Mapping Children’s Environmental Health
Mapping Environmental Health:
Marie Lynn Miranda Uses Geospatial Technologies to Protect Our Children

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These days maps can be amazing tools. They aren’t just those overly large pieces of paper that you fold out to plot your vacation trip anymore.

With GIS (Geographic Information Systems) technology, maps can be combined with layers of data to reveal information that might ultimately contribute to such things as predicting your children’s exposure risk to lead.

And right now, she is working with 11 health departments covering 16 North Carolina counties to help them utilize this GIS technology so they can launch preventive programs in your neighborhoods where children are at risk, not only for lead, but for allergens and asthma, pesticides and industrial contaminants.

She’d like to see the GIS analysis used in all 100 counties, and it’s not inconceivable that it could become a standard tool for health departments nationwide.

"Now we wait for children to get sick, and then we go into their home environments, into their schools, into their day care centers, and we try to figure out what made them sick. That’s the equivalent of using them as little canaries in the coal mine, or little biosensors in their environment, said Miranda, who is the Dan and Bunny Gabel Associate Professor of the Practice in Environmental Ethics and Sustainable Environmental Management.

"What I think we should be doing instead is having preventive programs where we figure out what are the locations and the kind of places most likely to give kids the exposures that will make them sick, and let’s go in and clean them up before the kids get sick. Let’s let children be children and canaries be canaries."

Children are especially vulnerable to environmental toxins because they behave differently from adults, and they are growing: They spend a lot more time crawling around on the floor. They don’t wash their hands carefully. They put things in their mouths. “So, they probably get exposed to a lot more stuff because of the way they navigate through the world,” said Miranda.

What makes toxins a triple threat for them is at the same time that they move differently through the world their metabolism is higher—so they take in more, faster than adults—and they are still developing. "They breathe more air per volume of body weight than you do; they take in more calories; they take in more water; they do not have fully mature reproductive systems; they do not have fully mature central and peripheral nervous systems; they do not have a fully mature immune system. Because of that, if they are exposed to the same chemicals as adults, they are more likely to express toxic effects.”

Brian Letourneau, health director of the Durham County Health Department, said his lead team will launch a multi-pronged community lead prevention strategy this fall using Miranda’s GIS model.

"The beauty of it is that it is a way to target individual homes rather than blanket a community; we can target our resources to specific addresses at high risk,” he said.
Without the GIS maps, his lead team has had to do outreach into the neighborhoods without being able to pinpoint specific houses. "What GIS does for us is allow us to take our limited resources and get the most out of them. By focusing on 30 percent of the housing stock, we can likely find 70 percent of the children with elevated blood lead levels."

"Marie Lynn Miranda’s work is extremely important and will pay dividends for years to come," he said. "She’s at the forefront of using GIS technology to help health departments to get the word out about lead. It’s my opinion that this is one of the most exciting tools we have developed in a long time that looks at population health and targets individual health."

Mark G. Swedenburg, health director of the Wayne County Health Department, whose department also is working with Miranda’s GIS technology, said that seeing a map offers a whole new dimension that brings better understanding, and he hopes, faster resolution of the root causes of the problems they are addressing.

"We’re very excited to have the opportunity to work with leaders in a way to dynamically enhance our understanding of the epidemiology of diseases of public interest. GIS allows clinicians and health care researchers to better understand the links between where a disease or health concern exists and how we can effectively address its control and eradication." For those who know her, who have tripped over the toys in her office, and who have seen her urge her T-ball players to make a run for home base, it should come as no surprise that the diminutive, but assertive, professor devotes all of her time to protecting and nurturing children—her children, my children, your children, North Carolina’s children, everyone’s children.

At work, this “superwoman” is in non-stop motion exploring new ways to extend the reach of her GIS methodology to cover a growing number of toxins and to find the funding to support each project. At the same time, as director of undergraduate programs for the Nicholas School, she nurtures undergraduates studying environmental sciences and policy at Duke. In the community, Coach ML (as her team fondly calls her) can be found with her children charging around the bases of a T-ball field, literally carrying a child to home plate where she helps him adjust his bat.

Miranda didn’t start out her career focusing on children, even though wherever she was working she found out about social welfare and justice issues as they affected children. After graduating from Duke and Harvard in economics, she spent three or four months a year traveling in places that she loved—Malaysia, Indonesia, Costa Rica and Honduras—to study how land-use decisions affected economically vulnerable groups.

Her “calling” became clear, however, when she faced the question all adults who work and want to have children face: “How can you be the parent you want to be while being the professional you aspire to be?”

She didn’t want to be away from her children for extended periods of time, and even though she could take them with her, she didn’t feel comfortable separating her husband, Chris, from them. She ventured into children’s environmental health slowly, first teaching a module on childhood lead poisoning in Environment 101 at the Nicholas School.

“Then it became clear that there was research that was crying out to be done, and that it required someone who had a particular set of modeling skills that matched up well with my own,” she said.

Lead was the starting point. She and her research team have since taken on asthma and allergens, and pesticides as well. Even though lead has been eliminated from paint and from gasoline, 50 million U.S. homes still contain lead-based paint, said Miranda. And children, especially those in low-income families who don’t have the money for renovations and house
upkeep, are susceptible to the sweet-tasting lead paint chips and lead-contaminated dust.

Lead poisoning can lead to serious disease that doesn’t become apparent in children until long-term, irreversible effects already have set in. Children exposed to lead levels far below what was once considered safe may be asymptomatic, but they can eventually develop learning and behavioral disorders, hearing impairment, decreased IQ, and decreased attention span, she said.

In 1998 Miranda received $25,000 from the National Institute of Environmental Health Sciences (NIEHS) in seed money and then major funding from the Centers for Disease Control to use GIS to create a household predictive model of lead exposure risks across the state.

GIS analysis has been widely explored for environmental sciences as well as for public health purposes. It works because most data contain a geographic component that can be tied to a specific location—a zip code, a state, a county, a single address.

Users can then overlay data by location and expose trends that might not be readily available in traditional spreadsheet software. What’s more, they can use GIS to generate maps and reports that can serve as the basis for developing policies and for doing community outreach.

To accomplish what Miranda envisioned, she and her team needed to develop methodologies to bring together information at a higher geographic resolution than previous public health GIS analysis had done. It wasn’t enough to generate information at the block level. To develop a predictive model that would be useful for practitioners who aimed to create prevention programs, she needed to find a way to work at the individual house level.

“Because the work is done at this very high level of geographic resolution, you can have a much more carefully tailored program. And that means for every dollar that you spend in your environmental public health programs, you can go beyond the census track level and start thinking about placing your priorities on a house-by-house basis,” said Miranda.

To construct a predictive model with a risk index using GIS technology and spatial analysis, Miranda and her team drew from county tax assessor data, U.S. Census demographic data and North Carolina blood lead screening data for six North Carolina counties: Buncombe, in the western portion of the state, Durham and Orange in the central piedmont, Wilson and Edgecombe in the eastern coastal plain, and New Hanover on the southeast coast.

Then once they had built a preliminary model, they sent a group to do house-by-house environmental sampling to enable them to validate and calibrate the model with what they found in the field.

Her team members are research associates Alicia Overstreet, data manager; Michelle Abrams, project manager; Christine Bradshaw, GIS programmer; Jennifer Silva, community relations manager; Dana Dolinoy, who is now at Harvard University working on her masters in public health; and field research associates Lyle Whitney and Matthew Stiegel. Several team members hold degrees from Duke: Overstreet, Abrams and Dolinoy graduated with bachelor’s degrees in environmental science and policy; Overstreet received a bachelor’s in biology; and Whitney received the Nicholas School’s masters of environmental management degree.

“We’ve been collecting environmental samples from mid-April to mid-October this summer and last summer. Our initial samples collected from 500 houses indicate pretty tight model validation. I have a lot of confidence in the lead model right now, and a paper on our preliminary results came out in the September issue of Environmental Health Perspectives.”

Sampling is a labor-intensive exercise that involves sending out hundreds of letters to homeowners asking them to allow a team from the Children’s Environmental Health Initiative to take samples in their homes. Out of 300 letters they might get 20 positive responses.

This summer, research associates Whitney and Stiegel were joined by state environmental specialist Alan Huneycutt driving in a white, equipment-laden van for dawn-to-dusk sampling.
Huneycutt moved about the houses taking readings for lead, while Whitney and Stiegel took air and dust samples for related projects on allergens and molds and for pesticides.

Miranda has a distinctive, almost musical laugh. And when she tells the story of how one project has led to another and then to another, she can’t help but laugh.

“It is a really expensive and time-consuming undertaking to get someone to open their house for you and to take environmental samples. So, when we were fully funded on lead, and we went to take the samples, we said, ‘Gosh, as long as we are going to people’s houses to collect lead samples, wouldn’t it be great if we collected some asthma triggers and allergen samples to use as pilot data to help us extend this model in other directions.’”

The pilot funding for the asthma project came from the Wallace Genetic Foundation, soon to be followed by full funding by the Department of Housing and Urban Development and from the Robert Wood Johnson Foundation. The Wallace Genetic Foundation also gave seed money for another piggy-backed project focusing on pesticides.

“When you think of children and environmental health, lead exposure has a big effect on neurological health, allergens and asthma triggers have an effect on respiratory health and the immune system, and pesticide exposure, which is related to neurological health can also be related to reproductive health. These are some of the more important exposures for children,” said Miranda.

The lead project is the most mature. They’ve built and calibrated the mapping model and are wrapped up the sampling this summer. Sampling next year will continue with asthma and allergen triggers, and hopefully, she said, for pesticides, as they work to adapt the GIS methodologies to work for these two projects as well.

After Hurricane Floyd stalled over eastern North Carolina in 1999 and flooded county after county, asthma rates increased in that part of the state.

“When the floods occurred, I felt a really strong desire to be a part of an effort to rebuild those communities, but I don’t know how to build houses. I don’t know how to lay drainage tile, I’m not a legislator or a meteorologist. But when asthma rates among children in those counties skyrocketed, I saw a part for this ‘nerdy professor’ to take,” she said.

Already the sampling is showing big differences between the level of mold and mold species that are found in Durham and Orange counties and those in Wilson and New Hanover counties. “Drywall is like mold candy. You had these houses that got flooded, and the drywall just sucked up the moisture. Even when you think the drywall is dry, it can harbor mold,” she said.

Miranda and her team have received additional funding from the State of North Carolina to develop GIS and environmental health services in five health departments serving nine North Carolina counties.

So, it’s an exciting time for Miranda and the team.

Not only does she see her program expanding far beyond her original dream, she has managed to accomplish what she set out to do when she started: protect and nurture her children at home and through her work.

Miranda’s children are very much a part of the Nicholas School. When her last child, Viviana Joy, was born, she stayed with her mom in the office and was available for “holding” every Tuesday and Friday.

“As a school of the environment, we try all the time to get our students to think about intergenerational issues whether they are interested in ecology or environmental human health. So, I think there is something to be said for having the next generation pitter-patterting around in a school that places such a big emphasis on problems that play out across enormous spatial and temporal scales.”

For information on Miranda’s work and CEHI projects, check out: www.env.duke.edu/cehi/ or www.env.duke.edu/faculty/bios/miranda.html.

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Scottee Cantrell is director of communications for the Nicholas School.

from left to right: Matthew Stiegel takes environmental samples from a crawl space; Lyle Whitney and Stiegel look over their inspection checklist; Alan Huneycutt takes lead readings; the sampling team moves on to the next house.
Marine mammals, sea turtles and seabirds traverse vast portions of Earth’s oceans, making it difficult for researchers studying them in different places to compare notes on their disparate populations.

Such a lack of data coordination is why the National Oceanographic Partnership Program (NOPP) and the Alfred P. Sloan Foundation have awarded researchers in Duke University’s Nicholas School $1.8 million to develop a digital archive of marine mammal, sea turtle and seabird distribution and abundance.

The archive will be part of the Ocean Biogeographic Information System (OBIS), which will provide unparalleled access through the Web to coordinate old and newly created research information. This meshing of various computer files worldwide will not only give scientists instant access to what is known about locations and numbers of given species worldwide, but such census counts will also be linked to what is known about the animals’ local environments.

