

DUKENVIRONMENT MAGAZINE

NICHOLAS SCHOOL OF THE ENVIRONMENT FALL 2015



WHY ARE WE MORE
DIVIDED THAN EVER
ON CLIMATE CHANGE?

P4

POLITICAL SCIENTIST
MEGAN MULLIN
EXPLORES THE CAUSES



DUKENVIRONMENT fall 2015

NEWS//SCHOOL

- 09 'PLANKZOOKA' LARVAL SAMPLER MAY REVOLUTIONIZE DEEP-OCEAN RESEARCH
- 11 CENTURIES-OLD SHIPWRECK DISCOVERED OFF NORTH CAROLINA
- 12 NOWACEK TESTIFIES BEFORE CONGRESS ON IMPACTS OF SEISMIC ACTIVITY ON MARINE LIFE
- 12 MARINE LAB TAKES TO THE AIR WITH DRONES
- 14 CHEMICALS IN HOUSE DUST MAY TRIGGER RECEPTOR LINKED TO OBESITY
- 14 SHIFTS IN ELECTRICITY GENERATION SPUR NET JOB GROWTH, BUT COAL JOBS DECLINE
- 16 IT'S MAGIC! NEW CONSORTIUM TO FOCUS ON CREATING FOOD AND FUEL FROM ALGAE

DEAN'S UPDATE

- 17 DIG DEEPER TO FIND A THOUSAND SEEDS OF CHANGE

FEATURE

- 18 OUR DEEPEST ROOTS
Nicholas School's 25 Years of Success Owes Much to the Three Programs from Which it Formed

NEWS//STUDENTS

- 22 THE COMMUNICATION DILEMMA
PhD Student Patrick Brown Discovers Just How Quickly Climate Change Results Can be Misconstrued
- 24 FOR THE LOVE OF BIRDS
Dedicated PhD Students Turn Their Desire to Reduce Bird Deaths Caused by Building-Window Collisions Into a Research Project
- 28 SPECIAL AWARDS

NEWS//ALUMNI

- 29 ON THE CASE
Lauren Gloekler MEM'13 is Working to Solve the Puzzle of Chemical Exposure
- 33 ALUMS OF DUKE ENVIRONMENT

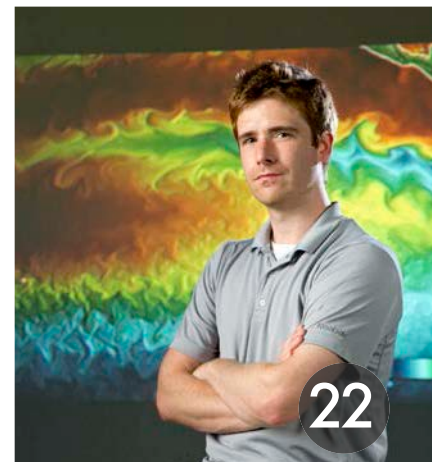
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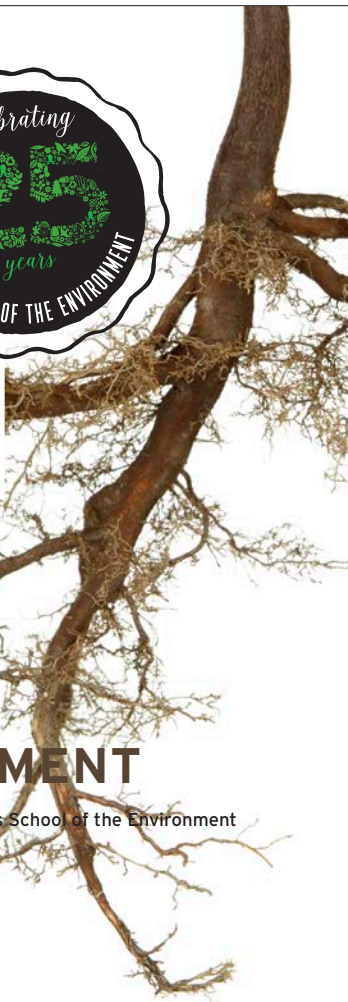
- 34 DUKE CELEBRATES 25 YEARS OF INTERDISCIPLINARY ENVIRONMENTAL EDUCATION WITH SPECIAL EVENTS, ANNIVERSARY CAMPAIGN

CALENDAR 35

COVER STORY

WHY ARE WE MORE DIVIDED THAN EVER ON CLIMATE CHANGE?
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WHY ARE WE **MORE** **DIVIDED** THAN EVER ON **CLIMATE CHANGE**?

POLITICAL SCIENTIST
MEGAN MULLIN
EXPLORES THE CAUSES

BY TIM LUCAS





PUNDITS have reminded us that “all politics is local” since American newspaper columnist Byron Price first used the phrase in 1932 to explain how hometown issues and economics shape national elections.

Old as the adage may be, it still holds true—especially, **Megan Mullin’s** research suggests, when it comes to the politics of climate change.

“The evidence for the effect of local weather on public opinion regarding climate change is overwhelming,” says Mullin, associate professor of environmental politics at the Nicholas School.

Numerous studies, by Mullin and other social scientists, have shown that many people conceptualize climate change, and form political attitudes about what we as a society should be doing in response to it, based more on personal experience than on scientific evidence. Their experiences with, or perceptions of, recent unusual changes in local weather often play a central role.

“As part of our psychological processes, we’re wired to reconstruct our experiences—real or perceived—into coherent stories that make sense to us,” Mullin says. “It’s human nature.”

But her research also suggests there’s more to it than that.

For the past five years, she’s been working to shed light on a tangle of underlying factors, both personal and political, that can shape beliefs about climate change, and to quantify what type of person is likely to be influenced by these factors, how long the impacts can last, and to what extent they affect our decisions at the ballot box.

As the 2016 U.S. election cycle swings into full gear, *Dukenvironment* magazine sat down with Mullin for a Q&A to learn more about how personal experience affects our political attitudes on climate issues, her research on the phenomenon, and how she thinks it might affect who our next national leaders will be.



WHAT ROLE DO YOU THINK CLIMATE CHANGE, OR ENVIRONMENTAL ISSUES IN GENERAL, MIGHT PLAY IN THE UPCOMING PRESIDENTIAL AND CONGRESSIONAL ELECTIONS?



“Evidence suggests the environment is not driving U.S. voters to the polls.

Now that our politics have become more polarized, we see more partisan division on environmental issues than ever before—especially with respect to climate change. Because environmental issues are now part of a bundle of positions and platforms that separates the parties, it’s hard to find evidence that the environment on its own drives many people’s vote choices. People don’t vote with climate change in mind, at least not in general elections; they vote with a bundle of issues in mind. That’s one reason it can be hard to make politicians responsive to environmental concerns.”



WHAT CAN BE DONE TO CHANGE THIS?

“That’s a question a lot of people are trying to get a handle on. One piece of the puzzle is to understand how the public interprets environmental problems.

In theory, democratic political processes are supposed to be responsive to voters’ concerns, so if the severity of a problem changes, so too should the response. But in a nation as large and diverse as the United States, people experience widely different environmental conditions. It can be hard for political organizations to gauge public response to problems that are difficult to observe and can vary dramatically from place to place and over time.

An example of my research in this area is on the ways that people’s perceptions about climate change are shaped by personal experience with recent local weather.

A study I authored with **Patrick Egan** of New York University in 2012 in the *Journal of*

Politics found that these experiences can affect attitudes about climate change in a significant and sizable fashion. For each 3.1 degrees Fahrenheit that local temperatures rose above normal in the week prior to a survey, we found that Americans became one percentage point more likely to agree there is 'solid evidence' that Earth is getting warmer."



HOW LONG DO THESE EFFECTS LAST?

"They're fairly short-lived, typically disappearing after about a week. Periods of unusual weather that last a longer time can have a larger effect on attitudes, but even these effects eventually dissipate. Our study shows that even a heat wave leaves no impact on climate change belief after about two weeks. It's a powerful influence, but not a lasting one."



WHAT ROLE DOES EXPOSURE TO POLITICAL RHETORIC ABOUT CLIMATE CHANGE SHAPE THESE PERCEPTIONS?

"Exposure to policymakers' polarized debate on climate can be a huge factor in shaping people's opinions, especially among people with strong political leanings or party affiliations.

Although our analysis showed that temperature's effect on opinion was as large or larger than the impacts of race, education, religion, or gender, we nonetheless found that party ID and political ideology still were the primary forces shaping people's perceptions of climate change.

One of the challenges in designing our study was disentangling politics from the effect of personal experience. Because climate change is such a polarized issue in American politics, people's self-reported experiences of the weather can be misleading. We perceive that weather is hotter, or cooler, if that's the pattern we expect. This tendency may be especially strong when people are responding to surveys that contain political content.

In our 2012 study, to see how, or if, perceptions about climate are shaped by personal experience outside the lens of politics, we collected actual local weather data and mapped temperature trends for the zip codes of respondents to five large national opinion surveys. Our findings showed that people's responses to survey questions about belief in climate change correlated strongly to their geocoded experiences with recent local weather, independent of external political influences."



WERE SOME PEOPLE MORE LIKELY THAN OTHERS TO BE INFLUENCED BY RECENT EXPERIENCE WITH HOTTER THAN NORMAL WEATHER?

"We saw the strongest effect among people with the lowest levels of education, who may be least likely to have formed opinions about climate change ahead of time. We also saw strong influence among political leaners—people who lean toward one party or the other but tend to be less informed about politics and have fewer strongly held issue positions.

To some degree, however, we all are influenced by recent personal experience because when we respond to surveys, we typically tap into information or experiences that are freshest in our minds and most readily accessible.

Climate change is hard to understand. Local weather is easy to understand and seems relevant to the topic. So it's understandable that our experience with local weather might influence our perceptions about climate and how we all respond to survey questions."



AS A POLITICAL SCIENTIST, WHAT DO YOU MAKE OF THAT?

"Considering that one of the chief effects of climate change in the United States is to raise the prevalence of unusually hot days, drawing conclusions about the existence of a warming climate from a recent string of usually hot local weather isn't entirely irrational.

On the other hand, it does give you pause for thought. Is this really how we are forming our opinions on difficult public policy issues such as climate change?

It's not surprising that many people form assessments of complex, society-wide issues like climate change based on personal experience. If you get mugged, you're more likely to think that crime is getting worse; if you lose your job, you're more likely to believe unemployment is rising. Scientists call this process attribute substitution. The problem is, it can lead you to discount other sources of information, such as scientific research, that are much more relevant."

cover



IT ALSO BEGS THE QUESTION THAT IF PEOPLE'S ATTITUDES ARE INFLUENCED BY LOCAL WEATHER, AND LOCAL WEATHER IS GETTING HOTTER ACROSS MUCH OF THE UNITED STATES, WHY AREN'T WE SEEING A CHANGE IN OPINIONS?



"That's the real question. Why is public opinion not reflecting the concern we should be giving to the issue given the increasing seriousness and scope of the problem?

One answer is that the effects we found were short-lived. Although temperatures in the United States have been rising, especially in winter so far, a cold snap can counteract warm weather's effects on opinion. But my colleague Patrick Egan and I suspect that long-term temperature trends are exerting their own influence on opinion, and we currently have research under way to investigate that possibility."



IN A COMMENTARY YOU PUBLISHED IN THE JOURNAL *NATURE CLIMATE CHANGE* IN 2014, YOU NOTED THAT SINCE 1988, WHEN CLIMATE SCIENTIST JAMES HANSEN PRESENTED THE FIRST TESTIMONY ON HUMAN ACTIVITY AND PLANETARY WARMING TO THE U.S. SENATE, THE AMERICAN PUBLIC HAS BEEN EXPOSED TO MORE THAN A QUARTER-CENTURY OF SUSTAINED ATTENTION TO THIS ISSUE. THERE HAVE BEEN HUNDREDS OF CONGRESSIONAL HEARINGS ON IT, THOUSANDS OF PEER-REVIEWED STUDIES, AND TENS OF THOUSANDS OF MEDIA REPORTS. DOES YOUR RESEARCH SUGGEST THAT ANY OF THIS HAS MADE A DIFFERENCE?



