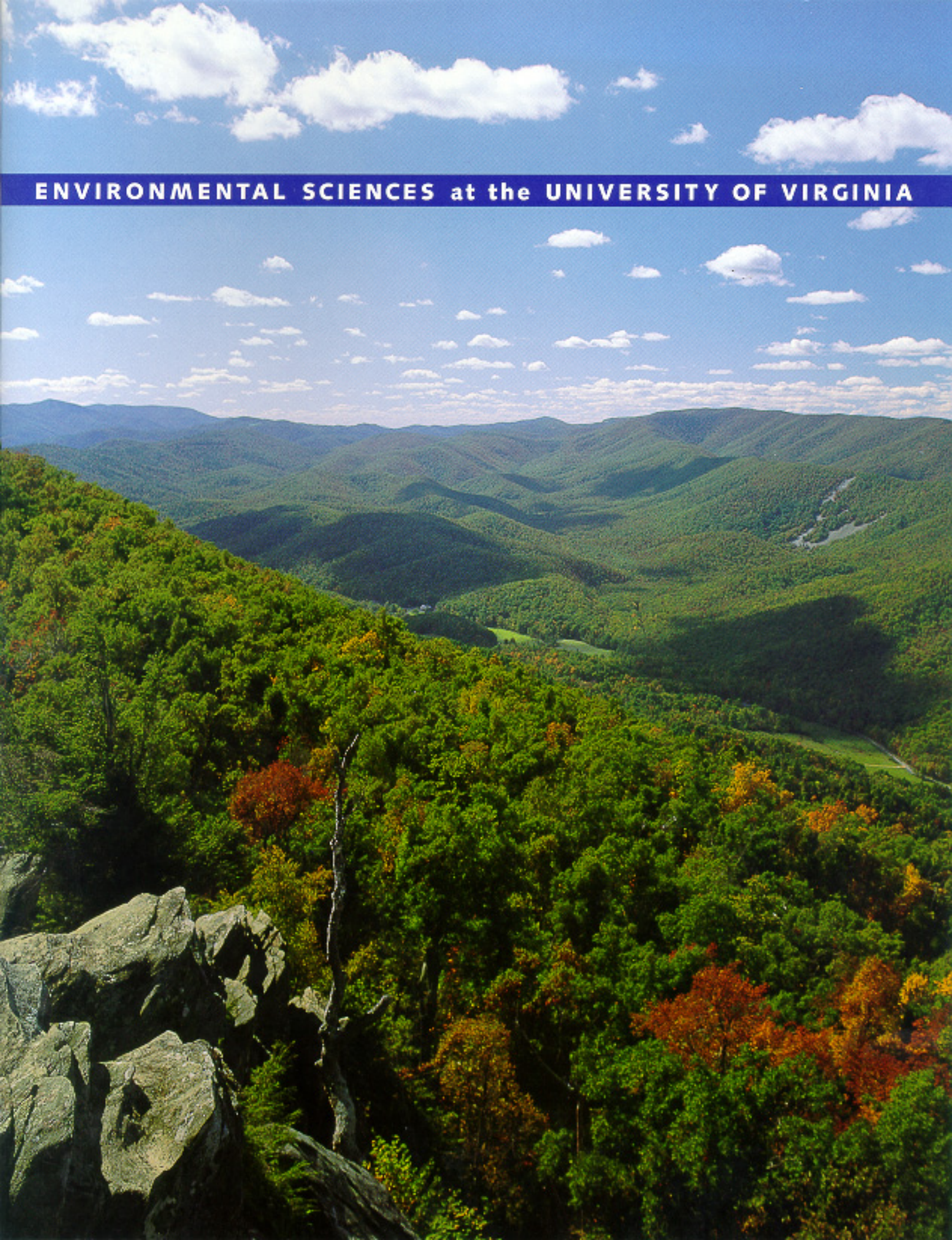
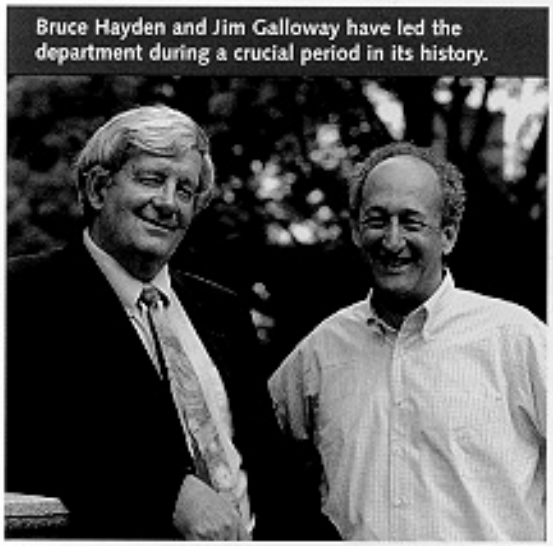

ENVIRONMENTAL SCIENCES at the UNIVERSITY OF VIRGINIA

The chair's letter that introduces this annual report traditionally focuses on the year in question. And certainly this year there were many highlights that we can look to with pride. To name just a few, we have established the groundwork for a series of research and educational exchanges with universities in southern Africa, we have released a definitive study showing continued acidification of streams in the Shenandoah National Park, we celebrated Blandy Farm's 75th year, we have begun work on new facilities at the Anheuser-Busch Coastal Research Center at Oyster, Virginia, and our graduate students organized an exceptional Environ-mental Sciences Research Forum that brought Dr. Charles Groat, director of the U.S. Geological Survey, to Charlottesville.


Bruce Hayden and Jim Galloway have led the department during a crucial period in its history.

These accomplishments are properly seen in the context of a department that is on the move. Over the last few years, we have experienced a resurgence in the number of our undergraduate majors, our class enrollments have increased significantly, and the amount of sponsored research has increased from about $3 million to between $5 and $6 million annually. Our faculty has been enriched and energized by the addition of new members with expertise in grasslands ecology, climatology, hydrology, and geosciences.

We have also taken significant steps to ensure the excellence of this department for years to come. For most of the department's 30-year history, we have sustained innovative research and educational programs despite poor facilities and limited private funding. This has all changed. A new 45,000-square-foot research addition is scheduled to open next summer, and we have received $10 million in state support and $14 million in private support, including $11 million in challenge grants. To date, we have raised $3.2 million toward those challenges! These accomplishments are a great credit to the staff, students, and faculty of the department!

Clearly, the department is well on its way to achieving its goal of becoming the first top-ranked science department at the University. I am, therefore, delighted to use this forum to introduce Bruce Hayden, who became department chair in August. For those faithful readers of previous annual reports and *Insights*, the department newsletter, Bruce is well known. A climatologist and ecologist who joined the department in 1970, Bruce leads the National Science Foundation–funded Long-Term Ecological Research program on Virginia's Eastern Shore. His experience in research, teaching, and administration will ensure that future annual reports will document the department's successes under his able leadership.

