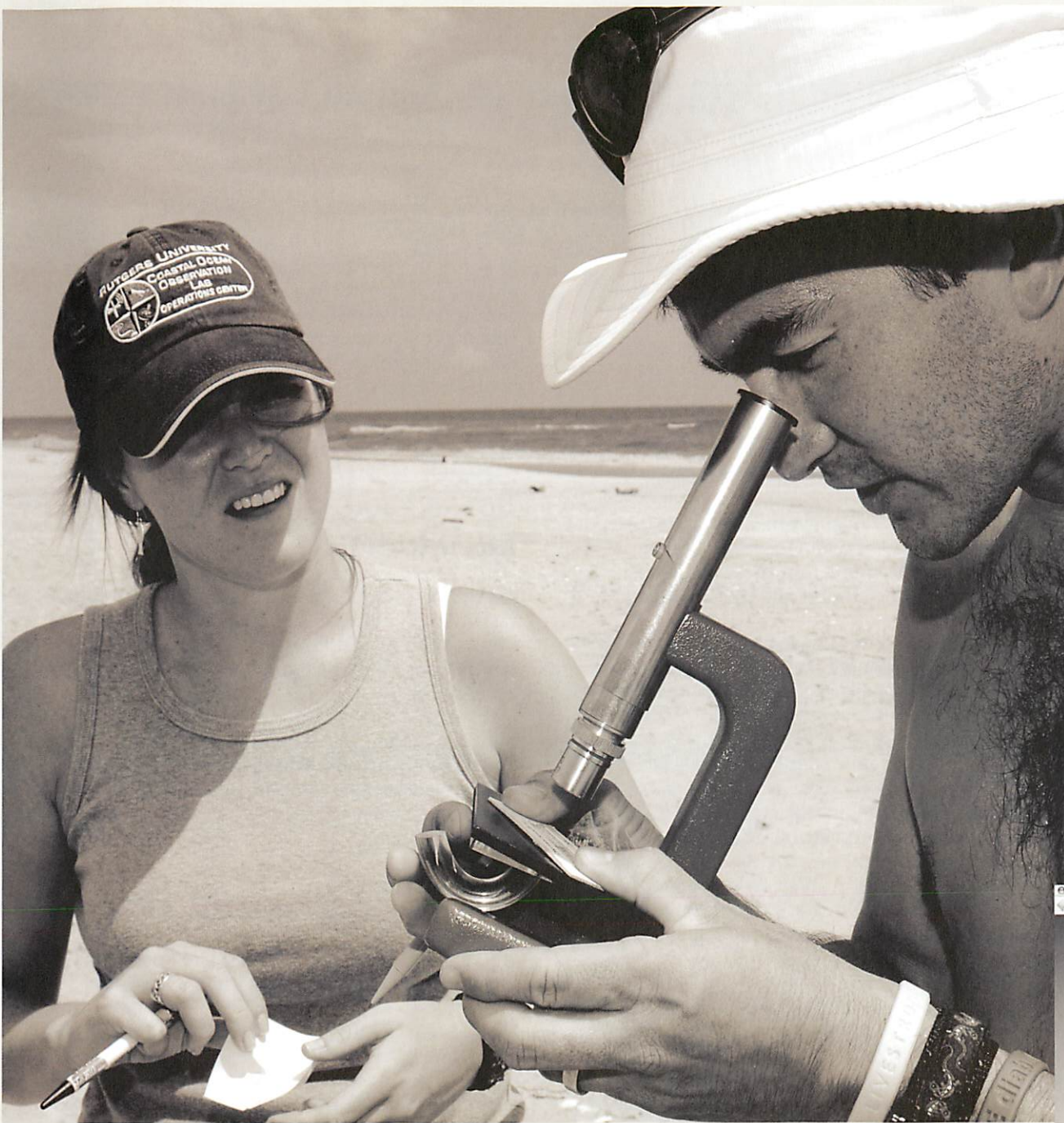
The Consortium recently expanded the reach of *Coastal Heritage* in grade 6-12 classrooms by initiating the *Coastal Heritage* Curriculum

Connection series, a supplemental classroom resource that accompanies each issue. The series is written for both middle- and high-school students and is aligned with the South Carolina state standards for the appropriate grade levels.

Supplements include standards-based inquiry questions that teachers can use to lead students through an exploration of the topic discussed in *Coastal Heritage*. Each issue of Curriculum Connection also includes a list of Web-based and hard copy resources and identifies field trips relevant to the topic.

Coastal Heritage Curriculum Connection is available on-line at www.scseagrant.org/education.





ABOVE: At Pine Knoll Shores, North Carolina, Elizabeth Joyner, former marine educator with the Consortium, investigates beach sediments with Steve Ahn, science teacher at Wade Hampton High School in Greenville, South Carolina. In July 2006, they participated in the Ocean Sciences Education Leadership Institute for middle- and high-school teachers from North Carolina, South Carolina, and Georgia. PHOTO/Scott Taylor

Consortium continues to spread news of coastal issues

The Consortium continues to improve its Web site (www.scseagrant.org) by enhancing interactive features, making the site more accessible to people with disabilities, and keeping the information up-to-date and relevant. The Consortium has posted a retrofitted Web site and is in the process of transferring all information to the new site. Total hits for fiscal year 2005-2006 increased 41.7 percent over those of 2003-04. Unique visits increased 62 percent.