"Yes, but perhaps not as much as some people might have hoped. Those who hoped the long-running debate we've had on climate change would close the gap between the scientific consensus and the public's divided beliefs are probably disappointed.

The public has become more aware about climate change, but levels of belief and concern have changed little over the last 20 years. The main change in opinion has been the emergence of a partisan gap as those who identify as Republican have become less worried about climate change, less likely to believe that it is attributable to human activities, and more suspicious of mainstream news coverage about the issue. Politicians have had more success than scientists in shaping the debate."



WHAT'S THE TAKEAWAY MESSAGE FROM ALL THIS?



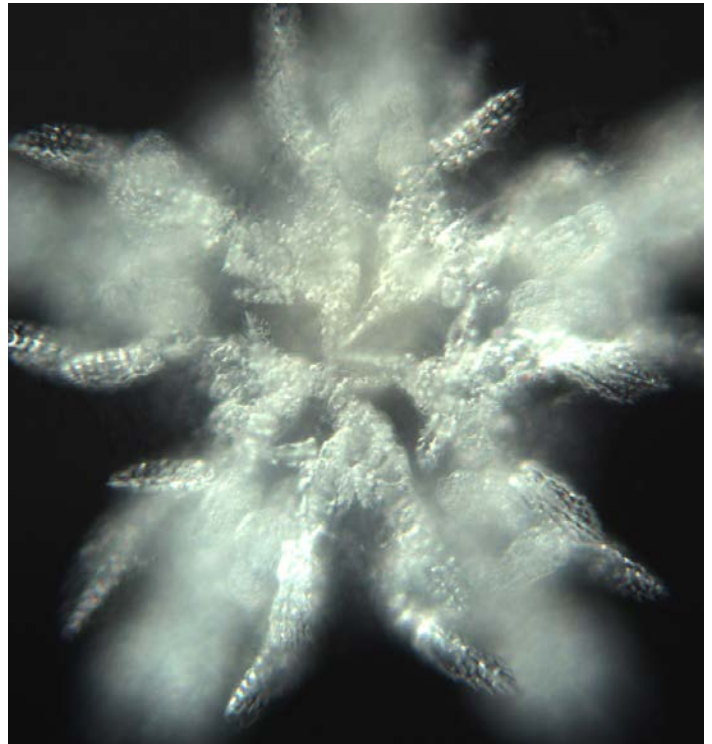
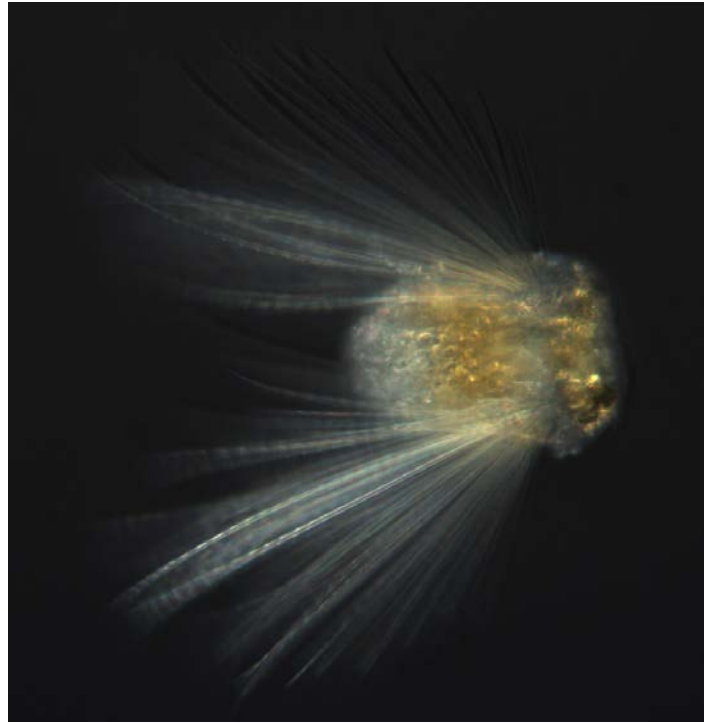
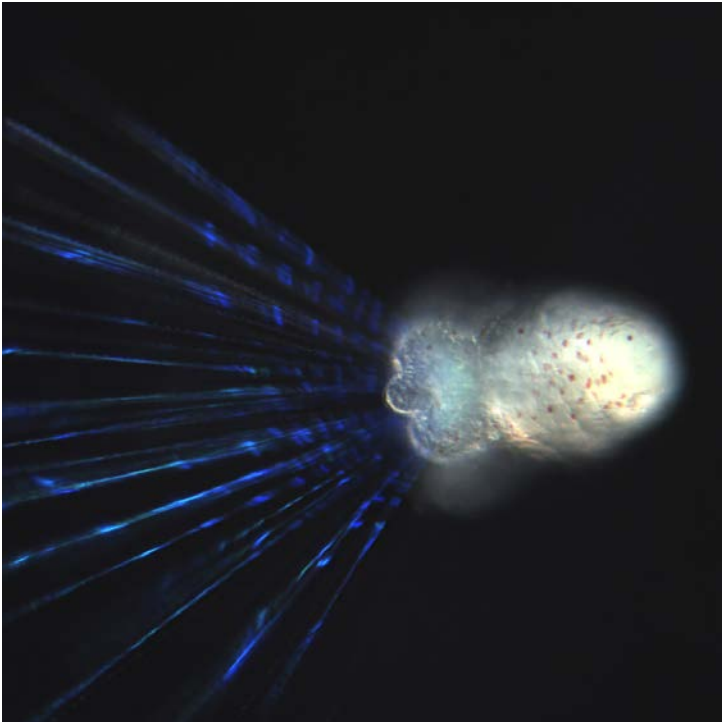
"As scientists and science communicators, we need to engage with the public using language and values that Americans recognize. Personal experience resonates more strongly than scientific evidence. Rather than discount people's experiences, we need to communicate science in a way that helps people interpret those experiences as being part of a broader phenomenon. Politicians are skilled at this form of communication—we scientists have a lot to learn from them."

Tim Lucas is senior writer for *DukeEnvironment* magazine and is the Nicholas School's director of marketing communications.



MEGAN MULLIN joined the Nicholas School faculty in 2014, and teaches the courses, "Environment 577: Environmental Politics," and "Environment 684: Politics of the Urbanized Environment." In addition to her research on political and social processes related to climate change, she is widely cited for her research on decentralized governance and water management. She is the author of *Governing the Tap: Special District Governance and the New Local Politics of Water* (MIT Press), which won the 2009 Lynton Keith Caldwell Award for the best book in environmental politics and policy.

You can view her full faculty bio at nicholas.duke.edu/people/faculty/mullin, or watch a video about how politics shape the environment by going to youtube.com and typing **Megan Mullin – I am Duke Environment** in the search box.



‘PLANKZOOKA’

LARVAL SAMPLER MAY REVOLUTIONIZE DEEP-OCEAN RESEARCH

Scientists from Duke, The University of Oregon and Woods Hole Oceanographic Institution (WHOI) have successfully conducted the first high-volume collection of plankton, including animal larvae, from

the deep ocean using a new sampling device mounted on a robotic submarine.

They deployed the new sampler—nicknamed PlankZooka for its uncanny resemblance to two bazooka rocket launchers—during a research expedition

this summer aboard the *R/V Atlantis* off the U.S. East Coast.

Unlike sampling devices used in the past, which often damaged the delicate planktonic specimens they collected, the new SentrY Precision Robotic Impeller

Driven (SyPRID) sampler uses spinning blades inside tubes to gently pump large volumes of water, and the microscopic organisms it contains, through a net system housed within two carbon fiber composite tubes.

“Part of the beauty of its design is that planktonic organisms are filtered gently so they remain intact for scientific analysis,” says **Cindy Van Dover**, director of the Duke University Marine Laboratory.

On its maiden voyage, the SyPRID sampler was carried by the autonomous underwater vehicle (AUV) Sentry to a depth of more than 2,150 meters—where pressures exceed a bone-crushing 3,150 psi—and drove a precise sampling pattern for more than eight hours just above a natural methane seep.

Thirty-nine deep-sea larvae, representing 16 different types of animals, were collected during the survey. Genetic and morphological analyses is to be conducted on the preserved specimens.

“The SyPRID sampler can allow us to gain a much clearer picture of where the larvae go and where they concentrate in the deep ocean,” says **Craig Young**, director of the Oregon Institute of Marine Biology (OIMB). “The uniqueness of this system is its ability to sample precise areas, at depth, for long periods of time while filtering enough volume to find the relatively rare organisms in the water.”

Natural methane seeps play an important but poorly understood role in the ocean ecosystem. The organisms that depend on methane from the seeps play a substantial role not only in the marine food web but also in altering the quantity of methane released to the ocean surface and, potentially, in the overall chemistry of the ocean.

Scientists lack a clear understanding of how sedentary or slow-moving animals move between the widely separated seeps, how new seeps are populated, and how resilient these ecosystems may be in the face of ocean change. Studying the microscopic planktonic larval stages of these animals may shed light on many of these processes.

Previous net-based sampling tools limited researchers’ ability to study deep-sea larval distributions because the samplers were not able to get closer than 50 meters to the sea bottom and could only move over long distances towed at an angle from the surface, notes **Carl Kaiser**, AUV program manager at the WHOI National Deep Submergence Facility, which owns and operates Sentry.

“By contrast, Sentry is capable of delivering the new sampling device to within two to three meters of the bottom, or any other desired depth, and within five meters of any desired point or pattern of points in more than 95 percent of the world’s oceans,” Kaiser says.

“This could revolutionize how we sample not only larvae but all plankton in the deep ocean,” says Van Dover. “We can now pick and choose where we sample, rather than reaching into a deep bucket and grabbing everything, from everywhere, on the way back up.”

Van Dover, Kaiser and Young jointly developed the concept for an AUV-deployed precision sampler, which was then designed and built by engineers at WHOI led by Kaiser and Andrew Billings.

The research expedition, which seeks to understand the genetic, oceanographic and larval connections among seep ecosystems in the Atlantic, also includes scientists from North Carolina State University.

Funding for the expedition and for the development of Sentry and the SyPRID Sampler comes from three National Science Foundation grants.

The methane seep the SyPRID sampler explored was identified by Van Dover on a previous expedition. **Laurel Hiebert** of OIMB led the on-board team responsible for sorting and preserving the collected larvae. **Svetlana Maslakova** co-leads the OIMB team with Young.



IMAGES

- 1 An octant or sextant and pottery jug from the wreck site give some sense of the age of the wreck found by scientists off the North Carolina coast. *Photo by WHOI;*
- 2 Brick pile from the newly discovered shipwreck, with a drift of Sargassum weed from the surface *Photo by WHOI;*
- 3 The research vessel *R/V Atlantis* with the submersible *Alvin* hanging off its stern. *Photo by Luis Lamar, WHOI;*
- 4 Launch of autonomous underwater vehicle *Sentry* from the research vessel *R/V Atlantis*. *Photo by Cindy Van Dover, Duke University;*
- 5 One of nine glass bottles observed at the site of the shipwreck. *Photo by WHOI*



2



3



Centuries-Old Shipwreck

DISCOVERED OFF NORTH CAROLINA

5

Scanning sonar from a scientific expedition has revealed the remains of a previously unknown shipwreck more than a mile deep off the North Carolina coast. Artifacts on the wreck indicate it might date to the American Revolution.

Marine scientists from Duke, North Carolina State University and the University of Oregon discovered the wreck this summer during a research expedition aboard the Woods Hole Oceanographic Institution (WHOI) research ship *R/V Atlantis*.

They spotted the wreck while using WHOI's robotic autonomous underwater vehicle (AUV) Sentry and the manned submersible Alvin. The team had been searching for a mooring that was deployed on a previous research trip in the area in 2012.

