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cover photo
An oil slick and tar balls creep across the backwaters of northern Barataria Bay in Plaquemines Parish, Louisiana.
Photo by Chris Hildreth, Duke Photography.
As the helicopter flew low over the golden marshes and indigo waters of southern Louisiana’s sun-drenched Barataria Bay, Curt Richardson couldn’t help himself. He smiled.
Challenges and Long-term Strategies for Restoring and Maintaining
the Health of the Gulf

*Dukenvironment* Talks with Nicholas School Faculty Members
Curt Richardson and Larry Crowder

by Tim Lucas

As the helicopter flew low over the golden marshes and indigo waters of southern Louisiana’s sun-drenched Barataria Bay, Curt Richardson couldn’t help himself. He smiled.

“Beautiful, isn’t it?” he asked a fellow passenger, gesturing to a spot hundreds of feet below, where the late-afternoon light cast a 24-karat glow on three small fishing boats. “Too bad they’re pulling in oil-coated boom and not shrimp.”

Richardson, professor of resource ecology at the Nicholas School of the Environment and director of the Duke University Wetland Center, visited Louisiana in late July as part of a Nicholas School fact-finding team headed by Dean William L. Chameides. The team toured three Louisiana parishes hard hit by the BP Deepwater Horizon oil spill. Its mission: To learn firsthand how the spill had affected the region’s ecosystems, economy and communities, and to explore potential future research and outreach partnerships to address those impacts. (*See story on page 10*)

It quickly became clear that the oil spill, while catastrophic, was merely the latest in a string of environmental disasters that have struck the Louisiana coast in recent history. Decades of coastal land loss, nitrogen loading and nutrient runoff from the Mississippi River, along with a reduction in life-giving sediment, had already taken a toll on the region’s wetlands and coastal waters, and on the communities of proud, resourceful, resilient people who depend on them for their livelihoods.

A month after the Nicholas School team returned from Louisiana, *Dukenvironment* sat down with Richardson and Larry Crowder, Stephen Toth Professor of Marine Biology and director of the Duke Center for Marine Conservation, to discuss the challenges facing the Gulf and long-term strategies for restoring and maintaining its health.

Q **Dukenvironment**: What should our priority be now that the Deepwater Horizon wellhead is capped and restoration can begin?

A **Richardson**: We immediately need to begin a thorough, independent assessment of whether the oil is really gone and how badly it hit wetlands, tidal creeks and other nursery areas. The government estimates that three-quarters of the oil has been dispersed and that only slightly more than 600 miles of Gulf coast, out of a total 7,000 miles, were affected. But we really don’t know. We need an outside assessment, free of political pressure.

A **Crowder**: There are lots of unanswered questions. Some studies show we still have considerable oil in the Gulf in the middle of the water column. Will larval fish that swim through these midwater plumes and try to breathe through their oil-coated gills survive? We don’t know. We don’t know what the impacts will be from the chemical dispersants used on the gushing oil. We’ve never used them in waters nearly a mile deep before. And all those warm-water bacteria in the Gulf—they consumed some of the oil, but used up oxygen in the process. Are they creating new dead zones? We need to study all this very carefully.

Q **Dukenvironment**: These sound like long-term projects, not immediate fixes.

A **Crowder**: They are. You’re not going to be able to restore a degraded ecosystem the size of the Gulf before the next election cycle. The only way to know how biophysical systems like marshes, fisheries and species are affected by an event like the oil spill is from long-term studies. Unfortunately, there is not much long-term data available for the Gulf, and what we have is not that strong.
**Q** DUKENVIRONMENT: Could short-term studies help fill in the gaps?

**A** RICHARDSON: A little, but not as much as you might hope. As adults, most species can withstand a fairly massive disturbance. But it could still affect their reproduction, and juveniles of the species are much more susceptible to low-level toxins. So the full effects may not show up until future breeding stock can be evaluated.

**Q** DUKENVIRONMENT: How much could these studies cost?

**A** RICHARDSON: Several billion dollars will likely be needed over several decades to address all the issues affecting the Gulf. Tens of millions will be needed just to study the impacts of the oil spill. This seems like a lot of money, but by comparison, cleaning up the Everglades is estimated to cost at least 10 billion dollars. The United States gets more than a third of its fish and a quarter of its natural gas and oil from the Gulf, so we have a vested interest in restoring that ecosystem’s health.

**Q** DUKENVIRONMENT: Where would the money come from?

**A** RICHARDSON: One approach I’ve proposed is establishing a National Institute of Wetlands that would operate totally independently, like the National Institutes of Health. It would take in money in the form of small fees from industries that mine or drill for oil or gas in wetlands or pollute them, and then use this money to fund research to develop restoration methods to sustain these ecosystems. Having a national institute that funded independent research would allow us to develop and implement adaptive management strategies based on science, not politics.

**Q** CROWDER: It’s important to put the funding question in context. Think of how much money BP and the government will spend in the Gulf in the next five years as a result of the spill. You can’t help but wonder how much of the problem could have been prevented if we had spent a tenth of that amount beforehand to understand how the Gulf’s biophysical systems—its fisheries, species and wetlands—work, the problems they face, and the impacts on the environment and the people who live there.

**Q** DUKENVIRONMENT: Which have been worse in your opinion: the impacts to the environment or to the people?

**A** CROWDER: You can’t separate the two. Humans are part of the ecosystem. One of my take-home messages is that in many of these communities, people live so close to the estuaries and Gulf that the health of their economy and culture is directly linked to the health of the Gulf ecosystems. Unfortunately, the Gulf has been on a pretty steady downward slide for a while.

**Q** DUKENVIRONMENT: What about the critically endangered Kemp’s Ridley sea turtle?

**A** CROWDER: The Kemp’s Ridleys have been increasing by 10 to 12 percent a year for the last 20 years. They nest on one beach in Mexico that wasn’t directly affected by the spill. The bad news is, at the time of the spill, adults were leaving for foraging grounds in the Gulf, to the exact spot where the spill was. We’ll need to monitor the populations closely in coming years to assess any impacts.
Q: **DUKEENVIRONMENT:** How big of an issue is coastal land loss?

RICHARDSON: Between 1956 and 2000, Louisiana lost 950 square kilometers of land, with an average of 62 square kilometers, or nearly 24 square miles, lost a year. I’ve seen one estimate that an area the size of Rhode Island has already been lost.

Q: **DUKEENVIRONMENT:** What’s causing it?

RICHARDSON: Silt-laden floodwaters from the Mississippi used to flow down into the bayous and marshes, building them up after hurricanes and other natural or human activities that cause erosion. Channelization of the river has put an end to that. The practices we use for flood control and to keep navigation channels open on the river are starving the marshes. All those flood walls, diversions and levees prevent silt-laden water from re-nourishing them.

Q: **DUKEENVIRONMENT:** Are there solutions?

RICHARDSON: One solution is to redirect some sediment-laden water from the Mississippi into the bayous and wetlands. This would help rebuild the marshes, but there are risks.

Q: **DUKEENVIRONMENT:** You can’t bury a marsh in sediment. You have to study what effects the sediment will have, and at what rate these additions are realistic. Also, it’s critical to understand what the ratio of freshwater to saltwater must be to maintain the marsh and any species that use it as nursery grounds. Researchers have tested this restoration technique in a few places with promising results, but not on a large scale.

Q: **DUKEENVIRONMENT:** What’s the impact on fisheries?

CROWDER: Considerable, especially in light of other fundamental changes taking place in the Gulf economy. Fisheries have largely shifted from commercial to recreational. A few commercial fisheries remain vital. Gulf menhaden still competes on the international fishmeal market, and shrimp, crab and oyster are still big for the domestic market. But other commercial fisheries haven’t fared well against low-cost international competition. In their place, recreational fishing has taken off. It’s now one of the most economically vital fisheries in the United States.

Q: **DUKEENVIRONMENT:** Channelization of the Mississippi also is linked to the seasonal dead zone off the Louisiana coast, right?

CROWDER: Very much so. We built a transportation system for moving things up the river, but we’ve discovered it moves things very efficiently downriver, too. Nutrient-laden runoff from 41 percent of the continental United States is being flushed out into the Gulf of Mexico, where it creates the nation’s largest low-oxygen dead zone each summer off the Louisiana coast.

Q: **DUKEENVIRONMENT:** Are the dead zone’s impacts worse for recreational fisheries than for commercial fishing?

CROWDER: Only in the sense that commercial fishermen can go a little farther down the coast to catch their shrimp if they have to, or they can drop their nets just outside the dead zone, where they’ve learned shrimp can...
cluster. Recreational charter boats, on the other hand, depend more heavily on having clean water and bountiful catches close to port. It’s what attracts customers to their business.

Q
DUKENVIRONMENT: Do we know a price tag for what the dead zone has cost Louisiana?

A
CROWDER: It’s difficult to get accurate data on daily catches, distances traveled from port, fuel costs and other variables that factor into the true cost. The Nicholas School’s Marty Smith and other economists are working on models to help us calculate this. But any way you slice it, the costs are substantial. In Louisiana, fishing—recreational and commercial combined—is a bigger industry than tourism. So any cut hurts. There are social costs, as well. People in many communities have been fishermen for generations. It’s not just their livelihoods that are disappearing, it’s also their culture.

Q
DUKENVIRONMENT: What’s the solution?

A
CROWDER: Reduce the amount of fertilizer being used upriver. Farmers in some parts of the Midwest apply it when the fields are still covered in ice. Because of its low cost, if some runs off with the spring thaw, no problem, they apply more. The problem, of course, is that all this excess fertilizer use creates excess nutrient runoff that gets flushed into the Gulf.

A
RICHARDSON: Berms and artificial barrier islands would cut off the saltwater supply to Louisiana’s marshes and estuaries. It would kill them.

Q
DUKENVIRONMENT: What you do think of Gov. Bobby Jindal’s proposal to build a berm or chain of artificial barrier islands around Louisiana to protect its coast from future erosion, pollution and environmental disasters?

A
CROWDER: The idea of surrounding Louisiana with artificial islands or using a berm—it gives pause. It brings to mind the Hippocratic Oath, “First do no harm.” We have to be careful that our cures aren’t worse than the disease.

