UNIVERSITY OF DELAWARE

Research

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Eco-Innovation

UNIVERSITY OF DELAWARE

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FSC
Mixed Sources
Product group from well-managed forests, controlled sources and recycled wood or fiber

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UD has deployed an autonomous underwater vehicle to scan the ocean interior for oil.

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Ecologist Doug Tallamy tells you how to landscape for butterflies, birds and a better life — using native plants.

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Discovery, innovation, invention — idea leadership is a pillar of UD's new brand. Janine Sherrier is one of a crop of UD researchers with big ideas.

FROM THE PRESIDENT

Welcome to the "Eco-Innovation" issue of *University of Delaware Research*. Just as "eco-innovation" describes one of UD's biggest research areas, "eco-leadership" describes one of our key missions.

We're fulfilling that mission with several sustainability milestones. This past summer, UD commissioned a 2-megawatt onshore wind turbine that's now powering our campus in Lewes, Delaware. We've since signed a research agreement with the National Renewable Energy Laboratory that could initiate the testing of commercial wind turbines off the Delaware coast — the first offshore turbines in the Americas.

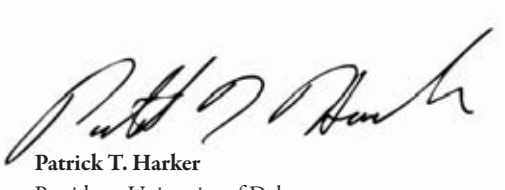
Our vehicle-to-grid technology — allowing electric car batteries to store excess energy when demand for power is low and send it back to the grid when demand is high — is undergoing its first large-scale demonstration project. Meanwhile, Delaware Governor Jack Markell signed the world's first bill mandating that electric car owners be compensated for electricity they return to the grid at the same rate they pay to charge the cars' batteries.

A Critical Zone Observatory at the Christina River Basin, funded by the National Science Foundation, is helping UD answer critical climate change questions, while our Energy Frontier Research Center, funded by the Department of Energy, is developing catalytic technologies that can more efficiently convert biomass into chemicals, electricity and fuels.

But this is just a snapshot: The University is conducting breakthrough research in photovoltaic solar cells, lightweight composites, next-generation magnets and hydrogen storage. UD's great opportunity now is to get our important innovations out of the lab and into our homes, our cars, our offices — our way of life.

We are closing the science/policy and policy/practice divides. U.S. leaders are turning to UD for guidance on alarming environmental events and their implications — from the massive oil spill in the Gulf of Mexico to the cleaving of a huge ice island from Petermann Glacier in northern Greenland. We've developed a cross-disciplinary undergraduate major in energy and environmental policy (our graduate programs were the nation's first), and conceived the Sustainable Energy Utility, a nonprofit delivering energy-efficiency and renewable-energy services to homes and businesses.

As an institution creating some of the world's most promising environmental science and policy — an institution with nearly 20 centers dedicated to energy and environmental research — the University of Delaware has an absolute imperative to do the interdisciplinary work that will solve this nation's sustainability crisis, and to be the first-stop resource for countries aiming to do the same. Our "eco-leadership" depends on it.



Patrick T. Harker
President, University of Delaware

STUART WATSON

UNIVERSITY OF DELAWARE

KATHY F. ATKINSON

Mark Barteau is UD's Senior Vice Provost for Research and Strategic Initiatives, and the Robert L. Pigford Chair of Chemical Engineering.

UD RESEARCH OFFICE

A laboratory for the nation

by Mark Barteau

"Think Globally, Act Locally." We have probably all seen this admonition on bumper stickers and elsewhere. It is indeed a valuable reminder that even with challenges as global as the health of our planet and the life it supports, individual decisions and individual actions matter.

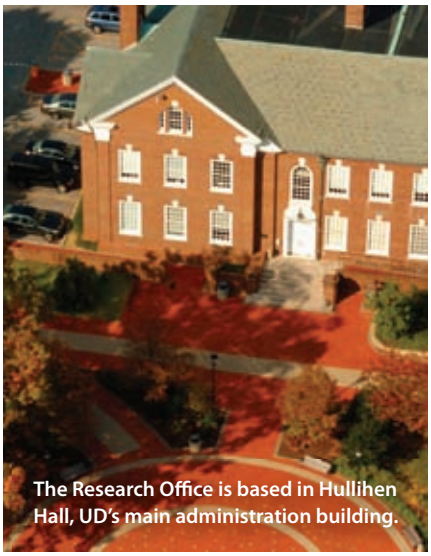
At the same time, the world in which we live is far too interconnected for individual actions to solve global problems, or even for the individual to fully appreciate all the consequences of his or her decisions. As we look at the challenges facing our society, from environmental preservation and amelioration, to clean energy, to a healthier society, to public education that prepares students for the "flat" world in which they will live, the common need is for *scalable solutions.* We seek ideas, systems, technologies, best practices that can be developed and tested at a meaningful scale, and that can be reproduced and adapted on national and international scales.

Enter Delaware! Our "Small Wonder" state and its flagship university continue to grow in their importance as a laboratory for the nation. Earlier this year, Delaware was named one of the first two states to be selected for Race to the Top funding by the U.S. Department of Education. This effort seeks to create new paradigms for public education in the 21st century by working at the statewide level.

University of Delaware faculty have been especially involved in Science, Technology, Engineering and Mathematics (STEM) teacher education and building capacity to deliver rigorous STEM courses statewide, as well as assisting school leaders to develop evidence-based plans for school improvement.

The Delaware Health Sciences Alliance, a partnership of the University of Delaware, Thomas Jefferson University, Christiana Care Health System, and Nemours/A.I. duPont Hospital for Children, is aimed at the development of health care solutions from bench to bedside, and to assessing the impact of these on population health at the statewide scale.

Delaware's Sustainable Energy Utility and enabling legislation for vehicle-to-grid technologies, both products of UD research and policy scholarship, represent first-in-the-nation, scalable solutions to our energy future. Our Critical Zone observatory, one of only six funded by the National Science Foundation, focuses on

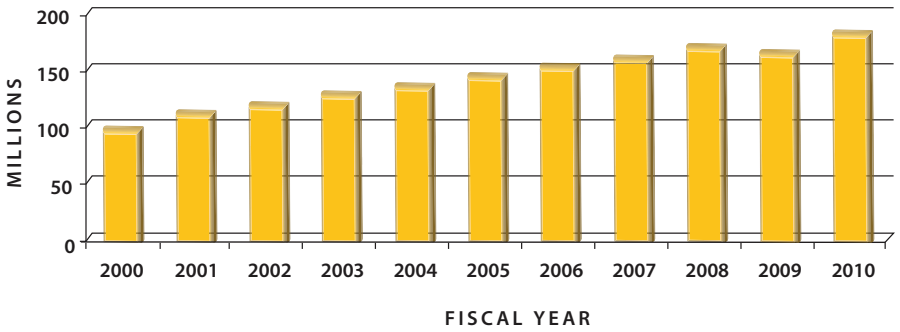


KATHY F. ATKINSON

The Research Office is based in Hullihen Hall, UD's main administration building.

Annual Expenditures

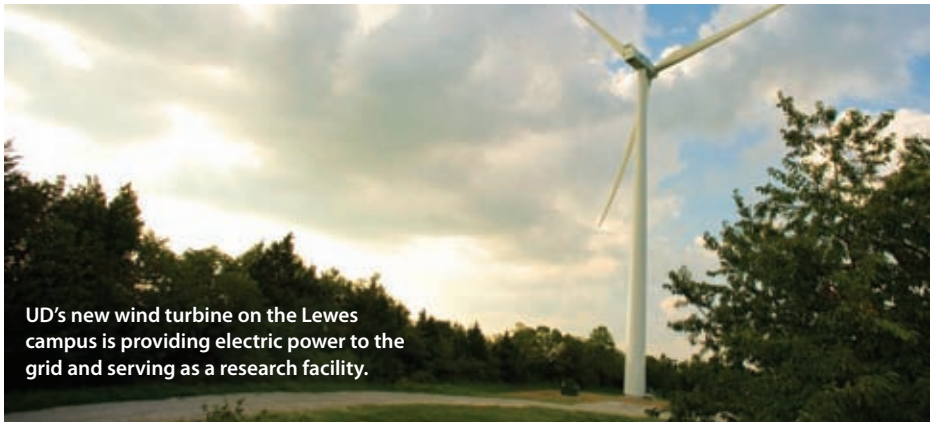
UD Sponsored Programs reached $180 million in FY 2010 (doubled in 10 years).



"Think Globally, Cultivate Locally"

key watershed issues that have regional impact and solutions that can be applied far beyond. The University's new wind turbine on the Lewes campus is already providing electric power to the grid, while serving as an important research facility for wind turbine technology in a marine environment. There are no offshore turbines anywhere in the Americas, and thus the knowledge that will be gained from this UD initiative promises to affect clean energy development and deployment on the scale of the hemisphere.

These are just some of the ways that the University of Delaware is driving the creation of knowledge, technology, education and policy of national importance. Delaware as a laboratory for the nation is not an idle dream, but a recognition of leadership and impact that grow every day. The redevelopment of the former Chrysler Newark assembly plant site into a science and technology campus that will house new ventures and partnerships opens new opportunities to translate university research, scholarship and creativity into truly scalable solutions.

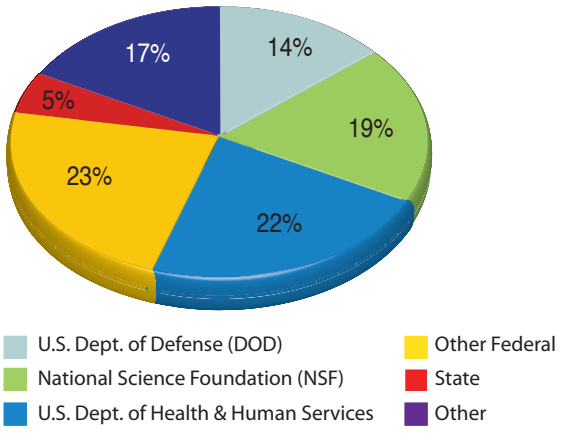


UD's new wind turbine on the Lewes campus is providing electric power to the grid and serving as a research facility.

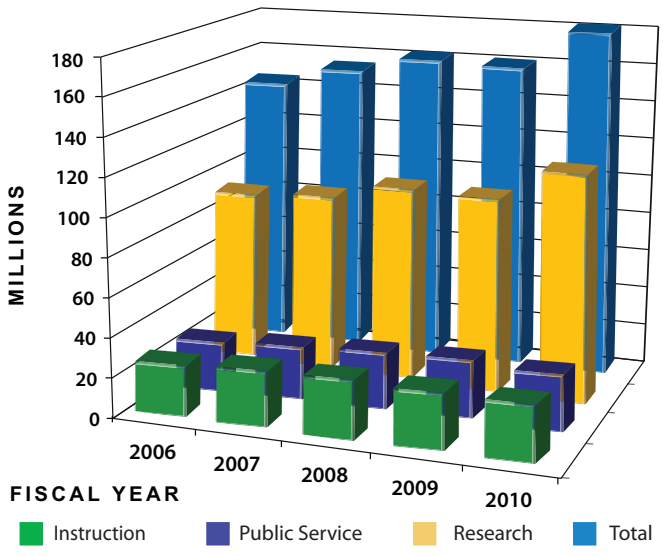
KATHY F. ATKINSON

"Think globally, cultivate locally." The opportunity to do great things rests on thousands of individual efforts, inspirations and interconnections. By any quantitative measure, the University of Delaware is among the nation's prominent research universities, and our pace is accelerating. But the real excitement comes not from the numbers, but the people. The best part of my job is learning about new research and creative activities of our faculty and students, from the arts to technology, from the local to the global. I hope you also will enjoy some of those "best parts" through the stories in this issue.

FY 2010 Research Expenditures by Sponsor



Sponsored Program Expenditures



Dare to be first.

Eco-Innovation

At the University of Delaware, discovery, invention and innovation matter. We're thinking big.

Mix human ingenuity, abundant resources and a location in a state known as an incubator of global, entrepreneurial R&D, and you have **Idea Leadership** — a key UD characteristic and a pillar of the University's new "Dare to be first" brand.

True to that brand, invention disclosures are on the rise at UD — up 60% from last year with support from our Office of Economic Innovation and Partnerships (OEIP). Here, you'll meet inventors who are planting ideas with "green" potential in more ways than one: helping the environment and growing new businesses.

Photos by Kathy F. Atkinson

"Genius is one percent inspiration and ninety-nine percent perspiration."

—Thomas Alva Edison (1847–1931)

Engineering the perfect cell

Imagine being able to create an ideal organism for producing biofuels and chemicals from renewable resources: resistant to toxic chemicals, a fast grower and producer, complete with only desired, beneficial bioprocessing characteristics.

While it sounds almost too good to be true, Eleftherios (Terry) Papoutsakis, Eugene du Pont Chair of Chemical Engineering at UD, has filed two invention disclosures this year that put him at the forefront of this uncharted research field.

A classical chemical engineer by undergraduate training, Papoutsakis, who joined the UD faculty in 2007, explains that, typically, genes from different species cannot mix, such as those from humans with those from dogs or camels, because cells do not recognize or express the foreign DNA.

"Organisms recognize their own specific elements of DNA that control the expression of the genes that produce proteins to do the desirable reactions or to get the desirable cell properties," Papoutsakis says.

"What we want to do is to be able to mix properties of microbes so you have a variety of new, semi-synthetic microbes, each one doing different things suitable for different applications."

Seeing the most promise for his research in the green sector, Papoutsakis gives the example of engineering a cell to be resistant to the toxic chemicals required to make the biofuels he wants to produce.

"My goal is to create a new cell — a new biocatalyst — for this process that is not only able to produce the chemicals of the biofuel that I desire, but also is very resistant to those chemicals, so that it does not die and keeps producing."

Papoutsakis is working to engineer one microbe so that it can recognize the DNA from another microbe, to, in turn, be able to express genes and change the programming of the cells.

He calls these gene combinations from different microbial species "alloys" and has discovered several different ways to integrate them into cells.

Through this integration, Papoutsakis is able to take the traits desired from each organism — each with a different type of DNA — and mix them together.

In addition to biofuels, Papoutsakis says the research method could even translate into the medical field or pharmaceutical industry, as it would allow for the production of a better cell that could produce small organic molecules for drug testing.

Papoutsakis leads a research group at the Delaware Biotechnology Institute at UD focused on genomic and metabolic engineering studies of microbial systems, as well as applications of stem-cell biotechnology for the production of blood cells.

His research contributions have been recognized by numerous awards, including most recently, the 2010 International Metabolic Engineering Award and the 2010 Elmer Gaden, Jr. Award from the journal *Biotechnology and Bioengineering*. He also is the inventor on more than 15 patents and patent applications.

— *Meredith Chapman*

DARE TO BE FIRST

Eleftherios (Terry) Papoutsakis (right), Eugene du Pont Chair of Chemical Engineering, works with postdoctoral research fellow Stephan Lindsey in the lab at the Delaware Biotechnology Institute.

A little collaboration grows a long way

EVERETT CROKER AND THE DBI BIO-IMAGING CENTER

Some people see bacteria as a deterrent to productivity. However, for two UD researchers, the colonization of plants by *Bacillis subtilis* holds promise for battling droughts and plant diseases and, ultimately, for increasing yield for farmers in Delaware and, possibly, around the globe.

Janine Sherrier and Harsh Bais, both professors of plant and soil sciences based at the Delaware Biotechnology Institute at UD, were sharing "eureka" moments from their research and realized they could achieve potentially revolutionary results if they collaborated.

"We have diverse interests, but we also have a lot of common ground," Bais says.

Sherrier works on a very well-defined system of legumes and bacteria known as rhizobia that live inside the roots of these plants, while much of Bais' work focuses on relating abiotic stress — chemical or physical factors, such as drought — to plant structure, behavior and function.

According to Bais, plants and some bacteria have evolved together to have beneficial interactions.

"We have shown in the past that plants can actually recruit beneficial microbes," he says.

Thus, when a plant is in distress, it sends a chemical signal; beneficial bacteria react and aid the plant. While using the plant as their energy source, the bacteria help fend off dangers and promote healthy plant growth.

Sherrier focuses her research efforts on biological nitrogen fixation in legumes.

"In the lab, we are trying to define the components that are necessary for a plant and a bacterium to recognize each other and form a symbiotic infection," she says.

During a successful interaction between bacteria and legume roots, the bacteria convert atmospheric nitrogen into a form that the plant utilizes for robust growth.

"Since nitrogen is often a major limiting nutrient for crop production, this interaction allows plants to grow successfully in nitrogen-poor environments without the addition of costly chemical fertilizers. Ultimately, there has to be a chemical conversation between the two partners, so our objective is to understand how this process occurs," she notes.

The scientists put their heads together and designed a research plan to take advantage of the beneficial interaction between diverse crops and growth-promoting bacteria.

"Roots normally forage — just like any herbivore — for a food source, for table water, for competition," Bais explains. "The interaction with *B. subtilis* enhances the ability of plants to combat stresses like disease, drought and nutrient insufficiency."

The research that Bais and Sherrier are doing with *B. subtilis* has the potential to increase biomass — resulting not only in greater yields but also expanded root systems, which can help plants to tackle abiotic stress, such as a mid-summer drought.

The use of *B. subtilis*, according to the research duo, is not only less expensive than utilizing fertilizers, fungicides and supplemental water, but also has a smaller environmental impact and is straightforward for growers to implement in both small-scale gardens and large, commercial settings.

This discovery could aid farmers with crop production, as well as help protect the environment — a combination of benefits that further fuels Bais and Sherrier in their research.

"I have always been a true believer in doing broad science, answering big and complex questions related to plant survival and fitness — it is what drives me every day," Bais says.

Sherrier, who primarily concentrates on fundamental research on plant-microbe interactions, is excited to have collaborated with Bais on this effort and to apply laboratory results in a field setting.

"When I consider the potential impact of this project for growers, the environment and on food production, it truly is a dream project for me," she says.

Aided by UD's Office of Economic Innovation and Partnerships, from patent procurement through the commercialization process, Bais and Sherrier hope that *B. subtilis* could eventually have a global impact, reaching farming communities in South America, Australia, Africa and beyond.

— Meredith Chapman

DARE TO BE FIRST

Janine Sherrier examines a test plot of soybeans grown from seeds treated with the beneficial bacterium *Bacillus subtilis*. The plants exhibit more extensive root systems, more rapid growth and overall greater vigor than plants grown from untreated seeds.

UNIVERSITY OF DELAWARE

OEIP

OFFICE OF ECONOMIC INNOVATION AND PARTNERSHIPS

Innovation on the rise

UD is the birthplace of such cool technologies as the touch screen in Apple's iPhone, to vehicle-to-grid (V2G), which allows electric car owners to send energy stored in their batteries back to the electrical grid, saving money while helping the environment.

Since the Office of Economic Innovation and Partnerships (OEIP) was formed at UD in 2008, a key mission of its Technology Transfer Center has been to protect and commercialize UD researchers' ideas.

In addition to streamlining the patent process, OEIP has opened it up to the entire University — anyone from an undergraduate student to a tenured faculty member can disclose an invention, regardless of its stage of development. OEIP files a provisional patent on the inventor's behalf, giving the inventor one year to develop and realize the idea's commercial potential. During that year, OEIP works closely with the inventor, providing advice and counsel.

As a result, invention disclosures, the first step in the patenting process, have increased by more than 60 percent in fiscal year 2010, with 56 filed.

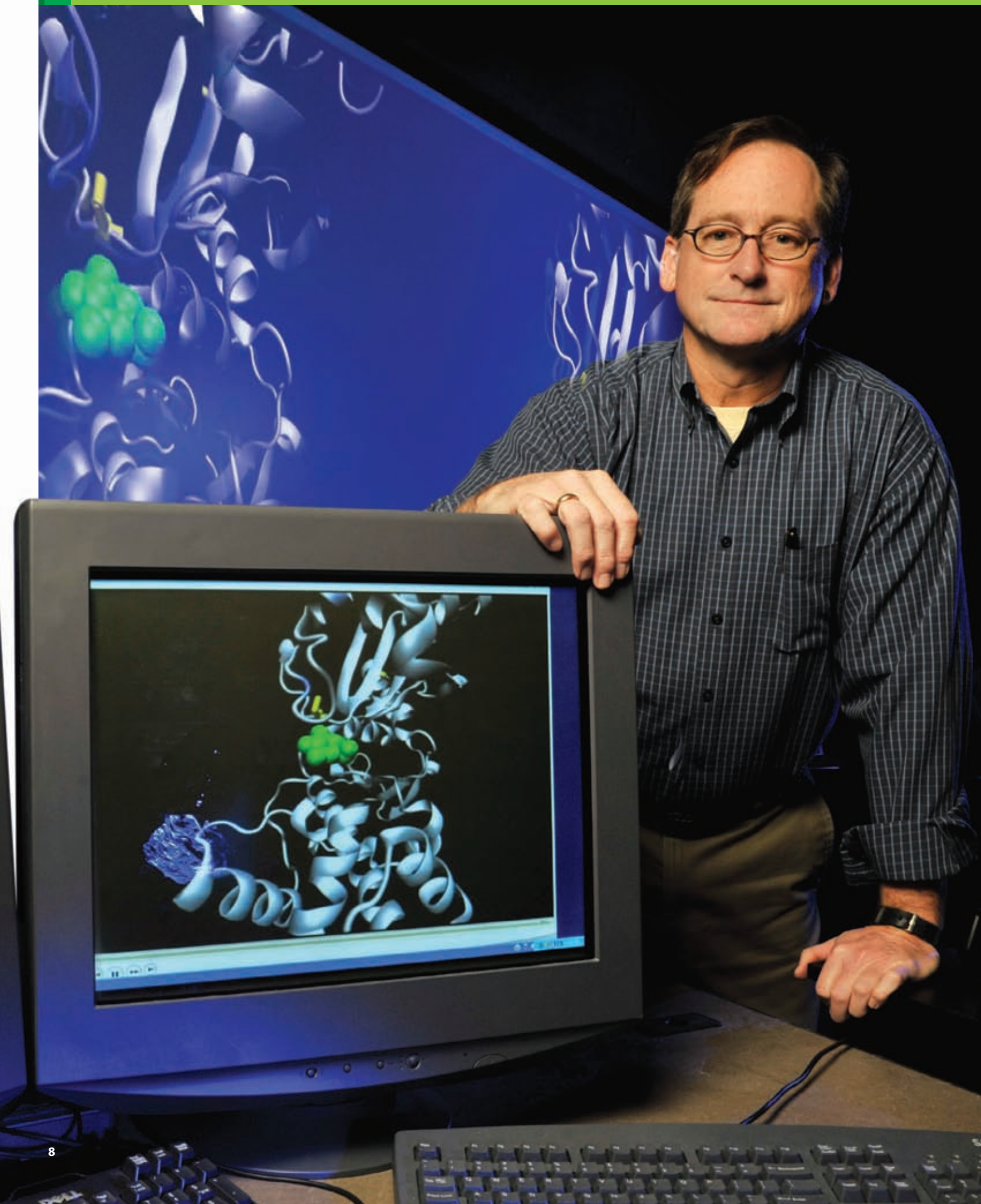
Here's a look at just a few of these bright ideas:

- Marine scientist Mohsen Badiey has two inventions useful for coastal surveying by autonomous underwater vehicles. One disclosure, called "MIMO," submitted in collaboration with fellow marine scientist Aijun Song, improves the accuracy of underwater data transmission. The second prototype provides accurate position and velocity information for underwater moving objects. When combined, these two technologies equate to underwater GPS.
- Software developed by plant and soil scientist Blake Meyers analyzes and identifies genes that are regulated in development or in response to stress. Such genes are useful for introducing special traits in plant biotechnology.
- Marine scientist Kathryn Coyne has discovered an algicidal compound capable of killing harmful dinoflagellates such as *Pfiesteria,* while having no significant effect on other algae. There appear to be parallels between the mechanism in the compound that causes death of the algae, and anti-cancer treatments.

Project managers from OEIP's Technology Transfer Center are working with each of these professors to develop commercialization strategies and identify partners to bring the technologies to market.

For more information on UD's available technologies, visit **www.udel.edu/oeip**. — *Meredith Chapman*

Visit UD's Office of Economic Innovation and Partnerships at www.udel.edu/oeip/.



Evozym Biologics homes in on prized proteins for biofuels, drug discovery

Evozym Biologics Inc., founded in 2009 by scientists at UD and the Desert Research Institute, aims to accelerate the discovery of useful proteins for the high-stakes fields of biofuels production and drug development, saving industries significant time and R&D costs.

Using novel data tools to understand how the genomes of organisms are built, including high-performance computers and proprietary algorithms and databases, the Delaware start-up has demonstrated that it can home in on as few as 50 potentially high-value synthetic proteins from hundreds of billions of possible trajectories, according to co-founder Adam Marsh, associate professor of marine biosciences at UD.

"Millions of years of evolution have shaped the genes and proteins and enzymes of microbes, animals and plants," says Marsh. "Our unique tools understand and systematically utilize these evolutionary rules of genome adaptation."

Deriving its name from "evolutionary enzyme," Evozym Biologics is the brainchild of Marsh, who is on the faculty of UD's College of Earth, Ocean, and Environment, and Joseph Grzymski, research assistant professor at the Desert Research Institute in Reno, Nev.

The two first met in Antarctica while doing research on "extremophiles" — organisms that thrive in harsh environments. Marsh does research on sea urchins in the frigid waters, and Grzymski on microbes that live in both terrestrial and aquatic polar environments. Both scientists were fascinated by how organismal genomes can become adapted to life in such difficult, stressful conditions, and it was this mutual interest that spawned their collaboration.