Traditional means of communication are still extremely important for information delivery. The Consortium produced over 100 publications from 2004-2006, which informed our constituents about coastal issues and, where appropriate, facilitated the transfer and exchange of information.



Rising tide raises all boats for teachers and students

The science curriculum for U.S. secondary schools is often called “a mile wide and an inch deep” because it covers so many topics superficially. As a result, critics say, students don’t have time to work on complex science projects and reach any depth of critical thinking. Teachers, moreover, have difficulty teaching what they’ve never had a chance to do themselves: work on a science project from beginning to end.

S.C. Sea Grant Consortium researcher Rob Young of Coastal Carolina University directed the “Rising Tide Project,” which brought researchers, K-12 teachers, and undergraduates together to collaborate on science investigations in local marine environments.

Says Young, “Often, teachers have a pretty good science background but might never have done an actual science project from hypothesis to conclusion. Or they’re teaching a subject that they didn’t focus on during their college education. They have a lot of teaching experience, and they know a lot of scientific facts, but they might never have participated in a full-scale research project.”

“In the Rising Tide Project,” Young adds, “we’ll have a science teacher work with a university faculty member and an undergraduate on an individual research question throughout the summer. Teachers learn how to attack a scientific question, to use all of the critical thinking involved in experimental design and data analysis and interpretation, moving from hypothesis to a conclusion.” Then teachers can bring their knowledge of scientific processes back to their

classrooms and integrate them into their lab exercises. Fifteen teachers from South Carolina schools have participated in the project.

Consortium places South Carolina students in prestigious fellowships

The S.C. Sea Grant Consortium is a statewide leader in supporting graduate and undergraduate students who are completing theses and dissertations in the coastal and marine sciences.

During 2004-2006, the Consortium placed five South Carolina graduate students in the highly competitive Dean John A. Knauss Marine Policy Fellowship Program.

To further the education of tomorrow’s leaders, the National Sea Grant Office sponsors the Knauss fellowship, which brings a select group of graduate students to the nation’s capital where they work in the federal government’s legislative and executive branches. Students learn about federal policy regarding marine and Great Lakes natural resources, and lend their scientific expertise to federal agencies and congressional staff offices.

In 2004, Susannah Sheldon worked in the office of Sen. Daniel Akaka (D-Hawaii). Rebecca Shuford worked for NOAA Fisheries, Highly Migratory Species Division, and Noel Turner completed her fellowship in the NOAA Office of Legislative Affairs’ executive branch. In 2006, Kristine Hiltunen worked in the NOAA Program of Planning and Integration and Liza Johnson completed her fellowship in NOAA Fisheries Office of Response and Restoration, Coral Reef Management.

In addition, the Consortium places South Carolina students in Coastal Management Fellowships. During 2004, two students were placed in state coastal-zone management programs, Amy Filipowicz working in New York and Jacqueline Shapo in Virginia.

“Seed” grant blossoms into new ecology and marine lab additions

According to Roper Mountain Science Center in Greenville, South Carolina, the S.C. Sea Grant Consortium played an integral role in the development of the Center’s Sea Life Room and Ecology Lab.

With the help of “seed money” from the Consortium back in the 1980s, the Center has grown by leaps and bounds. In 2005, Roper Mountain Science Center had over 90,000 students attend lessons.

The Center is in the process of developing education exhibits in the Sea Life Room and the Ecology Lab and projects that, in the coming year, will engage 8,000 students and teachers in the Sea Life Room alone, helping upstate residents learn about the coast.

Each lesson focuses on the South Carolina Science Curriculum Standards. Classes visit the Roper Center from 29 school districts in 14 counties. In addition, about 11,000 other children will see the Sea Life Room at designated public times. The Consortium plans to continue to support the Roper Mountain Science Center and assist with new exhibits to enhance teaching skills and experiences.



ABOVE: Elementary-school students work with a member of a local church's environmental mission group on Sullivan's Island. RIGHT: Middle-school students tackle a particularly needy marsh area on the causeway between Mt. Pleasant and Sullivan's Island. PHOTOS/Wade Spees

Statewide cleanup nets 70 tons of trash in 2004 and 2005

The 16th and 17th annual Beach Sweep/River Sweeps were held September 2004 and 2005, and 8,650 volunteers across South Carolina joined forces to rid beaches, marshes, and waterways of unsightly, and sometimes dangerous, debris.

In 2004, Hurricane Ivan made landfall in North Carolina the day before the Sweep, causing the inland cleanup to be rescheduled due to the flooding of rivers. Yet, 2,650 volunteers were not deterred along the coast, and 11.5 tons of debris were collected from Waites Island to Daufuskie Island.



Sunny skies prevailed in 2005, bringing 6,000 volunteers who removed 58.5 tons of trash statewide. Cleanup crews scoured over 1,050 miles in 38 of South Carolina's 46 counties, recycling as much debris as possible.

S.C. Sea Grant started the first Beach Sweep in 1988 and S.C. Department of Natural Resources joined as an organizing partner in 1990. From 1988 to 2005, volunteers removed 1,704,000 pounds of debris statewide. Litter is a major problem in South Carolina and many hardworking, dedicated volunteers return year after year, considering this community event a tradition. According to Independent Sector, an organization that provides information on the value of volunteer time based on Bureau of Labor Statistics data, Beach Sweep/River Sweep volunteers have given \$370,245 worth of their time, talents, and energy toward the 2004 and 2005 cleanups.

