Fighting the War Against Climate Change

Lessons From Duke Forest

Global Fellows @ The Marine Lab
COVER STORY
04 'THE SCIENCE IS THERE. THE NUMBERS ADD UP. THIS IS DOABLE.'
Drew Shindell Sees Real Opportunity for Us to Make Progress on Global Warming, Air Pollution and Food Security if We Work Smarter
Global view of black carbon on September 26, 2009. NASA/Goddard Space Flight Center Scientific Visualization Studio The Blue Marble Next Generation data is courtesy of Reto Stockli (NASA/GSFC) and NASA’s Earth Observatory.
THE SCIENCE IS THERE. THE NUMBERS ADD UP.
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DREW SHINDELL SEES REAL OPPORTUNITY FOR US TO MAKE PROGRESS ON GLOBAL WARMING, AIR POLLUTION AND FOOD SECURITY IF WE WORK SMARTER

BY TIM LUCAS
DREW SHINDELL IS A MAN ON A MISSION
Since 2011, he’s been leading the charge to promote a new, more winnable approach to fighting the war against climate change.

In a series of landmark studies and assessment reports, he’s shown that by aggressively curbing emissions of methane, black carbon and other potent short-lived climate pollutants (SLCPs) in addition to much longer-lived carbon dioxide, we could slow the rate of global warming by half over the next several decades and save 45 million lives.

“Short-lived climate pollutants are the low-hanging fruit of the climate world. They remain in the atmosphere for only a brief time but account for as much as 30 to 40 percent of the total short-term rise in global temperatures,” says Shindell, who joined the Nicholas School faculty as professor of climate sciences in 2014.

Expanding our mitigation strategies to target these short-lived drivers of global warming makes sense economically, politically and in terms of human health, he says.

Air pollution linked to SLCPs is the leading environmental cause of premature death. Reducing our exposure to these pollutants, particularly soot and other particles, would annually save up to seven million lives worldwide and improve respiratory and cardiovascular health for tens of millions of people. It would prevent 180,000 non-fatal heart attacks, 18 million missed work days and 11 million missed school days in the United States alone.

Curbing emissions that lead to tropospheric ozone, another potent SLCP, would boost agricultural economies and enhance food security for millions of people by increasing global crop yields by about 1 billion metric tons a year.

These gains could send skeptics and vacillating world leaders a message that meaningful progress is possible, and perhaps set an example that helps us tackle more persistent carbon dioxide.
Many of the technologies and tools needed to reduce SLCP emissions already exist or could be developed and scaled up for widespread use at a fairly modest cost, Shindell stresses. Emissions of black carbon, or soot, can be reduced through measures as simple as installing filters on diesel engines, replacing inefficient cookstoves, and banning the open burning of agricultural waste. Methane can be reduced through retrofits or upgrades to existing emissions-control technologies where most leaks occur: oil and gas wells, leaky pipelines, municipal landfills and wastewater treatment plants. Many of these actions pay for themselves, as the captured methane can be used for energy.

Quantifying and communicating the benefits of this integrated approach to climate change and air pollution has become a core focus of Shindell’s scholarly output. In addition to his ongoing research, he chairs the scientific advisory panel to the international Climate and Clean Air Coalition, chaired the 2011 Integrated Assessment of Black Carbon and Tropospheric Ozone by the UN Environment Programme (UNEP) and World Meteorological Organization, and was a coordinating lead author of the key chapter on anthropogenic and natural radiative forcing in the 2013 Fifth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC).

He’s also testified on climate change and air quality before both houses of Congress, the World Bank and the United Nations Framework Convention on Climate Change.

“The point I’m trying to drive home is that by working smarter we have a real opportunity to make progress on three critical issues: global warming, air pollution and food security,” he says. “The science is there. The numbers add up. This is doable.”

A PHYSICIST IN SEARCH OF PURPOSE

Although it’s too early to gauge its full impact in science and policy circles, Shindell’s call to action appears to have struck a chord. As a result of his leadership, the 2013 IPCC report shifted focus from measuring the causes of climate change in terms of concentrations of greenhouse gases in the atmosphere to including emissions of all climate pollutants.

Membership in the Climate and Clean Air Coalition—which was founded in 2012 in direct response to the UNEP report Shindell chaired and a related paper he published in *Science*—has grown from its initial roster of six nations to a current roster of 44 nations and 54 nongovernmental organizations, including big guns like the World Bank and World Health Organization.

“This has been the most direct link from science project to policy initiative that I’ve ever been part of,” he says. “I’m honestly floored.”

He shouldn’t be.

With more than 170 peer-reviewed papers and dozens of high-profile assessment reports, invited testimonies, book chapters and keynote presentations to his credit over the last two decades, Shindell is arguably one of the most influential voices in climate science and atmospheric chemistry today.

His discipline-blending work has reshaped scientists’ understanding of the natural and human drivers of climate change and air quality and how they interact.

NASA, the National Science Foundation, the American Geophysical Union, the American Association for the Advancement of Science and other leading agencies and organizations have all bestowed high honors on him for his contributions to climate research and outreach.

All things considered, it’s not a half-bad list of honors and accomplishments for someone who once looked down his nose at environmental science, and applied science in general.

“I only got into environmental research by coincidence,” Shindell admits with a laugh.

Growing up in 1970s in the East Bay region of California, a short drive from San Francisco and Berkeley, he was aware of the growing interest in the environment occurring all around him but didn’t see a future in it, at least not for him.

“I preferred the intellectual challenge of physics,” he says.
The connection between physics and the environment, and basic and applied sciences, didn’t crystalize for him until he was an undergrad at the University of California-Berkeley and took part in a research project studying a deadly gas eruption in Lake Nyos, one of two so-called “killer lakes” located in the central African nation of Cameroon.

In 1986, a large gas cloud erupted unexpectedly from volcanic Nyos, giving off large amounts of carbon dioxide that suffocated more than 1,700 people in surrounding villages. Shindell and the other members of the Berkeley team were tasked with explaining why the eruption had occurred with no advance warning, and what could be done to improve scientists’ ability to predict similar eruptions in the future.

“Applying physics to the study of such an event intrigued me,” he says. “It showed that environmental applications were relevant and interesting.”

After finishing his bachelor of arts in physics at Berkeley in 1988, he began doctoral studies in physics at the State University of New York at Stony Brook and spent the summer of 1989 conducting research on fundamental physics at the nearby Brookhaven National Lab synchrotron.

It was a life-changing experience. Just not in the way he anticipated.

“It was fascinating from an intellectual perspective, but by summer’s end I realized I didn’t want to spend the next few decades of my life doing something so esoteric,” he says. “I started looking for something more applied.”

A group of other physicists at Stony Brook had recently begun exploring the complex chemistry responsible for the ozone hole over Antarctica. Reviewing their work, Shindell realized he could help shed light on what was going on by building a model that would help the scientists better understand the measurements they were taking of ozone-depleting chemicals in the atmosphere. He joined the team.

“There was a chance to apply my work in a way that had clear benefits to society and involved travel,” he says. “I was in!”

His newfound focus took him to Antarctica three times and northern Greenland twice and became the basis for his doctoral thesis, for which he developed a photochemical model that calculated changes in atmosphere chemistry by comparing measurements of ozone depleters and ozone itself.

After graduating in 1995, he was hired by the NASA Goddard Institute for Space Studies at Columbia University to integrate his atmospheric photochemistry model into a climate model recently developed by NASA scientists.

“Back then, most climate models had no atmospheric chemistry whatsoever,” he explains. “Scientists knew ozone and other shorter-lived chemicals in the atmosphere affected climate, but the two areas of study had always been viewed as separate. We were just starting to realize we needed a more integrated understanding.”

For Shindell, it was a case of being in the right place at the right time, with the right skill set.

ANSWERING THE SKEPTICS

Major papers soon followed, including two seminal works published one month apart in 1999.

The first study, published in March in Nature, revealed that the greenhouse effect from burning fossil fuels was affecting weather and stratospheric wind patterns over the northern hemisphere more than previously thought, partially as a result of chemical processes. This was causing dramatic regional shifts in median temperatures. Some Arctic regions such as Greenland were warming during winter at a rate nearly 10 times that of the global average.

The second study, published in April in Science, showed that the interaction of increased solar activity and anthropogenic chemicals in the upper atmosphere also affected wind patterns and caused regional climate shifts.

Taken together, the two studies yielded strong new proof that increased emissions of manmade pollutants in Earth’s atmosphere were inextricably linked to climate change, especially on regional scales.

What the studies didn’t prove was equally important, Shindell stresses. Neither study found evidence to support skeptics’ claims that increased solar
activity or natural variability was the primary driver of global temperature increases.

“Our model clearly confirmed that greenhouse gases were playing the dominant role,” he says.

A third paper, published in Science two years later, built on this foundation and, in the process, took aim at one of the denier camp’s most oft cited objections to mainstream climate change theory: the Little Ice Age of the 17th century.

“During the Maunder Minimum, or the so-called Little Ice Age, there were almost no sunspots, and it got really cold in the eastern United States and Europe. This was the only time in recorded history that New York harbor froze over completely,” Shindell explains.

In 1998, however, when climatologist Michael Mann and two colleagues published their now-famous large-scale reconstruction of Earth’s climate dating back to the year 1400, their model showed only slight changes in climate during the 17th century.

The only major global temperature flux reflected in the model was rapid warming in the modern era, represented by a short, sharp upward spike at the end of a long, relatively flat line of temperature averages, giving the model a shape that vaguely resembled a hockey stick.

The following year, Mann and his team published a revised large-scale reconstruction dating back to 1000. Once again, it showed only slight changes during the 17th century. To compound matters, the new model also showed only a modest change during a time prior to 1250 known as the Medieval Warm Period.

Critics pounced. The flaws in Mann’s reconstruction were proof that climate data were unreliable, they claimed. And the so-called “hockey stick controversy” was born.