"That's the cool thing about science," Marsh says. "You'll never know where you'll end up. I'm working with a marine invertebrate in Antarctica and wanted to know how the organism's genome evolved in extreme cold. Joe had a similar interest with microbes that thrive in high temperatures at hydrothermal vents and in low temperatures in Antarctica, but was coming at it from another direction. We were working toward the same goal on two different tracks. When we got together and compared our findings, every result pointed to success."

A key to the process, Marsh says, is understanding how specific proteins are shaped by evolution, by how well they fit into their environment.

In the biofuels realm, a company might spend a million dollars or more on largely shot-in-the-dark research to identify proteins that are enzymes and serve as catalysts for certain biochemical reactions, such as breaking down the cellulose in plant material more easily.

With their computational platform of high-throughput computers and patented algorithms and databases, Evozym Biologics has zeroed in on a suite of 50 genes that likely contains several prime candidates for the job, Marsh says.

"The genes we've targeted cost only about $1,000 apiece to test," he notes.

In the drug development arena, the company's role is to pinpoint a pathogen's "Achilles' heel"— its most critical, sensitive genes — so that pharmaceutical companies can create drugs to knock them out.

"Multi-drug-resistant pathogens are a serious issue, causing staph infections, skin infections and other problems in hospitals and nursing homes," Marsh notes. "While one drug can target a single protein, a gene often can mutate and bypass that drug's effect. But if you could target three to four protein interactions with one drug, you could build a whole new class of antibiotics."

Marsh credits the University's Office of Economic Innovation and Partnerships (OEIP) for helping the company to protect and organize its intellectual property; OEIP's Small Business Development Center for advice on how to structure and market the business; and his dean, Nancy Targett, and associate dean, Chuck Epifanio, for allowing him to pursue a commercial application of the bioinformatic discoveries uncovered by his research.

Did Marsh speculate five years ago that he would be leading such a company?

"No way," he says. "But I really like the idea of bringing research to bear on problems, to make things better.

"I was so naïve," he adds. "I thought, 'ah, we're done,' when we got our algorithms completed. But that was just the beginning. I'm excited about the future, and I know we'll make a difference."

For more information, visit the company's website at **www.evozym.com.**

— Tracey Bryant

> "The beauty of nature — the driving, kicking forces — inspired me. Every day I'd write out a code, process it and then generate a new graph. I was the first person seeing this data. Every day was a day of discovery."
>
> *— Adam Marsh*

DARE TO BE FIRST

Using proprietary algorithms and databases, Adam Marsh's start-up company, Evozym Biologics, can home in on as few as 50 potentially high-value synthetic proteins from hundreds of billions, saving companies significant time and R&D costs. The company's target areas are biofuels and antibiotics.

Going Green

From protecting a National Wild and Scenic River flowing through main campus, to installing a 2-megawatt wind turbine to power the Lewes campus, UD is making major moves toward sustainability.

KATHY F. ATKINSON

THE UD BOTANIC GARDENS encompasses 12 gardens on 15 acres on south campus. The Native Garden and new Lepidoptera Trail are ideal for observing birds, butterflies and moths on native perennial plants of the eastern U.S.

DANIELLE QUIGLEY

THE UD WATER TEAM brings together a consortium of faculty, staff and students from departments and disciplines across campus to implement creative stormwater management initiatives.

A river runs through it

Did you know that the University of Delaware is one of only two universities with a National Wild and Scenic River on its campus? The UD Farm, operated by the College of Agriculture and Natural Resources (CANR), and much of UD's main campus in Newark, Del., drain into Cool Run, a tributary of White Clay Creek. The creek is now celebrating its tenth year with this ecological status symbol.

Even with this designation, White Clay Creek still has its fair share of environmental problems. Runoff from the campus and the city of Newark contribute to nonpoint source pollution of area streams and excessive runoff that causes downstream flooding. With stormwater management a major challenge for the University and the city, UD is uniquely poised to both study and protect the watershed.

The UD WATER Project (Watershed Action Team for Ecological Restoration) was formed in early 2008 as a collaborative initiative with the long-term goal of merging and facilitating University-wide efforts to minimize the environmental impacts of stormwater runoff from the campus. The focus has been primarily on ecological restoration of stream corridors, wetlands and other natural resource areas on campus.

With funding support from the Delaware Water Resources Center at UD and the nonpoint source pollution program at the Delaware Department of Natural Resources and Environmental Control (DNREC), one of UD WATER's first projects was to work with six undergraduate students during the 2008–2009 academic year to develop an action plan for the Cool Run watershed.

"The first part of our process was to identify the pathways by which water and pollutants move through campus to the 350-acre farm and flow into Cool Run," says Tom Sims, UD WATER co-director and CANR deputy dean. "Besides the obvious runoff from the farm, there is a considerable volume of contaminated water from lawns, parking lots, roads and roofs."

For the past three-and-a-half years, water quality has been monitored in these flow paths. Now the college is using the research gathered from scientists and students to systematically implement ecologically based best management practices to mitigate pollution from agricultural, urban and campus sources and reduce stormwater impacts on water quality.

In 2008, a poorly draining cow pasture on the farm was converted to a wetland. UD students were involved in every aspect of the project, from site design and installation to two rounds of planting. This wetland, now a

DANIELLE QUIGLEY

THE DAIRY, housing a herd of approximately 100 milk cows, is enhanced by solar power and a manure composting facility.

WATER QUALITY MONITORING, conducted by UD, is supported by the White Clay Creek Watershed Management Committee. Data from eight sites will be used to assess the impact of the new restoration projects.

DANIELLE QUIGLEY

WETLAND RESTORATION on the UD Farm was designed to improve water quality and enhance habitat. However, the ongoing project also will be used for research and teaching related to water quality, soils, ecology and horticulture.

EVAN KRAPE

The UD Farm is **28%** of UD's main campus

part of the UD Botanic Gardens, has been utilized as an outdoor classroom by landscape design, landscape construction, ornithology, wildlife management and wildlife ecology students.

Over the next several months, a degraded stream that delivers campus and farm runoff to Cool Run will be restored, and a stormwater retrofit is planned to address building and parking lot runoff on south campus.

"CANR is setting a great example on how to clean up the White Clay Creek. The watershed restoration plan includes different facets like wetland restoration, stream restoration, modern agriculture, conservation and even renewable energy," says Gerald Kauffman, director of UD's Water Resources Agency and UD WATER co-director alongside Sims.

"UD WATER and CANR are excellent models of watershed stewardship. We hope the stormwater best management practices and wildlife habitat improvements in the headwaters of Cool Run will spur others to similar action within the wild and scenic watershed," says Linda Stapleford, White Clay Creek Wild and Scenic River Administrator.

Jenny McDermott, CANR's facilities manager, acknowledges the fact that these restoration projects would not be possible without the help of partners internal and external to UD.

"Grant funding and assistance from several DNREC departments, the New Castle Conservation District, and the University's alumni-supported Sustainability Fund have been matched by funding from our college to not only implement environmental protection but to provide a teaching opportunity for students and a demonstration of watershed protection," McDermott notes.

Ecological restoration projects also are underway to return degraded habitats to healthy ecosystems, improve wildlife habitat and remove invasive plants. During the summer of 2010, students and faculty conducted research on a UD site that will serve as a "compensatory wetland" to balance the ecological functions of a wetland that is being removed due to construction at the Port of Wilmington, according to Susan Barton, assistant professor of plant science, who serves as a faculty adviser for the project.

"Five student interns will each work on an independent project that will contribute to the formation of the wetland and the overall health of the farm," Barton says.

Students are researching state and federal wetland mitigation policies and monitoring water quality, aquatic insects, terrestrial invertebrates, plants and birds.

"Our students are participating in every aspect of these projects, from collecting baseline data to implementing recommendations and documenting and monitoring successes," Sims adds. "The discovery learning opportunities that this project offers are preparing students well for careers in natural resources, agriculture and environmental fields. They are solving real-world problems just steps from their classrooms." — *Katy Lamborn O'Connell*

Wind turbine project puts new spin on

Culminating years of planning and study, the University of Delaware and Gamesa Technology Corporation began operating a 2-megawatt wind turbine at the Hugh R. Sharp Campus in Lewes this past summer.

"We couldn't be happier to partner with Gamesa on wind-energy research and technology," UD President Patrick Harker said at the turbine commissioning ceremony on June 11. "Together, we can make Delaware a U.S. leader in wind-power science, production and policy."

The land-based turbine stands 400 feet high from its tower base to the apex of its blade at peak rotation. Each of its three blades is 144 feet long.

A typical 2-megawatt turbine provides enough emissions-free electricity to power about 500 average homes, so the single turbine is expected to provide clean, carbon-free electricity for the entire campus, which is part of UD's College of Earth, Ocean, and Environment.

EVAN KRAPE

Gathering to flip a switch symbolizing the turbine's connection to the electrical grid on June 11 are, from left, foreground, Collin O'Mara, secretary, Delaware Department of Natural Resources and Environmental Control; Prof. Jeremy Firestone, one of the conceivers of the project; Nancy Targett, dean of the College of Earth, Ocean, and Environment; Gamesa North America CEO Dirk Matthys; and UD President Patrick Harker.

At times, the turbine will generate more than enough power for the campus, with the excess fed to the electric grid. The University will provide any excess power at the same cost the Lewes Board of Public Works pays wholesale, so there will be no additional charge to Lewes customers for getting a portion of their power from a local, clean resource.

"Gamesa has invested more than $220 million on U.S. manufacturing and wind energy development," said Gamesa North America CEO Dirk Matthys. "As an industry leader, we are always looking for new opportunities, like our partnership with the University of Delaware, to move America toward a more sustainable, domestic clean-energy future."

Gamesa specializes in sustainable energy technologies, mainly wind power. With an international workforce of 6,300 employees, including 850 in the United States, the company has installed some 16,000 megawatts of its main product lines in 20 countries over four continents.

In Lewes, however, carbon-free electricity is not the only benefit of the turbine.

"This project will enhance research in areas such as turbine corrosion, avian

The Specs

MODEL: Gamesa G90

GENERATOR POWER: 2 megawatts

TOWER HEIGHT: 256 feet

TOWER WEIGHT: 203 tons

NACELLE WEIGHT: 103 tons (houses mechanical and electrical components)

NUMBER OF BLADES: 3

BLADE LENGTH: 144 feet

BLADE WEIGHT: Approx. 7 tons

BLADE MATERIAL: Epoxy reinforced with carbon and glass fibers

ROTATIONAL SPEED: 9–19 revolutions per minute

ROTATIONAL DIRECTION: Clockwise (front view)

This logo represents the University of Delaware's commitment to environmental sustainability. The colored bars stand for UD's three-pronged approach: producing leading-edge research and scholarship on the subject; incorporating sustainability into our operations; and engaging the campus, state, nation and world in the issue. The three different colors highlight that UD's colors (blue and gold), when mixed together, make green.

clean energy

impacts and policy issues related to renewable energy," said Nancy Targett, dean of the college.

Another benefit of wind energy is economic, according to Collin O'Mara, secretary of Delaware's Department of Natural Resources and Environmental Control.

"Transitioning to a clean-energy economy has the potential to improve our environment and create thousands of jobs," he said. "The UD-Gamesa partnership will demonstrate significant economic and environmental benefits for this transition and serves as a model for future offshore development."

The Lewes wind turbine project is part of a joint venture, First State Marine Wind, between UD-owned Blue Hen Wind and Gamesa Technology Corp. The city of Lewes and Sustainable Energy Developments Inc. are also key partners.

Targett and Profs. Jeremy Firestone and Willett Kempton conceived the project. Firestone and Kempton have studied many aspects of wind energy, including the potential power supplied by Delaware's offshore winds as well as public reaction to and policies for wind-energy use.

Also this summer, the University and the U.S. Department of Energy's National Renewable Energy Laboratory announced they will collaborate on offshore wind research and work to facilitate the testing of commercial wind turbines off the Delaware coast.

Under a cooperative research and development agreement, UD will work with federal and state agencies to identify and meet criteria for establishing any potential offshore test sites. Public involvement is expected to be a key part of the process.

— Ron Ohrel

A Sustainable UNIVERSITY OF DELAWARE
www.udel.edu/sustainability

KATHY F. ATKINSON

Agent of change

Policy leader guides sustainability efforts

John Byrne, Distinguished Professor of Energy and Climate Policy

John Byrne, UD's Distinguished Professor of Energy and Climate Policy and director of the Center for Energy and Environmental Policy (CEEP), is recognized internationally as an innovator, the architect of novel policies for a sustainable future.

Byrne and his students invented the concept of the Sustainable Energy Utility (SEU), a nonprofit focused solely on advancing energy efficiency and renewable energy. In 2007, the Delaware General Assembly established the Delaware SEU — the first in the nation. To date, it has invested over $15 million in renewables and energy efficiency, including support for the 10-megawatt Dover SUN Park. Byrne co-chairs the SEU and is assisting others, from Washington, D.C., to South Korea, in designing their own SEUs.

He also is training the next generation of policy scientists. CEEP's graduate program ranks among the top three in the world, and now Byrne is launching the first undergraduate major in the field.

"One of the great things about our program is the exchange of ideas between the students," Byrne says. Currently, about 40% of the graduate students who enroll in CEEP have a prior degree in science or engineering; the remainder hold degrees in the social sciences and humanities.

"When the social science students need to understand a new technology, they go to the engineering students to find out how it works. Then the engineers find they need an understanding of the economists' models, and they go to the social science students for help," he says. "Our students learn, early on, the value and benefit of interdisciplinary collaboration."

CEEP is an official observer of the United Nations Framework Convention on Climate Change, which means its faculty and students are permitted to observe, participate and present briefing papers to the annual meetings of government delegates. A team of CEEP faculty and students is working on activities for the 2010 meeting in Cancún, Mexico, in December.

"It allows us to have a contribution to the process," says Byrne, who is a veteran member of the Intergovernmental Panel on Climate Change, which shared the Nobel Peace Prize in 2007. Byrne is designated as one of several hundred laureates for that year's award.

One of CEEP's key contributions has been calculating the target carbon budget or "footprint" of 3.3 tons of carbon dioxide emissions per person per year — a standard used globally for the greenhouse gases released from burning fossil fuels for electricity, transportation and other needs.

Americans, however, are way off this target. The United States currently tops 20 tons of carbon emissions per person per year. But there are ways to solve the U.S. "energy obesity" problem, he says.

"It's a big problem and not easy to solve. But at the same time, I've seen remarkable change — 35 states now require 15–20% of their energy from renewables," he says, noting that CEEP helped write Delaware's legislation, whose requirement of 25% by 2025 is one of the country's most aggressive. "And California has found a way to flatten their electricity use per capita since the 1970s despite rapid growth in the state's economy," he notes. Key to California's success has been using smart-grid technology and rewarding residents and businesses that cut energy demand.

An architect of the University's Climate Action Plan, Byrne said UD "walks the walk." Two more big steps have been taken, with the wind turbine online at the Lewes campus and a partnership with Standard Solar, Inc., to install solar panels on several buildings on main campus this fall. The solar power plant will be one of the largest at a U.S. university, generating over 1 million kilowatt hours of electricity each year while reducing carbon emissions by 1.3 million pounds. — *Tracey Bryant*

The new solar power plant on the UD campus is being funded, in part, by student power — the 2009 senior class gift.

JON COX

Targett steers college into future

Since Nancy McKeever Targett took the helm as dean of the University of Delaware's College of Earth, Ocean, and Environment (CEOE) five years ago, her life has been in high gear like the state-of-the-art wind turbine she recently commissioned at the Hugh R. Sharp Campus in a bold step toward a clean-energy future.

A leader in demand, Targett was invited to the White House in June 2010 to brief Vice President Joe Biden's Domestic Policy Advisory Committee staff about the Gulf oil spill and the need for greater coordination of scientific efforts. That was in her role as chair of the board of trustees for the Consortium for Ocean Leadership, a nonprofit comprising 96 top ocean science institutions and a number of nongovernmental organizations and industry affiliates.

She has flown to China several times in the past two years to foster the development of the Joint Institute for Coastal Research and Management with colleagues at Xiamen University. Launched in 2008, the institute highlights global perspectives and partnerships in areas of natural science, social science and public policy related to coastal environments and their management in the U.S. and China.

And as director of Delaware Sea Grant, part of a national network of 32 university-based programs aimed at promoting the wise use, conservation and management of marine resources, Targett has spearheaded initiatives for improving the forecasting of coastal storms, to increasing public awareness about climate change in Delaware and beyond.

Navigating a college with a new outlook

Most days, Targett, the road warrior, drives the 180-mile roundtrip from her home in Lewes, not far from the seaside Hugh R. Sharp Campus, to the University's main campus in Newark. There, from the dean's office in Robinson Hall, she is navigating the rapid evolution of a college that for 36 of its 40 years focused on marine science and policy — and graduate education — but now has an expanded scope.

With the recent additions of the geography and geological sciences departments, the former College of Marine Studies became the College of Earth, Ocean, and Environment (CEOE) and now includes work in both Earth and ocean systems from a natural and societal perspective.

"Before, our college was focused on the marine environment, and now we have broadened that, to link land, air and sea so that students can more readily understand the connections from both a science and society perspective," Targett says. "Our goal now is to produce scientists, educators and policy specialists who have the broad vision and interdisciplinary background to address the sweeping, interrelated issues that are part of the study of ocean and earth systems."

Currently, CEOE has 118 scientists, including 61 faculty, in six core areas: geography, geological sciences, marine biosciences, marine policy, oceanography, and physical ocean science and engineering. They work on topics ranging from climatology to declining fisheries; offshore wind power to environment and society.

CEOE operates the 146-foot research vessel *Hugh R. Sharp* and houses the secretariat of the international Scientific Committee for Oceanographic Research. CEOE also is home to the Delaware Geological Survey, part of a national network that conducts geologic and hydrologic research; the Delaware Environmental Observing System, with its critical roles in natural resource monitoring and emergency management; and the Delaware Geographic Alliance, which seeks to boost geography education statewide.

A new undergraduate degree in marine science

Four years ago, Targett was asked to lead a task force to examine undergraduate environmental education at UD. The task force engaged faculty from across the University to determine what curricular changes needed to be made to provide students with enhanced opportunities.

The process yielded new curricula and core requirements for bachelor's degrees in environmental science and environmental studies, and new concentrations that allow students to gain depth in their area of interest, from atmospheric science and sustainable energy technology to environmental policy and law.

Those programs were implemented in fall 2009, and soon Targett expects an exciting addition, pending Faculty Senate approval — UD's first undergraduate degree program in marine science.

"It likely will include a semester in Lewes and give students the opportunity to do experiments in a new wet lab with aquaria that will be viewable by people on our public tours," Targett says.

Students also will have hands-on access to state-of-the-art technologies in the Global Visualization (G-Vis) Lab in Lewes, with its stunning real-time data streams of ocean temperature to global winds projected on nine, integrated 55-inch flat-panel TV screens; and the Visualization and Advanced Simulation Training (VAST) Lab in Newark, which includes a command center that enables scientists to operate underwater vehicles remotely.

"What I really love about these technologies is that they enable people to literally see and understand the big picture — it helps facilitate a conversation that was in the abstract before. The G-Vis Lab has already been a catalyst for new collaborations," she says.

"There is a lot of emphasis today on science and society, and universities as catalysts for innovation," she adds. "I believe the college has long been a leader in that, from the days of the DELBUOY, which used wave energy to make potable water from seawater for island nations, to our wind turbine in Lewes, to our vehicle-to-grid technology for electric cars."

Targett recognizes the strong faculty in the college as the basis for many of her successes. As new ideas percolate from the faculty, she says her job is to aggregate them, help formulate the vision and get people working together. She is proud that major decisions, from the college's name to the installation of the new wind turbine, have received widespread faculty support.

At the end of the day, Targett says, it all comes down to a love of science.

"I knew when I was a little kid that I wanted to be a marine scientist," says Targett, who grew up in Pittsburgh, Pa., watching marine biologist Jacques Cousteau on TV.

Her desire for a science career was further piqued as a young girl when she saw an issue of *Parade* magazine with oceanographer Sylvia Earle on the cover. Targett wrote a letter to Earle about her hopes to become a marine scientist. Earle wrote back.

"She told me to 'stay the course, to keep your dreams,'" says Targett, who still has the letter.

Although Earle's letter was influential, Targett says her greatest inspirations have been her parents — her late father, who was a meat salesman, and her mother, a former telephone operator.

"In the early days, my Mom said, 'Find your passion and then do your best.'

"I really love my job," Targett says, smiling.

— *Tracey Bryant*

KATHY F. ATKINSON

Nancy Targett, dean of the College of Earth, Ocean, and Environment, is shown outside Robinson Hall, her base of operations on UD's main campus in Newark. Targett also oversees research facilities at the Hugh R. Sharp Campus in Lewes, 90 miles south, on the shores of Delaware Bay.

The view from THE PILOTHOUSE

An interview with Capt. Bill Byam

Ship Stats

LENGTH: 146 feet

TOP SPEED: 11.5 knots

RANGE: 4,000 miles

CREW: 6–7 when underway

DURATION: 18 days (max.)

CAPACITY: 14 scientists, 1 captain and 6–7 crew (2 deckhands, 2 engineers, 1 cook, 1–2 technicians)

MILES LOGGED SO FAR: over 100,000

OPERATING RANGE: Mid-Atlantic Bight, from Cape Hatteras, N.C., to Long Island, N.Y. Has sailed as far south as the Gulf of Mexico, as far north as Georges Bank, Canada, and as far east as the Bahamas.

Photos by Evan Krape

How long have you been a captain?

I'm on my seventh issue; each issue is five years, so I've been a captain for 35+ years. I've been at Delaware for 11½ years, and I'm one of the newest in the crew, which gives you some idea of the continuity of our crew. Before UD, I worked in the oil industry, ran ferries for International Paper and operated a charter sailing business.

What's a typical workday run?

It's six hours on and six off. My watch starts at 5:30 a.m. I'm on from 5:30 in the morning to 11:30/noon; and back on again from 5:30 to 11:30 at night.

How many days is the *R/V Sharp* typically at sea?

The target is 180–200 days per year. The crew sails two-thirds of the schedule. The captain and chief engineer can sail over 140 days. We work seven days a week. Christmas and Thanksgiving are the only holidays we always try not to schedule any cruises.

What's it like to be captain of UD's 146-foot flagship, *R/V Hugh R. Sharp*? Capt. Bill Byam fills us in on this state-of-the-art floating laboratory, described by *American Ship Review* as one of the most advanced coastal research vessels in North America.

UD scientist Doug Miller (center) examines a worm found in a sediment sample collected from the Atlantic Ocean floor.

What's most unique about this ship?

The design of the ship itself — it's modular, so we can change as technology does and incorporate new equipment to support the wide range of researchers we serve from institutions across the United States. Also, this vessel has diesel electric engines and Z-drives that enable you to turn 180° or go sideways. You can feather the drives down to very low RPM and rotate the Z-drives with no stops. It's also very acoustically quiet, which is a real benefit for studies of marine mammals and fish.

What kinds of science projects is the ship currently supporting?

We do a lot of work with AUVs [autonomous underwater vehicles] with researchers at the University of Delaware, plus we have projects in Delaware Bay with several UD scientists. We have a scallop project with NOAA [National Oceanic and Atmospheric Administration] that requires doing surveys in the waters from Virginia to Canada, and we completed two years of marine mammal and bird observations for the state of New Jersey.

What kind of data do you log?

Once underway, we're continually pumping water, monitoring temperature, wind, surface water, fluorescence, with a time-stamp log of all of this. Once an hour, we transmit the data via the Rolling Deck to Repository, which is a gateway to the national data centers [National Geophysical Data Center and National Oceanographic Data Center]. At the end of the cruise, the scientist gets a CD full of all that data. We have two systems here that allow us to do satellite communication by phone, fax or Internet. We still keep a captain's log also. It's done on all ships and is a legal document.

Ship technician Wynn Tucker makes a quick repair to the Scanfish, an undulating CTD (conductivity, temperature, depth) system. It operates to within 3 meters of the seafloor.

How has ship technology affected how science is done?

We're getting closer to the point where the crew can accomplish the work, and the scientist can stay back home and give instructions virtually.

How "green" is the ship?

The *R/V Sharp* is among the cleanest vessels in the fleet. The engines were designed to meet Tier 1 emissions standards of the EPA, and we burn a low-sulfur fuel. It also is much more energy-efficient than our old ship, the 120-foot *Cape Henlopen*. We use about 100 gallons less fuel per day, despite the fact that the *Sharp* is a much larger ship at 146 feet long.

UD geoscientist Art Trembanis examines his autonomous underwater vehicle (AUV) before it is deployed in the Atlantic Ocean off Delaware.

What conservation practices does the ship have?

We have a reverse-osmosis system for making water. We make 800 – 900 gallons a day and have a 2,200-gallon capacity of potable water. Everybody can shower daily, but we ask people to be smart about water, such as not leaving the faucet running. We advocate a "Navy shower" where you wet, turn off, soap up, then turn the water back on to shower off. We have a washer and drier on board also. The gray water is discharged when the vessel is offshore.

What's the most exciting thing that's happened at sea?

"Exciting" is a word we don't like to have in our vocabulary. We try to avoid it. "Uneventful" is the key word — that's really good in our business.... There is the aspect of seeing sunrises and sunsets and seeing marine mammals offshore. We caught an 18-pound lobster once and a pretty good-sized sturgeon at the mouth of Delaware Bay. One of our moorings off Chesapeake, Virginia, had an octopus on it. We've also done projects in the Bahamas with divers on the bottom, and we've helped retrieve gliders that fly offshore up to 30 days and then surface for recovery.

Doctoral student Nicole Raineault monitors the AUV's location with adviser Art Trembanis.