Beach Sweep/River Sweep is supported primarily with donations from the private sector, and is held in conjunction with the Ocean Conservancy's International Coastal Cleanup. For more information, visit www.scseagrants.org/education.

Beach Sweep/ River Sweep Major Sponsors:

Applied Technology and Management (ATM)
BP Cooper River Plant
Ben and Jerry's of Charleston
Charleston City Marina
Cisco's Cafe
Coastal Expeditions
Duke Energy Foundation
Hilex Poly Co., LLC



Magnolia Plantation and Gardens
Marine Terminals of S.C.
Mount Pleasant Waterworks
Piggly Wiggly Carolina Co.
South Carolina Ports—
S.C. State Ports Authority
Sunfire Grill and Bistro
Ocean Conservancy
Universal Data Solutions

International

- Aquatic Plant Management Society
- International Conference on Shellfish Restoration
- International Gullee-Geechee Coalition
- Ocean Conservancy

National

- American Geological Institute
- Consortium for Oceanographic Research and Education
 - National Ocean Sciences Bowl
- Joint Oceanographic Institutions
- National Federation of Regional Associations for Coastal Ocean Observing
- National Marine Educators Association
- National Non-Point Education for Municipal Officials Network
- National Oceanic and Atmospheric Administration (NOAA)
 - NOAA National Centers for Coastal Ocean Science
 - Coastal Ocean Program
 - NOAA National Ocean Service
 - Center for Coastal Environmental Health and Biomolecular Research
 - Coastal Services Center
 - Hollings Marine Laboratory
 - National Estuarine Research Reserve Program (NERR)
 - ACE Basin NERR
 - North Inlet-Winyah Bay NERR
 - NOAA National Weather Service
 - Weather Forecast Office—Charleston
 - NOAA Oceanic and Atmospheric Research
 - Atlantic Oceanographic and Meteorological Laboratories
 - Hurricane Research Division
 - National Sea Grant College Program
 - National Severe Storms Laboratory
 - National Undersea Research Program
 - NOAA Office of Ocean Exploration
 - NOAA Office of Education
- National Science Foundation
- Ocean.US
- U.S. Army Corps of Engineers
 - Charleston District
- U.S. Centers for Disease Control and Prevention
 - National Center for Environmental Health
- U.S. Department of Agriculture (USDA)
 - USDA Agricultural Research Service—Vegetable Laboratory

- USDA Cooperative State Research, Education, and Extension Service
- USDA Farm Service Agency
- USDA Foreign Agriculture Service
- USDA Natural Resources Conservation Service
- USDA Risk Management Agency
- USDA Southern Regional Aquaculture Center
- U.S. Department of Homeland Security
 - U.S. Coast Guard Sector Charleston
 - U.S. Federal Emergency Management Agency—Region IV
- U.S. Department of the Interior
 - U.S. Geological Survey
 - Coastal and Marine Geology Program
 - Water Resources of South Carolina
 - U.S. National Park Service
 - Charles Pinckney National Historic Site
 - Fort Moultrie National Monument
 - Fort Sumter National Monument
 - Ocmulgee National Monument
 - U.S. Environmental Protection Agency
 - Region 4: Southeast
 - Office of Policy, Economics, and Innovation

Regional

- Atlantic States Marine Fisheries Commission
- Carolinas Coastal Ocean Observing and Prediction System (Caro-COOPS)
- Center for Ocean Sciences Education Excellence—Southeast (COSEE-SE)
- Ocean Sciences Bowl, South Carolina and Georgia Region
- South Atlantic Fishery Management Council
- Southeast Atlantic Coastal Ocean Observing System (SEACOOS)
- Southeast Coastal Ocean Observing Regional Association (SECOORA)
- Southeast Phytoplankton Monitoring Network
- Southeast Universities Research Association
- Southern Building Code Council International
- Southern Shrimp Alliance
- Wild American Shrimp, Inc.

State and Local

- Berkeley-Charleston-Dorchester Council of Governments
- Catawba Science Center
- Charleston County Parks and Recreation Commission
 - Caw Caw Interpretative Center
 - Folly Beach County Park

- Coastal Discovery Museum
- County Governments in South Carolina (selected)
 - Beaufort County
 - Berkeley County
 - Charleston County
 - Colleton County
 - Dorchester County
 - Georgetown County
 - Horry County
 - Jasper County
- Discovery Place
- Elachee Nature Science Center
- Fernbank Science Center
- Georgia Aquarium
- Georgia Department of Natural Resources
- Georgia State Parks
 - Crooked River State Park
- Georgia Youth Science Technology Centers
 - Chattahoochee-Flint
- Hilton Head Sportfishing Club
- Jasper Soil and Water Conservation District
- Kiawah Island Community Association
- Leadership South Carolina
- Lowcountry Estuarium
- Lowcountry Council of Governments
- Lowcountry Science Fair
- Monterey Bay Aquarium Research Institute
- Murrells Inlet Fishing Club
- North Carolina Aquarium
- North Carolina Estuarium
- North Carolina Museum of Natural Sciences
- North Carolina Zoo
- Piedmont Environmental Center
- Public Works Commission Watershed Education Center
- Roper Mountain Science Center
- S.C. Association of Counties
- S.C. Center for Technological Innovation
- S.C. Commission on Higher Education
 - S.C. GEAR UP
- S.C. Department of Education
 - Office of the Science Coordinator
- S.C. Department of Health and Environmental Control
 - Environmental Quality Control, Bureau of Water
 - Office of Ocean and Coastal Resource Management
 - Trident and Waccamaw Health Districts
- S.C. Department of Natural Resources
 - Flood Program
 - Land, Water, and Conservation Division
 - Law Enforcement Division
 - Marine Resources Division
 - Outreach and Support Services Division
 - Waddell Mariculture Center
 - Wildlife and Freshwater Fisheries Division
- S.C. Department of Parks, Recreation, and Tourism
 - Charles Towne Landing
 - Edisto Beach State Park
 - Givhans Ferry State Park
 - Hunting Island State Park
 - Huntington Beach State Park
 - Myrtle Beach State Park

