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cover photo
The Miller-Caudill house, surrounded on three sides by the Hobet 21 mine, in the
Upper Mud River watershed in West Virginia. Photo by Scottee Cantrell.

photo above left: Twisted Gun Golf Course, Mingo County, W. Va.
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BENEATH

GROUNDBREAKING STUDY ALONG UPPER MUD RIVER IN WEST VIRGINIA PUTS TO REST CLAIMS THAT MOUNTAINTOP MINING WATER QUALITY IMPACTS ARE TEMPORARY AND LOCALIZED

BY TIM LUCAS   PHOTOS BY SCOTTEE CANTRELL
AS THE HELICOPTER CLEAR A RIDGE SIX MILES TO THE EAST, THE MINE COMES INTO VIEW.

Stripped of vegetation, its raw contours and flattened, mesa-top silhouette look out of place amid the densely wooded hardscrabble hill country of southern West Virginia.

“That’s Hobet,” Ty Lindberg says, pointing out the helicopter’s right window toward the mine’s distant northern boundary and then to the left to indicate how far south the site extends. “You can’t see it all from this distance, but it’s about 10 miles from end to end.”

Located in the sparsely populated Upper Mud River watershed about an hour south of Charleston, the Hobet 21 mine is one of the largest surface coal mining complexes in central Appalachia. Active since the 1970s, it yields nearly one ton of high-quality coal for every 16 tons of dirt and rock its giant excavators and trucks displace. Mining takes place within the complex 24 hours a day, seven day a week, 52 weeks a year.

It’s one of an estimated 500 mountaintop-removal mining sites in the region.

Since April 2010, Lindberg, a laboratory research analyst at Duke’s Nicholas School of the Environment, has led an interdisciplinary team of faculty and students in a detailed field survey of stream chemistry in the Upper Mud watershed to document the cumulative, long-term impacts mountaintop-removal mines like Hobet can have in a river network.

They’ve collected more than 15,000 individual measurements of everything from water temperature, pH and flow, to salinity levels, trace element concentrations and sediment content.

In the process, they’ve endured 18-hour work days, blistered feet, pit bull bites, bedbugs in local motels, straight-pipe sewer discharges, knee-deep mud, temperatures so cold they froze the test water in syringe filters, and once, being forced off a sampling site on public right of way by a secretive, gun-toting teenager.

The payoff? A groundbreaking study published in December 2011 in the Proceedings of the National Academy of Sciences. The study conclusively demonstrates that the extent of downstream contamination across a mined watershed is directly proportional to the extent of historic mining activity upstream and persists for decades after active mining stops—dispelling claims by some mining proponents that water-quality impacts are temporary and localized.

On this late August afternoon, the paper’s publication still months in the future, Lindberg cautiously leans his arm and camera out the helicopter’s window to capture his first images of the team’s study site from the air.

“You get a whole different perspective of its scale—how huge it is—from up here,” he says as the helicopter reaches the mine’s easternmost boundary and descends to allow a closer view.

To extract the shallow deposits of hot-burning, low-sulfur bituminous coal buried beneath mountains’ summits, companies like Patriot Coal, which mines the Hobet complex, use explosives and heavy machinery to clear away tens of millions of tons of dirt, vegetation and surface rocks, often to a depth of 400 feet or more.

It’s a massive job, requiring supersized equipment. Hobet’s dragline, a towering cranelike machine nicknamed Big John, can scoop and lift 83 cubic yards of rock and rubble in its bucket at a time—the equivalent of bench-pressing five full-sized SUVs. Its 330-foot-high boom dwarfs a fleet of bus-sized bulldozers working at its base. Every few minutes, Big John drops a new load of soil and rocks into the bed of one of a convoy of dump trucks that carry the cleared waste to adjacent valleys where it’s disposed, steadily filling in the valleys and burying what’s beneath.

Scientists estimate that valley fills like these at Hobet now cover more than 1,200 miles of Appalachian headwater streams. One of the largest of these, the two-mile-long Connelly Fill, buries nearly the entire length of Connelly Branch, a former major tributary of the Upper Mud.

A short distance upriver, a house framed by wide lawns and a recently harvested vegetable garden sits on a patch of wooded land. It lies just outside the Hobet boundary but is nearly surrounded by active or reclaimed mine sites.

“That’s the Miller-Caudill house,”
Hobet's dragline, a towering cranelike machine nicknamed Big John, can scoop and lift 83 cubic yards of rock and rubble in its bucket...

"They'd come in with cans of gasoline. You'd pass a building on the way to church on Sunday morning, and on your way home there was nothing left but embers," she says.

The Hobet 21 mine yields nearly one ton of high-quality coal for every 16 tons of dirt and rock its giant excavators and trucks displace.
Lindberg says. “It’s kind of base camp. It’s one of our sampling sites and one of the last inhabited homes on this part of the river.”

There used to be a community of 60 families living along the Upper Mud, but most were bought out or forced out by the mining company through eminent domain years ago. Homes, churches, schools and stores were condemned and burned, Anita Miller tells us later when we visit the family home.

“They’d come in with cans of gasoline. You’d pass a building on the way to church on Sunday morning, and on your way home there was nothing left but embers,” she says.

When push came to shove, her family battled the mining company all the way to the West Virginia Supreme Court to keep possession of their property, and won—even though they mostly used the old homeplace on weekends or for reunions.

“We felt we were preserving something more important than just a house,” she says.

Dozens of rural communities across central Appalachia have disappeared in recent decades as ridgelines become mountaintop mine sites and adjacent valleys are filled in.

Proponents say the mines—multiple numbers of which may be permitted to operate in the same coal-rich watersheds—are vital for fueling the region’s economy and providing America with cheap, plentiful supplies of domestic energy. The working conditions are less dangerous than in underground mining, and their environmental impacts are temporary, proponents claim. Runoff is monitored and treated to remove or reduce contaminants and keep mine discharges within safe standards. Once mining is done, the land is reclaimed to federally mandated standards. In future years, these safe, leveled, reclaimed sites can be used as parks, golf courses, airports and building sites, a major plus in a mountainous region where less than 7 percent of the land is easily developable.

The problem with this line of reasoning, Lindberg says, is that its key environmental claims hinge on an assumption that his team’s research conclusively disproves.

“Our analysis of water samples from sites along the Upper Mud and its tributaries shows that salinity and trace element concentrations, including selenium, increased at a rate directly proportional to the cumulative amount of current and historic surface mining activity in the watershed,” he says. “We found a strong, linear correlation.”

Changes in water quality due to the increased salinity from mine runoff were “exceptionally persistent,” he says. “Surface mines reclaimed almost two decades ago continue to release effluents with salinity levels similar to active mines in the region.”

To assess the cumulative impacts of the more than 100 permitted discharge outlets draining from approximately 28 square kilometers of active and reclaimed mountaintop mines in the watershed, Lindberg and his colleagues collected 152 sets of data from 23 sampling sites over 15 months. Sites were strategically located along the main stem of the Upper Mud and on eight of its mining-affected tributaries. Two sites were located upstream of any active or reclaimed surface mines to serve as controls.

Team members collected more than 15,000 individual data points, painstakingly recording everything from major ion and trace element concentrations and electrical conductivity—a measure of salinity levels in the water—to water temperature, pH, carbon and nitrogen levels, sediment content, geospatial coordinates, water flow, and the diversity and populations of key aquatic species in the water.

All data points were analyzed in the lab for significance, and collated in a way that would allow Lindberg to perform the mind-numbing but necessary statistical analysis.

“Even though we were focusing on measurements from just four months for our paper, I reviewed each of the 15,000 data points to make sure our sample-handling protocols and the data we were collecting were clean,” he says.

Early on, he began to see “some pretty interesting trends developing” in the data, particularly for selenium and conductivity, two important indicators of mining impact and ecological health. High salinity has been linked to reduced populations of some native species, including the mayfly, widely considered a sentinel species for Appalachian freshwater streams.

With each subsequent set of data collected, the trends grew stronger.

All conductivity measurements taken downstream of where Hobet mine runoff entered the watershed exceeded levels known to be harmful to aquatic life, says Richard Di Giulio, professor of environmental toxicology. At the two control sites upstream of any mines, conductivity levels remained within an acceptable range.

“Nearly 90 percent of the variations...
PhD students Raven Bier and Brittany Merola, and postdoctoral researcher Ashley Helton, co-authored the study. More than a dozen other students, including undergraduate and master of environmental management students, assisted with data collection. Funding was provided through a gift to the Nicholas School from Fred and Alice Stanback.

Invaluable on-ground support was provided by Anita Miller who “rode along on nearly every field trip, acted as our guide, and provided a set of extra hands in the field,” Lindberg says. “She and her family opened doors and gained us access to sites that were critical to our success.”

It’s still too soon to gauge what influence the study will have on future mine permitting decisions or whether it will help spur new and better practices for monitoring and treating runoff and reclaiming former mine lands.

Few farms or underground mines have ever been located in the Upper Mud’s river basin, and few people still live within the Hobet mine’s permitted boundary, so the team was able to discount other potential causes for the cumulative increases, Lindberg says. “Essentially, there was only Hobet.”

“This is a remarkably clean dataset and that’s why it’s so powerful,” says Emily Bernhardt, associate professor of biogeochemistry. “We see these incredibly strong patterns, which previously have not been well established.”

“Individual mine permitting decisions are typically made without consideration of the extent of historic mining impacts already occurring within a watershed,” she says. “Our survey helps fill that gap.”

And in January of this year, Patriot Coal agreed to a major legal settlement requiring it to clean up dozens of illegal discharges of selenium at three major mining complexes in southern West Virginia, including Hobet 21. Citing recent scientific research on selenium violations and selenium deformities in fish in southern West Virginia, the company agreed to construct and operate new selenium treatment systems to end ongoing water quality violations, and bring discharges into compliance with pollution standards within two to five years. The Charleston Gazette, one of coal country’s most influential daily newspapers, called the settlement “the most significant” of its kind in the past year.