A
RICHARDSON: The oil and gas industry is worth more to Louisiana than tourism and fishing combined. It’s not going away. It has to be part of any long-term restoration strategy. We have to find a way to make all these different industries and communities co-exist with a healthy coast and ocean.

A
CROWDER: I’m not opposed to offshore drilling. It just doesn’t make sense to do it if we don’t understand what its impacts could be. We used to think the footprint of an oil well extended in a circle 5,000 feet from the wellhead. This spill has made us re-evaluate that assumption. It’s an important lesson to remember when we’re setting future policies.

Q
DUKENVIRONMENT: People in Louisiana told the Nicholas School fact-finding team this summer that they can’t wait for long-term studies to yield results. They need help now. What can we do now to help restore the Gulf’s health?

A
CROWDER: Reduce fertilizer use upriver. That’s something we can do immediately.

A
RICHARDSON: Create a National Institute of Wetlands to oversee wetland research and develop management strategies that include the dual goals of restoring and maintaining healthy local communities and coastal ecosystems. It could help us integrate our efforts and scale them up more quickly, with less waste.
CROWDER: Using marine spatial planning in the northern Gulf would also help. It's one of the key recommendations for a new national ocean policy put forth by the Interagency Ocean Policy Task Force this year.

DUKENVIRONMENT: How does it work?

CROWDER: Spatial planning is a form of regional ecosystem-based ocean management that extends across economic sectors and accounts for the footprints of all human activities in those waters—energy, fishing, tourism, transportation, conservation, etc. It maps out the footprints of each activity so agencies can see how and where the activities interact. It's especially useful for preventing or resolving conflicts and improving emergency response in crowded coastal waters that have many different uses.

DUKENVIRONMENT: Could it have helped agencies respond more quickly to the oil spill?

CROWDER: We don't know. The task force didn't release its final recommendations until July, two months after the spill began. But we do know that poor communication and cooperation between federal, state and local agencies is the classic governance problem. It delays their ability to set priorities and respond to crises in a concerted way. It's a big part of the reason why the oceans are in the trouble they're in now.

Tim Lucas is the Nicholas School's national media relations and marketing specialist.
NICHOLAS SCHOOL DEAN
Travels to Gulf to Tour Areas Affected by Oil Spill

Dean William L. Chameides traveled to three coastal parishes in southern Louisiana on July 26-29 to tour communities and ecosystems that have been affected by the Deepwater Horizon oil spill and meet with local government officials, fishermen, business owners, community and environmental leaders, and Nicholas School alumni who are working on the response to the spill.

Accompanying Chameides on the fact-finding mission were Nicholas School Board of Visitors Chair Lynn Gorguze, Board Member Thomas McMurray, and members of the school’s Office of Marketing and Communications.

Curt Richardson, professor of resource ecology and director of the Duke University Wetland Center, represented the Nicholas School faculty on the trip. Richardson has conducted extensive research on southern Louisiana’s wetland ecosystems.

In addition to conducting helicopter and boat tours of the region’s vast wetlands and waterways, the group met with Plaquemines Parish President Billy Nungesser, whose parish has been among the hardest hit by the spill; Cindy Brown MEM ’93, a Nicholas School alumna who directs the Nature Conservancy’s Gulf of Mexico project and is helping lead efforts to restore offshore oyster reefs in the Jefferson Parish barrier island community of Grand Isle, La.; and Jim Pahl, a former postdoctoral research associate at the Duke Wetland Center who now directs statewide research for the Louisiana Office of Coastal Protection and Restoration. They also talked with local fishermen, business owners and Strike Force response team members in the parishes, and toured a jack-up barge that was being used as an offshore staging and resupply platform for the oil spill response.

On the final afternoon of the trip, Richardson collected numerous soil, water and plant samples from marshes, islands and canals in and around Barataria Bay, one of the coastal waterways most seriously affected by the spill.

Initial analysis of the samples, conducted back at the Duke Wetland Center lab in Durham, has revealed a surprising
finding; salinity levels in samples from brackish marshes vital to the region’s shrimp, crab and oyster fisheries were surprisingly low—likely a result of clean-up crews’ discharging large amounts of freshwater from upstream sources into the bay to help keep oil-coated ocean water coming ashore. Further research is needed, Richardson says, to determine what impacts the low salinity may have on the marshes and fisheries.

While Richardson collected samples, Chameides, Gorguze and McMurray traveled to neighboring Lower Terrebonne Parish to talk with Courtney Howell and Rebecca Templeton of Bayou Grace Community Services, a grassroots community nonprofit working to promote environmental stewardship and provide critical social services to residents of five rural, mostly poor coastal communities. The communities served by Bayou Grace have been severely affected by the oil spill and by years of coastal land loss and erosion. Templeton took the group to the Dulac Community Center to experience firsthand one of their community outreach partnerships, and to learn about the organization’s urgent need for volunteers. The community center’s executive director, Jamie Billiot, personally led the group on a tour of the facility.

“We went to Louisiana as representatives of President Richard Brodhead and Provost Peter Lange to assess the region’s needs in the wake of the spill and learn how the Duke community can engage with local communities and partners on long-term solutions,” Chameides says.

“Seeing the region firsthand—unfiltered by media hype—and speaking with the people living and working on the front lines of the crisis gave us a much clearer perspective of what our possible courses of action could be,” he says. “We came away with a deep respect for the resiliency and resourcefulness of the people of southern Louisiana, a more accurate understanding of the extent of the environmental and economic challenges they face, and some tangible ideas about how Duke can help.”

—Tim Lucas
Marine Lab Celebrates 70 Years

Duke Marine Lab alumni and friends returned to Beaufort in May to celebrate 70 years of research and education in marine science.

The first buildings were erected on Pivers Island in 1938, and today the Marine Lab operates year-round to provide educational, training and research opportunities to more than 3,500 annually, including undergraduate, graduate and professional students enrolled in the university’s academic programs.

More than 150 gathered to meet old and new friends, and to participate in two days of activities. Participants chose from a list of events including a boat tour to the Rachel Carson Research Reserve, lectures by experts on biofuels, sea mammals and sea level rise, and a night walk in the marshes.

Karl Leif Bates, Duke University director of research communications, blogged from Beaufort. Check out his entries, photos and video at nicholas.duke.edu/insider/trips/duml70/.

Night walk in the marshes
nicholas.duke.edu/nightwalk
Nicholas School Brings **former vice president** and **singer-songwriter** to Campus

**al gore**

Within about a week of each other this spring, Former Vice President Albert A. Gore Jr. and singer-songwriter and Rock and Roll Hall of Fame Inductee Jackson Browne came to Duke University to be honored by the Nicholas School.

Gore, who received the 2007 Nobel Peace Prize for his advocacy of environmental causes, gave the 2010 spring Duke Environment and Society Lecture before a packed house in Page Auditorium. In a speech sprinkled with self-deprecating humor, he talked to the audience about averting climate change.

The Duke Environment and Society Lecture is part of an ongoing series instituted in 2009 by Nicholas School Dean William L. Chameides to bring to Duke major players who are helping build a sustainable future.

“Since the beginning of his career, Al Gore has been relentless in his quest to bring the truth about global warming to the world, even when the world wasn’t listening,” said Chameides. “But the world can hear him now. We are fortunate and thrilled to have him bring his message to Duke.”

Gore, the 45th vice president and former presidential candidate, emerged from the political arena in 2000 to write “An Inconvenient Truth,” the best-selling book on the threat of and solutions to global warming. The movie made from the book received an Academy Award in 2007 and is one of the best-known documentary films in history.

**jackson browne**

Browne, at Duke to receive The Duke LEAF Award™, surprised the appreciative Alumni Weekend crowd in Page Auditorium by picking up his guitar and singing a song from the album he was recording this past spring.

“Jackson Browne is no pretender. While inspiring a generation to work for a better life and a better future for our children through his music, he has advocated for environmental stewardship and has a house that runs entirely on wind and solar power,” said Chameides. “Browne exemplifies what the Duke LEAF Award is all about. We were thrilled to have him come to the Duke campus to receive the award.”

While in Durham, Browne met with members of the Duke community. He was accompanied by artist Dianna Cohen, whose primary medium is plastic shopping bags. A showing of her multicolored wall hangings was held in Perkins Library during their visit.

Browne is listed by *Rolling Stone Magazine* as being one of the most influential singer/songwriters of his generation. He is known for bringing the personal and political to his music with such songs as “Lives in the Balance,” “For Everyman,” “The Pretender,” “Before the Deluge” and “The Drums of War.”
$2.2 Million Grant Supports Implementation Science Research on Malaria Control

A new $2.2 million, 4-year grant from the National Institute of Allergy and Infectious Disease will support research by a Duke University–led team to promote sustainable strategies to curb the spread of malaria and protect human and environmental health in regions where the potentially deadly, mosquito-borne disease occurs.

“We’ll be performing experiments in 24 villages in the Mvomero district of Tanzania to assess the effectiveness of different intervention strategies individually and in combination,” said principal investigator Randall A. Kramer, professor of environmental economics at Duke’s Nicholas School and the Duke Global Health Institute.

What Kramer and his colleagues learn will be used to refine a model they have developed, called the Malaria Decision Analysis Support Tool (MDAST), which scientists and public health officials can use to improve the effectiveness and safety of malaria control strategies in differing localized conditions and circumstances worldwide.

In the Tanzania experiments, villages will be randomly assigned to receive one of four disease-control options: no intervention; treatment with mosquito larvicides; rapid diagnostic testing for malaria by health workers; or both larviciding and rapid diagnostic testing. This will allow the researchers to better understand which strategy or combination of them works best, in different conditions, to protect human health without posing undue human or environmental risks from the misuse or overuse of chemical larvicides.

“The central objective is to improve malaria control through an implementation science approach that integrates health delivery and decision support modeling, to promote joint optimization of vector control and disease management strategies,” Kramer said.

Marie Lynn Miranda, associate professor of environmental sciences and policy and director of the Children’s Environmental Health Initiative at the Nicholas School, and associate professor of pediatrics at the Duke School of Medicine, is Kramer’s co–principal investigator on the new grant.

