



## Princeton Students Spend Summer Conducting Research in Bermuda

This summer, land-locked Princeton students took advantage of a new program offering them access to the open ocean, a fine research facility, and an expert group of marine scientists with whom they conducted independent research—all within steps of the beautiful beaches of Bermuda. The new summer undergraduate research program was initiated by the Program in Environmental Studies (ENV Program) of the Princeton Environmental Institute (PEI), along with the departments of ecology and evolutionary biology (EEB) and geosciences (GEO) in partnership with the Bermuda Biological Station for Research (BBSR).

Five Princeton students participated as research interns working with BBSR scientists on independent projects focusing on various aspects of marine biology and oceanography. This incipient program is the first step in what will be a broader Princeton-BBSR Summer Undergraduate Program, commencing with a course in marine biology to be taught by Professor James Gould (EEB) in the summer of 2006 and an additional course in oceanography to be taught by Professor Daniel Sigman (GEO) in the summer of 2007.

BBSR was founded as an independent marine research and educational institution in 1903 by scientists from Harvard and New York University to take advantage of Bermuda's ideal mid-ocean location for deep-ocean and coral reef research. Since then, BBSR has built a global reputation in blue-water oceanography, coral reef ecology, and research on the connections between ocean health and human health. Incorporated in New York in 1926 as a U.S. 501 (c) (3) non-profit organization, BBSR's mission is to conduct research and science education of the highest quality from the special perspective of a mid-ocean island

and to provide well-equipped facilities and responsive staff support to visiting scientists, faculty, and students from around the world. Thus it serves a wide range of scientists and students, both in Bermuda and from dozens of countries, each year.

The overall goal of the summer research internship program is to provide aspiring undergraduates an opportunity to obtain hands-on experience con-



PEI/BBSR interns and their mentors. Pictured here from left to right: (front row) Kim Zeeh (Eckerd College) Caitlin Gregg, Ellen Zuckerman, Ron Weissbard, Joanna Mandeki, Yulia Mostovoy. (Second row): James Wood, Gerry Plumley, Mike Lomas, Walt Carlson, Don Walker.

ducting research in marine sciences. The Princeton undergraduate science majors participated in the eight-week program which ran from June 4 to July 30.

The Princeton interns were paired with a faculty mentor from the BBSR and from the University. Each student chose to work on a specific research project and was required to maintain on-going research. Most of the projects were funded by federal grants from sources such as the National Science Foundation (NSF)

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and the National Oceanographic and Atmospheric Administration (NOAA).

In addition to daily lab work, students were required to participate in a weekly seminar where they presented either an update of their research project or a brief presentation on some recent scientific discovery. The weekly presentations required students to stay abreast of their own projects and helped each student integrate his or her specific project into the larger scientific community of research conducted in Bermuda. Final written reports of the summer-long project were due at the end of the session and students presented a formal seminar to BBSR staff and visitors on their projects.

Below are synopses of the research projects.

**Caitlin Gregg ('07, EEB)** studied signaling behavior in Caribbean reef squid, specifically how the squid react to each other's anti-predator defense responses. Squid are highly intelligent invertebrates that com-

*The overall goal of the summer research internship program is to provide aspiring undergraduates an opportunity to obtain hands-on experience conducting research in marine sciences.*

municate using complex visual signals. Studying them in a lab environment allows scientists to control the stimuli presented to the squid and carefully observe the subsequent behaviors. This program was supported by James Wood, BBSR research scientist, and Professor Gould.

**Joanna Mandrecki ('07, EEB)** was involved in devising a method using flow cytometry and stable isotope mass spectrometry to examine carbon and nitrogen uptake rates in open ocean phytoplankton populations. In the future this method will be used to study phytoplankton nutrient uptake under varying conditions (e.g., water column depth, location, time points) as input to model oceanic plankton uptake rates of atmospheric carbon dioxide. Several incubations and experiments have been conducted. The BBSR reports that flow cytometry data look excellent thus far with mass spec data expected soon. This project was supported by Mike Lomas, BBSR associate research scientist, and Jorge Sarmiento, professor of geosciences, Princeton.