Among the artifacts discovered amid the shipwreck's broken remains were an iron chain, a pile of wooden ship timbers, red bricks (possibly from the ship cook's hearth), glass bottles, an unglazed pottery jug, a metal compass, and another navigational instrument that might be an octant or sextant.

The wreck appears to date back to the late 18th or early 19th century, a time when a young United States was expanding its trade with the rest of the world by sea.

"This is an exciting find, and a vivid reminder that even with

major advances in our ability to access and explore the ocean, the deep sea holds its secrets close," says expedition leader **Cindy Van Dover**, director of the Duke University Marine Laboratory.

"This discovery underscores that new technologies we're developing to explore the deep-sea floor yield not only vital information about the oceans, but also about our history," says **David Eggleston**, director of the Center for Marine Sciences and Technology (CMAST) at NC State and one of the principal investigators of the science project.

After discovering the shipwreck, Van Dover and Eggleston alerted NOAA's Marine Heritage Program of their find. The NOAA program will now attempt to date and identify the lost ship.

The expedition has been focused on exploring the ecology of deep-sea methane seeps along the East Coast. Van Dover is a specialist in the ecology of deep-sea ecosystems that are powered by chemistry rather than sunlight, and Eggleston studies the ecology of organisms that live on the seafloor.

"Our accidental find illustrates the rewards—and the challenge and uncertainty—of working in the deep ocean," Van Dover says. "We discovered a shipwreck but, ironically, the lost mooring was never found."

NOWACEK TESTIFIES BEFORE CONGRESS ON IMPACTS OF SEISMIC ACTIVITY ON MARINE LIFE



ISTOCK Photo

Douglas Nowacek, Repass-Rodgers University Associate Professor of Conservation Technology, testified before a U.S. House of Representatives subcommittee this summer about the impacts of seismic activity on whales and other ocean life.

His testimony included policy-relevant recommendations for how to reduce the potential harm.

Nowacek, an expert on marine ecology and bioacoustics, presented his testimony to the House Natural Resources Committee's Subcommittee on Energy and Mineral Resources.

Seismic surveys associated with underwater oil and gas exploration are a major contributor to ocean noise, Nowacek

told the committee. Recent technological advances and market forces have led industry to extend the geographic scope of its exploration into once remote areas of the oceans, especially at higher latitudes and into deeper waters.

In some cases, the loud blasts generated by the air guns used to conduct the seismic surveys can be detected underwater more than 2,500 miles away.

Numerous studies have shown that these sound bursts—which can reach 260 decibels and may continue, almost nonstop, for weeks or months on end—can disrupt or harm marine life. Whales, for instance, rely on underwater sound for communication and navigation and to find food and avoid predators. Exposure to repeated loud blasts from a seismic survey can mask the sounds they rely on and lead to stress, disorientation, changes in foraging and nursing behaviors, and, in extreme cases, direct physical damage. At 260 decibels, the noise generated by seismic air guns roughly approximates the noise at “the epicenter of a grenade blast

MARINE LAB TAKES TO THE AIR WITH

DRONES

Duke University has opened a new research and training facility for the use of unmanned aircraft systems—commonly referred to as drones—in marine science and conservation.

The Marine Conservation Ecology Unmanned Systems Facility is located at the Duke University Marine Laboratory in Beaufort, N.C.

It flew its first operational missions earlier this month to support University of North Carolina researchers who were mapping nesting beaches and at-sea aggregations of endangered olive ridley sea turtles in Costa Rica.

In addition to flying research missions for private and public partners, the

new facility will offer courses, starting in summer 2016, to train students and working professionals on how to use unmanned aircraft systems (UAS) in coastal research and conservation.

It also is developing UAS-centered marine science educational outreach programs for local high school students.

“Unmanned aircraft systems have the ability to collect large volumes of data from even the most remote or extreme locations. They are transforming how we study and learn about the marine environment,” says **David Johnston**, executive director of the new facility and assistant professor of the practice of marine conservation ecology at Duke’s Nicholas School.



“Given the breadth of marine science expertise concentrated at university and government labs in eastern North Carolina, we believe there is significant opportunity for us to work together and establish our region as a global leader in the development and use of this new technology for research,” Johnston says.

Drones can be used for a wide array of difficult or dangerous research and conservation jobs, he says. These include identifying and analyzing marine debris in remote locations; monitoring protected and endangered species and their habitats; assessing fisheries stocks; monitoring the effects

and would easily cause the rupture of the human eardrum," Nowacek notes.

"The seismic testing permits currently under consideration by the U.S. Bureau of Ocean Energy Management would allow the continuous overlapping firing of seismic airguns along a broad range of the east coast from the New Jersey/Delaware border to central Florida," he told the subcommittee. "Each survey would discharge its airguns approximately every 10 or 12 seconds, and would operate 24 hours per day. If these permits are granted, ocean animals located in that wide area of the Atlantic Ocean would be exposed to noise levels that are likely to cause impacts and to disrupt essential behavior patterns."

The cumulative impact of chronic exposure to these sound blasts often far exceeds the projected short-term impacts regulatory agencies currently use to set acceptable sound-exposure levels, Nowacek says. These current standards, he says, are based "on decades-old guidelines."

To address this problem, Nowacek

proposed the adoption of a new "more realistic" metric for establishing a scientifically based threshold at which harm—short-term and cumulative—may occur.

He recommended that more comprehensive monitoring of regional marine populations be required before new seismic surveys can take place, and that the length and geographic scope of the monitoring be expanded.

He also recommended the use of seasonal closures to protect vulnerable species and important habitats, as well as new guidelines requiring companies to justify the size and geographic reach of their intended seismic activity.

You can read Nowacek's full written testimony at naturalresources.house.gov/uploadedfiles/nowacektestimony.pdf.

Nowacek has studied the effects of underwater noise on marine mammals and other ocean life for more than 20 years and served for more than 10 years on a panel of independent scientists, convened by the International Union for

the Conservation of Nature, to minimize the impacts of offshore oil and gas development on Western Gray Whales. He is the author of nearly a dozen widely cited peer-reviewed papers on the impacts of seismic surveys and other anthropogenic noise, and possible mitigation strategies to reduce it.

You can learn more about his most recent paper on the topic at nicholas.duke.edu/news/new-international-standards-needed-manage-ocean-noise.



Photo by Chris Kleponis



Photo by Scott Taylor

of climate change, coastal erosion and sea-level rise; and supporting emergency responses to marine animal entanglements or strandings and other marine crises.

"The facility's new education program will provide students and professionals with the basic skills and knowledge needed to achieve state and FAA certification, and operate unmanned aircraft systems safely and effectively in marine environments," says program manager and retired **U.S. Air Force Col. Everett Newton**.

Skills covered in the course will include flight planning, mission execution,

data management and analysis, and an overview of federal and state airspace restrictions and rules. Students may be given the chance to build and fly their own unmanned aircraft systems. "Building their own systems will greatly enhance students' ability to fly safe and efficient missions," says **Julian Dale**, the lead engineer of the new facility. "It's important to understand the components of these systems and how they work together."

An outreach project being developed in conjunction with the Carteret County Public School System will kickstart a student UAS club and support a UAS-based Advanced Placement science project for graduating seniors at East Carteret High School, Newton says.

Johnston, Newton and Dale established the new facility at the Duke Marine Lab following eight months of safety and operational training using unmanned aircraft systems for

coastal and marine research in eastern North Carolina, Florida, Nova Scotia and Hawaii. They have partnered with senseFly, a Swiss firm that designs and builds commercial drones for research and mapping, to provide the facility with access to the latest UAS technologies and platforms.

"We achieved initial operational capacity earlier this month and anticipate being awarded our FAA Section 333 exemption in coming weeks," Johnson says. "This will allow us to conduct commercial unmanned aircraft system flights and should help facilitate plans for a number of exciting projects we're working on with local partners, including mapping local estuarine reserves and estimating sea turtle density at Cape Lookout."

To learn more about the new facility, go to superpod.ml.duke.edu/uas/.



CHEMICALS IN
HOUSE DUST
MAY TRIGGER
RECEPTOR LINKED
TO OBESITY

Some chemicals commonly found in house dust may trigger a key receptor linked to human obesity, according to a Duke-led study.

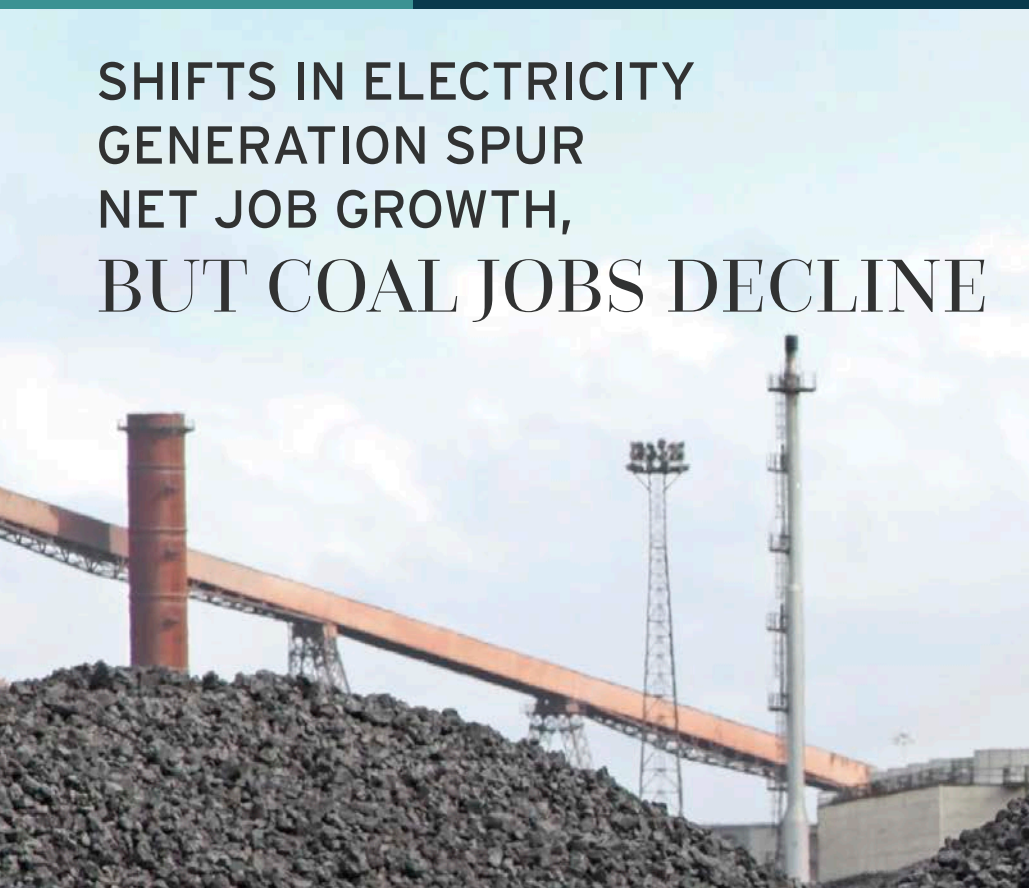
The study, though preliminary in nature, adds to a growing body of evidence that a wide range of chemical mixtures used as flame retardants and added to lubricants, hydraulic fluids and plastics can bind to the PPARgamma receptor and, under the right conditions, activate it.

This activation during early development “may be a key factor in obesity,” says **Heather Stapleton** of Duke’s Nicholas School, who led the study. Stapleton is the Dan and Bunny Gabel Associate Professor of Environmental Ethics and Sustainable Environmental Management.


PPARgamma—short for peroxisome proliferator-activated nuclear receptor gamma—regulates fat metabolism, cell proliferation and cell death.

Stapleton and her team published their new findings in July in the peer-reviewed journal *Environmental Science & Technology*.

ISTOCK Photo



SHIFTS IN ELECTRICITY
GENERATION SPUR
NET JOB GROWTH,
BUT COAL JOBS DECLINE



In the four years following the 2008 recession, the coal industry lost more than 49,000 jobs, while the natural gas, solar and wind industries together created nearly four times that amount, according to a new study.