In closing, I wish to thank all members of the department, its friends, and its alumni for their past and present support. It is that support that has made environmental sciences what it is today. And it is that continued support that will make the department even better in the future!

Thank you.
—James Galloway

INTERDISCIPLINARY PROGRAMS

The department's reputation for excellence rests, to a large extent, on the interdisciplinary programs sustained by our faculty. By focusing resources for the long term, these research programs help generate knowledge of complex environmental processes that could not be acquired by any other means.

Equally important, these interdisciplinary programs play a vital role in training the next generation of environmental scientists. The first-hand exposure to research our students gain while working with these programs can prove decisive in shaping the course of a career.

■ *Blandy Experimental Farm*

http://www.virginia.edu/%7Eblandy/

The 75th anniversary of the founding of Blandy Experimental Farm in 1926 provides an opportunity to assess the range of research and educational activities that it currently supports. Research at Blandy is flourishing. For instance, Blandy curator Dave Carr, Christopher Ivey of Florida International University, and Micky Eubanks of Auburn University are using a National Science Foundation grant to examine the importance of genetic variation to the ability of plants to defend themselves against herbivores.

Blandy director Michael Bowers leads field program for students.

Blandy has also made a priority of giving undergraduates from colleges and universities throughout the United States first-hand exposure to research activities. Blandy hosts a number of student researchers each summer, a program that will be expanded thanks to a $184,000 award from the National Science Foundation. Undergraduate fellows spend their first two weeks learning about ongoing research at Blandy. With guidance from faculty members, they then conduct independent research in environmental sciences during the remainder of their 11-week residence.

Public outreach is another important element of the Blandy mission. The Foundation of the State Arboretum of Virginia, which covers 170 acres of rare trees and shrubs within Blandy, has attracted a growing number of supporters, who raise funds for Blandy educational projects and who volunteer time and labor. With the assistance of the H. O. Peet Foundation, construction is about to begin on an educational pavilion to support the Arboretum's growing K–12 programs. In spring 2001 alone, an estimated 2,800 children attended a total of 134 presentations given by Blandy's education staff, and a week-long summer camp for children ages 6–8 was inaugurated in August.

■ *Global Environmental Change Program*

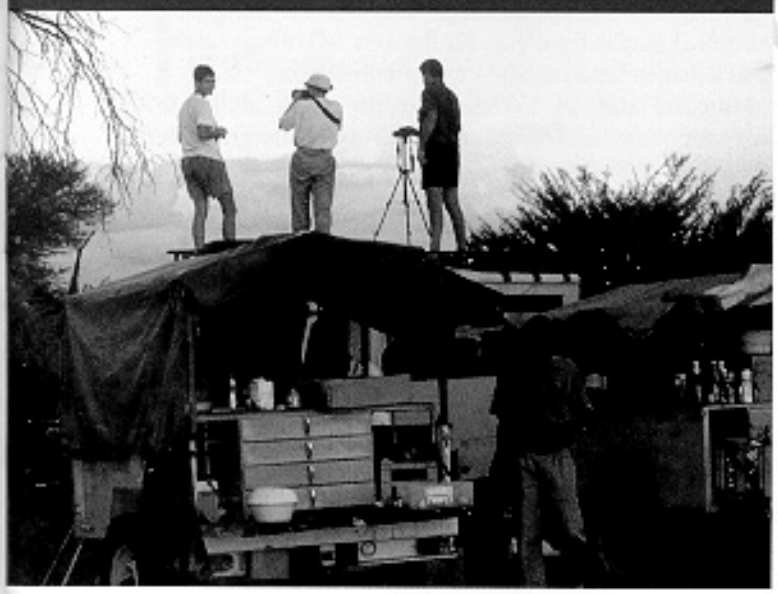
http://www.gecp.virginia.edu

One of the University's strategic goals is to strengthen and expand its international programs. The Department of Environmental Sciences is already playing a leading role in these efforts. Many of our faculty are addressing questions on a global scale or conducting research with implications for better understanding global systems.

But initiatives like the Global Environmental Change Program (GECP) do more than simply use exotic locales as laboratories for scientific research. They are an occasion for the University to engage in true partnerships with researchers from around the world and to apply its mission of service on an international scale.

GECP has been particularly active in southern Africa, with Professor Emeritus Mike Garstang, Research Professor Chris Justice, Research Assistant Professor Paul Desanker, and Professor Hank Shugart all conducting research and building relationships with universities and government agencies in the area. In late summer 2000, Assistant Research Professor Bob Swap was the U.S. scientific coordinator for the Southern African Regional Science Initiative, an ambitious, multinational project designed to produce a clearer understanding of the processes that drive the characteristic atmospheric patterns over the region. Researchers also studied the

Southern African Regional Science Initiative researchers in the field.



chemical and physical processes that affect the transport of gases and aerosols and investigated the ramifications, both locally and in other parts of the world, of the biomass burning that occurs each year in southern Africa.

As an outgrowth of this work, GECP hosted a workshop that brought administrators from five universities and research centers in southern Africa to Charlottesville to develop a comprehensive plan for research collaboration and student/faculty exchange. Formal agreements for collaboration have already been signed with the universities of Witwatersrand and Venda.

One of the first initiatives fostered by these relationships is an undergraduate, interactive distance learning course that professors Steve Macko, Paul Desanker, Bob Swap, and Hank Shugart are developing for the fall. With funding from the University, private donors, and the National Science Foundation, Shugart will teach his course on Africa: The Human and Natural Environment to students from U.Va. as well as from South Africa, Mozambique, and possibly Botswana.

By focusing resources for the long term, these research programs help generate knowledge of complex environmental processes that could not be acquired by any other means.

■ *Program of Interdisciplinary Research in Contaminant Hydrology*

http://atlantic.evsc.Virginia.EDU:80/%7Ealm7d/pirch/

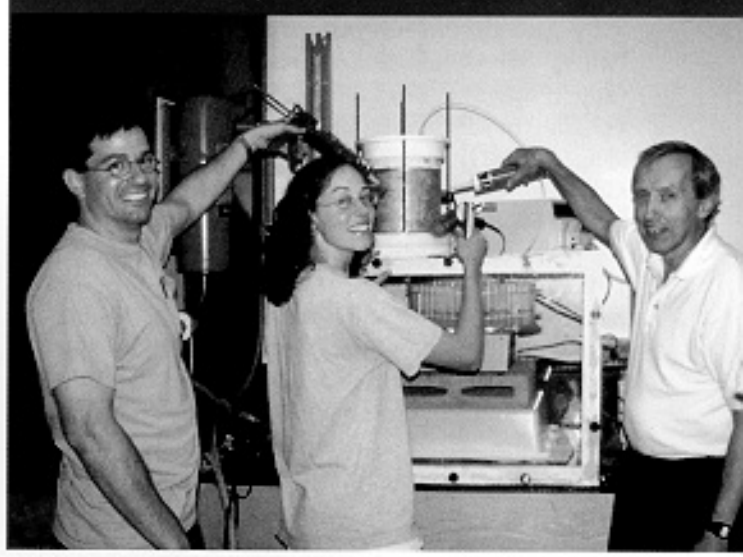
Researchers in the department's Program of Interdisciplinary Research in Contaminant Hydrology (PIRCH) began a series of new research initiatives in 2000–2001. This unique program brings together researchers from the departments of Environmental Sciences, Chemical Engineering, and Civil Engineering to understand how pollutants spread through soil and groundwater.