Their team includes collaborators from Duke, the University of Pretoria, South Africa, and the National Institute for Medical Research in Tanzania.

NEW STUDY
Estimates Sea Turtle Bycatch in the Millions

The number of sea turtles inadvertently snared by commercial fishing gear over the past 20 years may reach into the millions, according to the first peer-reviewed study to compile sea turtle bycatch data from gillnet, trawl, and longline fisheries worldwide.

The study, which was published online in the journal Conservation Letters (April 6), compiled and analyzed data from peer-reviewed papers, government reports, technical reports, and symposia proceedings published between 1990 and 2008. All data were based on direct onboard observations or interviews with fishermen. The study did not include data from recreational fishing.

Six of the world’s seven species of sea turtles are currently listed as vulnerable, endangered or critically endangered on the International Union for the Conservation of Nature’s Red List of Threatened Species.

“Direct onboard observations and interviews with fishermen indicate that about 85,000 turtles were caught between 1990 and 2008. But because
these reports cover less than one percent of all fleets, with little or no information from small-scale fisheries around the world, we conservatively estimate that the true total is at least two orders of magnitude higher,” said Bryan Wallace, lead author of the new paper.

Wallace is the science advisor for the Sea Turtle Flagship Program at Conservation International and an adjunct assistant professor at the Nicholas School. Most of his co-authors are researchers at Duke’s Center for Marine Conservation.

Their global data review revealed that the highest reported bycatch rates for longline fisheries occurred off Mexico’s Baja California peninsula, the highest rates for gillnet fishing took place in the North Adriatic region of the Mediterranean and the highest rates for trawls occurred off the coast of Uruguay.

When bycatch rates and amounts of observed fishing activity for all three gear types were combined and ranked across regions, four regions emerged as the overall most urgent conservation priorities: the East Pacific, the Mediterranean, the Southwest Atlantic, and the Northwest Atlantic.

“Although our numbers are estimates, they highlight clearly the importance of guidelines for fishing equipment and practices to help reduce these losses,” Wallace said.

Effective measures to reduce turtle bycatch include the use of circle hooks and fish bait in longline fisheries, and Turtle Excluder Devices (TEDs) in trawling. TEDs are a grid of bars that act like a trap door to allow turtles, and other nontargeted bycatch species such as marine mammals, to escape from trawl nets.

“Fisheries bycatch is the most acute threat to worldwide sea turtle populations today. Many animals die or are injured as a result of these interactions,” Wallace said. “But our message is that it’s not a lost cause. Managers and fishers have tools they can use to reduce bycatch, preserve marine biodiversity and promote healthy fish stocks, so that everyone wins, including turtles.”

The study stems from work Wallace began in 2005 as a postdoctoral research associate at the Duke University Marine Lab, where he helped develop the first global bycatch database for longline fisheries. That work was part of a three-year initiative called Project GloBAL (Global By-catch Assessment of Long-lived Species).

Co-authors on the new study—all of whom were part of the Project GloBAL team—are Rebecca L. Lewison of San Diego State University; Sara L. McDonald of Duke’s Center for Marine Conservation; Richard K. McDonald of the Center for Marine Conservation and the University of Richmond; Connie Y. Kot of the Center for Marine Conservation and the Marine Geospatial Ecology Lab at Duke’s Nicholas School; and Shaleyia Kelez, Rhema K. Bjorkland, Elena M. Finkbeiner, S’rai Heimbrecht and Larry B. Crowder, all of the Center for Marine Conservation. Crowder is director of the center and Stephen Toth Professor of Marine Biology at the Nicholas School. Lewison formerly was a research associate at the Duke Marine Lab.
LOUISIANA:
On the Frontline of Environmental and Ecological Change

BY SCOTTEE CANTRELL

Nicholas School Assistant Dean Scottee Cantrell travelled to Louisiana with communications department colleagues Nancy Kelly and Tim Lucas the first week in July to plan a trip to the Gulf for Dean William L. Chameides and to explore a possible role for the Nicholas School and Duke to help with the oil spill crisis. The group returned with the dean the last week in July and were joined by Nicholas School board members Lynn Gorguze and Tom McMurray, faculty member Curt Richardson, communications team member Erica Rowell, Duke University photographer Chris Hildreth and a video crew. They met with local government officials, alums and nonprofit groups, traveled across Plaquemines Parish—one of the areas hardest hit by the oil spill—talked with Nicholas alum Cindy Brown about oyster reef restoration off of Grand Isle, toured oil-damaged areas around Bay Jimmy and visited the community of Dulac with Bayou Grace Community Services.

I hadn’t been to Louisiana before. I didn’t know what to expect. My knowledge of its landscape was limited to what I witnessed on television in 2005 when I sat transfixed watching the sad saga of Hurricane Katrina unfold, and again on April 20 this spring when the Deepwater Horizon drilling rig exploded. I didn’t know I’d be a witness.

But in early July, I found myself standing on a narrow levee above the French Quarter. To my left was the muddy, slow-moving Mississippi River, which sat higher than the bowl to my right that was New Orleans. I kept staring first at the water and then at the city; I couldn’t get over how that small stretch of land below my feet was holding the deluge back from the vibrant community.

On the way in from the airport, I had passed the Superdome, the largest fixed-dome structure in the world, where some 30,000 sought shelter after Katrina
struck, and I thought about the woman I had witnessed on the television news. She stood out from a crowd of crying, sick, desperate people, garbage all around their feet, and she pleaded with anyone who could hear her voice to help her, to help them. Katrina is described as one of five deadliest hurricanes and the most costly natural disaster in U.S. history. Rising water, resulting from the hurricane, breached the levees protecting New Orleans, submerging 80 percent of the city. The southern part of Plaquemines Parish was wiped off the map.

And here, five years later, I was about to stand on the scene of another disaster in Louisiana—this one caused by humans. The Deepwater Horizon blowout has been called the worst accidental offshore oil spill in history and one of the worst environmental disasters the U.S. has faced. What would I find? Would I see oil fouling the beaches? Would I see one of my favorite birds, the prehistoric looking pelican, covered in brown crude?

I made two visits to the Gulf this summer, and if I had any inkling of what to expect before I drove into Plaquemines Parish, one of the areas most affected by the oil spill, it was not what I found. I thought I would see oil damage. And I did. But what I found was a people on the leading edge of environmental and ecological change. For those of us still sheltered inland, that change hasn’t swallowed our marshlands or our homes, but we have felt it. And while that woman may not be standing out in front of the Superdome anymore, her plea has remained at the forefront of my mind. It echoes across the marshland as a warning to us all that our lives are changing whether we like it or not, in ways we may not be prepared for nor expect.

We drove first to Belle Chasse through rush-hour traffic that didn’t seem heavy for such a large city. (The continuing effects of Katrina?) We stopped at a nondescript, concrete parish government building to talk with Billy Nungesser, the parish president and probably one of the most quoted men in America since April. Three fishermen, sitting impatiently in the waiting area where Billy’s name is scripted in big letters on the glass front, talked about him as if they knew him and counted on him. The fishermen, whose boats had been hired for oil cleanup, had to take biohazard training to learn how to deal safely with the oil and chemicals. This group of men were upset that the parish, pushed for resources and deluged with people wanting training, was no longer paying for the classes.

Billy was running late, but he greeted us warmly in a conference room and brought the fishermen into the hall behind us to make sure he had time to talk with them after he chatted with us. He was colorful, exuberant, and passionate about protecting and preserving his community—everything the newspapers said—and when he was through explaining what the parish needed, he agreed to meet the dean of the Nicholas School later in the month.

After leaving Billy, we drove down Highway 23 to the Panther Helicopter base. The primary north-south artery, the highway runs more than 74 miles along the west bank of the Mississippi below New Orleans and passes miles of marshland, oil refineries, marinas and gas stations.

I’m afraid of heights. Planes make me a little nervous. But I love being in a helicopter. Aside from the noise, it is like being a bird. Our veteran pilot, Chuck, who in recent months has ferried news crews and oil workers, gave us our safety instructions—for instance, if you hit the water, don’t get out until the pilot tells you. He revved the motor, we pulled on the bulky headgear needed to protect our ears and talk to each other over the din of the blades rotating, and the copter rose slowly above the marshes.

The view takes your breath away. As we flew toward Barataria Bay and on to Grand Isle, the sunlight glinted off the water and turned the landscape into a hazy blue sheen dotted with hundreds of islands for as far as we could see in every direction. Chuck talked about how he has watched those islands disappear over the years.

As amazingly beautiful as it was, it also seemed fragile. I thought: “How in the hell are they keeping the oil out of...
these wetlands?"

Well, when we took the boats out to Bay Jimmy the next day and when Dean Chameides went out later in the month, we saw what was keeping the oil out, or attempting to, anyway. As we made our way down green channels carved through the marshes by the oil industry and lined with flowering pink marshmallows, we saw booms. Thousands of yards of plastic yellow and orange booms with absorbent pads were everywhere. They were piled on jack-up barges (platforms on stilts driven into the marshes), dragged behind shrimp boats, and strung next to marsh edges and along beaches. Dirty, oily booms.

And there were fishermen in air boats swabbing up oil with white pads in an effort that seemed akin to stopping a flood with a Q-tip. There were fishermen vacuuming up oil with Shop Vacs. There were fishermen in shrimp boats converted to oil skimmers deploying booms to catch the oil off of the surface. Around them was dirty brown, dying marsh grass.

Fishermen is what they were before the oil spill, but because of fishing bans they had been transformed into oil workers, mopping up brown crude and ferrying reporters and visitors out to see what was happening in their precious marshlands. Every fisherman, every chopper pilot, every marina worker we spoke to was anxious for us to understand and to get the word out about what was happening, is happening in Louisiana. But not just about the oil spill.

As sobering as it was to see the oil washed into the edges of the marsh grasses—phragmites, black needlerush and Spartina—and slowly killing it, it increasingly was becoming apparent that the spill was only the most immediate crisis. Our boat captain told us that the map he kept in the boat was five years old because he liked to know where the land used to be in the marshes. At that particular moment, he said, "We're sitting over Big Island."

Big Island was on his map, and it existed in reality five years ago. But when we looked over the edge of the boat, there was no sign of it.

