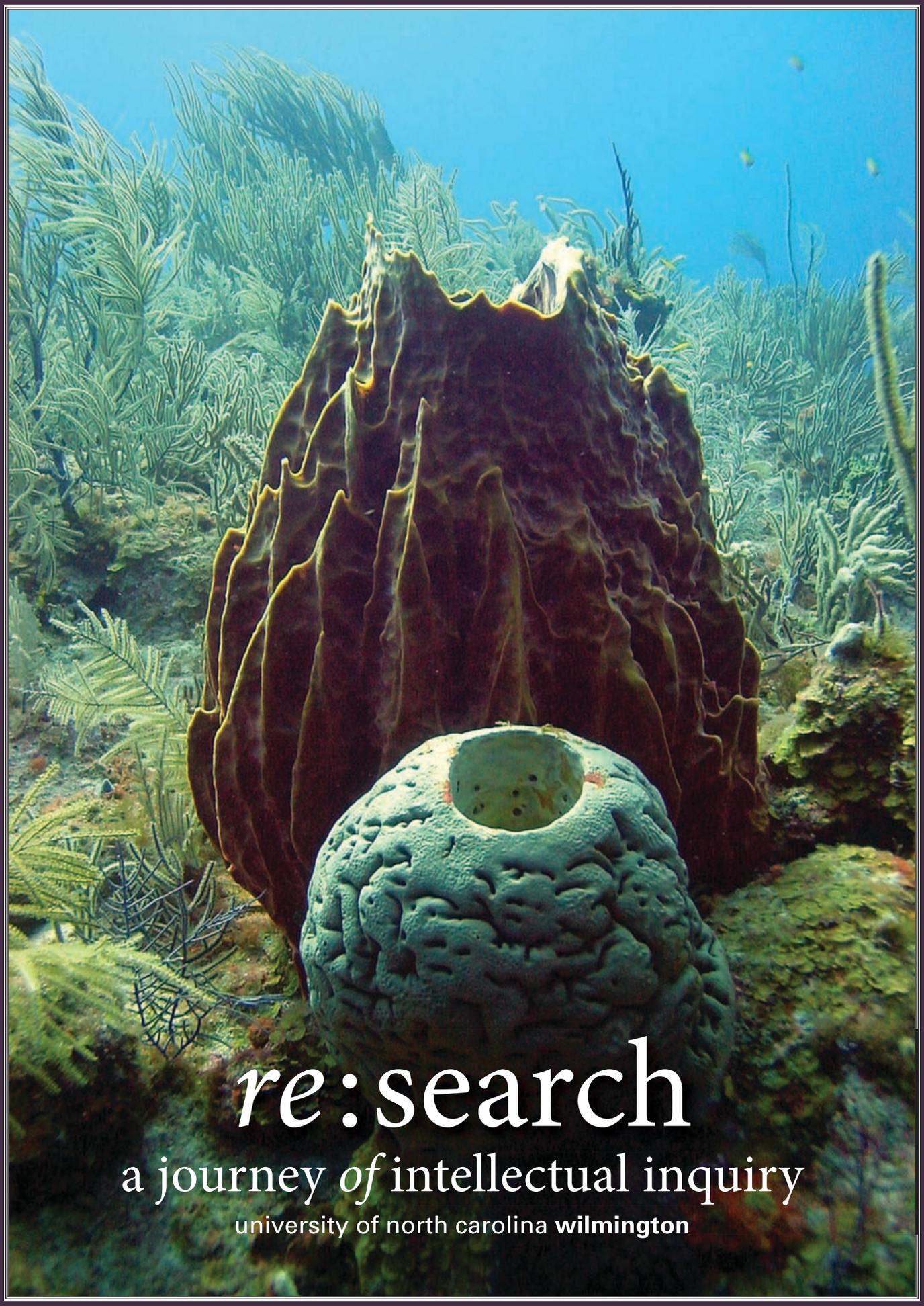


re:search

a journey *of* intellectual inquiry

university of north carolina **wilmington**

UNDERSTANDING OURSELVES AND OUR WORLD

Today, faculty and students conducting sponsored research at the University of North Carolina Wilmington are making an impact regionally, nationally and globally. This issue of *re:search* magazine highlights just some of many contributions that UNC Wilmington researchers are making to better our understanding of the world, from evolutionary biology to economics, from the Caribbean to the Antarctic.

Marine science is a cornerstone of the UNCW research enterprise. One area of the 'blue planet' that is the focus of a number of projects is the Caribbean Sea, particularly the coral reefs that are so essential to its ecology. UNC Wilmington's role in supporting the health of Caribbean coral reefs places the university at the center of international efforts to monitor and manage current stressors on this valuable part of the world's ecosystem. To support better decision making, a Cameron School of Business researcher puts the current threat from warming waters, oceanic pollution, uncontrolled tourism, shipping and fishing in terms of dollars and cents. How much *is* a healthy coral reef worth?

A Department of Geography and Geology researcher models the climatology and monitors the water budget of the Bahamas and northern Caribbean islands. A world away, a UNCW ornithologist and paleobiologist assesses the impact of global temperature change, measuring the past advance and retreat of the Ross Ice Shelf in Antarctica by locating and dating the signs of penguin habitation.

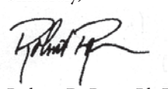
A dynamic group of researchers from the Department of Chemistry and Biochemistry and the Center for Marine Science study the composition of rainwater, particularly substances called chromophoric dissolved organic matter (CDOM). In rain, CDOM may act as a natural sunscreen to the planet and help to offset the effects of global warming.

Regionally, UNCW researchers collaborate with K-12 educators to advance education in the sciences, math and technology. A UNCW psychology professor's research will aid teachers across the region and nation in understanding how different minds visualize and comprehend mathematical concepts. Other regional research projects are restoring North Carolina's native oyster population and re-establishing the state's coastal bulkheads, preventing further loss of Carolina's estuarine shorelines and coastal marshes.

Faculty from UNCW's Center for Marine Science study the effects of red tide algae blooms and have found a compound in red tide algae with exceptional potential pharmaceutical promise. The center promotes marine biotechnology by providing postdoctoral fellowships that include completion of an MBA, giving young scientists the means to market valuable research.

Throughout this issue, we showcase the integral association of undergraduate and graduate students in faculty research – a true hallmark of UNCW. You will see features on the projects of doctoral students in marine biology and undergraduate students alike. We hope you enjoy reading *re:search* and come away with an appreciation of the breadth of scholarly activity and the excitement of discovery going on at UNCW.

Sincerely,



Robert D. Roer, Ph.D.
Dean of the Graduate School and Research

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UNCW

*re:*search a journey of intellectual inquiry
to explore or examine in order to discover

September 2007

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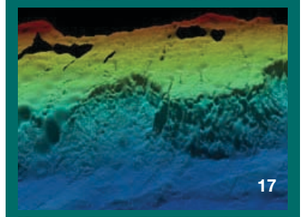

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THREE IN FIVE OR 60 PERCENT?

UNCW/JAMIE MONCRIEF

Psychology professor **Dale Cohen** has received a large grant – $691,000 – to study how people understand very small numbers.

The grant, awarded by the National Institute of Child Health and Human Development, part of the National Institutes of Health (NIH), resulted from a paper that Cohen published in the *Journal of Experimental Psychology* in 2002 titled "What Very Small Numbers Mean." Cohen found that people have considerable difficultly converting different representations of quantity in small numbers. One of his main objectives is to identify how training and learning can affect an individual's "number sense" of small numbers.

Number sense is the intuitive understanding of numeric formats that lays the foundation for mathematics education. Understanding that a biased interpretation of numerical symbols may lead to mathematical errors, Cohen's research will lay the foundation for quantifying an individual's number sense as well as further the understanding of cognitive processes that support number sense among individuals.

.5

50%

1 in 2

½

symbolize the same amount

Number sense is the intuitive understanding of numeric formats that lays the foundation for mathematics education.

For example, the following numbers symbolize the same amount: .5, 50%, 1 in 2 and ½. By understanding how these quantities are processed, visualized or related in the mind, we can develop educational techniques that will help individuals acquire a more accurate sense of numbers.

"Numerical relationships are important because we use them all the time to denominate the risk of disease, the probability of rain, and in countless other ways," Cohen says.

Yet, as Cohen points out, "Try to put 1 in 5 in a decimal form. It is very difficult." It is difficult because humans use a verbal rule-base system rather than an intuitive translation.

During the five-year grant period, Cohen will create mathematical and computer models to study participants' cognitive processes and use unique statistical procedures to understand and quantify numeric sense.

The international education community has recently come to recognize the essential role that the link between numerical symbols and intuitive sense of amount plays in the development of mathematical abilities. For example, the National Council of Teachers of Mathematics (NCTM) Principles and Standards document states that number sense is central to their Number and Operations Standard. The standard requires pre-kindergarten to grade 12 students to understand numbers, understand ways of representing numbers, relationships among numbers as well as number systems and be able to make reasonable estimates.

Cohen's important work on individual cognitive processes, and his assessments of teaching and learning outcomes have flourished here at UNCW.