**Yulia Mostovoy ('07, EEB)** was involved in a project whose long-term goals are to identify and characterize

the genes responsible for producing saxitoxin, a suite of toxic compounds that causes paralytic shellfish poisoning, a disease encountered during certain algal blooms. Mostovoy's short-term goal was to identify the restriction endonucleases present in saxitoxin-producing strains of a cyanobacterium. Her research was under the supervision of F. Gerald Plumley, BBSR deputy director, associate education director, and senior research scientist, and Laura Landweber, EEB professor, Princeton.

**Ron Weissbard's ('06, Chemical Engineering)** project was based on the premise that in order to predict and model carbon fixation from ocean biomass, it is necessary to understand uptake levels of limiting nutrients by plankton. Weissbard is researching a new method of quantifying consumption rates and levels of organic phosphorous, an important limiting nutrient in the north Atlantic, using enzyme-linked fluorescence (ELF) and flow cytometry. He has confirmed that the ELF method works well with the planktonic alga *Tetraselmis* and is currently testing other species as well as field samples from the open ocean. Advisors on this project included the BBSR's Lomas and Princeton's Professor Sigman.

**Ellen Zuckerman ('07, GEO)** studied Bermuda's anchialine caves, which formed around 900,000 years ago and are home to most of Bermuda's endemic species. She performed chemical analyses of the water within five different caves to determine whether or not sewage is seeping into the system, examined microbial life within two of the caves, and determined tidal flow and residence times within five caves and their neighboring sinkholes. Zuckerman's research was conducted with assistance from James Wood, BBSR assistant research scientist, and Professor Bess Ward, GEO, Princeton.

Students ended their Bermuda experience by participating in a "Give Back to Bermuda Day." Students combined outreach to K-12 students with physical labor and worked with Waterstart campers (Bermudians, ages 10 and up) to clean up flotsam from Walsingham Pond, a tidally influenced pond adjacent to property owned by the Bermuda National Trust.

*We are grateful to Anne and Bill ('69) Charrier, the Charrock Foundation, and BBSR for their generosity in supporting the Princeton-BBSR internships. Thanks also to F. Gerald (Gerry) Plumley, BBSR deputy director, associate education director, and senior research scientist, for his contribution to this article—Ed.*

# PEI Outreach Programs Increased in 2005

By Anne N. Catena, PEI Outreach Coordinator

Outreach, the dissemination of information about environmental science and current research, is central to PEI's mandate. This year, PEI's community outreach exceeded that of previous years due to growth in existing programs and the addition of the Cooperative Institute for Climate Science (CICS), one of the research programs within PEI. Below is an overview of the year's programs.

For more information, please go to PEI's website at <http://web.princeton.edu/sites/PEI/> and choose Outreach.

Established in 2003, CICS aims to be a global leader in understanding and predicting climate and the co-evolution of society and the environment, integrating the physical, chemical, biological, technological, economic, social, and ethical dimensions of climate changes, and training future generations to deal with the increasing complexity of these issues. In support of this commitment, CICS held a professional development program for local elementary school teachers to help them better understand the complexities of weather and climate studies. Sixteen teachers spent two weeks in July with Princeton Township middle school teacher Dr. Steven Carson, formerly of the Geophysical Fluid Dynamics Lab, learning about storms and the implications of global climate issues for the future.

Also in July, PEI hosted the CEBIC Summer

Institute for middle school teachers. The combination of molecular and large-scale environmental sciences pursued by the Center for Environmental Bioinorganic Chemistry (CEBIC) researchers provides a vehicle for explaining science, its motives, and its methods to non-scientists. Nineteen middle school teachers participated in the hands-on professional development program this year. Dr. Eileen Zerba, of the Environmental Studies Program (ENV), taught a one-week unit that focused on fresh and saltwater environments with the assistance of geosciences Professor Bess Ward and Danielle Schmitt, geosciences undergraduate lab manager. Professor Andrew Bocarsly of the chemistry department taught a one-week unit on

*The ... sciences pursued by the [CEBIC] researchers [provide] a vehicle for explaining science, its motives, and its methods, to non-scientists.*

chemistry and the human body. Chemistry Professor John Groves spoke to the teachers about the role of oxygen in the body.