"That patch of water behind us," he said, "that used to be land too. The marshes are disappearing."

On the second trip to Louisiana with Dean Chameides, we were riding from Houma to Dulac in a van with Rebecca Templeton of Bayou Grace Community Services, a nonprofit serving the five bayou regions in the Lower Terrebonne Parish. As we passed a stand of tree skeletons, victims of saltwater intrusion, she lifted her hand to catch our attention and pointed to an area outside the car window. "That is where my grandfather grazed his cattle," she said. We looked, and saw nothing but water.

As absurd as it sounds, Louisiana is losing a football field-sized piece of land to water every 30 minutes.

Our boat captain, the fishermen we talked to, Rebecca, Billy Nungesser, the children we would meet at the community center in Dulac—people whose families have lived in Louisiana for generations—they are witnessing their homeland being swallowed by water. Historically, the Mississippi River has created healthy barrier islands off the coast and a vast system of marsh and wetlands that have become home to a rich culture and an ecologically diverse community. The issue is more complex than this, but essentially, over the last 100 years, we have created a levee system that diverts the Mississippi to such an extent that it dumps silt directly into the Gulf, bypassing and leaving southern Louisiana unprotected. Hurricanes, fueled by global warming, crash through unprotected wetlands and strip them away. The water is rising.

Looking out over the disappearing landscape reminded me of the new story I read a year ago about a village of Eskimos in Alaska. They had survived in extreme weather conditions for thousands of years, and yet were having to abandon their village because of flooding brought on by climate change.

They, like the people in Louisiana, stand at the edge of massive environmental and ecological change. They see it every day and struggle with how to manage it. Those of us inland may not be abandoning our homes, planting marsh grass to reclaim our wetlands or building oyster reefs to protect and save our homeland and our livelihoods, but we are not safe. Change is here.

That woman I saw on TV outside of the Superdome—I may never see her again. But I heard her voice over and over again as I toured the marshlands. Rebecca Templeton would probably say "It's not too late. You can still help. We all have much to lose here."

Scottee Cantrell is Nicholas School assistant dean for marketing and communications.
It will be years before we know what, if any, are the long-term environmental consequences of the Deepwater Horizon blowout. But as a media event, the spill caused by the blowout was huge. Did the accident warrant all that special attention? Was it really a singular event in the world of oil extraction and transport, or just one of many? Let's take a look.

**OIL SPILLED FROM TANKERS**
Approximate number of barrels spilled from tankers globally from 1970 to 1979: 22 million
Approximate number of barrels spilled from tankers globally from 2000 to 2009: 1.5 million

**AVERAGE AMOUNT OF OIL SPILLED YEARLY INTO THE OCEANS**
Estimated number of barrels of oil spilled on average in North American marine waters each year: 700,000
Estimated number of barrels of oil spilled on average into marine waters worldwide each year: 4.7 million
Estimated number of barrels of oil released on average into marine waters worldwide from natural seeps: 4.2 million

**NUMBER OF ACCIDENTS CAUSING OIL SPILLS IN THE OCEAN**
Number of major oil spills in 2009 on the U.S. Outer Continental Shelf (tracked by the U.S. Minerals Management Service): 10
Number of barrels of oil spilled from those major accidents: 2,581
Number of oil spills or potential oil spills reported to the National Oceanic and Atmospheric Administration since the Deepwater Horizon accident: 17

**U.S. RECORD HOLDERS FOR LARGEST MARINE OIL SPILLS**
Largest U.S. marine oil spill: Deepwater Horizon (2010)

**bottom line**
There’ve been lots of accidents and oil spills. In fact, spills around the world, both on land and in the ocean, offer a troubling picture of this environmental threat. The latest oil spill from BP’s deepwater well in the Gulf is just one of many. When it comes to sheer volume, the Deepwater Horizon holds the worldwide title for accidental, marine spills, but it’s not the biggest overall U.S. spill. The nation’s largest oil spill to date is the Lakeview Gusher, which emptied some nine million barrels of oil into the California desert in 1910 near the towns of Maricopa and Taft over the course of 17 months. Let’s hope none of these record holders is ever topped.

Statistics courtesy of Dean William L. Chameides’ blog, The Green Grok, thegreengrok.com
A new study reconstructing thousands of years of fire history in the southern Appalachians supports the use of prescribed fire, or controlled burns, as a tool to reduce the risk of wildfires, restore and maintain forest health, and protect rare ecological communities in the region’s forests.

Duke University researchers used radiocarbon analysis of 82 soil charcoal samples dating from 1977 to more than 4,000 years ago to reconstruct the fire history of a 25-acre site in the Nantahala National Forest in western North Carolina. Their study, the first of its kind, appeared on the cover of the peer-reviewed journal Ecology (March 31).

“These are the first hard data showing that fires have occurred relatively frequently over much of the last 4,000 years and have played an important role in the health, composition and structure of southern Appalachian forest ecosystems,” said Norman L. Christensen Jr., founding dean and professor of ecology at Duke’s Nicholas School. “Prior to this study, people presumed fire had long played an important role, but tree rings were the only available tool to study it and they allowed us to look back only a few hundred years.”

Analysis of soil charcoal samples demonstrated that fires became more frequent about 1,000 years ago. This coincides with the appearance of Mississippian Tradition Native Americans, who used fire to clear underbrush and improve habitat for hunting, Christensen said.

Fires became less frequent at the site about 250 years ago, following the demise of the Mississippian people and the arrival of European settlers, whose preferred tools for clearing land were the axe and saw, rather than the use of fire. Active fire suppression policies and increased landscape fragmentation during the last 75 years have further reduced fire frequency in the region, a trend reflected in the analysis of samples from the study site.

The relative absence of fire over the past 250 years has altered forest composition and structure significantly, Christensen said.

“The vegetation we see today in the region is very different from what was there thousands or even hundreds of years ago,” he noted. “Early explorers and settlers often described well-spaced woodlands with open grassy understories indicative of high-frequency, low-intensity fires, and a prevalence of fire-adapted species like oak, hickory and chestnut, with pitch pines and other low-moisture species on ridgetops. Today, it’s become more mesic—we find more species typical of moist ecosystems. They’ve moved out of the lower-elevation stream-sides and coves, up the hillsides and onto the ridges.”

Aside from any inherent historic and scientific interest, knowing more about pre-settlement fire regimes in the region may help forest managers today understand the likely responses of species to the increased use of prescribed fire for understory fuel management, Christensen said.

However, he cautioned that because of widespread changes that have occurred in the forests as a result of centuries of fire suppression and other human activities, as well as climatic changes, “prescribed burns may or may not behave similarly to fires that occurred in the past. Fires today likely would burn hotter and more intensely than fires did in the past.”

Kurt A. Fesenmyer MEM/MF’06, a geographic information systems (GIS) specialist with Trout Unlimited in Boise, Id., coauthored the study, which was funded by the U.S. Forest Service. It was conducted at the Wine Spring Creek Ecosystem Management Area on the western slope of the Nantahala Mountains.
NORM CHRISTENSEN TO ASSUME RESEARCH PROFESSORSHIP

On Dec. 31, Norman L. “Norm” Christensen Jr., founding dean of the Nicholas School and professor of ecology, will be vacating his academic position to assume a research professorship in the school so that he can continue to teach and do research while having more time to pursue other interests.

“Norm has made an indelible mark on our school, on Duke, and indeed on the entire field of ecology in his 35-plus years at the university,” said Nicholas School Dean William L. Chameides. “As founding dean of the Nicholas School of the Environment, he presided over the school’s ascension to one of the leading environmental programs in the nation during his 10-year term.”

Christensen has established himself as a world-class scientist having received the A. Starker Leopold Award, been elected a fellow of the American Association for the Advancement of Science, and served as president of the Ecological Society of America.

“And, as exemplified by his Distinguished Teaching Award from Trinity College, Norm is a gifted and dedicated teacher and mentor,” Chameides said.

NEW $343K GRANT WILL FUND INTERNSHIPS AND FELLOWSHIPS IN GREEN ENERGY VENTURES

A Duke University green energy program has been awarded a $343,239 grant that will allow the hire of 18 interns and four fellows.

The program is a joint initiative of Duke’s Nicholas School, the Center for Energy, Development and the Global Environment (EDGE), and the Center for Entrepreneurship and Innovation. It has two components: an internship program that places students with North Carolina businesses to work on high-impact energy efficiency strategies, and a fellowship program that will help fund the launch of new clean energy businesses in the state.

The grant was part of $5.6 million in stimulus funds awarded by the North Carolina Energy Office through the federal American Recovery and Reinvestment Act. The federal funds are being combined with $3 million allocated from public and private agencies in North Carolina.

All told, the funds awarded by the Energy Office will create a statewide internship program that will employ 400 North Carolina students and recent graduates training in green-energy related fields. More than 20 private businesses, public agencies and universities are expected to participate, according to information from the North Carolina Department of Commerce.
Energy Conservation in South Could Save Billions, Create Jobs

Energy-efficiency measures in the southern United States could save consumers $41 billion on their energy bills, open 380,000 new jobs, and save 8.6 billion gallons of water by 2020, according to a study from Duke’s Nicholas Institute for Environmental Policy Solutions and the Georgia Institute of Technology. The study concludes that investing $200 billion in energy efficiency programs by 2030 could return $448 billion in savings.

The researchers modeled how implementation of nine policies across the residential, commercial and industrial sectors might play out over 20 years in the District of Columbia and 16 southern states.

“We looked at how these policies might interact, not just single programs,” said Etan Gumerman of the Nicholas Institute and co-lead researcher of the study. “The interplay between policies compounds the savings. And it’s all cost-effective. On average, each dollar invested in energy efficiency over the next 20 years will reap $2.25 in benefits.”

Policies considered by the study, “Energy Efficiency in the South,” include new appliance standards, incentives for retrofitting and weatherization, upgrades to utility plants and process improvements.

The South is rich terrain for efficiency improvements. Without them, the region might expect 15 percent growth in energy demand by 2030. Thirty-six percent of Americans live in the study region. The region consumes an outsized portion of American energy, 44 percent, but it also supplies 48 percent of the nation’s power.

