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2010 International Year of Biodiversity

Special  
International  
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# Periodic Elements

from the College of Science

## Taking the Earth's Temperature

"The population of the Earth is expected to reach nine billion by 2050," says Jagadish Shukla, University Professor and the founding chair of the Department of Atmospheric, Oceanic and Earth Sciences, citing United Nations estimates. "More people on Earth will increase the levels of carbon dioxide, increasing the Earth's temperature," he says, accelerating the problems of global warming. These numbers are not new,

but for Shukla, a member of the 2007 Nobel Peace Prize-winning Intergovernmental Panel on Climate Change, they represent a dire warning for world leaders, the global scientific community, and all of humanity to pay attention to the changes that people are causing to the environment.

As a researcher, Shukla wants to expand climate data models. He explains that currently the globe is broken into 100-kilometer segments, and weather is tracked over these large areas. By breaking the globe into smaller segments, such as ten kilometers, forecasting accuracy increases exponentially. As a humanitarian, Shukla is concerned about the effects of global warming on the poorest nations. He

explains that floods and droughts hurt people living off the land because they have the fewest resources to plan for and recover from natural disasters.

Shukla is also a man of action. He has founded the weather and climate research group at the International Centre for Theoretical Physics in Trieste, Italy, which provides training to many scientists from developing countries. He also has helped establish the National Center for Weather Forecasting in New Delhi, India, and he has played a key role in the establishment of a new Department of Atmospheric and Oceanic Sciences at Allahabad University, India.

In the College of Science, Shukla is instructing the next generation of climate researchers. In addition to a climate dynamics class on global warming, there are several new courses covering atmospheric science, weather analysis, and physical oceanography. "Climate studies is a growing field," he says. "There is a lot of interest, and we are working to meet student needs here at Mason."

### Symptoms of Change

When we speak about biodiversity, explains Shukla, we must also consider the enormity of climate on plants and animals and ultimately people. Data over the last fifty years confirms that the Earth is heating, he says. "This August, the Northwest Passage has opened." This is only the fourth time since the 15th century that this has happened. And while most people are unaware of Arctic shipping routes, there are more immediate changes. "We can expect many more hot days globally," Shukla says, and in the United States:

- Heat waves will be more frequent.
- Frost days will be fewer.
- Snow will be more infrequent.
- Drought frequency will change.
- Rainfall amounts will increase, causing floods.
- Hurricane numbers will remain the same, but storms will be stronger.



Photo - NASA

Rare Atlantic cyclone  
off the coast of Brazil

## International Workshop Promotes Climate Prediction Efforts

**D**ynamical seasonal prediction, or DSP, is a topic of great interest to scientists around the world. Emilia Jin, an assistant professor in the Department of Atmospheric, Oceanic and Earth Sciences (AOES), has been conducting research on DSP for several years at the Asia-Pacific Economic Cooperation Climate Center (APCC) in Busan, South Korea.

APCC produces real-time operational climate prediction information using a well-validated multi-model ensemble system that collects forecast outputs from fifteen institutions in eight countries.



AOES participants in U.S.-Korea Workshop (left to right): James Kintner, Bohua Huang, Emilia Jin, Jagadish Shukla, Youkyoung Jang, Liwei Jia, and Kristi Arsenault.

This past summer, Jin organized the U.S.-Korea Workshop on Dynamical Seasonal Prediction. Leading scientists from several research institutions and universities in the United States and South Korea met from June 21-24 at APCC to rigorously assess the current status of DSP and develop a visionary strategy to enable and accelerate collaborative activities between the two countries. Five AOES faculty members — Jin, Bohua Huang, James Kintner, Jagadish Shukla, and David Strauss — attended the workshop. Doctoral students Kristi Arsenault, Youkyoung Jang, and Liwei Jia also participated in the activities.

## A Global Snapshot of Biodiversity



Vikas Chandhoke  
Dean, College of Science

**T**he United Nations has proclaimed 2010 as the International Year of Biodiversity to illuminate the plight of biodiversity preservation. To support this global endeavor, the College of

Science offers this special issue of *Periodic Elements* to celebrate the kaleidoscope of life forms that inhabit the Earth — from bacteria living on the ocean floor to undisturbed forests on the Indochinese Peninsula — and the ongoing efforts to understand and preserve a fragile balance.