Days later, scientists from the U.S. Environmental Protection Agency published a peer-reviewed article in the journal Science of the Total Environment that cited the Nicholas School study three times as evidence of the impacts mountaintop mines and valley fills have on central Appalachian stream ecosystems—an indication of the study’s potential for shaping future policy.

“Many researchers have published important work on this issue in recent years, but it’s nice to think that our work may be playing some role,” Lindberg says modestly. “It’s the kind of impact you want as a scientist.” And a pretty good trade-off for the long days, blistered feet and bedbugs.

Tim Lucas is the Nicholas School’s director of marketing communications.
Dean William L. Chameides led a fact-finding trip to three counties in southern West Virginia on Oct. 3–5, 2011, to tour communities and ecosystems affected by mountaintop removal coal mining and meet with local stakeholders who represent differing views on the controversial practice.

Accompanying Chameides on the trip were Nicholas School Board of Visitors emerita Sally Kleberg and members of the school’s Office of Marketing and Communications and Duke’s Center for Documentary Studies.

Richard Di Giulio, professor of environmental toxicology, and Emily Bernhardt, associate professor of biogeochemistry, represented the Nicholas School faculty on the trip. On the first evening of the trip, they and Ty Lindberg, laboratory research analyst in Di Giulio’s lab, presented a detailed overview of their team’s peer-reviewed research on mountaintop mining’s cumulative impacts on downstream water quality in West Virginia’s Upper Mud River watershed. (See related story on page 4.)

Tommy Ellison, owner of Helicopter Solutions of Logan, W.Va., and a former mine manager, met with the group the following morning to share his views of the economic benefits of mountaintop mining and the environmental safeguards the coal industry employs to reduce the mines’ impacts on water quality and stream health. He is proud of the work he has done to manage and reclaim mining sites, and believes that most of his state’s coal-related environmental problems stem from its many below-surface mines, not its surface mines.

Ellison took members of the group on helicopter tours of dozens of active and reclaimed mine sites in Lincoln and Boone counties. Among the mines they viewed were the Hobet 21 mine complex in the Upper Mud watershed—the site of the Nicholas School team’s research—and the Kayford Mountain mine, which Ellison formerly managed.

He also flew the group to see Twisted Gun Golf Course in Mingo County. The 18-hole facility, which opened in 2006, was developed by mining companies on a 240-acre former mine site to showcase how reclaimed land can be used to benefit the public and promote economic development.

A thin layer of trucked-in topsoil underlies its greens and fairways, which are planted with Bermudagrass turf that is tolerant of high salt and mineral levels.
Irrigation comes from recycled runoff. To take advantage of the nearly flat, tree-less landscape, Twisted Gun is designed as a links-style course with serpentine mounds of low-growing grasses and shrubs acting as its rough. The mounds are formed from re-purposed mine slag.

Although it has yet to turn a profit, the immaculately maintained course has been named one of the 50 top public courses in the United States with green fees under $50. Course employees believe it will attract heavier use in coming years, after a four-lane highway opens and substantially cuts the two-hour drive from Charleston, the nearest big city.

To gain a different view on mountaintop mining, Chameides and the group visited the Miller-Caudill homestead along Mud River Road, and met with Anita Miller and members of her family.

The property borders the Hobet mine complex and is one of the last inhabited homes in the community of Mud, W.Va., where about 60 families once lived. After watching most of their neighbors be bought out or forced out, Miller and her family filed a lawsuit to prevent the mine company from taking their land through eminent domain. The family cemetery, located on a nearby ridge, is no longer accessible; the mining company owns the surrounding land and has blocked the only road leading there, citing safety concerns.

“We’re not against mining—coal is the lifeblood of this region—we just think there’s a better way to do it,” Miller said.

The field trip also included tours of several of the Nicholas School team’s water-sampling sites in the Upper Mud watershed; hikes to roadside valley fills; and a visit to Kayford Mountain, where the group viewed another large-scale active surface mining site and met with Chuck Nelson, a retired miner who now serves as chairman of the board of the Ohio Valley Environmental Coalition. His stories echoed many of those told by Miller and her family.

“Mountains are our soul and they’re taking it away,” Nelson told the group as they stood at the edge of the mine and watched the outcrop of a ridge across the way being blasted and falling away.

“We head home with a lot of information and images to digest,” wrote Chameides in a blog he posted about the group’s experiences at nicholas.duke.edu/thegreengrok/loganwv-mtm. An entire state with lopped-off mountains would be a tragedy, he wrote, but perhaps the ultimate tragedy would be the loss of a culture that is unique to West Virginia. “Whole communities have disappeared—not just the buildings or even the people, but the land itself. If you’re from West Virginia you may find that the price of progress is that the old country road no longer takes you home.”

—by Tim Lucas
One of America's most respected independent filmmakers and storytellers, John Sayles, is the 2012 recipient of The Duke LEAF Award for Lifetime Environmental Achievement in the Fine Arts. Duke University's Nicholas School of the Environment is presenting the award to Sayles on April 21 on Duke's campus.

An original “do-it-yourselfer,” Sayles figured prominently in the launching of the new independent film movement in the 1970s, writing and directing the critically acclaimed “Return of the Secaucus Seven” (1979) on a shoestring budget of $40,000. He followed with 16 other films he wrote and mostly edited, including “Matewan” (1987), and the Oscar-nominated “Passion Fish” (1992) and “Lone Star” (1996). His latest work is “Amigo” (2010).

The Duke LEAF has been given annually since 2009 to an artist whose work has lifted the human spirit by conveying our profound spiritual and material connection to the Earth, thereby inspiring others to help forge a more sustainable future for all. Previous recipients are Robert Redford, Jackson Browne and Barbara Kingsolver.

The selection committee for the LEAF was impressed and moved by the manner in which Sayles, as a filmmaker and writer, uses a sense of place and the land as the context for the human dramas that unfold in his narratives.

“John Sayles’ work subtly, but compellingly—and at times with humor—interweaves environmental themes and conflicts with themes of human conflict and struggle,” says Nicholas School Dean William L. Chameides. “Ultimately, Sayles makes us aware on a visceral as well as intellectual level of our strong material and spiritual connection to the natural world and, in the process inspires people to value and steward our environment.”

U.S. Environmental Protection Agency Administrator Lisa P. Jackson, a member of President Obama's cabinet, visited Durham in December for a conversation with more than 550 Duke community members about current EPA policies and recent Congressional challenges to environmental laws.

Jackson’s talk, part of the 2011 Duke Environment and Society Lecture Series sponsored by the Nicholas School of the Environment, was held in Reynolds Theater on campus.

Prior to the event, she visited with Duke President Richard Brodhead and Nicholas School Dean William L. Chameides, and joined a group of 20 faculty members and students for a roundtable lunch discussion.

Jackson, the first African-American to serve as EPA administrator, was named one of Newsweek’s “Most Important People in 2010” and was included in Time magazine’s 2010 and 2011 lists of the “100 Most Influential People in the World.” As head of the EPA’s staff of 18,000 professionals, she has pledged to focus on core issues: protecting air and water quality, reducing greenhouse gases, and preventing exposure to toxic contamination in communities. She has promised that EPA’s efforts will follow the best science, adhere to the rule of law, and be implemented with unparalleled transparency.

A video of her talk and an event slideshow are available at nicholas.duke.edu/deanseries.
Warming in the North Atlantic over the last 32 years has significantly reduced winter sea ice cover in harp seal breeding grounds, resulting in sharply higher death rates among seal pups in recent years, according to a new Duke University-led study.

“The kind of mortality we’re seeing in eastern Canada is dramatic. Entire year-classes may be disappearing from the population in low ice years—essentially all of the pups die,” says David W. Johnston, research scientist at the Duke University Marine Lab, part of the Nicholas School of the Environment. “It calls into question the resilience of the population.”

The study, published in the peer-reviewed journal PLoS ONE (January 2012), is the first to show that seasonal sea ice cover in all four harp seal breeding regions in the North Atlantic has declined by up to 6 percent a decade since 1979, when satellite records of ice conditions in the region began.

Harp seals rely on stable winter sea ice as safe places to give birth and nurse their young until the pups can swim and hunt on their own. Female seals typically seek out the thickest, oldest ice packs in sub-Arctic waters each February and March, and have adapted to the spring melt by developing unusually short, 12-day nursing periods.

“As a species, they’re well suited to deal with natural short-term shifts in climate, but our research suggests they may not be well adapted to absorb the effects of short-term variability combined with longer-term climate change and other human influences such as hunting and by-catch,” Johnston says.

To assess the cumulative impacts of these factors, the researchers analyzed satellite images of winter ice from 1992 to 2010 in the Gulf of St. Lawrence—a major breeding region off Canada’s east coast—and compared them to yearly reports of dead seal pup strandings in the region. They also compared the stranding rates to recorded measurements of the relative strength of the North Atlantic Oscillation (NAO), a climate phenomenon that controls the intensity and track of westerly winds and storms and greatly affects winter weather and sea ice formation in the region. These analyses revealed that higher pup mortalities occurred in the Northwest Atlantic harp seal herd in years with lighter ice cover and when the NAO was weaker.

Analysis of older data revealed that NAO-related changes in seasonal ice cover may have contributed to major declines in seal populations on the east coast of Canada from 1950 to 1972, and to a period of steady recovery from 1973 to 2000.

“There’s only so much ice out there, and declines in the quantity and quality of it across the region, coupled with the earlier arrival of spring ice breakup, is literally leaving these populations on thin ice,” Johnston says. “It may take years of good ice and steady population gains to make up for the heavy losses sustained during the recent string of bad ice years in eastern Canada.”