A combination of factors has left this disproportionate usage unexplored by policymakers keen on energy efficiency. The South historically has low electricity rates, which encourage consumption. Energy-efficient products have a lower market penetration than elsewhere in the United States. And these states spend less per capita on efficiency programs than the national average.

The researchers generated a “business as usual” scenario, without any policies, and compared it with scenarios that included specific sets of energy-efficiency investments, to capture the cost savings. The study, released in the spring, concludes that aggressive energy efficiency initiatives would:

Generate new jobs, cut utility bills and sustain economic growth. Overall utility bills would be reduced by $41 billion a year in 2020 and $71 billion in 2030; the average residential electricity bills would decline by $26 per month in 2020 and $50 per month in 2030; electricity rate increases would be moderated; and 380,000 new jobs would be created by 2020 (annual job growth increases to 520,000 new jobs in 2030). The region’s economy is anticipated to grow by $1.23 billion in 2020 and $2.12 billion in 2030.

Reduce the need for new power plants. Almost 25 gigawatts of older power plants could be retired and the construction of up to 50 gigawatts of new plants (equal to the amount of electricity produced by 100 power plants) could be avoided.

Result in substantial water conservation. The reduction in power plant capacity would save southern regions of the North American Electrical Reliability Corporation 8.6 billion gallons of fresh water in 2020 and 20.1 billion gallons in 2030.

“An aggressive commitment to energy efficiency could be an economic windfall for the South,” said Dr. Marilyn Brown of the Georgia Institute of Technology and co-lead researcher of the study. “Such a shift would lower energy bills for cash-strapped consumers and businesses and create more new jobs for southern workers.”

Profiles of the report’s results for each state are available at: www.seealliance.org/programs/research.php.

“Energy Efficiency in the South” is available on the Southeast Energy Efficiency Alliance (SEEA) website: www.seealliance.org/programs/research.php. State profiles also are available through SEEA, a nonprofit organization that promotes energy efficiency in the Southeast. This project is funded with support from the Energy Foundation (www.ef.org), the Kresge Foundation (www.kresge.org) and the Turner Foundation (www.turnerfoundation.org).

Check out the Institute’s new web site at nicholasinstitute.duke.edu.
Tucked into the back roads of Orange County, past a UPS warehouse and an old landfill, is a tract of Duke Forest that is almost unknown to the visitors who hike, bike, and picnic on more charismatic sections of the forest closer to Duke’s campus.

For the past 17 years, anyone who entered this site would be greeted by the steady thrum of machinery that was converting liquid carbon dioxide into gas and piping it into the forest to four circular plots, each 30 meters in diameter. A ring of 16 metal towers atop massive concrete bases surrounded each of these plots plus three additional control plots. Carbon dioxide was pumped from valves in these towers into the four experimental plots.

Late in October, the machines were turned off, and the only sounds on the remote site—besides birdsong—came from the labors of crews beginning to collect some last specimens for analysis, including 32 enormous trees, roots and all. In the next couple of years, the towers will come down, the sheds and trailers hosting equipment and offices will be cleared out, and only the seven rings of concrete bases will remain in the forest to provide a puzzle for archaeologists in a future millennium.

It is the beginning of the end of an ambitious scientific research project aimed at understanding the impact of rising carbon dioxide on ecosystems. Specifically, the Department of Energy, which funded the project, wanted to know whether forest ecosystems bathed in the higher carbon dioxide expected in a future scenario of climate change would actually sequester increasing amounts of the greenhouse gas from the atmosphere. Could forests solve the climate change problem, or at least ameliorate it?

**MEASURING THE IMPACT OF CARBON DIOXIDE ON PLANTS**

To understand this research, it is necessary to remember that plants synthesize food from carbon dioxide through photosynthesis. So adding carbon dioxide to the atmosphere is tantamount to putting the forest on a high-carbohydrate diet; trees are expected to grow faster and become larger than their colleagues in the control plots. And because trees hold carbon in their tissues, bigger trees should hold more carbon—keeping it
out of the atmosphere, theoretically.

Boyd Strain, professor emeritus of botany, did pioneering work on plant response to carbon dioxide with students and colleagues from 1976 until his retirement in 1998. They worked first with potted plants in growth chambers, where variables like temperature, humidity, and of course carbon dioxide could be controlled. Next, they used “open-top chambers”—plastic walls surrounding individual loblolly pines planted outside, eliminating the experimental “artifacts” they found when roots were artificially constrained by pots.

From these experiments, it became obvious that individual plants did respond to elevated carbon dioxide by accelerating their growth rate. “But we needed to eliminate the environmental impact of those walls,” Strain says. He was eager to test the effect of elevated carbon dioxide on an entire ecosystem: the trees, the understory plants, the soil, the forest animals, the insects, the nematodes, the soil structure and the hydrology.

At around the same time, George Hendrey and his colleagues at Brookhaven National Laboratory had become convinced, Strain says, that they could build a system that would bathe a natural forested ecosystem with carbon dioxide, using computers to detect wind speed and other variables in order to keep a steady amount of the greenhouse gas flowing into the research site, 24/7. In 1990, Strain and Roger Dahlman of the Department of Energy (DOE) visited an experimental site that Hendrey had created in an agricultural field in Arizona. The technology was called Free-Air Carbon-dioxide Enrichment, or FACE.

Strain and Hendrey, with Dahlman’s support, convinced DOE to fund a prototype in Duke Forest, to test the effectiveness of the technology in a tall-statured plant community.

FROM FEATURELESS FOREST TO ECO-CIRCUS

The prototype ring began operating in Duke Forest in 1994. By that time, Strain was close to retirement, and his botany department colleague William Schlesinger was tapped to be Duke’s principal investigator for the successful proposal to erect a full-fledged FACE experiment in Duke Forest.

It was Schlesinger who dispatched two laboratory technicians, Beth Thomas and Jane Raikes, into a dense forest dominated by fast-growing loblolly pines, where they fought poison ivy and chiggers to identify and map six sites that were as similar to each other as possible. He hired a contractor whose charge it was to erect the six new rings of towers—which jetted well above the tree line—with minimal impact to the ecosystem. Because the towers were supported solely by the weight of the cement bases, a considerable volume of cement was below ground. The holes were dug by hand and the cement brought in by wheelbarrow.

“We wanted the experiment to be as if it was dropped into this forest without causing any disturbance, so that . . . when we added carbon dioxide to three of these plots, that was the only thing that was altered,” Schlesinger recalls.

Hendrey and his colleagues at Brookhaven National Laboratory, who continued to run the site, had engineered the closest possible replicate of a forest ecosystem under future atmospheric conditions.

By the summer of 1996, the experiment was under way, and the forest was lively with activity. Shannon LaDeau, now a scientist at the Cary Institute of Ecosystem Studies, studied seed and pollen production at the site as a PhD student. She remembers calling the site the Eco-circus, referring to both the ring-shaped plots and the riot of instruments, leaf-collection baskets, and colored flags staking out individual research groups’ claims to a particular layer of soil or community of plants.

In 1999, Schlesinger and Evan DeLucia of the University of Illinois reported in Science that the trees bathed in the higher levels of carbon dioxide—levels expected to exist naturally by 2050—had experienced a 25 percent increase in their growth rate.

News reports at the time concluded that if all the world’s forests would experience such a dramatic growth spurt in 50 years, they could become an effective “sink” for excess carbon dioxide in the atmosphere.

But the FACE researchers urged caution. The experiment, originally funded for 10 years, was intended to determine whether such a growth rate was sustainable. “When you expose plants to a different stress or change,” Schlesinger says, “They’ll show an immediate response followed by a physiological acclimation. The immediate reactions tend to damp off.”

THE FOREST EXPERIMENT MATURES

The trees exposed to higher carbon dioxide were growing faster, just as they had in chamber studies. But was the ecosystem as a whole retaining more carbon? In particular, researchers had hypothesized that soil carbon might
increase under the experimental regime, creating an additional carbon sink.

“But soil carbon enhancement was not that great, if any at all,” reports Ram Oren, Nicholas Professor of Earth System Science, who became Duke’s principal investigator for FACE after Schlesinger became dean of the Nicholas School in 2001. In the 2000s, John Lichter of Bowdoin College published two papers with colleagues describing an initial growth then leveling off of soil carbon from dead leaves on the forest floor in the experimental plots. New carbon added to the forest floor as litterfall from the additional tree growth apparently stimulated soil microbes to decompose carbon contained in the soil—so equilibrium was achieved in the carbon cycle.

A second wave of research conducted under Oren’s leadership showed that the continuing growth response of plants to a “high-carb” diet depended on the native fertility of the site. Trees in fertile areas responded strongly to the carbon dioxide treatment and continued a higher growth rate, but trees in areas with poor soils did not retain their original growth response. That’s important in the real world, Oren says, because our most fertile soils tend to be cultivated for agriculture, leaving forests in less fertile tracts.

While the core research involving trees and soils was being conducted, an army of researchers was tackling ancillary projects, with measurements being taken deep into the soil, on understory plants, and on canopy insects, among others. One finding that made a splash was that poison ivy grew 70 percent faster under higher carbon dioxide. That, coupled with LaDean’s results showing greater pollen production, gave the world a taste of the public health implications of rising carbon dioxide.

Over the years, at least 100 scientists worked at the site, including 23 whose PhD research was conducted there. More than 250 scientific papers reported research findings, including eight in Science and Nature.

Trees that were 10 meters high when the experiment was launched grew to 21 meters, Oren says, and 70 percent of the biomass in those trees has been produced since the experiment began. The towers have been raised as high as possible, and “the invisible CO2 dome that sits on top of the plot would soon have been exceeded by the height of the trees,” Oren says.

THE LEGACY OF FACE

Time began running out on FACE in 2008, when the Department of Energy announced, to the research team’s dismay, that it would cease funding the project, and requested that the researchers remove some trees and soil, which will allow further analysis of the impact of the added carbon dioxide on the ecosystem. The results of that analysis, which should be completed by spring, will add to an expansive data set that Oren says is the most important legacy of the project. He explains that you can’t simply multiply the quantified effects of added carbon dioxide at Duke’s FACE site or any of the other half-dozen or so FACE experiments around the world by the global forest area in order to predict the effects of climate change globally. “The best way to get at that scope is by modeling,” he says.