A county-by-county geographical analysis of the losses and gains shows that few new jobs were added in regions hardest hit by coal’s decline, particularly counties in southern West Virginia and eastern Kentucky.

“Our study shows it has not been a one-for-one replacement. The counties that were very reliant on the coal industry are now in the most difficult position,” says **Lincoln Pratson**, who is the Truman and Nellie Semans/Alex Brown & Sons Professor of Earth and Ocean Sciences.

ISTOCK Photo

Previous studies by Stapleton's team have shown that many chemicals, including the widely used organophosphates and polybrominated diphenyl ether (PDBE) metabolites, can bind to PPARgamma. But the studies also showed that binding to the receptor did not always activate it.

To better understand whether environmental exposures can trigger the receptor's "on switch," Stapleton and her colleagues conducted their new study using a reporter gene assay to monitor PPARgamma activation in house dust samples. They chose to study chemicals in dust samples because indoor dust is an important pathway through which humans—especially infants and young children—become exposed to environmental contaminants. Young children ingest about 50 milligrams of house dust a day, according to U.S. EPA estimates.

Analysis by Stapleton's co-author, PhD student **Mingliang Fang**, showed that 28 of 30 semi-volatile compounds commonly found in indoor dust were "weak or moderate" PPARgamma

agonists—meaning they could bind to and activate the receptor. "But what was very interesting," says Stapleton, "was the level of activation observed following exposure to an environmentally relevant mixture of these contaminants in house dust samples."

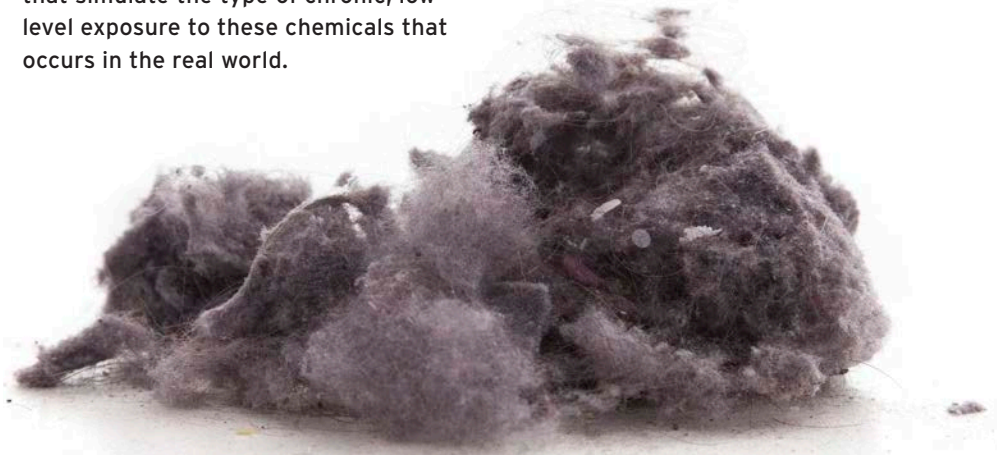
The researchers found signs of significant PPARgamma activation in more than half of the 25 dust samples collected from homes, offices and gyms, at a level of exposure that would be similar to a child's daily dose.

Further research is now under way to test the laboratory findings in conditions that simulate the type of chronic, low-level exposure to these chemicals that occurs in the real world.

"We are continuing to build on this research to determine what type of health effects may be caused by this level of activation in children," says Stapleton.

Stapleton and Fang authored the new study with **Thomas F. Webster**, professor of environmental health at the Boston University School of Public Health.

Funding came from the National Institute of Environmental Health Sciences and from Boston University School of Public Health pilot funding.



To estimate changes in electricity generation employment, Pratson and research analyst **Drew Haerer** examined data relating to both direct and indirect job growth and loss for each industry. This included operations and maintenance jobs at electric power plants, as well as operations and maintenance jobs in resource extraction and fuel transportation.

Data for solar and wind generator operations and maintenance jobs were provided by the industries themselves.

Job changes in the coal and natural gas industries were derived using a model that analyzed year-to-year economic activity and energy production occurring within each sector of the two industries to estimate gains or losses in employment that supported electricity generation.

Overall, regions that had the largest energy job increases were the Northeast, Southwest, Midwest and West. Regions that experienced the greatest job losses overall were Appalachia, the Uinta Basin of Utah and Colorado, and parts of the Powder River Basin in Montana and Wyoming.

The lack of geographic overlap of job loss and job creation is the result of many factors, Pratson says. "The areas where a lot of coal is mined in Appalachia, for example, are very rugged and heavily forested—not easy places to set up solar panels or wind farms."

Differences in the availability of state incentives for renewable energy also had an effect, noted Haerer.

"States with incentives have more growth," he says. "The Southeast is

incentive-free, and there is almost no development of green energy there compared to other regions."

Haerer said one way for states that depend heavily on the coal industry to cope with changing energy trends may be to transition to clean coal technology, which reduces coal plants' negative environmental impacts.

Pratson and Haerer published their study in the peer-reviewed journal *Energy Policy* earlier this year. They conducted the study with no external sources of funding.



IT'S MAGIC!

NEW CONSORTIUM
TO FOCUS ON
CREATING
FOOD AND
FUEL FROM

ALGAE

by Kati Moore, MEM'16

Zackary Johnson, Arthur P. Kaupe Assistant Professor of Molecular Biology in Marine Science, has received a three-year grant for up to \$5.2 million from the U.S. Department of Energy to establish a consortium to study the extraction, development and commoditization of various products from algae.

The Marine Algae Industrialization Consortium—or MAGIC—will include both university and corporate partners.

Algae-based oil has been pursued as a renewable source of fuel since the 1970s, but high production costs prevented it from becoming a competitor with crude oil. The consortium's goal, Johnson says, is to find ways to drive down the cost of oil extracted from algae. To do this, they need to maximize the value of other products that can be made from algae, such as proteins.

"To make algae a competitive player in this field you have to consider all the things the algae are producing," Johnson says. "We're essentially trying to make oil the waste product, so that it can compete with fossil fuels."

The key is to strike a balance.

One of the MAGIC researchers' goals will be to find the types of algae and the specific growing conditions that result in low-cost oil while providing high-quality protein products.

"They're not mutually exclusive, but you can't optimize everything at once," Johnson says. "There are trade-offs. That's where the economic analysis comes in."

Protein extracted from the algae may be used in a variety of ways. MAGIC will study using algae protein as a component of fish, poultry and swine feed, and as a substitute for current protein products in the food industry, such as whey, which is derived from milk.

"It turns out that whey is not very environmentally friendly," Johnson says. "If you can replace milk protein with algae protein, you can skip the methane produced by cows, the land use, the water use. Marine algae don't use fresh

water and don't have to compete with traditional crops for arable land, so to the degree to which they can produce food cheaply, they are highly attractive."

Substituting algae protein in animal feed may have human benefits as well. Because algae are high in iron, including algae protein in poultry feed would increase the amount of iron in the meat produced. Chicken is not considered a good source of iron compared with beef, but algae protein products could change that.

Previous work by Johnson and his colleagues at Cornell University has shown that some types of algae produce proteins that can be successfully incorporated into swine and poultry feed.

"Our work now is to identify better products, and make all those processes more efficient," Johnson says.

MAGIC will conduct research on the entire process of getting algae products to market, from algae selection and cultivation, to extraction and product preparation, creation of mass production methods, and techno-economical life cycle analysis.

Each step of the research process will include multiple investigators. "It's a team effort, and each partner brings their own expertise," says Johnson.

In addition to Duke, the new consortium will include the University of Hawaii, Archer Daniels Midland, Bentley University, Bucknell University, Cornell University, OpenAlgae, Shell Global Solutions (US) Inc., University of Nordland, The University of Southern Mississippi, and Valicor Renewables.

The mix of university and corporate partners means a mix of environmental and economic goals. But at the end of the day, Johnson says, they all want the same thing: a cost-effective, environmentally friendly source of fuel and food. "Everyone's committed to finding that balance."

Katie Moore MEM'16 is a Nicholas School communications student assistant.



DIG DEEPER TO FIND A THOUSAND SEEDS OF CHANGE

by Alan R. Townsend, Dean, Nicholas School of the Environment

In the fall of 1995, I boarded a distressingly shabby 727 for my first flight across the Amazon Basin. I glued myself to the small window, wanting to take in every second of a vast sea of green that I imagined stretching to every horizon. For portions of the flight, I wasn't disappointed: there were moments where the forest seemed to define the entire surface of the planet, soft green hues occasionally punctuated by bursts of yellow or pink flowers that only hinted at the riot of life below.

But as we landed, the lasting image was not of what I could see, but what I couldn't. Again and again, from the southern edge of the Basin to the heart of the forests around Manaus, thick blankets of smoke obscured the landscape. The forest was quite literally being moved from ground to sky, acre upon countless acre at a time.

Manaus was to be but a stopover before I caught another flight, but I had to wait a day to leave. At my intended destination an hour east along the Amazon River, there was too much smoke to fly.

Prior to that flight, I certainly cared about how humans were changing the planet—so much so that I'd chosen a career defined by studying global environmental change. But after that flight, I felt it. The environmental crossroads at which the world stood became more personal, more immediate, more urgent. I also learned a lesson that day, but it took me years

to understand many of its implications, even though it may seem like common sense. Facts and figures only take you so far, even if you happen to be drawn to the wonder and importance of scientific evidence. In the end, most people make choices because of what they experience, who they know, how they feel. Put another way, if we want to both understand and fix climate change—or any other major environmental issue—we have to know what makes people tick.

That's why the Nicholas School deliberately mixes the social and natural sciences under a single roof, from faculty to educational programs. It's why you will see stories on climate change in this single issue that look not only at how the earth system works, but how the people upon that earth make their choices. It's why Meg Mullin, one of our newest faculty members, is here. You can read about how Meg seeks to understand how our personal experiences and views shape our political choices, and in turn how those choices define the potential for progress on issues such as climate change.

And as you leaf through the pages of this issue, you'll see another theme emerge: history. The Nicholas School is approaching its 25th year, a year in which we will commemorate a generation of innovation and real world impact. And a year in which we will reflect not only on where we have been, but where we are going.

Only six months before my inaugural Amazonian flight, the first Conference of the Parties (COP)—intended to spur international action on climate change—was held in Berlin. The 21st such meeting will convene in Paris later this month, in a world that has still not made anywhere near enough progress in confronting one of the greatest challenges in human history. Will this COP meeting be the watershed moment? I'm an eternal optimist by nature ... but I doubt it.

Instead, my optimism is maintained by what I see at smaller scales. In local communities, in cities, in states, in private sector companies, all starting to take on the challenges of changing the world—be that climate or other threats—in pragmatic, collaborative and meaningful ways. For all the seemingly intractable (and yes, depressing) gridlock and absurdity we may see in national or international politics, dig a little deeper and one can find thousands of seeds of change, sprouting in places where people are transcending the traditional bounds of discipline or culture or political bent to get inspired around solving a true grand challenge.

I see that at the Nicholas School time and time again, and I think it's no accident that our now thousands of alumni are making this happen in myriad ways quite literally all around the world. As our 25th birthday as a school of the environment looms, that's truly something to celebrate.