Co-authors of the study are doctoral student Matthew T. Bowers and research scientist Ari S. Friedlaender, both of Duke, and David M. Lavigne, science advisor at the International Fund for Animal Welfare, which funded the study.
An expedition led by scientists from Duke's Nicholas School of the Environment, the Neotropical Conservation Foundation and the Hummingbird Conservancy (Fundacion Colibri) has discovered 17 new species of amphibians, reptiles and orchids in a previously unexplored region of Colombia.

The species—including a giant tree lizard that is three times larger than other known species in the genus—were discovered in the 2,000-hectare Reserva Natural Mesenia-Paramillo amid high-elevation cloud forests in Colombia's northwest Andes.

The biologically rich area had been closed to scientists and their students for many years because of political unrest. Explorations there have only just begun.

The 2011 expedition was led by Stuart Pimm, Doris Duke Professor of Conservation Ecology at the Nicholas School; Ted R. Kahn, executive director of the Neotropical Conservation Foundation and a research fellow at the Nicholas School; and Luis A. Mazariegos, founder of the Hummingbird Conservancy.

The expedition's discoveries exceeded expectations, Pimm says. “The cloud forests of northwest Colombia occur roughly between 1,500 and 3,000 meters above sea level. They are rich in species diversity and exceptionally rich in endemic species, that is, those species found here and nowhere else. We already knew that this area has 14 International Union for the Conservation of Nature (IUCN) Red Listed bird species. Even so, the numbers of unique and potentially endangered species this expedition discovered is extraordinary,” he says.

“Among the finds are nine species of frogs and toads: five frogs in the genus Pristimantis, one small red poison frog in the genus Andinobates, and three toads, two in the Rhinella genus and one Atelopus. Atelopus is perhaps the world’s most endangered terrestrial vertebrate,” Kahn says, “with 80 percent or more of Atelopus species having gone extinct in just the past 20 years. We also found four reptiles, including two small ground snakes of the genus Atractus, which are worm-eating specialists, and one Tantilla species, which is a centipede-eating specialist.” One of the more unusual finds was an arboreal lizard in the genus Anadia.

Eighteen new species of plants and animals—including mammals, birds and amphibians—that are found nowhere in the world outside the Andes-Amazon basin in Peru and Bolivia.

The threat to these species has become especially severe in recent years, Swenson said, as oil and gold mining, infrastructure projects, agriculture and other human activities encroach farther and farther into the region’s biologically rich landscapes.

“This is one of Earth’s most rapidly changing areas,” she said.

To conduct their study, Swenson and her colleagues collected more than 7,000 individual records of endemic species locations for 115 species of birds, 55 mammals, 177 amphibians and 435 plants. They combined these with satellite images and climate, topography and vegetation data to create models, detailed to one kilometer, that mapped endemic species distributions across the entire basin—from the forested slopes and dry inter-mountain valleys of the Andes all the way to the low-lying Amazonian wetlands and savannas.

By overlaying this data with maps showing modern political boundaries in the Andes-Amazon basin, the researchers found that only about 20 percent of the areas with high numbers of endemic species or high levels of irreplaceability fell within national parks or protected areas, and that 226 rare endemic species lacked any national-level protection at all. Irreplaceability is a term used by conservationists to denote biodiversity hotspots where high numbers of endemic species with very small ranges live. These are often among the most vital—and vulnerable—habitats in a region.

“Interestingly, one of the areas we identified with the highest number of bird and mammal species and one of the highest levels of irreplaceability was an unprotected region surrounding the World Heritage Site of Machu Picchu, one of the most heavily visited tourist destinations in the region,” Swenson said.

As the effects of development and climate change continue to shrink or shift geographic ranges in coming decades, some species may literally be running out of ground, she said.

“Conservation strategies across the Andes urgently need revising,” she said.

“There is already evidence of species migrating upslope to keep up with climate change. We hope our data will help protect this incredibly unique region.”

Bruce E. Young, director of species science at the nonprofit conservation organization NatureServe, was principal co-author of the study. Twenty additional collaborators from conservation agencies and organizations in Peru and Bolivia helped gather the study’s extensive data.
FORESTS NOT KEEPING PACE WITH CLIMATE CHANGE

More than half of eastern U.S. tree species examined in a massive new Duke University–led study aren’t responding as predicted to climate change.

“Many models have predicted that trees will migrate rapidly to higher latitudes and elevations in response to warming temperatures, but evidence for a consistent, climate-driven northward migration is essentially absent in this large analysis,” says James S. Clark, H.L. Blomquist Professor of Environment at Duke’s Nicholas School of the Environment.

The scientists analyzed data on 92 species in more than 43,000 forest plots in 31 states. They published their findings in the journal *Global Change Biology* (October 2011).

Nearly 59 percent of the species examined by Clark and his colleagues showed signs that their geographic ranges are contracting from both the north and south.

Fewer species—only about 21 percent—appeared to be shifting northward as predicted. About 16 percent seemed to be advancing southward. Only around 4 percent appeared to be expanding both north and south.

The study found no consistent evidence that population spread is greatest in areas where climate has changed the most; nor do the species’ response patterns appear to be related to seed size or dispersal characteristics.

“Warm zones have shifted northward by up to 100 kilometers in some parts of the eastern United States, but our results do not inspire confidence that tree populations are tracking those changes,” says Clark, who also holds appointments at Duke as a professor of biology and statistics. “This increases the risk of serious lags in tree migrations.”

Kai Zhu, a doctoral student of Clark’s at Duke, was lead author of the study. Christopher W. Woodall, research forester at the U.S. Forest Service’s Northern Research Station in St. Paul, Minn., was a co-author.

The study was funded by the National Science Foundation.

Flawed Assessments Overstate Water, Sanitation Progress in Middle East

Assessments by the United Nations’ Joint Monitoring Programme (JMP) “significantly overstate" the extent of progress being made to improve access to safe drinking water and sanitation in the Middle East and North Africa, according to a study by researchers at three U.S. universities.

"On paper, access to clean water in most countries looks great; it’s only when you break it down that you see the holes in the JMP assessments,” says Erika S. Weinthal, associate professor of environmental policy at Duke’s Nicholas School of the Environment.

"Factors like affordability, sustainability, and the substandard quality or intermittent nature of many of the ‘improved’ water and sanitation services aren’t being taken into account,” says Jeannie Sowers, assistant professor of political science at the University of New Hampshire.

The JMP assessments, which are based on household surveys and national health questionnaires, are used by the United Nations to measure progress toward achieving its Millennium Development Goals (MDGs) of halving the number of people worldwide living without access to safe drinking water and sanitation by 2015. In 2008 and again in 2010, the JMP concluded that with few exceptions, countries in the Middle East and North Africa were on track to meet their MDGs.

The new peer-reviewed study, published in the journal *Development and Change* (November 2011), paints a less rosy picture. It finds that while progress is being made, discrepancies remain between the extent of progress reported by the JMP and the extent reported by many other surveys and studies. The discrepancy is especially great in rural areas and densely populated informal settlements such as slums or migratory encampments on urban outskirts.

"These communities continue to be underserved,” says Neda Zawahri, associate professor of political science at Cleveland State University. “Most governments have focused on upgrading water and sanitation services in urban centers and suburban areas where private investments are more readily available to help fund new infrastructure.”

To enhance the accuracy of its assessments and encourage investment in all projects, the JMP should establish minimum scientific standards to define what constitutes improved water or sanitation, says Sowers. It also should place greater emphasis on ensuring access and affordability for the poor and less emphasis on built infrastructure.

“The Middle East and North Africa is home to 5 percent of the world’s population but has less than 1 percent of its available fresh water,” Weinthal notes. “Projected population growth by 2025 is projected to shrink the per-capita water availability by 30 percent to 70 percent. Faced with numbers like these, we need to make every drop of water and every investment dollar count.”
INSPIRATION AMIDST THE BIRDS
You can never tell when inspiration will strike. In this case, the big idea was born amidst millions of nesting albatross on Midway Atoll, in the center of the Pacific Ocean. Midway is an amazing place—after enduring essentially everything harmful that humans can do to a place (short of being nuked), the atoll teems with life and brings hope for the future. It was on Midway in January 2010 that I received word that Apple had announced a potentially transformative piece of technology—the iPad.

On that morning, I woke to millions of chattering birds and walked to breakfast with my friends and co-instructors, Andy Read and J. Thomas McMurray, who were with me in Hawaii to teach a Marine Conservation Biology course. Tom was our guest lecturer for the course and no stranger to the high-tech world. We talked excitedly about the iPad as we strolled down the dirt path, stepping over birds and occasionally ducking as some landed nearby. The three of us agreed that Apple might just have released a potentially transformative piece of technology—the iPad.

The tablet computer seemed the perfect device for educational computing, especially if it could be wirelessly connected to the gateways that students increasingly use to engage with the world of networked knowledge. While I was walking to breakfast with my friends amidst the birds, the idea of a digital textbook for our Marine Megafauna class took root in my mind.

BACK IN NORTH CAROLINA
Teaching Marine Megafauna at Duke is all about engagement. This class, open to juniors and up, provides a chance for us pointy-headed marine scientists to expose students from a variety of backgrounds to the nuts and bolts of marine science and conservation through engaging and inspirational examples that employ the biggest, most compelling creatures in the ocean.

I tell my students at our first class meeting that my goal is to sneak important, and often difficult, concepts in marine science into their brains on the backs of penguins. This is our novel pedagogical hook to grab the attention of students and identify those with interest and aptitude in marine science. Once we have accomplished this, it becomes easier to recruit them to the Duke Marine Lab to study with us, and perhaps, to help them find a career in marine science.