- S.C. Emergency Management Division
- S.C. Forestry Commission
- S.C. Government Webmasters Association
- S.C. Information Resources Council
- S.C. Soil and Water Conservation Service
- S.C. State Museum
- S.C. State Ports Authority
- S.C. Task Group on Harmful Algae
- Sandy Creek Nature Center
- School Districts
 - Berkeley County School District
 - Charleston County School District
 - Clarendon County School District 2
 - Colleton County School District
 - Darlington County School District
 - Dorchester County School District 4
 - Florence County School District 3
 - Hampton County School District 2
 - Orangeburg County School District 5
 - Richland County School District 1
 - Williamsburg County School District
- SciWorks Planetarium
- South Carolina Aquarium
- South Carolina Cities and Towns (selected)
 - City of Charleston
 - City of Folly Beach
 - City of Georgetown
 - City of Hardeeville
 - City of Isle of Palms
 - City of Myrtle Beach
 - City of North Myrtle Beach
 - Town of Bluffton
 - Town of Edisto Beach
 - Town of Hilton Head Island
 - Town of Kiawah Island
 - Town of Pawleys Island
 - Town of Ridgeland
 - Town of Sullivan's Island
 - Town of Surfside Beach
 - Town of Yemassee
- South Carolina Coastal Public Schools (>180)
- South Carolina Science Council
- Sturgeon City Environmental Education Center
- Waccamaw Regional Council of Governments
- Western North Carolina Nature Center

Academic Institutions

Member Institutions:

- Clemson University
- Coastal Carolina University
- College of Charleston
- Medical University of South Carolina
- South Carolina State University
- The Citadel
- University of South Carolina

Others:

- Florida Gulf Coast University
- Florida International University
- Georgia Institute of Technology

- Kennesaw State University
- Lowcountry Graduate Center
- North Carolina State University
- S.C. Sustainable Universities Initiative
- Sea Grant College Programs Nationwide (31)
- Skidaway Institute of Oceanography
- State University of New York—Albany
- Texas A&M University
- University of Connecticut Extension Service
- University of Florida
- University of Georgia Research Foundation
- University of Massachusetts—Dartmouth
- University of New Hampshire
- University of North Carolina—Chapel Hill
- University of North Carolina—Wilmington
- University of Texas—El Paso
- University of West Georgia
- Virginia Institute of Marine Science

Non-Governmental Organizations

- 113 Calhoun Street Foundation
- Allison Woods Foundation
- Ashley Scenic River Advisory Council
- Beaufort County Open Land Trust
- Beaufort County Water Quality Task Force
- Boy Scouts of America—Coastal Carolina Council
- Charleston Homeownership Center
- DeeDee Paschal Barrier Island Trust
- Friends of Hunting Island
- Friends of the Edisto
- Friends of the Rivers
- Girl Scouts of Carolina Low Country
- Gullah/Geechee Sea Island Coalition
- Historic Ricefields Association
- Keep South Carolina Beautiful
- Low Country Institute
- Maritime Association of the Port of Charleston
- Noisette Foundation
- Palmetto Bluff Conservancy
- S.C. African-American Heritage Council
- S.C. Aquaculture Association
- S.C. Aquatic Plant Management Society
- S.C. Association for Hazard Mitigation
- S.C. Coastal Conservation League
- S.C. Chapter of the American Planning Association
- S.C. Community Development Association
- S.C. Crab Industry Association
- S.C. Downtown Development Association/Community Builders
- S.C. Economic Developers Association
- S.C. Marine Association
- S.C. Marine Educators Association
- S.C. Municipal Association
- S.C. Nature-Based Tourism Association
- S.C. Seafood Alliance
- S.C. Shellfish Association
- S.C. Shrimp Growers Association
- S.C. Shrimpers Association
- S.C. Steering Committee of the Southern Passages Project

- S.C. Wildlife Federation
- Spring Island Trust
- The Nature Conservancy
- Trust for Public Land
- Upstate Forever
- Ducks Unlimited
- Winyah Bay Foundation