I invite you to look at how our scientists step outside their classrooms and laboratories and take biodiversity to the community and to the world. You will see how they introduce young students and their teachers to environmental stewardship; host expositions and conferences for international audiences; and examine problems and solutions with policy makers and government leaders to affect change.

The interdisciplinary environment at George Mason University encourages collaborative scholarship, new methods of research, and intense curiosity. We have some of the premier environmental researchers and policy experts in the world. Just as the United Nations hopes to draw attention to the world's urgency for biodiversity preservation, our scientists will continue to position us in an international forum for the contribution, exchange, and debate of ideas to preserve all that is unique on our planet.

The workshop, sponsored by the National Science Foundation, the Asia-Pacific Economic Cooperation (APEC), the National Research Foundation of Korea, and the Lotte Scholarship Foundation, was held in parallel with the annual APEC Climate Symposium. Participants developed a realistic roadmap to sustain continuing efforts for mutual benefit; new collaborative activities on Asian monsoon predictability, global system modeling, climate variability and change, high resolution modeling, and extreme weather-climate events; and long-term strategies.

“These international efforts will contribute to the enhancement of understanding prediction of climate modeling for the mutual benefits of the United States and Korea,” Jin says.

## Biodiversity: The Challenge of the Living Planet

Thomas Lovejoy has spent forty years in a love affair with the Amazon rainforest. He has shared its treasures and its adversities with the world to draw attention to the devastating effect of human behaviors and actions on what he defines as “the greatest expression of life on earth.”

In the first full-time faculty position of his career, Lovejoy holds a joint appointment as University Professor in the College of Science and the College of Humanities and Social Sciences.

An internationally acclaimed leader in the science and conservation of biological diversity, a term he coined three decades ago, Lovejoy is past president of The H. John Heinz III Center for Science, Economics and the Environment and currently holds the center’s Biodiversity Chair. He also is the founder of the public television series “Nature” — the most popular long-term series on public television, now in its 28th season.



Tom Lovejoy on one of his many trips to the Amazon.

“Earth is a living planet, and biological systems are tightly linked. There is not a single solution to biodiversity preservation.”



Scarlet Macaw parrots intensify the unparalleled beauty of the Amazon rainforest.

A hallmark of his distinguished career, Lovejoy continues to press for new avenues to educate global audiences about biodiversity preservation.

In a recent news conference held by the Convention on Biological Diversity — established by the United Nations in 1993 for worldwide biological oversight, Lovejoy supported the creation of an international panel to lead critical initiatives

in biodiversity science. Fashioned after the Nobel Prize-winning Intergovernmental Panel on Climate Change, the proposed Intergovernmental Science Policy Platform on Biodiversity and Ecosystem Services will be discussed at U.N. talks in Japan this fall. “It will be a principal agenda item,” he says, “and I’ll be there.”

Adamant that “we need to keep our sights set at a much more ambitious level than in the past,” Lovejoy says, “We have to pursue restoration of ecosystems at a planetary scale; reduce greenhouse gas emissions and concentrations to levels well below what has been discussed up to now; and manage the planet as the biophysical system it is.”

Without these efforts, he warns that biodiversity loss will result in a world with almost no tropical coral reefs, rainforest dieback, increased ocean acidity, and a major loss of island species.

Lovejoy explains that planetary-scale ecosystem restoration could remove a significant amount of carbon dioxide from the atmosphere and make ecosystems more resilient to climate change and other stresses. In addition, there is a need for nonbiological ways to lower greenhouse gas concentrations. “Not an outlandish goal,” he adds, noting that scientists at Stanford University and other research institutions are looking at new possibilities.

“Earth is a living planet, and biological systems are tightly linked. There is not a single solution to biodiversity preservation,” Lovejoy says. “The different approaches will be done on different scales, but added together can be significant. It will be an uphill battle and, unfortunately, the urgent always overshadows the important.”

## Around the World for Marine Mammals



*Students have a close encounter with a dolphin in the waters off the coast of Scotland.*

Chris Parsons recently returned from his tenth trip to the coast of Scotland where he and five College of Science (COS) students — two graduate students and three undergraduates — joined fifty British university students and sponsors in a summer program to study marine mammal ecology and conservation. In addition to whale watching and sightseeing, the trip included classroom lectures and lab work. “It’s a big natural history tour,” says Parsons, who teaches marine conservation. “Scotland is one of the best places to see whales and dolphins,” he adds.