Schlesinger explains that climate modelers—scientists who use computer simulations to predict future conditions—have long needed information about whether there would be a vegetation response to climate that would actually stave off the further rise of carbon dioxide. “That was the *sine qua non* of why we did this experiment,” he says. “And in fact I think we provided an answer that a lot of climate modelers were able to use, that there was some response of the forest but not a huge response.”

Even “not a huge response” is important, and here’s why. “The effects of climate change will be far reaching for agriculture and forestry, water resources and their management, coastal areas mitigation and adaptation policies, insurance, energy consumption, and so on,” Oren says.

Until the experiment is performed naturally in 30 or 40 years, global-scale climate models are the only tool we have for predicting the trajectory of climate change caused by rising carbon dioxide and its consequences. These models must reflect the best knowledge the scientific community can offer as to how the Earth will react to rising carbon dioxide.

Without the data from FACE, modelers would be postulating the response of forests to rising carbon dioxide. An error in either direction—postulating either no response or an enormous response—could change the types of decisions that governments and corporations will be making. Oren says, “The link to policy making, both in terms of combating climate change and adapting to it, should be obvious.”

Lisa M. Delwo is a Hudson Valley–based freelance writer focusing on science and nature. Her last article for *Duke Environment* was “Biogeochemistry on the Farm” (Spring 2008).
2010 Graduate PATRICK DUGGAN
Accepted into DOJ Honors Program

By Laura Cloak MEM '11 and
Duke Law News

Patrick Duggan JD/MA ’10 was accepted into the U.S. Department of Justice’s (DOJ) highly competitive Honors Program and joined the department’s Environment and Natural Resources Division in the fall of 2010. Duggan graduated in May with a Master of Arts in Environmental Science and Policy from the Nicholas School of the Environment and a Juris Doctor (JD) degree from the Duke Law School. He was an environmental consultant before coming to law school.

“I came to (graduate) school specifically to study environmental law,” Duggan says. “Being accepted into this program validated my decision to come here.”

The Honors Program is the only way entry-level attorneys can join the DOJ. According to its website, the department selects its employees based on academic achievement, participation in a journal or moot court competitions, legal aid and clinical experience, summer or part-time legal employment, and other factors—specialized academic studies or academic degrees, work experience, and extracurricular activities—related to the work of the department.

“Duke is small, and if you really have a passion for something, you can own it,” says Duggan, who led the Environmental Law Society for two years, served as student liaison to the Energy Subcommittee of Duke’s university-wide Sustainability Committee, and was the editor-in-chief of the Duke Environmental Law & Policy Forum.

In addition, Duggan participated in the Environmental Law and Policy Clinic the past school year, gaining experience he believes was critical to his acceptance into the program.

During his time at Duke, Duggan worked with students and faculty to increase collaborations between the Nicholas School and the Law School.

“The Nicholas School provides incredible scientific knowledge that is needed to make change. The Law School provides the policy means by which to actually make that change. Together, I think that students from the two schools can be very dynamic, and I hope that as I leave there is more of a bond than there was when I came,” he says.

James E. Salzman, Samuel F. Morse Professor of Law and Nicholas Institute Professor of Environmental Policy, and Michelle Nowlin, supervising attorney for the Environmental Law and Policy Clinic, encouraged Duggan to apply for DOJ’s Honors Program.

“In talking with Patrick about what his career goals were, it seemed that he would be able to gain the most comprehensive experience, best training, and broadest view of the issues in a way that was consistent with his values at a place like the DOJ,” Nowlin says. “Patrick has a curious mind and demonstrates a lot of initiative. He is eager to learn and is quite responsive to feedback and direction, but by the same token, he is not afraid to ask questions and challenge conventional wisdom. I think those attributes will serve him very well as an advocate for the protection of the environment and enforcer of the nation’s environmental laws.”
Nicholas School Student WINS Shell Energy for Tomorrow ESSAY CONTEST

Willem Fadrhone, a second-year student pursuing concurrent masters degrees in environmental management and business administration from Duke University’s Nicholas School and the Fuqua School of Business, won the 2010 Shell Energy for Tomorrow essay competition.

Students from 30 top graduate business schools submitted 1,000-word essays in the national competition, sponsored by Shell Oil and hosted by Time magazine. Essays described students’ vision for a workable and original model for a sustainable energy future.

Time posted the 10 finalists’ essays on its website, www.time.com/energyfortomorrow, this spring. The winning essay was selected by a panel of experts from the energy industry and media.

As winner, Fadrhone received a $5,000 donation made in his name to Duke, and had his essay printed in an Aug. 23 issue of Time and an Aug. 30 issue of Fortune. He also was invited to participate at the Fortune Global Forum conference in Cape Town, South Africa, in June.

In his essay, Fadrhone detailed the economic and environmental benefits of creating a market for point-source-created heat from industrial heat and power facilities. “In our current infrastructure heat is not a scarce resource; in fact, most heat generated in industrial processes is casually emitted to the atmosphere,” he wrote. “With minimal planning and proven technology, that emitted heat can be captured and applied to do work … There is no single silver bullet to provide a secure energy future, but efficient heat use and a market mechanism to encourage it is a workable method to prolonging our energy resource supply.”

“After a long and searching discussion with my fellow judges, we are delighted to award Willem Fadrhone … as the overall winner,” said Jeremy Bentham, vice president of global business environment at Shell International.

“I am delighted that we are honoring Willem, as the overall winner, for his well written and original piece,” said Michael Elliott, deputy managing editor at Time.

Much of Fadrhone’s graduate research focuses on the cost and complexity of low-carbon electric power generation technology. Prior to attending Duke, he worked as a mergers and acquisitions investment banker in New York City. He is a co-founder of Eco-Patriots, an environmental education organization focused on encouraging individual choice as a means for encouraging sustainability.

“Willem’s essay is an extremely well thought through piece of work which addresses a fundamental feature of the current energy system.”
THE DEAN’S AWARD FOR OUTSTANDING RESEARCH PAPER FOR 2010—
Given annually since 2008 to recognize outstanding research and writing done by a current
PhD candidate who has a manuscript accepted or published in a peer-reviewed journal.
Recipients receive a $3,000 prize, and their name is placed on a plaque hung in Hig Commons.

Jennifer M. Ayers, Earth and Ocean Sciences (First Award)
“Physical controls on the seasonal migration of the North Pacific transition zone chlorophyll front,”
MS, Masters of Space Studies, International Space University, 2003
BS, Biology and Symbolic Systems, Stanford University, 2001

Sally E. Thompson, Environmental Sciences and Policy (Runner-up)
“A Porous Convection Model for Grass Patterns,” The American Naturalist (volume 175, January 2010).
PhD, Duke University, 2010
BS and BE, University of Western Australia, 2003

VIRLIS L. FISCHER AWARD—Goes to the graduating professional degree student with the
highest academic achievement. Given by Bernice Fischer in memory of her husband.

MAURA PATRICIA NOWALK OF PITTSBURGH, PA.
MEM, Ecosystem Science and Conservation
Duke Activities: Co-chair of SAWS; volunteer, Duke Gardens Program with
DEI; Duke Wetland Center employee; TA, statistics and
undergraduate environmental policy course.
Awards/Honors: Nicholas School Alumni Association Scholarship.
Post-graduation destination: San Antonio, Texas, employed by San Antonio River Authority.

SARA LABOSKEY AWARD—
Given in recognition of personal integrity and academic excellence.

CIARA FRANCES WIRTH OF SACRAMENTO, CALIF.
BA, Environmental Sciences and Policy, and BS, Biology
Duke Activities: Environmental Alliance, Native American Student Alliance, Students for Sustainable Living.
Awards/Honors: Angier B. Duke Scholar, Graduation with Distinction, Summa Cum Laude.
Post-graduation destination: Fulbright in Ecuador to develop and pilot a bilingual ecology education course for Waorani secondary
school students.

DESHIRA WALLACE OF KEY WEST, FLA.
BA, Environmental Science and Policy
Duke Activities: Circle K (vice president), MI Gente, 2010 Winter Forum
Planning Group, Children’s Environmental Health Initiative (research assistant).
Awards/Honors: Graduation with Distinction

THOMAS V. LASKA MEMORIAL AWARD—
Given by the Earth and Ocean Sciences faculty to the most outstanding senior major.

ALEXANDER ROBEL OF MIAMI, FLA.
BS, Earth and Ocean Sciences, Physics (Math Minor)
Duke Activities: International Relations Association, Scientifica
Mentoring, Project Search.
Awards/Honors: Angier B. Duke Memorial Scholarship, Mellon-Mays
Undergraduate Fellowship, North Carolina Space Grant
Scholarship, Graduation with Distinction, Cum
Laude, National Defense Science and Engineering
Graduate Fellowship, National Science Foundation
Graduate Research Fellowship.
Post-graduation destination: Harvard University, Department of Earth & Planetary
Science, PhD program.

*Satisfaction with Distinction—Accords special recognition for academic excellence to students who
successfully complete a significant independent research project on the environment or earth sciences.

SOMETIMES IT’S EASY TO MISS THE SWAMP FOR THE OIL

by William L. Chameides

Sometimes it’s easy to miss the forest for the trees, or the swamp for the oil. That’s a lesson I learned anew from a
fisherman on a July visit to the Louisiana bayous.

Way back in April when the dimensions of the Deepwater Horizon gusher were beginning to emerge, many in
the media were describing the accident as our nation’s worst environmental catastrophe. But in late July, as the
gusher was being capped off, the media changed its tune. Now there were reports of vanishing oil, clean marshes
and abundant fish.

What, I wondered, was really going on? To find out, a Nicholas School team went down to the Gulf to see for
ourselves. What we found was not what we expected. We did find oil, and we eventually stumbled upon what may
very well be America’s worst environmental catastrophe. But the catastrophe didn’t start last April; it’s been going on
for decades.