Are there any ship superstitions?

None specific to this vessel, but in general, don't start a cruise on a Friday, and don't carry bananas.

What do you do during your 'down time' at sea?

I've always been a fan of sea stories — Ernest Hemingway, John Slocum.... Know the difference between a fairy tale and a sea story? A fairy tale begins with 'Once upon a time' and a sea story starts with 'I swear this is the truth....'"

— Interview by Tracey Bryant

A Top Crew

"It's just a great program — with such a large boat, you can do pretty much the science you want to do on it, and the crew are fantastic," says Jeff Cornwell of UD's research vessel. Cornwell, a professor at the University of Maryland Center for Environmental Science, has used UD's flagship frequently during the past 20 years — first the 120-foot *R/V Cape Henlopen,* and now its successor, the 146-foot *R/V Sharp.*

"It takes a top crew to run this ship," says Capt. Bill Byam, director of marine operations at UD. During the missions in the Chesapeake and Delaware bays when these photos were taken, Byam was serving as relief captain for Senior Research Vessel Capt. Jim Warrington. The crew also includes second mate Chris Bogan and assistant chief engineer Chuck Baird.

WYNN TUCKER

As the ship technician aboard the *R/V Sharp*, Tucker interacts directly with the scientists on the ship. She is in charge of all data collection, science equipment and deployments. Tucker says she "was destined" for a career at sea. She grew up on the water, traveling the Intracoastal Waterway with her parents. She holds a degree in marine technology.

MARY MOORE

A native of Lewes, Del., home port of the *R/V Sharp,* Moore is a deckhand/second engineer. When sailing as second engineer, she completes engine room rounds, repairs systems as needed and operates the deck winches and frames. Moore describes herself as a fourth-generation waterman. Her family does net fishing for sea trout, croaker and perch.

PAUL GOMEZ

As the ship's cook, Gomez plays a crucial role, making sure the crew and science team are well fed. A chef by training, he buys groceries, does the cooking, the cleaning and laundry. He prepares balanced meals three times a day even in rough seas. His specialty is a delectable seafood pasta made with shrimp, scallops and clams.

SHIP AT NIGHT. Research aboard the *R/V Sharp* continues through a warm August night. As UD's autonomous underwater vehicle (AUV) surveys the Atlantic Ocean floor, the instrument's location is monitored and recorded, along with what it sees. The AUV is mapping an artificial reef of sunken subway cars and ships on the seafloor.

TIM NORTH

As chief engineer, North oversees the four 500 KW diesel generators that supply power for the ship's propulsion and service (electricity for lights, computers, heating/air conditioning, pumping water, etc.). He also is a U.S. Coast Guard licensed captain. The Cambridge, Md., native comes from a commercial fishing background on the Eastern Shore.

OLIVER FULLARD

A native of Freedom, Pa., Fullard is the second engineer, the officer responsible for assisting the chief engineer in the daily maintenance and operation of the ship's engines. Fullard stands the 11:30 a.m. – 5:30 p.m. watch. During this watch, he does engine room rounds, operates all deck equipment and repairs systems as needed.

MARY FENN

Fenn lives in Cape May, N.J., and ferries across the Delaware Bay to Lewes, Del., to work aboard the *R/V Sharp* as a reliever when the ship's full-time second mate has scheduled time off. During her watch, Fenn is responsible for all ship operations, navigation and safety. She has handled boats all of her life.

UD's research vessel is named in honor of the late Hugh R. Sharp Jr., who served for many years on the University's board of trustees and was a staunch supporter of marine research. The ship is a national resource, available for charter by federally funded scientists through the University-National Oceanographic Laboratory System. The UNOLS fleet includes 21 vessels operated by 16 academic institutions. The National Science Foundation provides 70% of the funding for ship operations. Ships of the fleet range from 20 to 85 meters (65–278 ft) and work in the coastal waters of the U.S., the Great Lakes and the world's oceans.

THE GREAT Eco-Quest

Solving today's environmental issues demands innovative applications of science, engineering and public policy. The Delaware Environmental Institute (DENIN), launched at UD in 2009, is bringing outstanding researchers together in interdisciplinary projects and fostering partnerships among government, industry and the public to tackle eco-challenges. Don Sparks, DENIN director, fills us in on the new institute's progress.

AMBRE ALEXANDER

Donald L. Sparks, S. Hallock du Pont Chair in Plant and Soil Sciences at UD, is the director of the Delaware Environmental Institute (DENIN).

In his 31 years at UD, the maverick Sparks has made his mark. He has created an internationally prominent graduate program in environmental soil chemistry in the College of Agriculture and Natural Resources, authored over 284 scientific publications and three textbooks, mentored 50 graduate students and 25 postdoctoral researchers, and served as an invitational speaker at 79 universities and institutes on four continents — so far.

Sparks also has won over $31 million in research grants and lots of awards and honors. He received his latest recognition, the 2010 Liebig Award, from the 150,000-member International Union of Soil Sciences for outstanding contributions in soil science research.

Sparks' latest quest is to put DENIN in motion as a catalyst for collaboration in addressing environmental challenges. The institute's goals are to initiate large, interdisciplinary research projects at UD; support interdisciplinary academic programs and foster the development of new ones; forge problem-solving partnerships among government, industry and the public; and sponsor projects ranging from venture partnerships to public symposia focusing on the environment.

EVAN KRAPE

Learn about Delaware's Eco-Challenges at www.denin.udel.edu/.

Q: What have been DENIN's biggest accomplishments since its official launch in October 2009?

A: I think we have gained a better understanding of who at the University of Delaware and at our other state partners is involved in research related to the environment and what they're doing. DENIN has provided some great opportunities to get to know each other, to learn what our strengths are and what perhaps we could improve.

DENIN also has provided an opportunity to inform people outside the University about the research going on and to solicit their input on research needs, which can help us focus our efforts. When we interview people now, they know about the institute, and they're excited about the things that are going on and about the future.

Q: What are some promising initiatives that are under way or grants that have been awarded because of the institute?

A: One of the major successes we've had was getting the Critical Zone Observatory grant from the National Science Foundation *(see page 22).* It's one of six in the United States, and it's addressing a very important issue: climate change and carbon cycling. With this being such a major issue worldwide, having the observatory will certainly bring attention to the University and what we're doing.

I also think the new Interdisciplinary Science and Engineering Laboratory that UD is building is exciting. The institute will be physically housed there, and the new facility will help bring faculty and graduate students together to promote collaborations, enhance competitiveness in securing funding and attracting students and faculty, and provide state-of-the-art core facilities. And we're currently searching for the Howard E. Cosgrove Chair in Environment — that's a University-wide initiative that will certainly benefit DENIN and the entire University.

In collaboration with faculty from several colleges, we also are discussing the development of new interdisciplinary graduate programs.

Q: How is DENIN working to bring scientists and engineers from the different disciplines together?

A: We've had a number of seminars co-sponsored by different departments and colleges. We're trying hard to make sure that we not only talk about science but that we also include aspects of policy, economics and social dynamics. We've been facilitating the formation of teams of faculty from the sciences and engineering and policy or economics that should prove useful in enhancing our competitiveness in obtaining funding. A lot of federal agencies, for example NSF, are stressing the integration of these areas, particularly for environmental grants. So I think this is one way that DENIN can play a very valuable role.

Q: What will be the focus of the coming year?

A: In collaboration with the departments and colleges, the plan is to hire a number of new faculty in the environmental area. It's a great time to be hiring because so many places aren't hiring.

We really want to continue to come up with ways to add value to what we're already doing at the University, to make sure our environmental programs are stronger. I would like for DENIN to be one of the top environmental institutes in the USA and for UD to be viewed as the place where faculty and students who are interested in the environment want to be.

—Interview by Beth Chajes

New observatory explores Earth's "critical zone"

To the untrained eye, the verdant woods and babbling streams of White Clay Creek State Park in the northwestern corner of Delaware may look more pristine than most landscapes along the heavily populated Mid-Atlantic coast.

But the careful observer can find the telltale signs of past generations: abandoned roadbeds, traces of dams and millraces, and crumbling stone foundations are scattered throughout the park, testaments to 300 years of settlement, agriculture and industry.

The park is now more heavily forested than it was 100 years ago, and White Clay Creek has been designated a National Wild and Scenic River, but human activities such as forestry and construction have left behind a lasting imprint.

The state park is just one small section of the 565-square-mile Christina River Basin, which includes five counties and 60 municipalities in Delaware, Pennsylvania and Maryland and encompasses Brandywine Creek, White Clay Creek, Red Clay Creek and the Christina River and their watersheds. Land use within the basin ranges from more pristine areas, to second-growth forests, farm fields, suburban settings and highly industrialized and urbanized areas.

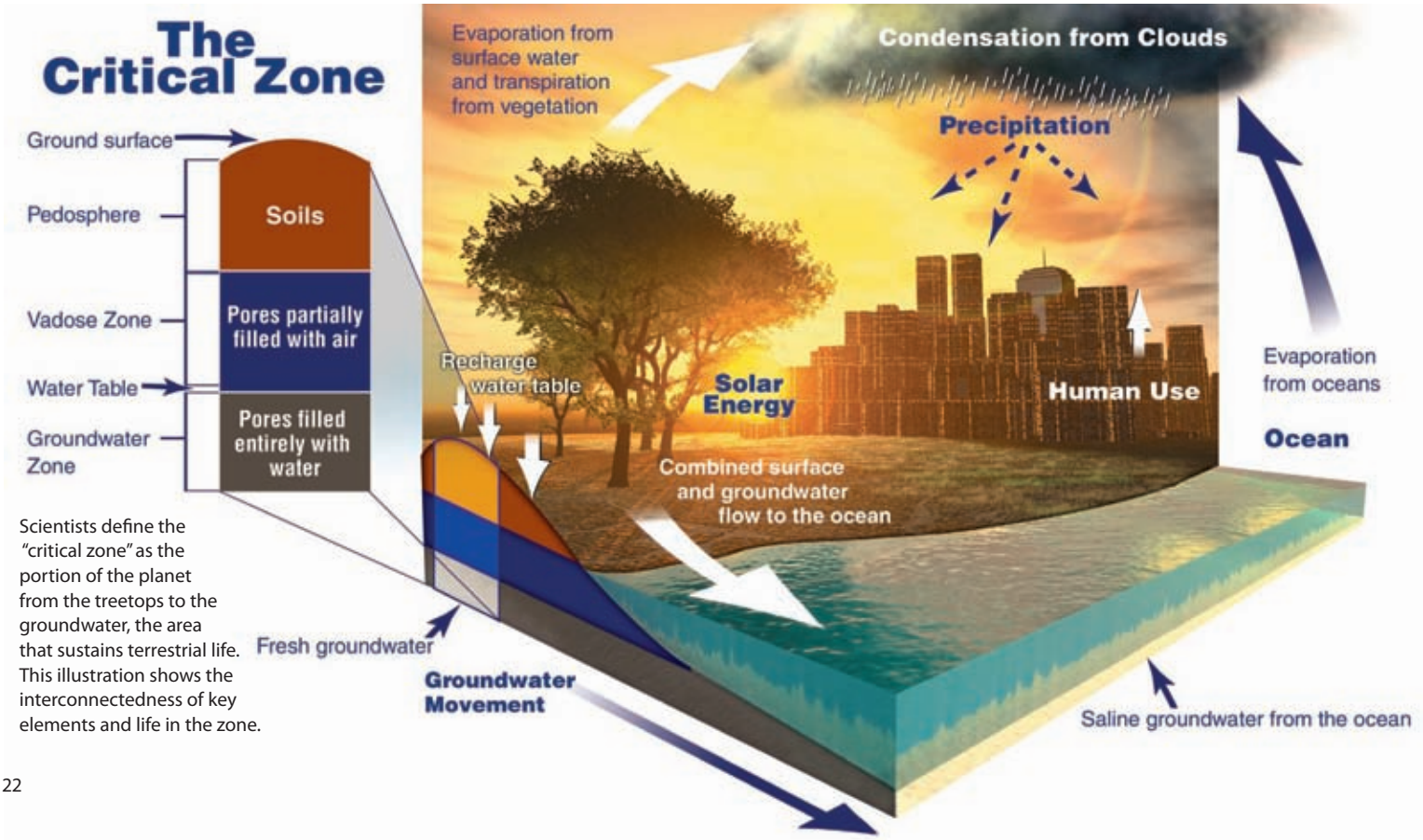
The Christina River Basin is now a living laboratory, one of six areas in the nation designated by the National Science Foundation as a "Critical Zone Observatory." In 2009, NSF awarded a multidisciplinary team of scientists from the University of Delaware and Stroud Water Research Center in Avondale, Pa., a five-year grant to study the basin. The $4.3-million grant was funded as part of the American Recovery and Reinvestment Act.

In the zone

Scientists define the "critical zone" as the portion of the planet from the treetops to the groundwater that sustains terrestrial life. Within this zone, chemical elements that are the building blocks of life — such as carbon, nitrogen and oxygen — circulate at various rates between "storage pools" in the soil, water, atmosphere and living organisms.

Carbon sparks particular interest among scientists since carbon-based molecules serve as the "batteries" that store energy from the sun for use by organisms. In addition, warming of the global climate has been attributed to the transfer of carbon from terrestrial and living storage pools to the atmosphere in the form of greenhouse gases such as carbon dioxide and methane.

Members of the CZO team, including three postdoctoral researchers, eight graduate students and more than a dozen under-

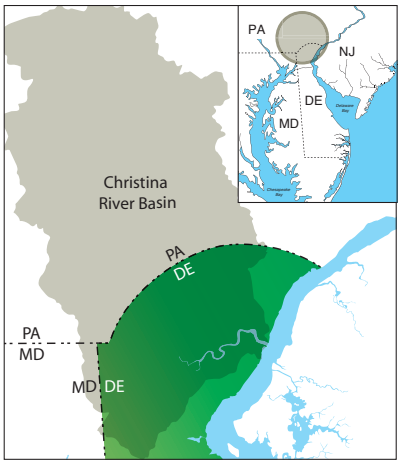


Scientists define the "critical zone" as the portion of the planet from the treetops to the groundwater, the area that sustains terrestrial life. This illustration shows the interconnectedness of key elements and life in the zone.

graduate students at UD and Stroud Water Research Center, are working to determine how, and how rapidly, soil erosion and sediment transport through rivers impact the exchange of carbon between the land and the atmosphere, and thus affect climate.

Factors influencing carbon cycling range from the chemical and physical processes of weathering and erosion that form the mineral basis of soil, to the changes caused by the addition of organic matter to the mix and the role of decomposer microorganisms in releasing carbon to the atmosphere.

As co-principal investigator Anthony Aufdenkampe, assistant research scientist at Stroud, explains, "Erosion and excavation activities expose minerals that mix with organic matter in surface soils and are transported through streams and rivers to the sea. We want to better understand how the interaction of carbon with minerals might sequester that carbon from the atmosphere and also understand how humans have altered that process. To do that effectively, we need to take a whole watershed approach to studying these processes at multiple scales in order to put them all together into a predictive model. That would be a significant contribution."



PHOTOS BY EVAN KRAPE

The Christina River Basin Critical Zone Observatory (CZO) covers five counties and 60 municipalities in Delaware, Pennsylvania and Maryland. Above right, research collaborators from UD and Stroud Water Research Center work together in White Clay Creek, a National Wild and Scenic River in the region. Dissertation research by UD doctoral student Chunmei Chen, lower left, will be among the first to answer the CZO's climate change questions.

A cutting-edge monitoring system

A research project of this magnitude requires the collection, management and analysis of large amounts of data. A key feature of the project is expanding and enhancing the network of environmental monitoring stations throughout the study area with some of the most sophisticated techniques available. For example, a partnership with NSF's National Center for Airborne Laser Mapping is providing for the collection and processing of extremely detailed and accurate topographic data by Light Detection and Ranging (LIDAR) measurements.

"The Christina River Basin is already one of the best-studied watersheds of its size in the nation, with more than 40 years of research conducted by the Stroud Water Research Center and governmental agencies," says lead investigator Donald Sparks, S. Hallock du Pont Chair of Soil and Environmental Chemistry and director of the Delaware Environmental Institute at UD. "But answering the big questions of earth and environmental science requires extensive real-time data and a collaborative effort that the cyber-infrastructure of this Critical Zone Observatory will make available to scientists around the nation."

New field installations and data management systems are enhancing the extensive existing network of stations used for monitoring water flow and water chemistry within the Christina River Basin. The network of monitoring sites extends from uplands to inland waters and from inland waters to the coastal zone and covers the range of human uses within the watershed. These niche regions will provide the students involved in the program with valuable multi-scale field training.

Cutting-edge technologies are being used for real-time gathering of hydrological, physical and chemical data at spatial scales ranging from the landscape to the molecular level. Advances in cyber-infrastructure that seamlessly merge real-time data with state-of-the-art graphics are further establishing the CZO as a community resource for sharing scientific data and public information.

As the CZO team learns about the Christina River Basin, they will share results not only with the scientific community but also with policy makers and the public. Results will be communicated regularly with the Christina Basin Water Quality Management Committee, which includes representatives from 15 federal, state and local environmental resource agencies and hosts an annual series of public workshops to identify the science needs of policy makers. Additionally, the Stroud Water Research Center maintains four full-time staff to translate research into educational programs for students, teachers and citizen/conservation groups. — *Beth Chajes and Tracey Bryant*

EVAN KRAPE

The Rising TIDE

With about half the world's population dwelling within 100 kilometers (60 mi) of a coast, few changes wrought by a warming climate will have as great an impact on so many as sea-level rise.

If the commonly accepted prediction of a one-meter (3.28 ft) rise by the end of the century occurs, entire island nations may be lost and millions of people forced to adapt or relocate.

At the University of Delaware, researchers are developing monitoring and modeling tools and pursuing ethical studies to aid policy makers locally and internationally in making the tough decisions driven by the rising tide.

"Time and tide wait for no man." — Geoffrey Chaucer

DEOS, a coastal monitoring system for Delaware

Dan Leathers

Delaware lies in one of the most vulnerable areas of the United States when it comes to sea-level rise. With the lowest mean elevation of any state in the nation, much of Delaware is already prone to flooding from coastal storms, and any amount of sea-level rise would be expected to exacerbate this problem.

After a major storm in May 2008 left one person dead and many homeless along the Delaware Bay coast of Kent County, the Delaware Department of Natural Resources and Environmental Control turned to the Delaware Geological Survey (DGS) and the Delaware Environmental Observing System (DEOS), both based at UD, for help in establishing a coastal flood monitoring system.

DEOS consists of 40 observation platforms around the state that monitor weather, atmospheric and near-surface soil conditions and makes the data available to users in real time. Through the DEOS Alerts System, subscribers can request notification when parameters of their choice cross certain thresholds.

"Delaware has probably the best instrumented and observed environment of any state in the country," says Dan Leathers, co-director of DEOS and professor in the Department of Geography. "Our station density is much greater than other states that have more area to cover."

DEOS personnel worked with DGS colleagues to put together a system that uses tidal surge prediction data from the National Weather Service in a statistical model that outputs potential inundation levels for a given community in a web-based mapping and data visualization system.

"The system can predict tide heights about five days in advance and warn community leaders and first responders of an impending flood event," Leathers says. "Our website provides forecasts, maps to show inundated areas, and cross-sections of evacuation routes so that people will know how deep water will likely be on the roads."

Learn more at **www.deos.udel.edu**.

EVAN KRAPE

Two new satellite receivers installed at UD in August 2010 collect information on a large swath of the globe — from the middle of the Atlantic to the center of North America, and from Cuba to Newfoundland.

About half of the land area of Bangladesh would be flooded if sea level rises by one meter.

Modeling the saltwater invasion

How will rising sea level affect the quality of groundwater and surface water that millions of people rely on for drinking? In a study funded by the World Bank, Holly Michael, assistant professor in the Department of Geological Sciences, is looking at water resources in Bangladesh, a low-lying and densely populated nation where an estimated 15 million people over 17,000 square kilometers (6,563 sq mi) could be displaced by a one-meter rise in sea level.

As Michael explains, saltwater can intrude into freshwater resources in several ways, most notably by overtopping surface and near-surface waters as sea level and storm surges reach farther and farther upland, and by lateral intrusion into deeper groundwater beneath coastal lands.

Using water quality and rock formation data from 20,000 coastal wells collected from the government of Bangladesh and international aid agencies, Michael has developed a simulation model based on past changes in sea level that predicts how the freshwater-saltwater interface in coastal groundwater will respond to rising sea level, as well as how fast those changes could be expected to occur.

"What our model indicates is that overtopping is a more immediate threat to water resources in Bangladesh because it will happen faster, on the order of decades to a couple hundred years," Michael says. "Lateral intrusion at the level of the deeper wells will likely happen at a much slower pace, perhaps over thousands of years. With similar data, we can extend these methodologies to other locations, including Delaware."


EVAN KRAPE


HOLLY MICHAEL

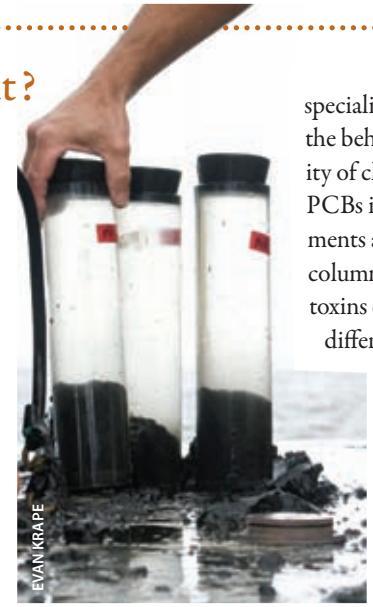
Holly Michael is researching the vulnerability of drinking-water supplies to coastal sea-level rise in Bangladesh as part of a World Bank study.

Bangladesh is among the world's poorest countries. The average per capita income was $1,500 in 2009.

Who let the toxins out?

Another potential risk of sea-level rise is the inundation of industrial coastal areas that harbor toxic chemicals in the soil. By changing the chemistry around soil particles, which then become aquatic sediments, saltwater may help release these contaminants from the soil and make them more available to organisms that swim in or drink the water or eat other organisms that do.

Dominic Di Toro, Edward C. Davis Professor of Civil and Environmental Engineering and member of the National Academy of Engineering, specializes in analyzing the behavior and toxicity of chemicals such as PCBs in aquatic sediments and in the water column. He notes that toxins can behave quite differently depending on the type of sediment.


EVAN KRAPE

Di Toro's models enable him to predict what the resulting levels of contaminants would be in the water if a site were flooded with seawater. He can then go on to predict the toxicity of these chemicals for organisms. His methods have been used to analyze sediments affected by the recent Gulf oil spill.

"By combining information about what is present in the soil, the physical properties of the tides and currents, and the chemistry of the water, we can provide risk assessments to the policy people whose job is to manage the risk," Di Toro says. "For example, they may consider dredging and relocating toxic sediments. The question for them becomes, 'Is it worth it?'"

Small islands face rising threat

Nowhere will the effects of sea-level rise be felt like the world's 51 small island nations. On these small, low-lying land masses and coral atolls, facing sea-level rise is a matter of survival — and is already a reality.

Countries such as Kiribati in the South Pacific are experiencing major erosion and damages to infrastructure and property due to higher than usual tides and storm surges. Their potable water supplies and farmland are being contaminated by saltwater.

Kiribati and places like it may one day even become completely inundated. The government of the Maldives announced it is setting aside tourism revenue to purchase a new homeland if necessary.

"Small island states are the most threatened by climate change and they typically lack sufficient resources to carry out needed adaptation and mitigation measures," says Biliana Cicin-Sain, co-chair of the UD-housed Global Forum on Oceans, Coasts, and Islands.

Cicin-Sain and her colleagues at the Global Forum are working to give the threatened nations a stronger voice in the development of international climate change policy.

"We provide vital forums for high-level leaders and experts to address the major policy issues affecting oceans, and especially small-island developing nations," says Cicin-Sain, who also is the director of UD's Gerard J. Mangone Center for Marine Policy.

For example, Cicin-Sain and her team drafted sets of policy briefs to provide information and perspectives on oceans and climate change for participants at the May 2009 World Ocean Conference in Manado, Indonesia, as well as those involved in the climate negotiations of the United Nations Framework Convention on Climate Change (UNFCCC).

A 3.5-meter (11 ft) concrete wall helps to protect Maléa, the capital city of the Maldives, from the sea.

Biliana Cicin-Sain, director of the Gerard J. Mangone Center for Marine Policy, and President Anote Tong of Kiribati. Photo copyright Marlene Awaad.

The Global Forum also co-organized Oceans Day at the December 2009 UNFCCC meeting in Copenhagen. That event brought together 320 leaders from 40 countries, representing governments, U.N. agencies, non-governmental organizations, the scientific community and industry to focus on the direct link between climate change, ocean health and human well-being.

"Oceans Day participants agreed that there is a need to craft an integrated oceans and coasts program within the UNFCCC by 2013 emphasizing, for example, that there should be sufficient funding to support island communities needing to adapt to climate change," says Cicin-Sain, who is planning the event for the 2010 UNFCCC meeting in Cancún, Mexico.

The island nations could certainly use the help. Their economies and livelihoods — fishing, tourism, and other activities that rely on a healthy sea — are already threatened by other effects of climate change. For instance, warming ocean temperatures and other related impacts threaten sensitive coral reefs, which support marine ecosystems.

And paradoxically, these countries collectively generate less than 1.3 percent of global carbon dioxide emissions. Yet they face the threat of their homelands disappearing entirely as a result of climate change while receiving limited attention at international climate negotiations.

"This effect, known as the 'Climate Divide,' has been a major theme in climate change policy," Cicin-Sain notes.