Most important, Parsons feels that when students can actually view the large marine mammals in their natural habitat, they get “a better understanding of [the mammals’] behaviors.” Parsons has also observed that students who participate in the summer course develop more enthusiasm for “conserving the marine environment,” as well.

The annual summer trip, which Parsons developed with renowned marine ecologist Rupert Ormond, is just one of many excursions that Parsons

*In addition to whale and dolphin watching, students accomplished considerable research during their summer program.*

will make throughout the year as associate professor in the Department of Environmental Science and Policy, instructor in the Smithsonian-Mason Global Conservation Studies Program, and member of the Board of Governors of the Society for Conservation Biology, the chief professional society for conservation scientists. He will also accompany his marine ecology students to the Galapagos Islands in January, and in May he will be in Victoria, British Columbia, attending the second International Marine Conservation Congress (IMCC) — a conference he was instrumental in establishing and that was originally held at Mason in 2009.



*Observing them in their natural environment offered students a better understanding of marine mammals.*

Mason’s sponsorship of the first IMCC, as well as Parsons’ involvement in other international conferences and symposiums throughout the year, has helped to establish the university as an important center for marine conservation studies. “Mason is on the cutting edge ... in the mid-Atlantic,” says Parsons. Since he joined the COS faculty in 2003, Parsons has seen his classes increase in size exponentially from twenty-five students. “Now we are capping classes at 125 students,” he adds, and notes that he has twenty graduate students in his program, as well.

Mason is also a cosponsor of the second IMCC, which will focus on two new themes: human dimensions in marine conservation and new techniques in marine conservation. “We’ve had a lot of help from the University of Victoria,” says Parsons... “And we are already starting to plan the third IMCC, which will take place in Edinburgh, Scotland, in 2014,” he adds.



Fireworm (*Hermodice carunculata*) feeding on coral

## Playing with Fire(worms)

“Scientists need to communicate their research in a way that people can understand,” says Staci Lewis, MS Environmental Science '09, an environmental scientist specializing in corallivores — animals that feed on coral. Lewis is a policy analyst for the Consortium for Ocean Leadership, a nonprofit supported by ninety-five oceanographic organizations working together to “advance research, education, and a sound ocean policy.” She is as comfortable navigating the waters of Congress and the sea of federal

“Coral reefs are stressed at a higher level than ever before.”

agencies as she is working beneath the seas. Her passion for researching coral reefs has taken her to Barbados, the Florida Keys, and the Flower Garden Banks off the coast of Texas to study the coral-eating fireworm, *Hermodice carunculata*.

“Coral reefs are stressed at a higher level than ever before,” says Lewis, explaining that climate change and the effects of warmer sea temperatures, pollution from runoff, and man-made disasters all contribute to the problem. Her work with fireworms serves to see if they are impacting the reefs. “We are trying to see how the balance has changed,” says Lewis. “We have observed fireworms eating diseased coral

and eating outside regular feeding times. One of our hypotheses is: Can we distinguish fireworm activity from coral disease, and do fireworms spread the disease to healthy coral?”

Lewis has continued her research relationship with the College of Science beyond her time as a student. This fall she will work with Esther Peters, her former advisor and an assistant professor in the Department of Environmental Science and Policy, to process fireworm samples from her recent Aquarius mission. Together they will publish their data and findings.



Photo- Chad King / Monterey Bay National Marine Sanctuary

A staghorn colony surrounded by gorgonians (soft corals) at Carysfort Reef off Key Largo

Lewis says “there is a lot more work to be done,” explaining that everyone needs to be concerned about the health of the world’s reefs. Many commercially viable fish begin their lives living on the reefs before heading out into deeper water. Reefs also protect the land from sea erosion during storms that could otherwise damage property. “It’s essential for the government to fund basic science research and important for scientists to tell the public what they discover,” Lewis says.

## Climate Change – An Ancient and Ongoing Challenge for Humans

### “How do humans adapt to unprecedented climate change?”

Through their separate but ongoing studies of civilizations – one that is partially isolated from the modern world and another that collapsed more than a thousand years ago – two College of Science (COS) professors are seeking answers to this question.