With the credibility of climate data at stake, Shindell decided to weigh in. With Mann as one of his co-authors, he ran his own model, which included the impact of atmospheric chemistry. It confirmed that the reduced solar output of the 17th century, combined with chemical feedback in the atmosphere—ozone—caused major regional climate changes but not a big overall change in global patterns.

Europe and parts of North America got colder, but other areas, including Africa and Australia, showed no major cooldown.

“This is why Mann’s large-scale reconstructions showed only slight global changes,” Shindell says. “It was a major finding, not only to validate Mann’s work and the agreement between climate data and models in general, but also to show that atmospheric chemistry played a much larger role than previously thought in affecting climate change, and that regional changes could be large even if global change was slight.”

The success of the paper, which has since been cited in nearly 570 other peer-reviewed studies, spurred Shindell to turn his sights to an even bigger challenge.

“The question I wanted to answer next was: Why do some regions change in one way, while others don’t? That was not well understood at all, but it was clearly crucial,” he says.

**AN INTEGRATED APPROACH**

To unearth the answer, Shindell began to study tropospheric chemistry and the interactions of all SLCPs, not just ozone.

The more he discovered about the uneven distribution of SLCPs in the troposphere, their uneven contributions to anthropogenic forcing, and how they interact with longer-lived greenhouse gases like carbon dioxide, the more certain he grew that it was neither logical nor efficient to segregate climate change and air pollution as separate problems.

“Through my work with UNEP, the U.S. Climate Change Science Program and other initiatives, I was coming into contact with medical and agricultural researchers and economists who were studying the broader health impacts of air pollutants,” he says. “It became clear that we were not dealing with global

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warming or air pollution, it was global warming and air pollution. They were directly related and we had to attack them as one.”

Working with these experts from other fields, Shindell expanded the focus of the assessment report he was chairing for UNEP.

“We quantified health impacts, we quantified crop yield impacts and we quantified climate impacts. It was like preparing a menu ready-made for policymakers,” he says. “We showed that we had 16 measures through which we could demonstrate that there were multiple benefits of reducing short-lived climate pollutants.”

UNEP published the assessment report in 2011 and founded the Coalition for Climate and Clear Air the following year to achieve the objectives Shindell and his colleagues had set forth. By 2013, the IPCC had shifted its focus as well.

Shindell’s mission to promote an integrated approach to climate change and air quality had reached critical mass.

But he’s not slowing down anytime soon.

Since joining the Nicholas School faculty last summer, he’s presented a policy talk about the benefits of SLCP reductions to delegates at COP15 in Lima, Peru, at the invitation of the U.S. State Department. He’s testified before Congress to support passage of the Super Pollutants Act of 2014, which would provide financing to help underwrite costs associated with emissions reductions. And he’s written another major research study.

The newest study, published in Climatic Change in February, calculated the true costs of our energy choices once the full environmental and health damages associated with their emissions are figured in.

Among other eye-opening findings, the study showed that a gallon of gasoline should cost around $3.80 more a gallon than we currently pay, the cost of heating our homes with natural gas should more than double; and the cost of our monthly bills for coal-fired electricity should more than quadruple. Solar and wind power, by contrast, are cheap.

“This builds on everything I’ve ever worked on: climate change and air quality, agriculture and human health, SLCPs and carbon dioxide. And it brings it down to a ground-floor policy-relevant level,” he says.

When he’s not working, Shindell, 48, likes to unwind by playing strategy games with his wife Miriam, a psychologist, and their three children: Cary, 15; Oliver, 12; and Leah, 6.

He also enjoys a good run. “Preferably something from a 5K up to maybe a half-marathon,” he says. “At those distances, it’s not all about speed or endurance. It’s a balancing act. You have to pace yourself and know when to kick it in.”

Tim Lucas is senior writer for Duke environment magazine and is the Nicholas School’s director of marketing communications.
NEW FOREST FINANCE INITIATIVE

AIMS TO TRAIN STUDENTS TO BE AS ADEPT AT FINANCIAL ANALYSIS AS THEY ARE AT RESOURCE MANAGEMENT

by Tim Lucas

Over the past 30 years, Duke forestry graduates have played leading roles in transforming how private forests in the United States are managed and valued for both timber and conservation objectives.

An innovative new initiative being developed at the Nicholas School aims to give current and future students the skills they’ll need to continue providing leadership for generations to come.

The Forest Finance Initiative will include new masters-level courses, a certificate program, student internships and scholarships, executive education courses and a speaker series.

Students accepted into the program will be trained in a broad array of skills critical to forest management today, including forest valuation, income opportunities through ecosystem services, how to structure conservation easements, investment fund structuring, risk assessment, financial reporting, and tax considerations.

The four-course certificate program is tentatively slated to begin in 2016. Individual courses in forest finance may be offered starting this fall.

“By summer, we plan to form a search committee and start recruiting a new faculty member, a chaired professor of the practice in forest finance, to head the program,” says Jeffrey R. Vincent, Clarence F. Korstian Professor of Forest Economics and Management.

Vincent is working with Nicholas School Dean Alan R. Townsend, members of the Duke faculty, Duke alumni, forest industry and conservation professionals, and the Nicholas School Office of External Affairs to develop the initiative.

Some of the program’s components are already in place, he notes. A Duke Environmental Leadership Program executive education course on timberland investment was first offered last year and proved to be very popular. A new speaker series, featuring some of the world’s top experts in forest management and environmental markets, was launched this spring. And forest alumni have been assisting with internship placements.

The new initiative is being developed in response to growing global demand for a new breed of forest managers, Vincent explains.

“Private forests increasingly are managed by timberland investment management organizations and real estate investment trusts, whose business models reflect a broad concept of forest finance,” he says. “They’ve realized that, compared to the stock market, returns on timber production are steady and not very risky, and potentially can be bolstered by payments for carbon storage, watershed protection and other ecosystem services.”

The creation of forestland as a new asset class and the emergence of new environmental markets has spurred demand for forest managers who are as adept at financial analysis as they are at resource management.

“Until now we haven’t trained master’s students in both skill sets,” Vincent says. “This is the perfect time to do it, given the need for professionals with these skills, and the growing interest in finance as a distinctive area of focus for the Nicholas School in the case of not only forests but also water and energy.”

The new certificate program and courses will be open to Nicholas School Master of Environmental Management and Master of Forestry students, as well as students pursing master’s degrees in related fields at other Duke professional schools.

For information about the new Forest Finance Initiative, contact Vincent at jeff.vincent@duke.edu or (919) 613-8025. See related stories on pages 26 and 34.

Tim Lucas is senior writer for Dukeenvironment magazine and the Nicholas School’s director of marketing communications.
Last fall our inaugural I am Duke Environment photo contest received a whopping 242 entries from faculty, staff, students, alumni, donors and Board of Visitors members. Narrowing down our selection to six winners was an incredibly difficult task because of the great images and the quotes that accompanied them. Check out the school’s website (nicholas.duke.edu/iamdukeenvironment), our Facebook page (facebook.com/DukeEnvironment) or our Flickr site (flickr.com/photos/nicholasschoolatduke) to see winners from the spring contest.

I am Duke Environment is an ongoing photo social media campaign sharing the faces and voices of Duke’s Nicholas School.

Charlotte Nuñez-Wolff has joined the Nicholas School as its first senior associate dean for finance and administration.

Nuñez-Wolff comes to the Nicholas School from the University of North Carolina at Chapel Hill’s Gillings School of Global Public Health, where she had been associate dean for business and administration and treasurer of the UNC Public Health Foundation since 2008. Prior to that post, she held a variety of top administrative positions at Duke, including serving six years as associate dean for resource planning at the Duke School of Medicine, and four years as director of general administration and finance at the School of Divinity.

“Charlotte brings an extraordinary range of skills and experience to this new position, and a wonderful energy for the job and the mission of our school,” says Dean Alan R. Townsend. “We are fortunate to have her join our ranks.”

As senior associate dean for finance and administration, Nuñez-Wolff oversees the Nicholas School’s senior staff leadership team and the operating budget and serves as primary advisor to the dean on administrative and business matters, including finance, human resources, facilities management, and instructional and information technology. In addition she works closely with Dean Urban, senior associate dean for academic initiatives. Dean Townsend created the new senior administrative position in 2014 and appointed Nuñez-Wolff to the post following a national search.

Nuñez-Wolff earned an EdD in higher education management from the University of Pennsylvania in 2007, an MA in liberal studies from Duke in 1999, and a BA from UNC-Chapel Hill in international studies in 1990.
NEW MODEL HELPS BOOST FISHERY PROFITS AND SUSTAINABILITY

By identifying the most efficient fishing practices and behaviors, a new model developed by economists at Duke University and the University of Connecticut could help fishermen land larger paychecks while reducing the risk of fishery depletion.

“We’re not talking about a trivial improvement. In some cases, we found that identifying the most efficient practices led to a 20 percent annual increase in total revenues if the fishery is managed differently,” says Martin D. Smith, professor of environmental economics at Duke’s Nicholas School.

“Under perfect conditions, you could see up to a 49 percent increase in profits,” he says.

The empirical bioeconomic model developed by Smith and Ling Huang, assistant professor of economics at the University of Connecticut, is the first of its kind. It was created using six years of previously unavailable fine-scale fishing data from the North Carolina shrimp fishery.

WETLANDS

MORE VULNERABLE TO INVASIVES AS CLIMATE CHANGES

In the battle between native and invasive wetland plants, a new Duke University study finds climate change may tip the scales in favor of the invaders—but it’s going to be more a war of attrition than a frontal assault.

“Changing surface-water temperatures, rainfall patterns and river flows will likely give Japanese knotweed, hydrilla, honeysuckle, privet and other noxious invasive species an edge over less adaptable native species,” says Neal E. Flanagan, visiting assistant professor at the Duke Wetland Center, who led the research.