Teaching a class like this has many challenges, one of which is assigning a textbook. Because the course covers details on marine species and systems that ranges from giant squid to grey seals, and from estuaries to deep sea vent fields, it’s impossible to find one text that will cover it all. In fact, to get what they need as background reading from traditional textbooks, students would have to buy four or five books and use only parts of each. This traditional approach would cost hundreds of dollars, perhaps more than the cost of an iPad. Many of these books would be outdated (and most likely were the day they were published).

To skirt this problem, we had been assigning articles from the primary literature as readings for the course. These readings captured the real science behind the information taught in class, with the added benefit of linking students directly to the source and providing informal lessons on how to decode facts from the sometimes-arcane academic knowledge stream. (Journal articles are, by their very nature, somewhat dry and conservative.)
This disjointed process seemed somehow “frankenstein-ian,” with bits and pieces cobbled together into something that worked, barely. It clashed with my aspiration to use compelling creatures to connect with students, and to do so using modern multimedia.

CREATED BY STUDENTS, FOR STUDENTS
Inspired by the release of the iPad, and supported by colleagues at the Nicholas School of the Environment and the Duke Center for Instructional Technology, I embarked on a process that aimed to leverage our research group’s massive repository of multimedia on compelling marine species into resources that could be exploited on tablet computers and used to teach our Marine Megafauna class.

After some inquiries to newly formed digital textbook companies about translating this material into an official title, it became clear that niche courses like Marine Megafauna were small fish to fry. The big money was in landing the textbook for Introduction to Biology, or Chemistry 101.

Luckily for us, Andrea Novicki from the Duke Center for Instructional Technology connected me with Robert Duvall and Richard Lucic in Duke’s Department of Computer Science. Richard and Robert had introduced a new class in the Spring of 2011 that aimed to teach students the process of software development for a client, and as part of this process the students were to develop and release an “app” that satisfied the client’s needs.

After pitching the idea to students in the class, the concept of a digital textbook for Marine Megafauna blossomed into reality as five students joined up to tackle the job. With the energy and ideas of these bright students injected into the mix, the project took on a life of its own. By the end of that semester, we had Cachalot version 1.0 ready for release on the iTunes App Store.

DECONSTRUCTING THE MONOLITHIC TEXTBOOK
Textbooks always have been monolithic in authorship and format: typically written by one smart person or by a small number of smart people, and found in bookstores as large, heavy volumes with thick covers. Great for collecting dust after students are done with them.

Until recently, most digital textbooks followed this lead. They’ve simply been digitized copies of existing monolithic texts with a few bells and whistles added—often offered as single-file downloads larger than 500 megabytes. Our approach, and that followed by others truly interested in redefining the textbook for the mobile device age, deviates from this format.

Instead of offering a giant download that captures everything in one file, we established a modular approach, allowing for bite-sized bits of information to be downloaded to the students’ tablet and consumed as needed. This approach relies on the growing bandwidth of wireless networks, and reduces the time it takes to access content, and the memory needed to store it. It also means that the content is easily updated, a far cry from the static texts we are so used to having on our shelves.

We also deviated from the monolithic author approach by crowd-sourcing the content. To do this we engage with scientists as direct contributors to the text. These researchers contribute content related to their fields of expertise, and we provide them a new outlet for their work—one that allows them to include the multimedia they find truly inspirational. To accompany their custom content, we still include PDFs of related journal articles, and allow students to interact with these materials within an annotation interface.
Most importantly, we’ve released Cachalot as an Open Access publication, one that is free for everyone to use and share. To accomplish this with media embedded, we’ve adopted a Creative Commons license that protects the contributors’ rights while allowing full educational use of their content.

**LET ME EXPLAIN THIS A BIT.**

The concept of Open Access publishing is changing how science is accessed by people around the world. The recent success of Open Access journals like PLoS ONE is a testimony to this, and we embed PLoS ONE articles within Cachalot to support lecture materials and other content within the app. By crowdsourcing Cachalot, and releasing it as an Open Access resource we embrace the “do-it-together” ideal espoused by many interested in using technology for teaching about science and environmental issues.

Pedagogically, Cachalot aims to help teach fundamentals in marine science and conservation by employing examples that resonate with students. These compelling species act as natural hooks to gain students’ interest and maintain their attention, helping them learn and retain key concepts. While most courses that focus on sea turtles or marine mammals emphasize taxonomic specialties as the end-point, we can reverse-engineer this to teach the fundamentals of marine science in engaging ways.

Finally, a transformative technology for teaching has arrived. Tablet computers are an exciting alternative to traditional textbooks and provide new ways to connect educators, researchers and students. No longer will large textbook companies be the sole gatekeepers of knowledge for students in formal educational programs.

**A TEXTBOOK RE-IMAGINED**

It is amazing what can happen in a year’s time. I pitched the idea of a digital textbook to the students in Computer Science in January 2011, and was teaching with the app in my Marine Megafauna class in January 2012.

Cachalot integrates Open Access journal articles, textbook-style content (including great photos and illustrations), video, audio and animations of animal behavior and anatomy within an annotation interface. It provides direct access to the experts who contribute to it, and the app incorporates a Twitter-based messaging system for students to communicate about course materials and a computational interface that hooks students into Wolfram Alpha’s knowledge-base, an answer-engine released in 2009. Much of Cachalot’s content is highly accessible to the general public, providing a new way to educate people about marine science in informal settings. The application has been developed as a framework, portable to other classes and other purposes.

Cachalot remains a work in progress, thanks to Adam Cue (the lead developer), Heather Heenehan, Kerry Irish and many others who have contributed their energy and knowledge. And we are continuing to re-imagine where we can go. In the near future we will announce a call for chapters in Cachalot that will take crowd-sourced textbook content fully into peer-review.

This process is designed specifically to establish an author’s contribution to the app as a legitimate academic endeavor in the eyes of those charged with overseeing academic promotion and tenure. As this experiment plays out, we hope Cachalot will become the first scalable Open Access textbook for teaching marine science in many forms, useful to anyone and everyone interested in employing it.
THREE REASONS TO BLOW UP A DAM
AND TWO WAYS TO GO ABOUT IT

ECOHYDROLOGIST MARTIN DOYLE STUDIES HOW AND WHY TO DECOMMISSION U.S. DAMS

BY LISA M. DELIWO photos by Jim Wallace
“I blow up dams,”

Martin Doyle says, describing his work with engaging hyperbole. Doyle recently joined the Nicholas School of the Environment as professor of river science and policy, one of four new ecologists on the faculty. He doesn’t blow up dams himself; but he hangs around blown-up dams to find out how rivers respond to the process.

Among environmentalists, it’s an article of faith that blowing up dams is a good thing, primarily because it restores the spawning runs of salmon, shad, and other migratory fish, as well as re-establishing the natural flow on which entire river ecosystems depend. Some readers may recall John McPhee’s description, in his 1971 book *Encounters with the Archdruid*, of dams as being “proportionately and metaphysically sinister to conservationists.” McPhee explains, “possibly the reaction to dams is so violent because rivers are the ultimate metaphors of existence, and dams destroy rivers.”

“To remove a dam is to liberate a river,” echoes ecologist Emily Stanley, a professor in the department of zoology and the Center for Limnology at the University of Wisconsin.

It was with Stanley that Martin Doyle collaborated on his first studies of dam removal, conducted for his PhD thesis at Purdue University. After having studied physics and hydraulic engineering for his undergraduate and master’s degrees, he was working in river restoration for a consulting firm in Montana. When his company went after a dam removal contract—and discovered that no one knew much about the impacts of dam removal—he went back to school to educate himself on the process. Fully intending to return to consulting, he was instead bitten by the research bug, and an academic career was born.

It turns out that “blowing up dams” is a dramatic bit of shorthand for dam decommissioning. If one takes it as a given that removing dams is a good thing, then the really interesting question—academically and practically—is what’s the best way to go about it? Blowing them up is one way: “Use explosives to blow a big notch in it and scrape out the rest with a backhoe,” says Doyle, describing a process known as “blow and go.” It’s the least expensive way to remove a dam. But it can unleash a torrent of pent-up sediment that many fear could cause just as much ecological damage as the dam itself.

The other way is to scrape off a few feet of the dam at a time, allowing the sediment to escape in increments and also establishing plantings that will keep some of the sediment in place. This method is more costly but could be gentler on the downstream ecosystem.

The key word is “could.” For as Doyle asks, is it better for the living creatures downstream to absorb “an uppercut to the face or a series of body blows?”

The experiment is being carried out on a grand scale on the Elwha River in Washington State. Two huge dams, built in the early twentieth century to power economic growth in the region, are now slated for removal. They contain millions of cubic yards of sediment. The dams are being removed gradually, and it is believed that historic salmon runs will return to the river’s upper reaches within a year after the project is complete.

The giant Elwha dams are symbolic of the U.S.’s flawed love affair with hydropower, Doyle says. Many never lived up to their economic promise. Some other dams, he says, were built out of necessity and remain critical for power generation or flood control. Despite the current fashion in dam removal and the potential benefits for spawning fish, these useful dams will never come down, he says.

The Elwha is not typical of dam removal projects, and spawning salmon are not the only organisms affected by dams or their removal. According to Doyle, most of the country’s dams are small, and a surprising number are abandoned. North Carolina, for instance, has upwards of 3,600 dams that were built for a bygone era—to provide power for textile mills or for agricultural purposes or simply because there was federal funding available for dam building. Many of them are owned privately. Removing these dams insulates the owners from liability for injuries and deaths associated with the dams and their spillways.

One of North Carolina’s small dams is the 15-foot Milburnie Dam outside of Raleigh, N.C. The firm Restoration Systems is currently completing the permitting process to remove the dam, and when that happens, Doyle will be there to study the impact, along with colleagues Dean Urban from the Nicholas School and David Strayer from the Cary Institute of Ecosystem Studies.