**S**heryl Luzzadder-Beach, associate professor in the Department of Geography and Geoinformation Science, has spent more than seventeen years traveling to Belize and the Yucatan Peninsula each summer to study the ancient Maya civilization and its agricultural practices. Now through observing the composition of soil layers of ancient wetlands and lakes, she is able to read the impacts of a civilization’s deliberate activities on an environment, such as agriculture, deforestation, or draining of wetlands inundated by rising sea levels. She says that although the prevailing wisdom is that the ancient Maya were responsible for devastating changes in their environment, “they actually were responsible stewards, as well.”

“Now through observing the composition of soil layers of ancient wetlands and lakes, she is able to read the impacts of a civilization’s deliberate activities on an environment, such as agricultural, deforestation, or draining of wetlands inundated by rising sea levels.”



*Sheryl Luzzadder-Beach at ancient Maya site, Marco Gonzales*



Luzzadder-Beach is also affiliated with Mason’s Center for Earth Observing and Space Research and says “you’d be surprised at the connection” between space research and geography. “The key is earth observing.” Through a number of technologies, such as ground penetrating radar, magnetometers, and a small device called a magnetic susceptibility meter, which measures how long sediment was exposed to certain elements, Luzzadder-Beach says, “We can map what’s under the ground without having to dig.” In flyovers of the Yucatan and Belize over the past five years, she and her teammates have discovered previously undisclosed ancient wetland fields through aerial photography.

In April, she was awarded the G.K. Gilbert Award for Excellence in Geomorphological Research by the Association of American Geographers. Her field—what she calls geoarcheology—is a combination of geology, geography, archeology, and earth science.

“Doing interdisciplinary work is really how science questions get answered. It’s very powerful when you put multiple perspectives together,” says Luzzadder-Beach, who helped develop curriculum for the Bachelor of Science Degree in Global and Environmental Change, which is offered jointly by her department and the Department of Environmental Science and Policy.



*Aerial photo of ancient Maya wetland fields, Belize*



*From Virginia to the remotest locations in the world, COS researchers seek to understand how climate is changing human activity and how human activity is changing the environment.*

**S**usan Crate, associate professor of anthropology in the Department of Environmental Science and Policy, has been studying Viliui Sakha, native agropastoralists living in northeastern Siberia, Russia, for more than twenty years. She has collected data on how Sakha — who have “an intimate knowledge of their environment” — are changing how they continue their subsistence in response to the local effects of climate change.

Explaining that the Sakha raise horses and cattle, Crate says, “The main issue that inhabitants are concerned about is that their hayfields are going under water.” According to regional scientific data, forty-five percent of the standing water is “coming up from the degrading permafrost” that is beneath their lands. To date inhabitants are still able to harvest enough hay to get their herds through the long Siberian winter but each year it grows more challenging.

Although Crate, who is fluent in both Russian and the Sakha language, will continue her work with the group, she is also launching a new research project in Labrador, Canada, this year that will look at similar issues to those she has



*Flooded hayfield in Siberia*

confronted in her studies in Siberia. Supported by a National Science Foundation grant, her new project will examine how changes in seasonality are affecting people. As Crate points out, “After all, we are part of the ecosystem.”

Crate teaches Human Dimension of Climate Change as part of the new interdisciplinary Bachelor of Arts Degree in Environmental and Sustainability Studies offered jointly by COS and New Century College in the College of Humanities and Social Sciences.

## Keeping a Watchful Eye on Ecosystems

For nearly thirty years, Chris Jones and his colleagues Donald Kelso and — more recently — Dann Sklarew have been observing and studying the health of the Potomac River. The research of these Department of Environmental Science and Policy faculty members, as well as their collective vision of an on-the-water, hands-on science facility, was a major impetus in the founding three years ago of the Potomac Environmental Research and Education Center (PEREC).

PEREC inherited several projects from the group, including their long-term study and monitoring of the ecosystems in Gunston Cove, a bay of the tidal Potomac in southern Fairfax County. Their observations, says Jones, PEREC's director, has revealed evidence that “the efforts of Fairfax County and other jurisdictions in the area have resulted in a partial restoration of Gunston Cove.” The improvement comes despite the dramatic residential and business development in the Northern Virginia region. In this way, “PEREC has made a significant contribution to the area's biodiversity and to Chesapeake Bay restoration,” Jones says. “We are learning that management efforts, if bold enough, can mitigate the impact of increased human populations on our natural ecosystems.”