"I feel that UNC Wilmington has allowed me the freedom to grow as a researcher. Many research universities force professors to publish quickly. Here, I can work on a project until I come to an answer, then publish a paper with five experiments and tell the full story. The university fosters freedom and independence and this has helped my research grow without limiting it," Cohen says.

RACISM AND TOURISM

Facing the Caribbean Sea to the northwest and one of the most beautiful bays in the world to the south is the city of Cartagena, Colombia. With its beaches, old walled city and historic forts it is a popular tourist destination.

Officially designated a United Nations World Heritage Site, Cartagena boasts some of the best hotels in Latin America and one of its largest, poorest urban black populations.

Of the city's approximate 1 million inhabitants, about 60 to 70 percent are Afro-Colombian, and while tourism attracts wealthy visitors and tourist-driven dollars to the area, the city's black population has not benefited. More than 30 percent of the city's Afro-Colombians fail to satisfy basic needs, and approximately 70 percent live in poverty, defined in Cartagena as making less than $2 USD a day.

One segment of the city's Afro-Colombian population is also a cultural icon, the *palenqueras.* The *palenqueras*, Cartagena's traditional women fruit sellers carry bowls of local fruits balanced on their heads up and down the beaches and through the city streets. They are the subject of a research paper by assistant professor of Spanish **Christopher Dennis** titled "From Fugitive Slave to Tourist Attraction: La Palenquera and Racial Iconography in Cartagena Colombia."

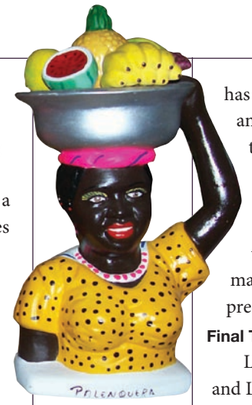
Dennis traces the history of these women and the racial implications inherent in their most popular iconic form: ceramic figurines that line souvenir shop shelves on row upon row. Images of these figurines are replicated and repeated on postcards, brochures, coffee mugs and other souvenir items throughout the city.

"Through an analysis of the iconography found on these handicrafts and souvenirs, I hope to demonstrate how the once rebellious symbol of the *palenquera* has been racialized, sexualized, domesticated and converted into the 'harmless' and even exotic image of the 'woman of color' selling her fruit in Cartagena," Dennis says.

Palenqueros are descendents of a group of *cimarrones* or fugitive slaves from the settlement Palenque de San Basilio, one of the more well-known freed-slave communities (*palenques*) founded in the Americas by self-emancipated slaves.

Although it is true that recent constitutional reforms have promoted ethnic rights in the country and spawned new debates on multiculturalism, Dennis maintains that "racism still exists, symbolized by the popularity of these type of souvenirs that reflect longstanding racial stereotypes and prejudices that continue to define race relations in the region."

"Souvenirs, almost by definition, are supposed to serve as somewhat truthful reminders of the people and places we visit," Dennis says. He believes that "it would be naïve to downplay the influence that the proliferation of this type of iconography has on the way local inhabitants and tourists perceive – and even treat – the *palenqueras."*



Dennis hopes that **"Perhaps this research will raise awareness of the importance of practicing cultural sensitivity in all parts of the world particularly regarding the way local cultures can be misrepresented and negatively affected by tourism."**

"This particular objectification," Dennis argues, "robs this group of black women of their living and evolving nature, making it difficult to transcend predefined identities and roles."

Final Thoughts

Like other parts of the Caribbean and Latin America, in Colombia, it is generally accepted that racial discrimination does not exist, or that if it does, it is at least very minimal.

Nevertheless, according to Dennis, this iconography serves as evidence that "full exercise of citizenship and benefits of belonging have not been totally achieved by Afro-Colombians, who continue to be subjected to daily, often subtle and trivial forms of racism. It can be implicit, embodied in social relations, transmitted through words, images and insipid behaviors; a type of racism manifested sometimes unconsciously by individuals with the best intentions."

CHRISTOPHER DENNIS

TECHNOLOGY, SOCIOECONOMICS AND STATUS AMONG THE MAYA

"Always remember that you are absolutely unique. Just like everyone else."

— ANTHROPOLOGIST MARGARET MEAD, 1901-1978

SCOTT SIMMONS

The Belize Barrier Reef is the second largest coral reef in the world, and more than 22 percent of the country is protected as parks, natural resource reserves and wildlife sanctuaries. Of particular interest to anthropologists and archeologists, Belize is also home to the highest concentration of Maya ruins in Central America.

Undisturbed Maya ruins at the large site of Lamanai, located on the New River Lagoon, brought UNCW associate professor of anthropology **Scott Simmons** to Belize to direct the Maya Archaeometallurgy Project in 1999. To date, just 20 percent of the extensive site has been excavated.

Simmons' work focuses on the relationships between metalworking, especially copper production, and socioeconomic differentiation and interdependence among the Maya. "We are trying to unravel not only how these people were making objects, but also how they organized their technology," Simmons says.

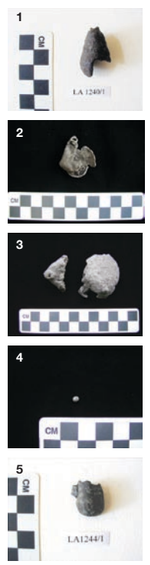
"It seems that the ancient Maya valued certain physical symbols that related levels of social standing to others within their communities in much the same way as many in Western society do today," Simmons says. Some of these valued symbols included elaborate button-like ornaments, finger rings and tweezers. Tweezers were often suspended around the neck, probably as a sign of elevated social status. The more common people also had access to metals, but were more likely to use metal for utilitarian objects such as axes, needles and fishhooks.

Copper was particularly prized for its color and its sound. When the Spanish arrived, they reported that the Mayas used copper bells and cocao beans as money. Spanish authorities routinely leveled fines for the possession of pagan idols and made the Mayas pay in these bells. Bells were also worn in dance ceremonies. Bells are the most commonly found metal artifact at Lamanai.

Simmons' research is the first of its kind to emphasize the nature of Maya metallurgy as a specialized craft activity, "in the sense that not everyone had the technological know-how to produce metal objects. It's likely that only a select few understood the mechanical properties of metal, and had the ability to melt and cast metal into desirable forms." Simmons says. "We haven't found a furnace or a crucible, but we have found the end products."

Recent recoveries of by-products of metal casting activities (see inset) are encouraging researchers that they may be close to locating a site of actual production.

Simmons is co-principle investigator with Elizabeth A. Graham, Ph.D. of University College London, England for the Lamanai Archeological Project of which The Maya Archaeomettallurgy Project (MAP) is part. The research is supported by the Foundation for the Advancement of Mesoamerican Studies, Heinz Family Foundation, York University, Canadian Funds for Local Initiatives, the Social Sciences and Humanities Research Council of Canada, the National Geographic Society and the University of North Carolina Wilmington. Simmons also directs the field school in archaeology at Lamanai during May, June and July, in which UNCW students participate each year.



Recoveries of by-products of metal castings encourage researchers that they may be close to locating an actual site of production: **1.** and **5.** Miscast bells; **2.** Copper bell remnant; **3.** Parts of casting reservoirs **4.** Copper prill, a by-product of casting.

SCOTT SIMMONS

Ball court at Lamanai

RESEARCH BY DAY, MBA AT NIGHT: THE BUSINESS OF MARINE BIOTECHNOLOGY

Daniel Baden, director of the Center for Marine Science (CMS) at UNC Wilmington, is offering a very few exceptional Ph.D. scientists the opportunity to conduct research by day while earning an executive MBA from the Cameron School of Business (CSB) – at night. The demanding program is attracting researchers worldwide.

"We are recruiting Ph.D. scientists on an international basis," Baden said. "Only three applicants make the cut from more than 100 applications."

Vince Howe, director of the Cameron School of Business MBA program, is enthusiastic. "UNC Wilmington is offering these 'post-docs' the chance to test the commercial feasibility of their research. We will graduate scientists savvy in the business of marketing and development. The majority of our most socially conscious students, those who desire to work with non-profits as well as those who enjoy the incentives that for-profit management brings, believe in the value of service-delivery as a necessary complement to profit incentive. Both for-profit and non-profit enterprises have the similar objective of bringing beneficial products and services to the widest number of users," Howe said.

At CMS, the Business of Marine Biotechnology program, funded by the MARBIONC program (Marine Biotechnology in North Carolina), is one part of a three-fold initiative promoting marine biotechnology and aquaculture. Other biotechnology research collaborations are underway with East Carolina University, NC State University, UNC-CH Institute of Marine Science and community colleges in the region. Further research targeting bioassay technique development, finfish mariculture, aquaculture technology, nutrition and commercial demonstration, marine pharmaceuticals and nutraceuticals derived from cultured organisms, bioengineered natural products, novel enzymes and biosynthetic pathways is also in progress.

The MARBIONIC-MBA program requires that candidates who have completed a Ph.D. degree in areas related to biotechnology finish the MBA program in the standard 24 months, taking the same classes as regular MBA students and participating in all required applied-learning projects.

Applied-learning projects provide an integration of practical and theoretical knowledge that explains the wide appeal of the MBA degree to people with managerial and/or administrative responsibilities – an integration that Baden wants to offer researchers.