Learn more about the issues surrounding small island nations at **www.oceanclimate.org** and **www.islandsfirst.org**. — *Elizabeth Boyle*

Weighty Decisions

With problems such as flooding, contamination of drinking water and loss of land impending, and with resources for dealing with these issues limited, government officials will face significant ethical dilemmas. Which areas and which citizens will receive help in adapting to the changes driven by sea-level rise? Will resources be used to remediate habitat loss or to protect personal property?

The Delaware Experimental Program to Stimulate Competitive Research (EPSCoR), supported by the National Science Foundation, has provided seed funding for two studies to explore these issues.

Kevin Adkin received his bachelor's degree in geography at UD and then entered UD's School of Urban Affairs and Public Policy for graduate study. He is using his seed grant to support his dissertation work, which focuses specifically on the needs of the Southbridge community — one of Wilmington's poorest neighborhoods with a number of brownfields located nearby — in the eventuality of sea-level rise.

In addition, Matt Oliver, assistant professor of oceanography, and a colleague from Princeton University, are using the Biblical parable of the Good Samaritan as a basis for exploring the obligation of scientists and engineers to use their knowledge to help people who are most vulnerable to sea-level rise.

Even in a worst-case scenario, sea-level rise is likely to occur at a gradual pace that should give communities time to plan a response. As Chaucer noted, however, "Time and tide wait for no man." UD researchers are determined to help their state and other communities around the world prepare wisely for the future.

— *Beth Chajes*

WHAT CAN YOU DO?

Illustrations by UD Coast Day 2009 visitors

HUNGRY TO HELP THE ENVIRONMENT?

Here's some food for thought. Eating less meat is healthier overall, lowering cholesterol and the risk of heart disease, diabetes and various cancers. But did you know that reducing your meat consumption also can help the environment? Meat composes only 14% of what people eat, yet its production is estimated to account for nearly one-fifth of global greenhouse gas emissions. A kilogram of beef produces 19 kilograms of carbon dioxide, while a kilogram of potatoes has a carbon cost of only 280 grams.

"COOL IT" IN THE SHOWER

If a family of four taking 10-min. showers each day lowers their water temperature to 75°F in the warmer six months of the year, they will save approximately $68 per person, totaling $272 per year. Cooler showers can boost health, too — improving blood circulation vital to cardiovascular strength, increasing the virus-fighting white blood cells in the immune system, stimulating the source of noradrenaline, a brain chemical that may help alleviate depression, and closing pores for more attractive skin and hair.

GIVE AND GET MORE GREEN

The average American throws away 68 pounds of used clothing annually, adding a whopping 2 quadrillion pounds of clothing to landfills each year. Donate rather than dispose of good clothes (and toys). Giving to a qualified charitable organization may also warrant a charitable contribution deduction against your income tax (provided deductions are documented). The actual cost of the gift is reduced by your tax savings. For example, the actual cost of a $100 donation for someone in the 35% tax bracket is only $65 ($100–$35 tax savings).

— Emily Houghton

ANDREAS MUENCHOW

Greenland glacier calves huge ice island

Andreas Muenchow

A University of Delaware researcher captured headlines around the world when he reported that an "ice island" four times the size of Manhattan had calved from Greenland's Petermann Glacier. The last time the Arctic lost such a large chunk of ice was in 1962.

"In the early morning hours of August 5, 2010, an ice island four times the size of Manhattan was born in northern Greenland," said Andreas Muenchow, associate professor of physical ocean science and engineering in UD's College of Earth, Ocean, and Environment. Muenchow's research in Nares Strait, between Greenland and Canada, is supported by the National Science Foundation.

Satellite imagery of this remote area at 81°N latitude and 61° W longitude, about 620 miles south of the North Pole, revealed that Petermann Glacier lost about one-quarter of its 43-mile-long floating ice-shelf.

Trudy Wohlleben of the Canadian Ice Service discovered the ice island within hours after NASA's MODIS-Aqua satellite took the data on Aug. 5, at 4:20 EDT, Muenchow said. These raw data were downloaded, processed and analyzed at UD in near real-time as part of Muenchow's NSF research.

Petermann Glacier, the parent of the new ice island, is one of the two largest remaining glaciers in Greenland that terminate in floating shelves. The glacier connects the great Greenland ice sheet directly with the ocean.

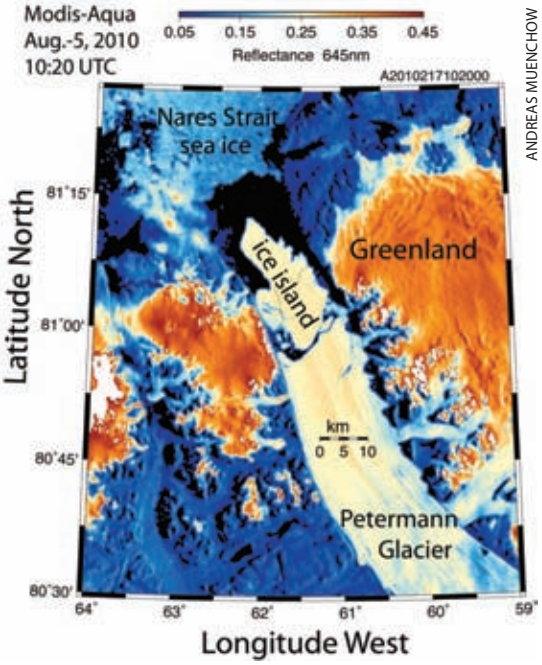
The new ice island had an area of at least 100 square miles and a thickness up to half the height of the Empire State Building.

"The fresh water stored in this ice island could keep the Delaware or Hudson rivers flowing for more than two years. It could also keep all U.S. public tap water flowing for 120 days," Muenchow said.

The island has since broken into two large pieces, which entered Nares Strait, a deep waterway between northern Greenland and Canada where, since 2003, a UD ocean and ice observing array has been maintained by Muenchow with collaborators in Oregon, British Columbia and England.

"In Nares Strait, the ice island encountered real islands much smaller in size and broke into smaller pieces as it was propelled south by the prevailing ocean currents. These pieces will likely follow along the coasts of Baffin Island and Labrador, to reach the Atlantic within the next two years," Muenchow said.

The last time such a massive ice island formed was in 1962 when Canada's Ward Hunt Ice Shelf calved a 230-square-mile island, smaller pieces of which became lodged between real islands in Nares Strait. The ice island was the largest piece of ice to break off Petermann Glacier since the Polaris Expedition of 1871.



ANDREAS MUENCHOW

In the field at TOOLIK FIELD STATION, ALASKA

A tundra ecosystem and its effects on global warming

Toolik Field Station encompasses 87,000 acres in the northern foothills of Alaska's Brooks Mountain Range. It has been a major location for scientific research in the Arctic since 1975.

It takes hundreds of years for some environmental effects to become fully realized. It's a domino effect, meaning that what we do in this day and age will affect generations hundreds of years from now.

Hence, what University of Delaware scientists are witnessing from their research in the Alaskan tundra today near Toolik Field Station (TFS), about 150 miles north of the Arctic Circle, is the result of a succession of environmental changes that began taking place hundreds of years ago.

"We have seen major changes in how the microbes are behaving," says Hanson.

UD's Tom Hanson, associate professor of marine biosciences and biological sciences, and Barbara Campbell, assistant professor of marine biosciences, have been studying the effects of global warming on this "arctic prairie." The TFS, which is part of the U.S. Long-Term Ecological Research network, is operated by the University of Alaska Fairbanks for scientists around the world.

Hanson and Campbell are working in collaboration with scientists Michelle Mack and Ted Schuur at the University of Florida. Their project, funded by the National Science Foundation, seeks to understand how changes in temperature and nitrogen deposition in different soil layers of the tundra have affected this fragile ecosystem.

In their study, nitrogen was added to plots on a yearly basis for 20 years, mimicking what is happening naturally over a longer period. Their work will enable them

to determine if other tundra ecosystems will be similarly affected by global warming.

"Understanding how changes in climate affect microbial populations will refine predictions of how stored carbon will behave relative to existing trends in global change," says Campbell. "Changes found in this study may also reflect past climate change events, helping scientists to understand the geological record."

Changing microbial activity

Tundra soil, like that at TFS, is a large reserve of carbon derived from plants. In fact, this soil is not granular, but rather an amalgamation of dead plant leaves, Campbell says. Because it is so cold much of the year, these dead plant leaves and detritus are not broken down, but instead accumulate.

However, climate change in the form of increased temperature or increased nitrogen input to the soil appears to increase the breakdown of plant material and the loss of soil carbon. This breakdown is carried out primarily by soil microbes, leading to the release of carbon dioxide and methane that has been observed in many tundra sites. Both are greenhouse gases.

"The soil freezes seasonally to become rock solid," says Hanson. "It thaws in the late spring to early summer. But what's relatively new is that increased nitrogen seems to be increasing microbial activity and soil carbon loss. We are studying the DNA of the organisms responsible for breaking down plant detritus and soil carbon to see if the same microbes are just more active now, or if different types of microbes occur in these more active soils."

Hanson and Campbell have used a high-throughput sequencing technique called pyrosequencing to analyze the DNA extracted from the soil samples.

"We used a novel method to identify between 5,000 to 10,000 microbes per sample by sequencing a short fragment of DNA present in all organisms," says Campbell. "This allowed us to get a snapshot of the microbial community in the soil samples."

These snapshots were compared between plots exposed to nitrogen and control plots with no added nitrogen. Microbial community function — what types of carbon the microbes degraded — also was measured.

The results, published in the journal *Environmental Microbiology,* indicate that nitrogen additions changed both microbial community structure and function in the soils exposed to nitrogen. This profiling of samples will allow scientists to identify microbial DNA and functional markers that can then be identified in other tundra microbial communities to signal that this same process — the loss of tundra soil carbon — may be occurring there as well.

"The goal of this research is to understand the role of microbes in this process, so

KAREN ROSSMASSLER

Barbara Campbell, assistant professor of marine biosciences, records soil data during summer field work in the Alaskan tundra about 150 miles north of the Arctic Circle.

TOM HANSON

About a hundred researchers each summer pursue projects in the tundra ecosystem at Toolik Field Station in the Alaskan arctic. Here, the UD team is shown collecting soil samples for microbial analysis.

The UD team at the Arctic Circle in the summer of 2009.

we can better document where and how fast carbon is being leaked from the tundra," says Hanson. "This will help us predict the future of other tundras around the world."

Through their work, Hanson and Campbell have already seen indications that change has occurred in the soil samples from Alaska. The next step is to study the mechanism of the microbes and how it contributes to the soil carbon loss — and to recognize what functions are being lost as well. Hanson will be working on this during a visit to the DSMZ, the German Collection of Microorganisms and Cell Cultures (www.dsmz.de), in Braunschweig, Germany, where he will be trying to culture relevant microbes from the Toolik tundra.

"We have seen major changes in how the microbes are behaving," he says. "The functions seem to be different as well, leading us to believe there is a correlation between the change in the microbial community's structure and the change in function."

It's clear from this research, as well as other reports, Hanson says, that nature's carbon footprint has increased because the human carbon footprint has increased. The world is changing, as some of our most beautiful natural phenomena degenerate — and this is one more great reason we should continue down the path of becoming more Earth friendly.

"A lot of studies indicate that if we made some changes today, and reduced our carbon footprint by 50 percent, we might see some significant, positive, changes in the environment in 50 to 100 years at the earliest. It's going to take that long," says Hanson.

It's a domino effect.

— *Laura Crozier*

Perils of thawing permafrost: The CALM before the storm?

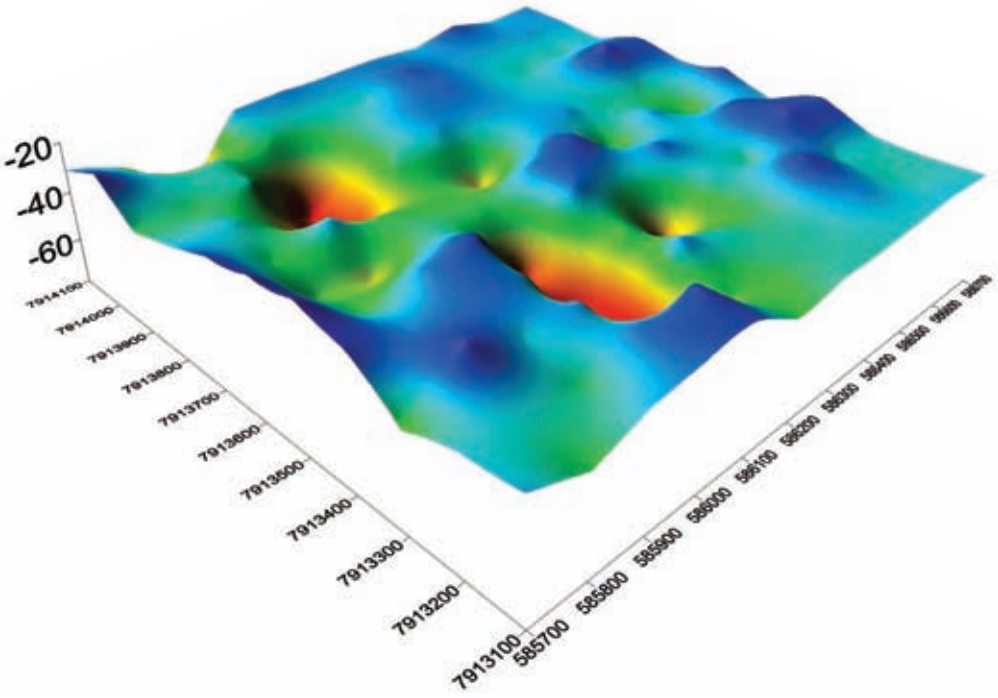
KATHY F. ATKINSON

Frederick (Fritz) Nelson has been a driving force behind the development of the international Circumpolar Active Layer Monitoring (CALM) network for observing and measuring changes in permafrost.

Frederick (Fritz) Nelson, professor of geography, learned early on that a firearm is handy for dealing with inquisitive bears while doing field research on Alaska's remote North Slope. The "Slope," as Alaskans call it, is the region extending from the northern foothills of the Brooks Range to the Arctic Ocean. The North Slope is a vast inclined plain festooned with striking geometric patterns such as ice-wedge polygons, frost boils and thaw lakes.

This tundra ecosystem is home to caribou, bears, arctic foxes and muskoxen. It is also home to the oil fields of Prudhoe Bay and the town of Barrow, the northernmost community in the United States, on the shores of the Arctic Ocean. Inhab-

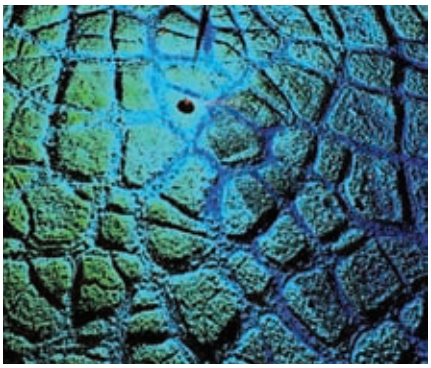
This figure represents the thaw depth of the "active layer," the soil that lies above the permafrost and freezes and thaws each year, for a 1 km x 1 km area near Barrow, Alaska, in August 2010. The yellow and red represent the largest active layer depths. The x and y axes represent the geographic coordinates of the plot. The z axis depicts the depth of thaw in centimeters. Figure courtesy of CALM network.



ited mostly by Iñupiat people, Barrow is on the front lines of a changing climate.

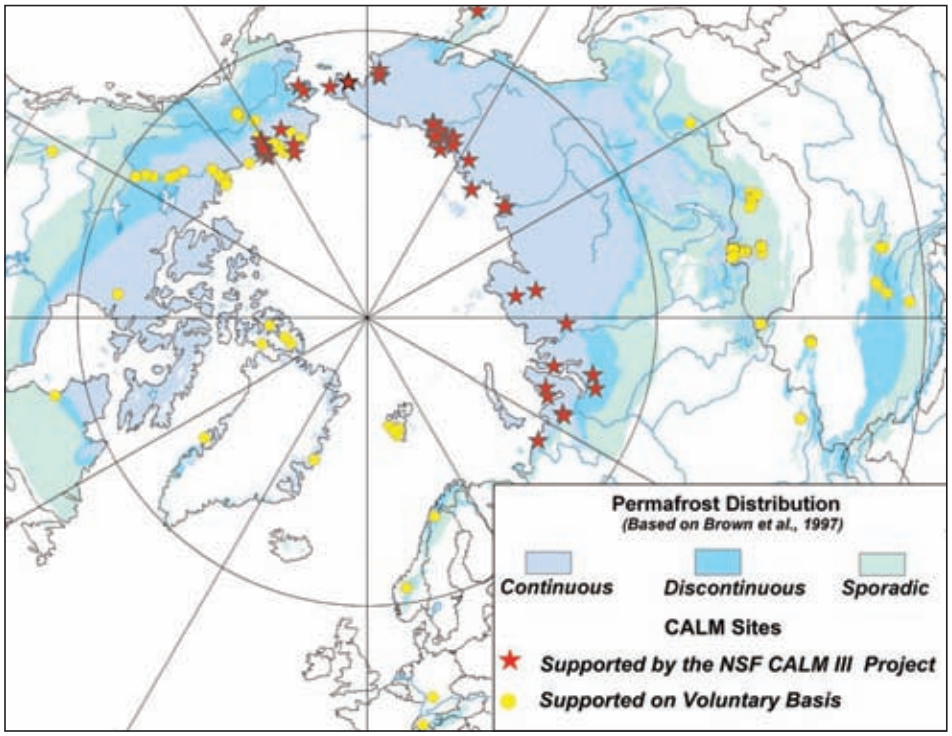
Permafrost is any part of the ground (soil, rock, ice, humus) that remains at or below 0°C (32°F) continuously for two or more years. Nelson and his team are studying the dynamics of the"active layer," the layer of ground between the surface and the permafrost, which freezes and thaws each year.

An authority on permafrost, Nelson has made the trip to northern Alaska nearly every year since the late 1970s. He has been a driving force behind the development of the Circumpolar Active Layer Monitoring (CALM) network, established in the early 1990s and now consisting of nearly 200 sites in 15 countries. The network is producing a long-term record of permafrost behavior that is used to document the response of permafrost to climatic "drivers" and to evaluate the performance of climate models.



Ice-wedge polygons form at cracks in the tundra where water has frozen and exerted its force on the surrounding soil. This view was produced by the CALM network on the Barrow Environmental Observatory in August 2010 using ground-based LIDAR (Light Detection and Ranging), a remote sensing tool that works by detecting the delay in time between when a wave of light is emitted and when it is received, providing precise ground-level readings. Image courtesy of UNAVCO, Boulder, Colo.

The CALM network's observatories are distributed throughout the Arctic, parts of Antarctica, and several mountain ranges in the mid-latitudes. Nelson has received funding continuously for both Alaskan fieldwork and administration of the international CALM network since the mid-1990s primarily from the U.S. National Science Foundation's Office of Polar Programs.



The permafrost regions incorporate more than one-fifth of the world's land surface. The Circumpolar Active Layer Monitoring (CALM) network, comprising nearly 200 sites in 15 countries, is observing and measuring changes in the active layer and shallow permafrost. The majority of the sites are in the Arctic.

On the North Slope, permafrost extends from a few inches below the surface to depths of up to 2,000 feet. During their fieldwork, Nelson and his team collect data on soil and air temperature, conduct field experiments, monitor active layer depth and processes, and obtain soil cores to examine ice content. They have been at the forefront of applying new technologies, including three-dimensional ground-penetrating radar, differential GPS, and LIDAR, to examine the structure and dynamics of near-surface permafrost.

Warming temperatures in the polar regions could lead to thicker active layers, which could change the moisture and plant communities on the surface and destabilize the ice-rich permafrost through the process of "thaw settlement," causing damage to roads, houses and other structures.

"While permafrost isn't necessarily an impediment to human occupation of the world's cold regions, all bets are off when ice is involved," Nelson notes. "Changes of temperature at the ground surface — whether induced by human activity or a warming climate — may trigger melting of the subsurface ice, which in turn leads to decreased volume and uneven subsidence of the ground surface.

"If permafrost degrades over large regions, as climate simulations indicate will be the case," Nelson says, "liberation of organic carbon stored in the shallow permafrost in the form of methane and carbon dioxide could make a very significant contribution to further warming of the climate." — *Tracey Bryant*

Fritz Nelson (far left) and colleagues Anna Klene (University of Montana) and Nikolay Shiklomanov (George Washington University) with their permafrost monitoring gear at a field site near Toolik Lake, where Nelson has worked since the late 1970s. Both Klene and Shiklomanov hold doctorates from UD.

The largest oil spill in history: UD scientists respond

Soon after the *Deepwater Horizon* spill occurred in the Gulf of Mexico, a group of public and private organizations — including the University of Delaware and the Delaware Biotechnology Institute (DBI) — came together to assist in the cleanup.

The institutions joined the Deepwater Horizon Response and were tasked with employing the best techniques to clean up the spill while trying to save the wildlife affected.

UD's contribution to the effort, led by oceanographer Matt Oliver, was to help the team understand where the oil might travel next and establish the baseline characteristics of the ecosystem before the oil moved in.

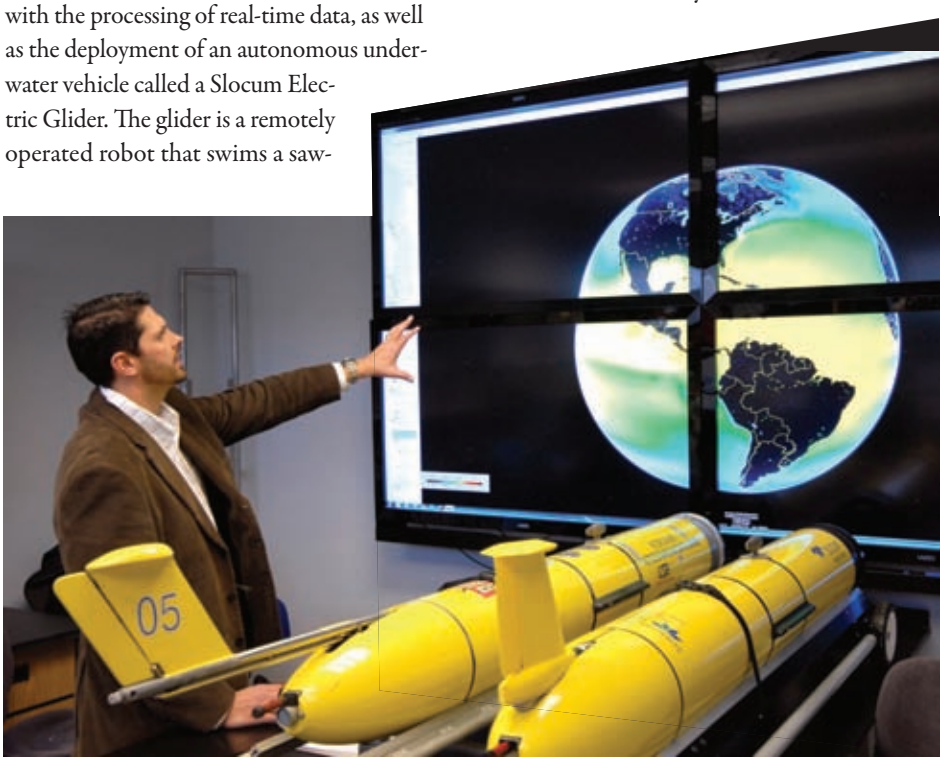
Oliver and his UD colleagues helped with the processing of real-time data, as well as the deployment of an autonomous underwater vehicle called a Slocum Electric Glider. The glider is a remotely operated robot that swims a sawtooth pattern and scans the ocean interior for traces of oil. Together with satellite data, the glider allowed scientists to track ocean currents, and therefore, where the oil might be traveling.

> "This effort to facilitate real-time monitoring of events in the Gulf is an example of how the DBI infrastructure can be effectively directed."
>
> — Kelvin Lee, DBI director

"This information helped us determine where we needed to focus cleanup efforts," said Oliver, who is an assistant professor of oceanography in the College of Earth, Ocean, and Environment.

The work was made possible through funding by the National Oceanic and Atmospheric Administration (NOAA), NASA, and through the Delaware Sea Grant program at UD.

UD's autonomous underwater vehicle took part in two missions, one in June that lasted about 26 days, and one in late July and early August, which lasted about that long.