Business and Industry

- Applied Phytogenetics, Inc.
- Applied Technology and Management, Inc.
- BASF
- Ben and Jerry's of Charleston
- Berkeley Electric Cooperative
- BMW Manufacturing Corp.
- BP Cooper River Plant
- Bull's Bay Seafood
- Charleston City Marina
- Charleston Metro Chamber of Commerce
- Coastal Expeditions
- Coastal Landscape Construction
- Copper Station Holdings
- Debra Hernandez and Co.
- Dewees Island Development
- Duke Power Company
- Dunes Properties
- Fife Plantation
- Gold Kist, Inc.
- Good Hope Plantation and Corporation
- Great Bay Farms
- Griffin BioSafe Systems
- Hilex-Poly Co., LLC
- Institute of Business and Home Safety
- Island Fresh Seafood
- Kinghorn Insurance Services
- Lockheed Corporation
- Lowcountry Seafood, Inc.
- Magnolia Plantation and Gardens
- Marine Terminals of S.C.
- Mistyvale Crawfish Farm
- Nada Williams Realty
- Noisette Company
- Okatee Club
- Osprey Point Golf Resort
- Palmetto Aquaculture Corporation
- Paradise Seafarm
- Piggly Wiggly Carolina Co.
- Professional Lake Management, Inc.
- Ripley's Aquarium
- S.C. Chamber of Commerce
- Santee Cooper
- SCANA Corporation
- SePro
- Southland Fisheries Corporation
- Spring Hill Plantation
- Swimming Rock Fish and Shrimp Farm
- Thicketwater Clam Farm
- Turkey Hill Plantation
- Universal Data Solutions

The S.C. Sea Grant Consortium competed for and secured the following coastal and marine research, education, and extension grants from non-state sources:

National Sea Grant College Program — Core Support

Program Management, Development, and Outreach

- Program Management (M.R. DeVoe - S.C. Sea Grant Consortium)
- Program Development (M.R. DeVoe - S.C. Sea Grant Consortium)
- Communications and Information Services (L.J. Blackwell - S.C. Sea Grant Consortium)
- S.C. Sea Grant Extension Program (R.H. Bacon - Clemson University Extension)

Ecosystem Dynamics

- Succession of Tidal Freshwater Wetlands on the Cooper River, S.C.: Ecological Functions and Management Alternatives (J. Morris and D. Tufford - University of South Carolina and B.J. Kelley - The Citadel)
- The Effectiveness of Vegetative Buffers in Reducing Nonpoint Source Pollution in Stormwater Detention Ponds (A. Lewitus - University of South Carolina and M. Burke - USDA Southern Forest Research Center)
- Control of Saltmarsh Cordgrass by Blue Crab Predation on Periwinkle Snails: An Immunological Gut Check (R. Feller - University of South Carolina)
- Functional Relationships (Coupling) Between Epiphytic Microalgae and Foodwebs in a Saltmarsh Estuarine System and Their Management Implications (R. Zingmark and A. Lewitus - University of South Carolina)

- Using Diamondback Terrapins as Surrogate and Sentinel Species for Monitoring Mercury Contaminants in Coastal and Estuarine Systems (D. Owens - College of Charleston)

Coastal Natural Hazards

- K-12 Educational Program on Wind Hazards Assessment and Mitigation Measures (T. Reinhold - Clemson University)

Marine Aquaculture and Fisheries

- Impacts of Stocked Red Drum on the Recreational Fishery and Local Community of Murrells Inlet: Biological and Economic Considerations (T.I.J. Smith - SCDNR Marine Resources Division)
- Developing Approaches and Associated Metrics for Restoration Success: Determining Intertidal Oyster Matching Goals with Using Small- and Large-Scale Reefs (L. Coen - SCDNR Marine Resources Division)
- S.C. Blue Crabs: South Carolina Blue Crab Regional Abundance Biotic Simulation (D. Childress - Clemson University and E. Wenner - SCDNR Marine Resources Division)
- Planning for a Regulatory System to Implement Ecosystem-Based Fisheries Management (K. Connolly - University of South Carolina)

Coastal Communities and Economies

- Addressing the Challenges of Coastal Growth in South Carolina: A S.C. Sea Grant Consortium Initiative (M.R. DeVoe and A. Turner - S.C. Sea Grant Consortium)

Marine Education

- Developing and Implementing a Southeast Marine Science Curriculum and Leadership Training Program: COASTeam Leadership Institute (L. Sautter - College of Charleston)
- Expanding the Rising Tide Project: Changing How Researchers, Educators, and Students Work Together (R. Young - Coastal Carolina University)

Extramural Grants and Projects

Coastal-Ocean Processes

- Southeast Atlantic Coastal Ocean Observing System - Initial Implementation - Office of Naval Research (through the University of North Carolina - Chapel Hill) - September 1, 2004 to August 31, 2006 (Years 3 and 4 of 4) - M.R. DeVoe and L. Spence (S.C. Sea Grant Consortium) and R.H. Bacon (S.C. Sea Grant Extension Program)
- Southeast Regional Association for Coastal Observations (SERA-COOS): Building a Regional Association Framework for the Coastal Ocean Observing System of the Southeastern United States - NOAA Coastal Services Center - October 1, 2004 to September 30, 2005 (Year 2 of 2) - M.R. DeVoe (S.C. Sea Grant Consortium)
- Demo 10: SouthEast Coastal Ocean Observations Regional Association - Southeastern Universities Research Association - SCOOP - September 1, 2004 to August 31, 2006 - M.R. DeVoe and S. Bernard (S.C. Sea Grant Consortium)

- SouthEast Coastal Ocean Observations Regional Association (SECOORA): Building a Regional Association Framework for the Coastal Ocean Observing System of the Southeastern United States - NOAA Coastal

Services Center - October 1, 2005 to September 30, 2006 - NOAA Coastal Services Center - (Year 1 of 3) - M.R. DeVoe and S. Bernard (S.C. Sea Grant Consortium)