Of particular interest are freshwater mussels that live in the Neuse River. Strayer is one of the leading experts on these bivalves, which can live for decades. He says that downstream fish are mobile and can swim away from trouble if a “big slug of sediment” comes downstream. But the mussels are not mobile. “If a dam is removed and sediment is flowing, that is an impossible situation for a mussel,” he says wryly. On the other hand, dams can isolate populations of fish and mussels from each other, and since the mussels are parasitic on fish, that also can be bad. “Over the long term, we may have committed ourselves to large losses with these dams,” says Strayer.

Doyle’s collaborations with ecologists like Stanley and Strayer are a hallmark of his academic career. “He is unconventional,” says Stanley. “He started in physics and math. He is an engineer. For his PhD, he collaborated with an ecologist.”

“He’s interested in making connections across fields,” Strayer says. “And you can argue that important science advances happen across the fields of knowledge.”

In fact, Doyle’s decision to leave a tenured position at UNC-Chapel Hill in 2011 to come to the Nicholas School was guided not just by the prospect of building a world-class program in river studies with a cluster of stellar colleagues (see sidebar, page 21) but also by the other academics he’d be rubbing elbows with. “I go down the hall and there are economists the caliber of
Marty Smith. There are chemists. Soon there will be someone working in environmental entrepreneurship. The crazier the hallway conversations, the more I feel at home,” Doyle says.

And why does a river studies guy need to talk to an economist or environmental entrepreneur?

It turns out that one of the main forces for dam removal in North Carolina (and many other states) is the stream mitigation market. Think of it as cap-and-trade for streams. If you’re a developer and your project will negatively impact a stream, you have to improve or restore one elsewhere. Or, you can buy restoration credits from “mitigation bankers.”

That’s what’s going on with the Milburnie Dam project, the one where Doyle and colleagues will be studying the impact on freshwater mussels. Private investors bought the dam—and others in the state—and will remove it in order to get bankable mitigation credits.

Stream mitigation trading is all based on ecosystem services, Doyle says, the idea that ecosystems do things that humans value. Natural ecosystems like streams and wetlands provide flood control, they filter pollution, they provide recreation. So entrepreneurs are capitalizing on the “natural value” provided by dam removal to participate in a market-based incentive system where they can literally take environmental conservation to the bank.

“North Carolina is a hotbed of this,” says Doyle. That’s partly because it’s a very wet state, particularly east of I-85. Every loop or bypass built around Raleigh crosses swamps and streams. If you want to build these roads, you need to mitigate streams and wetlands elsewhere—or pay someone else to do it.

“It’s fricking weird,” he says. “A landscape is being restored for economic reasons.”

What happens, then, in an economic downturn? Developers aren’t developing much of anything right now. “There’s much less demand for credits, so now there’s little demand for stream restoration.” That is to say that dam removals might be delayed, or, as in the case of the Milburnie Dam, they might be undertaken but at a financial risk, one undertaken in the hope that markets for restored aquatic ecosystems will rebound.

Is this good? Bad? Doyle says that it’s neither, but that this coupling of conservation and capitalism is here to stay. “My expectation is that we will continue to use markets” to achieve environmental goals. It’s the future of conservation, he believes.

And that’s why he has started identifying himself as specializing in river studies rather than river science. And why he’s happy to have an economist or two down the hall.

And it’s why he believes the environmental managers of the future—such as those trained at the Nicholas School—had better be just as well versed in financial markets as in hydrology and regulatory policy.

“The future of conservation will be more affected by incentives and market-entry dynamics,” he says. “Market forces will be doing the regulatory work.”

Lisa M. Dellwo is a freelance writer in New York’s Hudson Valley.
When the Nicholas School of the Environment set out to hire four ecohydrologists, it was expected that the new hires would create a core of strength in the school and bolster an already strong campus presence in wetlands studies and hydrology. What was perhaps a bit unexpected was that Duke was able to attract four rock stars in the field.

Together, Martin Doyle, Marco Marani, Jim Heffernan, and Brian McGlynn form a sort of Dream Team or Fab Four of ecohydrology, an interdisciplinary field that addresses how ecosystems affect the flow of water and vice versa.

Nicholas School Dean William L. Chameides recalls that when the four were being recruited, one prominent academic who was asked to write a letter of recommendation said, “It is mind-boggling to think of what would be possible” if we were to get all four of them.

“And we did get all four,” Chameides says.

Marani has recently arrived from Italy, where his research involved remote sensing in the famed Venice lagoon. “He’s high theory; his math is just wicked,” says Doyle. Heffernan is a biogeochemist whose research involves how aquatic ecosystems respond to natural and human-caused disturbances. Most recently, his work has involved the Florida Everglades. McGlynn is renowned for figuring out how to instrument a watershed and collect data that no one thought it would be possible to get, Doyle says. “We all work on rivers, but from different angles.”

Chameides says that the cluster of hires came about after he asked faculty to recommend a field that every division of the school has a stake in, as a way of bringing the three divisions closer together. The recommendation the faculty came up with was ecohydrology, he says.

That’s because water is simply one of the key environmental issues we face, he says, impacted by climate change, rising populations and land use policy. Hiring top water scientists and then connecting them with existing campus specialists within and outside of the Nicholas School was the plan.

Traditionally, new faculty hires are given funding to build a lab. Doyle, Heffernan, and McGlynn have opted to create a joint lab, now named the Duke Freshwater Science Laboratory and Research Center.

Chameides sees this lab as the hub of campuswide collaborations that will address water resources challenges from a variety of perspectives.

“Our program begins in science,” Chameides says. “Then understanding policy: the governance of water, international treaties, geopolitical problems. Then comes the business of water. Entrepreneurship and innovation might lead to better management of water.”

New hires are planned in the areas of environmental politics and environmental entrepreneurship, and while those faculty members will not necessarily be water specialists, he expects that they will interact with the water resources group.
by Colin Hoogerwerf MEM’13

What’s Behind the Label?

Shana Starobin is Trying to Make Sure You Know

by Megan Morr

Shana Starobin is working to answer these questions. Starobin, a PhD student at the Nicholas School of the Environment and recipient of Duke’s prestigious university-wide Kenan Graduate Instructorship in Ethics, is investigating eco-labeling as part of her dissertation on third-party certification. This spring, she’s teaching an undergraduate-level seminar about public and private regulation of food and agriculture in global supply chains. In 2010, she and Erika Weinthal, associate professor of environmental policy, published a paper in the peer-reviewed journal Business and Politics that examined how third-party certifiers gain credibility.

Using the kosher label as an example, the paper illustrates a system of oversight in which third-party certifiers have assumed a position of expertise and transparency, resulting in a process in which information is passed in a trustworthy manner between producers and consumers.

“The kosher label targets a small group of highly vigilant consumers who are strict adherents to Jewish dietary laws, with a deep and vested interest in making sure they know exactly what kosher labels mean,” Starobin says. “This is a group of people who care, in principle, about a set of values and also pay close attention, in practice, to ensure those values are upheld at both point of sale and production,” she says. They are astute in discovering and reporting false claims—levying their own reputational sanctions on community members or companies that have failed to uphold proclaimed standards.

By comparison, Starobin notes, “We hear less about vigilant environment-ally conscious consumers investigating eco-labels, publicizing false claims and holding the certifiers accountable.” Without a system of oversight and enforcement similar to what producers, certifiers and consumers of kosher foods have developed, the current proliferation of eco-labels risks rendering the...
information on the labels meaningless. Consumers may end up buying a product that isn’t what it claims, or selecting one carton of eggs over another because they misunderstand what its labeling means.

Producers pay a cost, too. Financially constrained producers may find themselves paying hefty sums of money to pursue additional certifications only to find that still more certifications may be needed to compete in the market. “How many is enough?” Starobin asks. “Organic, shade-grown, bird-friendly, fair trade, kosher…”

Some producers can afford to pay the costs associated with third-party certification, which involves site visits from independent auditors with the presumed expertise to evaluate whether a given farm, facility or organization conforms to the requisite standards meriting the certified label. But many producers can’t afford to participate, especially small-scale farmers in developing countries.

It’s a complex issue, raising questions not only about the regulation of the global food supply chain, but also sustainable development, social entrepreneurship and civic engagement—topics that have shaped and driven Starobin’s studies and actions for much of her life.

A GLOBAL PERSPECTIVE
After earning her bachelor’s degree in history and science from Harvard University in 2000, Starobin spent a year in Israel on a Dorot Fellowship, interning with a nonprofit organization that worked to foster public- and private-sector leadership on environmental issues during a period of intense conflict in the region.

She returned to the United States the following year to work with Green Corps on their education and advocacy efforts to protect the Arctic National Wildlife Refuge and promote renewable energy legislation.

Those experiences, combined with extensive backpacking through remote wilderness and rural areas in East Africa, New Zealand and Australia, motivated her to return to graduate school to further her education in natural resource management and policy.

In 2008, Starobin graduated with dual master of environmental management and master of public policy degrees from Duke, where she co-founded the Duke Microfinance Leadership Initiative. For her masters project, she investigated ways that socially motivated microfinance programs could incorporate environmental sustainability into their efforts. She spent a summer in Bangladesh with DukeEngage and BRAC, a development organization focused on creating innovative solutions for alleviating poverty, and another summer interning at a remote Nicaraguan branch office of the international microfinance organization FINCA. She also worked with other Central American grassroots development organizations in connection with American Jewish World Service.

“I wound up looking deeply at how
people organize themselves in relation to natural resources,” she says. While working with rural producer organizations in Central America, Starobin observed that the eco-labels seen on consumer products didn’t always paint an accurate picture of the production and certification standards and processes. And even when they did, how could a shopper thousands of miles away in Durham or Dusseldorf verify it?