“It will be an immensely powerful tool,” said Andrew J. Read, Rachel Carson Assistant Professor of Marine Conservation Biology at Duke, who is leading the research team. “The power of the Web will make previously inaccessible databases available in a format that will allow researchers to put marine mammals, turtles, and birds in the context of other marine animals and oceanography. It will open new avenues of research on marine populations that couldn’t have been done without OBIS.

“It’s tremendously exciting to bring together existing data from disparate sources from all over the world and make it available for oceanography,” added Read, a specialist in marine mammals. “There are many people out there collecting information on the distribution and abundance of sea turtles, marine mammals and seabirds, but it has not been coordinated in any fashion until now.”

OBIS is a component of the Census of Marine Life, a major international research program based in Washington, D.C. Other Web-based databases already have been created for OBIS on fish, marine mollusks, squid and other cephalopods.

The marine mammals, seabirds and sea turtles project will be a joint effort of Nicholas School researchers at the Durham campus and at the Duke Marine Laboratory in Beaufort. Other principal investigators include Patrick N. Halpin, assistant professor of the practice of landscape ecology and a geospatial technologies specialist; Larry B. Crowder, the Stephen Toth Professor of Marine Biology and a specialist in sea turtles; and David Hyrenbach, an assistant research scientist and specialist in seabirds. Crowder and Hyrenbach are based in Beaufort; Halpin is based in Durham.

Halpin and his research assistants will concentrate on the technical challenges of making the information both compatible with other OBIS data sets and Web accessible so researchers can seamlessly access it for analyses, modeling and mapping. Right now, “a researcher or a member of the public might go to several nodes to gather all the data they need,” he said. “They might have one node to find sea surface temperature, to another for marine mammals and another for fishes.”

He and his group will work on a new Geographic Information System data model that will allow geographic information to be observed in four dimensions: latitude, longitude, depth and time.

“Marine species move around,” Halpin noted. “It is not as simple as mapping out forests or geological features that can be considered to be static. In a dynamic ocean, you have to account for the time domain.”

The project officially got under way this summer, when Nicholas School researchers started working with outside groups and a scientific steering committee to map out the structure of the Web system and to determine how best to coordinate available data.

The Beaufort team members already have identified partners to provide existing data sets on marine mammals, sea turtles and seabirds. Those partners include the National Marine Fisheries Service Laboratories in Woods Hole, Mass., and in Miami, Fla.; the Sea Mammal Research Unit at St. Andrews University in Scotland; Cascadia Research Collective in Olympia Wash.; and Allied Whale, the Marine Mammal Laboratory of the College of the Atlantic in Bar Harbor, Maine.
Endangered Species Expert Named Doris Duke Professor in Conservation Ecology

Stuart Pimm, one of the world’s foremost experts on endangered species and habitat destruction, has been named the first Doris Duke Professor of Conservation Ecology in the Nicholas School.

The professorship was endowed with a $1.7 million grant given to Duke in 1997 by the Doris Duke Charitable Foundation, based in New York City.

Pimm, who joins the faculty after serving as professor of ecology at Columbia University’s Center for Environmental Research and Conservation, labels himself as the “investment banker of the global and biological accounts.” In his latest book, The World According to Pimm (2001), he balances the raw numbers of what the earth produces against what humans take away, and he finds the numbers don’t add up.

“I will not hector you about having many children, driving a large car, eating meat,” he writes. But, “the impacts I will describe already seriously degrade the lives of huge numbers of people. We must do something to make our actions sustainable. My key message is that it is possible to have biodiversity and eat too.”

Working on the front lines of conservation biology since the early ’70s, Stuart Pimm is one of the pioneers whose work has put the “science” in environmental science. His research covers the reasons why species become extinct, how fast they do so, the global patterns of habitat loss and species extinction, the role of introduced species in causing extinction and, the management consequences of this research.

His current work includes studies on birds in the Everglades, forests in Brazil, elephants in Africa, and predators in Madagascar and, crucially, the ecosystems on which these species depend.


He holds a bachelor of arts from the University of Oxford in England and a doctoral degree from New Mexico State University. He was named an Aldo Leopold Leadership Fellow in 1999 and a Pew Scholar in Conservation and the Environment in 1993, and he received the Kemper Prize for Distinguished Ecologists in 1994.

The Doris Duke Charitable Foundation’s mission is to improve the quality of people’s lives by nurturing the arts, protecting and restoring the environment, seeking cures for diseases, and helping to protect children from abuse and neglect. For more information, visit www.ddcf.org.

New Course Looks at Spirituality and Environmental Ethics

Ted L. Purcell sees the environmental crisis as a spiritual and a religious issue. You might think that is a natural view for someone who is the Duke University Baptist campus minister.

But, Purcell says, the ecological predicament is religious in the sense that, in this time of unprecedented danger to the planet we share, several inescapable questions emerge with renewed intensity:

• How does the plight of the earth reflect a crisis of moral values and religious faith?
• What spiritual resources do the various religious and ethical traditions hold for us at such a time as this?
• What do the different traditions have to say to one another that may clarify what it means to have a proper respect for the earth in our personal and social choices?
• And how do religious traditions need to be reevaluated and reconstructed in light of our increasing environmental difficulties?

It is from this perspective that he will launch his new six-week course this fall for Nicholas School students: Environment 298 Spirituality and Ecology: Religious Perspectives on Environmental Ethics.

Purcell said the course goal is to assist students in developing a functional personal and social environmental ethic that includes religious and spiritual values. The class will include reflection on the Earth Charter, an international and interfaith ethical vision for building a just, sustainable, and peaceful global society.

Students will be expected to keep a journal and write brief papers in response to readings, and they will have opportunities for small group interfaith dialogues and to hear guest speakers. One scheduled speaker is a Lumbee Indian who will talk about Native American traditions in connection to the natural world.
Second Duke Environmental Leadership Forum to Focus on Dealing with Disasters

The second Duke Environmental Leadership Forum, “Dealing with Disasters: Prediction, Prevention, and Response,” will be held Nov. 20-21 at Duke University. The forum will look at disasters that are accidental or “natural,” as well as those that are purposeful, such as terrorist acts.

The annual Environmental Leadership Forum, supported by the Starr Foundation, brings together leaders in business, science and policy to learn from each other about how best to address emerging environmental issues. The first forum, held in September 2001, addressed “Managing Risk in the Changing Global Environment.”

Dr. Richard A. Meserve, chairman of the U.S. Nuclear Regulatory Commission, will give the keynote talk at this year’s event, which is organized by the Duke Center for Environmental Solutions, the Nicholas School, Fuqua School of Business, and the School of Law.

Kathryn Saterson, executive director of the Duke Center for Environmental Solutions, said, “Our forum will convene business leaders, policymakers and scholars to think creatively about new approaches to predicting, preventing and mitigating disasters.”

In particular, said Jonathan Wiener, center faculty director, “The forum will explore innovative ways of dealing with risk agents that strategically change their behavior in response to preventive measures, such as pathogens and terrorists.”

The forum’s seven sessions include an opening overview, three sessions focusing on disaster prediction, prevention and response, two sessions focusing on chemical facilities and ecosecurity, and a closing summary session. Participants will discuss such questions as “What have we learned from recent natural and human-caused disasters that can help us in dealing with future disasters? What are the roles of science, law and business in predicting, preventing and responding to disasters? What new models are needed for risk prediction and forecasting that integrate the responsiveness of the risk agent into scenarios for prediction and prevention?”

William H. Schlesinger, dean of the Nicholas School, will speak and moderate a session. Other Nicholas School faculty involved include Norman L. Christensen Jr., James Clark, Peter Haff, Michael K. Orbach, and Jonathan Wiener.

For information, contact Sara Ashenburg, director of the Nicholas School Office of Executive and Continuing Education, at (919) 660-8082 or cee@env.duke.edu, or check out the Web site at www.env.duke.edu/forum02.

Environmental Economist Martin Smith Receives National Dissertation Award

Martin D. Smith, assistant professor of environmental economics at the Nicholas School, has received the 2002 Outstanding Ph.D. Dissertation Award from the American Agricultural Economics Association (AAEA) in recognition of his superior achievement in agricultural economics.

Smith earned his doctoral degree from the University of California at Davis in 2001. His dissertation was “Spatial Behavior, Marine Reserves and the Northern California Red Sea Urchin Fishery.”

The AAEA, a non-profit professional society for those interested in agricultural economics, environmental and natural resource economics, recognized Smith at its annual meeting in Long Beach, Calif., earlier this year with a certificate and a $1,000 award. The association is based in Ames, Iowa.

Smith’s research focuses on spatial issues in natural resource use and management. He specializes in applied econometrics and bioeconomic modeling. His research projects include evaluating marine reserves as a commercial fishery management tool and modeling the impacts of commercial fishing on endangered species through predator-prey interactions.

Duke Marine Lab Director to Give 2002 Revelle Lecture

Michael K. Orbach, professor of the practice of marine affairs and policy and director of the Duke University Marine Laboratory, has been selected to give the 2002 Roger Revelle Memorial Lecture sponsored by the National Academy of Sciences’ Ocean Studies Board (OSB).

Orbach, the fourth lecturer and the first social scientist in the Revelle series, will present “Beyond the Freedom of the Seas’ Ocean Policy for the Third Millennium.”

The OSB created the lecture series in honor of the late Roger Revelle, the first head of the Office of Naval Research’s geophysics branch and director of Scripps Institution of Oceanography for 12 years. The OSB chooses speakers and topics to highlight the important links between oceans sciences and public policy. This year’s Revelle lecture will be Nov. 13 at the National Academy of Sciences Auditorium in Washington, D.C. It is open to the public.

Orbach, who knew Revelle, said his talk will pick up on an earlier Scientific American article written by the noted oceanographer as the introduction to a 1969 special magazine issue devoted to the ocean.

In his speech Orbach will tackle the controversial topic of governance of the sea. Countries worldwide may govern fishing rights, marine environmental protection and scientific research within 200 nautical miles of their shores, but on the high seas, there is no uniform regulatory authority. “We can no longer afford the freedom of the seas policy that has been in place for the past 1,000 years,” he said.
"Our ability to exploit the resources of the ocean, our ability to pollute the oceans, is so great that we are going to have to extend some sort of more formal governance to the high seas, and closer governance to all of the world’s oceans."

Orbach said he will discuss how a new governance system might work that would shift the "burden of proof" standards now accepted on the oceans. "We need to have licensing and permitting for all ocean activities, with the burden of proof for a safe environment on those who want to take the action," said Orbach.

A new teaching fellows program at the Duke Marine Lab is giving K-12 students in four eastern North Carolina schools a direct window to research about life in variable and polluted marine environments.

A $1,006,850 grant from the National Science Foundation (NSF) placed 14 Duke students—three doctoral students, five Master of Environmental Management students, and six undergraduates—into Carteret County schools for the next three years, where they can share their research and add hands-on learning activities to the classroom experience.

The teaching fellows are devoting 15 hours a week to the project. The format encourages learning, and promotes the goal of the NSF to enrich science and mathematics education in the nation’s schools.

"The Duke Marine Lab has responded to concerns of local residents about coastal pollution by partnering with K-12 schools to raise environmental awareness. The addition of this program contributes to this partnership by benefiting the teaching fellows educationally and by allowing them to bring their special knowledge into the classroom to reconnect children to nature," said Celia Bonaventura, primary investigator for the project and professor of cell biology. Bonaventura is based at the Duke Marine Lab in Beaufort, which is part of the Nicholas school. Michael K. Orbach, director of the Duke Marine Lab, and Steve Desper, coordinator of the program for the Duke Marine Lab, are co-principal investigators.

Carteret County schools participating include Smyrna Elementary School, Newport Middle School, East Carteret High School in Beaufort, and West Carteret High School in Morehead City. As part of the program, some 27 computer-assisted microscopes will be installed in the schools and used in studies of marine and freshwater environments.

"It is the school system’s belief that relevant, hands-on activities help motivate students to become lifelong learners. As many families in Carteret County depend upon the water for their livelihoods, it is only natural that schools support the use of the local environment as a living laboratory."