Increased human disturbances to watersheds and nutrient and sediment runoff into riparian wetlands over the coming century will further boost the invasive species’ advantage, the study found.

“It’s death by a thousand small cuts. Each change, on its own, may yield only a slight advantage for invasive species, but cumulatively they add up,” says co-author Curtis J. Richardson, director of the Duke Wetland Center and professor of resource ecology at Duke’s Nicholas School.

If left unchecked, over time these changes will reduce the diversity of plants found in many wetlands and could affect the wetlands’ ability to mitigate flooding, store carbon, filter out water pollution and provide habitat for native wildlife, the authors say.

The scientists published their peer-reviewed findings in the Dec. 8, 2014, issue of the journal Ecological Applications.

The study, funded by the U.S. Environmental Protection Agency (EPA), is the first large-scale field experiment to simulate how future environmental changes linked to global warming and land-use change will affect plant communities in major river systems in the U.S. Southeast.

It was conducted using plant species and biomass surveys, continuous real-time measurements of water levels and water temperatures, and statistical modeling of long-term plant abundance and growing conditions at 24 riparian floodplain sites in North Carolina and Virginia over a three-year period.
fishery, provided to the researchers by the North Carolina Division of Marine Fisheries. “Every single vessel that went out was tracked—what it caught, when it fished, what price it sold its catch for, and what equipment was used,” Smith says. “We also tracked daily weather conditions, fuel prices, fishery closures and other external factors that affect fishermen’s decisions of whether to fish or not.”

Smith and Huang analyzed the flood of data using recently developed econometric modeling techniques to identify which individual fishing practices and decisions led to profitable and sustainable catches, and which led to low returns and overexploitation.

The results yielded some surprises. “Conventional wisdom says that congestion—having too many boats out at the same time—is bad because it makes it harder for individual fishermen to catch at the level they’re used to, so profits drop,” Smith says. “We found this is true in the short run, but there’s a potential long-term benefit fishery managers may be overlooking.

“When people’s profits drop due to congestion, they tend to fish less. This means more of the shrimp left in the water get to grow to larger sizes and can be harvested later in the season for higher prices,” he says. “So in some cases, congestion can actually increase potential late-season profits and reduce the risk of fishery depletion.”

Smith and Huang’s study focused primarily on the open-access N.C. shrimp fishery, but insights from it could help improve how other fisheries are managed as well.

“We’re leaving substantial profits on the table due to the way we’re managing many fisheries,” Smith says. “The standard one-size-fits-all management approach of allocating sustainable catch limits to individual fishermen on an annual basis is not universally efficient. In some cases, it’s actually counterproductive because it forces fishermen into a ‘race to fish’ early in the season that leads to falling profits and overexploitation.”

The key to avoiding this, Huang says, is to match the management approach of each individual fishery to the daily, fine-scale dynamics of its fishermen, its seasonal patterns, and the life history of the species being harvested.

“Our analysis shows there’s a sweet spot between having too much bureaucracy—such as daily quotas—and too little. That’s the spot we have to hit if we want to maximize profits and sustainable catches,” she says. “To get there, you have to dig down to the fine scale.”

Smith and Huang published their study in the Dec. 3, 2014, issue of the peer-reviewed journal American Economic Review. Funding came from the NOAA Center for Sponsored Ocean Research. Huang is a former student of Smith’s. She earned her PhD in environmental economics from Duke in 2009.

The Intergovernmental Panel on Climate Change (IPCC) projects that surface-water temperatures in the Southeast will increase by 1 to 5 degrees Celsius by the year 2100. Increased evaporation will reduce surface water base flows, while a 5 percent to 30 percent increase in precipitation, mostly in the form of intense storms, will cause pulsed hydrology—sudden, short-term rise—in water levels.

As these changes occur, the annual timing of when wetland soils warm up in spring will fluctuate and may no longer be synchronized with when river levels drop, Flanagan says.

This desynchronization will affect all floodplain plants, but the natural phenotypic plasticity of invasive species allows them to adapt to it better than native species, which need both exposed soil and warmer temperatures to germinate.

As native species’ germination rates decline, invasives will move in and fill the void, their increased abundance fueled by high levels of nutrients flowing into the wetlands in runoff from upstream agriculture and other disturbances.

These findings underscore the need for us to better understand the interaction between climate, land use and nutrient management in maintaining the viability of native riparian plant communities,” Richardson says.

“What makes this study so novel is that we used a network of natural, existing riparian wetlands to simulate the long-term impacts of IPCC-projected changes to water temperature and flow over the coming century,” Richardson adds.

Eighteen of the 24 wetlands used in the study were located downriver from dams or power plants built at least 50 years ago, he said. Ten of these wetlands were classified as warm sites, because water discharged back into the river by the upstream dam or power plant was heated by steam turbines or pulled from higher in a reservoir, where water temperatures were warmer.

Eight wetlands were classified as cold sites because the upstream dams pulled their outflow water from deeper in reservoirs, where temperatures were more than 5 degrees Celsius cooler than at warm sites.

“This allowed us to simulate the effect of long-term changes in water temperatures on native and invasive species abundance,” Richardson says. All 18 dams regulated their outflow of water, allowing the team to simulate the effects of projected lower base flow and increased storm flows. Six wetlands in the study were located on undammed rivers and served as control sites.

Mengchi Ho, associate in research at the Duke Wetland Center, also co-authored the study, which was funded by the EPA’s Science to Achieve Results (STAR) program.
Diversity and inclusion are central to the mission of any school, but especially a school of the environment, says Glenda Lee, assistant director of alumni affairs at the Nicholas School. “We live in a multicultural world. By mid-century, America is going to be a minority majority. The message we’re hearing from employers is that if we don’t get more people of color and from diverse backgrounds on our team, the environmental profession might go the way of the horse and carriage,” says Lee, who co-chairs the Nicholas School Diversity and Inclusion Committee.

The school is responding to this challenge with a new, more strategic approach to how it recruits and trains students, faculty and staff, she says. “Diversity has always been a high priority, but now we’re working smarter.” A big part of the new school-wide push is partnering with other conservation and environmental groups to leverage one another’s strengths. “For example, we’re now partnering with Conservation Trust North Carolina, which has a very successful diversity internship program that attracts hundreds of qualified applicants each year for 15 spots,” Lee says. “We’re developing a way to introduce their applicants to the programs and opportunities we offer, including by hosting professional development and recruitment workshops for them at the school.”

The Nicholas School’s Marine Science and Conservation Division—which recently received a prestigious Graduate School Dean’s Award for Inclusive Excellence in Graduate School Education for its leadership in diversity and inclusion—will host the students at the Duke Marine Lab in Beaufort this year, Lee says. In coming years, other units or divisions within the school will have the opportunity.

Other innovative diversity partnerships and initiatives being offered or developed at the Nicholas School include:

• A Duke Immerse student-exchange program on urban environmental justice and social entrepreneurship with Paul Quinn College, a historically black college in Dallas, Texas;
• Rising TIDE, a 20-hour diversity and inclusion training module for masters and PhD students;
• Pipeline, an outreach program to introduce K-12 students from diverse backgrounds to Nicholas School programs.

Pollution in urban and farm runoff in Hawaii is causing tumors in endangered sea turtles, a new study finds.

The study, published in the peer-reviewed open-access journal *PeerJ* last fall, shows that nitrogen in the runoff ends up in algae that the turtles eat, promoting the formation of tumors on the animals’ eyes, flippers and internal organs.

Scientists at Duke University, the University of Hawaii and the National Oceanic and Atmospheric Administration (NOAA) conducted the study to better understand what causes the tumor-forming disease Fibropapillomatosis, which is the leading known cause of death in green turtles, says Kyle Van Houtan, adjunct associate professor at Duke’s Nicholas School. “We’re drawing direct lines from human nutrient inputs to the reef ecosystem, and how it affects wildlife,” says Van Houtan, who is also a scientist in NOAA’s
Turtle Research Program.

This research builds on a study published in 2010 that found the disease was more prevalent in areas with high levels of nitrogen runoff. That study hypothesized the disease might be linked to how algae that the turtles eat store extra nitrogen.

"In this paper we drill down on whether excess nitrogen inputs are causing a nutrient cascade in the system that is ending up in these tumors in green turtles," says Van Houtan.

One way that algae store excess nitrogen is in an amino acid called arginine. The researchers found unusually high levels of arginine both in the algae in highly polluted waters and in the tumors of diseased turtles. Arginine levels in algae in less polluted waters and tumor-free tissues were comparatively low.

One non-native red algae species, *Hypnea musciformis*, had especially high levels of arginine compared to other species sampled. *Hypnea* is invasive and thrives in the nitrogen-rich waters caused by nutrient pollution. Since it grows more successfully than native species of algae, it can make up as much as 90 percent of the turtles’ diet.

Because this algae contains so much arginine and the turtles eat so much of it, the turtles have approximately 14 times more arginine in their systems than they would if they were eating native algae species in less-polluted waters, says Van Houtan.

Even worse, the turtles, which are herbivorous, have to eat twice as much of the invasive algae species to get the same amount of calories they would gain from eating native algae.

"The energy and arginine content of (the algae) may therefore act as a sort of one-two punch for promoting this disease," the study notes.

Arginine is thought to promote a virus that leads to the disease that forms the tumors. "If this disease is a car, arginine is its fuel," says Van Houtan. Without it, the virus can’t function. How the virus causes tumors is still unclear, he says.

Arginine is just one of the molecules the researchers measured in the turtle tumors. They also found elevated levels of amino acids that are common in human cancer tumors, such as proline and glycine, Van Houtan says.

Measuring amino acids in the turtle tumors allowed the researchers to better understand how the tumors form and function. Similar analyses of amino acids may also be useful in understanding human cancer tumors, says Van Houtan.