An area of recent concern is the use of estradial compounds that are added to animal feeds. These hormones ultimately make their way into groundwater, interfering with the reproductive cycles in reptiles and amphibians. With funds from the Virginia Water Research Center, Professor Janet Herman began work on the fate and behavior of these compounds.

PIRCH members Herman, Professor Aaron Mills, Professor George Hornberger, and Associate Professor of Chemical Engineering Roseanne Ford also received a Biocomplexity Incubation Award from the National Science Foundation. They are conducting preliminary studies on the relationship between microbial communities in aquifers and their functions within this ecological niche.

The work being conducted by PIRCH has attracted considerable interest from undergraduates. This year, three winners of the University's Harrison Award for undergraduate research are studying with members of PIRCH.

James Saiers, associate professor at Yale, graduate student Janna Levin, and Professor George Hornberger seal a temperature soil column as part of a National Science Foundation–supported experiment to explore the effects of moisture content and soil-water chemistry on the mobilization of colloids.



Shendandoah National Park's Paine Run in winter, one of the SWAS program's intensively studied streams.

■ *Shenandoah Watershed Study*

http://www.people.Virginia.EDU/%7Eswasftp/

The quality of its science and the longevity of its programs have marked the department's Shenandoah Watershed Study (SWAS) as one of the foremost efforts of its kind in the United States. Its activities this year reflect this standing.

On behalf of the National Park Service, SWAS researchers completed a landmark trend analysis of acidification in streams associated with forested watersheds. Based on quarterly data gathered over 12 years, they found that stream acidification continues despite reductions in the deposition of acidic materials mandated by the Clean Air Act of 1990. This is the first regional trend analysis conducted in the Southeast and is consistent with observations nationally. The conclusion: further reductions in acidic deposition are necessary.

As Assistant Professor Art Bulger notes, in the eastern half of the United States, rainwater is too acidic to support fish. It is only the buffering capacity inherent in certain kinds of rocks that enables some streams to support life. This year, Bulger, Research Professor Jack Cosby, and Professor Jim Galloway received a $331,000 grant from the National Resource Protection Program of the National Park Service to determine if water chemistry in poorly buffered streams can account for reduced fish diversity in Shenandoah National Park.

SWAS researchers are continuing to deepen our understanding of the factors that shape the response to environmental conditions in Shenandoah National Park watersheds. This year, researchers collected 80 soil samples from throughout the SWAS study area and analyzed the soil properties that determine the response to acid deposition. In many sites, the soil samples were accompanied by cores from red oak trees, enabling researchers to link nutrient states in trees to the chemical status of the soil. In addition, scientists are compiling historical land-use patterns for the area, allowing correlation between land use and current conditions.

Another sign of SWAS's maturity is its ability to accommodate increasing numbers of undergraduate students. The department is committed to giving its majors independent research experiences. This year, ten students worked on SWAS projects.

■ *Virginia Coastal Reserve LTER*

http://atlantic.evsc.virginia.edu/

With global warming and a history of rising sea levels becoming a concern, researchers at the Virginia Coastal Reserve Long-Term Ecological Research (LTER) site on Virginia's Eastern Shore have been trying to determine if marshes will be submerged by rising water levels. Scientists had previously supposed that high tides added fresh sediment to marshes and that low tide removed it, creating a balance. New data from Professor Pat Wiberg and her students presents a different view. Tides bring in new sediment twice a day, but this new sediment is washed away only during episodes of heavy rain at low tide. This evidence suggests that periods of drought favor upward marsh growth, a hypothesis that implies that marsh forma-

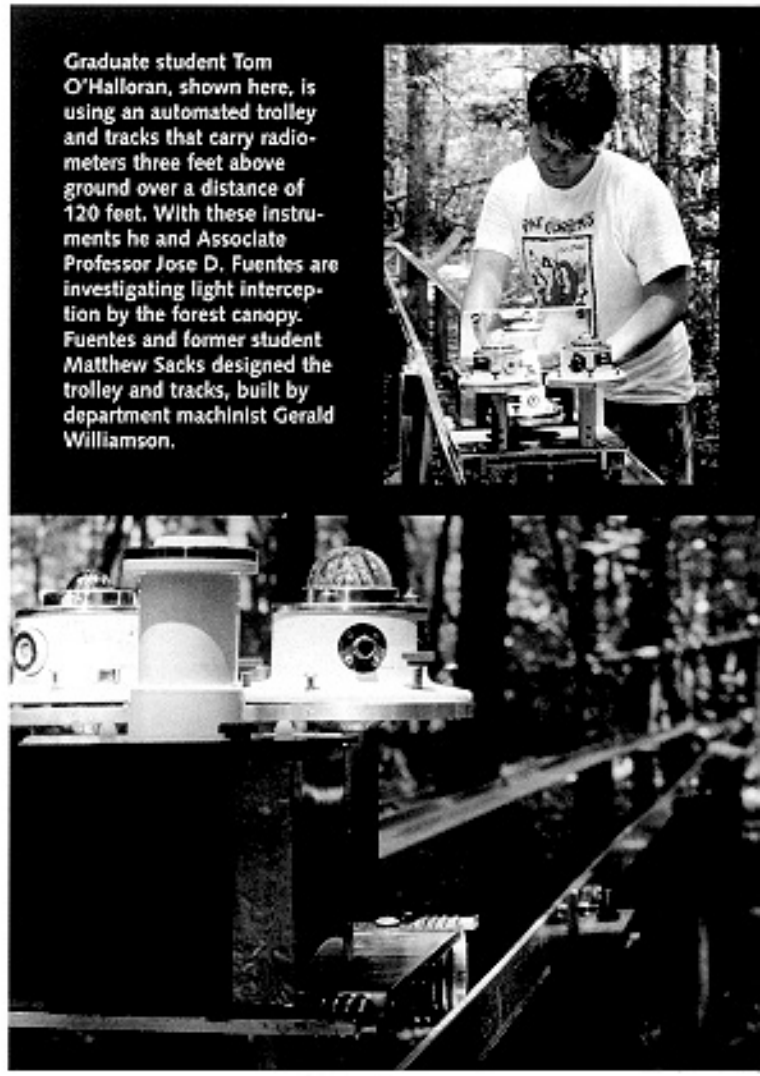
Christy Tyler, Ph.D. candidate, left, and Tracie Mastronicola, undergraduate student, examine a water sample taken from Hog Island Bay on Virginia's Eastern Shore. Tyler is investigating the effects of algae on nitrogen cycles in estuarine waters.