OUR DEEPEST ROOTS

NICHOLAS SCHOOL'S 25 YEARS OF SUCCESS OWES MUCH TO THE THREE PROGRAMS FROM WHICH IT FORMED

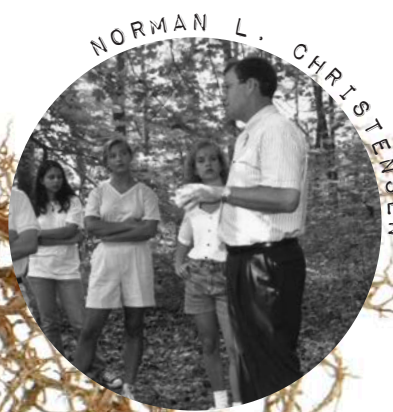
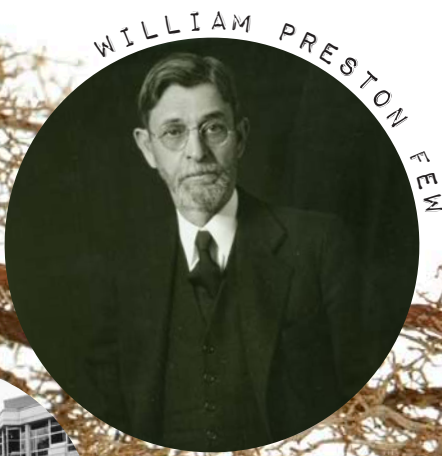
BY NORMAN L. CHRISTENSEN



CLARENCE KORSTIAN IN 1937



ARTHUR SPERRY PEARSE



TWENTY-FIVE YEARS AGO THIS PAST MAY,

an ad hoc Committee on Environmental Programs presented its findings to the Duke University Board of Trustees. The committee observed that arbitrary boundaries—boundaries between academic disciplines, governance units, basic and applied science, teaching and research—are among the most significant challenges to the sustainable conservation and management of Earth's environmental resources. Duke, they argued, was uniquely positioned to meet these challenges, and that it should seize the opportunity by creating a School of the Environment. The trustees agreed and unanimously resolved that such a school—one of the first of its kind in the world—should come into being on July 1, 1991.

The committee's recommendation and the board's resolution were indeed prescient. Today, the Nicholas School of the Environment is recognized worldwide as a center of excellence for interdisciplinary education and research focused on our sustainable future. Duke's long history of interdisciplinary collaborations, the consistent support from university leaders, and the contributions of time and resources from many friends and alumni are certainly among the factors contributing to its success.

As we approach our silver anniversary, it is especially important to remember that our school was not created *ex nihilo*, out of nothing; it owes much of its success to more than 50 years of development and evolution in each of the three programs from which it was formed: the School of Forestry and Environmental Studies, the Duke University Marine Laboratory and the Department of Geology. But how were these three programs created? To a greater or lesser extent, the energy and vision of one individual, **Arthur Sperry Pearse**, was important to the genesis of each one.

Flush with resources from James B. Duke's remarkable gift,

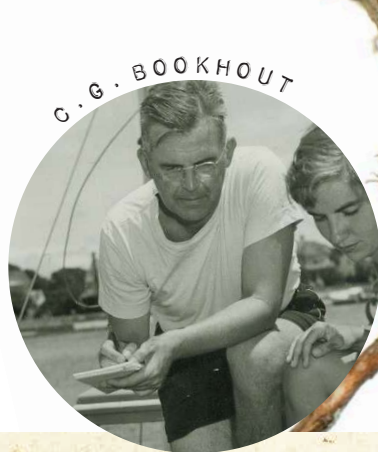
Duke President **William Preston Few** began searching in the mid-1920s for new faculty who would help him transform his then small college into a complex, internationally recognized university. University of Wisconsin ecologist **A.S. Pearse** seemed like just the person to lead Duke's biology program into this new era.

Pearse was widely recognized for the quality and remarkable diversity of his work. In addition to pioneering studies of freshwater lake plankton, he had recently published important work on the ecology of parasitic diseases such as hookworm and yellow fever. He had just completed a term as president of the Ecological Society of America and published the first textbook ever in animal ecology. Convincing Pearse to join Duke's faculty in 1927 was indeed a recruitment coup.

SCHOOL OF FORESTRY

Included in Duke's gift were nearly 5,000 acres of land surrounding what would soon become Duke University's West Campus. These lands clearly played a role in attracting Pearse to Duke. In 1926 and 1927 letters to President Few, he not only noted the opportunities that they would provide biological studies, but suggested that they could be the foundation for the creation of a graduate school of forestry similar to the distinguished program at Yale, but focusing on southeastern forests. In pursuit of this vision, Pearse contacted the director of the Forest Service Southeastern Experimental Station, **E.H. Frothingham**, asking for guidance. Frothingham directed him to an up-and-coming forest ecologist, **Clarence Korstian**, who had himself been trained at Yale.

After visiting with both men, Pearse convinced Few to meet with Korstian in 1927. Initially, Few was most interested in the question of what to do with the land and asked Korstian whether Duke ought to dedicate it formally for teaching



and research, much as Harvard and Yale had done with their eponymous forests.

Primed by Pearse, Korstian replied that, given the growing importance of forests and forestry in the Southeast, such a forest would indeed be valuable, but it “ought to be organized as a very definite adjunct to a graduate school of forestry.” He argued further that training and research in such a forest and school should not be limited to what people could extract from forests, as “this had led in the past to men receiving a limited education in forestry.” A Duke Forest and School of Forestry ought to focus on the long-term conservation of forests and all of the values that they provide.

Subsequent to this meeting, Pearse wrote to forestry schools and departments at Michigan, Cornell, Yale and Syracuse for information on their faculty and curricula, which he then forwarded to Few. After continued conversations over several years, and with the promise that a forestry school would be created eventually, Few convinced Korstian to come to Duke in 1930 to direct the newly dedicated Duke Forest. Over the next several years, Korstian refined his vision for a Duke School of Forestry, and The Board of Trustees enthusiastically supported that vision and voted to approve creation of the school in 1938.

Innovation and interdisciplinary collaboration in both education and research were embedded in the cultural genome of the School of Forestry from the moment of its creation. The school’s mission was centered on Korstian’s vision for “ecological forestry,” what today we call sustainable forestry. From the beginning, the school’s faculty was highly interdisciplinary, including ecology, economics, management, forest pathology, soil chemistry and wood technology.

Because of their unique training, the graduates of the school’s Master of Forestry (MF) program were widely recruited to leadership positions with both private companies

and public agencies. The school was renamed Forestry and Environmental Studies in 1970, and its priorities and mix of disciplines subsequently expanded to include such topics as environmental policy, biodiversity conservation, water quality management, wetlands, and environmental toxicology. Interdisciplinary education to meet an ever growing list of environmental challenges was the centerpiece of the school’s newly created professional Master of Environmental Management (MEM) program.

DUKE UNIVERSITY MARINE LAB

Arthur Pearse’s vision and energy also were central to the creation of the Duke University Marine Laboratory. About the same time he was connecting Duke to Clarence Korstian, he was educating President Few and the Duke Board of Trustees about the increasing importance of coastal issues and marine biology, and about the potential of establishing year-round teaching and research facility on the North Carolina coast.

He and other Duke colleagues explored a number of potential sites for such a facility, and they became convinced that Piver’s Island, a 20-or-so acre piece of land near the town of Beaufort, would be ideal. In addition to its accessibility and location on the central coast, the presence of the Federal Fisheries Laboratory (now the NOAA Mid-Atlantic Coastal Fisheries Center) on the north end of the island made this location ideal.

In 1935, the Duke Trustees voted to move forward with the purchase of the south portion of the Piver’s Island. Over the next three years, three small dorms, a two-room building for classes, and boathouse and dock were built. In the summer of 1938, 16 students and several faculty decamped on the island and the Duke University Marine Laboratory was born.

Up to 1950, the Marine Lab served largely as an outpost for studies and a relative few summer courses offered by Durham campus biologists. It was in that year that C.G. Bookhout was





appointed as the Marine Lab's first full-time director. Bookie, as he has affectionately known by everyone, had been among the first faculty to teach at the lab, and he energetically pursued Pearse's vision of it as a year-round teaching and research center.

Material dredged from the nearby Gallant's Channel was added to the south end of Piver's Island. This allowed lab to add three new buildings in 1954 and an additional dormitory in 1963. In collaboration with the University of North Carolina's Institute of Marine Studies, Marine Lab faculty convinced the National Science Foundation to locate a new oceanographic research vessel, the *R/V Eastward*, at the lab in 1961. The *R/V Eastward* was replaced by the *R/V Cape Hatteras* in 1981.

With these facilities and resources, the lab was able to recruit a diverse resident faculty who held primary appointments in the departments of zoology, botany, cell biology, and geology. The hands-on learning and the seamless integration of research and education were the hallmark of lab's undergraduate and graduate programs from the very beginning.

DEPARTMENT OF GEOLOGY

In a 1930 letter to distinguished ecologist and Wisconsin colleague **Chancey Juday**, Pearse noted that Duke's programs in the natural sciences were still very much in the development stage. He made particular note of the fact that the university had no faculty in the earth sciences. Indeed, it would be another six years before Duke hired **Willard Berry**, its first geologist.

Although I could find no written confirmation, I believe we can be pretty sure that Pearse was prominent among those supporting Berry's appointment. However, geology remained a one-man outfit until 1949 when **Duncan Heron** was recruited. **Orrin Pilkey**, a sedimentologist turned coastal

dynamics guru, joined the department in 1965. Faculty were gradually added so that by the mid-1980s, the department had grown to include faculty programs in paleontology, the dynamics of Earth's crust, seashore change, oceanography, and hydrology, to name a few.

For most of these years the department was housed in the Art Museum on Duke's East Campus. Because of the integration of Duke's Geology Department, the Nicholas School is unique among environmental programs in representing the full diversity of environmental science. But just as important as *bona fides* in the physical sciences, geology brought long traditions of excellence in undergraduate education and integration of basic science with its real-world applications.

The importance of these three programs to the development of the Nicholas School is evident in the identity of its three divisions: Environmental Science and Policy, Earth and Ocean Sciences, and Marine Science and Conservation. But the boundaries between these divisions have blurred, and many faculty hold appointments in more than one division.

Environment Hall which opened in April 2014, is designed to facilitate even more interaction and collaboration among divisions. Furthermore, the disciplinary composition and educational programs in each division have changed significantly; each one now includes disciplinary expertise from social and natural sciences, and each one is heavily invested in the school's undergraduate, professional and graduate programs. Each plays an essential role in the Nicholas School's mission to "create knowledge and leaders for a sustainable future."

Norman L. Christensen is founding dean of the Nicholas School and professor emeritus in the Division of Environmental Sciences and Policy.



Footnotes

- A.S. Pearse's papers, including hundreds of letters written and received over his entire career, are available in the Duke Archives. I am grateful to the staff of Duke's David Rubenstein Library for helping me access these materials.
- Many of the details of Clarence Korstian's vision and the formation of the school are described in a document titled, "Clarence Korstian: Forty Years of Forestry." This is a transcription of a 1959 interview of Korstian by Elwood R. Maunder which is available in the archives of the Forest History Society.
- Much of the history of Piver's Island, the Federal Fisheries Laboratory and the Duke University Marine Laboratory can be found in *A Story of North Carolina's Historic Beaufort*, Wilson, M.M. 2007, The History Press, Charleston, SC.
- My thanks to Duncan Heron for helping me understand the geological origins.

Photos courtesy of the Nicholas School, Duke Marine Lab and Duke University Archives

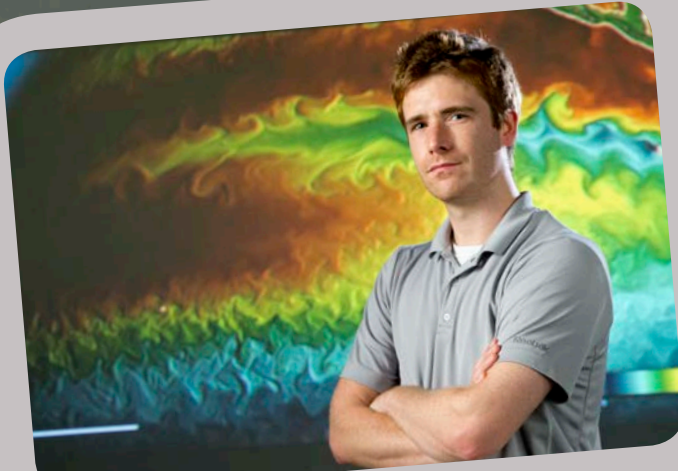


Photo by Jon Gardiner



the
COMMUNICATION
dilemma

PHD STUDENT
PATRICK BROWN

DISCOVERS JUST
HOW QUICKLY CLIMATE
CHANGE RESULTS CAN
BE MISCONSTRUED

by Kati Moore MEM'16

PhD student Patrick

Brown understands the importance of communication. Any scientific research requires some level of distillation to be made understandable to the general public, and climate science is no different.