As part of the CEBIC Summer Undergraduate Research Fellowship Program, 13 undergraduates were awarded eight-week fellowships in CEBIC laboratories. A central outreach focus for CEBIC has been to increase ties to local community colleges. Three of the summer fellows were from Mercer County Community College and Middlesex County College in central New Jersey. The students participated in research in bioremediation with bacteria and/or the effects of trace metals on diatom and bacteria growth. CEBIC

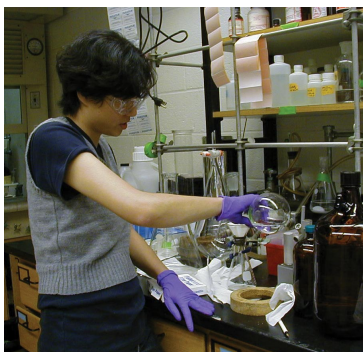


Middle school teachers from central New Jersey take water samples during field work at the CEBIC Summer Institute.

Research advisors were from Princeton University, Rutgers University, and the University of British Columbia. CEBIC also hosted Dr. Virender Kanwal, a faculty member from Middlesex County College, in Paul Falkowski's laboratory at Rutgers University. Kanwal learned about current research regarding cell adaptation to environmental stress.

With support from PEI's Center for BioComplexity, Ecology and Evolutionary Biology (EEB) Professor Henry Horn delivered a program called Integration Across the Curriculum for 12 elementary school teachers from central New Jersey that emphasized the integration of literature, science, math, and technology. The week-long program focused on identifying patterns in nature and incorporating literature into the teaching of science and math. Later that month, Horn held a workshop entitled "Book Crafting: Animals in the Picture" at the Cotsen Children's Library in Firestone Library for fifteen 10 to 12 year olds.

In March, more than 900 students and their teachers from 11 New Jersey middle schools participated in the second annual Princeton University Science and Engineering Expo. Program highlights



Suzy Yang, a student from Mercer County Community College working in Princeton chemistry Professor Jay Grove's lab, synthesizes porphyrin for potential drug applications.

included hands-on experiments provided by Becky Barak, '04; Joshua Weitz, visiting research fellow, EEB; and Barclay Satterfield, a graduate student in chemical engineering and a PEI-STEP Fellow.

These experiments included creating a cloud inside a glass chamber and experimenting with water

pollution in a watershed. Representatives from Stonybrook-Millstone Watershed modeled source point pollution and Jon Beyer '05, founder of Terra Cycle, showed the students how his company uses red worms to turn garbage into high-quality compost and fertilizers. Roberta Hotinski, information officer for PEI's Carbon Mitigation Initiative (CMI), explained the Stabilization Triangle game developed by the CMI (see [http://www.princeton.edu/~cmi/resources/CMI\\_Resources\\_new\\_files/Wedges\\_Concept\\_Game\\_Materials\\_2005.pdf](http://www.princeton.edu/~cmi/resources/CMI_Resources_new_files/Wedges_Concept_Game_Materials_2005.pdf)).

## Lecturer's Career Takes Another Turn, Students Benefit

# Hawkins Champions Smart Growth as Head of NJ Future

Since graduating from Princeton in 1983, George Hawkins has navigated an environmentally-centered career through positions in law, government, and local conservation. Most recently, in late 2004, he was named executive director of NJ Future.

Located in Trenton and founded in 1987 by New Jersey corporate, civic, and environmental leaders, NJ Future is a non-profit, nonpartisan organization advocating smart growth: well-planned and well-managed conservation and economic development policies that will help create a sustainable future for New Jersey.

A lawyer by training, Hawkins began teaching ENV 306, Environmental Law and Moot Court, a popular course with Princeton undergraduates and a valuable component of PEI's curriculum, in the spring of 2000.

*PEI News* spoke to Hawkins about his personal journey from Princeton graduate to a leadership role in the environmental advocacy movement and how his experiences combined to make ENV 306, in the words of many of his students, "one of the best classes at Princeton."

**PEI:** You have worked on environmental issues from many different angles. Would you describe the course of your career?

**GH:** After I graduated from law school [Harvard '87], I ran a restaurant and bar in Harvard Square and learned about customer service first hand, a valuable lesson that has paid tremendous dividends ever since. When the building that housed the restaurant was torn down, I decided to give up on the restaurant business and practice law. I joined the Boston and Washington, D.C. firm of Ropes & Gray. I worked at first in Boston doing mostly corporate transactions and litigation. Although I did not love the work, I received excellent legal training.