"A hallmark of cancer tumors is that they re-program their host cells and change their metabolism. Our findings here are similar."

The research was funded by a grant from the Disney Worldwide Conservation Fund and a Presidential Early Career Award in Science and Engineering.

Celia M. Smith, Meghan L. Dailer and Migiwa Kawachi of the University of Hawaii at Manoa co-authored the study.

Kari Moore is the student communications assistant for the Nicholas School’s Office of Marketing and Communications.
Sustainability in a World of Change:

LESSONS from THE LAND

BY NORMAN L. CHRISTENSEN
My favorite Duke Forest walk begins at Gate 23 on Mt. Sinai Road and descends to the wooden bridge that crosses New Hope Creek. Seeing the large oaks and pines, many who walk this heavily traveled trail probably assume that the woods that surround them are truly ancient, maybe even primeval. But travelers on this road 150 years ago were surrounded by abandoned and eroded farm fields—a landscape reminiscent of some of the most deforested and impoverished places on our planet.

The history of change that produced that 1865 landscape and the one we see today has much to teach us about sustainable land stewardship.

A Mr. John Patterson was the first person to have formal title to this land (more than 1,000 acres), having received it as a grant from the colonial governor in 1758. But he was by no means the first person to manage this land. Native Americans were already hunting and gathering here 10,000 years ago, in the midst of post-Ice Age climate change. Their numbers may have been sparse, but they had already hunted many large mammals to extinction and altered much forest land with their deliberate use of fire.

Five thousand years later, larger populations of semi-nomadic people were hunting elk, woodland bison and deer in the uplands and cultivating crops such as squash and tomatoes in the floodplains along nearby creeks and rivers. The first Europeans explored this region nearly 500 years ago, and they encountered large numbers of Native Americans. Tens of thousands farmed land near permanent villages. Others hunted and gathered in large expanses of fire-maintained oak savanna. What Patterson and his kin saw when they first traversed their estate were forests and bottomlands shaped by the actions of hundreds of human generations.

Early on, Patterson and most of his neighbors employed a form of shifting agriculture in the context of a subsistence economy. They grew enough to meet their needs, with surplus to trade in nearby towns for the things they could not grow themselves. Small tracts, 3-5 acres perhaps, were cleared—an arduous process given limited human and technological resources. Crop production would be robust for a few years, but would decline after that as soil nutrients were depleted by erosion and harvest. That tract would then be abandoned, and another one cleared and put into production.

In this region fallow land is very quickly re-vegetated naturally by a succession of plant species. Over 2 to 3 years, annual weeds give way to perennial grasses and herbs and the seedlings of shrubs and trees. After 4 to 5 years, those shrubs and trees form a diverse and impenetrable thicket. During these 4 to 5 years, soil organic matter and stores of essential nutrients are restored. Left to its own devices, this thicket will soon develop into a young forest. But at this point in the succession, farmers intervened and re-plowed fallow land to begin another cycle of growth. Fallow farming systems of this kind were sustainable as long as the total amount of land in production was small and fallow cycles were sufficiently long to ensure restoration of soil fertility.

The Patterson family sold this property to William Robson in about 1790 during a major transition in land use in this region. Worldwide demand for agricultural products—most particularly cotton, tobacco and dye stuffs like indigo—was rapidly growing. Technologies such as the cotton gin and mechanized looms allowed the processing of these crops on very large scales. Farm families like the Robsons were likely selling their produce and buying their necessities in fully monetized markets.

These developments vastly altered incentives for land use and stewardship, and they set in motion economic, social and ecological changes that would prove to be truly unsustainable. The fallow farming system was abandoned and declining productivity was countered by putting ever more land into production. The uncertainties associated with regional and global markets reinforced this pattern of deforestation. By 1830, many hundreds of acres of the Robson property were in cultivation. Given available technology, a single family, no matter how large, could not by itself farm that much land.

As we know too well, they accomplished this with slave labor. Slavery had been on the decline in the late 18th century, but this transition to market agriculture greatly increased the demand for and dependence on slave labor. We don’t know the specifics of the Robson’s holdings, but other ownerships of this size depended on the labor of scores of slaves.

By 1860, only 30 percent of the region’s forests remained, and these forest fragments had been severely degraded by livestock grazing and high-graded for fuel wood. An average of 1 to 2 feet of topsoil had been transported from exposed cropland to nearby streams and per-acre productivity was severely reduced. Deep erosion gullies still scar the hillsides in many places along the path to the

I BELIEVE our future will hinge much more on two other traits—the empathy to care for the well-being of others living now and in the future, and the humility to understand our proper place in the world and our dependence on the health and diversity of its ecosystems.

-Norm Christensen
The waters of New Hope Creek that flowed beneath the Wooden Bridge. The effects of this erosion extended well beyond individual farm fields as sediment polluted creeks and rivers, filled in mill ponds and caused the closure of water-driven mills on all but the largest streams.

Sustainability is often likened to a three-legged stool, with the legs representing social, economic and environmental systems and the seat representing the inescapable linkages among these systems. Surely, the changes for the Robsons and their contemporaries, the inexorable downward spiral of dependence on slavery, the diminished production and polluted waterways, and the ever increasing fragility of the economic system validate this tripartite metaphor.

The Civil War and the Reconstruction that followed brought new changes to the land and inaugurated a period of regional economic depression that would extend up to World War II. The Robson land, like that of so many neighbors, was put into foreclosure. Although tenant farming and sharecropping continued in some places, much land was simply abandoned. Most of the land along the Wooden Bridge trail was abandoned between 1870 and 1910, and that fallow succession was repeated once again. Old field weeds were soon replaced with dog-hair thickets of pines. Through time, these pine thickets thinned to respectable forests. When Duke Forest was formally established in 1931, pine stands were about 40 to 60 years old and broadleaved trees—oak, sweetgum, maples and hickories—were prominent beneath them. The waters of New Hope Creek that flowed beneath the Wooden Bridge in 1870 were red with sediment, and flash floods were common. But within a couple decades, the roots of regrowing forest trees and shrubs stabilized fragile soils and mitigated flows. Today, at least at that location, New Hope Creek runs clear and supports a diverse array of aquatic life. The fact that ecosystem change has repaired some of the impacts of those many years of unsustainable land use is reason for hope; but it is also true that no vestige of old-growth forest remains and that it will take many more decades, even centuries, to restore soils to their former productivity.

Rapid change continues on this landscape. Once-rural land is rapidly becoming urban. Forest is being replaced by complex, impervious surfaces like roof tops, parking lots and roads that greatly alter local climate, the quality, quantity and timing of water flows, and wildlife habitat. Is all of this change sustainable? The word “sustainability” is tricky. “To sustain” is defined in many dictionaries as “to keep in existence, to maintain.” To some this implies an idealistic sustainable endpoint—a destination. But if history tells us anything, it is that sustainability is a journey, not a destination, and that journey always occurs in the context of three kinds of change.

First, the world is changing. The capacity for ecosystems to change is essential to their persistence. Forested landscapes and watersheds are constantly being disturbed and constantly undergoing change. Over the long term, change is essential to adaptation and survival.

Second, we are changing. Each generation of human beings brings new technologies and values to the land. My interests and values are very different from those of my parents and grandparents, and the interests and values of my children and grandchildren are no less different from mine. And third, we are changing the world. This has always been true, but today there are more than 7 billion of us, and our individual effects on Earth’s ecosystems are disproportionately magnified by the power of the technologies we employ to garner the things we need or think we need.

We are today agents of unprecedented change. And we are hopeful that nature’s change processes will mitigate our impacts, too. But history provides no guarantee that that will be the case. Our human population has increased over eightfold since the Robsons abandoned their land, and each of us individually consumes 10 times more energy and resources than did the Robsons and their peers. Furthermore, many of our insults to our planet’s ecosystems have no precedent in either historic or prehistoric times.

Sustainability, I would argue, is an inherently anthropocentric concept. For millions and millions of years, Earth’s myriad ecosystems functioned wonderfully in our absence. It may be humbling, but it is good to remember that we are not an essential element to any of Earth’s ecosystems. No other single organism has changed our planet to the extent that we have. But, were we to disappear tomorrow, ecosystems would continue to change and life would continue to evolve. Eventually, our portion of Earth’s history would be reduced to a thin, albeit messy, layer in its geologic strata.

I have a favorite Gary Larson cartoon. A stegosaurus stands at a lectern before an audience of other dinosaurs and says, “Friends the picture is bleak; climates are changing, mammals are on the rise, and here we sit with brains the size of a walnut.” Dinosaurs are, unfairly I think, often depicted as the exemplar of unsustainability—unable to adapt, they were a cul de sac in the history of life. But, these remarkable beasts dominated Earth’s ecosystems for a remarkable span of time—150 million years.

Humankind has been around for about 1/1,000th of that amount of time, yet many seem to think that the entire history of life that preceded us occurred solely for our benefit. That view has encouraged the widespread belief that we cannot severely damage Earth’s capacity to sustain us or our children. But the history of our interactions with the land tells us otherwise.

We are fond of calling attention to two human features, intelligence and self-awareness, that set us apart from all the rest of creation; we have, after all, brains the size of a grapefruit. We are hopeful that these traits will lead us on a more sustainable path, although there is not much evidence in our history to support that hope. But I believe our future will hinge much more on two other traits—the empathy to care for the well-being of others living now and in the future, and the humility to understand our proper place in the world and our dependence on the health and diversity of its ecosystems.

Norman L. Christensen is founding dean of the Nicholas School and professor emeritus in the Division of Environmental Sciences and Policy.
HOW DO YOU SOLVE A WICKED PROBLEM?
Boiled down, the Nicholas School’s mission is to answer that question. Whether it’s a warming planet, rising seas, disappearing species, dirty air and water, sustainable food production or a litany of other environmental challenges, they’re all pretty wicked, for they all cut to the core of human desires, frailties and strengths. These aren’t questions you can answer by just pulling an all-nighter or two.