Last April, Brown published a paper in the journal *Scientific Reports* that looked at the statistical likelihood that the globe was on a more moderate versus extreme warming trajectory given that the global average temperature had been trending slightly downward over the previous 11 years. Brown and his co-authors found that it was more likely we had been on a more moderate path.

“It wasn’t actually a groundbreaking conclusion,” Brown says. But the media, “like a game of telephone,” he says, translated and re-translated his findings until they were touted as evidence against climate change.

“It was frustrating to see that,” Brown says. He responded via a personal blog post and through various media outlets. He also responded directly to dozens of emails asking for clarification, an opportunity he says he appreciated.

“You can’t always communicate everything you want in the paper or press release—sometimes it’s hard to be able to tell exactly what’s meant. It’s nice to be able to ask a direct question.”

Brown studies under **Wenhong Li**, assistant professor of climate in the Nicholas School’s Division of Earth and Ocean Sciences. Brown’s research includes comparing climate models and identifying ways to improve them.

The goal, he says, is not necessarily to lower the uncertainty associated with these models.

“There are certain limits on the predictive power of climate models,” he says. “Sometimes it’s better to just ask, how much uncertainty is there?”

Most uncertainty lies in the variation

of global average temperatures from decade to decade. Unfortunately, this is the time scale that is most important to policymakers who want to know what the climate will be like 10 to 50 years from now.

Climate models tend to agree on the physics of year-to-year variability, Brown explains. They also agree that, as long as greenhouse gas concentrations continue to rise, significant warming will occur in the next hundred or so years. It’s the time in between that is harder to predict.

A good analogy for this, says Brown, is waves and tides. At a certain point in time, if we know the current state of the ocean, we can predict how the next few waves will affect the water line on the beach. This is like predicting the weather for tomorrow or the rest of the week.

We also know if the tide is going in or out, so we can predict where the average water line on the beach will be several hours from now. This is like modeling the average temperature a hundred years from now, given a certain increase in greenhouse gas concentrations.

Predicting where the water line will be in 10 minutes is much more difficult. The tide won’t have had a large effect yet, and we have almost no way to predict the state of individual waves that far out. This is like trying to predict the weather or even average temperature a few decades from now, Brown says.

The decade-to-decade timescale is when natural variations are large compared to anthropogenic inputs. Though greenhouse gas concentrations may be rising steadily over 100 or more years, you might not see much change in average global temperature from one decade to the next due to unpredictable changes in air and ocean cycles.

And once you factor in social and political changes that might affect greenhouse gas concentrations between now

and then, such predictions become even more difficult.

Brown has been interested in weather and climate since elementary school, when he built his own weather stations to monitor local weather patterns and make forecasts for friends and family. After graduating from the University of Wisconsin at Madison, he worked for a year at Weather Central, LLC, drawing local and national weather maps for newspapers.

He went on to earn a master’s degree in meteorology and climate science from San Jose State University, where he became interested in climate models. He applied to the Nicholas School for its interdisciplinary approach to climate science.

“As I became more interested in climate change, as opposed to weather, I realized how important the ocean surface is, how important the land surface is, how important the biosphere is, and how important long timescales that incorporate geology are. I wanted to be in a department that incorporated all those aspects.”

In his first year at the Nicholas School he met his now fiancée, Heidi Winner, MEM’13. They live in Durham and have one cat. Brown enjoys hiking and running, but his main hobby, he says, is his blog. This is where he posts videos and articles explaining his research and climate science in laymen’s terms.

“The internet is full of misinformation and information created by people that frankly don’t know what they’re talking about. In this small area I feel like I do know what I’m talking about, so I want to have something out there.”

You can read Brown’s blog at patrickbrown.org.

Kati Moore MEM’16 is a Nicholas School communications assistant.

for the love of
BIRDS

Dedicated PhD Students Turn Their Desire to Reduce Bird Deaths Caused by Window Collisions Into a Research Project

by Lisa M. Dellwo





Bird image by istock, student photos by Amy Chapman Braun



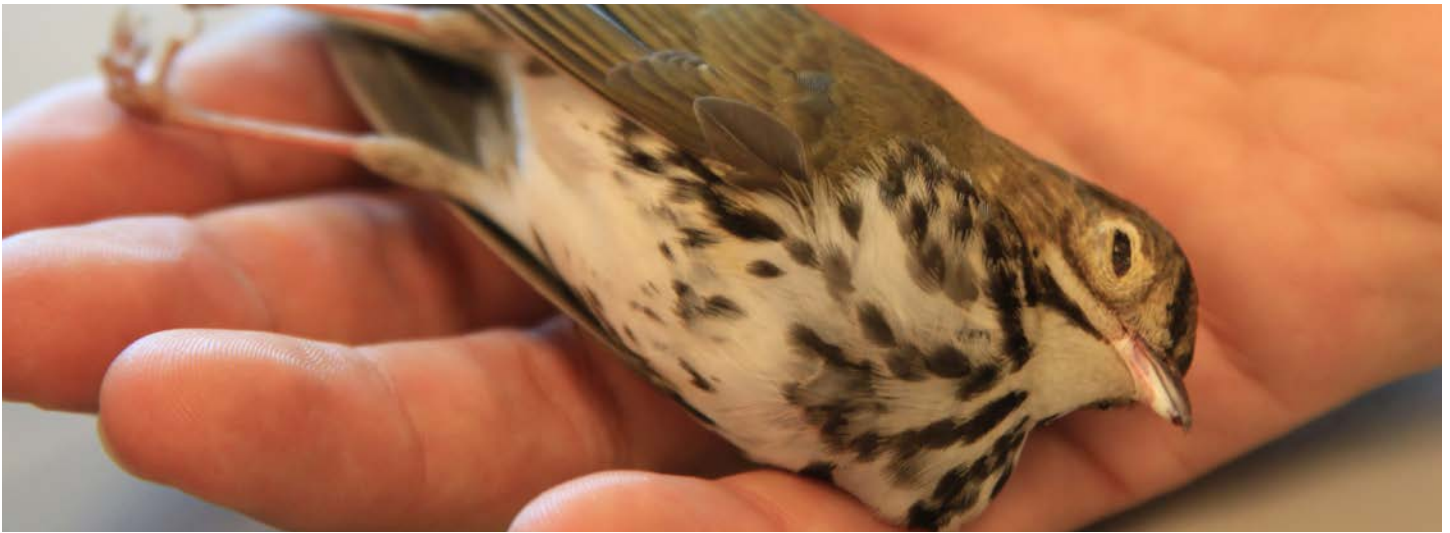


CHECK OUT THE PROJECT'S WEBSITE
AND SCOTT WINTON'S BLOGS:

- 1 sites.duke.edu/birdcollisions
- 2 blogs.nicholas.duke.edu/birds/
- 3 birdaholic.blogspot.com/



BETWEEN 265
AND 988 MILLION
BIRDS ARE KILLED
ANNUALLY BY
COLLISIONS WITH
BUILDINGS IN THE U.S.



nyone who lives in a wooded neighborhood is familiar with the problem of birds flying into windows. This most likely happens because the birds see the forested landscape reflected in the glass. Like many dedicated birders, **Natalia Ocampo-Peñuela** was concerned about this issue, particularly on the Duke campus where she is a PhD student studying tropical bird ecology.

She was concerned enough to urge Duke administration to address the problem in building construction and renovation. But like any good scientist, she decided that collecting data would strengthen her case.

Her PhD work involves bird conservation in her native Colombia. “I normally work with live birds,” she says. But Ocampo-Peñuela became known as the person to contact on campus when a bird was found dead next to a building.

“People started bringing dead birds to my office,” she says. Her research started with an Excel spreadsheet in which she logged each victim’s species and location. But logging serendipitous finds was not sufficiently rigorous scientifically. So in 2013, she approached Nicholas School instructor **Nicolette Cagle** about enlisting master’s students in a data collection effort.

Since that time, according to Cagle, 30 master’s students and a handful of undergraduates and Duke employees were involved in data collection for a project, spearheaded by Ocampo-Peñuela, involving bird collisions on campus. Three Master of Environment

Management (MEM) students, **Charlene Wu**, **Erika Zambello**, and **Thomas Wittig**, are coauthoring a journal article with Cagle, Ocampo-Peñuela, and Duke PhD student **Scott Winton** that will address the observed patterns of bird-window collisions.

This is not Ocampo-Peñuela’s first involvement in research on bird-window collisions. As an undergraduate ecology major at Pontificia Universidad Javeriana in Bogota, she began documenting bird mortality on campus after an administrator told her about deaths associated with window collisions. The work was published in a Colombian ornithology journal the year after she graduated.

Winton signed onto the project at about the time as Cagle. But Winton decided to address the problem through another route.

Winton was the Nicholas School’s Environmental Science and Policy representative on the Graduate and Professional Student Council (GPSC). In 2015, he introduced a resolution to the council asking Duke administration to “consider bird collision mitigation during the design and planning process of all future campus buildings.” In addition, the resolution asked Duke to consider retrofitting existing buildings and to become a leader in a bird-friendly campus movement.

The resolution was based on the results of more than a year of data collection on campus in which 168 bird deaths were documented, either in the formal data collection project

involving seven campus buildings or in a subsidiary project in which anyone could report a death anywhere on campus using the iNaturalist app.

It passed unanimously. According to Winton, any resolution passed by GPSC is forwarded to high campus administrators and members of the university’s Board of Trustees.

168 bird deaths might not sound like an actionable problem, but the big picture is that building collisions are second only to feral and free-ranging pet cats as a human-related source for bird mortality in the United States. A recent scientific paper states that between 265 and 988 million birds are killed annually by collisions with buildings in the U.S.

“Nationwide, buildings kill many hundreds of millions of birds each year—a major source of their mortality. And they need not: this is something where simple engineering can fix the problem,” says **Stuart Pimm**, Doris Duke Professor of Conservation Ecology in the Nicholas School and Ocampo-Peñuela’s advisor. “I’m delighted that, as part of its commitment to being green, Duke has chosen to embrace these simple solutions.”

The problem was most recently in the news when the Minnesota Vikings revealed the plans for a stunning new football stadium, to be constructed along the migratory corridor of the Mississippi River, complete with walls of bird-unfriendly glass. In January, the team declined to redesign the stadium using fritted glass, which has a pattern

that makes the glass more visible to birds.

On the Duke campus, you can see fritted glass on the recently built Penn Pavilion and on the street sides of the Nicholas School's new Environment Hall, and those airy buildings—according to the surveys—have very few bird collisions associated with them.

Where you would not find fritted glass, until recently, is on the Fitzpatrick Center for Interdisciplinary Engineering, Medicine and Applied Sciences (CIEMAS), a 322,000-square-foot LEED-certified complex completed in 2004. In surveys conducted from Spring 2014 through Spring 2015, 72 percent of the bird deaths documented on campus (81) were attributed to this building.

Now, perhaps, that rate will decline. **John Noonan**, vice president for facilities management at Duke, reports that toward the end of the summer, a patterned film had been applied to four towers and the outward-facing bridge facades at CIEMAS. The printed dots on the film reduce reflectivity and visually breaks up the glass expanse for birds in flight while still maintaining 98 percent

clear viewing for the humans inside the building.

"The solution came from a collaborative review of the study from the Nicholas School research team and Facilities Management architectural and engineering staff," Noonan says.

Duke's Fall 2014 data collection effort became part of a larger project in which researchers on 40 campuses across the country gathered bird-window collision data during fall bird migration. Principal investigator **Stephen B. Hager** of Augustana College is still analyzing data that he hopes will reveal whether the amount of window space in a building is a factor in bird strikes, as well as whether being surrounded by green space rather than other buildings is a quantifiable factor.