- Enhancing Communications and Coordinating Outreach Activities throughout the IOOS Community: The NFRA Contribution - NOAA Coastal Services Center - August 1, 2005 to July 31, 2006 (Year 1 of 1) - M.R. DeVoe (S.C. Sea Grant Consortium)

Ecosystem Dynamics

- Expanding Existing Surveillance Systems to Include *Pfiesteria*, Other Harmful Algal Blooms, and Marine Toxins in South Carolina - Centers for Disease Control - \$523,890 - September 1, 2005 to August 31, 2006 (Years 2 and 3 of 3) - M.R. DeVoe (S.C. Sea Grant Consortium)

Involved faculty and students from SCDNR Marine Resources Division, University of South Carolina, S.C. Department of Health and Environmental Control (SCDHEC), NOAA-NOS Center for Coastal Environmental Health and Biomolecular Research, and Medical University of South Carolina.

- Vegetational Classification of South Carolina Former Rice Impoundments: A Determination of Plant Community Patterns and Areas Using 1994 and 1999 NAPP DQPP Photography - SCDHEC-Office of Ocean and Coastal Resource Management (OCRM) - April 6, 2004 to December 10, 2004 - B.J. Kelley (The Citadel)
- State of Knowledge Report for South Carolina Coastal Wetland Impoundments - SCDHEC-OCRM - June 1, 2004 to December 31, 2004 - D. Tufford (University of South Carolina)
- Sea Grant Studies of Hypoxia in Long Bay, South Carolina - SCDHEC-OCRM - January 1, 2005 to February 28, 2006 (Year 1 of 2) - G. Voulgaris

(University of South Carolina) and E. Koepfler et al. (Coastal Carolina University)

Coastal Natural Hazards

- South Carolina Coastal Erosion Study - Phase II - U.S. Geological Survey - September 1, 2004 to August 31, 2006 (Years 4 and 5 of 6) - M.R. DeVoe (S.C. Sea Grant Consortium)

Involved faculty from Coastal Carolina University, University of South Carolina, College of Charleston, and Georgia Institute of Technology.

- National Sea Grant Coastal Hazards Theme Team - NOAA National Sea Grant College Program - \$15,000 - March 1, 2004 to February 28, 2006 (Years 5 and 6) - M.R. DeVoe (S.C. Sea Grant Consortium) and R.H. Bacon (S.C. Sea Grant Extension Program)

Emerging Technologies

- Cooperative Program in Fisheries Molecular Biology (FISHTEC) - NOAA National Ocean Service - September 1, 2004 to August 31, 2006 (Year 12 and 13 of 14) - M.R. DeVoe (S.C. Sea Grant Consortium)

Involved faculty from the University of South Carolina and scientists from SCDNR-Marine Resources Research Institute.

Marine Aquaculture and Fisheries

- Assisting Gulf States in the Development of Risk Management Plans, including Education, PHT Promotion, and Regular Controls - NOAA National Sea Grant College Program - June 1, 2004 to May 31, 2005 (Year 2 of 2) - K. Moore (Interstate Shellfish Sanitation Commission)
- High Rate Algal Systems for Sustainable Marine Bivalve Seed and Shrimp Production - NOAA National Sea Grant

College Program - \$40,000 - July 1, 2005 to August 31, 2006 - D.E. Brune (Clemson University)

- S.C. Sea Grant Fisheries Extension Enhancement Program - NOAA National Sea Grant College Program - May 1, 2004 to February 28, 2006 (Year 1 and 2 of 5) - M.R. DeVoe (S.C. Sea Grant Consortium) and R.H. Bacon (S.C. Sea Grant Extension Program)

- Facilitation of *Vibrio vulnificus* Risk Management Plan: Workshop for Educators, State, and Federal Agency Representatives, and Shellfish Industry - Online CME Course for Nurses and Dieticians - NOAA National Sea Grant College Program - June 1, 2005 to May 31, 2006 (Year 1 of 1) - K. Moore (Interstate Shellfish Sanitation Commission)

- Gulf Oyster Industry Program: A Training Workshop on Pigment-Based Detection of the Harmful Dinoflagellate *Karenia brevis* - NOAA National Sea Grant College Program - June 1, 2005 to May 31, 2006 - (Year 1 of 1) - T. Richardson and J. Pinckney (University of South Carolina)

- South Carolina Cooperative Fisheries Research Grant Program - NOAA Fisheries through the S.C. Department of Natural Resources - July 1, 2006 to June 30, 2007 (Year 1 of 2) - M.R. DeVoe (S.C. Sea Grant Consortium)

Coastal Communities and Economies

- South Atlantic Bight Land Use - Coastal Ecosystem Study (LU-CES) - NOAA Coastal Ocean Program - July 1, 2004 to June 30, 2005 (Year 5 of 5) - M.R. DeVoe (S.C. Sea Grant Consortium)
- Smart Growth Pilot Project - NOAA National Sea Grant College Program - March 1, 2004 to

February 28, 2005 - A. Turner (S.C. Sea Grant Consortium)