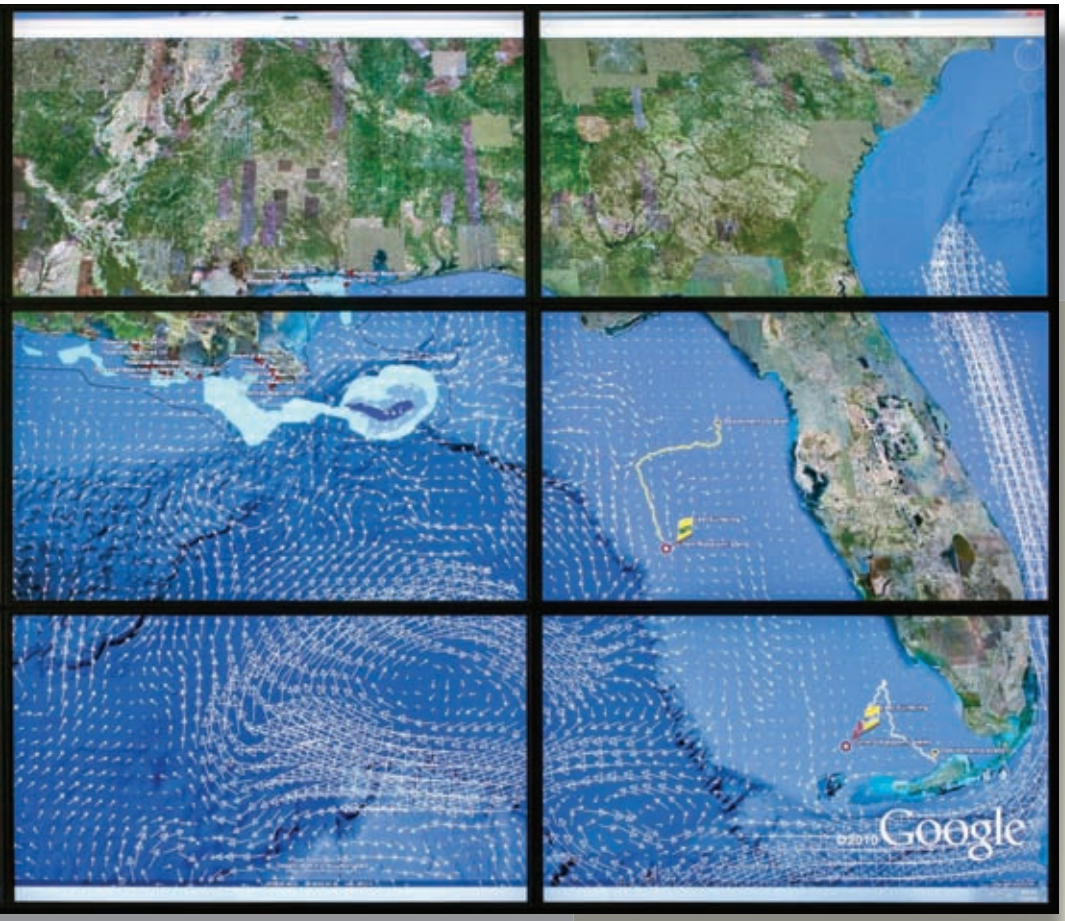
LISA TOSSEY

Oceanographer Matt Oliver is shown in the Global Visualization Lab at UD's Lewes campus with an autonomous underwater vehicle called a Slocum Electric Glider. The glider is a remotely operated robot that swims a sawtooth pattern and scans the ocean interior for traces of oil.

Halfway through its second mission, the glider hadn't seen any evidence of oil in the locations off west Florida where it was launched. It had, however, mapped out the location of phytoplankton in the area. Knowing the density of the microscopic plants that form the basis of the food web is important, Oliver said, because if they get wiped out by oil it would have effects throughout the food web.

"This glider effort gave us the best scientific picture of the West Florida Shelf that we've ever seen," he said.

The data Oliver and his team collected was analyzed through a cluster of computers housed at DBI. These computers use the institute's powerful cyber-infrastructure to calculate data based on input from UD's team of researchers. These data streams were visualized in real-time at the Global



KATHY F. ATKINSON

When viewed on the large flat-panel TV screens in UD's Global Visualization Lab and navigated with a 3-D mouse, Gulf spill data are seen with such high resolution and detail that viewing the image feels more like a high-flying helicopter ride. Projected in light blue is the Gulf spill in June and UD's glider deployments monitoring for oil off Florida.

Visualization Lab on the Hugh R. Sharp Campus in Lewes, Del.

The G-Vis Lab, as it is known, uses Google Earth to view many real-time data streams all at once on a large collection of flat-screen TVs.

"The interactive display of the G-Vis brought all this data into one spot so we could make intelligent decisions about where the glider should go next for sampling," Oliver said.

"This effort to facilitate real-time monitoring of events in the Gulf was an example of how the DBI infrastructure can be effectively directed to support faculty research, interact with other institutions and help reduce the environmental impact of the leak," said Kelvin Lee, DBI director.

UD is one of several university partners involved with the Integrated Ocean Observing System (IOOS), which coordinated the creation of the Deepwater Horizon Response. — *Laura Crozier and Elizabeth Boyle*

G-Vis Lab provides gee-whiz view of the environment

UD's Global Visualization (G-Vis) Lab uses Google Earth to view real-time data streams on everything from ocean temperature and currents to the movement of ships in Delaware Bay — all at once.

The data come from a wide variety of sources, including satellites, autonomous underwater vehicles, and floating buoys, and are pulled into Google Earth via KML files, special file types that let you see geographic data.

When viewed on the lab's flat-screen TVs and navigated with a 3-D mouse, the Google Earth globe and any data illustrated on it are seen with such high resolution and great detail that viewing the image feels more like a high-flying helicopter ride.

Not only is it incredibly impressive to see in action, the technology represents a new way for oceanographers to see a wide variety of real-time data all in one spot and in a standardized format that anyone with Google Earth and the right KML files can use.

The technology provides a completely new sense of the ocean, said the lab's creator, Matt Oliver, assistant professor of oceanography.

"Oftentimes you're out on a boat and you wonder what it is that you're missing. When you're out there you feel so small," Oliver said. "This technology really allows you to see the large scales of the ocean unfold in front of you."

Oliver is part of a larger cooperative effort between multiple universities and institutions working on the visualization project, including the Mid-Atlantic Regional Coastal Ocean Observing System, Rutgers University and NASA's Jet Propulsion Lab. The endeavor is funded by the Office of Naval Research, NASA, the National Science Foundation, the National Oceanic and Atmospheric Administration, and Delaware Sea Grant, among others.

Besides its current use in oil spill cleanup efforts, scientists foresee far-reaching applications for the technology, from studying the health of coral reefs, to the salinity of Delaware Bay, to how climate change has affected habitats on the West Antarctic Peninsula.

Graduate students Matt Grossi and Erick Geiger are working with Oliver on files that will allow researchers to see new types of geographic data, even view real-time tracks of electronically tagged penguins. — *Elizabeth Boyle*

Prof's work critical to predicting oil's toxic effects

Like most of us, Dom Di Toro cringes when he sees photos of oil-slicked pelicans in the Gulf of Mexico and tar balls in the shore's sugary sand. But he's just as worried by what he can't see — the toxic effects of oil on the water and sediment environments.

"It's easy to see the direct, or physical, effects," Di Toro says, "while the chemical effects tend to be invisible. However, what's going on below the surface can be just as devastating as the oil slicks that we can see on the surface."

Di Toro, the Edward C. Davis Professor in UD's Department of Civil and Environmental Engineering, is an expert in water quality and sediment quality criteria models for organic chemicals, metals and mixtures.

The Environmental Protection Agency (EPA) relies on researchers like him to help develop methodologies for predicting toxicity so that criteria for water and sediment quality can be developed. Such criteria are used to assess risk and guide cleanup efforts.

"At first glance, it would seem that it is difficult to determine just how toxic oil is," Di Toro says. "Petroleum is made up of tens of thousands of hydrocarbons, and it's not feasible to perform toxicity tests on that many chemicals." The issue is further complicated by the fact that the chemicals involved are combined into mixtures, suggesting the potential for incremental toxicity.

However, all oil compounds are narcotic chemicals — that is, they all exert their toxicity by the same mechanism, Di Toro says. Their similar mode of action means that their toxicities can be added using a method called toxic units, and it also means that 30 or 40 compounds — rather than 10,000 — can be measured to provide a fairly accurate picture of what is happening.

"Just how clean is clean?" Di Toro asks. "At what level of concentration do you have to remediate the water or sediment that has come in contact with it?" This is the central problem in assessing damages caused by the spill, and the problem that water and sediment quality criteria are designed to answer.

Sediment, an area of particular interest to Di Toro, comprises an ecosystem in itself, with the oil's toxins affecting not only the organisms dwelling in the sediment, but also the creatures who feed on them.

Di Toro and his research group have developed a procedure for deriving equilibrium partitioning sediment benchmarks, an approach that enables the toxicity of nonionic chemicals in sediments to be predicted mathematically using only chemical measurements. The procedure is now an EPA methodology that is being applied to help establish baseline information about conditions in the Gulf and to assess changes in those conditions as the spill progresses.

Di Toro and his colleagues have also carried out studies to determine the effect of weathering on the toxicity of oil components. Common wisdom would suggest that because lighter compounds are less toxic than heavier components of oil and evaporate more quickly, toxicity would increase over time. But it turns out that the heavier compounds are so much less soluble in water that the overall toxicity of water that is in contact with oil actually decreases over time.

"Quantity is everything in this business," Di Toro says. "Zero concentration is a meaningless idea in an industrial society. The fact is that contaminants are in our environment. What matters is the amount and their bioavailability — whether there is enough to harm us or the wildlife or the plant life. In toxicology, the dose makes the poison."

— Diane Kukich

"…What's going on below the surface can be just as devastating as the oil slicks that we can see on the surface."

— Dom Di Toro

The Deepwater Horizon oil spill in the Gulf of Mexico ranks as the largest marine oil spill in history. The U.S. government estimates that about 4.9 million barrels of oil were released, of which about 800,000 barrels have been captured by containment efforts. U.S. Coast Guard photo by Petty Officer 3rd Class Patrick Kelley

Presidential disaster declarations on the rise, national expert says

The Loma Prieta and Northridge earthquakes, the terrorist attacks on the World Trade Center and the Pentagon, and Hurricane Katrina are among the most memorable disasters of the past several decades, but they represent just a fraction of the events that have triggered presidential declarations of disaster since the first one was issued in 1953.

Richard Sylves, professor of political science and a national expert on presidential disaster declarations, has long been fascinated by the intersection of political and governmental institutions with the phenomenon of "disaster."

"I believe that how a national government addresses disaster says a great deal about the politics, policy, governance and political culture of that country," he says. "Presidential disaster declarations are 'shock absorbers' that help us cope with and recover from incidents as extraordinary as Katrina and the 9/11 attacks and as comparatively mundane as flooding, storms and other calamities that temporarily overwhelm localities throughout the nation."

With the assistance of David Racca, policy scientist in UD's Center for Applied Demography and Survey, Sylves created a website called "All About Presidential Disaster Declarations." Funded by the non-profit Public Entity Risk Institute, the site enables users to build tables of information about presidentially declared disasters in every U.S. state and territory plus the District of Columbia. Users can also extract data down to the county level.

The site is used for a broad array of applications, from emergency management, grant applications, and risk studies to presidential studies and climate science, seismic, sociological, economic and geographic research.

"People in other nations also visit the site to compare U.S. disaster histories with those of their own countries," Sylves says, "and I often hear from journalists seeking information about recent and historic disasters."

While there are some dips and peaks in the data, the overall trend has been an increase in the number of presidential declarations of major disaster or emergency over time. In 1953, 13 were issued; by mid-year 2010, 60 had already been granted. The two highest years so far have been 1996 and 2008, with 75 each.

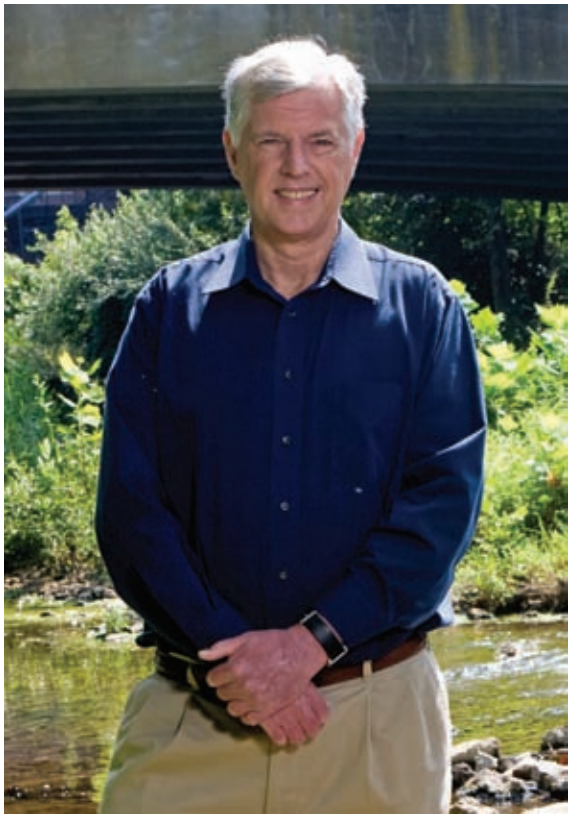
The reason for this increase is highly debated, according to Sylves. "Some scholars claim that most declarations are issued for political reasons," he says, "though few suggest that turndowns of governor requests for them are politically motivated. Declarations are almost always issued for 'real' events, but homeland security concerns now are part of the family of declarations, and some are issued on the grounds of terrorism vulnerability for events such as inaugurations."

Only about one in four gubernatorial requests is turned down currently, and governors are highly motivated to seek presidential declarations, as the economic implications of most disasters and emergencies are daunting.

Federal assistance gained through declarations helps pay for the rebuilding of disaster-ravaged public infrastructure such as bridges, roads, airports, stadiums, government buildings and essential public service organizations.

"Individuals also benefit via a basket of key benefits," Sylves says, "including emergency repairs to homes, housing aid and public sheltering, unemployment relief, reconstruction aid and emergency medical costs. A core purpose of federal disaster relief is to restore communities, to the extent possible, to their pre-disaster conditions and to implement improvements likely to mitigate or prevent similar disasters and damage in the future."

Delaware has had only 13 disaster declarations since 1953, with none between 1965 and 1992. But Sylves warns against complacency.



AMBRE ALEXANDER

Rick Sylves, UD professor of political science, stands near White Clay Creek in Newark, Del. In 1999, a state of disaster was called in Delaware when Hurricane Floyd significantly altered the course of the creek and caused extensive flooding.

"Delaware benefits from being geospatially small, making it a smaller target for many disaster-inducing phenomena," he says. "However, the state has many more vulnerabilities than people think."

"Delaware has undergone a significant degree of deforestation owing largely to development, and this allows more rainwater runoff and snow melt, which results in more flooding. The state also bears the threat of hurricane damage and suffers from the effects of sea-level rise as saltwater penetrates further inland every year, jeopardizing wetland environmental resources and public water supplies."

Sylves' extensive knowledge of presidential declarations of disaster is documented in four books, including his most recent, *Disaster Policy and Politics,* published by Congressional Quarterly Press in 2008.

The book offers a contextual history of disaster policy and politics, discusses global issues and influences, explores the politics of planning and funding for the next disaster and provides a window into the future of emergency management. — *Diane Kukich*

Discovery learning comes of age

Today, three decades after it began, UD's nationally recognized Undergraduate Research Program engages about 700 undergraduate students each year at the frontiers of discovery. They work closely with faculty advisers across all disciplines on research and creative activities ranging from cancer studies to literary compositions.

KATHY F. ATKINSON

Lynnette Overby directs UD's Office of Undergraduate Research and Experiential Learning.

"Thirty years after its inception, the Undergraduate Research Program continues to provide intentional opportunities for students to deepen their knowledge and discover answers to many important societal and disciplinary questions. With the mentoring of outstanding faculty, the walls dividing student from professor begin to evaporate and colleagues in pursuit of knowledge emerge," says Lynnette Overby, professor and director of the Office of Undergraduate Research and Experiential Learning.

With a background in both the arts and sciences, Overby has had a multifaceted career as an administrator, educator, researcher and choreographer. Since she joined the UD faculty in 2008, her goal has been to build on "the wonderful program of undergraduate research that has been in place, and also to become involved with societal and community concerns, many of which overlap with academic pursuits."

With the support of the Office of the Provost, she plans to create additional opportunities for undergraduate students to conduct research and creative activities, including interdisciplinary and global projects.

In compiling a history of UD's Undergraduate Research Program working with program coordinator Meg Meiman and Prof. Joan Bennett, who retired as the program's director in 2007, Overby found that UD's program is one of the first — if not *the* first — in the nation.

"The first manifestations of undergraduate research at UD were undergraduate student theses, the first written in 1897 by a student in mechanical engineering," she says.

Then in 1936, the University awarded the first Degrees with Distinction. To obtain this honor, undergraduates were expected to become involved with both creating original knowledge and documenting this knowledge in a thesis. Students in chemistry, English, mathematics, biology and physiology were the first recipients.

By the late 1970s, the University was awarding increasing numbers of Degrees with Distinction and thus decided to expand the idea of involving undergraduates in the creation of new knowledge. Instead of just having a few highly motivated students work in the lab with individual professors, why not make research part of the larger education available at the University of Delaware? Thus, the University Honors

"The experience I gained with research and writing in the Undergraduate Research Program at the University of Delaware helped me tremendously in graduate school and law school. Also, research and writing have been an important part of my legal and judicial jobs. The skills I learned, and the opportunities I had to work on them as an undergraduate researcher, have been invaluable throughout my career."

— Leonard Stark
Judge, U.S. District Court
for the District of Delaware

(B.A., Honors-Political Science; B.S. with Distinction, Economics; M.A., European Medieval and Modern History, UD, 1991; Rhodes Scholar)

Program and, shortly thereafter, the Undergraduate Research Program, were born.

At the 30th anniversary celebration in May, Overby and her colleagues welcomed students, program alumni, faculty and friends to a weekend of events, including a special symposium.

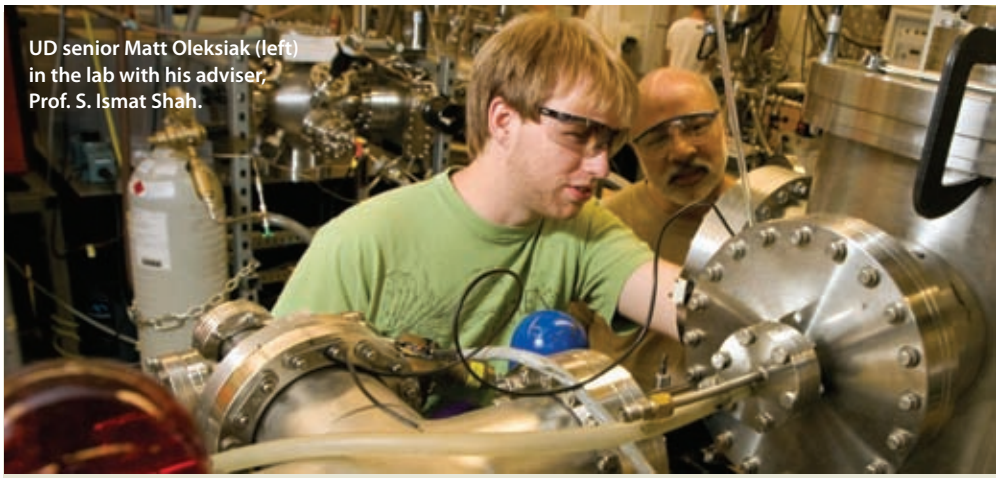
The three keynote speakers were all program alumni. Chiara Sabina graduated from UD in 2000 with an Honors degree in psychology and Spanish studies and is now an assistant professor of social sciences at Pennsylvania State University.

Joseph Salvatore, who received an Honors degree in history from UD in 1995, is now a playwright and director based in Manhattan and also the artistic/education director for Learning Stages, an award-winning, nonprofit theater company in New Jersey dedicated to providing artistic opportunities for children and young adults.

And Charles Bergquist, who received an Honors degree in chemistry from UD in 1996, is the director and contributing producer of National Public Radio's *Talk of the Nation: Science Friday*.

The focus of Sabina's talk was how undergraduate researchers can use science to work on social problems. "While I came to college knowing that I wanted to do good, it was here at UD where I first started really understanding some of these problems and how we can use the tools of science to address them," Sabina said.

AMBRE ALEXANDER



UD senior Matt Oleksiak (left) in the lab with his adviser, Prof. S. Ismat Shah.

Welcome to the incredible world of shrinking technology

Although he had always loved chemistry, Matt Oleksiak wanted to enter a more specialized field of study. When applying to colleges, he saw that fewer schools offered a chemical engineering major and decided to take a risk, hoping this major would prove to be the right choice. Drawn to the University's superior program, Oleksiak enrolled as a chemical engineering major at UD. Now approaching his senior year, Oleksiak's choice was clearly the right one.

Through UD's Undergraduate Research Program, Oleksiak is exploring techniques to assist in the world's never-ending quest for shrinking technology. Funded by the National Science Foundation's Nanotechnology Undergraduate Education (NUE) Program, Oleksiak is one of a three-person team researching the synthesis and characterization of iron platinum nanoparticles in a boron nitride matrix. Under the advisement of Prof. S. Ismat Shah, Oleksiak and UD graduate student G. Hassnain Jaffari are investigating the use of iron platinum particles with the potential for application in hard drives.

All the information stored on your computer, cell phone, iPod, etc., is saved to a hard drive. Therefore, it only makes sense that smaller hard drives must first be created in order to produce smaller technological devices. Hard drives are made up of magnetic particles that act as storage units called "bits." Each bit has a magnetic spin arranging it in an up or down direction. The compilation of numerous bits makes up each file of data stored.

To successfully construct a smaller hard drive, Oleksiak must shrink particle sizes to the nanoscale while maintaining separate magnetic regions (up and down spins). This task may sound simple, but it is difficult when "you are forcing something to bypass what would be more favorable naturally and kind of make it do what you want," Oleksiak says. Often when particle sizes are reduced to the nanoscale, normal ambient temperatures are enough to cause fluctuations in the magnetic spins. These fluctuations randomize the magnetic spins of the particles, ruining data stored on the hard drive.

To achieve the size and stability he is looking for, Oleksiak turned to iron platinum particles. Iron platinum has a high anisotropy constant, meaning that the energy required to change the magnetic spin of the particles is very high. Iron platinum particles are more stable and thus less likely to be affected by surrounding thermal energy. The stability of iron platinum particles will hopefully allow Oleksiak to decrease their size significantly and maintain their magnetic spins, enabling efficient smaller technological devices.

A major resource used by many, if not all, people and important industries such as health care, defense, education and more, computers have become an essential part of everyday life.

"We live in the age of technology with so many different applications that require computers, hard drives and information storage," says Oleksiak. And in a field where smaller is better, his research is extremely important.

Nearing the end of his undergraduate studies, Oleksiak plans to attend graduate school to pursue his doctorate in chemical engineering.

Unafraid to experiment in the lab and in life, Oleksiak offers words to live by, saying, "Even bad results can be successful. If you think something's going to work and you prove that it doesn't, that is also good." *— Emily Houghton*

Matt Kinservik, professor and chairperson of English (left), and student Brion Abel examine books in the University Library's Special Collections.

KATHY F. ATKINSON

Groundbreaking English project gives undergraduate researchers new view of the humanities

When Matt Kinservik looked at the common perception of humanities research, he says he saw a fairly dull picture of a scholar toiling alone in a library for years, poring over materials and eventually producing a book.

By contrast, when the professor and chairperson of English at UD looked at accounts of scientific research, he often saw pairs or groups of people working together, actively engaged in their laboratory and discussing their findings. Even the photos that accompanied these accounts were different, he noticed. Test tubes and beakers in the lab contained colorful liquids, while the dust jacket of the humanities professor's book often seemed muted.

Kinservik decided something should change, starting with the way undergraduates learn about research.

"Our department discussed this, and we asked: How can humanities scholars mentor undergraduates and involve them in the way we do research?" he says. "It seems that all people usually see is the result of our research — a book or article. The whole process of how we did the research mystifies people, especially undergraduates, because we don't share enough of that."

With the support of a Transforming Undergraduate Education grant from the College of Arts and Sciences, some English department faculty members tried a new approach, taking their cue from the physical sciences. They set up some projects through the University's longstanding tradition of undergraduate research and modeled them on a team-based and laboratory-based method.

Teams of students, some also including graduate students, were formed under the faculty member's direction. Then, the faculty leader divided the research among the team's members, with each student taking a particular book or aspect of the subject matter to examine. The team members, including the faculty researcher, met regularly, shared ideas, focused and re-focused their research topics and sometimes did fieldwork together.

"It was a much less solitary way to do research, and the collaborations were very effective," Kinservik says of his own two projects that used this new model. His research involved book history, while other faculty members worked on topics involving journalism, composition and English education.

The first of Kinservik's projects concerned a group of Irish radicals around 1800, with the research focused on learning details of the time the men spent in exile in the United States. One of the radicals, Archibald Hamilton Rowan, ended up in Delaware, and while conducting research at the Historical Society of Delaware, the UD students discovered boxes of letters Hamilton Rowan had written that had never before been published.

"There was so much material that we decided to focus just on him," Kinservik says. "There was plenty to keep the students busy."

The project went on to include a trip to Ireland for further research by Kinservik and then-undergraduate English majors Brion Abel and Alice Lippincott. The three have written an article about their findings, to be published in the magazine *History Ireland*.

"This research project was a great experience, a life-changing experience for me," says Abel, who graduated in 2010 and is working for a year while exploring graduate programs. "It really changed my view of research and made me want to go to grad school."

With the team members dividing up the boxes of documents and then sharing their findings, everyone benefited from hearing other perspectives and insights, Abel says, describing their meetings as "massive brainstorming sessions." The experience of talking

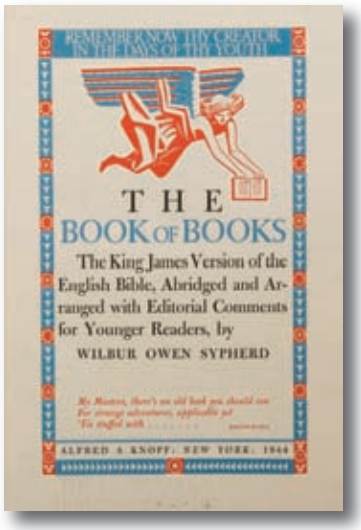
to one another also "helped us learn to write for a wider audience," he says.

Kinservik's second research project using the team model involved the common 18th-century practice of abridging books. The students in that team looked at different works, or different categories of books, and spent a week in Los Angeles working in rare-book libraries.