Shoppers might be willing to pay more for products with characteristics they deemed desirable—like fair wages paid to workers in developing countries or the absence of chemical fertilizers and pesticides—but ultimately, what observable proof did they have that a bag of coffee was organic or fair trade?

Determined to help find answers, Starobin returned to Duke to conduct doctoral research and “dig further into the relationship between international development and the environment.”

THE KOSHER EXAMPLE

With input from Weinthal, her faculty advisor, she began to investigate the kosher food market as an example of a successful certification process.

Studying the kosher label made sense for a variety of reasons. Through her ongoing work with American Jewish World Service, Starobin often came into contact with Jewish leaders who provided insight into kosher laws and their implications for the average consumer. Also, it drew upon her personal experience of adhering to ethical eating values. The more deeply she delved, the more she realized the checks and balances that made kosher certification trustworthy and effective could serve as a guide for improving label certification in other markets as well.

Her research showed that close-knit relationships in the kosher market—where people tend to know one another, and often even know the identity of auditors inspecting kosher food production—make it possible for communities to use reputational sanctions as a means of enforcement, and may lower costs associated with label monitoring. Third-party kosher certifiers are trustworthy because they are known by the community, so any willful wrongdoing can affect their personal relationships and reputations.

Shoppers looking for information to verify label credibility can turn to several trustworthy sources, including other community members, rabbis, or—increasingly—online databases and websites.

Not all of these checks and balances may work in broader, more anonymous markets, Starobin says, but the underlying principles still apply.

WHAT CAN CONSUMERS DO?

First and foremost, ask questions.

“A question is the first sign of demand in the market,” Starobin says. By asking questions and reporting what seem to be false claims, citizen-consumers, whether individually or organized in groups, can amplify oversight in a low-cost and robust way, enabling more rapid feedback and response. This is particularly important where incidents of harm might occur.

Second, be vigilant.

This means not only asking questions, but relaying these questions to organizations and institutions that have the capacity to respond. By doing nothing, consumers passively reinforce a status quo that serves the interests of big-box retailers and large-scale food manufacturers, not the consumer.

Finally, stay informed.

Read the news. Talk to other consumers who share your interests and concerns. And be cognizant of where information is coming from. Manufacturers’ claims about themselves and their products can lack credibility, even if they prove true. So don’t just rely on labels or ads. Seek out multiple sources of information, especially from independent parties who have no vested stake in the sale of products and are free of any conflict of interest.

The internet can be a good place to start, Starobin notes. There are now many online tools to help consumers evaluate products and the accuracy of eco-labels.

GreenerChoices.org, a creation of the watch-dog group Consumers Union, grades eco-labels on food products based on criteria such as meaningfulness, consistency and transparency.

The Environmental Working Group’s “Shopper’s Guide to Pesticides in Produce” (www.ewg.org/foodnews) can be useful when deciding which fruits and vegetables are best bought organic, and which are okay to buy conventional.

GoodGuide.com has its own teams of scientists, life-cycle analysts, sociologists and other experts who test food and other consumer products for their health, environmental and societal impacts. It has an application that scans barcodes and offers immediate reports.

Shoppers concerned about the accuracy of labels on personal care and hygiene products can check out the Environmental Working Group’s “Skin Deep Cosmetics Database” (www.ewg.org/skindeep). The site provides “hazard scores” from 0 to 10 for around 69,000 products, from nail polish and shampoo to toothpaste and sunless tanning lotions. Scores are based on the scope of safety data in the Skin Deep database and the number of studies available in the open scientific literature.

Using these and other third-party resources and sharing information with trusted members of the community can help consumers understand what goes on behind the scenes in product labeling and make choices in line with their own personal ethical values, says Starobin, who plans to continue her career in research and teaching after completing her PhD.

Government regulations play a vital role in the oversight process, she says. But ultimately, it’s up to us to arm ourselves with information about what to look for—and what to question—the next time we’re at the store comparing labels.

Organic and cage-free. Who says?

Colin Hoogerwerf MEM’13 is the Nicholas School’s student communications assistant for 2011–12.
Imagine a building on the Duke University’s campus that is

- Designed and constructed along the highest standards of sustainability;
- Operated as a living laboratory for aligning human behavior, functionality and sustainability;
- A showcase for artists portraying our profound connection to the natural world; and
- The home of one of the world’s premier environmental programs.

Since arriving on the Duke campus in 2007 I, along with my colleagues at the Nicholas School, have not only been imagining such a building but doing everything we could to make it a reality.

At long last our dream is about to be realized; our work is coming to fruition. In February, the Duke Board of Trustees gave the go-ahead for the 70,000-square-foot Duke Environment Hall. We will break ground in April during Duke’s Reunions Weekend and we anticipate that construction will be complete by summer 2013.

The iconic glass-and-concrete structure that rises from the footprint of our old parking lot will house classrooms, offices, laboratories, study lounges, meeting spaces, computer labs and an environmental arts gallery, and will serve as the hub of environmental activity on campus.

It will stand as a bold statement of our university’s environmental aspirations and leadership, and as a testing ground for technological innovation. It also will provide our school the much-needed space and resources to keep pace with our growing enrollments and the expanding scope of our academic, research and professional programs.

The five-story hall will be the first programmatic building on the Duke campus to be certified LEED Platinum, the highest rating awarded by the U.S. Green Building Council. It will push the boundaries of sustainable design by employing technologies such as a chilled beam system for air conditioning and a thermal corridor to provide natural insulation. Solar hot water and photovoltaic panels systems and natural lighting will enhance energy efficiency. Graywater and rainwater will be recycled for use in toilets and irrigation. A green roof will mitigate urban heat island effect, provide a habitat for wildlife, reduce stormwater runoff and provide improved thermal insulation, while serving as a student testing ground for sustainable gardening and agriculture.

In the end, however, Duke Environment Hall’s success—and by extension, our success as environmental educators and leaders—depends as much on the human factor as on the high-tech bricks and mortar we employ.

Our responsibility to push the boundaries of sustainability won’t end with construction. Once occupied, Duke Environment Hall will become a living laboratory where students and faculty, using an advanced energy monitoring and management system, explore how human behavior can be most effectively aligned with technology to maximize building performance and occupant productivity. The results of these “experiments” will not only reap benefits for the Environment Hall but, through the experiential learning afforded our students and the insights revealed, will reverberate throughout and well-beyond the Duke campus.

The natural and social environmental sciences are the lifeblood of the Nicholas School. But there is something else, something that exists outside of the scientific enterprise that also is important to our mission: it provides us with a more visceral, perhaps spiritual as well as material connection to the Earth. It is the arts. Through internal and outdoor design elements and an Environmental Arts Gallery, the Duke Environmental Hall will showcase the essential role of the arts in conveying that profound connection and, in so doing, inspiring others to help forge a more sustainable future for all.

Fulfilling our dream for the Environment Hall requires significant financial capital. Our university’s leaders have made a substantial and far-sighted investment to get the Hall on its way, but funding challenges and opportunities remain for like-minded visionaries who want to join us in this historic project.

As we celebrate Duke Environment Hall’s construction, we must not lose sight that this building, much needed and long delayed by the global economic downturn, is not an end in itself. It’s a milestone, a major step toward our mission of creating knowledge and leaders of consequence for a sustainable future.

This dream is now a reality. There are many more to pursue.

William L. Chameides is dean of the Nicholas School of the Environment and Nicholas Professor of the Environment
STORY BY ERICA ROWELL
Photos courtesy of Kristine Young
“When you eat them fresh, they almost pop inside your mouth,” says Kristine Young MEM’09, describing something most people have not experienced.

“Cranberries are unique in that they’re not a sweet fruit, definitely more on the bright side of a profile,” she continues, schooling the uninitiated on the taste of a fresh cranberry. “I would describe them as bright and refreshing.”

Young’s burgeoning authority on the cranberry is a result of her position at Ocean Spray. As sustainability manager, she integrates sustainable environmental practices into the business of making products, primarily from cranberries but also citrus fruits. Eating fresh cranberries has been part of her on-the-job training, along with learning the ins and outs of growing the native North American berry, and turning the tart, highly nutritious fruit into beverages and snacks.

She came to the job with the sustainability piece in hand, thanks to her Duke University master of environmental management degree, and she has taken to being sustainability manager, one might say, like a duck to water.

Water, it turns out, is a big part of her story.

“[Cranberries] float, which is why our entire harvesting process is based on floating and water,” Young explains.

But water also is the common thread that weaves together her lifelong interests, her career and her studies, both as a graduate student at the Nicholas School of the Environment and an undergraduate studying photography at the University of North Texas.

WATER WORLD AND FIELD PHOTOGRAPHY

“Growing up in Texas,” says Young, a native of Fort Worth, “there’s a lot of awareness around water conservation. It’s just part of life, a way of being. Water restrictions are a common theme every summer. So I’m familiar with water challenges.”

That familiarity with water, combined with her curiosity about how humans interact with and depend on such a vital resource, became the basis for her photography projects.

For her senior exhibition, she put together a photographic series showing objects floating on water and their reflections. It created what she calls an “interaction” between the actual items on the surface as caught on camera and their reflections captured both on the water and on film. She did another installation showing a series of nightscapes with long exposures around water.

Perhaps most prescient of her career to come was the photographic exhibit she did involving actual physical interaction between the medium and its subject. For this week-long installation, four photographs, each depicting a different water source—a duck pond, a Japanese garden, a recreational river and a reservoir that supplied her local water—sat in four separate jars of water collected from the location pictured. The jars, each labeled with water-quality metrics (such as pH levels) that she had tested for, sat illuminated on a mantel-like shelf built by Young. Throughout the exhibition, observers could see the water slowly eat away at the images, sending the photographic materials into the water column.