Duke is one of 22 institutions nationwide to receive three-year grants from the NSF’s Graduate Teaching Fellows in K-12 Education (GK-12) program. The program is intended to encourage graduate students to increase their communication skills by sharing science and mathematics expertise. Assisted by faculty mentors, the teaching fellows will bring inquiry-based projects into the K-12 classrooms. The projects will draw on marine resources and illustrate the importance of science, mathematics, engineering and technology.

Simon Rich to Lead Nicholas Board of Visitors

Simon B. Rich Jr. is the new chairman of the Nicholas School Board of Visitors, succeeding Douglass F. Rohrmann, who retired this spring. Rich and his wife, Nancy, recently relocated to Durham from Redding, Conn., where he was chairman of Louis Dreyfus Natural Gas and president and chief executive officer of Louis Dreyfus Holding Company.

"Rich has an extremely broad background for this job," said Dean William H. Schlesinger. "He knows the environment as a farmer, a sportsman, a conservationist, and an energy executive, and he knows Duke as a student, an alum, a parent and a board member."

Rich began his career as president of First Colony Farms. It was during this time that he first met Norman L. "Norm" Christensen Jr., a young botany professor at Duke after Christensen became the first dean of the Nicholas School.

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Celia Bonaventura frequently ventures beyond the lab to help reconnect children to nature.
"The dean of the Nicholas School had unusual items on his windowsill," laughs Rich. "I knew what they were, but couldn’t figure out why he had them. They were peat extrusions made by a machine I had purchased in Finland in 1979. As he saw me noticing the peat, we remembered each other—same people, but very different roles."

Rich joined the board shortly thereafter, and has been instrumental in the school’s strategic planning and outreach to new constituencies. "The major challenge facing the school is to fund the education of the highest quality people and launch them into an economy that does not provide pay scales commensurate with the importance of the task or the cost of the education. I would like to see adequate scholarship funds available to accomplish this goal." The Riches have established the Nancy A. and Simon B. Rich Scholarship Endowment.

**Teaching the Teachers**

Craig Stow (center) of the Nicholas School talks with high school teachers Dwight Dutton of East Chapel Hill High School, Keith Camburn of West Mecklenburg High School, and Kathryn Williams of Scotland High School, about adding water quality exercises to the high school curricula. The teachers were among 15 attending a six-day Environmental Science Institute in July sponsored by the Nicholas School’s Center for Environmental Education with funding from the Z. Smith Reynolds Foundation. The participants trekked through Duke Forest and visited a sewage treatment plant in Chapel Hill and a building materials manufacturer in Roxboro to gain insights for the classroom.

**Special Awards Recognize Graduates**

Two Duke graduates received special awards during 2002 Nicholas School spring recognition ceremonies held during graduation weekend in May.

Daniel Edwards Lyons, a student in the coastal environmental management program, received the Virlis L. Fischer Award during the recognition ceremony for graduates of the Nicholas School professional program. The award, which is presented each year to the graduating professional student with the highest academic achievement, is given by Bernice Fischer in memory of her husband, who dedicated his life to the advocacy and wise use of natural resources, especially forests. He was a member of the Board of Visitors of the School of Forestry and a fellow in the Society of American Foresters.

A native of Stamford, Conn., Lyons graduated with a bachelor of science degree in civil engineering from Princeton University in 1992. This spring, he received a joint Master of Environmental Management degree from Duke and an Urban and Regional Planning degree from the University of North Carolina. At the Nicholas School, he was a Stanback Fellow with the Conservation Trust of North Carolina, and he received both a Sea Grant Fellowship and a Knauss Marine Policy Fellowship.

David Geier, who received a bachelor of science in earth and ocean sciences, was awarded the Thomas V. Laska award during ceremonies for earth and ocean sciences undergraduates. The award is given by the EOS faculty to the most outstanding senior major. The recipient receives a Brunton Compass and his name on a plaque in the EOS divisional office. The award was endowed in the early 1970s by Andy and Vera Laska in memory of their son, who was a geology major at Duke.

Kathryn S. Fuller, president and chief executive officer of the World Wildlife Fund (WWF) since 1989, was guest speaker at the 2002 Recognition Ceremony at the Nicholas School. Introduced by Nicholas Board of Visitors member, Marshall Field V, she spoke on "Our Living Planet."

**Check Out eDuke— Three New Ways to Get the Latest Duke Information**

Getting the latest news about Duke can be as easy as opening e-mail.

Over the past several months, communicators and others from across Duke have worked together to develop a set of electronic communications called eDuke. The three e-mail products will be free through a single online subscription form:

- **eDuke daily**, which provides the latest material from Duke’s Office of News and Information (this was formerly the Daily Dialogue)
- **eDuke media clips**, which brings you the latest news media reports about Duke—from the local TV broadcasts to national networks, and from the New York Times to the International Herald Tribune; and
- **eDuke monthly**, which provides the month’s top news about Duke, along with information on topics of interest to individual subscribers. (Be sure to request news about the environment.)

"With the growing use of the Internet, we realized Web-based communication would be one of the best ways to keep students, faculty, alumni, parents and others up-to-date on what’s new and exciting at Duke," said David Jarmul, associate vice president of news and communications.

To subscribe to one or more service, go to www.eduke.duke.edu.
Cruise to the Incipient Rift: Emily Klein ‘Mows’ the East Pacific to Reveal Secrets of Magma

by Monte Basgall

A contingent of scientists and students from the Division of Earth and Ocean Sciences in the Nicholas School spent August on a ship moving back and forth, lawn mower-like, over a long lava-emitting crack in the Pacific Ocean’s floor.

Led by geochemist Emily Klein, an associate professor of earth sciences at Duke, with Woods Hole Oceanographic Institution marine geologist Deborah Smith serving as co-principal investigator, the expedition thoroughly mapped the area’s underwater topography, extensively photographed the bottom geology, and brought up enough rock samples to harden the muscles of Klein’s predominantly female scientific crew.

Voyaging on a Scripps Institution of Oceanography vessel, the 279-foot R/V Melville, they braved hurricane-infested waters en route from San Diego to a spot just north of the equator for the rare opportunity to catch a new geological feature in the act of formation.

Called the “Incipient Rift,” (abbreviated IR,) this feature is part of the restless process of Plate Tectonics that splits the Earth into slowly migrating plates separated by zones of stress. Along those zones, called mid-ocean ridges, new ocean floor is created to the accompaniment of earthquakes and volcanic eruptions.

The R/V Melville did its work off one of those ridges, called the East Pacific Rise, which separates the huge Pacific Plate to its west from several other plates to the east. Two of those eastern plates are separated by another crust-making ridge system that currently culminates just east of the East Pacific Rise in a deep canyon called Hess Deep. Hess Deep was the target of another Duke-led geological expedition in 1999 on which Klein was a co-principal investigator (the Web site is accessible at www.env.duke.edu/hessdeep/hessdeep.html).

During a break in the Hess Deep schedule, that expedition repositioned about 30 miles northwest so Klein could get her first look at the IR, which appears to be a brand new mid-ocean ridge. Located at depths between 2,800 and 3,500 meters below the surface (9,200-11,480 feet), the IR was discovered by other researchers in the 1980s. It is known to extend about 75 kilometers (46 miles) to the east from a spot on the East Pacific Rise. Its edges are believed to be spreading apart, as ocean ridges do, at a glacial pace ranging between 0 and 33 millimeters a year. It also is known to be emitting lava—making it another ocean crust maker, if only a baby version.

During her 1999 mini-visit to the IR, Klein used a primitive technique called wax coring to pull up samples of basaltic glass, a form lava can take when it erupts at a temperature of 1800 degree Fahrenheit and suddenly solidifies on encountering near-freezing ocean floor seawater.

“Wax coring is “the most rudimentary way possible” to collect geological samples from the ocean floor, Klein acknowledged in a pre-expedition interview. On the other hand, “it’s fast, it’s cheap, you don’t have to bring a lot of equipment with you, and it’s very easy to do,” she added.

Geological specimens are like time machines, preserving evidence about the environment in which they formed. Flakes of black basaltic glass preserve a record of the chemistry of the lava at the moment that it suddenly ”froze” after its passage from deep underground.

All but one of the 12 wax cores Klein retrieved from the Incipient Rift in 1999 contained fresh basaltic glass. After she brought those samples back she analyzed them with the aid of a special tool called an inductively coupled plasma mass spectrometer.

Bought with a grant from the National Science Foundation, which also funded Klein’s expedition back to the IR, the special spectrometer separates elements by the different weights of their isotopes with the aid of a powerful magnetic field. She could thus identify the different elements in the basalt, which provided vital hints about how lava was produced and changed during its upward journey.

The spectrometer study and other testing, “produced some tantalizing results for me,” Klein added. Particularly compelling was how concentrations of the element magnesium varied at her sampling spots along the rift.
Scientists believe the percentage of magnesium in a basalt sample’s makeup provides a benchmark for how much it physically and chemically “evolved” during its lengthy upward journey from the “mantle” region—a hot, high pressure netherworld about 7 kilometers below the ocean floor.

Until it erupts, lava is technically known as “magma” to geologists, who believe that the more a magma sample has cooled en route to the seafloor the lower its magnesium concentration. They reason that the “missing” magnesium would have been crystallized out and left behind.

Indirect clues such as magnesium levels are all scientists have to study what they can’t see: conditions in the deep extensive underground plumbing system that Nature uses to deliver fresh hot crust to repave the ocean floors.

One central question that Klein’s August expedition sought to address is how that magma is collected and channeled beneath the East Pacific Rise before it erupts there. Like popping a champagne cork, such eruptions are believed to release some of the pent up pressure in the mantle deep below. That causes some mantle material to rise and melt as it decompresses.

“It is now understood that melt comes from what is believed to be a very wide area of the mantle, something like 100 kilometers wide, and is being focused in a pyramidal shape towards the East Pacific Rise where it erupts,” Klein said.

Researchers have been trying to determine how magma compositions may vary under that 100 kilometer mixing zone, but they “couldn’t get their hands on it,” she acknowledged. That’s because by the time the lava emerges on the East Pacific Rise, its chemistry has evolved from all the mixing and moving the magma underwent on the way.

The chemical clues Klein got from her 1999 samples suggested that the Incipient Rift could help resolve this uncertainty. She proposed to the NSF that, since the IR slices across the East Pacific Rise’s huge underground magma reservoir, the “little melts” it emits would provide lava samples representing various stages of magma movement and evolution.

“It’s like tapping a rubber tree,” she said. “The point of this study is, perhaps for the first time ever, to be able to provide information on the composition of melt in this wide and deep area that we can never get our hands on.”

The RV Melville left San Diego on Aug. 5. Its passage was mostly smooth through “hurricane alley,” the area of the eastern Pacific where hurricanes can form this time of year. That was a great relief to Elizabeth (Betsy) Williams, a second-year Duke graduate student in geology who worried about getting seasick.

Before Williams left land, she “battle tested” motion sickness medications by ordering her boyfriend to “drive me around, swerving all over the road, with me reading and my face down, and no air conditioning.” She turned 30 on her third day out from the dock, and happily celebrated with a helping of cake.

Motion issues aside, this voyage was a rite of passage for Williams. After majoring in English at Haverford College she had spent seven years in the science and mathematics textbook publishing industry before taking up geology at Duke. “I always had this nagging thought in the back of my mind that I should be doing science,” she said, “So here I am.”

While this was William’s first at-sea experience, the trip will provide a doctoral dissertation for fourth-year graduate student and ocean veteran Heather Hanna, who studies geochemistry under Klein. “There’s been so little work on this that it should be a very interesting project,” she said.

Hanna previously went to the middle of the Atlantic Ocean as part of a multi-university expedition called MARVEL that ended up discovering “The Lost City,” a new and unique geothermal vent field. “I learned so much on the MARVEL cruise, and I really enjoyed working on the ship,” she added. “I love being at sea.”

Joining Williams and Hanna at the Incipient Rift was another graduate student, Meagen Pollock. Also aboard were Mark Rudnicki, a Duke research scientist and chief investigator, charts dredge positions.
in marine geochemistry, and three Duke undergraduates: Carrie Donnelly, Ryan Cheney and Jenny McGuire.