Undergraduate Sarah Gelotte took part in the research, looking specifically at abridgments of Bibles and other sacred texts. She says she joined the project, not only because she wanted to learn to conduct in-depth research but also because of its collaborative nature.

"I think this was the most appealing aspect for me — that I'd be able to explore these questions with a very small group of undergraduate and graduate students," Gelotte says. "When you're working with peers, and in my case with individuals who have had experience with research before, it was easy to keep interested, inspired and really hone in on the questions that I wanted to research personally."

Kinservik says he and other faculty members consider the experiment with the team-based model a success and are seeking additional grant funds so that future projects can also include travel if needed. "Part of what made the experience so special for students was the fieldwork," he says. "Working in a group, in a library surrounded by other researchers, really gives students a new view of the humanities." — *Ann Manser*



Undergraduate researcher Sarah Gelotte examined abridgments of Bibles such as this one, from the University's Special Collections. The author, Wilbur Owen Sypherd, was a professor of English at UD (1906 –1947) and University president from 1944 to 1946. Sypherd Residence Hall is named for him.

EVAN KRAPE

Amanda Lee Welch inspects the hoof of a cow in UD's dairy herd with Prof. Robert Dyer.

Pre-vet student combats hoof disease in dairy cattle

Amanda Lee Welch is one of four UD undergrads in 2010 to receive the Goldwater Scholarship recognizing exceptional students pursuing careers in science, mathematics, and engineering.

She also continues to excel as an Undergraduate Research Program scholar. With funding from the program and from the U.S. Department of Agriculture, Welch is conducting research on laminitis and sole ulceration in the bovine claw.

As a young girl, Welch always dreamed of becoming a veterinarian, and while most childhood dreams change with age, Welch's never did. Currently an animal and food sciences major, Welch chose the pre-veterinary program at the University of Delaware because, she says, "it is more directly focused on animals, providing the hands-on experience I was looking for."

Working at the University of Pennsylvania's New Bolton Center in Kennett Square, Pa., starting at the age of 15, Welch was introduced to Dr. Jim Orsini, an associate professor studying laminitis in horses. An avid horseback rider with her eye on becoming a veterinarian, Welch was very interested in his research.

"I had seen cases of laminitis in horses before, and it is tragic. I wanted to help find a solution to the problem. That is when Dr. Orsini introduced me to Dr. Dyer, who was conducting similar research with dairy cattle. I began working in his lab at UD," says Welch.

Under the advisement of Dyer, Welch is working with fellow undergrad Caitlin Gromley and grad student Trista Reeder researching sole ulceration in the bovine claw. Her study focuses on the distribution of involucrin, a structural protein of the cytoskeleton and cornified envelope, and proliferating cell nuclear antigen (PCNA), a protein expressed in the cell nucleus during the synthesis phase of the cell cycle, in normal and ulcerated bovine sole regions. An increase in PCNA expression appears to be associated with marked changes in the intensity and pattern of involucrin staining across the suprabasal layers of keratinocytes of ulcerated epidermis. Lameness from claw horn lesions is the second most important health problem prevalent in dairy cows behind mastitis, an infection in the udders.

Ulcerated soles are a direct result of hemorrhagic trauma to the cow's hoof, a disease that Welch and many others believe may be related to the cow's diet. Previously grass-grazing animals, dairy cattle now receive rations of grains and corn, which can severely disturb their digestive systems. Similar to diabetic foot ulcers in humans, dairy cows are developing painful ulcers as a result of this new diet high in sugars and carbohydrates. Sole ulcers greatly decrease the welfare of the animal, and if left untreated, result in afflicted animals being separated from the herd and sent to slaughter.

The number of dairy cattle affected by sole ulcers has caused great economic losses for dairy farmers; on average, each case will cost a dairy producer $627. Welch's study of the bovine sole aims to characterize the changes that occur in hoof ulcers in dairy cows that may lead to further understanding the disease, opening doors to establish treatments to help improve the life of the animals and the U.S. dairy industry.

As a senior nearing the end of her undergraduate work, Welch plans to attend a research-based veterinary school to study disease pathogenesis for biomedical applications in pursuit of a combined Ph.D. and doctorate in veterinary medicine. — *Emily Houghton*

Historian shows that recycling is an idea that's coming around (again)

Today's focus on environmental sustainability may seem to be a modern concept, but such key elements as recycling, reusing and repurposing are actually recycled themselves from 19th-century American life, according to historian Susan Strasser.

In fact, says the Richards Chair of American History at UD, U.S. households produced almost no trash before the 1890s. Instead, families took old clothing apart and made new garments from the fabric, repaired broken tools or utensils, and turned over scraps of useless leather or rags to peddlers, who in turn sold them to factories for reuse as raw materials.

Strasser explored the consumer, technological and economic changes that replaced that culture with today's throwaway society in a 1999 book, *Waste and Want: A Social History of Trash.* It was her third book and the first to be generally seen as focused on environmental history.

Her first two books, written in the 1980s, explored the history of housework and then the rise of advertising and mass marketing of consumer goods in America. *Waste and Want,* she says, was a natural next step in her research.

"My books have gotten attention in different sub-fields of history — the history of women, or technology, or environmental issues — but to me, they're all about the same thing," she says. "Each one led into the other."

Strasser recalls that as she was researching her first two books in the 1980s, the news was filled with accounts of environmental disasters: the 1984 leak of poison gas from an industrial plant in Bhopal, India, that killed thousands; the 1986 nuclear plant accident at Chernobyl in the Soviet Union that caused widespread contamination; and the so-called "garbage barge," which left New York with over 3,000 tons of trash in 1987 and ended up traveling up and down the East Coast seeking a willing disposal site.

"All of us were getting more environmentally aware during that decade, and I think my research made me especially aware," she says. "Environmental history is a field that had been developing; people were really thinking about it as a separate focus. For me, the creation of American consumer culture was a subject that led to the idea of recycling and reuse. They're all very much tied together."

Waste and Want examined two facets of American consumer culture before about 1890 — what Strasser calls the "tremendous focus on reuse within households" and what today would be called "post-consumer recycling" in which unusable bits of materials were returned to factories. The unwillingness to waste anything was so prevalent, in fact, that Strasser says even when municipalities first began offering trash disposal, they paid employees to sort through the material and remove anything useful before the true waste was burned or dumped.

> "...For me, the creation of American consumer culture was a subject that led to the idea of recycling and reuse. They're all very much tied together."
>
> — Susan Strasser

Strasser found that, as America shifted to a consumer culture at the same time that large factories grew up and mass marketing began, today's cycle of waste production and disposal got under way.

"I realized that the era of profligacy that I was born into wasn't really all that old," she says. "That was fascinating to grapple with. You tend to think that things have always been the way they are now, but in fact, it turns out that they used to be very different."

Her latest research also relates to the environment, as she works on a book to be called *A Historical Herbal,* an account of the commerce and culture of medicinal herbs, many of which became endangered or less plentiful as they were overcollected or lost their habitat through development.

Susan Strasser, Richards Chair of American History

In addition to her research, Strasser teaches classes in American and global environmental history.

Strasser's interest in environmental history is just one example of the emerging field of study known as environmental humanities, in which the traditional focus of environmental studies — physical sciences and public policy — is expanded to include history, English, languages and other humanities. At UD, other humanities faculty members dealing with environmental issues include Eve Buckley, assistant professor of history who specializes in Brazil, and McKay Jenkins, Tilghman Professor of English, whose newest project is a book about toxic chemicals in consumer goods.

Ann Ardis, senior associate dean for the humanities in the College of Arts and Sciences and director of UD's Interdisciplinary Humanities Research Center, says the University has created a new faculty position in environmental humanities. An interdisciplinary search committee will work during the 2010–11 academic year to fill the position by September 2011.

"This will be a truly interdisciplinary position," Ardis says. "Our hope is that this person will not only teach courses in different departments, or even different colleges, but will also help build programs and collaborations across campus in this important new area." — *Ann Manser*

UD works to improve water quality at its doorstep and 10,000 miles away

The University of Delaware has long been a leader in improving water quality locally. Now UD is involved in water-quality efforts 10,000 miles away, in China, through a unique research partnership. Nonpoint pollution of ground- and surface water is a growing concern in China, particularly as that nation's economy expands and agricultural activities intensify.

"Collaborating with state and industry partners, we've made significant progress in helping provide Delaware's farmers with 'best management practices' that can optimize crop production while minimizing the impact on the environment of the fertilizer and manure nutrients essential for crop growth," says Tom Sims, deputy dean of the College of Agriculture and Natural Resources (CANR) and T. A. Baker Professor of Soil and Environmental Chemistry.

"Now we're moving into exciting new territory as we extend our reach internationally to collaborate with Chinese researchers in the development of solutions to their country's pressing environmental issues."

UD's nutrient management efforts have been recognized globally and led to an agreement in 2008 with China Agricultural University (CAU) and the University of Pennsylvania Department of Clinical Studies, School of Veterinary Medicine, to participate in joint research and exchange activities.

Since 2009, UD has hosted Prof. Fanghao Wang, a visiting CAU scientist who studies nutrient management in animal production. He has been conducting research at UD with Sims, as well as at the University of Pennsylvania's New Bolton Center in Kennett Square, Pa., where he has worked with project co-leader Prof. Zhengxia Dou. She is renowned for her work on nutrient management in dairy production.

"Here in the U.S., there are so many opportunities to study nutrient management with some of the top research scientists in the field," Wang says. "I have been able to attend demonstrations with extension professionals and attend national meetings that will all help me as a scientist in China." Wang also published his research in the U.S., one of his goals.

In August 2009, a delegation from CAU visited UD for a whirlwind week that included a joint scientific workshop and tours of a Sussex poultry farm, Perdue's Agri-recycle manufacturing plant, the New Bolton Center, and UD's Carvel Research and Education Center in Georgetown. This past July, four CAU researchers arrived for a five-week visit that featured discussions on possible research collaborations with UD faculty and their colleagues at Penn State, Purdue and the University of Maryland.

CAU and UD also joined Wageningen University and Research Centre of the Netherlands to host the Third International Workshop on Nutrient Management Technology and Policy in Beijing. Sims presented a keynote talk on the chemistry and management of soil phosphorus, a major pollutant of the Chesapeake Bay. David Hansen, associate professor of soil and environmental quality and Cooperative Extension specialist for nutrient management, also presented.

"Our international collaboration is rewarding — we're using our years of research and extension experience on nutrient management in Delaware and Pennsylvania to contribute to solutions to China's serious agri-environmental problems," Sims says. "At the same time, our Chinese colleagues are visiting with us regularly to learn about the practices and policies we're working on to protect water quality locally."

Hansen illustrates that point. While an eager participant in the UD-China collaboration, his topic at the Beijing conference —"environmental regulations affecting agriculture in the Chesapeake Bay watershed" — reflects his longstanding commitment to protecting local water quality.

Hansen and Greg Binford, associate professor of plant and soil sciences, develop and conduct all of the nutrient management training required for growers under Delaware law. Hansen also is the extension water quality coordinator and sustainable agriculture research and education coordinator, as well as Delaware's representative to the Chesapeake Bay Program's Scientific and Technical Advisory Committee and chair of the program's Nutrient Subcommittee. He is helping to craft policy that will impact the Chesapeake for generations to come, while maintaining an active research program related to nitrogen and phosphorous management in production agriculture.

Binford recently won a $550,000 grant from the U.S. Fish and Wildlife Service to develop a nutrient management program that will result in less nitrogen leaving cornfields and entering Chesapeake Bay. The key, he says, is to revise plans currently used by growers so there is a mechanism in place that allows for an evaluation at the end of the season.

"UD's nutrient management team is crafting innovative solutions in pursuit of improved environmental quality here in Delaware and on the other side of the globe," notes Sims. "Their efforts provide critical benefits to agriculture while protecting the environment." — *Margo McDonough*

DANIELLE QUIGLEY

From left, Robert Emerson, Weifeng Zhang, visiting scientist from China Agricultural University, Tom Sims, deputy dean of the College of Agriculture and Natural Resources, and Anna Stoops, New Castle County agricultural extension educator, discuss nutrient management practices during a visit to Emerson's dairy farm in Middletown, Del.

View of Wilmington, Del., near the location of Prof. Murray Johnston's pollution studies. Research shows that much of Delaware's air pollution is generated beyond the state's borders.

JON COX

The search for solutions to air pollution

One-of-a-kind device sweeps air-quality research forward

Understand this: Murray Johnston doesn't want the air to be polluted. In fact, he's a pollution fighter.

But Johnston does find infinitely fascinating the chemistry of volcanic dust to the tantalizing aroma of grilling burgers swirling in the air.

"Atmospheric chemists look at the world in a different way than most people," says the professor of chemistry and biochemistry at UD.

"When the air is very clean, it's pretty boring for us. When it's polluted, it's really interesting from a chemistry perspective," Johnston says. "That gives us a lot to look at."

Johnston and his research group of budding analytical and atmospheric chemists want to know more about microscopic particles suspended in the air — particles containing a vast assortment of materials — sand and dirt, sea salt, lead and other metals, soot, toxins and more. They especially want to learn about the smallest of these — nanoparticles — where they come from and how they change over time, and then help to devise strategies to mitigate the harmful ones.

After all, the air we breathe is more than just oxygen. It's actually 78% nitrogen and 21% oxygen, with the remaining 1% composed of carbon dioxide, traces of helium, neon, and other gases, and a potpourri of microscopic contaminants, even minuscule amounts of gasoline from filling your vehicle's tank.

Just how small are nanoparticles? A single hair has a diameter of about 100,000 nanometers. The particles that Johnston and his group are studying are less than 50 nanometers in size. Most are smaller than 25 nanometers.

To analyze them, Johnston and his team invented the nano-aerosol mass spectrometer (NAMS), an instrument that can trap and then analyze nanoparticles in real time. The one-of-a-kind instrument, the size of an office desk on wheels, has been used in air quality assessments in Delaware and California so far. It provides measurements of particle size and composition, which the UD researchers combine with environmental data such as temperature, rainfall, wind speed and direction, and solar radiation, to understand how nanoparticles form and grow in the atmosphere.

The risks posed by ambient nanoparticles to human health and the environment are not well understood. However, there is concern about these super-small particles because their chemistry differs considerably from larger particles and their size enables them to penetrate the lungs more deeply and enter the bloodstream.

Epidemiological studies recently have shown a strong correlation between particulate air pollution levels, lung and heart diseases, various cancers and mortality. However, these adverse effects appear to be dependent on a number of factors such as genetics, existing disease, exposure patterns and particle chemical composition.

The state of Delaware, through the Delaware Department of Natural Resources and Environmental Control (DNREC), has been monitoring airborne particles for some time, and Johnston has been a collaborator on a number of the research initiatives.

In a 2009 study of urban air, funded by the non-profit Health Effects Institute and the Environmental Protection Agency, Johnston and his team trucked the NAMS to a monitoring site near the intersection of Justison Street and Martin Luther King Boulevard in downtown Wilmington, Del. Their primary goal was to determine how many nanoparticles are emitted from motor vehicles compared to other sources.

Thanks in part to the NAMS, which provides a minute-by-minute snapshot of air quality, the researchers found that during peak driving times, almost half the nanoparticles come from vehicles that are stopped at the intersection and then accelerate, producing a burst in emissions.

Some vehicles emit up to 30 times more nanoparticles than others," Johnston notes. "Most of the emissions are from a few vehicles, so if you can identify those vehicles, you'll get a lot of bang for the buck. Another idea is to time our traffic lights differently so that there's not so much stop-and-go traffic at major intersections when, for example, students are walking to school."

Sunlight also plays a role in nanoparticle formation. Ozone gas, a major component of "smog," is formed on hot, sunny days when energy from the sun reacts with the volatile organic compounds and nitrogen oxides in industrial emissions and motor vehicle exhaust. Ozone itself is a health hazard, but it can also react with other chemicals in air to produce nanoparticles.

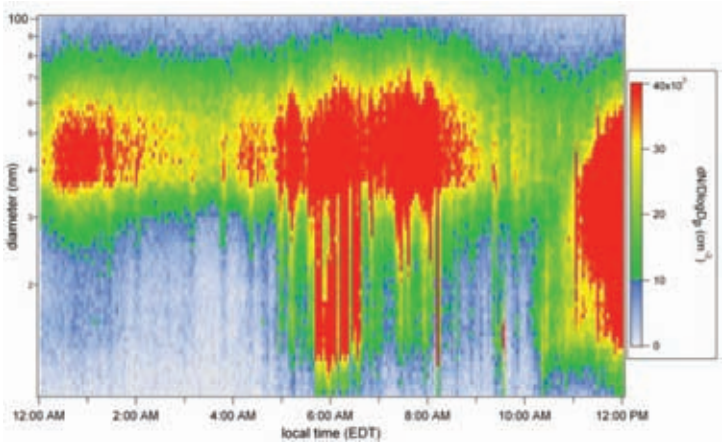
Many of the compounds that make airborne particles are actually blown to Delaware from other places such as the Ohio River valley, Philadelphia and Baltimore, according to DNREC.

"Reducing air pollution in Delaware is a real challenge because much of the state's air pollution is generated beyond its borders," Johnston notes. "In a 2005 study we made in Wilmington in collaboration with DNREC, long distance pollution sources accounted for about 40% of airborne particulate matter, with the remainder from local sources such as motor vehicles and industrial activity along the Delaware River."

Johnston's team recently shipped the NAMS to Los Angeles for a study of roadway pollutants. He says that research has made him very conscious of his distance from highways.

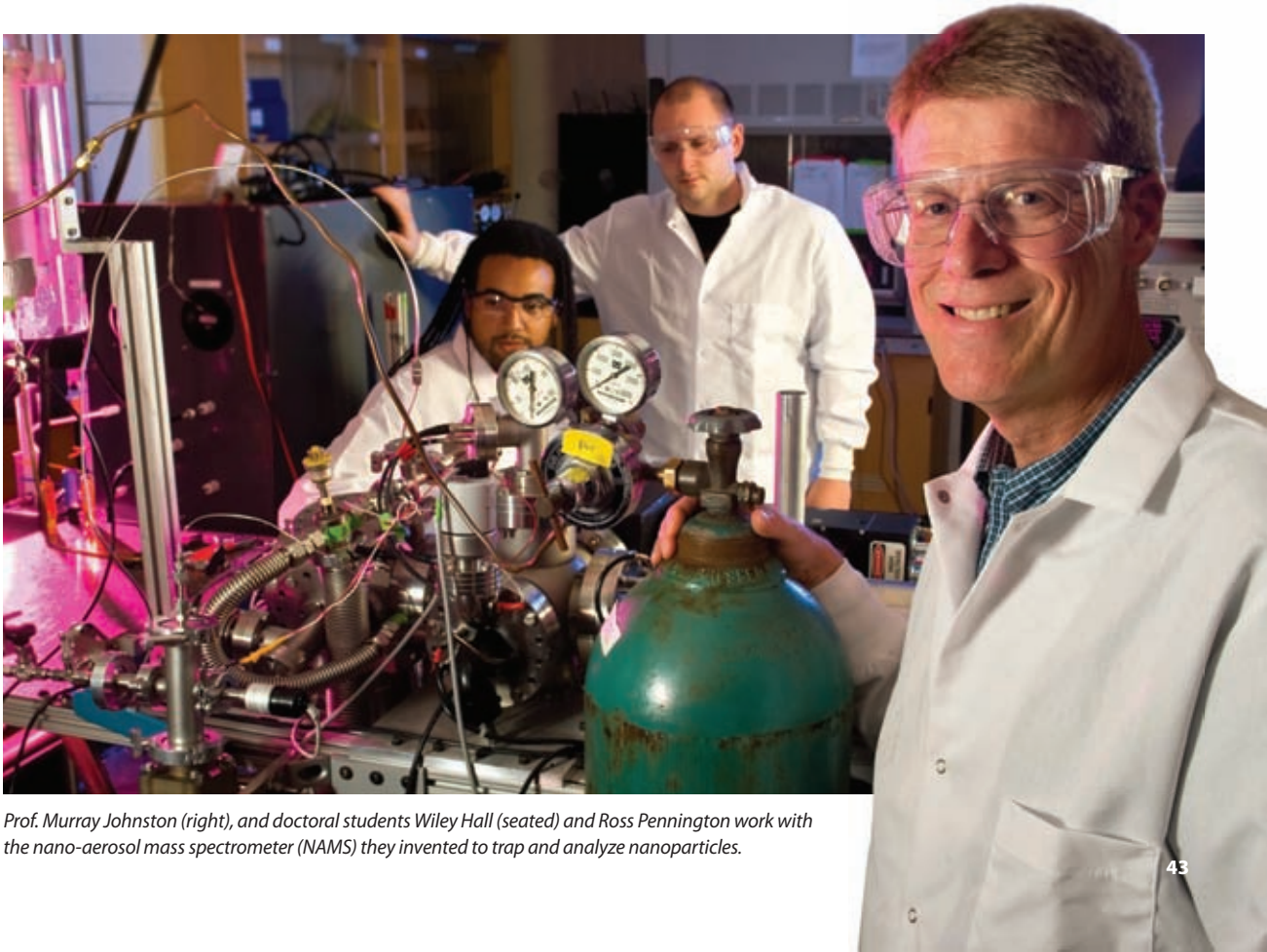
"Proximity to a roadway determines how many nanoparticles and other pollutants you're breathing in — the first 100 meters is especially important. In southern California, a lot of people live within 100 meters of a freeway. I thought about that when we were out there because our hotel was right by one," Johnston says. "I think of this now when I see housing developments springing up in our area along major highways."

— *Tracey Bryant*



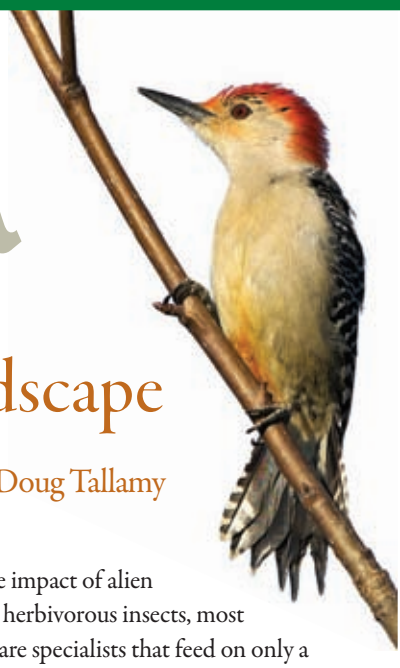
The vertical spikes in this graph of particle size and concentration vs. time in Wilmington, Del., represent the high concentration of nanoparticles emitted by individual vehicles after stopping at a stoplight and then accelerating.

KATHY F. ATKINSON



Prof. Murray Johnston (right), and doctoral students Wiley Hall (seated) and Ross Pennington work with the nano-aerosol mass spectrometer (NAMS) they invented to trap and analyze nanoparticles.

Native Son



Ecologist Doug Tallamy wants you to landscape for butterflies, birds and a better life

Photos by Doug Tallamy

Armed with a shovel, Doug Tallamy, chair of UD's Department of Entomology and Wildlife Ecology, is leading a new American revolution, and he wants you to join him.

All you need to do is plant one native tree or shrub in your yard — perhaps an oak or willow tree, a blueberry or cranberry bush.

It's not hard to do, it doesn't cost much and the paybacks, Tallamy says, will be immediate. Caterpillars will begin feeding on these native plants, and then birds will discover the caterpillars and start snapping them up. Add more native plants, and your rewards will be even greater, as a richer web of life springs forth.

"When plants bring life into your yard, it's instant gratification," Tallamy says. "It's especially critical for kids to understand the linkages. By putting native plants in your yard, you can make those connections for the future stewards of our planet."

Although that Bradford pear tree with its snowy spring blooms, the burning bush with its flame-red leaves in autumn, and the stately English ivy bordering your home may look lush and attractive, ironically these alien species are contributing to the ecosystem's demise, he notes.

Why are non-native plants so damaging to the ecosystem? The simple answer is that insects — the primary food of birds — cannot, or will not, eat this unfamiliar vegetation. Programmed by eons of evolution, many insects don't even recognize alien plants as potential food, he says.

Tallamy recently completed a National Science Foundation research project focusing on the impact of alien plants on herbivorous insects, most of which are specialists that feed on only a few different plant species.

If an insect has adapted to a native plant, the general thinking among scientists had been that the insect should be able to adapt to that plant's close relatives.

"However, we've found that there is still a significant loss of abundance of insects in that situation — around a 50% loss," Tallamy says. And if there is not a close relative, then there is a 75% loss in that insect's abundance."

Alien plants are rapidly replacing native ones across North America because the non-natives typically outcompete native plants, and homeowners often unknowingly are planting non-natives in their yards.

In a study of randomly selected homes in suburban developments built from

Grouping native plants such as these river birches provides good habitat and lots of bird food in the form of insects.

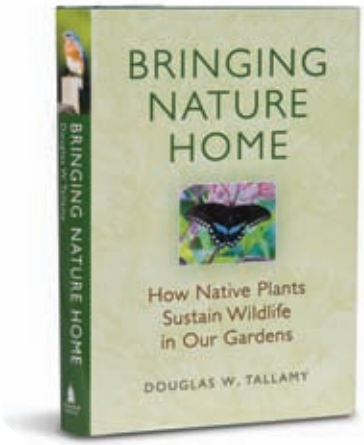
1990–2005 in New Castle County, Del., and neighboring Chester County, Pa., Tallamy and his colleagues have found that 92% of the landscapable area around those homes is lawn, which is akin to a desert in terms of wildlife habitat. On the remaining 8% of landscapable area, 75% of the plant species are non-natives, and 83% of the total number of trees, shrubs and flowers are non-natives, offering very little in the way of food for insects or birds.

Put Life Back into Your Landscape

"We largely have a barren landscape. But it doesn't have to be that way," Tallamy says, in his office in Townsend Hall in the College of Agriculture and Natural Resources.