Perhaps the most recurrent clarion call for wicked problems is: “be interdisciplinary.” You can’t solve these problems, the argument goes, without a diversity of expertise. You need economists and ecologists, paleoclimatologists and political scientists, geophysicists and geographers ... the list goes on and on, because you need to know how both people and the world around them work, and ultimately how they can play well together.

It’s a valid argument, one that led to the genesis of the Nicholas School itself. But a melting pot of disciplines is not enough. The people matter too.

Talented people with the potential to help solve our environmental challenges can come from anywhere. They are men and women of every race, culture and religion; they are both rich and poor. But while they can come from anywhere, they don’t come and succeed at equal rates. This is what we must seek to change, not only because it’s the right thing to do on basic human terms, but because it’s central to achieving the missions of this school. Whether it’s the wickedest of problems, or just the next compartmentalized task on the daily agenda, we won’t be as collectively smart, innovative, efficient or quick if we aren’t also diverse.

Don’t take my word for it. Look at the data. From corporate performance, to problem solving experiments, to innovations across multiple sectors of society, groups that employ and embrace a diversity of background, culture, gender, race and thought come out ahead.

Why? Because when everyone looks like you, thinks like you, prays and plays like you, when everyone went to a school like yours and goes home to a family like yours ... well, your meetings might be quick and harmonious, but your list of new ideas will be shorter, and your potential for wrong assumptions will go through the roof. It doesn’t matter how smart, caring or well-intentioned you might be, we all have biases and limitations. The collective whole of who you are and where you came from has intrinsic borders, ones you can only expand as an organization when the overlap among those individual cartographies is deliberately lessened.

Whether at the Nicholas School or in environmental fields as a whole, we’re not there yet. In many respects, we still have a long way to go. But I’m proud to work at a place that is taking diversity seriously (see related story, page 14). Our Rising Tide Program—an innovation of Nic School staff, faculty and students—is providing some of the tools future environmental leaders will need to successfully recruit and manage a diverse workplace. Our growing partnership with Paul Quinn College in Dallas, a historically black college undergoing some remarkable innovations under the leadership of President (and Duke alumnus) Michael Sorrell, grew out of Nicholas School faculty research on environmental justice. And as dean, I’ve asked that our recruiting efforts at every corner, from students to faculty to staff, make the formation of a more diverse community a priority.

These efforts take time, dedication and resources. But they’re worth it. Beyond the moral imperative of making a search for global solutions represent the people of that globe, we all need those solutions to come soon. Humans have come to dominate the life support systems of our planet. If we’re going to keep those systems going in ways that can allow even more of us to live happy and healthy lives, we need new ideas, we need changes in behavior, and we need a collective will that emerges best when we seek out and embrace our differences.

Sadly, that is not the recent trajectory of society as a whole. Too many of us are retreating into our own echo chambers, a path ironically facilitated by a more connected world. That’s not a trend restricted to a subset of ethnicities, religions, cultures, economic classes or political views. The culpability is broadly shared, including by many of those working in environmental fields.

It’s time to change that. At the Nicholas School, I hope to see us leading the way.
SUMMER INSTITUTE GATHERS STUDENTS AND PROFESSIONALS FROM AROUND THE WORLD FOR AN IN-DEPTH LOOK AT GLOBAL MARINE CONSERVATION ISSUES  BY KATI MOORE, MEM’16
Marine conservation is without a doubt a global issue. With about 44 percent of the world’s population living on or near coastlines, the challenges presented by overfishing, sea level rise, and increasing severity of natural disasters require an integrated, international approach.

That’s where the Duke Marine Lab comes in. For the second year in a row, the Marine Conservation Summer Institute (MCSI) will bring students and environmental practitioners from Duke and around the world to its campus in Beaufort, N.C., this summer to learn about marine conservation issues both in and out of the classroom.

The five-week intensive course covers emerging and ongoing issues facing marine conservation today.

“There’s nothing like it anywhere in the world. What we have created is an environment where we teach people what it’s really like to do marine conservation and marine conservation biology and policy,” says MCSI Director Doug Nowacek.

One of the most valuable tools of the program, Nowacek says, is the experience the participants themselves bring to the table.

Last year, for instance, 15 environmental practitioners, from countries including India, Tanzania, Peru, Indonesia and Colombia, took part in the program as Global Fellow scholarship recipients.

Seventeen students from Duke and other universities also took part. They hailed from a diverse mix of nations, too, including Zimbabwe, Trinidad and Tobago and the South Pacific island nation of Tonga.

All told, 32 students and Global Fellows were enrolled in the program.

The participants bring knowledge of region-specific conservation issues as well as knowledge about what it’s actually like to do conservation work on the ground. The Fellows share their experiences with the other students and take what they learn back to their home countries to apply to their own conservation efforts.

“We’re creating a global network of marine conservation scholars and practitioners,” says Nowacek.

Global Fellows are awarded a scholarship that covers the entire cost of tuition, room, board, and travel for the duration of the program. This is made possible in part by a grant from the Oak Foundation, though Nowacek says he hopes to make the program self-sustainable in coming years, while maintaining the vital support
to Global Fellows. (See related story, page 34.)

"Most of them wouldn’t be able to come without some amount of support, and having their perspective is invaluable to the whole Institute," he says.

The program also attracts international students from Duke itself. Tapiwa Sondaiy, a sophomore at Duke from Zimbabwe, said his interest in conservation and public policy drew him to the program.

"I felt it would teach me not just about the issues we’re dealing with but how to advocate for those issues and how to make policy and law regarding those issues," he says.

The program is made up of four one-week modules following an introduction to human interactions with marine environments. Each module is taught by experts on different aspects of marine conservation.

In addition to traditional classroom lectures and discussions, students gain practical skills such as policy memo writing and get hands-on experience during excursions around Beaufort and the Outer Banks:

- Last summer following a week of intensive study of invasive marine species led by James Morris, an ecologist in the National Centers for Coastal Ocean Science’s Center for Coastal Fisheries and Habitat Research, students went out to local pet stores and nurseries to catalogue what species of animals and plants were available. Back at the lab, they researched these species to determine which were native and non-native. If non-native, students then determined what their potential invasiveness might be if released.

The students also began what will be an ongoing search for invasive species at the Rachel Carson National Estuarine Research Reserve, just a short boat ride from the Marine Lab.

- In a module taught by Marine Lab Director Cindy Van Dover and McCurdy Visiting Scholar James Kraska—focused on deep sea conservation, ecology, and law—students took part in a mock international arbitration panel before faculty about the role the International Seabed Authority should play in the management of marine genetic resources.

- In a module on marine megafauna and marine law, taught by environmental lawyer Steve Roady and marine mammal expert Andy Read, participants wrote a letter to the President of Mexico imploring him to take action to save the highly endangered vaquita, a rare species of porpoise.

The group also held a mock meeting of the International Whaling Commission to debate the recent decision from the International Court of Justice on Japanese whaling in the Southern Ocean.
“Our students don’t just sit in a classroom to learn about these issues—they learn what it’s like to actually roll up your sleeves, dig into an issue, and defend your position,” says Nowacek, who is also an associate professor of conservation technology at the Nicholas School.

The hands-on experience is extremely valuable to students such as Sondayi. Writing policy memos was of particular use to him, he says, because it allowed him to dig into a topic close to home.

He looked into the effect the Kariba Dam in Zimbabwe is having on populations of kapenta fish, which are an important source of protein for lower-income Zimbabweans, he says. His memo was about possible solutions for preserving the kapenta.

“It’s one of those issues that wouldn’t be in the news, that you wouldn’t find very easily unless you looked for it. So this allowed me to see one of the environmental issues being faced back home that I never knew was an issue,” Sondayi says.

Sondayi plans to apply what he learned at the summer institute to a future career in policy making. He adds, “Conservation is definitely a prominent issue, and I don’t think it’s one that any policymaker will be able to run away from.”

The benefits for MCSI students go beyond the five weeks spent at the marine lab. MCSI also keeps an online database of all the information collected by students on the different topics covered each week. These data are available to all MCSI students and alumni.

One example of data collected by students last summer was information about invasive species from their home countries. Students did this research during the module on invasive marine species led by Morris.

This summer’s modules will include some of the same elements as last year, including invasive species and marine mammal law and policy. One week will be devoted to the emerging issue of aquaculture and aquaculture conservation.

The inspiration for this topic came from last year’s discussions on mangrove conservation. Students found during their research at the marine lab that conversion to aquaculture is a major cause of mangrove destruction.

The students will look into the effect aquaculture has on mangrove forests as well as coastal environments in general. Morris and guest lecturer João Ferreira, a professor in environmental sciences and engineering at the New University of Lisbon in Portugal, will teach this section of the program.

MCSI continues to bring together an exceptional group of experts, working professionals, and eager students to learn from each other how best to tackle the most pressing issues facing marine ecosystems and the people that depend on them. As the program grows, it will continue to foster new ideas and develop new environmental leaders, positioning both Duke and the Marine Lab as global leaders making real environmental change.

For more on MCSI, go to superpod.ml.duke.edu/mcsi.

Kati Moore MEM’16 is the student communications assistant for the Nicholas School’s Office of Marketing and Communications.

Photos provided by students and staff at the Duke University Marine Laboratory.
PHD STUDENT
LAUREN WYATT
CROSSES DISCIPLINES TO LEARN MORE ABOUT THE EFFECTS OF MERCURY EXPOSURE ON CHILDREN
BY KATI MOORE, MEM’16

Photo by Jared Lazarus
Not many graduate students can get the best of both worlds: quiet, methodical bench work in the lab and unpredictable, exciting field work in the tropics. Lauren Wyatt, a third-year PhD student at the Nicholas School studying under Bill Pan and Joel Meyer in the Integrated Toxicology and Environmental Health Program (ITEHP), has struck this balance.