- Urbanization and Southeastern Estuarine Systems (USES) - NOAA Coastal Ocean Program - August 1, 2004 to July 31, 2006 (Year 15 and 16 of 16) - F.J. Vernberg (University of South Carolina)
- Addressing the Challenges of Coastal Growth in South Carolina: A S.C. Sea Grant Consortium Initiative - M.R. DeVoe and A. Turner (S.C. Sea Grant Consortium)
- NOAA National Sea Grant College Program - March 1, 2004 to February 29, 2006 (continuing) - M.R. DeVoe (S.C. Sea Grant Consortium)
- Cooperative Coastal Processes Specialist Extension Position - Coastal Carolina University - January 1, 2004 to December 31, 2005 (continuing) - M.R. DeVoe (S.C. Sea Grant Consortium)
- Palmetto Bluff: Evaluating the Potential Impacts of Elevated Boat Traffic and Related Anthropogenic Effects with Regard to Shoreline Changes and Intertidal Oyster Habitat Status and Trends - Palmetto Bluff Conservancy. L. Coen (S.C. Department of Natural Resources)

Public Awareness and Outreach

- Sea Grant Abstracts - NOAA National Sea Grant College Program - \$95,000 - March 1, 2004 to February 28, 2006 - F. Shephard (Woods Hole Database, Inc.)
- Support for Beach Sweep/River Sweep '04 and '05 Activities - Private Donations - September 2004 and 2005 - S. Ferris Hill (S.C. Sea Grant Consortium)

Marine Education and Training

- Southeastern Center for Ocean Sciences Education Excellence (COSEE-SE): A Systematic Approach to Forming Ocean Science Education Partnerships - National Science Foundation (with partial funding provided by the National Oceanic and Atmospheric Administration) - September 1, 2004 to August 31, 2006 - L. Spence (S.C. Sea Grant Consortium)
- Sea Grant Knauss Fellowships (5) - NOAA National Sea Grant College Program - \$82,000 - March 1, 2005 to February 28, 2007 - M.R. DeVoe (S.C. Sea Grant Consortium), College of Charleston (four students) and University of South Carolina (one student)

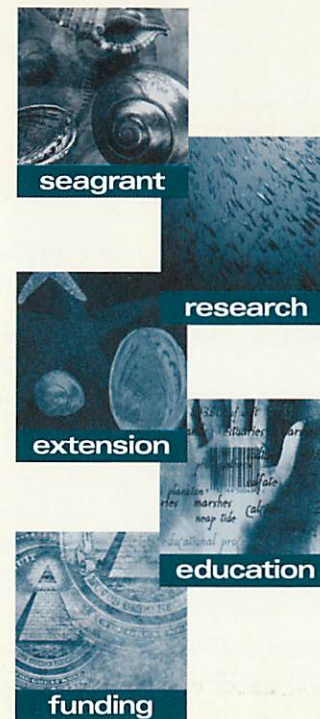
Program Development Projects

- Sampling Program to Understand Functional Relationships (Coupling) between Epiphytic Microalgae and Food Web in a Salt Marsh - R. Zingmark (University of South Carolina)
- Water Quality Restoration for the S.C. Subdivision Pond, Lake Edmonds - M. DeLorenzo (Belle W. Baruch Institute, University of South Carolina)
- Wind Tower Deployments and Pressure Sensor Installations on Coastal Homes - D. Prevatt (Clemson University)
- Conference Support of Society of Wetland Scientists - 26th Annual Meeting - J. Pollack (Belle W. Baruch Institute, University of South Carolina)
- Support of Joint Southeastern Stormwater Management and Erosion and Sediment Control Conference - C. Moore (University of Georgia)

- Co-sponsorship of 3rd National Conference on Coastal and Estuarine Habitat Restoration - H. Potts (Restore America's Estuaries)
- S.C. Space Grant and S.C. Sea Grant Kathryn Sullivan Science and Engineering Fellowship - M. Russell (College of Charleston)
- Evaluating Habitat Restoration Success Using Community and Larger Scale Intertidal Oyster Reefs in S.C. - L. Coen (S.C. Department of Natural Resources)
- Travel Support for Dean John A. Knauss Fellow - S. Sheldon (United States Congress)
- Effects of Inlet Restoration on Control of Invasive Species, Sandpiper Pond, S.C. - J. Luken (Coastal Carolina University)
- Sponsorship of Spring 2005 Southeastern Estuarine Research Society Meeting, Charleston, S.C. - P. Pennington (National Oceanic and Atmospheric Administration)
- Support of Grice Marine Biology, College of Charleston Graduate Student Colloquium - J. Weinstein (The Citadel)
- Support of 2005 Conference of the S.C. Marine Educators Association - N.M. Stephenson (S.C. Marine Educators Association)
- Study of Newly Reported Parasitic Nematode of the Southern Flounder (*Paralichthys lethostigma*) in a S.C. Estuarine System - I. deBuron (College of Charleston)
- Behavioral Ecology of Spotted Seatrout (*Cynoscion nebulosus*) at Spawning Aggregations in the Charleston Harbor - D.G. Sancho (College of Charleston)

- Demonstration Project to Construct a Semi-automated Auger Conveyor System for Bagging Oyster Shell - L. Coen (S.C. Department of Natural Resources)
- Support for Ph.D. Student's Dissertation on Oyster Disease - A. Mount (Clemson University)
- College of Charleston Graduate Program in Marine Biology Student Research Colloquium (printing of abstracts) - E. Burge (College of Charleston)
- Regional Oyster Workshop Support - J. Whetstone (S.C. Sea Grant Consortium and Clemson University)
- International Conference on Shellfish Restoration Support - M.R. DeVoe (S.C. Sea Grant Consortium)
- Support for the Regional S.C./GA National Ocean Sciences Bowl - A. Miller (Belle W. Baruch Institute, University of South Carolina)
- Meeting Support for the National Shellfisheries Association Annual Meeting - S. Shumway (University of Connecticut)
- Marine Eco-genomics Workshop Support for Regional Research Partnership Assessment Workshops - E. Lacy (Medical University of South Carolina)
- S.C. Space Grant and S.C. Sea Grant Katherine Sullivan Science and Engineering Fellowship Student Award - J. Babcock (College of Charleston)
- Research Support for Functional Relationships (Coupling) Between Epiphytic Microalgae and Food Webs in a Salt Marsh - R. Zingmark (University of South Carolina)