Regional corporate collaborations extend opportunities and benefits. Product ideas are assessed for marketability in the earliest stages of their development. AAIPharma and other regional companies network with the MARBIONC-MBAs to support patent processes and, if realized, eventual licensing. Finally, "the researchers themselves are a value-added product of the program," Baden says. "The intellectual property these researchers generate will have far-reaching impacts on economic growth and development in the region and beyond. Their skills become a regional asset as well."

Graduates of the MARBIONC-MBA collaboration, trained in the marketing and development of biotechnology products, offer North Carolina a pool of professional talent that will assure its quality of life by providing clean, well-paying jobs from products that will protect the environment as they grow the economy.

PHOTOS: UNCW/JAMIE MONCRIEF

MARBIONC-MBA candidate **Dr. Shah Alam** (left) and CSB-MBA candidate **Vickie Chambers** present their final projects. Alam hands his mariculture study on the biochemical structure and composition of fish feed to produce high quality farm-raised Southern flounder and black sea bass – at a competitive price – to Wade Watanabe, research professor at CMS.

Other final practicum projects from post-doctoral MBAs: **Dr. Michael Denture**, a protein chemist, presented his project on the properties of an antitoxin derived from the algae that causes red tide fish kills. **Dr. Julie Gauthier** investigated the marketability of a user-friendly test for diseases in oysters that could enhance consumer protection from unhealthy shellfish.

Dr. Becky Porterfield, associate professor of management at Cameron School of Business, is the practicum course leader for MBA final projects.


WILMINGTON STAR-NEWS

PRESERVING AN ICON OF CAROLINA COASTAL CULTURE: RESTORING CAROLINA OYSTER REEFS

As **"ecosystem engineers"** oysters protect the estuarine body and impact local water quality, marsh erosion and habitat health.

Guests at a North Carolina oyster roast are more likely to enjoy this staple of Carolina cuisine and culture shipped in rather than caught from local waters. Carolina oysters are in decline. **Martin Posey**, professor and chair of the Department of Biology and Marine Biology, and **Troy Alphin** research associate (pictured above), are part of a national group examining how to proceed with regional oyster restoration. Posey and Alphin examine past restoration efforts along the Carolina coast and offer new strategies on how to direct regional restoration efforts.


MARTIN POSEY

Oysters are as essential to coastal ecosystems as bones and kidneys are to the human body. Oysters provide structure and protection to the estuarine bodies. When located against the shore, oysters disrupt waves, reducing marsh erosion. Recognized by most coastal states as a critical nursery habitat, oyster reefs furnish primary hiding places and feeding areas for small fish, crabs and shrimp. As natural filters, healthy oyster populations filter out material in overlying waters, contributing to improved water quality and nutrient flows.

Still, many people think of oysters primarily a seafood resource. However, these "ecosystem engineers" are so important to the health and protection of the estuarine body that restoration efforts are justified by the animals' positive impact on local water quality, marsh erosion and habitat quality.

In North Carolina over the past 50 years, oyster populations have declined to only 5 percent of past highs. Posey and Alphin's research concentrates on understanding the biology of the oyster to better understand the causes of this decline – including aspects of disease, impacts of development and predators, recruitment of small oysters and causes of death among large oysters. They also study best approaches to oyster reef design and other restoration techniques to enhance oysters' key ecological functions.

Recent restoration efforts by coastal conservation groups have incorporated Posey's and Alphin's research in best-reef designs for varied coastal habitats. Their research has shown that reefs designed primarily for the enhancement of habitat for fish, crabs and shrimp should be built as several closely spaced reefs with highly convoluted edges – designs known to enhance the quality of life for deer and other "edge" species in forest habitats. Different reef designs may be appropriate for water quality aspects, where surface area, orientation to flow and local landscape need to be considered.

The restoration of this icon of North Carolina coastal life will produce ecological and aesthetic benefits as well as renew a valuable seafood resource.


MARTIN POSEY

VIRTUAL LEARNING

While demand for Information Technology (IT) professionals is projected to increase over the next five years, a dwindling number of American students choose to specialize in IT fields. Now, a grant-funded partnership between the University of North Carolina Wilmington and the New Hanover, Pender and Brunswick County schools is addressing this issue.

A $1.18 million grant from the National Science Foundation will fund the partnership's efforts to design, develop and deliver expanded IT programs to tri-county students and their teachers.


UNCW/JAMIE MONCRIEF

Using "Squeak" technology, **Heywood**, **Narayan, Morge, Tagliarini** and graduate student **Lucas Gillispie** train educators to design IT experiences for students grades 7-12.

Visit **www.squeakland.org** for more information.

"Students may become interested in IT careers in college, but find that they lack related science and math skills," said **Sridhar Narayan**, associate professor of computer science and co-principal investigator of the grant. "We want to pique their interest in the science, technology, engineering and math fields at a much earlier age."

The three-year project will work directly with about 75 educators who teach Science, Technology, Engineering, Mathematics (STEM) curricula and 150 of their students, grades 7-12. Teachers and students will learn to use "Squeak" programming language, a Smalltalk implementation, derived directly from program originators during their time at Apple Computer and later at Walt Disney Imagineering, where it was developed for use in Disney projects. Squeak is a full-featured, object-oriented programming language and environment that allows novice users to easily model media-rich worlds.

UNCW undergraduate student Daniel Heywood '08 (seated left) developed a Squeak simulation that enables children to virtually manipulate a canoe crossing a river. With the instrument, students can visualize the concept of relative motion and the Pythagorean Theorem before they begin tackling equations.

In addition to Narayan, the research team includes Gene Tagliarini, associate professor of computer science, Shelby Morge, assistant professor of elementary, middle level and literacy education in the Watson School of Education and two technology coordinators from each of the school districts.

"With these tools, students will learn how technology can help them find answers to challenging problems and acquire problem-solving and critical-thinking skills that will assist them in future situations," Morge says.

The program will actively recruit underserved, underrepresented and minority populations within the three participating school districts. Each of the districts will receive a benefit amounting to more than $100,000 during the grant period, including direct support to the school districts and stipends for participating teachers.

The grant is part of the National Science Foundation's ITEST program, established in direct response to the concern about shortages of technology workers in the United States.

JOSEPH PAVLIK

CORAL REEFS

A changing ecosystem: the Caribbean coral reefs

While coral reefs make up a very small portion of the oceans, reef ecosystems are among the most productive, diverse and oldest in the world, the marine equivalent of terrestrial rainforests.

Coral reef structures help protect shores from storms and provide habitat for fish, lobster and other animals. They also deflect storm waves that may otherwise wash out beaches.

Local economies rely on fishing, tourism and recreational resources of coral reefs, yet these economies are now threatened by the decline and possible extinction of the healthy reefs on which they depend.

In 2005, according to NOAA Coral Reef Watch, up to 40 percent of coral around the U.S. Virgin Islands disappeared. In Puerto Rico, in the 1970s, coral cover hovered at around 50 to 60 percent; by 2001 coral cover had decreased to below 20 percent.

Through research and study of the diverse facets of reef ecology, the extent of the threat is becoming better understood, and new directions for remedy are being discovered.

"In the Caribbean,
coral recruitment rates are very low.
In many areas corals have been lost, and
you basically end up with algae, sponges,
soft corals and other things,
but not hard coral."

CARLY RANDALL: UNDERGRADUATE RESEARCH

"We know that heightened water temperatures kill adult coral, but we don't know what happens to all of the larvae floating around out there," UNC Wilmington professor of biology Alina Szmant says.

The effect of elevated temperatures on earlier life stages of corals remains poorly studied, yet these are the very stages that hold the best hope for coral recovery.

Under the guidance of Szmant, undergraduate marine biology major **Carly Randall** '07 conducted an experiment to test whether or not elevated temperatures have an effect on the survivorship and settlement of larvae of the Caribbean coral, *Favia fragum*.

Planulae released from adult colonies were introduced randomly to one of four seawater temperatures: 27° and 29° C (80.6° and 84.2° F) (controls) and 31° and 33° C (87.8° and 91.4° F) (elevated). After 144 hours, only 2.7 and 0.9 percent of larvae survived at 31° and 33° C, respectively, whereas 78 and 61 percent survived at 27° and 29° C, respectively. Only 2 percent of the larvae settled at the elevated temperatures, compared to over 40 percent settlement at the two lower temperatures.

This suggests that the settlement stage of the life cycle is especially sensitive to global warming. Randall enters UNCW's graduate marine biology program in the fall of 2007 to continue her research on the effects of elevated temperatures on coral larval.

THE NATURE AND NURTURE OF CORAL REEFS

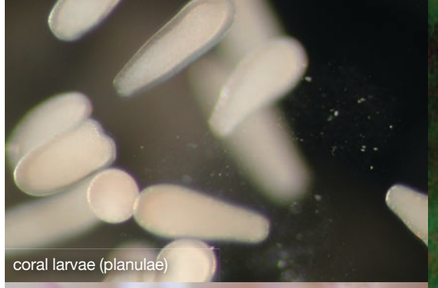
Having grown up in the Caribbean, professor **Alina Szmant** is passionate about coral preservation.

"Reef-building corals are long-lived, but there is always reproduction to replace the ones that get old and die," says Szmant. "In the Caribbean, coral recruitment rates are very low. In many areas corals have been lost, and you basically end up with algae, sponges, soft corals and other things, but not hard coral."