My interest in environmental law started about a year later and saved my legal career. I had decided that I wanted to work for a cause that I could be pas-

sionate about and was thinking of leaving the firm. At that moment, from a chance meeting with a partner in a hallway, I was asked whether I had time to take a case about a water discharge permit in Peabody, Massachusetts. Of course I said yes, associates always have time, and read through the permit late that same evening. I vividly recall realizing that I had found my career. I loved environmental law from the first, because it is filled with science, public policy, and complicated



George Hawkins

laws and regulations, and outcomes matter to people and countless living organisms. I could imagine dedicating a career to the environment.

I moved out of corporate litigation and became an environmental lawyer, mostly working with companies to assess

their compliance with existing laws.

After five years, I left the firm and became a federal enforcement lawyer for the New England branch of the U.S. Environmental Protection Agency (USEPA). After several years specializing in big municipal landfill clean-ups, I was appointed special assistant to the regional administrator. In this position I had the chance both to develop enforcement policies for companies that violated the law--but also to create new programs that helped businesses understand what was expected of them and to offer incentives for performance better than what regulations required. Vice President Gore liked this approach and brought me to Washington, D.C. to join the National Performance Review [which in, 1998, became known as Vice President Al Gore's National Partnership for Reinventing Government] in Washington, D.C. I was tasked with developing concepts to reinvent how environmental laws are used to protect the environment.

The irony is that after working on the subject for almost a year, I became convinced that I had to reinvent myself, because the environmental challenges of the modern era were changing, and the federal government is simply not the key player. The issue today is how and where we develop land, or preserve it, which at least on the East Coast is a matter of local zoning laws. I decided to become intimately involved in local land use, and for that reason, left Washington to come back to New Jersey. In 1997, I became

the executive director of the Stony Brook-Millstone Watershed Association, and spent the next seven years in a labor of love working on local preservation and development issues in central New Jersey.

My latest revelation is to understand the importance of focusing on how we treat our existing developed areas, cities and older suburbs, which in New Jersey are often in dilapidated condition, both to improve the quality of human habitat, and by making these places more desirable, to reduce the development pressure on remaining areas of natural habitat.

**PEI:** What does your position as executive director of NJ Future entail?

**GH:** NJ Future is concerned about development and its relationship to natural areas. Since New Jersey will be the first state in the nation to finish building all the development that is allowed by zoning laws [called "build-out"], we need to be most careful where this growth is located and how it is designed. Dumb growth, or sprawl, spreads out over the landscape, separating people from their jobs and each other, making them dependent on driving on congested roads, and consuming natural land at a much faster rate than population growth. NJ Future favors "smarter" growth, which plans for revitalizing existing cities or designing new town communities where people live near public transportation, can walk to school and to shop, and can be surrounded by open space and farmland accessible by bike or foot. Smart growth also saves money as taxes are spent in existing communities, rather than paying for new roads and sewers to development spread out into the countryside.

NJ Future is a policy outfit working on these issues. We provide advice to government officials, development professionals, community activists and environmental groups. For one example, the USEPA has hired NJ Future to come up with a national smart growth agenda for the governors and their key department officials. For another example closer to home, NJ Future will publish this fall a smart growth agenda specifically tailored to New Jersey and the new incoming governor.

The bottom line is that I have come to fervently believe that our economic and environmental futures are inextricably intertwined. Protecting a sustainable environment is fundamental not only to the myriad of miraculous creatures that live in nature, but fundamental to our own economic survival and sense of well-being. At the same time, a thriving economy

requires thriving human communities, developed and sustained in concert with the natural world. NJ Future seeks to accomplish this vision by working on these connected issues as a whole, not just economic, or just environmental, but both.

**PEI:** What were the origins of your course, ENV 306: Environmental Law and Moot Court?

**GH:** I developed the idea in 1998 when I was invited to give a lecture to ENV 201 about how laws work, and were changing, to protect water quality. PEI Director François Morel came to the lecture and we had lunch afterwards. He pitched the idea to me and I agreed to teach a class on environmental law for PEI.