- Support for Marine Education Workshops through the S.C. Marine Educators Association - N.M. Stephenson, (S.C. Marine Educators Association)
- Research Support for Utilization of Dissolved Organic Phosphorus by Phytoplankton in Winyah Bay, S.C. - T. Richardson (University of South Carolina)
- Research Support for Testing a New Method to Assess Fluctuations in Sea Level Along the South Carolina Coast: Use of Palynomorphic Signatures to Identify Changes in Positions of *Juncus roemerianus* High Level Salt Marshes Over Time - A. Cohen (University of South Carolina)



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www.scseagrant.org

financial report

March 1, 2004 - Feb. 28, 2005

Program Area

	State & Other Matching Funds	Federal Funds
Abstracts		\$ 95,000.00
A Harmful Algal Bloom Initiative for SC		\$ 25,390.00
Climate and Hazards		\$ 15,000.00
Coastal Ocean Studies	\$ 43,142.00	\$ 78,445.00
Ecosystem Dynamics	\$131,362.00	\$ 214,516.00
Emerging Technologies	\$ 35,985.00	\$ 59,600.00
Expanding Existing Surveillance Systems to Include <i>Pfiesteria</i> (CDC)		\$ 523,890.00
Interstate Shellfish Sanitation Commission		\$ 100,005.00
Land Use-Coastal Ecosystem Study (LUCES)	\$191,482.00	\$1,097,652.00
Marine Aquaculture and Fisheries	\$104,840.00	\$ 185,199.00
National Marine Aquaculture Initiative		\$ 162,800.00
Other Funds (Palmetto Bluff, Beach Sweep/River Sweep)		\$ 62,734.00
Program Management, Development, and Outreach	\$108,371.00	\$ 367,670.00
S.C. Coastal Erosion Study (USGS)		\$ 500,000.00
S.C. Sea Grant Fisheries Extension Program	\$ 39,931.00	\$ 78,254.00
Sea Grant Knauss Fellowships		\$ 114,000.00
Sea Grant Marine Education	\$ 55,543.00	\$ 108,918.00
Sea Grant Marine Extension	\$196,015.00	\$ 302,322.00
Southeast Atlantic Coastal Ocean Observing System (SEACOOS)		\$ 143,000.00
Southeast Regional Assn. for Coastal Observation Systems (SERA-COOS)		\$ 93,979.00
Southeast Center for Ocean Sciences Education Excellence (COSEE-SE)		\$ 300,000.00
State of Knowledge Report for South Carolina Coastal Wetland Impoundments		\$ 31,142.00
SURA Coastal Ocean Observation and Prediction		\$ 220,000.00
Urbanization and Southeastern Estuarine Systems	\$ 60,383.00	\$ 831,829.00

March 1, 2005 - Feb. 28, 2006

Program Area

	State & Other Matching Funds	Federal Funds
Abstracts		\$ 47,500.00
Climate and Hazards	\$ 24,099.00	\$ 62,998.00
Cooperative Coastal Processes Specialist		\$ 36,015.00
Cooperative Institute for Fisheries Molecular Biology		\$ 90,000.00
Ecosystem Dynamics	\$146,650.00	\$ 275,171.00
Enhancing Communications and Coordinating Outreach to IOOS Community		\$ 24,995.00
Expanding Existing Surveillance Systems to Include <i>Pfiesteria</i>		\$ 523,890.00
Facilitation of <i>Vibrio vulnificus</i> Risk Management Program		\$ 126,050.00
Interstate Shellfish Sanitation Commission		\$ 29,048.00
Marine Aquaculture and Fisheries	\$123,351.00	\$ 205,788.00
National Marine Aquaculture Initiative		\$ 40,000.00
Other Funds (Beach Sweep/River Sweep)		\$ 19,630.00
Program Management, Development, and Outreach	\$108,371.00	\$ 386,084.00
S.C. Coastal Erosion Study (USGS)		\$ 450,000.00
S.C. Cooperative Fisheries Research Grant		\$ 585,000.00
S.C. Sea Grant Fisheries Extension Program	\$ 59,829.00	\$ 78,254.00
Sea Grant Knauss Fellowships		\$ 83,000.00
Sea Grant Marine Education	\$ 57,197.00	\$ 104,307.00
Sea Grant Marine Extension	\$196,015.00	\$ 297,322.00
Sea Grant Studies of Hypoxia in Long Bay, S.C.		\$ 159,303.00
Southeast Atlantic Coastal Ocean Observing System (SEACOOS)		\$ 120,260.00
Southeast Coastal Ocean Observing Regional Association (SECOORA)		\$ 379,549.00
Southeast Center for Ocean Sciences Education Excellence (COSEE-SE)		\$ 400,000.00
Urbanization and Southeastern Estuarine Systems		\$ 957,234.00



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