They joined an additional contingent of scientists and graduate students from Woods Hole Oceanographic Institution (WHOI) in Massachusetts, which supervised the photographic and geomagnetic observations that backed up Klein’s geochemical investigations.

The mission was unusually heavy on female help, whose job descriptions would include plenty of heavy lifting. “All the same 5 foot 2,” exclaimed Williams. “But, heck, if the men can do it so can we, right?”

As Duke and WHOI students documented from the ship on a Nicholas School Web site, www.env.duke.edu/IncipientRift/, expedition researchers began using a shipboard sonar device called SeaBeam to map the ocean floor topography (scientists call that “bathymetry”) while they were still hundreds of nautical miles from the IR.

“We’ll make a map of the whole region,” Klein said. “It’s called “mowing the lawn.” In essence, the whole ship became the pen for an evolving underwater chart, with sound waves serving as ink. Each ping of sonar swath covered about five kilometers of ocean bottom, but it took multiple course changes, back and forth, to blanket the whole area.

One purpose of this extensive “mowing” was to see if the IR really stops cold 75 kilometers east of the East Pacific Rise or instead continues at another location on the other side. “Ridges can do those little jumps,” Klein said.

The R/V Melville also towed a magnetometer, a device that detects magnetic variations in ocean floor rock. When molten lava hardens into basalt, on-board students explained, magnetic constituents in the stone align with Earth’s magnetic field as it existed at the time. These alignments then begin to decay as the stone oxidizes.

Scientists can thus deduce when the rift began forming, as well as how recently additional lava erupted. It was such magnetic observations, said WHOI graduate student Clare Williams, that provided the estimate that the Incipient Rift first began cracking through the ocean floor only about 1 million years ago—yesterday, geologically.

Ten days into the cruise, the expedition was wrapping up its sonar and magnetic work and beginning its second stage of operations. That’s when it first dropped the Melville’s dragline dredge, a huge heavy jaw of iron that emptied into a large iron net resembling chain mail.

Dragged behind a cable about 3,000 meters beneath the ship, the dredge served as a brutish counterpoint to the wax cores the group began dropping too. Successful wax core missions would return with tiny bits of basaltic glass. But a good dredge run would scoop up piles of rocks for the students to heft from deck to laboratory for sorting and sawing into geological samples.

Also launched was WHOI’s TowCam—nicknamed “RabbitCam” for the slogan painted on its side. As its name implies, TowCam was also lowered underwater by a cable and pulled behind the ship where its digital camera made up to 1,000 pictures of the bottom each run.

With TowCam’s 300-watt strobe light introducing wedges of day in the deep ocean’s perpetual night, the Nicholas School’s Web site quickly began posting crisp images of unusual features in the unclouded water. Those included a possible extinct hydrothermal vent (with startled crab), and what Duke undergrad Donnelly termed a “baby giant squid.”

Another photograph of fresh lava flowing over older rock, coupled with the basaltic glass recovered from almost every initial dredging run, provided Klein an early surprise. “It is truly remarkable how magmatically active the Incipient Rift is,” she exclaimed in an e-mail from the ship.

Also of interest from the SeaBeam sonar studies was how much the Incipient Rift’s walls appear to have spread apart.

On their very last day, IR researchers discovered a new and previously unknown V-shaped rift, called a ”propagating rift,” northeast of the Incipient Rift. Klein said it was one of the exciting findings of the cruise. “This finding may prompt us to rethink our understanding of the whole microplate boundary system in this area.”

Klein quickly noted that final assessments and discoveries will happen in her Duke lab, perhaps well after the cruise is over. “The heart of this cruise is to study the geochemistry of the lavas,” she wrote. “And we are not doing chemical analysis at sea.”

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You might call it an adventure: completing a master’s project (MP) in the Nicholas School sometimes involves exotic travel, usually requires learning new things, frequently entails unexpected challenges, and generally means that you can wind up some place entirely different than you imagined when you started.

But for students in the Masters of Environmental Management and Master of Forestry programs, their MP adventures can open windows to real work experiences that give them valuable insight into their future jobs, and the journey can even be fun.

MEM students Susan Watts Chinn and Enid McNutt, who graduated in May, took two very different journeys to complete their MPs. But they both discovered very quickly that the key to a successful project is being able to adapt to unexpected change.

Like most students in the Nicholas School, they used their summer internships to do the groundwork for their projects. Pursuing her interest in international development, Chinn hopped on a plane to Latin America to undertake what she originally thought would be a project on community-based conservation of sea turtles. McNutt stayed close to Duke, thinking that she would study wetlands. But, as their stories unfolded, they found themselves facing some very interesting challenges.

For Chinn, whose focus was resource economics and policy, her first priorities were to get an internship and then to get funding. One of her professors gave her a hand in locating an internship. He put her in touch with Fundacion Cocibolca, a non-profit organization that manages several national parks in Nicaragua. Then she just needed to acquire enough funding to spend three months in Nicaragua. Chinn, who was active in the Nicholas School’s Student International Discussion Group (SIDG), was known for her hard work and persistence in getting a job done.

"I lucked out really,” Chinn said. "I had to come up with what I wanted to do very early on in the process in order to compete for grants, but I was able to get funding through the school even though my project eventually changed from what I thought I would do.”

Communication with Cocibolca proved to be sporadic, which meant she had to use her own resources to define her MP focus. But knowing that Cocibolca’s conservation activities were based at two main sites—one at Mombacho Volcano Natural Reserve and the other at La Flour Wildlife Refuge—she opted to focus on the latter.

Chinn received two grants from the Nicholas School—one from SIDG and the other from the Kuzmier–Lee–Nikitine Endowment Fund. The other two came from the Center for Latin American and Caribbean Studies, and the Duke Center for International Development at the Sanford Institute of Public Policy.

From then on her trip took on a storyline that involved real-life lessons—some challenging, some disappointing—on how to manage a project in a different country with a different language.
"I had been forewarned by friends who had gone to Africa and Latin America the year before: You can try to figure this out now, but try to keep an open mind because when you get there it’s going to be different than you think. You’ll have to adapt,” she said.

**Lesson #1:** You have to adapt. When Chinn finally established communication with the executive director of Cocibolca, he suggested that she might have more luck completing a project at the Volcano Mombacho Natural Reserve, because of several problems at the sea turtle refuge. So Chinn took that in stride and continued plans for her trip.

As her flight time got closer, she heard from the executive director that he would be in the United States when she arrived, but he gave her the name of two people who would help her. “Contact these people,” he told me. ‘They’re expecting you. They’ll know what to do. Here’s the address,” Chinn said.

On the ground in Nicaragua, however, she found that no one in the organization office was expecting her or knew what the executive director planned for her to do. An appointment with one of the two people the director had referred her to turned out to be even more surprising.

He welcomed her to the office, “and then he explained that the executive director had resigned before leaving for the United States,” Chinn said. “So, I was a little frazzled at the beginning.”

**Lesson #2:** You have to adapt. Having spent her junior year of college in Spain, Chinn was fluent in Spanish and felt confident that language wouldn’t be a problem. But, “I got there and realized that the Nicaraguan accent is so different. They could understand me, but I had a hard time understanding them,” she said. “It took me a few weeks before I got used to their accents.”

Called enchanted by some, the Mombacho Volcano Natural Reserve covers some 1,700 acres of high-altitude forest southwest of Managua and is part of Nicaragua’s National System of Protected Areas. “The trees are covered entirely with bromeliads and moss, and a trail weaves around the perimeter of a volcanic crater that is truly spectacular to behold. Most often clouds mask the view, but on a clear day you can see all the way to Lake Nicaragua (also called Lake Cocibolca).”

Overseeing this reserve has proved a challenge for Cocibolca, which has been charged by the Nicaraguan government with conserving and protecting its natural resources and with controlling and monitoring park visitation with trained park rangers and a reserve manager.

Chinn set out to do her part by giving Cocibolca information that would help them determine what changes should be made to improve the operation and what the reserve’s potential was to return a profit.

“While there, I evaluated the quality of the reserve’s services and infrastructure and visitor demand for such services by implementing a survey of visitors,” she said. “I also evaluated the efficiency and transparency of the operation by surveying the reserve’s personnel.”

In the process, she gained valuable insight into collecting data and surveying populations in a developing country. “The survey participants were responsive, but some of them had never filled out a conventional survey before. I had a bunch of questions where they had to evaluate aspects of the reserve on a scale of one to five, and they had a really hard time figuring out what to do.”

Before Chinn headed back to the United States, she made an informal presentation to the organization of her preliminary findings on the obvious areas for improvements, as well as the strengths of the biological station at the reserve. It took until December for her to finish tabulating the survey results and to produce a formal report for the organization and her grant sources.

**Lesson #3:** You have to adapt. Chinn got out of the internship what she needed: her MP, a trip to an amazing part of the world, and a lot of valuable experience that just doesn’t come from a book.

The methodology she used to create and administer the surveys came directly from a course she took with Randall Kramer, professor of resource and environmental economics in the Nicholas School. So, she was encouraged by the opportunity to put her classroom education to the test. In addition, her interactions with the park officials, ecologists, and park visitors provided her with insight into a region where she hopes to continue concentrating her efforts.

But there was disappointment, too. She’s not sure if the organization put her suggestions to use.

“If they do get something out of it, that’s great, and it’s disappointing if they don’t. But, I’ve had to step back and realize that their using it was really the secondary purpose,” said Chinn.

Over the summer, Chinn got married and moved to Boston, Mass., where she hopes to pursue a career in environmental policy analysis, economic evaluation, or community-based conservation work, ideally in developing countries.

Although she took an entirely different approach to her MP, Enid McNutt, also learned that flexibility is the only way to make it through the process when the unexpected crops up.

Unlike Chinn, McNutt, who focused on resource ecology in the Nicholas School, determined that her summer would be best spent close to home, so she applied for a Stanback Internship through the Nicholas School to work with the North Carolina office of The Conservation Fund in Chapel Hill.

Then she teamed up with classmate and fellow intern, Tara Childs, with the idea of conducting intensive wetlands fieldwork. Soon realizing that three months was too short to collect substantial data, the team settled on another project on The Conservation Fund list—conserving North Carolina millponds.

Many millponds were constructed more than 200 years ago as power sources for wheat and flour mills, and they also served as community gathering places. One of their environmental benefits...
is that they play a similar role to beaver ponds, providing a niche for aquatic, semi-aquatic and migratory fowl species. Millponds also act as constructed wetlands, improving water quality by slowing water flow and filtering out sediments—a much needed role in the farming areas of rural North Carolina.

“But, during hurricanes Fran and Floyd, many of the dams were destroyed, prompting private millpond owners to approach The Conservation Fund and ask for assistance in repairing the dams,” said McNutt. Unlike many other conservation organizations, The Conservation Fund often handles projects that preserve cultural and historical sites as well as ecologically significant areas.

In beginning their research, McNutt and Childs identified 300 North Carolina millponds and drew up a list of areas that had been the hardest hit by the hurricanes. They then narrowed their search to 10 millponds that were in the greatest need of restoration.

Because The Conservation Fund could not finance the repair of dams at each pond, “we decided to do a prioritization of the millponds using decision analysis,” said McNutt. Decision analysis is a quantitative analytical method for reaching a decision when there are multiple courses of action.

Taking this step in the MP process proved to be quite a learning experience for both of them as neither had yet taken a course on decision analysis. But, they set to work teaching themselves different methods of decision analysis with the help of their newly chosen adviser, Lynn Maguire, associate professor of the practice of environmental management in the Nicholas School. McNutt learned Multiple Attribute Utility Analysis (MAUT), while Childs learned Analytical Hierarchy Processor (AHP), which they applied to the millpond prioritization and compared results.

In order to evaluate the millponds, they produced objectives hierarchies, as well as lists of prioritized attributes, which they gathered through research, interviews with pond owners, and their adviser at The Conservation Fund.

“After completing our analyses, we each had a list of 10 millponds, in order from one to 10 in terms of priority for preservation,” said McNutt. “Comparing our two lists, we found that in our rankings, millponds one through five were identical.”