That first spring [2000] I had no idea what I was getting into. I had 18 students, a law school text book, and a curriculum I developed from scratch. I ended up working almost every night for several hours. I had never taught before, never graded papers before, and each lecture I gave was a first. I had 18 times three papers to grade, case teams to develop, and the details of moot court to work out. There was a point

*“ . . . I have come to fervently believe that our economic and environmental futures are inextricably intertwined.”*

during the middle of the semester that I was not sure if I was going to make it.

Starting the next year, I limited the class size to 12, which allows me to focus more time on each student. I improve the course a little every year, but the fundamental structure remains the same. Today, I am humbled that the class is filled mostly with juniors and seniors and there is a waiting list.

The bottom line for the class is that I want students to learn to think, write, and speak like lawyers, separating the skill of persuasion from belief by learning to advocate for any side of an issue. No matter what their personal beliefs and inclinations are, I am not trying to change their minds, they must learn how to understand other points of view. They need to learn how to prepare arguments and they must think about notions of common ground between their point and the other person's. The students get to participate in moot court twice each semester, once as a plaintiff and once as a defendant, and write short briefs. I love teaching the students and probably get more from the class each year than they do.

**PEI:** Has your position at NJ Future resulted influenced the curriculum for ENV 306?

**GH:** I plan in 2006 to add discussion about laws and smart growth. How can we encourage or even require growth in particular areas while protecting others? How do we respond to issues of environmental justice as we focus development in cities, potentially increasing pollution for the people who reside there? If we seek to redevelop in cities, how do we respond to the challenge to property rights from the use of eminent domain by municipalities?

I can say that NJ Future's concept of smart growth relates very much to the concept of "Princeton in the Nation's Service." I advise my students to pick a career that will enable them to make a meaningful difference to humanity and the world which, in turn, will give their own lives more meaning. This sounds trite, but I can hardly count the number of conversations I have had with classmates who long for more purpose in their work.

**PEI:** Do you encourage students to consider careers at nonprofit organizations?

**GH:** I believe in choices and change. At every step of my career I have tried to expand my range of experience, expanding, I hope, my choices for future work and career steps. I have had wonderful experiences in private firms, in government, in academics, and in community service, and it is the sum of these experiences that eclipse any one of them. There are, of course, career trade-offs with the choices we make, I, for example, left the earnings of a private career when I went into government. On the other hand, I have gained good friends, a sense of purpose in my work, and a relatively unique sense of this arena from almost every perspective. And now I face questions that matter to the people of this state: What do we want to protect and save? Where do we want new growth to go? What do we want our homes to look like? Where should our jobs be located?

Princeton is educating the next generation of leaders. Teaching a class at Princeton allows me to work with very gifted students and help them, and me, see the world differently. As business leaders, they can make environmental issues a priority at the places they work. I just want students to think about service as a worthy pursuit and I believe it is incumbent upon everyone to build that into their lives.

To learn more about NJ Future or to contact George Hawkins, please go to [www.njfuture.org](http://www.njfuture.org).

## Alumni Chat: Christopher Kim '95



**G**rowing up near Berkeley, Christopher Kim '95 became interested in geology and environmental issues at an early age. Kim graduated summa cum laude with a degree in geology and an ENV certificate in 1995. As a graduate student at Stanford University he earned a Ph.D. in geological and environmental sciences. Kim conducted post-doctoral research at the Lawrence Berkeley National Laboratory then joined the faculty of Orange County-based Chapman University in 2004. As a member of the department of physical sciences, he teaches earth science, environmental science, and chemistry in addition to conducting research.

**PEI:** Why did you pursue the ENV certificate?

**CK:** When I came to Princeton, I wanted to choose a major that would allow me to pursue my environmental interests, and geology seemed like the most logical choice. My thesis was titled "Absorptive Properties of Magadiite: Implications for Hazardous Waste Containment" and looked at the potential of a specific sodium silicate mineral to absorb organic contaminants such as benzene from landfill runoff. This sparked an interest in the field of environmental geochemistry—which I decided to pursue in graduate school. My Ph.D. thesis was on mercury contamination issues in the California coast range, which hosts the largest natural mercury deposits in North America. Before grad school, though, I

took the opportunity to teach English in South Korea through the Princeton-in-Asia program.