These interdisciplinary programs play a vital role in training the next generation of environmental scientists.

tion on the relatively wet barrier islands of Virginia may be different than barrier island marsh growth along the relatively dry Texas coast.

Other researchers at the Virginia Coastal Reserve have been tracking the nitrogen content in coastal streams. They have found that the nitrogen content of these streams is significantly lower than that of the groundwater that feeds them, which comes from heavily fertilized agricultural fields. They are now trying to understand the role that biological and physical processes play in the fate of this nitrogen, a critical issue in preventing eutrophication of offshore lagoons.

The LTER program is not devoted to scientific discovery alone. A complementary goal of the program is to foster math and science education at local public schools. This year, staff of the Virginia Coastal Reserve worked closely with teachers at Northampton High School to develop a series of classroom presentations and field exercises featuring modern research equipment. Among other activities, the LTER purchased global positioning units and taught students how to use them to locate their latitude and longitude and to determine speed of travel. The students then used the GPS units to participate in an ongoing LTER effort to pinpoint dead trees near the shore, an indicator of rising sea levels.



Graduate student Tom O'Halloran, shown here, is using an automated trolley and tracks that carry radiometers three feet above ground over a distance of 120 feet. With these instruments he and Associate Professor Jose D. Fuentes are investigating light interception by the forest canopy. Fuentes and former student Matthew Sacks designed the trolley and tracks, built by department machinist Gerald Williamson.

■ *Virginia Forest Research Facility*

http://www.people.Virginia.EDU/~jf6s/pace/

The Virginia Forest Research Facility is the department's newest site for interdisciplinary work. Located at the Pace Estate in nearby Fluvanna County, the Virginia Forest Research Facility allows researchers to understand more about the environmental processes that characterize the Piedmont area of the southeastern United States. One particular process being investigated is the effect on the Earth's carbon budget of the widespread emergence of second-growth forests in a landscape that, up until several decades ago, had been agricultural for centuries. As such, the VFRF is a perfect complement to work being done on Blandy Farm, where researchers study fields that are currently being cultivated or are in succession back to forest following recent abandonment.

Much of the work under way this year involved characterizing the vegetation at the site with data collected by Associate Professor Tom Smith as well as developing a baseline of information for future research. For instance, Associate Professor John Albertson and graduate student Chris Williams are using instruments placed on the VFRF's 40-meter tower to characterize the air turbulence within and above the forest canopy under various conditions. Turbulence is a key factor affecting the exchange of energy, carbon dioxide, and water between the forest and the atmosphere. Associate Professor Jose D. Fuentes, colleagues, and students are investigating the amount of sunlight penetrating down to the forest floor. This information is crucial to an understanding of chemical reactions and processes taking place not only above but also within the forest canopy that drive the formation of gases such as ozone.

Over the next year, members of the VFRF team hope to integrate the information they have gathered with similar research programs like AMERIFLUX being carried out around the country. They also look forward to the installation of AC power, a critical addition to the facility.

INDIVIDUAL INITIATIVES

This is a department that is energized by the enthusiasm and intellectual curiosity of its members, and the topics that engage our faculty are wide-ranging. This breadth of perspective is not only a distinguishing feature of research programs under way in the department, but it animates our education efforts as well.

■ *Going to Court*

Between 1947 and 1971, manufacturers of DDT in the Los Angeles area discharged wastewater containing the now-banned pesticide into city sewers that empty into the Pacific Ocean off the Palos Verdes peninsula. The result: over 100 metric tons of the chemical settled in a vast sediment deposit covering 17 square miles, making up the largest concentration of DDT found anywhere in the world.

The responsibility for cleaning up the site has been the subject of a protracted lawsuit, which was finally settled out of court for $73 million in December 2000 after almost a decade of litigation. Professor Patricia Wiberg was an expert witness for the Department of Justice.

Since dumping was halted, the highly contaminated sediment on the ocean floor has been covered by a layer of less contaminated sediment. Consequently, the defendants contended that any DDT they might be responsible for was buried and did not contribute to DDT at the surface of the seafloor. The government, on the other hand, asserted that a combination of biological and physical processes was bringing the buried DDT to the surface, where it entered the food chain.

Wiberg, whose specialty is sediment transport and the transport of contaminants associated with these sediments, was part of a team studying the ability of storms and animals living in the seabed to disturb the sewage-affected deposits. "The process was similar to work I do in other contexts," she explains. "We placed instruments on the continental shelf to measure turbidity, currents, and wave conditions." She and her fellow researchers concluded that biological mixing of the seabed brought buried DDT to the surface where storms could mobilize and transport it around the region.

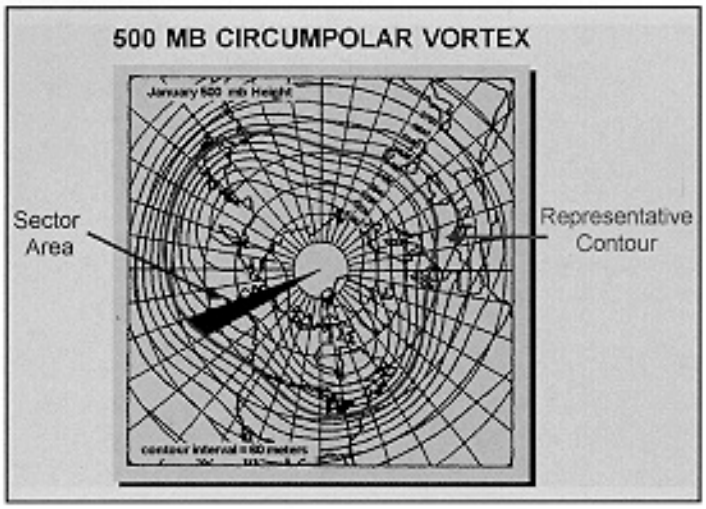
The case went to court in October 2000 and was settled after the first week of testimony. "I was very impressed by the judge," Wiberg remarks. "He worked very hard to follow the science." The Environmental Protection Agency is now working on plans to place a cap on the deposit.

■ *The Consequences of Weather*

Associate Professor Bob Davis is a synoptic climatologist. He is interested in the factors that shape daily changes in weather as well as the consequences of these events on human activities. During the past few years, he has been working with Adam Burnett of Colgate University and Chip Knappenberger, a former student in the department, to study the relationship of changes in the circulation in the upper atmosphere to surface temperatures. Their approach has been to track the position of the circumpolar vortex, a region at 500 millibars of pressure, as it migrates around the North Pole. This vortex marks a zone of rapid transition between warm and cold air that is linked to the jet stream and is the source of most midlattitude storms.