McNutt reported her final list of 10 millponds in ranked order to The Conservation Fund and recommended that those showing the highest value in terms of preservation should be restored first. “I also demonstrated the usefulness of decision analysis as a way to make complicated, multifaceted natural resource management decisions,” she said.

Their Conservation Fund adviser, who had not been exposed to decision analysis in a conservation context, liked the MAUT technique so much that she said she would use it in the future for complex issues.

McNutt said she appreciated the MP experience and feels that the knowledge she gained from the project will be useful in her future career plans, which she hopes will involve restoring wetlands out West. “I’m really interested in wetlands, and the millponds are havens for many wetland species including cypress trees,” she said.

At the end of the MP journey just before graduation, both Chinn and McNutt had to make 20-minute presentations of their work at the Nicholas School’s annual MP symposium. They found that their colleagues, too, had weathered many challenges and they had all come through the year with a new look at their future work.

Fortunately, “The school is good at getting us prepared for the oral presentations in the spring,” said Chinn. “I was dreading my MP presentation from the first day of school, but it actually turned out to be a good experience.”

And then, it was over, and they were on to the next challenge in their lives.

Julia Connors T’04 studies French and does documentary work and photography on the side. She is considering a career in medical journalism.

Julia Connors took the photos of Enid McNutt and of Yates Millpond. McNutt and Connors were given a tour of the millpond— which is being restored in southwest Raleigh— by Rebecca Cope, who told them about her experiences during the restoration process.

Susan Watts Chinn provided photos from the Mombacho Volcano Natural Reserve, including the red-eyed frog.
Whither Forestry at Duke?

by William H. Schlesinger

One frequent question during my first year as dean was, “So what are you doing with forestry in the Nicholas School?” Frankly, I was surprised. New approaches to traditional forestry education were a major tenet in the creation of the School of the Environment at Duke more than 10 years ago. Certainly, we wanted to retain the option of a Master of Forestry (MF) degree, and the Society of American Foresters reaccredited our program recently. We continue to make extensive use of the Duke Forest as an outdoor classroom for forest management. But, as for an explicit focus on production forestry, Duke was out.

Even 10 years ago, this was not to say that we thought forests were unimportant, but rather, we wanted to develop new educational programs that extend beyond traditional training in production forestry. Here, Duke could play a special role: with the creation of the Nicholas School of the Environment and Earth Sciences, we could see more in the forest than the trees.

Forests host the greatest fraction of the world’s biotic diversity, sequester significant quantities of carbon dioxide from Earth’s atmosphere, and cleanse the air and waters that pass through them on a daily basis. These are services that nature provides free of charge. As humans have reduced forest cover globally from 40 percent at the dawn of the Industrial Revolution to about 29 percent today, we have sacrificed a good deal of nature’s services, usually in favor of only short-term gain.

A holistic view of forestry is needed. What this means is that for our students the traditional courses in a forestry curriculum—with names such as dendrology, mensuration and silviculture—may well be replaced by classes in forest economics, forest watershed management, conservation biology, and biogeochemistry. Our goal is to train students who can practice sustainable forest management. We will provide value added graduate education in forest ecosystem management, recognizing that extractive management must be done in ways that minimize environmental impacts, maximize conservation benefits, and sustain the broad array of values of forested lands. The forest products industry knows how to grow trees; what it needs to know is how to manage land for the diversity of other goods and services that a healthy forest ecosystem can provide. This is a role that the Nicholas School is uniquely qualified to play—in the Southeast, across the country and around the world.

We will continue to look to forests for fuel and fiber. Indeed, somewhere recently a tree was cut to provide the paper for this magazine. As the human population grows, we will increasingly depend on the ecosystem services of forested land as much as we depend on its timber.

No, the Nicholas School of the Environment and Earth Sciences has not abandoned forestry. In fact, with the help of the Sullivan and Tukman families, we have just created a new endowed chair in forest resource management and environmental economics and policy (see page 27). We are proud to have trained managers who are now found throughout the forest products industry in the United States and abroad. What we must do now is to provide broad training on forest ecosystem management to a large cadre of young professionals who will care for our forests of the future.

Schlesinger is Dean of the Nicholas School and James B. Duke Professor of Biogeochemistry.
Boat Bottoms, Barnacles and Modern Medicine: Dan Rittschof Hopes the Drug Store Will Offer a Safe Substance to Keep Barnacles Off Boats

by Tinker Ready

There are happy clams and for a while, there may have been a few extra cheerful barnacles in Professor Dan Rittschof’s lab. In his search for a new compound to keep the pesky shellfish from clinging to boats, the Nicholas School zoologist fed small doses of a popular antidepressant to barnacles. He wasn’t thinking the medicine would relax the tiny arthropods so they would loosen their costly and invasive grip. Antidepressants just happened to be among the drugs he used to test the theory that human pharmaceuticals might chemically—and safely—thwart a barnacle’s ability to settle on ships.

The tests established proof of principle. Now comes the hard part.

After 20 years of trying to find a replacement for the effective but toxic tin–laden paint that protects the hulls of most of the world’s ships, Rittschof learned that there are no simple solutions. The original idea was to find something that was environmentally benign, so it made sense to look for naturally occurring compounds. And, there seemed to be candidates among the many marine organisms that continuously produce antifoulants. But, “natural” does not necessarily mean simple or benign. Rittschof found the technical, financial and regulatory barriers to bringing such a product to market prohibitive.

“I pretty much had reached a dead end,” he said. “I went from natural products, which are relatively complex models, to looking for things that were a dollar a pound that prevent barnacle settlement.”

Willing to cast his intellectual net in places others might overlook, Rittschof may have found what he was looking for in his medicine cabinet. By recognizing the metabolic similarities in humans and barnacles, Rittschof and a collaborating group in Singapore have identified many common medications that prevent the critters from attaching to boats and pilings.

But it took two decades and six untapped patents before Rittschof reached that point.

The stakes in this search are extremely high. Boats encrusted with barnacles, algae and other shellfish are slower and burn more fuel. Virtually all of the world’s boats—cargo ships, cruise liners, oil tankers and pleasure craft—use paint laced with toxic tributyltin (TBT) to keep them off. In the 1970s, the TBT paint was seen as an improvement over older lead and arsenic–based coatings. But, studies found that the compound can persist in the environment and decimate sea life, including human foods such as oysters, clams and mussels.

In response to the unacceptable environmental impacts of TBT, the World Maritime Organization, an arm of the United Nations, is banning the substance as of 2003. In July, the European Union—which banned the use of TBT and other organotins on pleasure boats in 1989—extended the ban for all member ships. As a result, some companies have turned to copper–based paints. But they too can be harmful and are banned in some countries.

It was the search for an alternative that brought Rittschof to Duke University in the early 1980s. He’s the guy with the beard and the baseball cap who spends as much time paddling around the estuaries of Carteret County as he does in the Duke Marine Lab in Beaufort, N.C., where he is based. As both a scientist and a professor, Rittschof’s work centers on the biochemistry of marine animal behavior. Helpful, hardworking and friendly, he has a reputation as an innovative and enthusiastic researcher. One colleague described him as “scientifically creative.” Over the years, Rittschof has helped create better food for farm–raised fish. And he’s identified the chemical signals that guide blue crabs, draw predators to oysters and help hermit crabs find shells. The classes he teaches include The Biochemistry of Marine Animals and Ecology of Chemical Signals.
Rittschof came to the Duke Marine Lab in 1982 to join a team that was searching for natural compounds to replace TBT. Led by retired researcher John Costlow—with the support of the U.S. Office of Naval Research—they were looking at the antifouling properties of whip coral. They weren’t having much luck, Rittschof said.

“They had been going for three years and didn’t have any results” he said. “What I brought to them was the ability to integrate chemistry and biology. I could make the science work.”

And he did, to a point. Well versed in barnacle breeding, his lab spawned billions of larvae over the years by developing a specialized water treatment process. He helped Costlow and his team identify the active ingredient in the coral’s ability to resist fouling—a disk shaped molecule known as the pukalide. Too complex and expensive to produce, the pukalide structure hinted at other chemicals that might prove useful.

That led them to the sea pansy and a class of chemicals called “renillafoulins,” which the scientists patented in 1986. But again, those chemicals were complex. And, the team found it difficult to meld their compounds with existing paints and coatings.

“Making a coating is a lot more than mixing a chemical with paint,” Rittschof said. “There is chemistry and there is biology and there is polymer coating science and the engineering that goes with that.”

While the compounds worked, they didn’t work as well as tin, which at the time, was still the industry standard, Rittschof said. So, industry interest—needed to move their work out of the lab and on to boats—was lukewarm. And then there was the Environmental Protection Agency review. It can take years and cost millions to put a new compound through the tests and reviews needed to make sure it too won’t contaminate the environment, said Rittschof.

“Making a coating is a lot more than mixing a chemical with paint,” Rittschof said. “There is chemistry and there is biology and there is polymer coating science and the engineering that goes with that.”

Recognizing that was a big “if,” Rittschof turned his attention elsewhere. What about human pharmaceuticals? he thought. The main idea may have been around for more than 100 years, but only from a biological perspective and not from a chemical or engineering perspective.

“Development of commercial coatings using natural products is blocked by cost, the time horizon to meet government regulations, and the performance standards based on coatings with unacceptable environmental impact,” he wrote in a 2000 article of the journal Biofouling.

“If blocks are removed, the potential for environmentally acceptable solutions that combine natural products with organic biocides is high.”

After all, barnacles and humans share something on a cellular level—metabolic pathways. Many drugs interfere with specific biochemical and neurotransmission pathways. Because many of these human pathways are old, evolutionarily, they occur in barnacles as well. Those same pathways are involved in the physical changes that allow barnacles to transform themselves from swimming larvae to stationary pests.

“There is a complex metabolic cascade that’s involved in that metamorphosis, and you should be able to interfere with it somewhere,” he said. “The drugs have known mechanisms and absolutely known chemistry, so if you find the right pathways to interfere with, you can pick the right chemistry.”

Rittschof, has explored most of the Beaufort area’s waterways, will have a new and distant place to paddle for this project.
—Singapore. He found little interest in his project in the United States.

But, a group of professors from National University of Singapore (NUS) invited him to work with them after he gave a speech two years ago in the Southeast Asian country. Home to global shipping, Singapore has a huge interest in the science of shipping, the marine environment and in intensifying its economic base.

The scientists at the NUS Tropical Marine Science Institutes operate a biofouling program that concentrates on biodiversity, ecology and larval studies. They are “trying to get a grip on fouling in the tropics which is poorly understood and sometimes almost anecdotal,” said Serena Teo, a research fellow at the institute and the principal investigator for the pharmaceutical study.

“Dr Dan’s project with us falls under the larval studies component,” she said via e-mail. “The concept is really simple: if you know how barnacles stick, you know how it won’t happen.”

Jonathan R. Matias, who knows Rittschof and his antibiofouling work well, also thinks the Duke researcher is on the right track. Matias’ New York City–based company, Poseidon Ocean Sciences, has been using Rittschof’s testing system for years. He has identified a natural antifouling agent and plans to register it with the EPA this year.

“The approach that Dan is doing is reasonable and hopefully he will find some products that are low enough in cost and approved by the EPA at the same time,” Matias said.

Earlier this year, Rittschof spent four weeks setting up an antifouling lab at a brand new, palatial marine laboratory nestled among the coconut trees of Singapore’s St. John’s Island. For the next few years, Rittschof will shuttle between North Carolina and Singapore to serve as an adviser and collaborator.

The team set out to pinpoint metabolic pathways mutual to both humans and barnacles. Then they targeted those that, in the shellfish, serve as a key link in the biochemical events that lead to its metamorphosis from swimming larvae to stubborn barnacle. They were looking for drugs that, for example, interact with the human opioid-2 pathway in both creatures. They tried a range of common prescription and over-the-counter products and found a few.

So, it was back to the barnacle larvae, known as nauplii. After they shed their outer shells several times, the larvae turn into “cyprids,” creatures that live on their own fat. However, if cyprids don’t anchor themselves to a hard surface within two weeks they die. Drawn by pheromones, they seek out surfaces already colonized by other barnacles, where they attach themselves and transform again, this time into filter feeders.