Her research focuses on better understanding the effects of mercury exposure on human health. When not in lab, she conducts field work in small Peruvian communities affected by mining that uses mercury to extract gold.

“They use mercury because it binds well to gold, which aids in extraction since the mercury can be evaporated, leaving the gold behind,” Wyatt explains. This contaminates the air and may have negative effects on the people that breathe it and on the surrounding environment, as it can enter waterways and the food chain.

Though the effects of mercury poisoning on the nervous system are well understood, not much is known about the long-term effects of mercury in small doses, particularly on such functions as immune response. “Mercury’s impact on the immune system is complex, which is why it needs to be investigated further,” Wyatt says.

Wyatt’s work combines two very different fields: public health and molecular biology.

“That’s an unusual combination,” her co-advisor Meyer says. “I think it’s a great example of what ITEHP and the Nicholas School in general are trying to do, which is train people in interdisciplinary approaches.” ITEHP is a pre-doctoral training program that prepares students for research careers in environmental health.

This means that while she spends a lot of time in the lab, she also is on the ground working directly with people in sometimes challenging field conditions.

“Every day is beautiful but it’s also really stressful. You may have random weather events that throw you off schedule or strand you. It creates interesting stories,” she says.

She has spent two field seasons with Pan and a Bass Connections Team in the Madre de Dios region of southeastern Peru, which borders Brazil and Bolivia. The researchers work with a team of local medical practitioners to collect blood and other human samples from residents in communities influenced by mining. (Bass Connections is a Duke-wide initiative that links students and faculty with complex challenges.)

Wyatt works specifically with young children. She’s interested in assessing the impacts of mercury exposure on child immune responses by measuring concentrations of routine vaccination antibodies and cytokines, which are important in immune cell signaling, in blood serum. “If an effect is present we think that it would be noticeable in younger children as their immune systems are not fully developed yet,” she adds.

The Pan lab recently traveled to Peru again to collect samples that will be analyzed by Peruvian and U.S. collaborators and at Duke, where Wyatt has been working with Meyer to test for DNA damage and changes in DNA damage repair following mercury exposure in C. elegans, a microscopic nematode model organism for genetic research.

_C. elegans_ is widely used in genetic labs because it shares a high percentage of genes with humans. It is also a convenient model because of its three-day life cycle, which allows experiments to be repeated quickly and easily. For Wyatt, this was quite a different lab experience from her Master’s research on fish and aquaculture at the University of New Hampshire.

“Fish are awesome. I love fish. But fish are needy. Someone’s going to have to come in on every holiday and feed them.”

Whereas a population of fish might require an entire building to house them and people to feed them every day, _C. elegans_ are so small that they can be kept in stacked petri dishes in the lab incubators.

“It’s almost been a relief ... If something goes wrong I’ll just try again,” she says.

Though Wyatt’s background is in zoology and marine science, she says she enjoys working on an issue that directly affects human health.

“We’re exposed to a lot of things like mercury that exist naturally in the environment, and how they impact different aspects of our health is really important to understand,” she says.

Meyer put it this way: “Lauren really wants to do work that’s useful and helps people. And I think the project she’s doing gives her a really great opportunity to do that.”

Wyatt learned about Pan’s work with mercury toxicity by doing one of her first-year rotations in his lab.

“I never would have thought to go this direction,” she says. “But doing rotations allows you to see that there are other options and there aren’t penalties for saying, ‘Well, now I’m going to do something completely different.’”

Outside of her research, Wyatt also plays intramural sports with the Nicholas School teams, and recently joined the Triangle ultimate frisbee league.

“I like to stay active, since you can’t just sit around or stand in lab all day,” she says.

In between lab work, field work, and sports, she also makes yogurt, which is easier than it sounds, she says. She found recipes online and decided to try it herself. “It’s fun when I have time to do that,” she says.

As for life after grad school, Wyatt says while academia, government, and industry all have attractive benefits, right now she’s leaning toward pursuing a career with the Centers for Disease Control and Prevention.

“They’re involved in a number of environmental exposure issues, and to be able to do research on such a large scale would be really cool,” she says.

No matter where Wyatt’s career path takes her, her range of experience and passion for protecting human health is sure to serve her well.

Kati Moore MEM’16 is the 2014–15 student communications assistant for the Nicholas School’s Office of Marketing and Communications.
Nicholas School Alums
TAKE THREE PATHS TO LEADERSHIP IN THE Forestland/Conservation Investment Sector
by LAURA ERTEL

While they each came to the forestland and conservation investment sector via decidedly different paths, three Duke University alumni have one thing in common: They have each played prominent roles in shaping how we look at land values, and finding innovative ways to balance strong investment returns with a strong commitment to environmental stewardship.

1
The Paper Industry Insider

Like many of his Duke Forestry classmates, Tom Colgan T'75, MF'76 joined the paper and pulp industry right after graduation. For 17 years, he helped manage and expand the Scott Paper Co.'s large tracts of forestland in Maine.

Then, in the early 1990s, Colgan personally lived through the forest sector's transformation as companies like Scott decided to sell their timberland holdings to focus solely on paper production. With his professional expertise, this shift presented a huge opportunity. In 1994 he joined Wagner Forest Management, a company that acquires and manages long-term timberland investments in the northeastern United States and Canada for large and small clients committed to natural resource stewardship and the support of local communities.

Colgan is now president and CEO of Wagner, a company recognized as a pioneer in finding innovative ways to add value to forestland. “We’ve sold conservation easements that preclude development on land best kept from that pressure, and sold land to federal and state governments and individuals for conservation purposes. We’ve also been very active in promoting renewable wind energy on our properties, and have 10 wind farms operating in New Hampshire, Maine and Nova Scotia. We’re even taking some timberland in Maine and Nova Scotia and converting it to wild blueberry production.”

“So we look for niche things to do, but the timber always has been the most significant portion of the reason for buying the property as an investment,” he says.

Colgan, who earned his both his bachelor’s degree (in Trinity College) and a master’s degree in forestry at Duke through the 3+2 program, thinks the Nicholas School’s plan to start a Forest Finance Initiative is a great opportunity (See related stories, pages 10 and 34).

“Forests are no longer strictly a source of commodity products to be manufactured into something else, but also a source of potential wind power, conservation easements and ecosystem services like carbon sequestration and clean water. There is certainly a demand in all areas of the forest industry for people with that mindset and skillset, who understand the underlying investment motivations.”
Chris Zinkhan's path into forestland investment wound through academia. Zinkhan came to Duke through the 3+2 program after earning his undergraduate degree at Franklin and Marshall, then added one more year so he could complete a joint MF/MBA at the Nicholas School and Fuqua in 1981. After earning a doctoral degree in finance from Mississippi State University, he joined the faculty at University of Georgia and Campbell University, where he studied changing land ownership trends for U.S. forestland and consulted for institutional investors. He wrote a book on timberland investments and pioneered the application of option pricing to timberland valuation.

As ownership of U.S. timberland shifted away from large forest products companies to investors—due to factors such as tax policy changes and shareholder pressure, Zinkhan notes—forest finance transformed from a cottage industry into a full-blown sector. His consulting work evolved into a full-time pursuit, and in 1995 he and four partners co-founded The Forestland Group, the sixth timber investment management organization (TIMO) in the country.

Today The Forestland Group is one of the top five landholders in the U.S. While many TIMOs focus on fast-growing timber plantations, The Forestland Group saw substantial investment value in hardwood forests, CEO Zinkhan explains. "Hardwoods grow in complex ecosystems. Ninety percent of our portfolio is natural hardwood forests, which provide a variety of species, quality and products that range from industrial products like railway ties to high-end furniture, millwork and flooring. We found these hardwood forests, which are mostly in the East, to be a bit more neglected and complex, with some mispricing opportunities that offered intriguing investment options."

Zinkhan, a highly regarded forest finance expert who presents and teaches around the world—including in the Nicholas School’s Duke Environmental Leadership program—also sees the value in the school’s new Forest Finance Initiative in helping students gain insights into approaches for assessing forestry and related resources from an investment perspective. "Duke brings to the table a very broad array of expertise in different ecosystems, as well as more of a global perspective on the environment and forestry than other schools," he says.

For Nick Dilks T’96, the journey into conservation finance led through the nonprofit sector. Dilks, who earned his bachelor’s degree in environmental science and policy at Duke (the major is administered through Trinity College in close collaboration with the Nicholas School), began his career at The Conservation Fund, a national nonprofit land conservation organization.

During 10 years at The Conservation Fund, most recently as vice president for real estate, Dilks earned a reputation as an innovator in land conservation strategies. In 2006 he left the organization to co-found Ecosystem Investment Partners, a private equity fund manager that acquires, restores and protects conservation properties across the United States to generate land-based environmental offsets.

“Our company is structured almost identically to a TIMO, but the returns we generate are mainly from mitigation credits rather than timber management or harvesting,” Dilks, a managing partner of the Baltimore-based firm, explains. “We do have a fair number of properties that are forested wetlands, so we’re very much into forest management, but the credits come from restoration rather than for commercial tree harvest.”

A quick primer: Under federal, state and some local environmental laws, certain natural resources like wetlands, streams and endangered species habitat are protected. Land development projects with unavoidable, permitted impacts to these resources must offset their impact so there is no net loss of ecosystem services. Rather than producing these offsets themselves, businesses and government agencies can purchase offsets generated from conservation projects in that area. Firms like EIP acquire, restore and protect properties in order to generate, and then sell, those offset credits—in a transaction that generates a return for their investors.
Dilks is known for his leadership in finding creative ways to monetize non-timber services of forests and other natural lands. “Each project we do is quite different, depending on the restoration needs of the property. For instance, we’re converting a pine plantation that was planted with non-native plant species. We’ll harvest that property, restore the wetlands and replant native pines. In another project, we’re restoring a coastal marsh by pumping dredge material back into areas that have eroded or reverted to open water. In each instance, it’s the same basic concept: restoring a property’s natural condition in order to provide an environmental offset that’s required under law.”