PEREC's most pressing issues, according to both Jones and Sklarew, PEREC's associate director, are continued improvement of water clarity, which allows light to reach underwater vegetation, and restoration of aquatic vegetation, which provides a habitat for fish and other animals to nest or hide. Another priority is educating K-12 students and science teachers in the region about watershed stewardship through the National Oceanic and Atmospheric Administration-supported Chesapeake Bay B-WET program.

*Workshops give middle school teachers the skills and confidence to inspire environmental stewardship in their students.*

Mason's environmental science students, and both undergraduate and graduate students work as field interpreters when the middle school students visit the outdoor labs. Smith points out that a number of retired Prince William County science teachers also work as field interpreters. “I love the people we work with,” she says. “It's hard to have a bad day when you see how much fun they are having.”



Photo - Creative Services

*Dann Sklarew encourages young investigators at Occoquan National Wildlife Refuge.*

## B-WET Program Connects Students to the Chesapeake Bay

Over the next three years or so, more than 30,000 Northern Virginia sixth- and seventh-grade students will pull on hip waders and sift through the muck along the banks of the Potomac River and nearby streams and ponds to discover what lives in and around the water. Guided by field interpreters — some volunteers, others who are College of Science environmental science interns or graduate students—the youngsters will check how much sediment is in the water, observe the kinds of animals that live in it, and monitor its pH, oxygen, and nitrate levels.

According to Dann Sklarew, associate director of the Potomac Environmental Research and Education Center (PEREC) and an associate professor in the Department of Environmental Science and Policy, these students are receiving a “meaningful watershed educational experience” through PEREC's collaboration with Prince William County and Fairfax County public schools and the Chesapeake Bay B-WET (Bay Watershed Education and Training) program—a partnership that fosters stewardship of the bay through experiential education for middle school students and their teachers.

The Chesapeake Bay B-WET program, now eight years old, is the original of six regional B-WET programs supported by the National Oceanic and Atmospheric Administration. Program applicants are eligible to receive as much as \$200,000 a year for up to three years to fund a single project.

With additional support from the Alice Ferguson Foundation, National Geographic, and regional parks and refuges, PEREC and its partners are currently delivering two B-WET projects: “Spatially Connecting Kids to the Bay,” a project for more than 13,000 Fairfax County seventh graders, and “From the Mountains to the Estuary, From the Schoolyards to the Bay,” a project for nearly 19,000 Prince William County sixth-grade students. Both programs are currently underway through 2013, and pilot programs that reach high school students also are in the planning stages.



Photo - Creative Services

## Seeing Both the Forest and the Trees

On a hot January day, Andrea Weeks, an assistant professor in the Department of Environmental Science and Policy, was exploring a ridge in Madagascar with her team of local Malagasy guides and interpreters. This was her first trip to the island nation, a place she describes as “the last botanical frontier.”

As they reached the top, it was clear that a large part of the forest had been scarred by man-made deforestation. Madagascar is one of the poorest countries on Earth, she explains. “People do realize the damage they are causing to the environment, but they also need to live, and they harvest the trees to make charcoal to sell.”



*Deforestation in Madagascar*

Yet as startling as the deforestation was, when she looked to the other side of the ridge she was even more startled. Standing in a surviving clump of trees was what she knew immediately to be a *Commiphora*, a genus of trees that is known around the world. This, however, was no ordinary

*Commiphora*, and as she got closer she instinctively knew it was a tree that had never been described — until now.

Weeks, a systematic biologist, says, “My research focuses on understanding the systematics, historical biogeography, and evolution of flowering plants.” She is well-known for her study of frankincense and myrrh, two trees from the same family but with different properties. Since 2005 she has been teaching students in the College of Science about the evolution of organisms, the intricacies of taxonomy, and the relationships that plant species share with the Earth. She joined the Mason faculty after completing a two-year post-doctoral assignment with the Army. “I wasn’t looking for a position per se, but the job here at Mason was a perfect fit,” says Weeks, who enjoys her classroom work and her research.

“Standing in a surviving clump of trees was what she knew immediately to be a *Commiphora*, a genus of trees that is known around the world. This, however, was no ordinary *Commiphora*, and as she got closer she instinctively knew it was a tree that had never been described — until now.”