Rittschof’s team was trying to find a way to spare the nauplii, which are an important part of the maritime food chain, but kill the cyprids before they could settle. So they conducted a toxicity test by bathing the nauplii in drugs. Since the larvae need to move at that stage in order to find a place to settle, the researchers measure how much of the drug they could handle without dying. If they stopped swimming, it was too much. They then expose cyprids—settlement stage larvae—to different concentrations of drugs to see if they have any effect on its ability to settle. By combining data from the two tests, they were able to come up with a therapeutic ratio—in other words, enough to kill the cyprids without killing the nauplii.

So the same dose that is safe for nauplii will kill a barnacle. But, what else will it kill? Rittschof said that drugs have the potential to be just as harmful to the marine environment as metals. But because drug effects and fates are so well studied in humans, they should have predictable lifetimes in the environment.

“In a drug, you know the most likely place on a molecule for a compound to break down,” he said. “You know how it interacts with other compounds and you know what’s been done to keep that from happening. There is just so much more of a knowledge base because billions of dollars have been spent on building drugs.”

This summer, Rittschof presented a paper on his work at the 11th International Congress on Marine Corrosion and Fouling, an international scientific conference on the chemical and biological deterioration of materials in the sea. Now, the team Rittschof advises is ready to start engineering the technology. To do that, they will be looking at the drug’s chemistry to see if it can be made compatible with existing antifouling coatings.

Informed by the lessons of the past, Rittschof is hoping that he’ll have a head start this time.

“The next round we’ll become much more specific in the way we work with things,” he said. “If we really understand our chemistry, we shouldn’t have to go back to the drawing board.”

**NUS Tropical Marine Institute**
www.tmsi.nus.edu.sg/

**World Wide Fund Statement on Tin Coatings**
www.worldwildlife.org/toxics/whatsnew/pr_25.htm

**International Maritime Organization**
www.imo.org/home.asp

**Industry Antifouling Site**
www.antifoulingpaint.com/default.asp

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Tinker Ready is a health and science writer based in Cambridge, Mass. She writes regularly for Nature Medicine, the Utne Reader and the Los Angeles Times.
Jim Miller: A Forester in the Nation’s Capitol

A monthlong, cross-country camping trip with his parents and two older sisters at the age of nine was the start of a lifelong love affair with the out-of-doors for Jim Miller MF ’70. “We started in Virginia and camped to California and back,” reminisces the new president of the Nicholas School’s Alumni Council. Today, Miller crisscrosses the United States overseeing trails, caves and outdoor ethics programs for the USDA-Forest Service.

The Virginia native did his undergraduate work at William and Mary, then headed to Duke’s School of Forestry as part of the 3/2 program. His three years at William and Mary and two years at Duke resulted in a bachelor of science degree in biology and a master’s degree in forestry in five years. “I chose Duke because of the combined degree program with William and Mary. There were other colleges and universities with similar programs, but Duke offered an extraordinary education. It was value for the dollar that I couldn’t pass up.”

Asked to recall his favorite Duke memories, Miller confessed that “some aren’t printable, but anyone from my era will remember the blue bus, Professor Ralston’s cigarettes at the bottom of soil testing holes, Dr. Stambaugh’s field trips to western North Carolina and life at Cameron before Coach K.” One particularly vivid memory involves a copperhead that sat in on Dr. Fred White’s field discussion. “The session was soon regrouped back on the road,” Miller said, laughing.

Following summer stints as a research associate for Dr. Ralston and as a wilderness aide in the Sierra National Forest, Miller worked for the National Park Service at Ford’s Theatre and The House Where Lincoln Died. He then served in the U.S. Army in Germany and later became assistant post forester at Fort A.P. Hill in Virginia. His work as a forester has taken him to some of the nation’s most dramatic locations including the Tongass National Forest in Alaska and the San Bernardino National Forest in California. He currently serves as a member of the Recreation, Heritage and Wilderness Resources staff at the national headquarters of the USDA-Forest Service in Washington, D.C.

“My work covers a lot of ground, and I find it interesting that as new programs with new names are developed, I keep saying ‘So what’s new? I learned that at Duke.’ I don’t mean that I learned it all, or that there are not new things to learn, but I believe that the basic concepts of considering all environmental relationships were firmly in place during my studies at Duke.”

“There is no question that the forestry program has changed at Duke. Today there is more emphasis on subjects that were not part of a traditional forestry education when I was in school. Those subjects are still important and are still available, but I am glad that Duke is responding to the times with new courses that address changes in business and society.”

Miller has served on the Alumni Council in various capacities since 1992 and became president earlier this year. His goals are to improve communication with alumni and to complete funding of the Alumni Fellowship Endowment that was launched by alumni in 1987. “The Alumni Fellowship Endowment Fund provides at least three scholarships every year, with one specifically earmarked for a minority student,” explains Miller. “I feel so strongly about the opportunities the fund provides that I contribute every year in addition to my Annual Fund gift. I’ve sat on the committee that awards these fellowships, and what I say to the recipients is: Your fellowship is a gift from former students who were once in your shoes. We care about you. When you get the chance, please respond in a similar manner if you can.”

Miller is married to Linda Miller and they have two children, Kyle, 22, and Kelley, 20. When not enjoying the great outdoors or coaching his girls’ recreational soccer team, Miller enjoys reading and collecting model trains.
Wood Artist Featured at Field Day 2002

Alumni, faculty, staff, students and their families gathered April 13 in Duke Forest for food, fellowship and traditional forestry games as part of the University’s Reunion Weekend.

A special feature of this year’s Field Day was watching world-renowned wood artist, Clyde Jones of Bynum, N.C., create “critters” from wood using his chainsaw and recycled objects. “Clyde Critters” have been exhibited nationally, including the Smithsonian Institution and the North Carolina Museum of Art. They also have visited such diverse places as The Great Wall of China, San Francisco and Times Square. Thanks to Jones’ generosity, two pieces were auctioned to benefit the Environmental Internship Fund.

Don’t miss next year’s festivities. Mark your calendar now for Saturday, April 12.

Krista Bofill Appointed Director of Alumni Affairs and the Annual Fund

Krista Bofill has joined the Nicholas School as director of alumni affairs and the annual fund. “We were delighted to recruit Krista,” said Associate Dean Peggy Glenn. “She comes to us after stints with engineering, arts and sciences, and the Duke Medical Center and brings a wealth of experience to the job.”

Bofill began her career at Duke in 1994. She served as director of young alumni, the annual fund and special events at the School of Engineering before becoming director of special events for Arts and Sciences in 1997. In 2001, she

Class Notes

C.P. Patrick Reid MF ’66, Ph.D. ’68 was elected president of the National Association of Professional Forestry Schools and Colleges for a two-year term in January 2002. Reid is director and professor in the School of Renewable Natural Resources at the University of Arizona in Tucson.

Adrian S. Juttner MF ’70 recently left the South Dakota Department of Agriculture where he worked as a forest pathologist in the Resource Conservation and Forestry Department. He also published a paper on Mountain Pine Beetles edited by Dr. Paul A. Mistretta MF ’70. As Juttner wrote, “I got to try out some of my concoctions on them—fascinating stuff!”

South Carolina is home for Beth W. Trump MF ’82, her husband John and twin boys, Noah and Samuel. Trump does land management in Columbia for SCANA. For her 40th birthday, she treated herself to an accelerated free fall sky dive!

Christine L. Tripp MEM ’92 is project manager with Plexus Scientific Corp. in Alexandria, Va. where she facilitates a DoD bilateral Data Exchange Agreement (DEA) for Environmental Technology between the governments of the United States and Germany.

Laura A. Watt MEM ’92 finished her doctoral dissertation entitled “Managing Cultural Landscapes: Reconciling Local Preservation and Institutional Ideology in the National Park Service,” in December 2001 at the University of California at Berkeley. This spring she taught a class in environmental policy at Berkeley.

William E. Cleveland MEM ’93, his wife, Linda, and their two girls, Alex and Hannah, now live in Shreveport, La. Bill is busy identifying Class Agents for the upcoming Reunion in April 2003. Any volunteers? Contact Bill.Cleveland@alumni.duke.edu

Jagdish Krishnaswamy MEM ’93, Ph.D. ’99 (Environmental Science) has been a fellow with the Ashoka Trust for Research in Ecology and the Environment (ATREE) in India since August, 2001. He married Deepa in April, 2001.

Katharine C. Hetts MEM/MF ’94 is a fire use module leader for the U.S. Forest Service at Stanislaus National Forest in California. She passes along this message to classmates, “Out of the Maoist insurgency and into the fire…”

Geoffrey R. Archer MEM ’95 and his wife went on a three-week motorcycle tour of New Zealand earlier this year (see www.nzbike.com). Quoting Geoff, “Man, does that make California look boring!” He would like to hear from hardwood experts or entrepreneurs (geoffarcher@yahoo.com).
became director of donor relations and special events at the Duke Medical Center. She also teaches a popular course on planning special events for Duke's Continuing Education Program.

Nicholas School Needs You to Serve as a Class Agent


Bill Cleveland, MEM’93, has offered to coordinate identification of class agents. He will be calling many of you soon. However, if you want to volunteer now, you can contact Cleveland at 318-868-6265 or by e-mail at bill.cleveland@alumni.duke.edu. You can also call the Office of Alumni Affairs and the Annual Fund at (919) 668-8035 or e-mail Krista Bofill at k.bofill@duke.edu.

Members of the Class of 1977 returned to the Duke Marine Lab for their 25th Reunion: Front row (from left), Mei Ling Yee, Professor Joe Bonaventura; second row, Patti Krikorian Fowler, Debbie Henry, Neal Stahl, Chris Newgard, Sherri Cooper (Zia and Anji), Julia Deal; and back row, Mike Bradley, Buck Henry, Jim Whitaker, Peter Griffith, John Moses.

The Class of 1992 gathers at Field Day: Front row, from left, Brad Dethero, Martha Papp Sheils, Heather Potter, Lori Sutter, Rikki Grober, Jamie Gerlaugh, and Bill Cleveland; back row, Brett Wood, Kevin Malloy, Kay Carlson, Hudson Slay, Mark Forney, and Robbie Brown.

Mark L. Tukman MEM ’95 and his wife announce the birth of their baby girl, Olivia Lois Tukman, on Aug. 15.

Susanna Butler MEM ’96 and Rob Herrmann MEM ’97 were married at the Wolffer Estate Vineyard in Sagaponack, N.Y. on July 21, 2001. In attendance were MEM 1997 graduates Thomas Grant, Edward Oswald, Jud Wolfe and Chad Wright, along with Julia Kertz-Grant MEM ’98. The couple are employed by En-Consultants Inc., an environmental consulting firm in Southampton, N.Y.

David F. Burch MEM ’97, BS ’93 and his wife, Kerry Burch MEM ’96, have returned to Durham, N.C. to live. David is working for ICF Consulting (again) in Research Triangle Park and Kerry continues to work for Ariel Research.

John M. Hall MEM ’95 and Vanessa Winter Hall MEM ’96 were married in April 2002 and now live in Alexandria, Va. where Vanessa works for Navigant.

In 1999, Lori E. Lacy MEM ’97 married Garrett P. Sonnier MEM ’97. They are living in Los Angeles where Lori works for Toyota Motor Sales in the Environmental Coordination Office. Garrett is working on his doctorate at the University of California-Los Angeles.

Whitney Wagamon MEM ’98 left her position with Parsons Transportation Group on Aug. 1 and entered law school at George Mason University in Arlington, Va.

James S. Konuito MEM ’99 is working at AllWest Environmental Inc. in San Francisco, Calif. He wants Nicholas alumni to know his firm is looking for new staff to help clients understand and manage potential environmental liabilities.

Tancred Buddie Miller MEM ’99 has joined the Sierra Club in Raleigh, N.C., as a conservation organizer. His son, Max, was born in October 2001.

Kimberly T. Murray MEM ’99 and her husband, Paul Kostovick, announce the birth of their son, Dylan Murray Kostovick, on March 7. Kimberly is working as a fishery biologist for the National Marine Fisheries Service at the Northeast Fisheries Science Center in Woods Hole, Mass.