"Changes in atmospheric circulation are linked to temperature changes in some areas of the world, but not others," Davis notes. He and his colleagues found a correlation between the circumpolar vortex and increasing temperature changes in western Canada, but no relationship with the strong warming in northern Siberia. "Clearly there are other factors operating there," he says.

Davis also studies the effects of weather on human activity. For instance, with former doctoral student Greg Jones, now a professor at the University of Southern Oregon, he has investigated the effect of weather on wine quality in Bordeaux, concluding that weather conditions conducive to early flowering in the vineyards are a major



JennieMoody with her graduate students Mark Lilly, Owen Cooper, and Tony Wimmers.

factor in creating great vintages. More recently, he has been studying the effects of weather on mortality rates in major cities across the United States. Using data from the National Center for Health Statistics, he has shown that in most cities there has been no significant relationship between incremental increases in apparent temperatures in the 1980s and 1990s and mortality.

"The implication is that global warming will not necessarily lead to higher mortality rates in the United States during the summer," he says. "It's clear that people in many cities are capable of adapting to rising temperatures."

■ *Following the Ozone*

Research Associate Professor Jennie Moody describes herself as the "person on the atmospheric side of things who focuses on real-time, large-scale meteorological work." And if the weather Web site (http://windfall.evsc.Virginia.EDU/~mcuser/) she maintains for the University is any indication, it's an accurate description. You find everything there from national satellite image loops to Virginia Zone forecasts.

Moody herself has had a hand in increasing the utility of data measured by satellites. One of her research interests is following the transport of dry air in the lower atmosphere, or troposphere. The satellite data used to measure water vapor in the troposphere, however, measures relative humidity, not the specific humidity data that she needs to monitor dry air motion. Moody and her students developed a method to process this raw data by removing the effect of temperature, enabling researchers to more accurately track the water vapor in the troposphere. This new set of data is important to Moody because the movement of dry air in the upper troposphere is associated with ozone transport from the stratosphere, or upper atmosphere.

In addition to studying large-scale upper-air dynamics, Moody also works closer to the ground on occasion. At the University of Michigan Biological Station, where her colleagues have established an instrumented tower through the forest canopy, she is adding a meteorological dimension to their study of atmospheric chemistry. The station, located near the tip of the lower peninsula of Michigan, is periodically exposed to high concentrations of pollutants from Chicago and Milwaukee. Using a boundary-layer wind-profiler radar system and tethered balloons, Moody and her students study how the surface boundary layer fluctuates during the day and how this changing volume of well-mixed air influences the concentration of ozone and other trace gases.

■ *Analyzing Isotope Signatures*

Professor Steve Macko's specialty is isolating and analyzing stable isotopes of carbon, nitrogen, sulfur, and other elements. His lab at the University of Virginia is one of the best of its kind in the world—and as a result he has had the opportunity to tackle a variety of projects, from assessing George Washington's diet to examining meteors for extraterrestrial amino acids to determining the best boundaries for a marine sanctuary in the Dry Tortugas.

Stable isotopes differ only in the number of neutrons they contain. A number of natural processes determine the ratios between heavier and lighter isotopes, leaving a signature of a specific environment. Protein produced from food in a marine environment differs from that produced on land. Even finer distinctions are possible. For instance, the isotopic signature of corn is different from that of wheat. When human beings or other animals eat food from specific environments or specific kinds of food, the protein they produce as hair, nails, and other substances reflects its characteristic isotope ratios.

Macko has studied hair from Oetzi, the 5,000-year-old man whose body was found in 1991 in the Alps (he was essentially a vegan), as well as hair from George Washington (his diet was typical of his time). "Hair is a tape recording," Macko remarks. "What you eat for breakfast shows up seven days later in your hair."

Macko's work has also led him to descend into the Gulf of Mexico, where he is part of a team from the National Oceanic and Atmospheric Administration studying the ecology of gas hydrates, mounds of frozen methane found on the seafloor. He will examine tissues from bottom-dwelling plants and animals to determine if the benthic food chain in these areas leads back to the gas hydrates. Here again, he will be using the characteristic stable isotope signature of the gas hydrates as his starting point.

Steve Macko in his lab.

Thirty years ago, natural science faculty at the University of Virginia embarked on what was for the time a pioneering experiment. Their idea: end the compartmentalization that had fragmented the study of our natural surroundings and create a new department bringing together researchers in hydrology, atmospheric science, geosciences, and ecology. The logic behind this decision was straightforward. While specialized expertise would continue to provide the basis for discovery, the complexity of natural systems demanded an integrated approach.

The last three decades have amply demonstrated the wisdom of this decision. A succession of outside observers have praised the Department of Environment Sciences for its interdisciplinary practice, and it is widely recognized as one of the leading departments of its kind in the nation.

The department is now poised to take the practice of interdisciplinary research in the environmental sciences to a new level, thanks to the imminent completion of the Clark Hall addition and a systematic renovation of the existing building.

Although generations of environmental sciences students and faculty have developed a genuine fondness for Clark Hall, it has not been for its qualities as an academic building suitable to the natural sciences. When Clark Hall opened its doors in 1932 to serve the law school, planners at the time never envisioned that it would be modified to support laboratories, and subsequent piecemeal renovations have only made the building more unwieldy, with its multiplicity of levels and maze-like traffic flow. That the department has been able to attract and sustain world-class research and teaching in such a building is a testament to the tenacity of our faculty.

With the opening of the Clark Hall addition in June 2002 and the completion of the Clark Hall renovation the following year, we believe that the study of environmental sciences at the University of Virginia will be primed to attain a new level of eminence. Never before have our faculty worked in laboratory space designed from the very start for that purpose and arranged to promote collegiality and the free interchange of ideas among researchers and between faculty and students.

The combined renovation and addition projects have

given the department's faculty the ability to reconceive the entire building—and an extensive planning process was undertaken before the first brick was laid. As discussions continued, certain design principles emerged. Public rooms—classrooms, conference rooms, and administrative offices—would be located in the front of Clark Hall, while new laboratories, supported by ventilation, plumbing, clean power, and safety systems required by modern laboratories, would be housed in the addition.

Special attention has gone into the design and placement of the new laboratories. The floorplans promote easy access between labs and office areas, and graduate students will be able to have offices near their laboratories. In addition, much of the laboratory space is flexible. It can be converted to new uses as department priorities shift. The goal is to create a building that addresses the department's needs today while sustaining faculty and students for years to come.

In the meantime, work on Clark Hall continues according to schedule, and faculty members have accommodated themselves to the noise of construction and the necessity of moving to temporary quarters when their office space is renovated. The inconvenience will be well worth it. The expanded, renovated Clark Hall promises to be an outstanding environment for research and teaching and will play a prominent role in the department's ability to continue to attract top-notch scholars and talented graduate students to Charlottesville.