OUR GULF ITINERARY: THE NICHOLAS SCHOOL GOES SNOOPING
You might say that we got around during our Gulf visit. We motor-boated up and down bayous and took water
and soil samples, we helicoptered over wetlands, and we met with various folks —some by appointment and some by
happenstance. Our official appointments included:
• Billy Nungesser, popular president of Plaquemines Parish and the oil
spill go-to guy for the news media;
• Jamie Billiot of the Dulac Community Center, which services a roughly 50-percent Native American rural community on Bayou Grand Caillou (median income—less than $9,000/year);
• Rebecca Templeton of Bayou Grace Community Services, a nonprofit organization that works with five poor bayou communities in Lower Terrebonne Parish;
• Cindy Brown, graduate of Duke’s Nicholas School and director of The Nature Conservancy’s Gulf of Mexico program; and
• Jim Pahl, former Nicholas School postdoc and manager of Applied Research and Development at the Louisiana Office of Coastal Protection and Restoration.

THE OIL STORY
Despite what the media might tell you, we found oil. We saw oil slicks and we visited badly oiled marshes. Even so, the immediate situation was not nearly as bad as I’d expected. Huge stretches of coastline and marshes appeared to be unscathed by Deepwater Horizon oil. And we saw abundant wildlife—egrets, brown pelicans, porpoises, crabs and alligators.

How could this have happened? Well, perhaps the early reports of catastrophe were overblown, but even so things would have been a lot worse if steps had not been taken to keep the oil off the marsh—steps that may have long-term consequences. Jim Pahl told me that the state dumped huge quantities of freshwater into the Gulf to push the oil-polluted water away from the coast. All that freshwater almost certainly has decimated the Gulf oysters that require saltwater to survive. It will take years for the oyster industry to recover—this is one aspect of the response that has gotten little or no play.

The rampant use of dispersants also was key. Ricky Galjour, an out-of-work fisherman who was our bayou tour guide, told us that BP sprayed dispersants at night without government consent—a story confirmed in the New York Times a week later. The long-term effects of the dispersants and the oil took to the bottom of the Gulf. No one knows.

So the oil spill—was it an unprecedented environmental catastrophe? For now the answer seems to be no, but that could change as the long-term effects of the oil and the dispersants unfold.

THE ENVIRONMENTAL CATASTROPE RIGHT BEFORE OUR EYES
As we were motoring though Bay Jimmy, Ricky made an offhand remark. “You see that water over there?” he said, pointing in the opposite direction from the thoroughly oiled marshes. “That used to be land.”

I looked at the huge expanse of water he pointed out, and thought: Of course, I came looking for an oil-spill catastrophe but there’s already an environmental catastrophe in the Gulf. It’s been going on for decades: the slow-moving, ongoing destruction of one of our most valuable natural resources—the Gulf Coast’s wetlands.

The construction of levees and diversions on the Mississippi River, the extraction of oil and gas, and a host of other environmental missteps, combined with natural processes, are causing the marshes to subside at an alarming rate and the ocean’s salt water to intrude. Unless the country takes action, it is estimated that an area the size of Rhode Island will have been lost by 2040.

The catastrophe in the Gulf also has a human dimension. The people of the bayous are amazingly resilient, gracious and friendly, but the slow loss of their wetlands presents a constant hardship. Jamie Billiot’s people have lived in the area for more than 100 years, but life is becoming intolerable; her town is flooded two or three times each year because of inadequate marshes to protect them from storms.

For Jamie and the bayou people, the Deepwater Horizon blowout is just one more continuing environmental insult; a cascade of disasters. Life gets harder each year as they struggle to hold onto their rich and unique heritage as it floods and erodes away.

The Nicholas School is determined to help sustain these bayou communities in the face of environmental adversity. Stay tuned.

William L. Chameides is dean of the Nicholas School and Nicholas Professor of the Environment.
New Orleans Native

Works to Restore the Wetlands One Bed at a Time
by Erica Rowell

“Perhaps we are the most endangered city on the North American continent,” says Cindy Brown MEM’93.

She is speaking of New Orleans, and expressing a concern she had well before the Deepwater Horizon exploded in April 2010, killing 11 men and going on to spill more barrels of oil than any marine accident in history.

Brown grew up in the city, and has witnessed troubling changes to this very rich and important ecosystem.

“The Deepwater Horizon accident has shined a spotlight on an area that has had tremendous habitat loss over the decades,” says Brown. “I grew up fishing these wetlands. I’ve seen through the years what was once expanses of marsh that we’d get lost in, turn into open water. And it’s heartbreaking, frankly, to see an entire ecosystem and way of life disappearing right in front of our eyes.”

Brown is the director of the Gulf of Mexico program for The Nature Conservancy, and the sinking of Louisiana is a big part of the conservation puzzle Brown and her colleagues are trying to solve in a place where human economies are intricately tied to the natural resource base and the major industries (e.g., shipping, navigation, oil and gas) that rely on that base. When those resources are jeopardized, so are all the human and ecological systems dependent on them.

“It’ll be interesting to see how this oil spill plays out,” says William L. Chameides, dean of the Nicholas School, who traveled to New Orleans in July to see the effects of the oil spill first-hand.

“I was struck when Hurricane Katrina hit and shut down the Port of New Orleans,” recalls Chameides. “It rippled through the energy sector throughout the country in a way that I thought was really quite sobering for Americans.”

The oil spill offers up another sobering look at the area—and a chance to ponder its ecological riches, challenges and vulnerabilities.

Looking at that bigger picture is what Brown’s team is doing as they try to move the Gulf from vulnerability to resiliency.

CONNECTING THE DOTS IN THE GULF OF MEXICO: WETLANDS, HURRICANES, FISH, OIL, GOODS

Brown is no stranger to Louisiana’s naturally occurring hurricanes and tropical storms. She knows they’ve blown through for centuries, and she’s lived through her fair share over the decades. But she also understands how the severe loss of natural storm buffers puts coastal Louisiana in an even more precarious position. When the likes of Katrina strike Louisiana’s shores these days, their potential reach and destructive force are greater than in times past because of weakened coastal defenses. Stopping the eroding sea is critical to the area’s future.

“What we’ve seen already,” says Brown, “is a loss of about a million and a half acres of wetlands just in the delta of the Mississippi River.”

And the problem is much larger and ongoing—wetlands the size of a football field are lost every half hour.

It was while Brown was at Duke’s Nicholas School to work on her Master of Environmental Management degree that she homed in on her long-term focus. The fit was natural enough: wetlands and water resource management.

Since graduating, Brown has worked protecting and restoring wetlands, first at South Carolina’s Department of Natural Resources and for the past 15 years at The Nature Conservancy. Stemming the loss of wetlands is an enormous challenge for the region; and wetlands loss itself, though too few realize, is a looming problem for the entire country.

Nicholas School Professor Curt Richardson, head of the Duke University Wetland Center and Brown’s former masters-project adviser, explains the linkages between the Gulf of Mexico, the Mississippi River that opens into it, and the rest of the nation like this: “The Mississippi River … is the lifeline to the Midwest. It’s where the majority of our nation’s agricultural barge traffic comes from; all of our products go both north and south on it. … The port of New Orleans is extremely important—it’s the first thing they put into operation after Katrina.”

Continued loss of a critical component in this lifeline means potential trouble rippling through trade, energy, our seafood supply and beyond.

“Wetlands make up roughly 5 percent of the entire globe,” says Richardson, “but they control a third of the carbon in the world. In the Gulf they’re especially important because they provide about a third of the fish and shellfish for the United States and about 25-30 percent of the oil and natural gas.”

It’s all linked, he stresses, and they have to be looked at as a linked program.

Today that’s just what Brown does, finds ways to make TNC’s myriad Gulf state projects complement each other and fit into the overall goal of restoring an ecosystem vital to America.

WORKING TO RESTORE THE GULF COAST ECOSYSTEM

Brown’s work is just one piece of the Gulf’s daunting puzzle.

“The Gulf of Mexico is a huge ecosystem, and as much work as we and others have done here, we’re a long ways from restoring it to a resilient system,” says Brown.

Building on TNC’s 30 years of Gulf conservation, Brown leads projects from Texas to Florida aimed at:

- rejuvenating wetlands with sediments and fresh water,
- restoring lost habitat and reducing habitat destruction,
- reducing overfishing, and
- preventing nutrient-loading in upstream watersheds to reduce the Gulf’s huge dead zone.

Much of this work entails building coalitions, finding funding and helping the restoration community understand goals and funding priorities.

As for wetlands restoration, while there has been some progress, much
Alum Cindy Brown talks about Louisiana project
nicholas.duke.edu/cindybrown

more is needed.

“We’ve protected and restored about three million acres,” says Brown, “The trick now is figuring out how to scale up those projects to an effective level of conservation—and understand what more is needed.”

One such effort involves an innovative way of reviving a keystone species, which happens to be a favorite New Orleans hors d’oeuvre: the oyster.

**BRINGING BACK OYSTERS TO PROTECT SHORES AND REVITALIZE THE MARINE ECOSYSTEM**

When we think of oysters, different images spring to mind, depending on our frame of reference. One might picture servings on the half shell of plump Wellfleet, Bluepoint, or Malpeque, or, if in the other camp, a mouthful of slime. If one is an optimist, one might think “the world is my” or aphrodisiac. Not Brown—she thinks architects and engineers.

“Oyster reefs are very much like coral reefs,” Brown explains. “They provide habitat and structure so that soft shorelines are better protected. We need to be smarter than we have about managing oysters and in terms of understanding their role as architects of these ecosystems.”

In 2008–09 TNC, partnering with shellfish experts around the world, studied the global extent of oysters. Their findings were astounding.

“We’ve lost 85 percent of all of our oyster reefs globally,” says Brown.

That’s not just bad news for oysters and the people who enjoy eating them. It’s bad news for the entire network of undersea life dependent on them.

Oyster banks are a biocoenose, the term coined by German zoologist Karl Mobius in 1877 for the social community he observed while studying French oyster banks. In a paper published that same year, he wrote that “oyster-beds are richer in all kinds of animal life than any other portion of the sea” and that extended disruptions to reefs would transform the entire community.

Disruptions from overfishing to coastal degradation, says the TNC report, have now pushed oyster reefs “near or past the point of functional extinction globally.” And with them goes an array of important ecosystem functions—infrastructure for various fish and shellfish, shoreline protection and water quality.