Dilks, who also earned an MBA while working at The Conservation Fund, was still at Duke when the shift of forestlands from industrial owners to investment partnerships began. “Industrial landowners could take a much longer view, while investment partnerships have a more limited timeframe to work within, so there’s a different focus in terms of managing these assets to find a good return while producing a good conservation or stewardship outcome on these sites.”

Dilks sees a need for people with the skills that the Nicholas School’s Forest Finance Initiative will provide. “I’ve always been a big advocate of the hard skills associated with business and finance. I think that skill set allows folks to sharpen their pencils and understand both good resource management and sustainable financial management. That’s a really valuable skill set that we look for in hiring people, and I think land management investment with a stewardship overlay is going to be a major growth area for the foreseeable future.”

Laura Ertel is a freelance writer based in Durham, N.C.

We asked two Duke alumni in the forestry industry to share one of the most valuable lessons they learned at Duke and how it has contributed to their success.

Here’s what they had to say:

**Scott R. Jones, MF’81**
Co-President, Forest Capital Partners in Boston

“What Duke gave me was not any one class or tool, but the ability to tailor my studies to a career in forest finance. I had access to Duke Business School classes, internships and a variety of both traditional forestry and business experiences. I never felt boxed in; Duke allowed me to make my own box.”

**Tiffanie Joy Starr, T’97**
Duke Undergrad, AB Environmental Science & Policy; University of Georgia, MBA 2002/MFR 2003; Senior Acquisition Manager, Timberland Investment Resources in Atlanta

“Marie Lynn Miranda (now an adjunct professor at the Nicholas School) was an inspiration to me during my tenure at the Nicholas School. She worked tirelessly to impress upon us an interdisciplinary and holistic approach to understanding our world, and stressed the importance of empathizing with the stakeholders and communities affected by our efforts in any field. Dr. Miranda emphasized the need for an appreciation for cultural customs, economic principles and financial drivers required for our success in developing programs and policies to positively affect the natural and human systems we were working to enhance or preserve.

“My role in developing timberland transaction opportunities requires an understanding of the guiding principles of the landowners and our clients as well as a deep understanding of the economics of owning and managing a particular asset due to the specific attributes of the ecology, markets and demographics of the region. Without the ‘big picture’ approach to my undergraduate studies at Duke, I would not have the appropriately balanced mindset to be successful in my field.”
KEEPING
THE TREES
FROM FALLING IN
GUYANA

DEL-MEM ALUM CURTIS BERNARD STRIVES TO FIND THE BALANCE BETWEEN PRESERVING OLD GROWTH FORESTS AND IMPROVING ECONOMIC OPPORTUNITIES

BY JILL WARREN LUCAS
Today, the commodity crop is responsible for about 20 percent of the annual revenue in Guyana, which is located on the northern coast of South America. It is particularly known for the shimmering brown sugar produced in the Demerara River basin.

As this poor, lightly populated country seeks to improve economic opportunities for its citizens, however, the demand for sugar has been outstripped by an aggressive push to mine for gold. The industry is welcomed by those desperate for jobs, but there is concern among conservationists who see the country’s largely intact native forests at grave risk.

As technical director at Conservation International Guyana, Bernard is one of the people striving to strengthen his homeland’s environmental future by preserving the old growth woods that still cover 85 percent of the country. He is responsible for working with diverse stakeholders who have very different views about the value of that forest. This includes powerful mining interests and members of indigenous communities who might otherwise not have a voice in the debate.

Indeed, some citizens are dismissed for their belief in ingrained folklore that attributes mystical power to the massive Silk Cotton trees that canopy and, according to legend, protect the country from harm.

The solution, Bernard believes, is Guyana’s low-emission development strategy, which he helped to draft in 2009. “Our country has almost all of its original forest, which is quite unusual,” says Bernard, 39, who earned his master of environmental management degree from the Duke Environmental Leadership (DEL) Program in 2014. Part of the Nicholas School, the DEL program provides environmental professionals with opportunities to continue their development through an online MEM degree and executive education courses.

“Through the international REDD (Reduced Emissions from Deforestation and Degradation) program,” he adds, “we are committed to helping Guyana as a country to improve the living standards of our citizens while at the same time maintaining the natural bounty that we have.”

Much of Bernard’s work is in partnership with the kingdom of Norway, which has pledged financial support in return for Guyana achieving a reduced deforestation rate and other performance targets, such as identifying critical areas of biodiversity protection and demarcation of indigenous lands.

REDD protocols typically are deployed in countries with dangerously high deforestation rates. Guyana's deforestation rate is less than 0.01 percent annually, but surging development interests threaten to reduce the forest’s footprint more rapidly. The biggest threat comes from gold mining, which is loosely regulated and fragments the forest with deep environmental scars.

“Traditionally, Conservation International has not focused a lot on the mining industry in Guyana, but in the past two years we put emphasis on ways in which we might effect change,” Bernard says, reflecting the time he was completing his master's project. “We’re looking at improving efficiency of the industrial process itself, as well as a mechanism by which the country would use mining revenue to grow other parts of the economy.

“We understand the importance of mining to Guyana families,” he adds, “but at the same time we need to support other industries that will continue after gold reserves are depleted.”

Bernard and Conservation International believed that advanced training was essential to Bernard’s ability to achieve such goals for Guyana. He set his sights on earning his master’s degree from the Nicholas School but was unable to dedicate two years as a residential student. The online DEL Program is designed to meet the needs of mid-career environmental professionals, allowing them to remain at home and on the job while earning their degree.

Bernard credits the interdisciplinary focus of his studies
with helping him develop and present plans that take into consideration all stakeholder interests. It also helped him to institutionalize an improved documentation system.

“In the Guyanese culture, we have a tendency to not, as they say, blow our own trumpet,” Bernard explains. “Even though we do very good work, we are sometimes reluctant to turn what we do into a knowledge product that can help others. Documenting projects in real time means we can show others, inform others, and share how our results can be applicable in other situations.”

Bernard believes that his exposure to environmental economics has empowered him to act in the best interests of his country’s future.

“Economics was the field that I had the least understanding about, but it is a large part of the solutions that we have to work on here,” he says. “Gaining a better understanding of economics in relation to natural resource exploitation—how economic tools can be applied to affect environmental behavior—has accounted for my greatest growth.”

Among Bernard’s ongoing challenges is balancing the interests of members of poor indigenous communities, who crave a more stable livelihood, with those of large, profitable mining operations, which threaten sensitive natural resources.

REDD seeks to reduce emissions caused by deforestation and degradation, which can result from aggressive mining and logging. By meeting targets, Guyana earns offset funding to help keep its native forests intact and develop alternative economic opportunities.

Remarkably, despite pressures to grow its economy through environmentally risky measures, Guyana stands in stark contrast to other tropical countries that have lost significant portions of their carbon-absorbing forests. Its old growth canopy provides broad ecosystem services, including improved water quality and flood control, which in turns benefits agriculture. It also serves as a draw for ecotourism.

So when trees don’t fall in Guyana, the impact is heard in other tropical rain forest countries, which also are striving to save them as a means to improve public health and well-being.

“Without question, Curtis is one of the world’s top in-country experts on REDD,” says Brian Murray, director of the Environmental Economics Program at Duke University’s Nicholas Institute for Environmental Policy Solutions. An expert in the economics of climate change policy, Murray taught Bernard’s DEL class in environmental economics and was his advisor for his master’s project in forest conservation, aspects of which were put into practice long before the project was completed.

Bernard’s education allowed Guyana to rely on him as a committed, homegrown resource. “When you’ve got people flying in from the U.S. or Europe—consulting but not staying to make sure implementation happens–then it’s not as likely to succeed,” Murray says. “More of these countries need people like Curtis to ensure positive change.”

Murray, who chooses to teach DEL students because their goals align with the Nicholas Institute’s mission of engaging with policymakers, says the program is ideally suited for high-achieving students like Bernard.

“There is no opportunity for anything like this in Guyana. I’m not sure that there’s quite anything like this in the U.S., either,” Murray says. “DEL provided him the extra time to learn all he could and write a master’s project that really fit the needs of what he was doing at work. I’d say it was a high return on investment for everyone.”

For more on DEL, go to nicholas.duke.edu/del.

Jill Warren Lucas is a freelance writer in Raleigh, N.C.
I was dreaming of taking six months off to immerse myself in research on watershed protection programs in South America. But I wasn’t sure if I’d get the funding or the time off. After a lot of planning, I succeeded in making it happen. Here is how I put it all together—including a detour into the food cart business.

As the regional Sustainable Water Infrastructure Coordinator for the U.S. Environmental Protection Agency in the Intermountain West, I was growing frustrated with the atomistic approaches to sustainability in managing our region’s water infrastructure. Sure, we were implementing solar energy projects and retrofits for automation and greater efficiency. While these projects were important, and an improvement over the status quo, there was a bigger opportunity, a chance to reframe how we think about community and infrastructure sustainability in a more integrated manner.

Specifically, I was interested in understanding how to invest in watersheds as a core and critical component of a community’s infrastructure portfolio, as had been famously done in New York City, which protected 1,600 miles of watershed in order to avoid building expensive filtration plants.

I was captivated by the question of whether a business case could be made for utilities to more actively engage and invest in source water protection. In particular, could this happen in the large majority of U.S. communities without the regulatory incentives that drove such projects in New York City as well as the Pacific Northwest?