“I imagine a lava lamp,” she says, describing the debris that floated in the water, detritus from the water source as well as the photograph. “Over the course of the week, the photographs disappeared—the heat from the light removed the emulsion from the photographs in layers, taking off the red, then the blue, and finally the yellow,” says Young.

“It was a total interconnection of the physical aspect of water and our perspective of it. It played with our perceptions of what we see as pristine and beautiful and the reality of the environmental aspect of the resource.”
After receiving her bachelor of fine arts, Young got her feet wet in the business world, where ideas for her career path began percolating. As a store manager for both Apple Computers and Starbucks, she found that she liked the experience of working for popular brands that sold “amazing products.” Her exposure to the coffee giant’s efforts to source sustainably grown coffee sharpened her focus—she wanted to work with top companies to make a business case for sustainability and to be able to know how to make that case.

For the how part, she chose the Nicholas School. A visit to campus left her impressed with the school’s interdisciplinary approach. She liked that the program was grounded in science, and found appealing the easy access to the Sanford School of Public Policy, Duke Law, and the Fuqua School of Business. Other selling points: flexibility and opportunity—the ability to mix forestry and wetland classes and fieldwork with the potential to work with professionals in the business program.

As a student at the Nicholas School in the environmental economics and policy track, she used her philosophy as an artist to guide her program of study: study what you love so you can do what you love when you graduate. For Young that meant that water, not energy (the popular pairing with business studies), would be front and center.

“When looking at the critical challenges facing humanity and our Earth,” Young says, “energy is important, but you can harness energy. Energy comes from very different forms and many different means and it’s through human ingenuity that we learn how to capture and utilize it. We cannot create water as much as we would like to think that we can. It’s a finite resource that is critical for life. It’s life-sustaining; it’s also business-sustaining.”

So she plotted her coursework, focusing on business, water, and whatever other subjects she found appealing.

“I took a lot of forestry courses that involved being more outside than in the classroom,” she says. “And I now find those classes to be very helpful in
my current position because it was an opportunity for me to see sustainability from the side of land management and the stewardship perspective. In much of the same way a forest manager is trying to look at land resources over the long term, that same concept is very helpful in thinking about sustainability when I'm working with farmers and agricultural production systems and global supply chains.”

Her work with global supply chains began with another big beverage company. The fall after graduating from Duke, she landed a consulting position at The Coca-Cola Company, working on Bonsucro, now a publically available certification standard. Then, it was being developed to reduce the environmental and social impacts of producing sugar-cane, a very thirsty crop. She also helped assess ways in which the company’s water resources could be improved.

She credits a life cycle analysis class, offered during her last semester at the Nicholas School, with providing her the right skillset for the job.

“[The course] completely overloaded me,” she says. “I did not need the credit, but it was a tool I was very interested in and that has served me very well. It opened up opportunities for me to work on very specific projects at Coca-Cola—and that same concept has transferred when I look at water footprints on consumer packaged goods.”

**AFTER FIELDS OF SUGARCANE, CRANBERRY LAND**

Last April, Young moved from consultant at Coca-Cola to sustainability manager at Ocean Spray, the giant Massachusetts-based agricultural co-op owned by more than 700 cranberry growers and 50 citrus growers.

Contrary to popular belief, the floatable cranberry, cultivated in the United States since the early 19th century, grows not in water but on low-lying vines. The plant’s pink blossoms reminded European settlers of the head of a crane. (Eventually the crane-berry morphed into the cranberry). But along with acidic soil and sand, cranberries require lots of water.

It’s fall harvest season that gives rise to the iconic image of the cranberry farmer up to his or her waist in water, raking the berries. And during last year’s harvest, Young hiked up a pair of waders, and waded through cranberry bogs. She corralled the berries toward a big funnel that then shot them up into a truck.

The berries are later tested for bouncability (good berries not only float, they bounce). Harvest days are long and wet, but the harvest season is relatively short, meaning just a few days of the exhausting-in-water work for most bogs.

In Massachusetts, Young says, “the growers coordinate, so when the water leaves one bog it goes to another. Water may pass through 2 to 4 cranberry bogs before it’s released back into a water system.” She says she’s been impressed with how some bogs in Massachusetts, the number two cranberry-growing state after Wisconsin, are used as storm-water control, taking on and holding extra water until local waterways can handle the influx of water.

It’s capitalizing on these types of things, and getting the relevant stakeholders onboard, that allows Young to help Ocean Spray improve its environmental practices and stewardship.

Ocean Spray’s sustainability program focuses on five key areas: sustainable agriculture, water stewardship, climate change and energy, packaging, and waste reduction. Setting five-year targets in each area, Young and her colleagues monitor and measure their progress in meeting those goals.

Recently, the company reduced its carbon dioxide (CO₂) footprint just by reevaluating and optimizing their logistics network. After seeing that a big chunk of demand was coming from the Southeast while bottling was done out of New Jersey and Texas, Ocean Spray contracted with a bottler in Florida to get the supply-and-demand chain in closer proximity. The change resulted in 14,000 tons in CO₂ savings as well as reduced costs.

While cutting costs is something that generally translates well across all stakeholders in business, one of the challenges Young faces is reducing environmental impacts that do not necessarily carry cost savings.

“One of the challenges I’m always facing is trying to make the case for looking at water resources as closely as we do energy resources even though there isn’t always a cost reduction associated with it,” says Young. “There’s a business continuity guarantee that comes with looking at and planning for long-term water risk.”

For water used in manufacturing, for instance, Ocean Spray’s goal is a 15 percent reduction per production unit. To achieve this, the company is continually looking for water leaks they can stop up, as well as opportunities to reuse water. For example, they have identified places to capture evaporators’ condensate for reuse in cooling tower systems and general cleaning. And through a partnership with The Nature Conservancy they are looking at upstream and downstream impacts in watersheds where the company’s manufacturing facilities are located to identify long-term trends and potential mitigation activities.

On the agricultural side of water use, there’s not much room for conservation since, unlike with traditional crops, the water used to grow cranberries is not consumed but is reused and recycled for irrigation and harvesting. Young and her colleagues are, though, working with Ocean Spray’s growers on a comprehensive water management plan to aim for high water quality in and around bogs.

As she did at the Nicholas School, Young divides her time between being indoors, this time in an office, and going out in the fields to meet with growers on their farms, some of whose cranberry fields go back many generations, some even more than a century. She thinks these professionals have a lot in common with her Nicholas School colleagues.

“They very essence of being a cranberry farmer is rooted in sustainability,” Young says of her new colleagues. “They understand the long-term necessity for managing the crop for environmental impacts.”

**Erica Rowell is managing editor of Dean Chameides’ blog, TheGreenGrok.com. She is based in New York City.**
The first of a two-part series. Part 2 will appear in the Fall 2012 Dukenvironment.

Tim Mohin MEM’84, director of corporate responsibility for Advanced Micro Devices (AMD), thinks business and the environment can be harmonious pursuits. His decades-long-and-counting career is a case in point.

Before AMD, he spent 10 years in government shoring up air-quality protections, then he led sustainability

While many see “corporate responsibility” as an oxymoron, this is a fast growing, impactful career path. Society expects more from corporations and, as these expectations increase, there is a growing need for people to work for social and environmental causes from inside companies.

By effectively working within a company you can influence decisions that have massive societal benefits across the globe. And there has never been a better time to work on these changes. The race to be the greenest, most responsible company on the planet is in full bloom.
efforts at Intel and Apple. Along the way, the corporate sustainability arena expanded its scope to the broader field of corporate social responsibility (CSR).


Dukenvironment sat down and talked with him about his book and his career.

Q&A DUKENVIRONMENT: Before we dive into the book, where did you go after graduating from Duke?
MOHIN: My first job was with the Environmental Protection Agency. The interesting part of that was, during the Reagan administration there had been a real slowdown in regulatory activity and the focus was on the Air Quality Office. There was a shakeup within the agency and President Reagan brought in Bill Ruckelshaus for his second term as EPA administrator, and Ruckelshaus immediately was called before Congress and grilled on why hadn’t there been more air regulations—he promised there would be 20 new air toxics regulations by year’s end.

Putting that in context, there had been seven in the entire history of the Clean Air Act. And so they needed help—and fast. Duke publishes a resume book, my name was in it and had “Eco Tox” in the title. I got a call from EPA.

At EPA I got to work on the Clean Air Act amendments which were signed into law in 1990, and that gave me a lot of legislative experience, which led to the job in the Senate Environment and Public Works Committee where I worked on several different pieces of environmental legislation.

Q&A DUKENVIRONMENT: How did you move into the private sector?
MOHIN: When the Senate majority flipped in the 1994 elections I started to search for a new role. Eventually, I was asked to stay on at the Senate, but by then I had found a great job at Intel.

Intel fit me like a glove because they really care about environmental protection; they just wanted to do it faster than the government allowed. It was an agenda I felt very comfortable representing.

Q&A DUKENVIRONMENT: Faster than the government allowed or required?
MOHIN: Required. Basically it came down to this: Intel was more than capable of meeting or exceeding environmental standards—what they couldn’t stand was delay. Permitting, reviews and administrative red tape, when you’re building semiconductors in a highly competitive environment, just wasn’t working for them.

Q&A DUKENVIRONMENT: Okay, now on to your book. It reads like a handbook, full of good advice for the CSR professional and beyond. What was the impetus for writing it?
MOHIN: You have to learn before you teach. And maybe this will sound a little sour grapes-like but there are a lot of sustainability and CSR books out there, and I’d say the vast majority are from people who haven’t actually worked in CSR. So the reality is different from what’s being published.

Being a board member of Net Impact, I know there’s a legion of young people who want to work in something bigger than themselves. But the reality of being an environmentalist inside a big company can be a steep learning curve.