That project was conducted under the umbrella of the Ecological Research as Education Network (EREN), an organization devoted to involving undergraduate students in collaborative research projects. With EREN, Ocampo-Peñuela says, "You pitch an idea that needs replicates and access to a network of researchers." In May, she pitched an idea for a study

comparing bird deaths associated with LEED-certified buildings to non-LEED buildings, which was approved and then got under way this fall.

"LEED buildings are designed for energy efficiency, views and lighting," she says. "All of these speak to more windows, more glass."

MEM student Erika Zambello, with Ocampo-Peñuela's help, took the lead in gathering data across 15 campuses.

"Soon, we will be able to elucidate if green buildings are more dangerous to birds, and hopefully push for a more strict, bird-friendly protocol to certified buildings, contributing to ongoing work by the American Bird Conservancy," says Ocampo-Peñuela.

Lisa M. Dellwo is a writer specializing in nature, environment, science, and foodways, based in Down East Maine. Her previous article for *Dukeenvironment* was a profile of Duke Ph.D.s Andrew Gronewold and Craig Stow, focusing on their Great Lakes research.

STUDENT SPECIAL AWARDS

THE DEAN'S AWARD FOR OUTSTANDING RESEARCH PAPER FOR 2015

Given annually since 2008 to recognize outstanding research and writing done by a current PhD candidate who has a manuscript accepted or published in a peer-reviewed journal. This year's co-winners were acknowledged at the spring graduation ceremony and received a check for \$1,500 each.

PATRICK BROWN (ADVISOR, WENHONG LI)

"Comparing the Model-Simulated Global Warming Signal to Observations using Empirical Estimates of Unforced Noise," *Scientific Reports*, (Brown, Li, Cordero and Mauget, 2015) doi:10.1038/srep09957.

PhD candidate, Earth and Ocean Sciences

SARAH BRODY (ADVISOR, SUSAN LOZIER)

"Changes in Dominant Mixing Length Scales as a Driver of Subpolar Phytoplankton Bloom Initiation in the North Atlantic," *Geophysical Research Letters*, (Brody and Lozier, 2014) doi:10.1002/2014GL059707.

PhD, Earth and Ocean Sciences, Duke University, May 2015

Virilis L. Fischer Award

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

LUKE SLIVINSKI of St. Petersburg, Fla.; MEM'15, Coastal Environmental Management

Sara LaBoskey Award

Given in recognition of personal integrity and academic excellence.

PATRICK HUNNICUTT of Midlothian, Va.; BA, Environmental Sciences and Policy, Graduation with Distinction

Thomas V. Laska Memorial Award

Given by the Earth and Ocean Sciences faculty to the most outstanding senior major.

VIRGINIA ISAVA of Coral Springs, Fla.; BS, Earth and Ocean Sciences, Graduation with Distinction

**ER
STOS**



**DANGER
ASBESTOS**



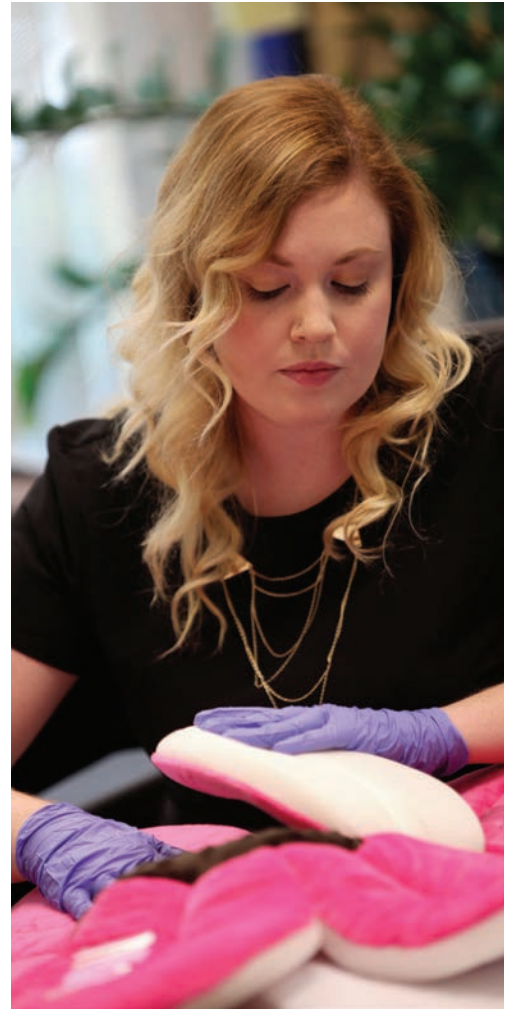
ON THE CASE

LAUREN GLOEKLER MEM'13

IS WORKING TO SOLVE THE PUZZLE OF

CHEMICAL EXPOSURE

BY TAWNEE MILKO MEM'12



photos by Vai Westover Photography

Until the late 1970s, millions of U.S. workers were exposed to asbestos mineral fibers once widely used in construction, maritime and manufacturing industries.

Today, asbestos is recognized as a known human carcinogen, one that may increase the risk of lung cancer, mesothelioma and asbestosis following sufficient doses decades after initial exposure. Though the 1980s and 1990s saw it phased out of most commercial uses, manufacturers are now being faced with hundreds of thousands of asbestos-related lawsuits—what one global policy think tank has called the longest, most expensive mass tort in U.S. history.

Enter **Lauren Gloekler**, associate health scientist for California-based consulting firm Cardno ChemRisk.

Gloekler, MEM'13, handles and reviews client cases in the field of

workplace safety and health litigation. Any given day in the office finds her combing through scientific literature, deposition testimony and other legal documents. Her objective: reading and summarizing large volumes of information in order to create a comprehensive occupational and exposure history for the purposes of estimating the potential health risk posed by specific instances of exposure to asbestos and other environmental toxins.

“It really is like detective work,” she says. “Using science in its purest form, we’re compiling the facts to help clients solve the puzzle of chemical exposure.”

Gloekler is as much in the business of asking questions as she is of answering them. The company’s investigative process involves collecting detailed information about a suspected health hazard, usually a chemical, and evaluating the relationship between a specific exposure amount, or “dose,” and the human body’s response to

it. She assists with applying the full spectrum of available toxicological and epidemiological data to assess exposure levels and risk of disease in some of her client cases.

Regularly, she queries: What products did this person work with? How often did they work with them, and how were they using them? What do we know about the target chemical, and how does the body process it? Where does it accumulate? How fast is it removed?

“The biggest thing I’ve learned from working here is that there’s always two sides to the story,” she says. “You can’t assume anything. You have to start from the beginning, look at all the details, read the scientific literature, and then objectively put the facts together into one picture.”

Gloekler has possessed a scientist’s curiosity since youth. Graduating from University of Texas–Arlington in 2008 with a bachelor’s degree in biology, she was soon drawn to the Nicholas School’s Ecotoxicology and Environmental

“I LIKE TO MAKE NEW DISCOVERIES. I LIKE HELPING PEOPLE AND FEELING LIKE I’M MAKING A DIFFERENCE BY USING SCIENCE TO GIVE OUR CLIENTS AND THE PUBLIC INFORMATION THAT HASN’T BEEN THERE BEFORE.”

Health MEM concentration, but was originally keen on studying the nexus between chemicals in food and sustainable agriculture.

Then, in her first semester, she took “Chemical Fate of Organic Compounds,” taught by Ecotoxicology and Environmental Health (EEH) program chair **Heather Stapleton**. Stapleton’s course transformed Gloekler’s interest, and future, completely.

“Heather got me super fired up about chemistry,” Gloekler says enthusiastically. In particular, she was fascinated by the idea of how a chemical’s structure relates to what Stapleton calls the chemical’s “personality,” which in turn relates to its behavior in the environment. Does the chemical volatilize into the air? Does it solubilize in water? Does it like to adhere to things?

These characteristics not only affect where in the environment chemicals will ultimately end up and how long they might stay there, but how people might be exposed to them through everyday products like cosmetics, personal care products, furniture and electronics.

Motivated by environmental chemistry’s real-world applicability, Gloekler quickly became involved with Stapleton’s ongoing research in children’s exposure to environmental contaminants—specifically, polybrominated diphenyl ethers, or PBDEs, a class of widely-used brominated flame retardants that are designed to reduce flammability.

Gloekler also joined forces with then-EEH program chair **David Hinton**, Nicholas Professor of Environmental Quality, to achieve her dream of spending a summer internship abroad. In a stroke of fate or luck, Hinton had recently developed a relationship with Hong Kong’s City University, whose

researchers were also investigating problems that arise from flame retardant compounds.

Supported by a \$2,500 Nicholas School International Internship award, Gloekler developed a Masters Project to assess flame retardant exposure among students at Shantou University in southern China and at City University from handling everyday electronics. The data collection process involved visits to students’ dormitories to collect dust samples and hand-wipes, as well as to administer behavior and lifestyle questionnaires that could help build a better picture of potential flame retardant exposure pathways.

Preliminary studies have linked the accumulation of flame retardants in the body to a variety of developmental impairments in children, as well as other potential health effects like disruptions in endocrine activity. Gloekler’s study, the first documenting levels of PBDEs and replacement compounds measured in hand-wipes from a Chinese population, lent more data toward the mystery of how humans are exposed to these chemicals in the first place and what behavioral variables influenced the levels of exposure.

“Until we understand how chemicals are transported out of a product and how we come into contact with them, it’s really difficult for us to evaluate risk to human health,” explains Stapleton, who has been exploring the relationship between flame retardants and environmental health for more than a decade.

Despite lack of fluency in Cantonese or Mandarin, Gloekler successfully navigated the logistics of leading international research teams at Shantou and City University, including demonstrating proper sampling techniques and managing English-

Mandarin translations of research documents.

Immersing herself in a foreign culture was a key aspect of her time abroad. She recalls arriving at Hong Kong International Airport on a Saturday and, as she was dropped off at her hostel, being told, “We’ll see you Monday.”

“I was literally all alone in the most densely populated area in the world,” Gloekler says, then laughs. “It was insane. I’m an adventurous eater, so I spent a lot of time exploring the city and trying new foods. There was a lot of dining by myself and making friends with people on the streets.”

Her international experiences have played directly into her leadership role at Cardno ChemRisk, where clear communication and a background in research design has been critical. She and several colleagues are also working on two studies that stem from her research with flame retardants at the Nicholas School.

One, a simulation study to better understand migration of flame retardants from baby products, was among a group of research projects that were internally funded by Cardno ChemRisk. The company encourages its employees to conduct research to advance scientific knowledge in new areas of toxicology, epidemiology, occupational health and safety and related disciplines, and completed papers are submitted to relevant peer-reviewed journals for publication.

In her study, Gloekler is ultimately trying to understand the flame retardant transfer efficiency from a baby product to a child’s hand, and subsequently from the hands into the body via hand to mouth contact. Are PBDEs and other flame retardant compounds transferred by contact with a product? If so, which products? Or are they in a home’s dust



photos by Val Westover Photography

particles, and does exposure to dust particles lead to higher PBDE exposure?

As one might expect, one of the primary routes for chemical exposure in young children is through hand to mouth transfer.

“You have to think about it as if you were the consumer using the product,” Gloekler explains.

“If you’re a mother and you have a baby, you know the baby’s on or using a baby product ‘x’ amount of hours per day. Then they’re likely putting their hands in their mouth ‘x’ amount of hours per day. That can all play into exposure level.”

One would think that constant contact with studies and real-life cases about the potential hazards of everyday chemical exposure would be enough to make anyone a cautious, if not nervous, consumer herself. For Gloekler, however, the opposite has proved true.

“I’ve realized that just because a product contains a chemical doesn’t necessarily mean that it’s harmful to my health,” she says. “I try to tackle the issue like a scientist would, asking,

‘What is it? How much is there? Is that a level that I need to be concerned about based on how much or little I use the product?’ I am more wary of jumping to conclusions.”