But as many water and wastewater utilities already are challenged financially to keep up with basic, existing needs, it is difficult to motivate utilities to invest in programs for which no regulatory requirements or external funding existed, and for which scant data was available to
quantify benefits of such investments. It became obvious that my best opportunity to explore this topic in greater depth would be a sabbatical during which I could immerse myself in research without the burden of day-to-day job responsibilities.

Dreaming of a sabbatical is one thing, but making one happen is another beast. The major hurdles would be securing funding for the sabbatical and requesting leave from work. After reviewing my options, I decided to apply for a Fulbright Fellowship to pursue my research interests. My interest had been piqued by a growing number of nontraditional partnerships between utilities and agricultural/forested land managers to protect source water quality in Latin America. I was particularly intrigued by Brazil, in part because of the love I had developed for the country during previous visits. More importantly, Brazil has risen in the international arena as a leader in efforts to institutionalize the role of healthy watersheds in the provision of freshwater needs for its citizens, communities and industries. I had countless conversations with key agencies/organizations working in Brazil on Payment for Watershed Services (PWS) efforts in order to identify potential areas of mutual interest and explore opportunities.

At the same time, I was laying the groundwork at work. More than a year before applying for the Fulbright, I began conversations with my supervisor regarding my proposal for a sabbatical and how it fit with my vision for my professional and career development; more, how this sabbatical could benefit the needs and interests of the agency.

I was determined to do this sabbatical, whether or not I got the Fulbright and whether or not I was granted a leave of absence. That’s where the dumplings came in. In case all funding fell through, I knew I needed to save enough money to cover my expenses for at least six months. I already had a full-time job, so decided that my second job had to be fun, and on my own terms. So I started “Dumpling, Love”–Colorado’s first bicycle-powered food cart. Every weekend for about five months, you’d find me slinging dumplings at art, music and athletic events. The funds I saved from this little enterprise bought me the financial freedom I needed to pursue the sabbatical no matter what.

In the end, the best-case scenario did play out. I was awarded a Fulbright Fellowship that funded my research in Brazil, and I also was granted a leave of absence to complete the fellowship. My host institution was the Agência das Bacias dos Rios Piracicaba, Capivari e Jundiaí (Watershed Agency for the Piracicaba, Capivari and Jundiaí Rivers in the State of São Paulo). Support from my host institution played a critical role to gaining access to drinking water utility managers, operators and (most importantly!) their data. Further, the opportunity to work with and interact with my Brazilian colleagues provided great perspective on strategies and incentives to foster PWS schemes in the United States.

Overall, I developed a greater appreciation for the challenges to environmental protection in Brazil, but also an appreciation for the differing institutions in Brazil at play, that at times, allowed for more creativity and flexibility in approaches to watershed protection. The opportunity to build long-term relationships with Brazilian colleagues working on similar issues of concern is, to me, perhaps one of the most valuable outcomes of the experience.

Oh, and the dumpling business? I sold it at a profit.

### Fulbright Info Here...

If you are thinking of applying for a Fulbright, here are some additional things to consider:

- **Begin planning two years in advance.** The Fulbright Fellowship application process is lengthy; it is almost nine months from when the request for applications opens to the public, to when one can begin the fellowship. You generally have two years within which to conduct your field work in country. Awards differ by country, both in terms of the amount of funding as well as the length of the fellowship; it can last anywhere from a few months to a year. Time to secure support from work as well as preparing your home for an extended absence also goes without saying. Here is a link to the Fulbright website: [http://www.cies.org/](http://www.cies.org/).

- **Identify any requirements on research topics.** Some countries have explicitly identified areas of research that they will consider for that year. Make sure your research interest matches those of the country that you are applying for.

- **Identify and satisfy any language requirements.** Many but not all of the fellowships have a language requirement. I listened to Portuguese podcasts and hired a private language instructor to get my Portuguese up to snuff.

Elaine Lai MEM/MPP’04 is an environmental scientist at the U.S. Environmental Protection Agency in Denver, Colo. She was a 2014 Fulbright Science Scholar in Brazil. Top photos courtesy of Elaine Lai.
FOREST FINANCE

NICHOLAS SCHOOL IS LEVERAGING LONGSTANDING STRENGTHS TO BUILD TWO INNOVATIVE, FUTURE-FOCUSED PROGRAMS

HERE’S HOW YOU CAN HELP

If the articles on the Nicholas School’s new Forest Finance Initiative or Marine Science Conservation Institute have piqued your interest, there’s still time for you to become a partner in the school’s efforts to create and sustain these innovative programs.

THE DUKE FOREST FINANCE INITIATIVE

The Forest Finance Initiative (see feature, page 10) will draw on the expertise of Nicholas faculty at one of the oldest and best forestry education programs in the world, other programs and resources at Duke, and a strong network of alumni in top management positions in TIMOs, REITs and conservation organizations to provide enhanced educational opportunities for master of forestry and environmental management students who desire an edge in forest finance. Graduates will be prepared to help their organizations achieve both their financial and environmental stewardship objectives.

YOU CAN HELP ADVANCE THIS PROGRAM BY:

- **Establishing one or more endowed scholarships** for master’s students interested in a career in forest finance, and internship stipends to enable students to work with TIMOs, REITs and other organizations that make or manage forest investments. (Endowment opportunities start at $100,000; other opportunities begin at $5,000.)
- **Providing program support** for a new Certificate Program in Forest Finance to prepare students to address challenges specific to the global forestry sector; a Forest Finance Speaker Series that brings sector leaders to campus to share their experience and perspectives with students and faculty; and continuing education courses for practicing professionals through our Duke Environmental Leadership (DEL) program. (Gifts of $1,000 or more are particularly welcome and appreciated.)

IN ADDITION TO PHILANTHROPIC SUPPORT, THE SCHOOL ALSO IS SEEKING ALUMNI AND FRIENDS IN THE FOREST FINANCE SECTOR TO HOST STUDENT INTERNSHIPS AND VOLUNTEER EXPERTISE AS GUEST SPEAKERS OR MENTORS.

FOR INFORMATION—OR TO CONTRIBUTE TO EITHER OR BOTH OF THESE IMPORTANT PROGRAMS—CONTACT THE NICHOLAS SCHOOL’S OFFICE OF DEVELOPMENT AND ALUMNI RELATIONS AT (919) 613-8003 OR VISIT NICHOLAS.DUKE.EDU/GIVING.
Mark your calendar for the following dates and monitor our website at nicholas.duke.edu for additional events.

**APRIL 23-25**
**Biodiversity Days with E.O. Wilson**
Duke Environment Hall
nicholas.duke.edu/eowilson
Contact: Nancy Kelly at nkelly@duke.edu

**APRIL 30–MAY 1**
**Beaufort Masters Project Symposium**
(Coastal Environmental Management Students)
Auditorium, Duke Marine Lab, Beaufort, N.C.
Contact: Sarah Phillips, 252-504-7531 or sarah.anne.phillips@duke.edu

**MAY 7–8**
**DEL-MEM Masters Project Symposium**
And Place Based Session
LSRC A158
Contact: The DEL Program, 919-613-8082 or del@nicholas.duke.edu

**MAY 9, 9 A.M.**
**Nicholas School Recognition Ceremony**
For Graduate and Professional Degree Candidates
Keynote Speaker: Beth Stevens, Senior Vice President, Disney
Location: Chemistry Lot, Circuit Drive, West Campus
Contact: Nancy Kelly, 919-613-8090 or nkelly@duke.edu

**MAY 9, 1 P.M.**
**Nicholas School Ceremony For Undergraduates**
Location: Chemistry Lot, Circuit Drive, West Campus
Contact: Nancy Kelly, 919-613-8090 or nkelly@duke.edu

**MAY 10, 10 A.M.**
**University Commencement Exercises**
Wallace Wade Stadium, West Campus
Contact: Academic & Enrollment Services 919-613-8070 or admissions@nicholas.duke.edu

**AUG. 9–14**
**ESA 100th Annual Meeting**
“Ecological Science at the Frontier: Celebrating the ESA’s Centennial”
Baltimore Convention Center
Baltimore, Maryland
Contact: esa.org/baltimore/info/

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**THE MARINE CONSERVATION SUMMER INSTITUTE**

The Marine Conservation Summer Institute (MCSI) builds upon the success and impact of the Nicholas School and its Duke Marine Laboratory—in particular the Lab’s 70-plus-year track record for international leadership in marine science and conservation research and education—to create the world’s “go-to” international training program in this field. This ambitious program will create a global band of active, engaged marine conservationists who possess the knowledge, skills, connections and resources to understand and address marine conservation issues within the context of today’s global society. (Read more, page 20.)

The annual MCSI brings together 40 bright, accomplished graduate and undergraduate students and environmental practitioners, recruited from all over the world, with an emphasis on developing countries. For five weeks, these scholars engage in a rigorous learning program that combines natural and social sciences, law and policy to explore pressing marine conservation concerns from all angles. MCSI alumni return home equipped to effect meaningful change, with the opportunity to apply for mini-grants to help launch conservation efforts in their homelands and a robust support network of Duke faculty and fellow MCSI alumni around the world.

Oak Foundation, a longtime supporter of the Duke Marine Lab and our Global Fellows Program, has offered to match, dollar-for-dollar, every gift up to $500,000 made in support of the MCSI before June 2016. Here are some ways you can take advantage of this offer from Oak Foundation and invest in the future leaders of global marine conservation:

- **Provide program support** to underwrite existing elements of the MCSI and enable the Marine Lab to continue to broaden and enhance program offerings. (Gifts of any amount are appreciated, but those of $1,000 or more go an especially long way.)

- **Sponsor one or more fellowships** that will help to enable international scholars to participate in the MCSI. (A gift of $7,000 underwrites one fellowship.)

- **Create an endowment** that will provide ongoing, long-term support for the MCSI. (Named endowment opportunities start at $250,000.)

Laura Ertel is a freelance writer in Durham, N.C.
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