Hard coral that make up the backbone of the reefs are invertebrates composed of coral colonies made up of polyps. Generally, polyps begin their life cycle as tiny, free-swimming larvae, or planulae, that are about the size of the head of a pin (see upper right). The larvae, which prefer temperatures between 70° and 85° F, drift along with the plankton and are often eaten. Those that survive eventually settle and produce new colonies.

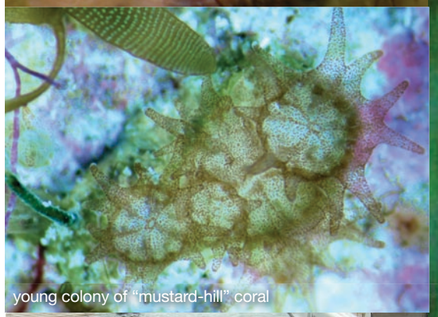
"We don't know much about the larval stage, where the larvae go, how long they float in the water and how long it takes them to settle," says Szmant whose research focuses on the role of chemical cues in informing the larvae when and where to settle.

Szmant circumvents the difficulty of collecting spawn in the field by fertilizing and culturing young juvenile corals in the laboratory for induced settlement onto either pre-conditioned or natural surfaces. Her objective is to experiment with cultured larvae of as many species as possible to learn what factors contribute to improvement of settlement and post-settlement survival.


coral larvae (planulae)


mature planula of elkhorn coral seeking a place to settle


newly settled primary polyp of elkhorn coral; first skeleton can be seen through translucent tissue


young colony of "mustard-hill" coral

Alina Szmant (right) pursues the understanding of the nature and ecology of coral reefs. "Coral reefs take tens of thousands of years to grow and require a set of ecological conditions and balances to thrive. Now they are dying."


JOSEPH PAWLIK

Aplysina archeri
Corals are bleaching and dying in the Caribbean, yet sponges are flourishing. Why are sponges doing so well?

THE CARIBBEAN'S MASTER CHEMISTS

Corals are bleaching and dying in the Caribbean, yet sponges are flourishing. Why are sponges doing so well?

Answering this question requires an understanding of the complex relationships between predators and competitors in coral reef environments. It is the subject of study for UNC Wilmington marine biologist **Joseph Pawlik**.

Funded by the National Science Foundation's Biological Oceanography Program, the research conducted by Pawlik and his team addresses the ecological functions of the unusual chemical compounds found in the tissues of Caribbean sponges.

"Sponges often rival hard corals in diversity and abundance on coral reefs, where they play many functional roles; they filter large volumes of water, harbor photosynthetic bacteria and provide refuge to numerous cryptic species of fishes and invertebrates," says **Tim Henkel**, Ph.D. candidate in marine biology and member of Pawlik's marine chemical ecology laboratory.

According to Pawlik, "Sponges may have a simple body plan, but they are really master chemists. Working with symbiotic bacteria or alone they produce a host of bizarre metabolites that chemists love. When I say bizarre, I mean chemical compounds with ring structures that have never been described before, also, unusual ways of binding carbon, nitrogen, sulfur and other elements.

"Most recently we've started looking at interactions between sponges and corals. Corals are dying, perhaps in part because of global warming, and now sponges dominate some reefs," Pawlik says.

Pawlik's interest in understanding the ecological functions of compounds produced by sponges has led him to examine competition between sponges and corals. He has found that some sponges may use their unusual chemical compounds to kill corals. With the use of a sophisticated device called a diving-PAM fluorometer, "we can tell if the number of symbiotic algae living in coral tissue has been reduced after exposure to sponge metabolites or whether the algae have been poisoned," Pawlik says.

Pawlik's research has documented the chemical defense mechanisms of sponges as well. Sponges use their strange metabolites to deter predation by hungry reef fish, such as angelfish and parrotfish. Thus far, Pawlik has surveyed the chemical defenses of more than 70 Caribbean sponge species and has been able to isolate and identify deterrent compounds from several species.

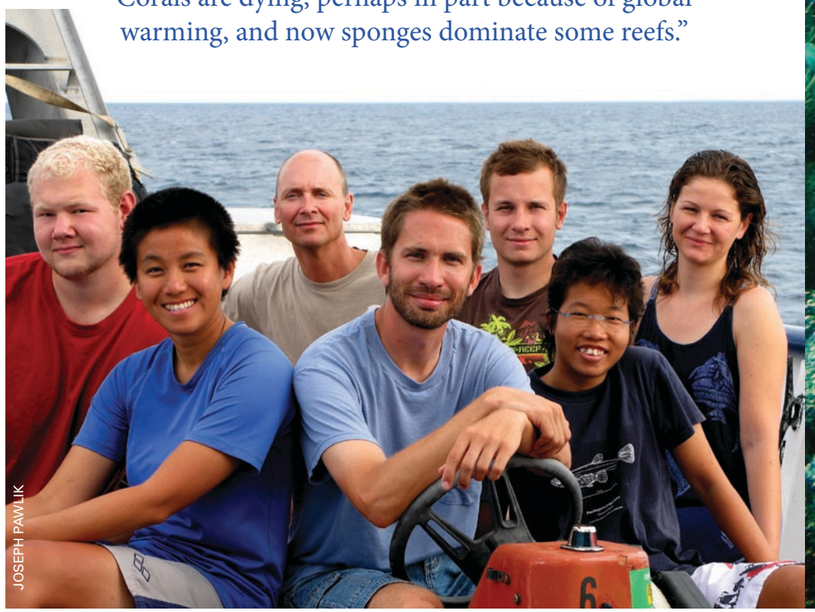
Pawlik also receives funding from the NOAA Coral Reef Conservation Fund to study the Caribbean barrel sponge (*Xestospongia muta*). This sponge is a common member of the Caribbean coral reef community and is called "the redwood of the reef" because of its massive size and long life span. Since 1997, Pawlik has monitored 12 sites off Key Largo, Fla., and has documented patterns of both cyclic and fatal bleaching, the latter involving a newly described "sponge orange band" syndrome that results in enhanced fish predation and death and probably involves a microbial pathogen.

Despite this threat, long-term data from Pawlik's study indicate that the overall population of barrel sponges on Florida's reefs is actually increasing. However, this may be because coral population is in decline.

Federal grants to Pawlik for marine chemical ecological research support training for undergraduate and graduate students and for a Fulbright postdoctoral investigator. The program has fostered collaboration between scientists and students from six nations and has facilitated Web-based outreach, including the production of a photographic key to the sponges of the Caribbean.

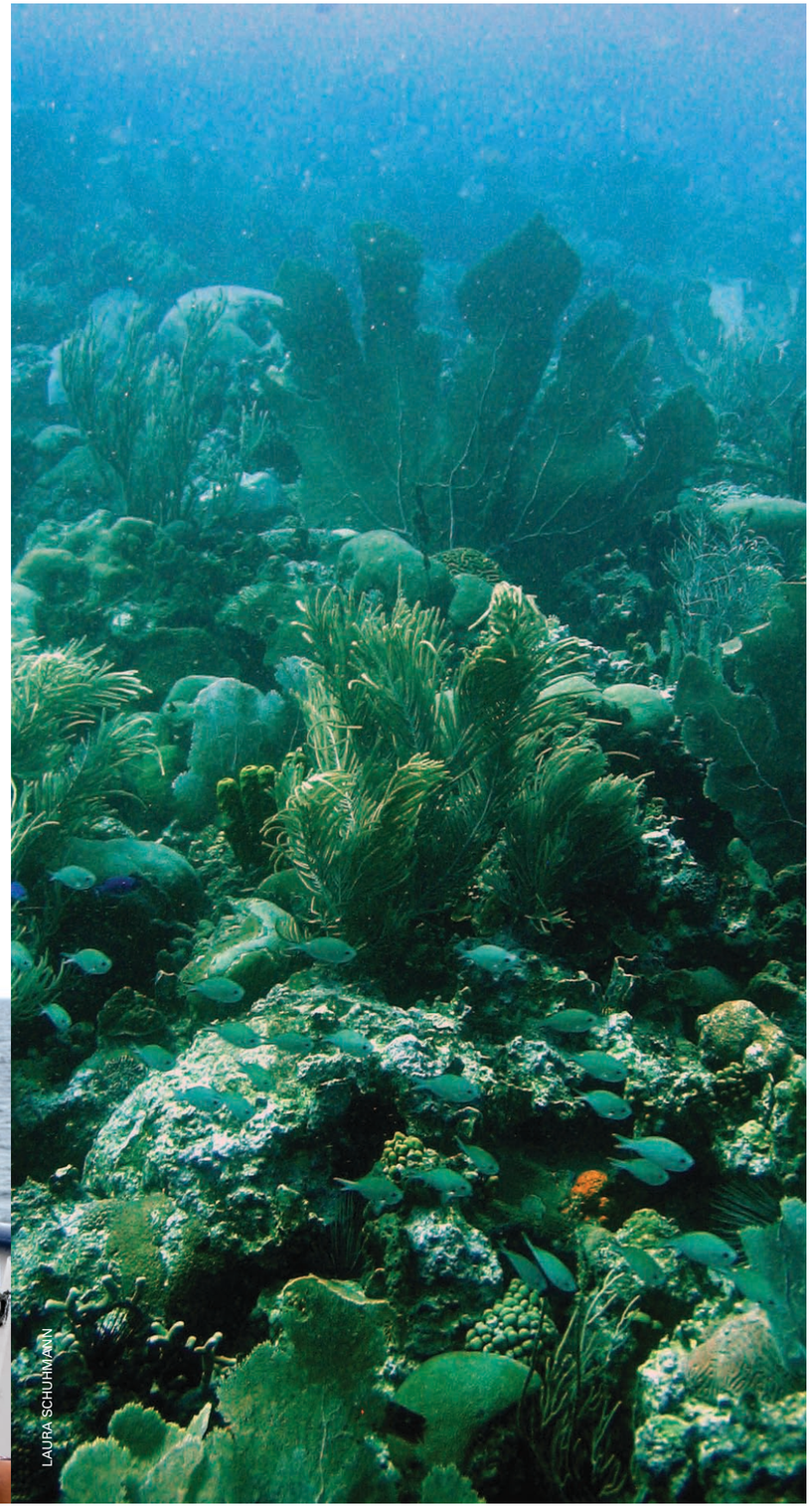
Results continue to advance understanding of the complex relationships between predators and competitors in coral reef environments as well as the applicability of chemical defense theories derived from studies of these ecosystems.