Kristopher A. Pickler MEM ’99 received his J.D. from UNC-Chapel Hill School of Law in May. He has joined the firm of Buist, Moore, Smythe & McGee, P.A. in Charleston, S.C., as an associate. He will practice corporate, coastal, environmental and real estate law.

William E. (Rusty) Painter, Jr. MF ’00 is director of land protection for the Conservation Trust for North Carolina, the statewide land trust and service provider for the network of local land trusts in North Carolina. He and his wife, Carrie, live in Durham.
Presentations and Conferences


On June 6, Michael K. Orbach, director of the Duke Marine Laboratory and professor of the practice of marine affairs and policy moderated a day-long symposium in the U.S. House of Representatives on "Coral Reefs at Risk: Challenges and Solutions." This symposium, part of Capitol Hill Oceans Week and sponsored by the House Oceans Caucus, featured presentations by coral reef scientists from around the world and a panel discussion involving members of the U.S. House of Representatives and the assistant secretaries of the Departments of State, Interior and Commerce.

Daniel D. Richter, professor of soils and forest ecology, delivered the Third Annual Lyle Nelson Soil Science Lecture at Mississippi State University in Starkville, in February. The topic was soil acidity and acidification.

Richter and Duke Forest Manager Judson Edeburn continued their involvement with the dual certification project through the Southern Center for Sustainable Forests. They participated in a conference in June on "Implementing Forest Certification: The Real Experience by the First Dual-Certified State and University Forests" in Raleigh, N.C.

William H. Schlesinger, dean and James B. Duke professor of biogeochemistry, was the invited speaker for The Fourth Annual Patrick Lecture at Louisiana State University, Baton Rouge, La., April 30. His lecture was "Global Futures: Measuring Human Impacts on the Biosphere."

Schlesinger also presented the paper "The Global Carbon Cycle" at the Sixth International Symposium on the Geochemistry of the Earth’s Surface, Honolulu, Hawaii, May 20–24, and again for the British Society of Soil Science, London, June 28.

Martin D. Smith, assistant professor of environmental economics, presented papers at the following conferences over the spring and summer: World Congress of Environmental and Resource Economists in Monterey, Calif.; American Agricultural Economics Association Annual Meetings in Long Beach Calif.; Camp Resources X in Wilmington, N.C.; and International Institute for Fisheries Economics and Trade in Wellington, New Zealand. At the latter he was co-organizer of a session called "Risk and Uncertainty in Capture Fisheries."

Dharni Vasudevan, assistant professor of environmental chemistry, and associate in research, Ellen M. Cooper, presented the talk "Sorption of organic anions in iron oxide rich soils: Role of soil P and Al," at the symposium on Complexity at the Water-Solid Interface: Mineral Surfaces and Nanoparticles, Division of Geochemistry, American Chemical Society National Conference, Orlando, Fla., April 2002.

Vasudevan also presented "Environmental chemistry at the mineral-water interface: Implications of chemical fate and transport" at the Department of Inorganic and Physical Chemistry, Indian Institute of Science, Bangalore, India, July.

The Nicholas School had many participants at the Second World Congress of Environmental and Resource Economists in Monterey, Calif., June 24–27. School faculty in attendance were Randall A. Kramer, professor of resource and environmental economics, and Martin D. Smith, assistant professor of environmental economics. Adjunct faculty present were, Subhrendu Pattanayak, Research Triangle Institute (RTI); Brian Murray (RTI); Carol Mansfield (RTI); and Tom Holmes, United States Forest Service (USFS). Former doctoral and master’s students attending were Erin Sills (NC State); Priya Shyamsundar (World Bank); David Newman (University of Georgia); Tijen Arin (World Bank); Paul Ferraro (Georgia State); and Wolfram Sclenkler (UC Berkeley).

The Congress is sponsored by the Association of Environmental and Resource Economists (AERE) and the European Association of Environmental and Resource Economists (EAERE), and is hosted by the Giannini Foundation of Agricultural and Resource Economics at the University of California at Berkeley and Davis, together with the Donald Bren
School of Environmental Science and Management at the University of California, Santa Barbara.


On April 4, Wiener presented "Precaution" at Vanderbilt University School of Law in Nashville, Tenn., and on March 1, at University of Colorado Law School in Boulder, Colo., he presented "Reconstructing Climate Policy."

In Print


John W. Terborgh, James B. Duke Professor of Environmental Science, has co-authored "Beta-diversity in tropical forest trees," published in Science, Jan. 25.


Gabriel G. Katul, professor of hydrology and professor of ecology, Ram Oren, and others are co-authors of the paper "Mechanisms of long-distance dispersal of seeds by wind" which was published in the July 25 issue of the journal Nature.


In Print

Lincoln Pratson

Assistant professor of sedimentary geology Lincoln Pratson is co-author of "The Shaping of Continental Slopes by Internal Tides," with D.A. Cacchione and A.S. Ogston, published in the April 26 issue of the journal Science.

Peter K. Haff, professor of geology and civil and environmental engineering and chair of the Division of Earth and Ocean Sciences, published "Neogeomorphology," a discussion of the role of human as geologic agents, in the July 16 issue of EOS, a publication of the American Geophysical Union.

Gabel Associate Professor of the Practice in Environmental Ethics and Sustainable Environmental Management Marie Lynn Miranda, together with research associates Dana C. Dolinoy, Mayra A. Overstreet have published "Mapping for Prevention: GIS Models for Directing Childhood Lead Poisoning Prevention Programs," in the September 2002 issue of Environmental Health Perspectives.

William H. Schlesinger, dean and James B. Duke Professor of Biogeochemistry has authored or contributed to the following published papers:


Martin D. Smith, assistant professor of environmental economics, has two new publications:


Jonathan B. Wiener, associate professor of law and of environment, has published the following:

Memberships, Appointments, and Awards

Gary S. Hartshorn, professor of the practice of tropical ecology and president and CEO of the Organization for Tropical Studies (OTS) based at Duke, is president-elect of the American Institute of Biological Sciences (AIBS) for 2002. AIBS is a federation of 87 professional associations and societies representing approximately 240,000 biologists. Hartshorn will serve as president in 2003.

In July, professor of resource and environmental economics Randall A. Kramer was named to the World Commission on Protected Areas (WCPA). The WCPA is a group of protected area experts who promote the establishment and effective management of a worldwide representative network of terrestrial and marine protected areas and provide advice to the World Conservation Union (IUCN). While on sabbatical during the past academic year, Kramer was a visiting scholar at the IUCN headquarters in Gland, Switzerland. He has worked on protected areas in the United States, Indonesia, Madagascar and Mozambique.

Michael K. Orbach, director of the Duke Marine Laboratory and professor of the practice of marine affairs and policy, has been elected to the National Board of Directors of the Surfrider Foundation. Orbach was elected in the fall of 2001 for a 3-year term beginning in 2002.

Kathryn Saterson, research scientist in the division of environmental sciences and policy and executive director of the Duke Center for Environmental Solutions, was elected secretary of the Board of Governors for the Society for Conservation Biology. Her term runs through 2005.

Robert L. Wolpert, professor of statistics and decision sciences and professor of the environment, was selected by the Institute of Mathematical Statistics as 2002 Medallion Lecturer. He also has been selected to the International Society for Bayesian Analysis Board of Directors.

Jonathan B. Wiener, associate professor of law and of environment, has been named a University Fellow of Resources for the Future, Washington D.C., through 2005, and also was elected to the governing Council of the Society for Risk Analysis, 2001–04.
Sullivan and Tukman Families Create Forestry Professorship

Synergy is defined as the interaction of two or more forces so that their combined effect is greater than the sum of their individual effects. The word also can be used to define the Nicholas School, which was created by a synergy of disciplines in 1991.

Today, a synergy of two devoted Nicholas School families, the Sullivans and the Tukmans, has created the Korstian Professorship with a combined gift of $1 million to be matched by the Nicholas Faculty Leadership Initiative for a total commitment of $1.5 million. Named in honor of the late Clarence Korstian, the professorship itself is a synergy of two important disciplines—forest resource management and environmental economics and policy. Korstian was the first director of the Duke Forest, the first dean of the School of Forestry, president of the Society of American Foresters and the Ecological Society of America, and the author of a groundbreaking textbook entitled, The Ecological Basis of Silviculture.

The Sullivan family—Raymond E. Sullivan T’26, James Madison “Matt” Sullivan, John Vance Sullivan MF’86, and James Blake Sullivan MF’89—are stalwart supporters of forestry at Duke. The elder Sullivan’s will created the Raymond E. Sullivan Trust, which continues to support the Nicholas School. Matt Sullivan established the John and Blake Sullivan Endowment fund in 1987 for the School of Forestry and Environmental Studies in honor of his sons. “My father was a pioneer in conservation and understood the worth of the land long before it was widespread,” said Matt Sullivan. “Land was a liability in the south in the 1930s and 40s due to taxes, but he had a vision of turning wasteland into stands of pine plantations. His goal, to plant 1 million pine seedlings per year, was far exceeded by the 40 million planted prior to his death. My father wanted to leave the land better than it was when he acquired it, a feat he certainly accomplished. The tradition continues today with his grandson, Blake Sullivan, managing the family land.”

“As third generation foresters, John and I both benefited from our master of forestry degrees,” said Blake Sullivan, president of Sullivan Forestry Consultants in Americus, GA. “Establishing the Korstian Professorship guarantees that future generations will continue to receive superb instruction in forestry at the Nicholas School.”

The Tukman family—Mel and Lois Tukman and Mark Lee Tukman F’95—issued the challenge for a professorship in forestry...
and are delighted to see their dream become a reality. “After Mark’s graduate experience, we wanted to support Duke,” said Mel Tukman. “With Mark’s interest and career focus on forestry, we wanted to add power to Duke’s historic forestry strength. Deans Christensen and Schlesinger were totally behind the idea. We’re excited to contribute to the Nicholas School’s future in this way.”

Dean William Schlesinger concurs with the goals of both families. “The creation of the Korstian Professorship was a seminal moment for the Nicholas School. By blending the strong tradition of forestry at Duke with a focus on regional, global, and economic issues, our faculty and students will have an immediate and lasting impact on sustainable forestry and the policy and management issues facing foresters today and in the future.”

Daniel D. Richter Jr., professor of soils and forest ecology and co-director of the Southern Center for Sustainable Forests agrees, “Forests support humanity and the environment in ways we often take for granted. Though forests are typically undervalued, they provide an array of benefits essential to our daily lives including wood-fiber products, and high quality water, wildlife habitat, and recreational opportunities. Throughout the world, the future of forest ecosystems depends on well-educated professionals who can creatively apply scientific principles and ever more sophisticated plans and management regimes. There is no doubt that the Korstian Professorship will have a major beneficial impact on the future of forests.”

“On behalf of the entire Duke University community, I want to thank the Sullivan and Tukman families most warmly for their enlightened support of the Nicholas School through the establishment of the Korstian Professorship,” said Duke University president Nan Keohane.

"Institutions of higher education are characterized as ‘great’ for many reasons. One of the most profound, and most enduring, is transformative and stimulating teaching. This generous gift helps ensure that such teaching will continue at the Nicholas School for many generations to come.”

Duke University has been a force in forestry education and research since 1938, and today is one of the few institutions so well equipped to provide solid leadership in decisions affecting our forested landscapes. Two research centers, The Southern Center for Sustainable Forestry and The Forest, Soil and Water Lab, are working full-time on forestry issues, and employers in the forest products industry consistently comment that Nicholas School graduates are among the best trained in the field.

A Charitable Annuity: The Gift That Pays

In exchange for a gift of $10,000 or more, Duke can offer you (or you and another named beneficiary) a fixed annual income for life. Your ages, your financial needs, and current interest rates determine the annuity rate Duke can offer.

Some sample rates:

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*Annuity rates are subject to change. Once your gift is made, the annuity rate remains fixed.

The staff members of the Nicholas School Office of External Affairs are available to consult with you or your advisers about planned giving opportunities that benefit you and the School.