“What we also found from that study,” says Brown, “is that the northern Gulf of Mexico is pretty much the only place left in the world where we can restore this ecosystem in a timely way. It’s relatively healthy, we have a thriving commercial fishery, and we think there is hope for not only putting oyster reefs back in this ecosystem so they provide us with all the functions that they once did but that we can have a commercial industry alongside it.”

And so The Nature Conservancy set out to introduce manmade oyster reefs behind Grand Isle, the only inhabited barrier island off Louisiana, figuring that if they built the substrate, the oysters would come.

**ASSEMBLING AN OYSTER REEF, IN 3-D**

The first order of business was constructing frames for the reefs—latticed, waist-high triangles made of steel, with enough bulk that they can reduce erosion, trap sediment and rebuild marsh.

Workers then fitted bags of cleaned oyster shells into the frames creating the infrastructure that oyster larvae—known as spat—are attracted to.

“Eventually,” says Brown, “what will happen is oyster spat in the water column will take hold—they’ll colonize these units. And eventually all the steel [and] plastic bags that hold the oyster shells will disintegrate and we’ll have a two- to three-foot high oyster reef that not only puts spat back in the water … but also will dissipate wave energy.”

In time, all that surface area provides great habitat for the many species, such as bluefish, redfish, Spanish mackerel, spot and striped bass, that have historically turned oyster reefs into veritable eateries, nurseries and condos.

In late April TNC and its partners began putting the shell-studded frames into the water. Two days in, the Deepwater Horizon blowout occurred, threatening the Gulf’s fragile ecosystem and putting TNC’s project on hold.

**THE GULF, BEFORE AND AFTER THE DELUGE OF OIL**

Since April, the eyes of the nation and indeed of much of the world have been trained on the Gulf, watching the accident play out in excruciating slow motion. Even with the flow finally
stanched, and the Macondo well “effectively dead,” in the words of National Incident Command Admiral Thad Allen, it’s more hurry-up-and-wait to learn the extent of the damage from unleashing so many hydrocarbons into this biologically diverse area.

Meanwhile, getting on with the necessary conservation and restoration is Brown’s day-to-day challenge. She hopes the history of natural events colliding with manmade mistakes here can provide valuable conservation lessons.

“Our emphasis is to restore the Gulf of Mexico by introducing fresh water and sediments back into the delta’s marshes, looking at freshwater inflows, and doing habitat-specific restoration projects like the oyster reefs,” says Brown. “Project by project, we’re very hopeful that we can restore this ecosystem to some point of resiliency so that we don’t have such dramatic consequences when these events hit.”

Jonathan Swift wrote that the first human to eat an oyster was bold; it will take far greater boldness—and determination—to bring back the oyster. And Brown is at the fore of that cause, which is but one important piece of the long-term restoration.

“What’s lacking at this point is really the money to do that and the public will,” says Brown, adding that she hopes the accident will sustain awareness of the Gulf’s importance to all Americans.

“It’s not just people here that benefit from all that we have,” says Brown. “We produce about half the nation’s oil and gas here. Almost half of all the commercial fisheries come out of this region. The shoes on your feet were probably shipped through our ports here in south Louisiana. Once the nation understands the importance of this region to their own livelihoods, hopefully we’ll be able to generate the attention, the public will and the money that’s required to do these projects.”

Erica Rowell is managing editor of Dean Chameides’ blog, TheGreenGrok.com. She is based in New York City.
JACKSON HOLE: At the Nexus of Nature and Development

by Laura Ertel

Over the summer a cadre of the Nicholas School’s friends and supporters accompanied Nicholas School Dean William L. Chameides to Jackson Hole to see firsthand the challenges of balancing economic development and environmental stewardship.

Sally Kleberg of New York smiled as she released the newly banded Northern flicker and watched it fly away. Kleberg, an avid nature traveler, has visited many places in her life. But standing in the shadows of the Grand Teton while working with scientists at the Teton Science School to catch, band, study and then release birds as part of a national avian project was an experience she won’t soon forget.

Kleberg is one of 13 members of the Vanguard of the Blue Sky, the highest echelon of leaders in giving to the Nicholas School Annual Fund. Each summer, the Vanguard members are invited to take part in an environmental retreat that provides uncommon access to environmental leaders.

“This trip was like being in an outdoor laboratory,” Kleberg said. “It was an experience that really illuminated the importance of the work that is done at the Nicholas School.”

“We chose Jackson Hole for our inaugural Vanguard retreat because it is an exemplar of the worldwide environmental challenge we face,” explained Dean Chameides, who hosted the event. “It’s a place of incredible beauty with soaring mountains, colorful valleys, breathtaking vistas and a plethora of wildlife. But modernity and development encroach, with many ranchers selling their land to developers who build condos, homes and golf courses. This was a chance to look at how one region is struggling to balance the need—indeed the necessity—to preserve the natural and the wild while accommodating the economic imperative to develop.”

In addition to bird banding, the group visited the 3 Creek Ranch, a residential and golf development that preserved hundreds of acres through conservation easements and creek restoration. They met with Michael Jimenez of the U.S. Fish and Wildlife Service, who heads the Wyoming Wolf Recovery Program designed to reintroduce the gray wolf into the northwestern United States. Jimenez, who walks the line between ranchers and environmentalists, believes that wolves can play a constructive role at the top of the food chain in the West but that they cannot be allowed to roam and propagate without limit. The group was also led on several scenic hikes by Vanguard and board member Tom McMurray, who lives in Jackson Hole and helped coordinate the trip.

Board member Ed Macyn of Coos Bay, Ore., said of his experience: “Experiencing firsthand the mountainous environs of Jackson Hole, listening to expert discussions about the denizens of the forests and learning of the symbiosis existing between wolves, elk and their shared habitat was eye opening.”

Blue Sky is reserved for members who have made an extraordinary commitment to the school. For more information, visit nicholas.duke.edu or call (919) 613-8003.

Laura Ertel is a freelance writer based in Durham, N.C. Check out Dean Chameides’s Green Grok post at nicholas.duke.edu/thegreengrok/jacksonhole

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2010 ANNUAL report

July 1, 2009 – June 30, 2010

Thanks to the efforts of our faculty, staff and students, the school remains in sound financial shape. The Nicholas School pursued additional belt-tightening measures in 2009-2010 to ensure that the school could weather another weak financial year and still push ahead with activities that are critical to its success.

These measures allowed us to apply our investments in direct support of teaching and research, to continue to hire faculty critical to our mission and to open our doors to a large, academically strong class of graduate and professional students.

The largest source of revenue and the biggest expense for the school derives from research grants, which provide 41 percent of the Nicholas School’s annual budget of about $46 million. In comparison, tuition supports a little more than one quarter of the budget. In the near future the biggest factors, in addition to the economy, to maintaining a strong school financial base will depend on our success in obtaining grants and retaining solid tuition revenue.
Mark your calendar for the following dates and monitor our website at nicholas.duke.edu for additional events.

**Nov. 18**
DUKE FOREST ANNUAL GATHERING
5 p.m.
New Hope Improvement Association Center
Chapel Hill, NC
CONTACT: Office of the Duke Forest, 919-613-8013 or dukeforest@duke.edu

**Jan. 14**
PROSPECTIVE STUDENTS (MEM/MF) VISITATION DAY
8 a.m.–3 p.m.
Bryan Center Von Canon C and LSRC Duke University campus
CONTACT: Erika Lovelace, 919-613-7459 or admissions@nicholas.duke.edu

**Feb. 5**
16TH ANNUAL DUKE/YALE ENVIRONMENTAL RECRUITING FAIR
Gallaudet University
Washington, DC
CONTACT: Thelma Jernigan, 919-613-8610 or tjernigan@duke.edu

**Feb. 25**
STANBACK CONSERVATION INTERNSHIP INTERVIEW DAY
Bryan Center, Von Canon Rooms Duke University Campus
CONTACT: Glenda S. Lee, 919-613-8079 or gslee@duke.edu

**March 25-26**
NICHOLAS SCHOOL ALUMNI COUNCIL’S SPRING MEETING
Location TBD
CONTACT: Celeste Brogdon, 919-613-8035 or celeste.brogdon@duke.edu

**April 1-2**
ADMITTED STUDENTS (MEM/MF) VISITATION WEEKEND
Levine Science Research Center
Duke University campus
CONTACT: Erika Lovelace, 919-613-7459 or admissions@nicholas.duke.edu

**April 7-8**
NICHOLAS SCHOOL BOARD OF VISITORS’ SPRING MEETING
Washington Duke Inn
Durham, NC
CONTACT: Celeste Brogdon, 919-613-8035 or celeste.brogdon@duke.edu

**April 9**
THE DUKE LEAF AWARD
Location TBD
CONTACT: Celeste Brogdon, 919-613-8035 or celeste.brogdon@duke.edu

**April 14-15**
MASTERS PROJECT SYMPOSIUM
MEM and MF candidates/masters project presentations
Von Canon Rooms, Bryan Center
Duke University campus
CONTACT: Erika Lovelace, 919-613-7459 or admissions@duke.edu

**April 16**
SPRING SOIREE
American Tobacco Campus, Bay 7
Durham, NC
CONTACT: Nancy Kelly, 919-613-8090 or nkelly@duke.edu

**April 28-29**
BEAUFORT MASTERS PROJECT SYMPOSIUM
(Coastal Environmental Management students)
Repas Center, Duke Marine Lab, Beaufort, NC
CONTACT: Lauren Stulgis, 252-504-7531 or lauren.stulgis@duke.edu

**May 13**
DEL-MASTERS PROJECT SYMPOSIUM
8:30 a.m. – 5 p.m.
Levine Science Research Center, A158, Duke University campus
CONTACT: The DEL Program, 919-613-8082 or del@nicholas.duke.edu

**May 14**
NICHOLAS SCHOOL RECOGNITION CEREMONY FOR GRADUATE AND PROFESSIONAL DEGREE CANDIDATES
9:30 a.m.
LSRC Great Lawn
Duke University West Campus
CONTACT: Nancy Kelly, 919-613-8090 or nkelly@duke.edu
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