(e.g., last year, more than 5,500 companies around the world issued sustainability reports, up from about 800 10 years ago) and appears to have substantial staying power. Companies of all types are looking for people to help improve their environmental, social and ethical performance. By learning the skills and strategies of working for good within a company, you can create large, immediate and lasting change.

Instead of empty rhetoric, this point of view is the essence of my own career choices. I have done more for people and the planet working within corporations across a global supply chain.

To a certain extent, being a corporate treehugger is a line-walking exercise. Corporations are indeed focused on profit, and being an activist within a company is very different than being an activist for a non-profit organization. But as transparency and awareness increase, the expectations for corporate behavior are changing. These macro-level changes are opening up new jobs across a broad spectrum of industries that can be rewarding on many levels.
Especially if they’re reading some of these more academic sustainability treatises, they might come away thinking, well, this is easy, and not get a full picture of what it’s really like. So the idea behind the book is, as you said, to be a handbook or a manual, with step-by-step instructions for practicing CR.

Q&A
DUKENVIRONMENT:
Your book draws on a wealth of experience, but if you had to cite several key themes, what would they be?

MOHIN:
Two things: capabilities and content. I talk about how to build the essential capabilities for corporate responsibility. What’s interesting is that these skills also have value for other careers. The second is content—the book lays out what you actually do in a step-by-step way. It starts with setting the strategy then gets into the programs and processes. One I would highlight, because it’s growing fast, is supplier responsibility. There are actually two chapters on that.

From my career in Apple it became very clear to me that, as business continues to outsource and globalize, the responsibility for labor, human rights, environmental health, safety, is falling to companies. And so it is the people in corporate responsibility jobs who must ensure that labor, health, safety and environmental expectations are met.

The exciting thing is that this change happens faster [in the corporate sphere than in government], and I think it’s more effective because it’s truly global. In government, there’s legislation, regulation, litigation and finally you get to some sort of action—but the only leverage is through enforcement which some companies may not view as a threat, and even then, it’s only within a certain jurisdiction. With companies it’s global and covers a broad range of issues—including environmental, health, safety, ethics, labor and human rights. Also things happen more quickly because suppliers will typically do what it takes to keep the business. Business can be far more effective as a motivator; as I say in the book, it comes down to “our dollars, our values.” In my experience working within a corporation, nothing moves people faster than economic reality.

Erica Rowell is managing editor of Dean Chameides’ blog, TheGreenGrok.com. She is based in New York City.
Karanth, who received her PhD from Duke in 2008, is an expert on human dimensions of conservation, such as risk assessments of human-wildlife conflicts, land use change and people-park relationships.

With her new National Geographic grant, she will assess human-wildlife conflicts in five parks of India’s Western Ghats. The project will identify and map risks and consequences for local people and the implications for conflict-prone wildlife species such as elephants, wild pigs, leopards and tigers. Field methods will include thousands of household surveys, interviews and mapping exercises.

India’s rich wildlife has been severely reduced over the past century and continues to be threatened by habitat destruction, prey depletion, poaching and the global wildlife trade.

“The declines of species are so dramatic, widespread and so recent,” Karanth says. “I wish I could have seen what the country was like in the 1800s with all this wildlife. In many parts of India there is human tolerance for some species, and this is why they still persist despite rapid changes in land use and high densities of people. This ‘cultural’ tolerance must be harnessed.”

As a National Geographic grantee, she joins an illustrious list of scientists and conservationists who have received funding from the society over the last 120 years. Past grants have supported the excavation of Machu Picchu, the discovery of the Titanic wreck, Jane Goodall’s chimpanzee research, and other pioneering work.

“Krithi is emblematic of the direction of National Geographic in many ways,” said John Francis, vice president for research, conservation and exploration at National Geographic. “She studies human interactions with declining and impacted wildlife, and she has had a rich personal history as a field biologist.”

You can read an interview with Karanth about her grant at newswatch.nationalgeographic.com/2011/12/08/and-the-10000th-national-geographic-grant-goes-to/.

A feature story celebrating the 10,000-grant milestone and the 10 most important National Geographic grants to date appeared in the January 2012 issue of National Geographic Magazine.

In addition to her adjunct faculty position at the Nicholas School, Karanth is Ramanujan Fellow with the Government of India, assistant director for India’s Centre for Wildlife Studies, and adjunct assistant research scientist at Columbia University.

At Duke, Karanth’s faculty advisors were Norman L. Christensen, professor of ecology and founding dean of the Nicholas School, and Stuart L. Pimm, Doris Duke Professor of Conservation Ecology.
In January, Kevin P. McCarthy joined the Nicholas School of the Environment as associate dean for external affairs.

For the former vice president of development and executive director of the Holy Name Health Care Foundation, part of the Holy Name Medical Center in Teaneck, N.J., the new Duke post marks a return to North Carolina, a state his family loves. McCarthy has more than 23 years of senior-level experience managing development programs and producing fundraising solutions for nonprofit institutions. He has raised nearly $100 million in philanthropic commitments over his career.

As associate dean, McCarthy directs all development and related outreach programs for the Nicholas School, providing strategic advice to the dean on fundraising initiatives. He oversees a program responsible for major gifts, corporate and foundation relations, alumni relations, outreach programs and annual giving.

“We are fortunate to have Kevin join the Nicholas School team,” says Dean William L. Chameides. “He brings a huge base of experience and an impressive record in fundraising, as well as a creative, strategic mind and a passion to make the world a better place. I look forward to working with him as we take the school to new heights. Kevin has already hit the ground running, as we plan for the new Duke Environment Hall on the Durham campus, the new Marine Sciences and Conservation Genetics Center at the Marine Lab, and a future Duke fundraising campaign.”

“I am excited to learn much more about the environment and to help the Nicholas School play a leadership role in addressing our most vexing environmental challenges,” says McCarthy. “Reading about environmental issues in the news is one thing, but to actually play a role in funding the growth of the school’s mission and make a difference in supporting the faculty’s work and education of students is an opportunity I relish.”

Before rejoining Holy Name, McCarthy was vice president of development and executive director of the WakeMed Foundation in Raleigh. He sees his evolution from fundraising for healthcare to the environment as a logical one. “The connections between environmental health and human health are clear. My daughter has asthma, so I am particularly tuned in to the impacts of air pollution and indoor environmental safety. I feel fortunate that my career still has the same sense of purpose and mission. In fact it is two-fold now: we are improving lives for current and future generations as we improve our global environment.”

McCarthy holds a master of science in leadership and strategic management from Manhattanville College and a bachelor of arts in political science from State University of New York College at Fredonia. He is a Certified Fundraising Executive and holds a certificate from the Duke University Nonprofit Management Program.

Laura Ertel is a freelance writer based in Durham, N.C.
April 19 6:30-11 p.m.
SPRING SOIREE
Durham Armory, 220 Foster St.
Durham, N.C.
CONTACT: Nancy Kelly
919-613-8090 or nkelly@duke.edu

April 19-20
NICHOLAS SCHOOL BOARD OF VISITORS’ SPRING MEETING
Hug Commons, Levine Science Research Center (LSRC), Duke Campus
CONTACT: Sue Yager
919-613-8003 or sue.yager@duke.edu

April 20 8:30 a.m.-3:30 p.m.
INTEGRATED TOXICOLOGY AND ENVIRONMENTAL HEALTH SYMPOSIUM
Causes and Consequences Connecting Environmental and Human Health
Washington Duke Conference Center
Durham, N.C.
CONTACT: Eve Marion
919-613-8078 or eve.marion@duke.edu

April 20 3 p.m.
DUKE ENVIRONMENT HALL GROUND-BREAKING CEREMONY
North side, LSRC (outside student lounge)
CONTACT: Nancy Kelly
919-613-8090 or nkelly@duke.edu

April 21 2 p.m.
DUKE LEAF™ AWARD CEREMONY
JOHN SAYLES, HONOREE
Reynolds Theater, Bryan Center
Duke Campus
Reception following ceremony at Blue Express Cafe
CONTACT: Nancy Kelly
919-613-8090 or nkelly@duke.edu

April 21 8:00 a.m.
3rd ANNUAL DUKE FOREST PINE CONE PACER 5K
Durham Division, NC-751
CONTACT: Office of the Duke Forest
919-613-8013 or dukeforest@duke.edu

May 3-4
BEAUFORT MASTERS PROJECT SYMPOSIUM (COASTAL ENVIRONMENTAL MANAGEMENT STUDENTS)
Repass Center, Duke Marine Lab
Beaufort, N.C.
CONTACT: Lauren Stulgis
252-504-7531 or lauren.stulgis@duke.edu

May 11 8:30 a.m.-5 p.m.
DEL MASTERS PROJECT SYMPOSIUM
A158 LSRC, Duke Campus
CONTACT: The DEL Program
919-613-8082 or del@nicholas.duke.edu

May 12 9:30 a.m.
NICHOLAS SCHOOL RECOGNITION CEREMONY FOR GRADUATE AND PROFESSIONAL DEGREE CANDIDATES
Keynote Speaker: Tim Mohin MEM’84
director of corporate responsibility,
Advanced Micro Devices
LSRC Great Lawn, Duke Campus
CONTACT: Nancy Kelly
919-613-8090 or nkelly@duke.edu

Present-June 17
ALEXANDER CALDER AND CONTEMPORARY ART: FORM, BALANCE, JOY
Nasher Museum of Art, Duke University
CONTACT: Marianne Wardle
919-684-5203 or marianne.wardle@duke.edu

Aug. 5-10
ECOLOGICAL SOCIETY OF AMERICA 2012: 97TH ANNUAL MEETING
Oregon Convention Center
Portland, Oregon
CONTACT: 202-833-8773 or esahq@esa.org

Mark your calendar for the following dates and monitor our website at nicholas.duke.edu for additional events.

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