For further information, contact us:

Nicholas School, Office of External Affairs, A233, LSRC
Box 90328, Durham, NC 27708-0328
tel: (919) 613-8003 • fax: (919) 613-8077
email: anita.brown@duke.edu • www.env.duke.edu
Anita Brown Named New Director of Major Gifts

Anita Brown has joined the Nicholas School as director of major gifts. Brown comes to the school after serving 17 years at Duke, most recently holding the position of senior director of development at Duke Law School. During her Law School tenure, Brown helped plan and direct two successful capital campaigns, the latest of which topped the $55 million goal in June of this year.

She holds a bachelor of arts degree in economics from the University of North Carolina at Chapel Hill, where she graduated with highest distinction and was elected to Phi Beta Kappa.

"Anita has a great deal of experience in helping donors make the gift they want to make, but might not know how to structure," said Sally Kleberg, chair of the school’s capital campaign. "I encourage anyone who wants to maximize income and/or tax benefits while making a gift to the school to talk with Anita."

Christensen Scholarship Reaches $1 Million

Thanks to the generosity of alumni, faculty, staff, and friends of founding dean and professor of ecology, Norman L. “Norm” Christensen Jr., the Christensen scholarship fund has surpassed the $1 million mark. “Leading the Nicholas School was an honor,” said Christensen. “Knowing that a Christensen scholar will forever grace the halls of the school is the greatest honor of all. I sincerely thank everyone who made this scholarship possible.”

Donors to the fund wanted a scholar named as quickly as possible, and many accelerated their pledge payments during the past year. The first recipient, Arthur Fisher, entered the Nicholas School this fall to study resource ecology.

Fisher is a 2001 graduate of Dartmouth. Excellent academic recommendations reflect his intelligence, scholarship, strong work ethic, independent thinking and commitment. At Dartmouth, he was selected from among a competitive pool of applicants to study in Africa where he conducted research and lived in the African bush. An experienced field researcher, he spent the summers of 2000 and 2001 on Mount Rainier. More recently, he worked for the California Department of Fish and Game where he has done complex field surveys, earning the comment from a supervisor that “he did an excellent job of analyzing and preparing a summary of the information.”

Most recently, Fisher was an environmental and outdoor educator teaching a coastal communities program to children at the Don Lee Center in Arapahoe, N.C. Arthur said that he is interested in the interrelation of species and in the relationship of humans to these natural communities. “I believe that a Nicholas School education will give me the foundation I need to begin a career in environmental management, whereby I can use my knowledge of ecosystems to conserve the earth’s wildlife while still allowing humans to meet our resource needs.”

Much like Fisher, applicants to the Nicholas School of the Environment come from diverse backgrounds and are among the most highly qualified and promising students. Competition among schools for the best students is steadily increasing and financial aid is often the deciding factor for prospective students. Cynthia Peters, director of enrollment services, said, “Increasing educational costs and substantial undergraduate debts often impact a student’s academic and career decisions. The generosity of the Christensen Scholarship is one way to alleviate a constraint that might otherwise push a student to select another school or career.” One of the highest priorities for the Nicholas School in the Campaign for Duke is to increase resources for student financial aid. “Awards of $2,500 to $5,000 per year can often persuade a student to matriculate at Duke rather than at a competitive peer institution. Our impact on the nation’s environmental problems will be greatest if we can continue to enroll the best and brightest.”

For additional information about scholarships, fellowships or other funding opportunities, contact Anita Brown, director of major gifts, at 919-613-8029 or anita.brown@duke.edu.
Gift Club Members Enjoy Second Beaufort Experience Weekend

More than 50 Gift Club members and their families joined faculty and staff at the Duke Marine Lab on July 19-21 for the second annual Beaufort Experience Weekend. Activities included a dinner reception with faculty on Friday night, presentations by faculty and students on Saturday morning, a field trip to Cape Lookout and trawling with Professor William Kirby-Smith aboard the R/V Susan Hudson on Saturday afternoon, and a seafood feast on Saturday evening. The weekend was topped off with a farewell brunch on Sunday morning.

Presentations by Stephen A. Toth, Professor Larry Crowder and doctoral candidate Damon Gannon were highlights of the weekend according to many guests. “My stepson, Capt’n ‘Bucky’ Trujillo, spent many years as a commercial fisherman,” said James E. Lee T’51 MF’52. “Both of us were fascinated by the Lab’s latest research on sea turtles and dolphins. It was a new perspective on some of the issues facing the fishing industry. We both learned a lot and enjoyed the weekend tremendously.”

Children’s activities included a special tour of the Duke Marine Lab led by Dana Wusinich MEM ’02, a discussion of swordfish, sharks and sailfish in the Marine Lab’s collection, and fun in the sand and surf at Cape Lookout. “Going out on the boat and the sea turtle talk were my favorite things,” reported Carl Ward, age 9. “Body surfing with Dr. (Michael) Orbach was mine,” said Laura Brown, age 10.

The Beaufort Experience Weekend is one of the ways we say ‘thanks’ to the school’s many friends who support the Annual Fund at a Gift Club level,” said Associate Dean Peggy Glenn. Gift Club memberships range from $500 to $25,000 and provide support for fellowships, lab supplies, software and student research. Young alumni are eligible to join the Korstian or Pearse societies at a special rate of $100.

“The best part of my Duke experience was the semester I spent at the Marine Lab. It was great to be able to share this experience with my wife and children,” said Dr. Scott Litofsky T’81.

The next Beaufort Experience Weekend will be held July 25-27, 2003. For more information, contact Carol Dahm at cdahm@duke.edu or 919-613-8001.
Duke University Gift Club Levels

William Preston Few Association
President’s Executive Council
$25,000 Minimum Gift

President’s Council
$10,000 Minimum Gift

Few Associates
$5,000 Minimum Gift

Washington Duke Club
Washington Duke Club Fellow
$2,500 Minimum Gift

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$1,000 Minimum Gift

Washington Duke Young Alumni Member
Duke University
Undergraduates 5-9 years post-graduation may join for $300. Duke University undergraduates 0-4 years post-graduation may join for $100.

Clarence F. Korstian Society
$500 or more to the Nicholas School of the Environment

A.S. Pearse Society
$500 or more to the Duke University Marine Laboratory

Nicholas School Gift Club Benefits
In gratitude for the financial support provided to the Nicholas School by gift club members, we offer these tokens of our appreciation in addition to benefits provided by the university.

William Preston Few Association
• Invitation to special lecture and dinner in Washington, D.C.
• Invitation to Beaufort Experience Weekend
• Annual synopsis of faculty publications
• Nicholas School bookmark
• Luggage tags
• Listing in Dukenvironment Magazine

Washington Duke Club
• Invitation to Beaufort Experience Weekend
• Annual synopsis of faculty publications
• Nicholas School bookmark
• Luggage tags
• Listing in Dukenvironment Magazine

Korstian and Pearse Societies
• Invitation to Beaufort Experience Weekend
• Annual synopsis of faculty publications
• Nicholas School bookmark
• Luggage tags
• Listing in Dukenvironment Magazine

Nicholas School Young Alumni Member
Individuals who have graduated from the Nicholas School of the Environment in the last four years may join the Korstian or Pearse Society for $100.

**did you know?**

- that it would require $12 million in endowment funds to produce the $625,000 that the Annual Fund will provide to the Nicholas school in 2002-2003?
- that the Annual Fund provides more than $375,000 in tuition assistance to students each year?
- that the Annual Fund benefits every level of the school from field trips for undergraduates, to conference travel for graduate students, to special career workshops for professional students?
- that it will take gifts from more than 2000 alumni, parents, and friends for the school to reach its Annual Fund goal in the 2002-2003 academic year?

“The Annual Fund provides the discretionary support the school needs to attract the best students, to offer special programs and to react quickly to unanticipated opportunities. I hope every graduate, every parent and every friend will join me in supporting the Annual Fund before June 30, 2003,” said Dick Heintzelman MF’69, chair of the school’s Annual Fund. “We are in tough economic times, and every gift will make a difference.”
The Nicholas School of the Environment and Earth Sciences wishes to thank all of the alumni, parents and friends who generously contributed to the Nicholas School and to the Annual Fund from July 1, 2001 through June 30, 2002. Annual Fund gifts are also included in the Nicholas School goal for The Campaign for Duke.

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CAMPAIGN HONOR ROLL

The Nicholas School of the Environment and Earth Sciences wishes to acknowledge the extraordinary generosity of its alumni, parents, friends and members of its volunteer leadership boards. As of September 27, 2002, the School had reached the $58 million mark toward its goal of $60 million. This list recognizes gifts totaling $1,000 or more made to the Nicholas School and the Duke University Marine Laboratory since the start of the Campaign for Duke through July 15, 2001.

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The Nicholas School greatly appreciates the generous donations from all its supporters. In order to conserve paper and resources, all gifts in this category can be viewed online at: www.env.duke.edu.

Thank you for your continued support of the Nicholas School.

Every effort was made to ensure the accuracy of our Honor Roll. We regret any errors or omissions that may have occurred and ask that you bring them to our attention immediately by calling Carol Dahm at 919-613-8001 or e-mailing her at cdahm@duke.edu

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Nov. 13, 2002
Revelle Lecture by Michael K. Orbach, director, Duke Marine Lab
National Academy of Sciences
Washington, D.C.
Contact: Belinda Williford, (252) 504-7508 or bbw@duke.edu or www4.nationalacmies.org/DELS/osb.nsf/web/Event002

Ronald Perkins Lecture Series
"Is the World Running Out of Oil? An Assessment of Global Oil, Gas and NGL Resources"
By Thomas S. Ahlbrandt, U.S. Geological Survey
4 p.m., Love Auditorium
Levine Science Research Center
Contact: Rita Baur, (919) 613-8003 or rbaur@duke.edu

Nov. 20-21, 2002
Duke University Environmental Leadership Forum
"Dealing with Disasters: Prediction, Prevention and Response"
Contact: Kathryn Saterson, (919) 613-8080 or saterson@duke.edu

Dec. 2-13, 2002
U.S. Forest Service PASS Training Seminar
Presented by the Office of Continuing and Executive Education
Levine Science Research Center
Contact: Sara Ashenburg, (919) 613-8063 or sea3@duke.edu

Jan. 13-17, 2003
Preparing and Documenting Environmental Impact Analyses
Presented by the Office of Continuing and Executive Education for National Guard
Levine Science Research Center
Contact: Sara Ashenburg, (919) 613-8063 or sea3@duke.edu

Feb. 14, 2003
Duke/Yale Career Fair
Washington, D.C.
Contact: Karen Kirchoff, (919) 613-8016 or kgki@duke.edu
Or www.env.duke.edu/duke_yale_fair

March 11-13, 2003
Biotechnology and Environmental Regulation
Presented by the Office Continuing and Executive Education
Levine Science Research Center
Contact: Sara Ashenburg, (919) 613-8063 or sea3@duke.edu

April 11, 2003
Forestry Forum and Presentation of Ralston Award
Levine Science Research Center
Contact: Krista Bofill, (919) 613-8035 or k.bofill@duke.edu

April 11-13, 2003
Alumni Reunion Weekend
Contact: Krista Bofill, (919) 613-8035 or k.bofill@duke.edu
Or www.dukealumni.com, and click on Reunions

April 12 & 13, 2003
Nicholas School Alumni Council Meeting
Contact: Krista Bofill, (919) 613-8035 or k.bofill@duke.edu

April 12, 2003
Global Change: The Fiction, the Facts, the Future
Featuring Dean William H. Schlesinger
Love Auditorium
Levine Science Research Center
Contact: Krista Bofill, (919) 613-8035 or k.bofill@duke.edu

Field Day
Duke Forest
Contact: Krista Bofill, (919) 613-8035 or kbofill@duke.edu

May 11-14, 2003
American Association of Petroleum Geologists Annual Meeting
Salt Lake City, Utah
Contact the AAPG: (800) 364-2274 or convene@AAPG.org

Duke University Alumni Reception
AAPG
Salt Lake City, Utah
Contact: Rita Baur, (919) 613-8003 or rbaur@duke.edu

May 10-11, 2003
Commencement Weekend
Duke University

May 15, 2003 (tentative date)
National Geographic Society Dinner and Lecture For Nicholas School and Duke Marine Lab members of William Preston Few Association
Washington, D.C.
Contact: Rita Baur, (919) 613-8003 or rbaur@duke.edu

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