"Most recently we've started looking at interactions between sponges and corals. Corals are dying, perhaps in part because of global warming, and now sponges dominate some reefs."



JOSEPH PAWLIK

left to right: **Dave Hines**, undergraduate, rising M.S. student; **Tse-Lynn Loh**, M.S. student; **Joe Pawlik**; **Tim Henkel**, Ph.D. student; **Steve McMurray**, M.S. student; **Wai Leong**, undergraduate, rising M.S. student; **Susanna Lopez-Legentil**, postdoctoral researcher and Fulbright scholar, on the aft deck of the *R/V Seward Johnson* off Sweetings Cay in the Bahamas.



LAURA SCHUHMANN

HOW MUCH IS A CORAL REEF WORTH?

How much is a coral reef worth? Can we measure the economic value of a pristine beach or a healthy sea turtle population?

Economist **Peter Schuhmann** is doing just that. "Natural resources have real economic value, and that value can and should be measured so that we can make good decisions about the use of those resources," says Schuhmann. He is working to estimate the economic value of natural resources related to recreation and tourism in the Caribbean. "Coastal and marine resources in the Caribbean supply a wide range of goods and services, including seafood, numerous recreation opportunities, habitat for wildlife and coastal protection," says Schuhmann.

Schuhmann is employing non-market valuation methodologies to estimate the economic value of coral reefs, reef fish, hawksbill turtles and green turtles. He is also working to estimate the value of wide clean beaches and the potential costs of coastal development. With the economic value of these coastal and marine resources in hand, leaders and policy makers in Caribbean nations can better develop sustainable and informed management policies.

"Many policy actions could be implemented, such as the use of set backs for coastal development, establishing protected areas, installing and requiring the use of mooring buoys and modifying fishing regulations," Schuhmann says. "Given a limited budget available for protection, which measures might deliver the most value for the cost?"

Working to develop cost-benefit analysis of different policy decisions such as different methods of preserving coral reef quality, Schuhmann says, "More and more governments are realizing that their economies are heavily dependent upon the quantity and quality of their natural resources, and without an understanding of the nature and scope of that value, it is difficult to analyze the trade-offs inherent in any policy."

Schuhmann's current work in Barbados and Tobago is part of a larger interdisciplinary effort with fishery biologists, resource managers from the University of the West Indies and officials from the Barbados government.

HAMLET FISH SPECIATION


OSCAR PUEBLA

In the world of evolutionary biology, one of the most important discoveries is one species in the process of evolving into multiple species, a process called speciation.

"Complexes of closely related species represent cases in which speciation is rapid and often still in progress," says UNC Wilmington biologist **Michael McCartney**. Scientists look to these complexes, such as Darwin's finches, as models of how speciation occurs.

For a number of years, McCartney has been investigating small, colorful reef fish known as hamlets, *Genus hypoplectrus*. The dozen or so known species of hamlets intermingle throughout Caribbean coral reefs. Though closely related, each species has a strikingly different color pattern.

"On large Caribbean reefs, five or six species may occupy the same habitats during the daytime, yet in the evening, these species pair up to mate assortatively – only with members of the same color group," McCartney says.

Different hamlet fish show no skeletal differences. McCartney has used the most sensitive DNA fingerprinting methods available, but is "barely able to genetically distinguish the hamlet species," he says. "These studies show that rapid changes in color pattern and mating preferences based on coloration are powerful means for promoting speciation in coral reef fishes, the most diverse group of vertebrate animals."

"These studies show that rapid changes in color pattern and mating preferences based on coloration are powerful means for promoting speciation in coral reef fishes, the most diverse group of vertebrate animals."

McCartney and colleagues Oscar Puebla of McGill University and Eldredge Bermingham of the Smithsonian are working to further determine the function of color patterns in hamlets.

Some hamlets use their color patterns to aid their approach to unwary prey. For example, the blue hamlet, which lives off the coast of Florida, looks strikingly similar to the blue chromis, a plankton-feeding, non-predatory fish. The hamlet's blue chromis mimicry allows it to eat more prey. Thus, if the blue hamlet mates with a different-colored hamlet, its offspring's survivability may be greatly reduced.

McCartney has determined that "hamlets are in their earliest stages of species differentiation. They are very strongly isolated by color, and that tells us that coloration and mating preferences evolve very quickly." The genetic changes that lead to complete speciation may follow.

MONITORING & ASSESSING TSUNAMI RISK IN PUERTO RICO

About 75 miles north of Puerto Rico and extending eastward into the Atlantic Ocean, lies the Puerto Rico Trench. Plunging more than five miles below sea level, it creates the deepest point in the Atlantic Ocean. The narrow trench extends eastward for more than 1,000 miles forming a long, deep gash in the seafloor.

Scientists believe the trench began to form nearly 70 million years ago as the North American plate and the Caribbean plate ground past each other. The existence of the trench just north of Puerto Rico, along which there is evidence of a large slump, (Schwab et al., 1993) and many other smaller ones (ten Brink and Smith, 2003; Hearne et al., in press) poses a significant landslide-tsunami threat for the island. UNCW professor of geology **Nancy Grindlay**'s research focuses this area where plate motions are rapid and complex and could cause earthquakes, submarine landslides and tsunamis.

In 1918, an earthquake of magnitude 7.3, centered approximately 15 miles off the northwestern coast of Puerto Rico, generated a tsunami that produced a run-up more than 19 feet high along the western coast of the island. Of the 116 people killed by the 1918 earthquake, 40 deaths were attributed to the tsunami. In current U.S. dollars, the cost damage to coastal communities of that event would equal $50 million.

A Massive Landslide and Groundwater Seepage

Grindlay has been studying the Puerto Rico Trench since the mid-90s. Using bathymetric mapping and seismic reflection profiling of the sea bottom in the trench, Grindlay has mapped the entire trench. This research, suggesting the probability of numerous tsunamis in the past, has uncovered evidence of more recent submarine landslides.

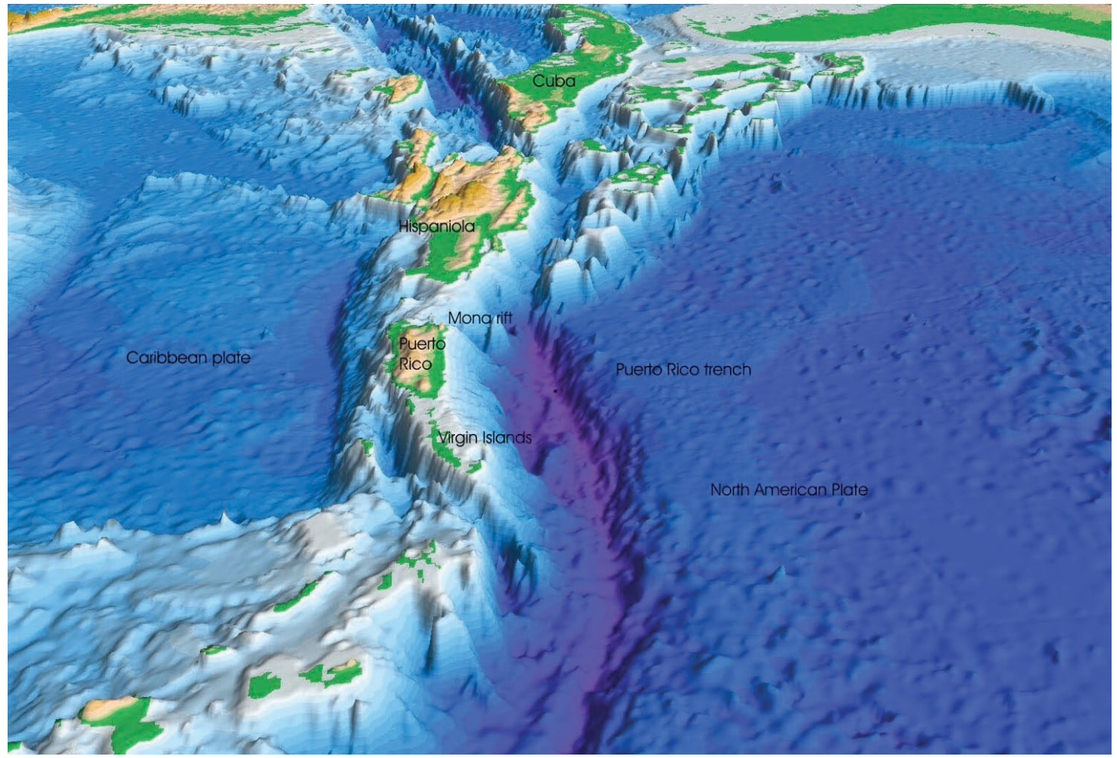
From her monitoring of the Puerto Rico Trench, Grindlay has also discovered, on the edge of the slope, groundwater seeping out from the island of Puerto Rico. Submarine groundwater discharge is another possible contributor to submarine landslides.