CLARK HALL RENOVATION AND ADDITION HIGHLIGHTS

The cost for the renovation and addition to Clark Hall is $30 million. There is 45,000 square feet of net assignable space in the addition.

Ground Floor

Renovations: New classrooms

Addition: Three large wet labs, six smaller labs

First Floor

Renovations: New classrooms, mural room preserved, new department offices

Addition: Three large labs, six smaller labs

Second Floor

Renovations: Conference room, office space, new teaching laboratories, balcony offices redesigned, bridge connecting front of building to the addition

Addition: Six dry labs for quantitative work (adaptable to wet labs in the future)

Third Floor

Renovations: Quantititive research space, offices for field research stations

Addition: Faculty offices, conference rooms, quantitative research space

CELEBRATING OUR MOST DISTINGUISHED UNDERGRADUATES

The department's Distinguished Majors Program attracts our best students, who take on the challenge of conducting a significant research project during their fourth year. Working in close collaboration with a faculty adviser, they master the techniques needed to conduct their research, learn to organize and present information clearly, and experience both the trials and satisfaction of conducting original research. In the process, they gain a better understanding of their own interests and strengths. We are very proud of their accomplishments this year.

Distinguished majors 2001: Corinna Shapard, Rachel Cassoff, Christina Spellerberg, Elizabeth Darrow, and Charles Fievet. Not pictured: John Murphy.

Rachel Cassoff

Relationships among Landscape Structure, Deer Abundance, and Lyme Disease Incidence in Virginia
Research Adviser: Michael Bowers

Geographic information system programs have become an important tool for environmental research, allowing scientists to create layered maps that reveal the interplay of variables in specific regions. In her effort to correlate landscape structure, deer abundance, and Lyme disease, Rachel Cassoff naturally employed this powerful tool. "Learning the program and entering the data was the most time-consuming part of the project, but it was worth it," she says.

Working with data from different government agencies, Cassoff entered land-use, deer abundance, and Lyme disease data culled from a variety of sources. She found that deer flourished in areas where there was a mixed habitat of forests and open spaces.

"This is pretty much what we expected to find," she notes. "Deer need forest for cover and open areas for forage." The incidence of Lyme disease did not, however, correlate with deer abundance, suggesting that there are other variables that account for the spread of the disease.

Cassoff was enthusiastic about the experience. "I wanted to work with Michael Bowers, and I wanted to challenge myself," she concludes. "The Distinguished Majors Program gave me a real taste of what research in graduate school might be like."

Elizabeth Darrow

Clam Hemocyte Chemotaxis as a Bioindicator of Environmental Stress
Research Adviser: Dave Smith

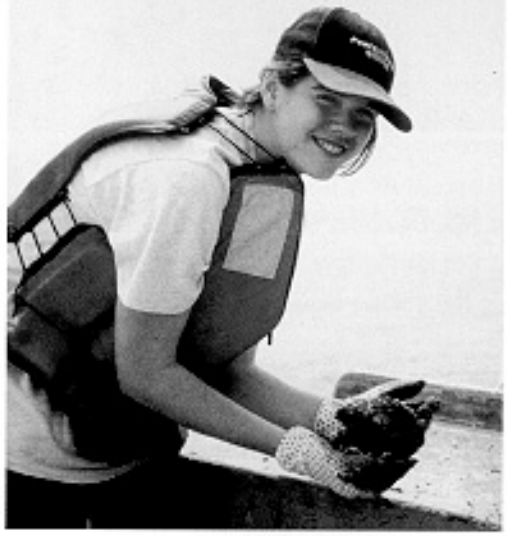
Researchers know that one sign of environmental stress among animals is a weakened immune system, which leaves them susceptible to disease. The goal of Beth Darrow's project was to find a technique to apply this insight to clams, which were once widely abundant throughout the Chesapeake Bay.

At the suggestion of her adviser, Dave Smith, she placed blood taken from her subjects in one part of a Boyden Chamber and a bacterial protein in the other

and measured the migration of blood cells across a membrane separating the two sections. She found that blood taken from clams that had not been subjected to environmental stresses such as heat were more prone to migrate across the membrane, a process called chemotaxis, than those that were not.

Adopting the Boyden Chamber for this purpose was not, however, smooth sailing. "It was frustrating at times," she says. "I tinkered with it for days trying to make small adjustments. I had worked in labs before using techniques that had been fully worked out. I now appreciate how much work went into refining these methods."

Distinguished major Beth Darrow gets her hands on her clams.



Charles Fievet

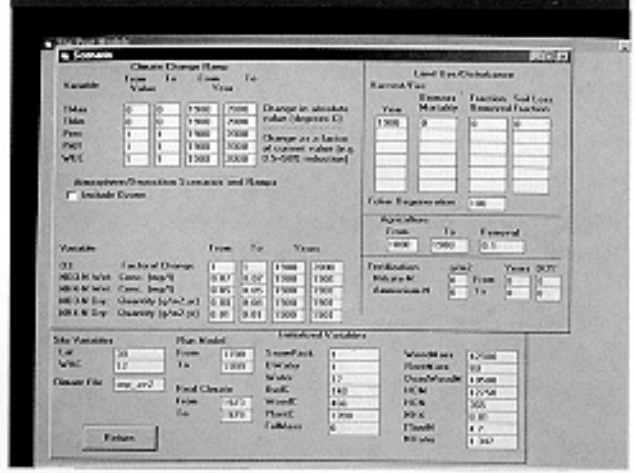
Application of the PnET-CN Terrestrial Ecosystem Model to Shenandoah National Park, Virginia
Research Advisers: Jack Gosby and Jim Galloway

Human activity has changed the nitrogen dynamics of temperate forests in Virginia, with important implications for the health of aquatic ecosystems. For instance, air pollution has greatly increased the rate of nitrogen deposition in the Shenandoah Valley, with the potential to increase the acidity of local streams. At the same time, land-use practices, extending back centuries, shape the way the environment processes this additional nitrogen.

Chip Fievet turned to PnET-CN, a terrestrial ecosystem computer model, to explore the intersection of these two variables. His goal was to create a system that can be used to assess their probable effect on nitrogen cycling in the future.

Fievet did extensive research on land use in the area,

Distinguished major Chip Fienet uses computer modeling to assess nitrogen dynamics in the Shenandoah Park.



using maps created when the park was created. He also drew on 20 years of data on nitrogen deposition accumulated by department researchers and others. Entering this information into PnET-CN, he was able to create scenarios that reflected different amounts of land cleared, rainfall, and nitrogen deposited.