At the same time, Gloekler wishes there was an easier way for the general public to access reliable information explaining the complexities of chemical exposure, and the toxicology of common chemicals found in consumer products.

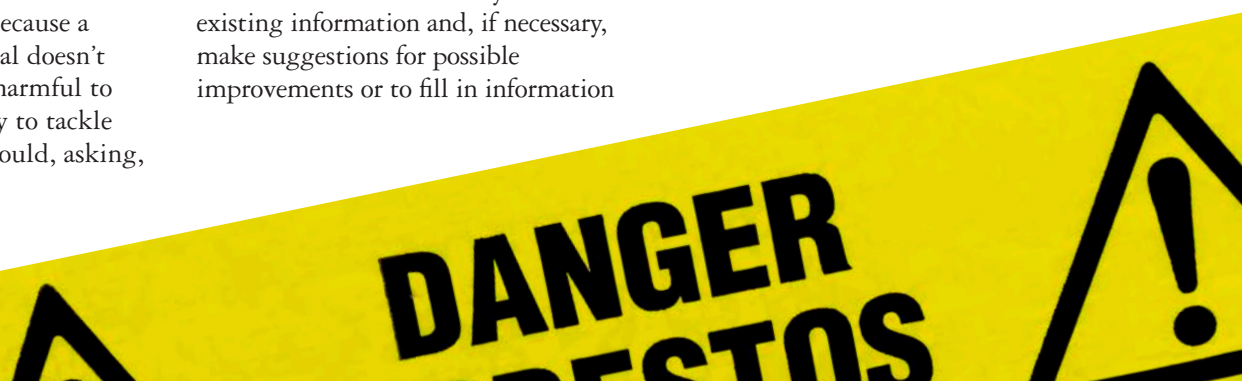
To that end, Gloekler, who blogged for The Nicholas School about her Hong Kong internship, has returned to the blogosphere to write about timely occupational health and toxicology topics. In her most recent post, she took a closer look at the scientific and regulatory literature surrounding the health and safety issues of nail salon workers, prompted by a May 2015 series of *New York Times* articles on the subject.

Gloekler seeks to not only review existing information and, if necessary, make suggestions for possible improvements or to fill in information

gaps. In future research, she also hopes to delve into new areas of study, including foods and dietary supplements.

“I like to make new discoveries. I like helping people and feeling like I’m making a difference by using science to give our clients and the public information that hasn’t been there before,” she says. “I mean, there’s nothing better you could ask for, really, than using your interests to do some good.”

Tawnee Milko MEM’12 was the Nicholas School’s coordinator for the Nicholas Ambassador Initiative from 2012 through September 2015. She is now planning a trip around the world. We will miss her and wish her well on her journey.



ALUMS OF DUKE ENVIRONMENT

We're getting ready to kick off our third **I am Duke Environment** Photo Contest. If you are a member of the Nicholas School community—faculty, staff, students, alumni, board of visitors members and donors—we encourage you to join these Nicholas School alumni. They shared how they are forging a sustainable future by submitting photos.



Brandon Semel BS '13



Bronwyn Llewellyn MEM '06



Nari Sohn BS '12



Peter Griffith BS '78



Venai Shenoy MEM '12



Jordan Williams MEM '07



Sylvia Earle PhD '66 and
Harriet Nash MEM '01



Britta Victor MEM '13, Kirsten Hagfors
MEM/MBA '13, and Maureen Quinlan
MEM '13



Dave Shreffler T' 85

**THE CONTEST RUNS BETWEEN NOV. 9 AND 24
AND FEATURES PRIZES FOR THE WINNER**

Go here to find out more: NICHOLAS.DUKE.EDU/IAMDUKEENVIRONMENT
I am Duke Environment is an ongoing photo social media campaign
sharing the faces and voices of Duke's Nicholas School.

Duke Celebrates 25 YEARS

OF INTERDISCIPLINARY ENVIRONMENTAL EDUCATION WITH SPECIAL EVENTS, ANNIVERSARY CAMPAIGN

by Laura Ertel

The 25 years since the creation of the interdisciplinary School of the Environment at Duke have been filled with momentum and milestones. As founding Dean **Norman L. Christensen** recounts on page 18, an enduring spirit of inquiry and innovation has led the seeds of this school, planted in the 1930s, to blossom into a multi-faceted program. It is now known globally for preparing graduates for successful careers in a wide range of fields and advancing research that has opened new doors to environmental understanding and stewardship.

This coming year, we celebrate the 25th anniversary of the visionary convergence of the Duke Marine Laboratory, School of Forestry and Environmental Studies, and Department of Geology that set the stage for Duke's rising reputation as one of the world's premier institutions for interdisciplinary environmental education, research and real-world impact. Yet we are not just looking back: We also are laying the groundwork to ensure continued leadership and excellence for the next quarter-century and beyond.

IGNITING INTERDISCIPLINARY COLLABORATIONS

The 1991 merger of programs and faculty to create an interdisciplinary School of the Environment and Earth Sciences (renamed the Nicholas School of the Environment in 1992) has led to collaborations and achievements beyond those even dreamed of by school founders.

- Educational programs, such as our Coastal Environmental Management and Energy and Environment concentrations for professional master's students and the Marine Science concentration for undergraduates, draw on the collective wisdom and resources of our divisions of Marine Science and Conservation, Earth and Ocean Sciences, and Environmental Sciences and Policy and other programs throughout Duke.
- Experiential learning opportunities, such as the Stanback Internships and field trips to environmental hotspots, teach our students that tackling complex real-world environmental issues requires diverse perspectives and teamwork. As a result, our alumni are breaking new ground a wide range of environment-related fields.
- Research initiatives in Water Resource Management and Environment and Human Health underscore the necessity of harnessing wide-ranging expertise across

our campus to successfully address these pressing environmental issues.

- Buildings such as Environment Hall on the Durham campus and the Pilkey Center at the Marine Lab, and Durham-based labs such as the Duke River Center, nurture that spirit of cross-disciplinary collaboration and demonstrate Duke's commitment to inform and advance sustainable building and management practices.

These successes and many others, along with the philanthropic support of our many friends and alumni, have burnished Duke University's international reputation and drawn top students and world-class faculty to join our community.

A YEAR OF CELEBRATIONS

Over the next year, the Nicholas School will celebrate several milestones. (In October we marked the first milestone of 75 years of forestry education at Duke.) Save these dates and visit the Nicholas School website for additional details coming soon.

STANBACK INTERNSHIP ANNIVERSARY SYMPOSIUM: A CELEBRATION OF 20 YEARS

April 14, 2016

Features a day of speakers, networking and environmental fellowship. Hear from former Stanback interns who are now leading significant environment organizations in the United States and around the world.

25TH ANNIVERSARY GALA

Nov. 17, 2016

Join us to celebrate the school's history and future as we recognize past and current leaders and philanthropists who have made the Nicholas School what it is today.

A CAMPAIGN FOR THE NEXT QUARTER-CENTURY

Philanthropy has always played an essential role in the growth and leadership of the school. As we revel in the school's 25th anniversary, we also must set the stage for the continued excellence of Duke Environment for the next quarter-century and beyond, says Nicholas School Dean **Alan Townsend**.

In the final two years of the Duke Forward Campaign—having surpassed our first fund-raising milestone—the Nicholas School will launch a new multi-million initiative to raise additional resources for financial aid for the professional graduate and PhD level students to help recruit talented students and lower their debt obligations after graduation.



This new initiative also will support a handful of important Dean's initiatives, including health in the environment, energy in the environment and new educational programs in forest finance and biodiversity, and marine conservation.

"Environmental issues remain persistent and pernicious, and we must do everything we can to ensure that Duke can continue to be agile and equipped to remain at the forefront of environmental thought and action," says Townsend. "In particular, we need to strengthen our ability to offer increased financial aid packages to passionate, driven students who will be part of the solution. This 25th anniversary initiative will help us do just that."

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



FOR INFORMATION—
ABOUT THE NICHOLAS
SCHOOL'S 25TH
ANNIVERSARY CAMPAIGN
AND HOW YOU CAN HELP,
CONTACT ASSOCIATE
DEAN KEVIN MCCARTHY,
OFFICE OF DEVELOPMENT
AND ALUMNI RELATIONS,
919-613-8003.

calendar

EVENTS+ HAPPENINGS

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

NOV. 5-6

PROSPECTIVE STUDENTS VISITATION DAY

Environment Hall and Levine Science
Research Center (LSRC) (Nov. 5)
Duke West Campus

Duke University Marine Lab (Nov. 6)
Beaufort, NC

Contact: Academic & Enrollment Services
919-613-8070 or
admissions@nicholas.duke.edu

NOV. 12, 6-8:30 PM

DUKE FOREST ANNUAL GATHERING

New Hope Improvement Association Center
4012 Whitfield Road, Chapel Hill, N.C.

Contact: Office of the Duke Forest,
919-613-8013 or dukeforest@duke.edu

DEC. 1

WINTER MASTERS PROJECT (MP) SYMPOSIUM

MEM and MF candidates master project
presentations
Environment Hall/ LSRC
Duke West Campus

Contact: Academic and Enrollment Services
919-613-8070 or
admissions@nicholas.duke.edu

DEC. 10, 6-8 PM

PROSPECTIVE STUDENT OPEN HOUSE

Duke in DC, Washington, D.C.

Contact: Academic & Enrollment Services
919-613-8070 or
admissions@nicholas.duke.edu

JAN. 8, 9 AM-3 PM

PROSPECTIVE STUDENTS VISITATION DAY

Environment Hall/ LSRC

Duke West Campus

Contact: Academic & Enrollment Services
919-613-8070 or
admissions@nicholas.duke.edu

FEB. 26

STANBACK INTERNSHIP PROGRAM INTERVIEW DAY

Searle Center
Duke West Campus

Contact: Rhonda Sarmiento, 919-613-4442,
rhonda.sarmiento@duke.edu

APRIL 1-2

ADMITTED STUDENTS VISITATION WEEKEND

Searle Center
Duke West Campus

Contact: Academic & Enrollment Services
919-613-8070 or
admissions@nicholas.duke.edu

APRIL 7-8

SPRING MASTERS PROJECT SYMPOSIUM

Environment Hall, Duke West Campus

Contact: Academic & Enrollment Services
919-613-8070 or
admissions@nicholas.duke.edu

APRIL 7-8

RESIDENTIAL AND DEL-MEM MP SYMPOSIUM

Environment Hall, Duke West Campus

Contact: DEL Program, 919-613-8082 or
del@nicholas.duke.edu

APRIL 14-15

SPRING MEETING OF THE NICHOLAS SCHOOL BOARD OF VISITORS

Board Room, 5th Floor, Environment Hall
Duke West Campus

Contact: Kevin McCarthy, 919-613-8019 or
kevin.p.mccarthy@duke.edu

APRIL 14-15

SPRING MEETING OF THE NICHOLAS SCHOOL ALUMNI COUNCIL

Board Room, 5th Floor, Environment Hall
Duke West Campus

Contact: Glenda Lee, 919-613-8035 or
gslee@duke.edu

APRIL 26-27

TIMBERLAND INVESTMENTS FOR PROFESSIONALS

DEL Executive Education (open
enrollment courses)
Durham campus

Contact: DEL Program, 919-613-8715 or
del@nicholas.duke.edu

MAY 7-8

DEL-MEM PLACE-BASED SESSION

LSRC A158
Duke West Campus

Contact: The DEL Program, 919-613-8082 or
del@nicholas.duke.edu

MAY 14, 9 AM

NICHOLAS SCHOOL RECOGNITION CEREMONY FOR GRADUATE AND PROFESSIONAL DEGREE CANDIDATES

Contact: Nancy Kelly, 919-613-8090 or
nkelly@duke.edu

MAGAZINE SURVEY

Spend 10 minutes to tell us what you think about *Dukenvironment* magazine and get a chance to win one of three **\$100 REI gift certificates.**

Get started now!

nicholas.duke.edu/dukenvironment/survey

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