Monitoring the Earthquake Factor

An earthquake of 7 or higher often triggers tsunamis and results in seafloor offset along faults. The shaking motion of an earthquake can also lead to submarine landslides.

"To help with monitoring the earthquake hazard, we provide information to risk assessment officials, such as the size of the landslide that we see, and what kind of tsunami a landslide like this one might generate," Grindlay says.


LEWIS ABRAMS

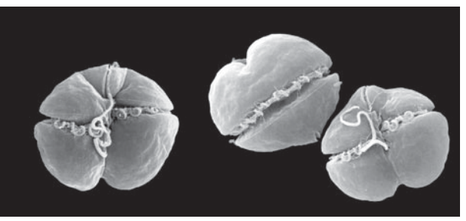


PAUL SCHMIDT/CHARLOTTE SUN HERALD

FLORIDA RED TIDE BREWS UP DRUG FOR CYSTIC FIBROSIS

by Carol Potera

Condensed and reprinted with permission from Science Magazine,
15 JUNE 2007: VOL. 316. NO. 5831, PP.1561 – 1562 DOI: 10.1126/SCIENCE.316.5831.1561 **NEWS FOCUS**



Karenia brevis'.
photo courtesy of Florida Fish & Wildlife Conservation Commission

When a red tide coincides with an onshore breeze, emergency rooms brace for an influx of patients: the organism, *Karenia brevis'*, airborne poisons – collectively known as brevetoxins, constrict bronchioles and send asthmatics and others with breathing difficulties scrambling for treatment. So the last thing you might expect from this nasty organism is a compound that alleviates wheezing and shortness of breath and helps clear mucus from the lungs.

A compound called brevenal is being evaluated as a potential treatment for the debilitating lung disorder cystic fibrosis.

Yet, one oddball in *K. brevis'*, armamentarium, a compound called brevenal, does just that, at least in sheep. It's being evaluated as a potential treatment for the debilitating lung disorder cystic fibrosis (CF), which affects 30,000 people in the United States, and researchers are poised to test it on Florida's endangered manatees next time some of the mammals are poisoned by a red tide.

Under investigation since the compound was first discovered in 2004 at the Center for Marine Science (CMS) at the University of North Carolina Wilmington, new findings reported at the Society of Toxicology meeting in Charlotte, North Carolina in late March, indicate that the compound binds to a novel receptor in the lung, and that a synthetic version seems to work as well as the natural compound in the laboratory and animal tests.

Yet to be determined, however, is just why *K. brevis* produces a compound that counteracts some of the effects of its own fearsome suite of toxins. But then again, it's not clear why it produces those toxins either, notes CMS Director Daniel Baden.

A Serendipitous Discovery

CMS pharmacologist Andrea Bourdelais was measuring the lethality of extracts isolated from brevetoxins by adding a tiny bit of test material to a beaker containing water and a guppy. If the fraction is toxic, the fish dies. Toxicologists usually retire fish that survive such tests to prevent subsequent chemical interactions, but the laboratory's supply of guppies was running low, so Bourdelais reused the survivors. When she added a known toxic fraction to beakers with leftover guppies, to her surprise, they did not die. "I had a spontaneous gut feeling – a gee-whiz moment – that the first material was an antidote to the second one," Bourdelais recalls.

Bourdelais subsequently showed that the mysterious extract (later named brevenal) protects guppies from death by brevetoxins in a dose-dependent fashion. The lab already had discovered that brevetoxins act on sodium channels, so Bourdelais used a standard lab test to check whether brevenal prevents the toxins from binding to the sodium channel receptor. It did.

Bourdelais then sent the mysterious compound to William Abraham, research director at Mount Sinai Medical Center in Miami Beach, Florida, who had determined that all brevetoxins set off bronchoconstriction in a sheep model of asthma. Brevenal, he discovered, suppresses this effect.

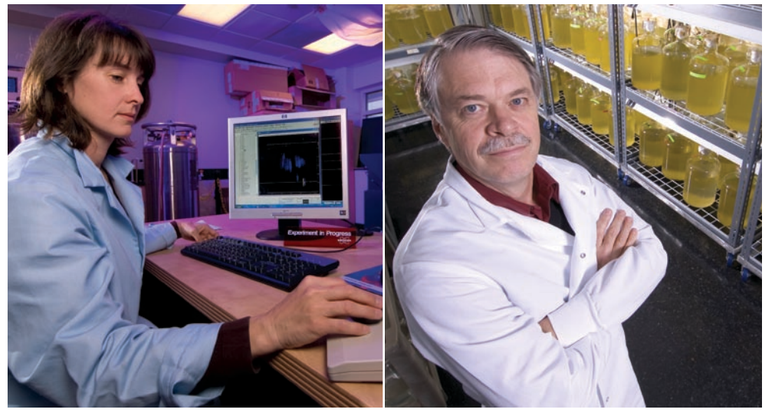
Since then, Baden, Bourdelais, Abraham and their colleagues have continued to probe brevenal's modus operandi. At the toxicology meeting, they reported that it acts on a new drug target: it binds a novel receptor in lung tissue associated with voltage-gated sodium channels.

Promises of new therapies for CF surface regularly, but many fizzle out. And, in spite of its early promise, brevenal still has a long way to go. In fact, humans may not be the first test subjects for brevenal's therapeutic potential. That honor may go to Florida's endangered manatees. "A red tide event spreads like a wildfire and poisons birds, fish, sea turtles, manatees and dolphins," says Andrew Stamper, a veterinarian at Disney's Animal Programs in Lake Buena Vista, Florida. In March and April of this year, about 30 manatees died following a red tide spike. Only 3,000 of the mammals are estimated to live along Florida's coast.

In February, Stamper received a "compassionate use" permit from FDA to evaluate the safety and effectiveness of brevenal in manatees. Stamper's colleague, veterinarian David Murphy of Lowry Park Zoo in Tampa, Florida, will test brevenal on rescued manatees brought to the zoo's rehabilitation center. When poisoned by brevetoxins, manatees become paralyzed and drown because they cannot hold their head above water to breathe. Murphy straps lifejackets underneath rescued manatees and supports their half-ton bodies in shallow tanks. Normal breathing resumes in a few days, but full recovery takes months.

Brevenal "will add a new weapon in our arsenal," Murphy says. The next time a red tide hits, "we'll be ready to go," says Stamper.

Carol Potera is a science writer in Great Falls, Montana. Original article may be accessed at www.sciencemag.org.



UNCW/JAMIE MONCRIEF

Assistant research professor **Andrea Bourdelais** (left) at the Center for Marine Science and **Daniel Baden** (right), William R. Kenan Distinguished Professor of Marine Sciences, work on *Effects of Inhaled Florida Red Tide Brevetoxins*, research funded at more than $7.5 million by the National Institutes of Health and the National Institute of Environmental Health Sciences.

PHOTOGRAPHY BY JAMIE MONCRIEF

A team of researchers from UNCW, including **Robert Keiber** (right), received a three-year $533,000 grant from the National Science Foundation Atmospheric Chemistry division to study rainwater.

HIDDEN COMPOUNDS IN RAINWATER

Organic compounds exist in all natural waters, including freshwater, rainwater and seawater. In rainwater, scientists have documented the presence of more than 300 different organic compounds that come from both natural and manmade sources. To date, fewer than half of these compounds have been identified.

Roughly half of the organic compounds found in rainwater fall into the category of chromophoric dissolved organic matter (CDOM), the predominant form of carbon in rain. Some of these compounds are by-products of the natural decay of vegetation, while others come from the burning of fossil fuels.

CDOM interacts with sunlight, affecting temperature and how much of the sun's energy gets to the earth's surface.

It also reacts with trace metals in rainwater. For example, the presence of CDOM makes iron more soluble in seawater which is good for phytoplankton growth. Healthy phytoplankton in turn absorbs more carbon, perhaps helping to offset global warming.

Brooks Avery, **Robert Kieber**, **Robert Whitehead** and **Joan Willey** received a three-year $533,000 grant from the National Science Foundation (NSF) Atmospheric Chemistry division to study CDOM in rainwater. The project seeks to find out where CDOM comes from, study its chemical characteristics, determine how it interacts with light and discover more about its involvement in metal speciation. The researchers will examine rainwater collected in Wilmington, N.C., in New Zealand and over the open ocean.