Weeks travels the globe seeking the “evolutionary lineage” of plants. The Madagascar *Commiphora* is an example of how she and other botanists are working to preserve the Earth’s biodiversity. “Extinction is a natural process,” she says. “The problem we face now is that species are disappearing faster than ever before. This means our ability to understand life is disappearing, as well.”

Weeks was able to collect leaf and seed samples from the *Commiphora* and now has them in her lab. She has begun the meticulous process of research that is needed to see if this is truly a new tree. Once she has finished documenting her evidence, she will publish her findings to the international scientific community.

Weeks admits that the find is exciting but says new species are found all the time. A new orchid was found last year in Virginia, confirming that biodiversity is all around us, not just in the far, exotic places on Earth. Weeks is also the director of the university’s Ted R. Bradley Herbarium, where she and her students are making information about native Virginia flora available to the public via the Internet.

## Keeping the Environmental Protection Torch Burning

The exploration of life on Earth and how humans impact the environment has been a sixty-year quest for Lee M. Talbot, professor in the Department of Environmental Science and Policy, whose work in ecology, geography, and international environmental policy has helped shape the way the world now sees and responds to environmental challenges.

As the first staff ecologist for the International Union for Conservation of Nature (IUCN), Talbot began a career that would change the world's view of the environment. "I spent time with the heads of governments of forty countries," he says. An influential advisor to the Nixon, Ford, and Carter administrations, Talbot also helped pen the Marine Mammal Protection Act in 1972 and the Endangered Species Act in 1973.



*Lee Talbot exploring in Laos*

Talbot says that the greatest threat to the environment today is "the expanding human population and how it changes habitats." A dirt road cutting through a forest may be seen as progress, but it also permanently changes the environment. Yet, instead of lamenting environmental degradation, he has devoted his career to changing how governments view the environment. "I'm driven by wanting to make a difference," says Talbot. "During the '50s and '60s, the U.S. government didn't take the environment seriously as a concern." Today, he explains, there are thousands of environmental nongovernmental organizations across the globe working to support the environment.

As an educator, Talbot is shaping a new generation of scientific and policy advocates. He teaches a rotation of eight classes, and his students are a mix of policy professionals

“Talbot says that the greatest threat to the environment today is “the expanding human population and how it changes habitats.” A dirt road cutting through a forest may be seen as progress, but it also permanently changes the environment.”

looking to better understand science and science professionals looking to better understand policy. He says that it is essential for scientists to bridge their findings with public policy in a way that people can understand, adding that “George Mason University has the only department that focuses on the importance of the intersection of policy and science.”

He speaks with pride of the work his graduate students are now doing, such as research on the policy implications of the Gulf oil spill and the policy and politics involved in the reintroduction of wolves and grizzly bears to Yellowstone National Park. Talbot sees these students as adding new voices to the global environmental policy discussion.

Talbot himself is still on the world scene. Since the late '90s, he has made yearly research trips to Laos in an effort to work with the Laotian government to protect an undisturbed forest he discovered in an area he describes “from the standpoints of biological diversity and cultural diversity as one of the most significant areas in the world.”

Now eighty, Talbot is still making a difference as his ideas and understanding of the importance of policy and how to work with governments spread through his students. Population growth may be the greatest cause of environmental damage, but Talbot also knows that people are the only solution.

“Today there are thousands of environmental nongovernmental organizations across the globe working to support the environment.”



*River Nam Ou near Nong Khiao in Laos*

## Alumna Voice

# Birds Migratory Habits May Reflect Climate Change

**B**irds are often used as indicators of environmental change because they are ubiquitous, easily observed, and present at many levels in the food web. Remember the canary in the coal mine?

In the continental United States, average temperatures in January — the coldest month of the year — rose more than five degrees Fahrenheit in the last four decades. What affect, if any, has this had on bird ranges? All across the country, birders are finding bird species farther north than they used to be, but this is just anecdotal evidence. What do the scientists have to say?

“Birds have been shown to be moving both their breeding ranges and their wintering ranges northward. Is it just a coincidence that this is happening at the same time global temperatures are rising?”