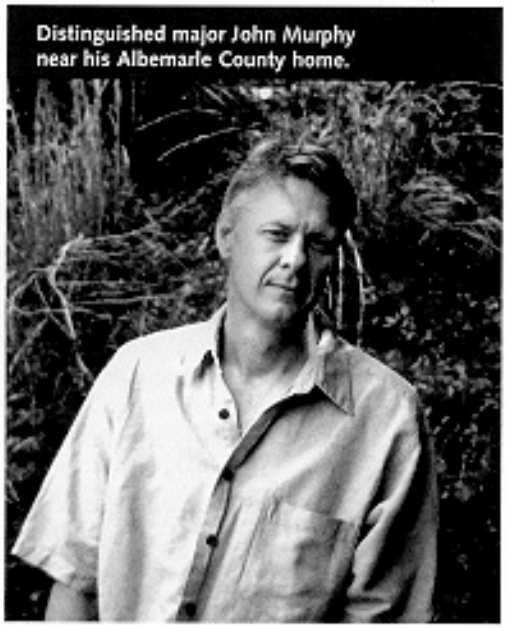
Fievet jumped at the opportunity to participate in the Distinguished Majors Program. "I enjoy working independently," he says, "and taking on research I wouldn't get to do in a normal classroom."

John Murphy

Protecting Biodiversity and Ecosystem Health in Albemarle County
Research Adviser: Carleton Ray

Albemarle County resident John Murphy has always been interested in local issues. Before moving to Virginia ten years ago, he was involved in grassroots progressive

Distinguished major John Murphy near his Albemarle County home.



politics in Southern California. When he was searching for a topic for his distinguished majors project, he knew he wanted to write on a local conservation issue.

Murphy noticed an unusual clause in the Albemarle County planning document that declared biodiversity a resource worth protecting and established a biodiversity committee to make recommendations for land use to be included in the county's land protection program. He decided to explore the implications of using biodiversity as a framework for planning under the direction of Carleton Ray.

Using data from the Virginia Department of Game and Inland Fisheries, he found that there are a number of endangered bird species in the county with diverse and conflicting habitat requirements, making it very difficult to develop a coherent biodiversity plan based on species protection alone. A more effective way to preserve biodiversity, he argues, is to employ a wider perspective that includes overall ecosystem health.

Corinna Shapard

An Assessment of the Role of Oyster Bars and Drift Macroalgae in the Associated Benthic, Macro-organismal Community of Hog Island Bay, Virginia
Research Adviser: Dave Smith

One of the things that Cory Shapard learned in the course of completing her distinguished majors project is that researchers often have to do more than gather and analyze data. They have to build the equipment that enables them to collect their data in the first place.

Working with Dave Smith, Shapard set out to analyze the organismal community associated with the oyster bars and drift algae in Hog Island Bay, part of the Virginia Coastal Reserve LTER. In order to accomplish this goal, she had to begin by designing a rugged collection device that wouldn't be damaged by the sharp oyster shells and that was appropriate for use with the kinds of organisms found near the bars. Dense mats of drift algae quickly clogged seine and gill nets, and broken shells on the oyster bars easily snagged and tore them.

Collaborating with former master's student Craig Layman, Shapard built tray traps that allowed her to measure the volume of drift algae. She found that at below certain concentrations, the drift algae support a varied organismal community, but that the quantity and variety of associated organisms dropped off above a certain level.

"I spent parts of two summers on the project as well as many hours during the school year," Shapard notes. "It was a great introduction to conducting field research in ecology."

Christina Spellerberg

Climatic and Land Use Effects on Soil Respiration Rates during the Winter Season in the Virginia Piedmont
Research Adviser: Howie Epstein

The emission of carbon from soils through the decomposition of organic matter, root respiration, and microbial respiration is a major part of the global carbon cycle. Most studies of this subject have been done during the growing season, and while carbon exchange during the winter has been recognized as a significant contributor to this process, the factors driving winter soil emissions are not well understood.

With the guidance of Howie Epstein, Chrissy Spellerberg examined the carbon nitrogen ratio and the total percent of carbon in soils on a series of plots at Blandy Experimental Farm and at the Virginia Forest Research Facility. She found that winter soil respiration is influenced primarily by temperature and moisture. When soil properties were similar, the effects of land use were minimal. These conclusions have implications for global warming. If the winters become warmer, we can expect, at least initially, to find increased carbon emissions from the soil.

"This whole process was invaluable to me," Spellerberg says. "I learned to structure a research project, how to seek out and review relevant materials, and communicate my findings effectively."

AWARDS, APPOINTMENTS, AND ACHIEVEMENTS

UNDERGRADUATE STUDENTS

Corinna J. Shapard was recognized for giving the best undergraduate poster presentation at the Environmental Sciences Research Forum. **Melanie L. Allen** had the best undergraduate presentation at the same event.

Rachel M. Cassoff, Elizabeth S. Darrow, Charles J. Fievet, Jr., John A Murphy, Corinna J. Shapard, and **Christina C. Spellerberg** all completed the department's Distinguished Majors Program.

The department recognizes outstanding fourth-year students in each of the environmental sciences. This year, the Mahlon G. Kelly Prize in ecology went to **John A. Murphy**, the Wilbur A. Nelson Award in ecology was given to **Melissa J. Cardwell**, the Michael Garstang Atmospheric Sciences Award went to **Matthew Sachs**, and the Departmental Interdisciplinary Award was designated to **Christina C. Spellerberg**.

Of the 43 Harrison Research Awards presented by the University, undergraduates from the department earned five. These students were **Laura A. Cacho, Noah E. Egge, Rachel A. LeRoy, Katrina E. Mabin,** and **Kennedy F. Rubert IV**. They were awarded grants of up to $3,000 each to conduct a substantial research project.

Noah E. Egge was the recipient of a Bloomer Scholarship, while **Sean B. McGinty** received a Mitchell Scholarship.

This year's Wallace-Poole Prize for the fourth-year student majoring in environmental sciences with the highest grade-point average went to **Rachel M. Cassoff**.

Melissa A. Kenney was one of 80 students nationwide selected for a prestigious Morris K. Udall Scholarship.

GRADUATE STUDENTS

Katharina M. Ross was the winner of the Fred Holmsley Moore Teaching Award. Since she joined the department in 1996, she has served as a teaching assistant in several courses including Physical Geology, Earth Surface Processes, Geomorphology, Fundamentals of Ecology, and Sedimentary Processes.

Environmental Sciences Research Forum Outstanding Presentation Awards were earned by **Sebastian M. Riedel, Steven J. Turaski, Katharina M. Ross,** and **Kelly K. Caylor**.

The department offers a series of awards honoring outstanding graduate students in each specialty in environmental sciences. This year **Larissa Read** earned the Graduate Award in Ecology, **Joe Carr** won the Graduate Award in Hydrology, **Kristina Russell** won the Joseph K. Roberts Award, and **Christie Feral** received the Robert Ellison Award for interdisciplinary studies.