The group hypothesizes that part of the rainwater CDOM comes from fossil fuels, part from windblown soil dust and part may be produced in the atmosphere. This investigation is the first to demonstrate that CDOM is present in rainwater and exists in such large quantities that it is the dominant chromophore (light absorber) and fluorophore (light emitter) in precipitation.

Because water plays such a critical role in climate and is a potent and abundant greenhouse gas, it is important that scientists develop a thorough understanding of how light absorption and emission takes place.

By understanding where CDOM comes from and its chemical properties, the group also hopes to shed light on the incredibly complex global carbon cycle. This cycle models how carbon is transferred between the earth and the atmosphere where high levels of carbon dioxide are thought to be primarily responsible for the current dramatic rise in global temperatures.

Kieber notes that carbon budget models are only as good as the scientific data used to validate them. "Our data is a step or two away from the global warming issue, yet in a sense, we are trying to help with the global warming problem," he says.

"This research will provide significant new information regarding the chemical and physical factors influencing source, fate and atmospheric impacts of rainwater CDOM," says Kieber.

"We are a unique group in that we collaborate on everything. We all get along great. Part of our success is that NSF perceives us as a productive team performing state-of-the-art research at a comprehensive master's institution," says Kieber.

Kieber also notes that the NSF funding will support a post-doctoral researcher, two master's level graduate students, two undergraduates and one high school student per year. A local high school science teacher will also participate in this research for one month each summer.

"To date, 69 undergraduate students, 39 master's students and five post-doctoral fellows have participated in and contributed to NSF-funded research in atmospheric and marine chemistry at UNC Wilmington. Young students are attracted to this type of study because they perform high-profile environmental research of international interest, which ultimately motivates them to choose a career in science," Kieber says.

below: Graduate student **Joshua Dixon** works with Professor **Joan Willey** in the chem lab.

right: First-year graduate student **Josephine Yauari** and undergraduate **Kaitlin Morrison** collect samples of rainwater to bring back to the lab for analysis.

Brooks Avery is an assistant professor of chemistry. Robert Kieber is a professor of chemistry and graduate coordinator of the chemistry department. Robert Whitehead is a research specialist at the UNCW Center for Marine Sciences. Joan Willey is the associate director of education at the Center for Marine Sciences and a professor of chemistry. For more information on this and other marine and atmospheric chemistry research programs, visit www.uncw.edu/chem/research-marine.html.

FRESHWATER RESOURCES IN A CHANGING CLIMATE

Development on the Caribbean's tiny islands is limited by available freshwater, which is supplied by rainfall, and consequently severely impacted by climate change and variability. Geographer **Doug Gamble**'s research seeks to understand how climatology impacts freshwater availability on the small island of San Salvador, in the southern Bahamas. Spring rains, hurricanes and summer droughts have huge ramifications for San Salvador. Gamble's research finds that global warming has and will continue to greatly affect island water availability.

"Climate change projections indicate that the Caribbean is expected to experience moderate warming in the future with an increase in maximum summer temperatures," Gamble says. Yet the Caribbean is not a uniform land or sea mass. Different parts of the Caribbean have different climates. "It is difficult for models to predict climate change for the Caribbean since the models do not have the resolution to determine island scale impact," he says.

Typically, models for larger land masses are decreased to a smaller scale, yet this is not accurate in the case of small islands, because small islands interact very differently with the surrounding air and water than larger continents do. For example, the Bahamas have little relief or variation in elevation and land surface, and do not modify weather patterns like continents or large mountainous islands.

Studies show that global warming can lead to decreasing rainfall in the central Caribbean. "Models do indicate that the mid-summer droughts that I have been studying will increase in magnitude at least and perhaps in duration," Gamble says.

Douglas Gamble is an associate professor of geography in the Department of Geography and Geology. For more information on his research, visit **http://people.uncw.edu/gambled/index.htm**.

The availability of freshwater on Caribbean islands like San Salvador is of great concern. San Salvador does not contain rivers; islanders rely on rainwater, surface water and groundwater for their freshwater needs. Spring rains fill the ponds and recharge the groundwater and are one of the main sources of freshwater for island inhabitants. A surplus of rainwater in the early spring collects in surface ponds, but the rate of evaporation often exceeds the rate of precipitation, causing the ponds to turn brackish; and water shortages ensue.

"Most people believe there will be a water surplus during the hurricane season, but we've found that isn't the case," says Gamble. Unless an island receives a direct hit from a hurricane or tropical storm, it is not likely that a storm event will drop a significant amount of rainfall. He notes that water should be collected after large storm events, but that islands should not rely on hurricanes and tropical storms for the majority of their freshwater.

The Bahamas depend on tourist dollars, yet large-scale tourist development uses much of the available freshwater, leaving less for locals. Rainwater catchments in above-ground storage tanks are a viable alternative to depending on pond sources. However, because it is considered a sign of poverty, the use of storage tanks is seen as a stigma, and most inhabitants will not use this method.

ENVIRONMENTAL CHANGE IN AN EGGSHELL

Adélie penguin history offers humans valuable lessons – and warnings.

LARRY COATES

STEVEN EMSLIE

The Ross Ice Shelf in Antarctica, roughly the size of the Yukon Territory of Canada, towers over the Ross Sea with ice cliffs as high as 200 feet. For millions of years this ice sheet has retreated and advanced, proving that climate change is nothing new. Yet, until recently, there has been no precise way to measure the shifting interface between shore, ice and open water or to document exactly when these changes occurred.

LARRY COATES

Cover art used with permission "Copyright (2007) National Academy of Sciences, U.S.A." Emslie, Steven D., and William P. Patterson. "Isotopic record of penguin diet." *Proceedings of the National Academy of Sciences of the United States of America* 104.28 (2007): 11666-11669.

Now, marine ornithologist Steven D. Emslie, UNCW professor of biology and marine biology, has discovered a way to measure the advance and retreat of the Ross Ice Shelf by locating and dating ancient Adélie penguin (*Pygoscelis adeliae*) colonies.

Unlike Emperor penguins who do not build nests, Adélie penguins, the most common of all penguins in Antarctica, gather small rocks and pebbles that they find near the shore to build nests in groups called colonies. Preferring ice-free areas near the edge of the sea, these penguins leave behind a wealth of construction debris from their prodigious home-building and feasting-places near the edges of an ever-changing seascape.

Abundant fish bones, fish ear bones (otoliths) and squid beaks that represent prey remains, along with tissue, feathers, guano and eggshells deposited by the penguins during the nesting period are almost perfectly preserved in the frigid, dry atmosphere. By careful sifting of this debris, Professor Emslie has been able to reconstruct a history of Adélie occupation over centuries. Using radiocarbon dating methods on the organic debris, Emslie has been able to determine precisely where and when penguins nested in this region of Antarctica over the past 45,000 years.

Since these penguins require open water along the shoreline to access their nesting sites, wherever they were present in the past means that open water, and not sea ice or an ice shelf, existed there at that time. Thus, the dates on the ancient colonies provide insight on specific periods in the past when the Ross Sea was ice free. Moreover, the absence of nesting colonies during certain time periods suggests that the sea was covered with ice then, blocking access to any ice-free terrain that the penguins could use for nesting.

Using these and other research methods, a record of the Adélie's preference for oceanfront property connects the penguins' habitation history to the advancing and retreating ice sheets, denoting the movement of the open sea's edge that can be measured over time – ranging from hundreds to tens of thousands of years ago.

Emslie published these findings with Larry Coats and Kathy Licht in the January 2007 edition of *Geology*, determining that the Ross Ice Shelf began its last northward advance about 27,000 years ago and didn't stop until about 13,000 years ago, before it began retreating at the end of the last ice age around 11,000 years ago.

This research led Emslie and others to pose new questions. With further investigation of the penguins' dietary preferences, researchers sought to determine prey species changes that they suspected would parallel or equate to warming and cooling trends in some predictable pattern.

In a most recent article, published as the cover story of the *Proceedings of the National Academy of Sciences* July 10, 2007 issue, Emslie, with researcher William Patterson of the University of Saskatchewan in Saskatoon, revealed surprising findings.

Expecting changes in diet to relate to climate shifts fluctuating over time, their research revealed but one, singular, abrupt dietary shift. As determined from isotopic analysis of eggshell pieces, that one shift occurred only about 200 years ago.

The timing of this historical shift in prey coincided not with climate change but with ecological change, the removal of baleen whales and krill-eating seals at the height of the commercial whaling industry of the 19th century. Emslie and Patterson posit that as humans vigorously hunted whales and seals, the penguins turned from fish to the newly abundant krill left behind.

Today, krill abundance and distribution is changing. As humans continue to take more from the planet than they need or are able to restore, more and different food sources are shrinking and disappearing. Aggravated climate change in combination with fisheries that are harvesting large quantities of fin-fish and krill are already stressing the Adélie's resources, and options for prey are diminishing.

Now, Emslie worries that without energetic protection of the ecological balance of life in the Ross Sea, the Adélie penguin could face a dire future.