The Breeding Bird Survey (BBS) is conducted every spring throughout the United States and Canada to determine the breeding range for more than 400 bird species. In 2006, U.S. scientists Alan Hitch and Paul Leberg used this data to compare the ranges of twenty-six bird species that breed east of the Rocky Mountains and south of forty-four degrees north to their breeding ranges in the late 1960s. They found that nine species exhibited a significant northward shift in their breeding ranges. As a control, Hitch and Leberg also compared ranges for twenty-nine bird species that breed east of the Rocky Mountains and north of thirty-four degrees north but found no shift in the southern boundary of their breeding ranges.

Their results were in agreement with a 1999 study in Britain that showed multiple species of birds expanding their ranges northward following a period of global warming; leading them to conclude that range changes of multiple bird species across two continents could only be the result of climatic warming.

So there is evidence that birds are moving their breeding ranges northward. But what about wintering birds?

The Christmas Bird Count (CBC) is conducted every year between December 14 and January 5 to document the status of wintering bird populations. Researchers at the National Audubon Society analyzed CBC data over the past four



Susan Heath shares the beauty of the White-tailed Hawk.

decades to determine if the wintering ranges of bird species in the United States were changing. Their findings document significant northward range movements of fifty-eight percent of observed bird species. Admitting that causation is nearly impossible to prove, they feel that global climate change is the most probable explanation.

Birds have been shown to be moving both their breeding ranges and their wintering ranges northward. Is it just a coincidence that this is happening at the same time global temperatures are rising?

My professors at George Mason University taught me that you can never prove anything in science, but I tend to agree with the conclusions these researchers reached. Birds haven't survived through the millennia without knowing a thing or two about how to adapt. However, I am both a bird geek and a science geek, so perhaps my opinion is biased.

– Susan A. Heath, MS Biology '03,  
PhD Environmental Science '08

Susan A. Heath is an avian conservation biologist at the Gulf Coast Bird Observatory ([www.gcbo.org](http://www.gcbo.org)) in Lake Jackson, Texas. Currently she is the principal investigator for a study of American Oystercatcher distribution and nesting along the Texas coast.

## New Environmental Programs Offer Students an Opportunity to Change the World

Of the new degrees offered at Mason for the first time this fall, the Bachelor of Arts Degree in Environmental and Sustainability Studies is unique among them.

A joint effort between the College of Science (COS) and New Century College (NCC) in the College of Humanities and Social Sciences (CHSS), the program is administered by a joint commission of COS and NCC educators — an arrangement Robert Jonas, chair of the Department of Environmental Science and Policy, views as “an exciting administrative adventure.”

The curriculum consists of a two-year core program and two years of study focused on a specific topic area. Courses encompass both social and earth sciences and include economics, biology, anthropology, sociology, and statistics of sustainability. Experiential learning, such as internships and field studies, also is an essential component of the curriculum.



photo- Creative Services

*COS offers students a variety of program options in environmental studies.*

Another unique aspect of this program is that “we insist that students select a concentration,” says Jonas. “Without a concentration, [employers] might not know what you can do.” Students can select from several concentrations, including climate change and society, environmental policy and politics, environmental economics, and equity and environmental justice. According to Jonas, graduates from this program “can change the world with just a bachelor’s degree.”

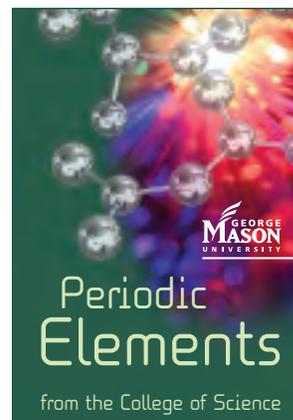
COS also launched a new Bachelor of Science Degree in Environmental Science this fall, which offers students an

“Experiential learning, such as internships and field studies, also is an essential component of the curriculum.”

opportunity to explore techniques of environmental science and engineering, environmental policy, risk assessment and management, and the processes involved in public and private decision making.

Jonas explains that both degrees have a similar architecture and will appeal to a broad array of people. He also is quick to point out that a “comprehensive set of degrees” in environmental science and policy—from the undergraduate to the doctoral level—is now available to students.

To support these two undergraduate degree programs, as well as a variety of other science and non-science majors, three new minor programs also were introduced this fall: The Conservation Biology Minor is designed for students with an interest in wildlife and habitat conservation issues; the Environmental Science Minor exposes students to environmental concerns that impact the natural world and society; and the Environmental Policy Minor promotes a better understanding of environmental policy matters.



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