Amber Soja has been awarded a three-year EPA STAR Fellowship to further her work on her dissertation on remotely sensed patterns of fire and landscape change in central Siberia. The award includes tuition, a stipend, and an allowance for use at the student's discretion.

Monika Calef and **Oliver Frauenfeld** were recipients of Moore Research Awards.

At this year's Arts and Sciences Graduate Research Poster Exhibition, **Kristina Russell** received a second-place award, and **Kelly K. Caylor** and **Todd Scanlon** received third-place awards.

Kevin Jones and **Carmen Yip** were awarded Department Research Awards.

Keith Reinhardt received the Trout Unlimited Award.

The Maury Environmental Sciences Prize went to **Owen Cooper**.

FACULTY MEMBERS

Bob Davis was appointed editor of *Climate Research*.

Several of our faculty were featured in televised documentaries made this year. **Mike Garstang**'s work was highlighted in a National Geographic film on elephant communication, while **Steve Macko** was interviewed for the "Ultimate Guide to Mummies," broadcast on the Discovery Channel.

Paul Desanker was appointed to the review committee for the Fulbright Senior Specialists Program.

John Albertson earned the Collaborator of the Year Award from the National Resource Institute.

Earth's Climate: Past and Future by **Bill Ruddiman** won a merit award for text design from the Tri-State Publishers Guild.

Bill Keene was invited to serve as editor of *Atmospheric Chemistry and Physics*.

Observations of Surface to Atmosphere Interactions in the Tropics by **Mike Garstang** and David Fitzjarrald was nominated for the University's Phi Beta Kappa Award.

Jim Galloway was appointed an associate editor of *ScientificWorld*, a new electronic journal. He was also featured by the Virginia Center for Stewards as a steward of the month and received department awards from both the Environmental Sciences Organization and the Graduate Student Association. He shared the Environmental Sciences Organization Award with **Wally Reed**.

A number of our faculty were singled out for recognition by the University. **Deborah Lawrence** received a University Teaching Fellowship, **Tom Smith** received a Faculty Senate Teaching Initiative Award, and **John Albertson, Howie Epstein,** and **Mike Mann** received one of four major grants from the Fund for Excellence in Science and Technology.

Bill Rickards was honored by the Sea Grant Association for his service as treasurer and executive board member.

Governor Gilmore appointed **George Hornberger** to serve a five-year term on the Board of Trustees of the Virginia Museum of Natural History. George is also listed among the nation's most influential researchers on the ISIHighlyCited.com Web site.

Hank Shugart was honored by the University of Arkansas for his work that helped revolutionize methodology for evaluating environmental factors in biological communities.

Vivian Thomson was awarded the Distinguished Fulbright Chair in American Studies at the University of Southern Denmark.

Robert Swap was the scientific coordinator of a major NASA project, SAFARI 2000, in southern Africa that involved aircraft, satellite and ground-level investigations.

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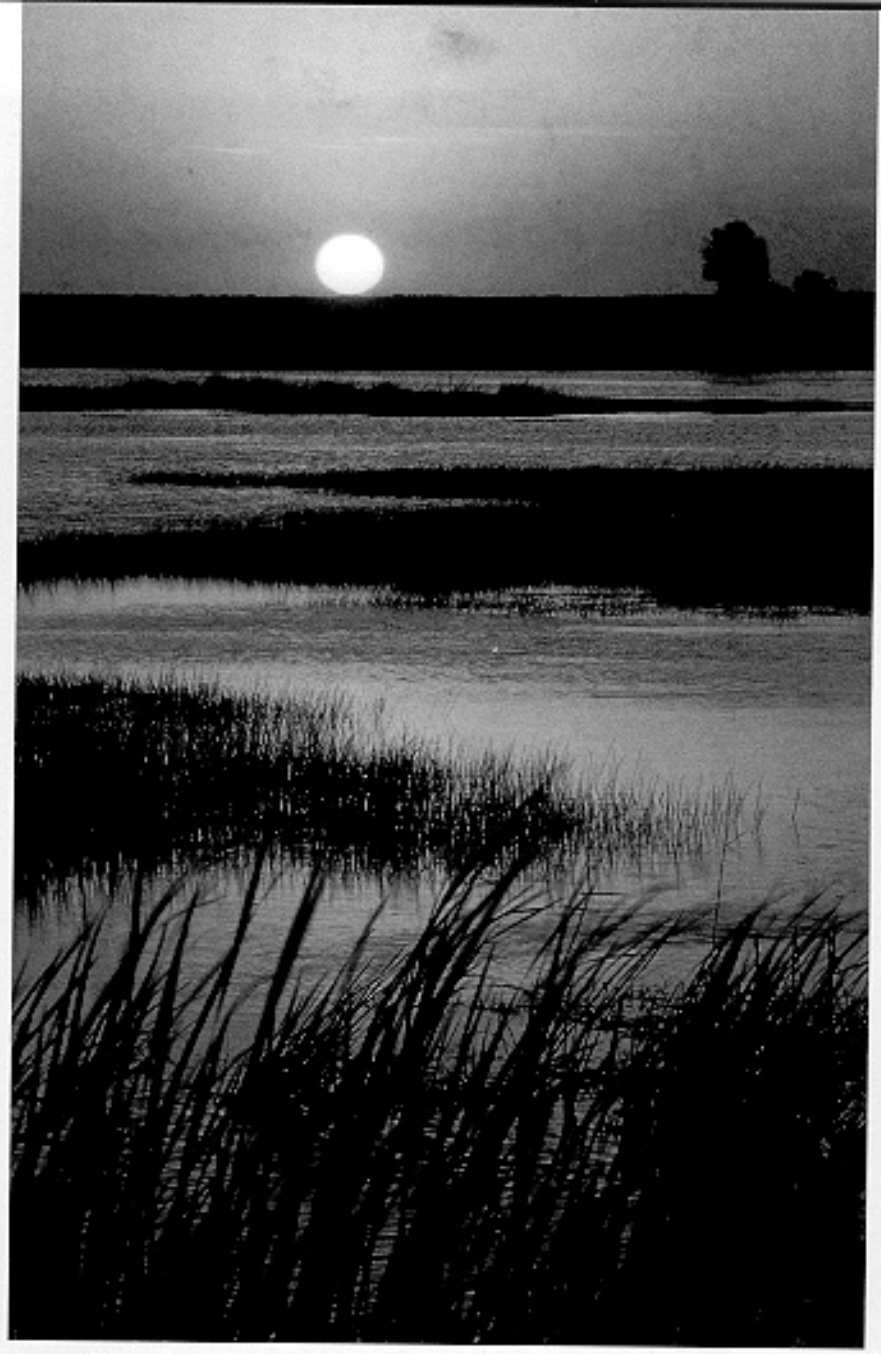

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