Covering his desk are research proposals and speaking invitations for national symposia to local garden clubs, while a nearby table holds an assortment of jars containing water samples from a wetland he's helping to create in a former cow pasture on UD's Farm.

"We can landscape in ways that support insects and birds and other life," he says. "It's especially easy to do in suburban areas. It may be harder to do in places like Manhattan, but even there, it's not impossible."



Tallamy spells it all out in his award-winning book, *Bringing Nature Home: How Native Plants Sustain Wildlife in Our Gardens* (Timber Press, 2007). Enhanced with full-color images, the book covers everything from the vital new role of the surburban garden, to gardening for insect diversity. It also includes a list of the top woody plants *(see page 46)* for supporting one of the largest orders of insects — Lepidoptera, more commonly known as butterflies and moths. The oak tree ranks at the very top, providing habitat for some 534 species.

The list was born from exhaustive searches of the scientific literature by Kimberley Shropshire on Tallamy's research staff.

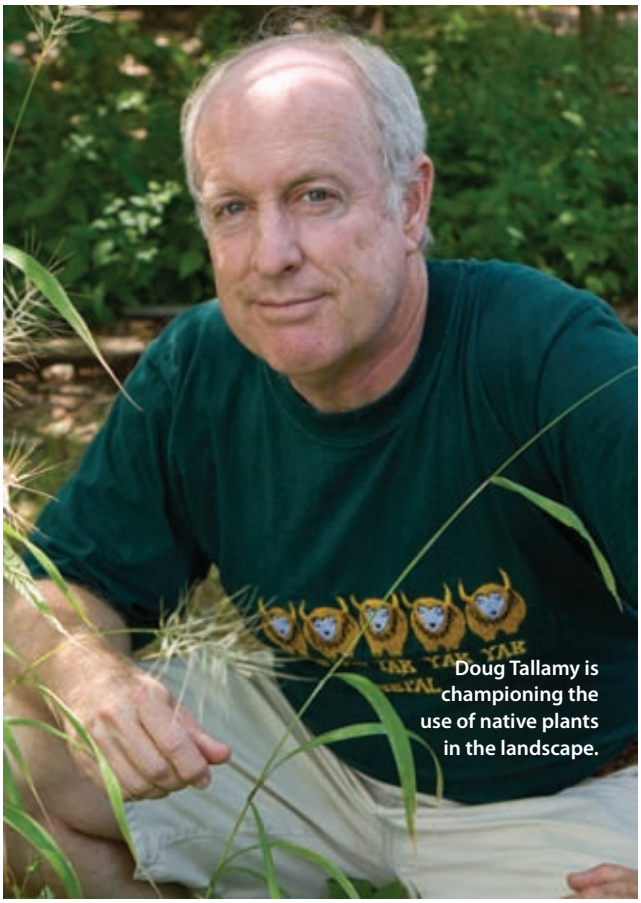
"I'm not saying to rip out non-native plants and start over from scratch," he says. "However, when a non-native plant dies on your property, replace it with a native one. If you replace alien species with native woody plants, you'll be putting a lot more life into that landscape. Plants dictate the life that can live there."

Based on all of the presentations he's given to garden clubs and homeowners' associations across the United States, and in media interviews with the *New York Times* to National Public Radio, Tallamy says that most people don't realize how critical their choice of landscaping is to the life around them. But once they understand the connections and the importance of native plants, they are eager to take action in their yards and communities.

A few concerns and myths are easily dispelled, he says.

"People should not worry, for example, about being overrun with insects if they plant native species. Our research does not bear that out," Tallamy notes.

There also is a misperception that a native landscape may look "raggedy" or lack the beauty of ornamental plants from distant lands, but well-designed native gardens can be indistinguishable from gardens dominated by aliens, he says.


Doug Tallamy is championing the use of native plants in the landscape.

AMBRE ALEXANDER

Tallamy also encourages people to think differently about their lawns. Open your door on any Saturday morning in suburbia during summer, and you'll hear America mowing.

"Instead of carving out small corners of the lawn where you want to plant a tree or a few shrubs or a flower bed, we need to reverse that thinking. Consider the trees, shrubs and flower beds as taking up the majority of the area, and the lawn as the path that connects them," he advises. "You'll save energy and increase biodiversity.

"People want managed, beautiful landscapes that are alive, and native plants are the key," Tallamy notes. "We just need to make the new status symbol the number of hummingbirds you see on your property versus your well-manicured lawn!"

Although Tallamy is smiling as he speaks, there also is a strong sense of urgency behind his words.

"It's very clear to me that in my 30 years in academia, this work is the most important thing I have done," he says. — *Tracey Bryant*

Top 10 Natives

for butterflies & moths

1 OAK

Family: Fagaceae
Genus: *Quercus*

The mighty oak supports 534 species of butterflies/moths, and its acorns feed deer, turkeys, bear, squirrels, even wood ducks. There are 80 oak species in North America.

2 WILLOW

Family: Salicaceae
Genus: *Salix*

With 97 willow species in North America, there are lots to choose from. They support some of the showiest butterflies, e.g., viceroys.

3 CHERRY, PLUM

Family: Rosaceae
Genus: *Prunus*

Native plums and wild cherries, including black cherry, choke-cherry, and pin cherry, are excellent sources of food for wildlife.

4 BIRCH

Family: Betulaceae
Genus: *Betula*

Birches support hundreds of butterfly/moth species, plus they produce seeds and flower buds that feed a variety of birds, from songbirds to turkeys.

5 POPLAR

Family: Salicaceae
Genus: *Populus*

Lepidoptera love these fast-growing trees. They harbor 7 giant silk moth, 7 sphinx moth, 77 noctuid (nocturnal moth) and 10 butterfly species.

6 CRABAPPLE

Family: Rosaceae
Genus: *Malus*

There are only four native species of crabapples in the U.S. The fruits are favorites of birds, deer and other wildlife.

7 BLUEBERRY, CRANBERRY

Family: Ericaceae
Genus: *Vaccinium*

Underused in ornamental plantings, they host butterflies/moths and nourish birds and mammals.

8 MAPLE

Family: Aceraceae
Genus: *Acer*

Since the demise of the American chestnut, maples have expanded their role in the forest. They support 285 Lepidoptera species.

9 ELM

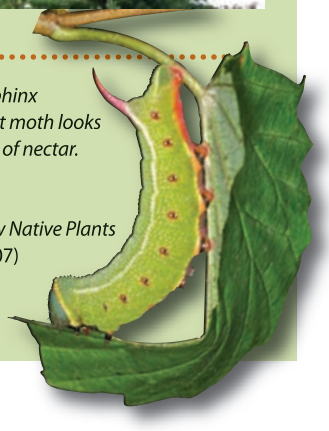
Family: Ulmaceae
Genus: *Ulmus*

Intense breeding programs have produced disease-resistant American elms. A few caterpillars eat nothing else and look like its leaves.

10 PINE

Family: Pinaceae
Genus: *Pinus*

Despite their resins and terpenes, pine needles are a favorite food of 203 species of butterflies/moths in eastern forests.



This hornworm is the larva of the hummingbird sphinx moth. The "horn" near its tail is harmless. The adult moth looks like a hummingbird and feeds on flowers with lots of nectar.

From Doug Tallamy's *Bringing Nature Home: How Native Plants Sustain Wildlife in Our Gardens* (Timber Press, 2007)

KATHY F. ATKINSON

UD entomologist Judy Hough-Goldstein with her nemesis, mile-a-minute weed *(Persicaria perfoliata)*, and below, the tiny weevil that's curbing it.

Can a weevil put the brakes on a speeding weed?

Like Burma Shave advertisements, a series of signs along the Pennsylvania Turnpike once read: "You can go, A mile a minute, But there is, No future in it."

At the University of Delaware, entomologist Judy Hough-Goldstein is working to slow down a different speeder: mile-a-minute weed.

Although this prickly vine with triangular leaves and iridescent blue berries doesn't grow as fast as its name implies, it can branch out a good 20 feet a season in the Mid-Atlantic region, the professor of entomology says. And the weed is rapidly invading new territory.

Since arriving in the 1930s at a nursery in Stewartstown, Pa., mixed in with holly seeds from Japan, mile-a-minute weed has spread to 10 states and the District of Columbia.

Also known as "Asiatic tear-thumb" due to its sharp spines, this weed plagues forests and meadows, parks, orchards, roadsides and rights of way, climbing over everything in its path. Seedlings, shrubs and trees are completely enshrouded, rising up like topiary stalagmites from a field of green. The weed blocks sunlight from reaching the vegetation, weakening and in some cases killing it.

However, a natural nemesis — the Asiatic weevil *Rhinoncomimus latipes* — is now coming on the scene, after extensive testing by Hough-Goldstein and her students. The weevils were introduced in Delaware in 2004 as part of a biological control program.

The research began in 1999 when the U.S. Department of Agriculture (USDA) Forest Service contacted Hough-Goldstein to see if she would be interested in doing the tests to determine if the Asiatic weevil is host-specific to mile-a-minute weed in the United States, just as it is in China. She became the first researcher in the world to test and obtain a permit to release the weevil as a control agent for the weed. Today, her lab is still the only one in the United States — and one of only a handful in the world — attempting to control the invasive plant through biological means.

She notes that Ding Jianqing, a collaborator at Wuhan Botanical Gardens in China, has been critical to the study, as well as the USDA Beneficial Insect Research Laboratory and its quarantine facilities near her lab at the College of Agriculture and Natural Resources.

"If the weevil switches hosts, it's likely to be a close relative. So our mission was to expose the weevil to various plants over several weeks and see what happened," she says.

Although some insects are generalists that feed on multiple species of plants, most insects are specialists, linked by evolution to only one or two host species.

"Plants can produce hundreds of toxic chemicals, so the insects that depend on these plants need to be very in tune with them to be able to thrive," she says.

A telling clue is where an insect lays its eggs. The researchers found that these weevils, only as large as half a grain of rice, lay eggs on mile-a-minute weed, but not on other plants. The larval stage of the weevils feed inside the stems, while the adults bore holes in the leaves.

Although the weevil will never eradicate mile-a-minute weed, the long-snouted insect can definitely curb it. At a test site on Pea Patch Island in Delaware Bay, location of a Civil War prison and one of the East Coast's largest heron rookeries, the weevil has reduced the infestation by half in only two years.

Yet other members of the ecosystem are aiding the weed's spread. Deer and birds eat the tart berries and disperse the seeds.

Resource managers in Massachusetts contacted Hough-Goldstein about using the weevil to put the brakes on a growing infestation in an area with rare and endangered plants.

Although scientific models have shown that the Asiatic weevil will have naturally expanded its range to New England in 30 years, resource managers there won't have to wait that long. The New Jersey Department of Agriculture is rearing the weevils and recently sent some to Massachusetts for the first time.

The unsung heroes in the research are her graduate students, Hough-Goldstein says. Over the past decade, they've grown hundreds of plants in the greenhouse and insects in the lab, conducted multiple tests in the lab and field, documented the extent of the weevils' stem boring and defoliation, and helped to report the results to scientists and the public.

"This work is really a credit to them," she says of the high-stakes effort.

"Mile-a-minute weed could infest a high percentage of the United States and Canada," she notes. "Although this is not a silver bullet, the signs are positive that this weevil will help put infested areas back into ecological balance." — *Tracey Bryant*

First Person

Tricia Wachtendorf is an associate professor of sociology and the associate director for the Disaster Research Center (DRC), the first center in the world focused on the social science aspects of disaster. She writes about the center's quick-response work, in which faculty and students are sometimes among the first researchers in the field after a disaster. DRC was founded at the Ohio State University in 1963 and moved to the University of Delaware in 1985.

On September 11, 2001, I gathered with colleagues in a media room at UD watching the terrorist attacks unfold. We deployed to New York City two days later.

On December 26th, 2004, I was vacationing in Hawaii consulting by email with researchers about the Indian Ocean tsunami. We deployed to India and Sri Lanka in less than one month.

On January 12, 2010, I was at home scouring the Internet, looking for news about Haiti earthquake relief provisions. We deployed the first of several teams one week later.

We may be at work, on vacation, or at home, but for researchers who study disaster events, the initial hours are critical.

Much transpires in the first hours, days, weeks, and months after a disaster. As disaster researchers, we try to record those activities before information is lost. Responders sometimes fail to document what they do as they turn their attention to urgent tasks. Helpers move on. The environment changes, and memories fade under stressful circumstances. The sooner disaster researchers can get on the ground and begin documenting response activities, the better chance we have to learn about what went right and what could be improved.

Often that means mobilizing to the impact zone. After the Haiti earthquake, Susan Brink, a DRC and civil engineering graduate student, was the first of us to arrive in Port au Prince. But Haiti was hard-hit, and it took several weeks for her to get there. Our interests, however, include other areas associated with the response.

On January 20, 2010, I deployed to Florida. From there, I documented the work at donation warehouses, observed earthquake victims arriving at Orlando International Airport and sat in on a planning meeting for the Haiti Earthquake Relief Task force where many attendees were part of the Haitian diaspora.

Tricia Wachtendorf outside a faith-based donation depot in Miami.

At the same time, Jenniffer Santos-Hernandez, doctoral candidate in sociology, traveled to the Dominican Republic to document its role as a gateway for relief efforts.

Some of this early groundwork set the stage for subsequent DRC trips to Haiti, Dominican Republic and Florida. It was on these trips that civil engineering professor Rachel Davidson found that confusion about land-title rights is a significant impediment in recovery; Manuel Torres, a recent doctoral graduate in sociology, noted the importance of existing relationships between organizations helping victims coming to the U.S.; and Lucia Velotti, a doctoral student in public policy, observed that food distribution efforts were focused on temporary camps and often ignored the needs of those outside the camps.

DRC bases its decisions to deploy on whether or not we feel we are well suited for the research. Are we conducting other research in the area? Does our center do research on themes emerging as significant in the particular event? Do we have relationships that will facilitate entrée in the area? Sometimes it comes down to studying what appears to be a watershed event, like the Haiti earthquake. While faculty members secure funding, obtain approvals for human subjects research, and seek out contacts in the area, the students at DRC often do much of the logistics work. From gathering developing news, to finding accommodations and putting together supplies, the students take a very hands-on role. Our resource coordina-

$1.1 billion has been collected in the U.S. for Haitian relief efforts among 23 charities.

A hospital at the border between Haiti and the Dominican Republic receives earthquake survivors.

We may be at work, on vacation, or at home, but for researchers who study disaster events, the initial hours are critical.

tor gathers literature related to the event. Our administrative staff sets in place mechanisms for us to travel on a moment's notice. Teamwork is essential to prepare and position researchers in the field quickly.

This research has had visible impacts. For example, what we learned from our recent reconnaissance research following the Indian Ocean tsunami and the 2008 China earthquake is already included in training material distributed by the Federal Emergency Management Agency (FEMA).

DRC researchers also are called upon dozens of times each year to disseminate our findings directly to national and international emergency response organizations. During our observations in New York City after 9/11, I was pleasantly surprised to hear a key decision-maker note the work of a former DRC graduate in his description of emergent organizations he was encountering during the disaster response.

Our work is as much about learning from disasters as it is about teaching the next generation of disaster researchers. The graduate students who led DRC quick-response trips in the 1960s and 70s went on to direct other top disaster research centers and head up major programs that fund disaster studies. More recently, our graduates have become the young leaders of the research field and have also taken positions in such organizations as FEMA. Findings from these reconnaissance trips make their way into UD classrooms, sometimes the same semester in which the disaster occurred.

Advance theory, train the next generation of researchers and bring new knowledge into the classroom. Underlying all the collaborative work, however, is an attempt to make a real difference. Sure, disasters are "social occasions" to study behavior, but they are foremost occasions to learn and help ameliorate their impacts in the future. When we can take knowledge gleaned in the immediate aftermath and talk to practitioners, policy makers or even to the public through a radio interview about its implications, we use that opportunity to be first in the field to strive to help make communities more disaster resilient.

Haiti Earthquake

On Jan. 12, 2010, a catastrophic 7.0 magnitude earthquake struck Haiti. The epicenter was near the town of Léogâne, 16 miles west of Port-au-Prince, the Caribbean nation's capital. As this issue goes to press, only 2% of the rubble from the quake has been cleared.

2010 Year in Review

[FACULTY HONORS]

University of Delaware scholars have won recognition at home and abroad during the past year. UD's distinguished faculty includes Guggenheim Fellows, Fulbright Fellows, and members of the National Academy of Sciences, National Academy of Engineering, and Nobel Prize-winning Intergovernmental Panel on Climate Change, to name only a few. Here is a selection of honors from the past year.

Kirchman receives UD's highest faculty honor

David Kirchman

David Kirchman, Maxwell P. and Mildred H. Harrington Professor of Marine Biosciences in the College of Earth, Ocean and Environment, won the 2010 Francis Alison Award, the University's highest faculty honor.

Established by the Board of Trustees in 1978, the award is given to a faculty member who has made notable contributions in his or her field of study and who best characterizes the "scholar-schoolmaster," as exemplified by the Rev. Dr. Francis Alison, who in 1743 founded the institution that is now the University of Delaware. The honor includes a $10,000 prize and membership in the Alison Society.

On the UD faculty since 1986, Kirchman developed the method that scientists use to measure the rates at which bacteria grow in the ocean. His research has taken him from Delaware Bay to the waters of the Arctic and Antarctic. In 2008, he was elected a Fellow of the American Academy of Microbiology, the honorific leadership group within the American Society of Microbiology, the world's oldest and largest life-science organization.

Golinkoff wins lifetime achievement award in developmental psychology

Roberta Golinkoff

Roberta Golinkoff, H. Rodney Sharp Professor in UD's School of Education, said it was a moment of shock when she found out she was the 2011 recipient of the American Psychological Association's Urie Bronfenbrenner Award, which recognizes a lifetime contribution to developmental psychology in the service of science and society. As a co-founder of the Head Start Program, Bronfenbrenner was tireless in his work to support children and families.

"I was speechless," said Golinkoff. "I was his teaching assistant in graduate school at Cornell University. Now I have the award that bears his name."

Golinkoff and collaborator Kathy Hirsh-Pasek, a professor at Temple University, were both recipients of the award. The two have worked together for 30 years on studies of preschool children, including how kids learn language and the importance of play and playful learning in children's lives.

Signorielli honored for research on broadcast media

Nancy Signorielli

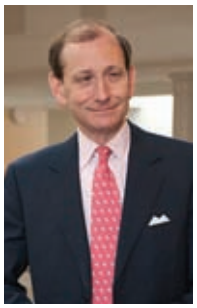
Nancy Signorielli, professor of communication and director of UD's master's program in communication, received the 2010 Broadcast Education Association (BEA) Distinguished Scholar Award for significant contributions to research and scholarship involving broadcast and electronic media.

BEA is the professional association for professors, industry professionals and graduate students who are interested in teaching and research related to electronic media and multimedia enterprises. There are currently more than 1,500 individual and institutional members.

Signorielli has conducted research on images in the media and how they are related to people's conceptions of social reality (cultivation analysis) for the past 40 years. An original member of the Cultural Indicators Research Team at the University of Pennsylvania's Annenburg School for Communication, she published one of the first (and frequently cited) studies of characterizations on television. Current work includes examining portrayals of aging, sex roles, occupations, minorities and violence on prime-time network television and children's programs.

She has written or edited seven books, including *Violence in the Media: A Reference Handbook* (ABC-CLIO, 2005), published more than 90 journal articles and book chapters, made over 150 presentations at invitational conferences, and testified before Congress on television violence and its impact on children.

Elson leads blue-ribbon panel in corporate governance study



Charles Elson

Charles Elson, Edgar S. Woolard Jr. Chair and director of the John L. Weinberg Center for Corporate Governance in the Lerner College of Business and Economics, is leading a nonpartisan expert group to study the roles of boards of directors in corporate governance and generate a report containing findings and recommendations on board practices.

The study is funded by a grant from the Rockefeller Foundation, which was co-awarded to the University of Delaware and to the Columbia University Graduate School of Business, whose efforts were led by Glenn Hubbard, dean and Russell L. Carson Professor of Finance and Economics and former chairman of the White House Council of Economic Advisers.

The group, co-chaired by Elson and Hubbard, was put together with Frank Zarb, former chairman and CEO of Smith Barney, NASDAQ and "Energy Czar" in the Ford Administration. The blue-ribbon panel includes Paul O'Neill, senior adviser and consultant to The Blackstone Group and former secretary of the U.S. Treasury; William T. Allen, director of New York University's Pollack Center for Law and Business and former chancellor of the Delaware Court of Chancery; Damon Silvers, associate general counsel and head of corporate governance for the AFL-CIO; David Becker, Securities and Exchange Commission (SEC) general counsel; and former SEC chairman Arthur Levitt.

Fulbright winners forging global ties

Six UD faculty won awards in the Fulbright Program, the flagship international educational exchange program sponsored by the U.S. government, designed to "increase mutual understanding between the people of the United States and the people of other countries."

GONZALO ARCE, Charles Black Evans Professor of Electrical and Computer Engineering, is the first recipient of the Fulbright-Nokia Distinguished Chair in Information and Communications Technologies, funded by the Nokia Foundation and the Finnish Fulbright Commission. He is working with Helsinki University of Technology and Nokia Research Center on compressive sensing. This technology recovers signals and images from far fewer data than traditional methods and has potential impacts in medical imaging to consumer electronics.

AJAY MANRAI, professor of marketing and faculty director of graduate and executive programs in the Lerner College of Business and Economics, won a Fulbright-Nehru Research Scholar Award for research in India in spring 2011. Hosted by the Indian Institute of Management in Hyderabad and the Anand Group of Companies in New Delhi, he will conduct research on the similarities and differences in the marketing strategies of Indian companies, and multinational companies with origins in both the U.S. and abroad.

BETH MORLING, associate professor of psychology, is researching social support on her Fulbright at Kyoto University in Japan. She and Yukiko Uchida of the Kokoro Research Center are studying a phenomenon observed by other scholars, that in East Asian cultural contexts, people are more reluctant to ask friends or family for help when under stress because they don't want to burden others with the obligation. However, in European-American contexts, people tend to feel more comfortable, perhaps because they think others are free to help or not, by individual choice.

JEAN PFAELZER, professor of English with appointments in the Women's Studies and East Asian programs, has been awarded a Senior Fulbright in Holland for spring 2011. Hosted by the American studies program at the University of Utrecht, she will teach seminars on Asian American culture and 19th-century women authors. She also will use Dutch archives, from diaries to court and maritime records, to complete her research on *Muted Mutinies,* a study of slave rebellions on ships transporting kidnapped "coolies" from China to work on Caribbean sugar plantations.

DAVID PONG, professor of history, received a 2009–2010 Fulbright Scholar grant to lecture at the Chinese University of Hong Kong and to serve as a consultant for the reform of Hong Kong's higher education system. He worked part-time with the Hong Kong General Education Initiative, which consists of six other academic members and university administrators from the United States. The group, known as "Team Fulbright," is studying general education issues, especially the transition of the region's seven universities from three-year colleges to four-year colleges in 2012.

SUSAN STRASSER, Richards Professor of History, won a Fulbright appointment as a senior lecturer in history at the Free University of Berlin for spring 2011. She will join the Free University's John F. Kennedy Institute for North American Studies, where she will teach graduate and undergraduate courses in American consumer culture and in global and American environmental history, her specialties. She will also deliver talks to academic and public audiences on subjects drawn from her new book project, *A Historical Herbal: Household Medicine in a Developing Consumer Culture.*

Binder-Macleod receives national physical therapy award

Stuart Binder-Macleod

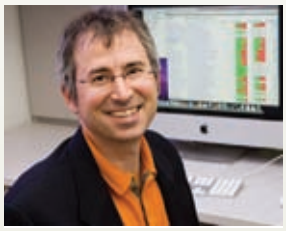
Stuart Binder-Macleod, Edward L. Ratledge Professor and chairperson of UD's Department of Physical Therapy, received the 2010 John H. P. Maley Award for Outstanding Contributions to Leadership in Research by the American Physical Therapy Association (APTA).

The selection marked the second year in a row that a UD physical therapy faculty member has received the award. Lynn Snyder-Mackler, Alumni Distinguished Professor of Physical Therapy, won the award last year, making UD the first university to have two recipients.

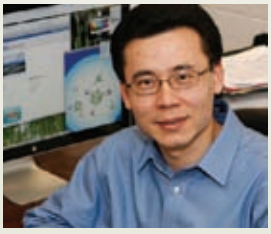
Binder-Macleod is internationally known for his research on muscle physiology and electrical stimulation. He and his colleagues in physical therapy and mechanical engineering developed an innovative technique to help people who have had strokes improve their walking. Known as FastFES, the treatment combines two interventions: treadmill walking at precise speeds designed to maximize walking efficiency, and functional electrical stimulation (FES) of leg muscles during treadmill walking to strengthen weak muscles and improve gait mechanics.

Three win National Science Foundation Early Career Awards

John Cavazos



Stephen Siegel



Zhihao Zhuang

Assistant professors John Cavazos and Stephen F. Siegel, both in the Department of Computer and Information Sciences, and Zhihao Zhuang in the Department of Chemistry and Biochemistry are winners of the National Science Foundation's Faculty Early Career Development Award. The prestigious award supports faculty early in their careers who exemplify the role of teacher-scholars.

Cavazos is using his $416,709 grant to develop adaptive compilers for multi-core computer environments, freeing software developers from laborious hand-tuning of compilers and helping machines make fuller use of their performance capabilities. Compilers translate applications written by developers into the code that executes on the computer, and they transform, or optimize, applications so they run more efficiently.

Siegel's $412,000 grant is for researching the accuracy of scientific software.