"People tend to think of Antarctica as a pristine environment. It is *relatively* pristine, but has undergone enormous impacts by humans in the past that continue today. These impacts are affecting a species of penguin that numbers in the millions, so think what is happening to other species that are much less abundant and more restricted in their distribution. We need to take action now to maintain our planet's biodiversity before it is too late. More sustainable management of our natural resources is key to this survival," Emslie says.

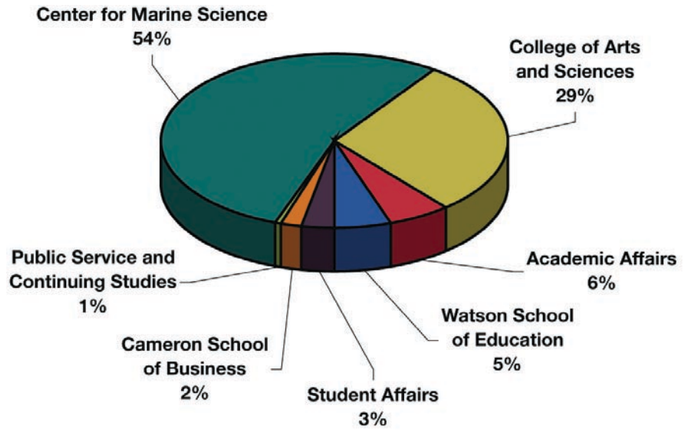
Emslie's research has been funded by the National Science Foundation, the National Geographic Society and NASA.

RESEARCH **REPORT**

summary of sponsored activity

220 funded proposals $18,650,993 total funding 77 sponsors

data provided by UNCW Office of Research Services and Sponsored Programs
www.uncw.edu/orssp



AWARD DOLLARS BY SPONSOR TYPE

Federal	$ 15,517,173
State	$ 1,170,238
Foundation	$ 570,231
Non-profit	$ 236,549
Industry	$ 286,067
Other	$ 870,735

TOP FEDERAL FUNDERS BY AGENCY

NOAA	$ 6,587,687
NSF	$ 2,079,982
NIEHS	$ 1,636,296
US DOED	$ 1,206,029
NIH	$ 1,116,117
US ACE	$ 522,007
USGS	$ 383,432
US SBA	$ 316,399
US DOD	$ 298,541
CDC	$ 267,798
NSA	$ 224,637
ONR	$ 159,212

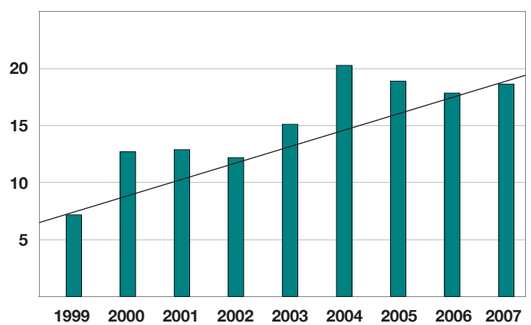
AWARDS BY SCHOOL OR UNIT

Center for Marine Science	$ 10,076,811
College of Arts and Sciences	$ 5,385,308
Academic Affairs	$ 1,076,538
Watson School of Education	$ 1,016,813
Student Affairs	$ 536,510
Cameron School of Business	$ 354,707
Public Service and Continuing Studies	$ 115, 484
All other units	$ 88, 822

TOP FUNDED UNITS

Center for Marine Science	$ 4,474,842
National Undersea Research Center	$ 3,643,387
Biology and Marine Biology	$ 2,509,089
Computer Science	$ 1,405,484
Chemistry and Biochemistry	$ 1,085,728
Watson School of Education	$ 1,016,813
Psychology	$ 789,887
Geology and Geography	$ 659,178
Physics and Physical Oceanography	$ 559,489

SPONSORED RESEARCH AWARD DOLLARS
(in millions) 1999-2007



The **Center for Marine Science** promotes basic and applied research in the fields of oceanography, coastal and wetland studies, marine biomedical and environmental physiology, and marine biotechnology and aquaculture. Single-year and multi-year grants and contract awards, some of which are continuous since 1999, had a total value of $39,388,191 in 2006-07.

2007 NOTEWORTHY AWARDS

❶ **Daniel Baden** (William R. Kenan Distinguished Professor of Marine Sciences) **$7,530,581** *Effects of Inhaled Florida Red Tide Brevetoxins*, National Institutes of Health, National Institute of Environmental Health Sciences

❷ **Gene Tagliarini** (computer science), **Sridhar Narayan** (computer science) and **Shelby Morge** (education) **$1,180,847** *Using Squeak to Infuse Information Technology into STEM Curriculum in Grades 7-12*, National Science Foundation

❸ **Dale Cohen** (psychology) **$691,736** *Quantifying Stimulus, Response, and Numerical Biases*, National Institutes of Health, National Institute of Child Health and Human Development

❹ **Robert Kieber**, **G. Brooks Avery**, **Joan Willey** (chemistry) and **Robert Whitehead** (Center for Marine Science) **$532,752** *RUI: Chemical Characterization and Reactivity of Chromophoric Dissolved Organic Matter (CDOM) in Rainwater*, National Science Foundation

❺ **Steve Ross** (Center for Marine Science) **$530,604** *Trophic Connectivity (Energy Flow) Among Gulf of Mexico Lower Continental Slope Communities Related to Chemosynthetic and Hard Substrate Habitats*, U.S. Geological Survey

❻ **William McLellan** and **Ann Pabst** (biology and marine biology) **$427,849** *Right Whale Data Collection Mid-Atlantic Coast*, National Oceanic and Atmospheric Administration

❼ **Caroline Clements** (psychology) **$348,725** *Safe Schools/Healthy Students Initiative Uniting for Youth*, New Hanover County Schools

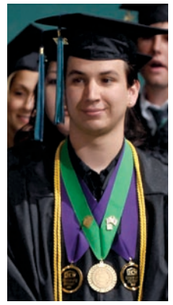
FOCUS: UNDERGRADUATE RESEARCH

PHOTOGRAPHY BY JAMIE MONCRIEF

ELANA NUÑEZ
Spanish and French
'07
Wilmington, N.C.

ELANA NUÑEZ

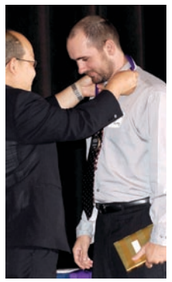
Elana Nuñez's research project focuses on the social and linguistic factors that determine the pronunciation of *y* and *ll* in Mexican Spanish. She conducted her research in Mexico and with immigrants from Mexico within the United States. Results confirmed her hypothesis that the differentiation between the two sounds was less prominent among U.S. speakers. This variation has not been previously studied in Mexico and among Spanish-English bilinguals living in the United States. Nuñez provided empirical data concerning the sound change and its distribution among monolingual and bilingual speakers that had not been documented previously. Nuñez plans to return to Mexico to expand her research, taking into account these factors.



IAN SHEFFER
Philosophy and Religion and Biology
'07
York, Pa.

IAN SHEFFER

For his honor's project, Ian Sheffer examined ethical arguments surrounding assisted suicide, using theories and principles commonly applied in healthcare ethics to examine the issue. Sheffer also explored the issue's history and how attitudes toward suicide have evolved since classical times. His analysis found assisted suicide justifiable from a moral standpoint. Sheffer examined data from Oregon, which has allowed assisted suicide since the passage of the 1998 Death with Dignity Act, finding that only about 280 people have ended their life under the provisions of the act. Sheffer will attend Temple University School of Medicine.



T. BRIAN SHIREY
Biology
'07
Talladega, Ala.

T. BRIAN SHIREY

Denitrification is an important microbial process that removes excess nitrogen, which may kill fish and cause eutrophication in aquatic environments. Brian Shirey examined the diversity and structure of denitrifying communities using sediments collected from the Cape Fear River estuary. The sampling sites within the Cape Fear estuary varied along environmental gradients with each site exhibiting unique physical, chemical and biological sampling parameters. Sequence analysis showed the presence of diverse and unique denitrifying bacteria within the estuary. Shirey will pursue a Ph.D. in biological sciences at the University of Alabama.

CARLY RANDALL
Marine Biology
'07
Rockville, Md.

CARLY RANDALL

Carly J. Randall is one of three students to be named a Portz Scholar by the National Collegiate Honors Council (NCHC) for her senior honors project, "Elevated Sea Surface Temperature Reduces Survivorship and Settlement of Larvae of the Scleractinian Coral, *Favia fragum*." Randall will present her Portz Award-winning paper at NCHC annual conference Oct. 31 – Nov. 4 in Denver, Colo.

Randall's research focus is coral reef ecology. She has presented her research at the 5th Annual Undergraduate Research Conference of the Colonial Academic Alliance at UNC Wilmington and the Scientific Conference of the Association of Marine Laboratories of the Caribbean in St. Thomas. Randall will continue graduate studies at UNCW under the direction of coral reef expert, professor Alina Szmant.

UNCW/JAMIE MONCRIEF

UNC Wilmington's combination of mentored-research, superior teaching and engaged regional service offer undergraduate and graduate students alike rich opportunities to connect knowledge, choices and action to challenging contemporary questions and complex problems.

MARTIN POSEY

SUSANNA LOPEZ-LEGENTIL

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the human experience
regional perspectives
the coral reefs
sustaining seascapes
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