"We know that most software is very 'buggy,' and the software written and used by scientists is no different in that regard," Siegel says. "Defective software can lead to inaccurate results, invalid conclusions, and in the worst case, loss of life."

Zhuang's five-year, $783,000 award supports an integrated research and outreach program focusing on the development of new chemical methods that efficiently bond ubiquitin, the so-called "kiss of death" protein, to proliferating cell nuclear antigen (PCNA), a key protein in DNA replication and repair. He is exploring at the molecular level how cells bypass damaged DNA in a process called translesion synthesis.

Year in Review [STUDENT HONORS]

Nearly 3,500 graduate students and more than 700 undergraduates are engaged in research and creative projects at the University of Delaware. Highlighted here are national and international award winners selected from dozens across UD during the past year. We salute their excellence!

UD's Yamada awarded Japan's top academic award for Ph.D. graduates

Masahiro Yamada

Masahiro (Masa) Yamada, a doctoral candidate in linguistics and cognitive science at the University of Delaware, has been awarded a three-year, postdoctoral fellowship from the Japan Society for the Promotion of Science (JSPS).

The fellowship is Japan's most prestigious academic award for Ph.D. graduates, providing a generous stipend, as well as funding for incidental expenses such as research trips. Half of the fellowship period may be spent anywhere in the world the recipient wishes to conduct research.

Yamada has been working on natural language expressions of reciprocity. For example, in English, the sentence "Romeo and Juliet love each other," contains a reciprocal situation: Romeo loves her, and Juliet loves him. Among the world's languages this seemingly innocuous aspect of grammar has turned out to be enormously complex — a hybrid notion of many semantic aspects, such as plurality, event semantics, verb aspects, and pragmatic reasoning, Yamada notes.

He is the second student from UD's Department of Linguistics and Cognitive Science to win the JSPS fellowship. Yurie Hara, a 2006 doctoral graduate, landed a tenure-track position at the City University of Hong Kong after her fellowship.

Melissa Institute scholarship supports research on bullying

Lydia Romano Barhight, a doctoral student in psychology, has received the 2010 Belfer-Aptman Scholars Award from The Melissa Institute for Violence Prevention and Treatment, based in Miami.

The award, which includes a $2,000 grant to defray the costs of research, is designed to further scientific knowledge in the field of violence prevention.

Barhight's dissertation topic is "Children's Psychological and Emotional Reactions to Witnessing Bullying."

Art history students garner top dissertation fellowships

Seven graduate students in art history have won fellowships supporting their doctoral research focusing on American art.

A highly competitive fellowship from the National Gallery of Art's Center for Advanced Study in the Visual Arts will enable Sarah Beetham to travel to Italy to study classical Roman art and architecture in preparation for her dissertation on 19th-century American sculpture.

Melody Deusner, most recently a fellow at the Metropolitan Museum of Art, won a three-year postdoctoral fellowship at Northwestern University through the Terra Foundation for American Art. She is interested in the Aesthetic Movement, and the collectors who gave their works of art to museums.

Catherine Holochwost and Kerry Roeder received Henry Luce Foundation/American Council of Learned Societies Dissertation Fellowships. Holochwost is exploring constructions of vision and multisensory effects of landscape representation in 19th-century America, and Roeder is studying American comic strip artist Winsor McCay, who created such comics as "Little Nemo in Slumberland."

Nenette Luarca-Shoaf, whose dissertation is titled "The Mississippi River in Antebellum Visual Culture and Imagination," holds the 2010–11 Barra Foundation Fellowship at the Philadelphia Museum of Art. Her research focuses on ways in which maps, prints, and other widely available images constructed cultural ideas about this region of U.S. national expansion between the 1830s and the Civil War.

Catherine Walsh won the Jane and Morgan Whitney Fellowship at the Metropolitan Museum of Art. Her dissertation, "'Tell Me a Story': Narrative and Orality in Nineteenth-Century American Visual Culture," examines the relationships between the spoken or written story and the painted or printed image, exploring how images 'told' stories, and readers and viewers created stories from details in pictures.

Mary "Katie" Wood won a Patricia and Phillip Frost predoctoral fellowship at the Smithsonian American Art Museum. Her dissertation examines Benjamin West's sculptural pediment at London's Royal Naval Hospital dedicated to the memory of Admiral Horatio Nelson, which Wood describes as "a significant object that lies at the nexus of many critical political, cultural and economic impulses circa 1812."

Health science student receives award of promise

Shannon Whalen (left) and Lauren Van His (right)

Shannon Whalen, who completed her bachelor of science degree in health and physical education at UD, received the Student Recognition Award from the Adapted Physical Activity Council.

Recipients are selected on the basis of showing exceptional promise as leaders, providing exceptional service to individuals with disabilities, and/or providing an inspiration to others in the field of physical education, therapeutic recreation, or related areas such as aquatics or dance.

Whalen collaborated with senior Lauren Van Hise on a service learning project to increase fitness levels in children with Asperger syndrome. Whalen began working at Perryville and Bainbridge elementary schools in Maryland in February.

Six NSF fellowship winners pursuing graduate studies

Six UD students have won highly competitive National Science Foundation Graduate Research Fellowships, which support three years of advanced study, including tuition, a stipend and an allowance for international travel.

Nicholas Brubaker, a doctoral student in mathematics, is studying mathematical models that are motivated by micro- and nano-electromechanical systems.

Scott Crown, a doctoral student in chemical engineering, is working to understand lipid biosynthesis at the metabolic level, which would allow scientists and engineers to identify drug targets and develop novel therapeutics for individuals with type II diabetes.

Autumn Kidwell, a master's student in engineering in UD's Center for Applied Coastal Research, is studying the horizontal pressure gradients throughout the swash zone — the area where waves wash up and down the beach face. The results will enable improved predictions of erosion caused by storms and climate change.

Vassili Vorotnikov, doctoral student in chemical engineering, is studying multiscale modeling of catalyst nanoparticles applied to specific reaction networks. He's particularly interested in ammonia decomposition as a potential source of hydrogen in fuel cells.

Recent UD graduates Marco Bedolla and Karin Twardosz Burghardt also won fellowships. Bedolla, who holds a bachelor's degree in chemical engineering from UD, entered the doctoral program in chemical engineering at the University of Wisconsin in fall 2010.

Burghardt, who earned her bachelor's degree in wildlife conservation, is attending Yale University to pursue a doctorate in ecology. Both students were in UD's Honors Program.

Marine policy students embark on capital experience

Amardeep Dhanju and Caitlin Snyder, graduate students in marine policy, are among 46 students from across the U.S. who are working in Washington, D.C., as Dean John A. Knauss Fellows.

Amardeep Dhanju

Caitlin Snyder

The National Sea Grant College Program in the National Oceanic and Atmospheric Administration sponsors the fellowships, which the students began in February 2010.

The program matches graduate students with host agencies in the legislative and executive branches of the federal government for year-long paid assignments.

Dhanju is assisting with marine spatial planning at the Minerals Management Service, which manages the nation's natural gas, oil, wind and other resources on the outer continental shelf. He is mapping areas suited for offshore wind energy, drawing on his UD experience.

As a liaison between the Congressional Affairs Office of the U.S. Fish and Wildlife Service and Congress, Snyder's duties include preparing Fish and Wildlife officers for congressional testimony and keeping both entities up to date on each other's activities, and on ocean issues such as coral reef protection to sea otter recovery.

Brilliance of chemistry-biochemistry students recognized globally

"Crystallography is a powerful tool that allows us to rationalize, predict and engineer certain physical properties of a given material," says Bayrammurad Saparov.

Saparov, a doctoral student in UD's Department of Chemistry and Biochemistry, won the prestigious 2010 Ludo Frevel Crystallography Scholarship Award from the International Centre for Diffraction Data. Named in honor of the founder of the scholarship fund, the award is given annually to aspiring crystallographers.

Juan Carlos Rodriguez-Reyes, also a doctoral student in chemistry and biochemistry, received the Dorothy M. and Earl S. Hoffman Award at the 56th International Symposium and Exhibition of the American Vacuum Society in San Jose in November 2009. The award is the top honor given by the society to a graduate student.

Rodriguez-Reyes is studying surface chemistry in both aqueous and ultra-high vacuum conditions for application in microelectronics, heterogeneous catalysis and other fields of surface science.

Four UD students win prestigious Goldwater scholarships

All four of the University of Delaware's nominees were selected to receive prestigious Goldwater scholarships for the 2010–2011 academic year. The scholarship program, honoring the late U.S. Sen. Barry M. Goldwater of Arizona, encourages outstanding students to pursue careers in mathematics, the natural sciences and engineering. It covers the cost of tuition, fees, books, and room and board up to $7,500 per year.

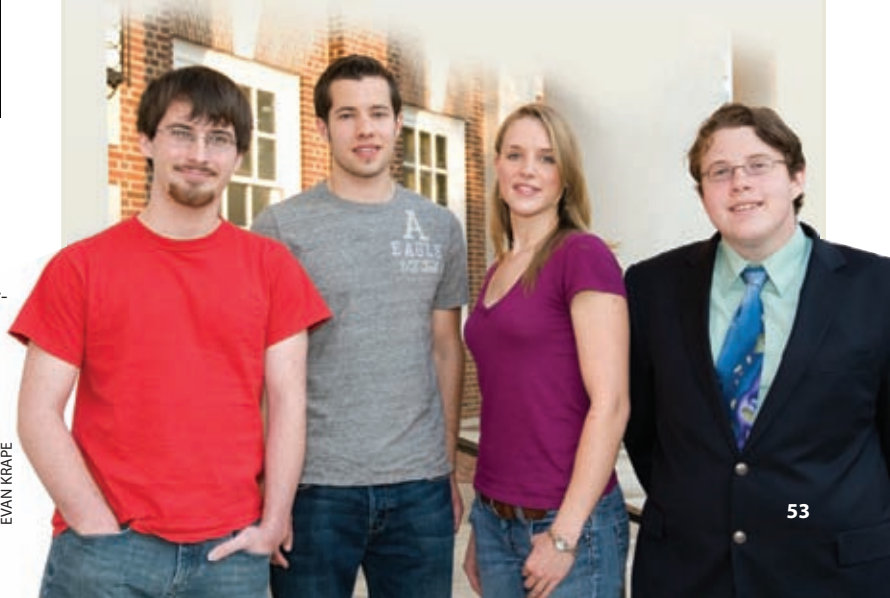
Amanda Lee Welch, a junior animal science major, is studying ulceration in the bovine claw through the Undergraduate Research Program. She plans to attend a research-based veterinary school to pursue a combined doctor of veterinary medicine (DVM) and Ph.D. degree to explore disease etiology for biomedical applications.

Michael G. Napolitano, a senior biochemistry major and Honors Program student, has been conducting research on the evolution and emergence of pathogenic bacteria. He has his sights set on graduate school in biology and biochemistry, with a focus on evolutionary biology.

After graduating from UD, Patrick Robert Devlin, a senior mathematical sciences major and Honors Program student, plans to pursue a doctorate in mathematics and become a professor.

Mark Clayton Weidman, a senior chemical engineering major and Honors Program student, will continue his research on fuel cell catalysis during his senior year. Then he wants to attend graduate school to earn his doctorate in alternative energy technology. He hopes to eventually lead a research group in industry or academia to "find effective, abundant and reliable catalysts for fuel cell technologies."

From left, Goldwater Scholars Patrick Robert Devlin, Mark Clayton Weidman, Amanda Lee Welch and Michael Napolitano.



EVAN KRAPE

Year in Review [UNIVERSITY BOOKS]

A selection of books by UD authors and their publishing honors.

Ray's book wins national honor

Meredith Ray

Meredith K. Ray, associate professor of Italian in UD's Department of Foreign Languages and Literatures, won the 2009 American Association for Italian Studies Book Prize in the "Medieval, Renaissance and Baroque" category for *Writing Gender in Women's Letter Collections of the Italian Renaissance.*

In the award-winning book, published by the University of Toronto Press, Ray examines the collections of letters of a diverse group of writers, including a noblewoman, a courtesan, an actress, a nun and a male writer who used female pseudonyms.

Valeria Finucci, professor of Italian studies and theater studies at Duke University, said: "Meredith K. Ray makes the case for the importance of the genre of letter writing for women as she shows how difficult it was for intellectual women to adopt a public persona. She also illustrates how popular it was at the time to 'write like a woman,' to the point that even male authors wanted to catch the wave. Brava!"

KATHY F. ATKINSON

Prof connects war, revenue and state building

Sheldon Pollack

In *War, Revenue, and State-Building: Financing the Development of the American State* (Cornell University Press), Sheldon Pollack, professor and director of the Legal Studies Program at UD, reveals how war has been a major catalyst for "revenue extraction." It all began with the American Revolution, and the taxes on whiskey and tobacco, land sales and tariffs that paid off war debt.

Then the Civil War brought the first income tax (5% on incomes above $600 per year, graduated up to 10% for incomes over $10,000). Although that tax expired in 1872, an amendment to the U.S. Constitution in 1913 permitted an income tax. Up to $3,000 in income for single individuals was exempted, and the tax rate on up to $20,000 was only one percent. Because the exemption was so high, only 2% of households paid income tax the first few years.

That changed dramatically with World War II and the escalation in federal expenditures from $9.6 billion in 1940 to $95 billion in 1945. Today, the Internal Revenue Service raises $2.5 trillion a year.

Higher-ed planning and assessment focus of book

Michael Middaugh

Michael Middaugh, associate provost for institutional effectiveness at UD, said he wrote *Planning and Assessment in Higher Education: Demonstrating Institutional Effectiveness* (Jossey-Bass) because he saw a need for a book that spelled out how schools could plan, achieve and substantiate institutional effectiveness in today's educational world.

"It is essentially a road map for educators," Middaugh said.

Noted John Cavanaugh, chancellor of the Pennsylvania State System of Higher Education: "Only Michael Middaugh, the unquestioned national leader in this field, could write such a lucid overview of how to make institutional assessment and planning really work as a tool rather than as a tedious requirement."

Middaugh cites UD extensively in the book as an example of the self-assessment process and institutional effectiveness. The Delaware Study of Instructional Costs and Productivity, which he developed, is widely acknowledged to be the best data collection tool for measuring productivity, instructional costs and externally funded scholarship, with close to 600 four-year colleges and universities participating.

Three history-making women come to life in *Moses and the Monster and Miss Anne*

Carole C. Marks

In *Moses and the Monster and MIss Anne* (University of Illinois Press), UD sociology professor Carole C. Marks brings to life three history-making women from antebellum Maryland.

"Moses" refers to Harriet Tubman, hailed as "the Moses of her people," who led slaves to freedom on the Underground Railroad and later was a women's suffragist.

The "Monster" is Patty Cannon, thief, murderer and leader of a gang who kidnapped free blacks and sold them back into slavery.

"Miss Anne" refers to Anna Ella Caroll, an unmarried slaveholder who exerted her influence on legislators to keep Maryland in the Union when others were clamoring for it to join the Confederacy.

All three women lived for a time on Maryland's Eastern Shore. Although they never met, their lives intertwined over the intersecting and conflicting forces of race, economics and gender that threatened to tear a nation apart.

Yagoda pens *Memoir: A History*

Ben Yagoda

For a literary genre that traces its origins to Julius Caesar, the memoir is still going strong, and Ben Yagoda, professor of English at UD, has some ideas why.

In *Memoir: A History* (Riverhead Books), Yagoda offers both a survey of the genre's most illustrious works, including the 5th-century classic, *Confessions of Saint Augustine,* while fast-forwarding to look at contemporary bestsellers such as *Going Rogue*, by former Alaska governor and vice presidential candidate Sarah Palin.

Besides screening the good, the bad and the ugly of the genre, Yagoda examines the underlying reasons for America's enduring fascination with the memoir. He also addresses controversial issues such as honesty, accuracy, privacy and trust in memoir writing today.

Although previously the domain of the most eminent individuals in politics, science or business, these days almost anyone can write and publish a memoir, Yagoda says.

"I think there is a connection between the popularity of reality shows, and talk shows, like 'Oprah,'" he notes. "There seems to be more of a hunger for something true or real, in a basic sense. The Internet also has made self-publishing a book pretty easy and not all that expensive."

Stalin's social order repression highlighted in new book


David Shearer

Policing Stalin's Socialism: Repression and Social Order in the Soviet Union, 1924–1953, written by UD history professor David Shearer and published by the Yale University Press, is one of the first books to emphasize the importance of social order repression by Stalin's Soviet regime in contrast to the traditional emphasis of historians on political repression.

Based on his extensive examination of new archival materials, author David Shearer, UD associate professor of history, finds that most repression during the Stalinist dictatorship of the 1930s was against marginal social groups such as petty criminals, deviant youth, sectarians and the unemployed.

Shearer details informant networks, police registration systems, and widespread police cleansing campaigns and surveillance systems. Despite the combined work of the political and civil police, these efforts to cleanse society failed, setting the stage for the massive purges that decimated the country in the late 1930s.

Book examines impact of globalization on family life


Bahira Trask

The world is experiencing a fundamental global restructuring of social life, says Bahira Sherif Trask, professor and associate chair of the Department of Human Development and Family Studies at UD.

Her newest book, *Globalization and Families: Accelerated Systemic Social Change* (Springer), examines the linkages between globalization and gender identities, work-family relationships, and conceptualizations of children, youth and the elderly.

From a social standpoint, Trask says the biggest issues surrounding globalization deal with poverty and inequality. The crux of the debate is whether globalization leads to more opportunities for people, or increasing inequality. For example, in the West, the growing prevalence of women in the workplace is associated with the empowerment of women, while in other areas of the world, women may not receive the same benefits as men, or they may face risky work conditions.

Trask says globalization also can provide the tools for individuals to mobilize and get their agenda heard worldwide, in order to benefit those who may need help.

Paul R. Jones, African-American art collector celebrated


Margaret Anderson and Neil Thomas

Living Art, The Life of Paul R. Jones, African American Art Collector, chronicles the multifaceted life of the visionary UD benefactor. The book is written by Margaret Andersen, Edward F. and Elizabeth Goodman Rosenberg Professor of Sociology, and Neil F. Thomas II, senior associate director in the Office of Communications and Marketing. It was published in September 2009 by the University of Delaware Press. Jones died four months later, on Jan. 27, 2010, in Atlanta, after a brief illness, but his legacy lives on.

The Paul R. Jones Collection at UD is one of the oldest, largest and most complete holdings of African American art in the world. It includes works by such noted artists as Charles White, Herman "Kofi" Bailey, David Driskell, Elizabeth Catlett, Earl Hooks, Leo Twiggs, Stanley White, Jacob Lawrence, Romare Bearden, P. H. Polk, and Selma Burke, who created the image of Franklin Delano Roosevelt that appears on the dime.

Housed in Mechanical Hall, the collection is used in research and instruction, for special symposia and leadership training, so that students can understand its historical, cultural and artistic significance. Works from the collection have been featured in numerous public exhibitions since Jones made the gift to the University in 2001.

"I knew I could sell the collection at its appreciated price and get myself a chauffeur, a cook, a maid, and travel the world," Jones once said. "But I realized I wanted to do something with my collection that would have a lasting impact, both in my lifetime and beyond."

"Selling Sounds" highlights music industry's origins


David Suisman

David Suisman, associate professor of history, won the 2010 Hagley Prize, awarded for the best new book in business history, for *Selling Sounds: The Commercial Revolution in American Music* (Harvard University Press). The book also was named a Choice "Outstanding Academic Title" of 2009 and is a finalist for an Award for Excellence of the Association of Recorded Sound Collections.

Selling Sounds brings to light the origins of the modern music industry, the publishers and promoters of sheet music in New York City at the turn of the 20th century. Driven by entrepreneurial zeal, they cultivated songwriters and developed formulas for light, catchy hit songs, exploited the new technologies of the phonograph and radio, and turned music into a mass-produced, international commodity.

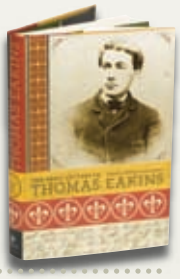
Letters of Thomas Eakins cast new light on renowned artist


William Homer

The Paris Letters of Thomas Eakins (Princeton University Press), edited by William Innes Homer, H. Rodney Sharp Professor Emeritus of Art History, casts new light on the renowned American artist.

The letters present a lively account of Eakins' years in Paris — from his trip across the Atlantic and battles with bedbugs, to his art classes at the Ecole des Beaux-Arts, his rowdy classmates, and his explorations of the city and its art treasures.

"Longtime Eakins biographer William Homer has edited these letters with illuminating insight and contextual information," said John Wilmerding, professor emeritus of American art at Princeton. "Both the artist's own observations and the attendant commentary are likely to be indispensible for all future Eakins publications."



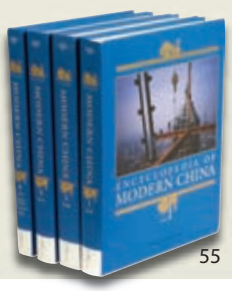
Homer won a Wyeth Foundation for American Art Publication Grant, administered by the College Art Association, to work on the book. It won an award in the scholarly books category at the 2010 Bookbinders' Guild of New York, New York Book Show, which celebrates the fine art of bookmaking.

China focus of book


David Pong

The *Encyclopedia of Modern China,* for which UD history professor David Pong served as editor-in-chief, won honorable mention in the Dartmouth Award competition of the Reference and User Services Association, a division of the American Library Association. The book is one of 11 titles honored as outstanding reference sources for 2010.

Published by Charles Scribner's Sons, a part of Gale, Cengage Learning, the four-volume, illustrated work spans more than 2,000 pages and is available in both print and eBook editions. The 940 entries, written by over 400 scholars around the world, provide information about the people, politics, economics, religion, philosophy, traditions, art and literature of China, from the beginning of the 19th century to the present.



A review in *Booklist* said: "Both authoritative and highly accessible, this encyclopedia is strongly recommended for academic, public and high-school libraries."

Test your Knowledge

Special thanks to Prof. Doug Tallamy for the images!

Who's Who?

Can you match up the larva in the left column with its beautiful adult form in the right column?

KATHY F. ATKINSON

I like maple, wild cherry and birch trees. I turn into North America's largest native moth, with a wingspan up to six inches.

One of my favorite plants is sassafras trees, but that's not all. My eyespots make me look like a snake to scare off predators, but I am harmless.

I develop only on milkweed. When I grow up, you can tell I am a male by the spot behind the center of my wings, where I release pheromones.

I am a master of disguise, sticking pieces of the flowers I'm eating on my back. I become a very lovely moth!

I feed on willows, poplars and cottonwoods. The butterfly I become exhibits Mullerian mimicry, in which two equally toxic species mimic each other for the benefit of each.

MONARCH
Danaus plexippus

CECROPIA
Hyalophora cecropia

VICEROY
Limenitis archippus

SPICEBUSH SWALLOWTAIL
Papilio troilus

WAVY-LINED EMERALD
Synchlora aerata

Check out the answers below!

1 — CECROPIA 2 — SPICEBUSH SWALLOWTAIL 3 — MONARCH

4 — WAVY-LINED EMERALD 5 — VICEROY

Take the challenge!

UNIVERSITY OF DELAWARE
Research
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Colleges

- College of Agriculture and Natural Resources
- College of Arts and Sciences
- Alfred Lerner College of Business and Economics
- College of Earth, Ocean, and Environment
- College of Education and Human Development
- College of Engineering
- College of Health Sciences

Research Centers & Institutes

Agricultural Experimental Station
Applied Science & Engineering Laboratories
Art Conservation Laboratories at Winterthur
Avian Biosciences Center
Bartol Research Institute
Elbert N. and Ann V. Carvel Research & Education Center
Catalysis Center for Energy Innovation
Center for Applied Coastal Research
Center for Applied Demography & Survey Research
Center for Archaeological Research
Center for Bioinformatics & Computational Biology
Center for Biomedical Engineering Research
Center for Carbon-free Power Integration
Center for Catalytic Science & Technology
Center for Climate and Land-Surface Change
Center for Climatic Research
Center for Community Research & Service
Center for Composite Materials
Center for Disabilities Studies
Center for Drug & Alcohol Studies
Center for Economic Education & Entrepreneurship
Center for Energy & Environmental Policy
Center for Environmental Genomics
Center for Fuel Cell Research
Center for Historic Architecture & Design
Center for Information & Communications Sciences
Center for Innovative Bridge Engineering
Center for Managed Ecosystems
Center for Material Culture Studies
Center for Molecular & Engineering Thermodynamics
Center for Neutron Science
Center for Political Communication
Center for Public Horticulture
Center for Remote Sensing
Center for Research Development
Center for Spintronics and Biodetection
Center for the Study of Metals in the Environment
Center for Translational Cancer Research
Christina River Basin Critical Zone Observatory
Computer Architecture & Parallel Systems Lab
Delaware Asteroseismic Research Center
Delaware Biotechnology Institute
Delaware Center for Transportation
Delaware Education Research & Development Center
Delaware Environmental Institute
Delaware Geological Survey
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Delaware Sea Grant College Program
Delaware Space Grant Program
Delaware Water Resources Center
Disaster Research Center
Early Learning Center & Laboratory Preschool
Exelon Trading Center
Halophyte Biotechnology Center
Institute for Global Studies
Institute for Public Administration
Institute for Transforming Undergraduate Education
Institute of Energy Conversion
Institute of Soil and Environmental Quality
Interdisciplinary Humanities Research Center
Gerard J. Mangone Center for Marine Policy
OCEANIC — The Ocean Information Center
Small Business Development Center
University of Delaware Botanic Gardens
University of Delaware Energy Institute
Water Resources Agency
John L. Weinberg Center for Corporate Governance

Dare to be first.
UNIVERSITY OF DELAWARE

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