**PEI:** What inspired you to study mercury contamination?

**CK:** I took a class during my first year where I wrote a research paper on mercury deposits in California; right around the time that I met a geologist at the U.S. Geological Survey who was an

*"The ENV Program gave me a legitimate academic avenue to expand my environmental awareness, both from a scientific and societal viewpoint."*

expert on these same deposits. All the right conditions seemed to converge at the same time, and with my advisor, we wrote a grant proposal to the U.S. Environmental Protection Agency (USEPA). It was funded and provided me with financial support for the rest of my time at Stanford. After that I was known as the "mercury guy."

Following my graduate work, I held a joint post-doctoral fellowship with the Earth Sciences Division of Lawrence Berkeley National Laboratory and the Earth and Planetary Sciences Department of the University of California, Berkeley. My research focused on the ability of iron oxyhydroxide nanoparticles to absorb heavy metals such as arsenic, copper, mercury, and zinc.

**PEI:** Are you still doing research?

**CK:** I'm continuing some of the work I did during my post-doc: using nanoparticles in possible remediation strategies to clean up heavy metals in contaminated water supplies. I'm also looking into broader trends of metal concentrations in mine wastes as a function of particle size, a topic of substantial interest right now to the EPA and Bureau of Land Management (BLM). And, of course, I'm still the mercury guy, so I've been spending some time working on new techniques for identifying mercury species in natural samples at levels far lower than those I studied in graduate school.

**PEI:** How did the ENV Program impact your career choice and goals?

**CK:** The ENV Program gave me a legitimate academic avenue to expand my environmental awareness, both from a scientific and societal viewpoint. The experience fueled my growing interest in both environmental research and teaching, which in my mind fits an academic career perfectly.

**PEI:** Do you have any advice for students pertaining to a career in the environmental field?

**CK:** I encourage students to consider the ways in which their environmental interests can be manifest in all aspects of their lives—academically, socially, personally, and globally. A student trained and educated in environmental issues has both a significant opportunity and the knowledge to make a difference. Make it!

## Five Students Tapped for Awards at PEI's 2005 Class Day Celebration

PEI honors environmental studies certificate (ENV) students, and others with an interest in the environment from a broad range of disciplines, by conferring awards and prizes each year on class day. The 2005 Environmental Studies Prize recipients are listed below.

### The Peter W. Stroh '51 Environmental Senior Thesis Prize

This prize was established in 2003 as a memorial to Peter Stroh, an active and effective member of PEI's Advisory Council and a strong supporter of the Environmental Studies Program.

Carol Rosenfeld '05, Civil and Environmental Engineering. Advisor: Catherine Peters. *Limitations on Power Production in the Delaware River Basin: Current and Future Cooling Water Use.*

### Environmental Studies Thesis Prize

Kyle Meng '05, Civil and Environmental Engineering. Advisors: Michael Celia and Robert Williams. *Identifying Opportunities for Carbon*

*Capture and Storage Demonstration Projects in China.*

### Environmental Leadership Prize

Christina Harris '05, Anthropology. Advisor: Larry Rosen. *The Structural Poverty of Agricultural Laborers: A Consequence of the South Eastern Agricultural System.*

### Becky Colvin '95 Field Research Award

This award is a grant that supports environmental field research projects for the senior thesis. The fund was established and is supported by Dr. and Mrs. Robert Colvin in memory of their daughter. Becky Colvin '95 was an ecology and evolutionary biology major who was committed to field ecology and environmental studies. The co-recipients are:

Alexander Nees '06, Ecology and Evolutionary Biology. Advisor: Stephen Pacala. Planned project: Studying the impact of invading tamarisk on native cottonwoods along rivers in Colorado.

Madeline Renny '06, Ecology and Evolutionary Biology. Advisor: B. Rosemary Grant. Planned project: Conservation of the diamond-back terrapin.

## PEI Faculty Awards

Simon Levin, professor of ecology and evolutionary biology, has been named a 2005 recipient of the Kyoto Prize in honor of his contributions to environmental science. The Inamori Foundation of Japan presents the annual awards in recognition of lifetime



achievement in the categories of basic science, advanced technology, and arts and philosophy.

Levin will receive the award in Kyoto in November.

Robert Socolow, professor of mechanical and aerospace engineering, has been honored by the Royal Swedish Academy of Engineering Sciences (IVA) and the benefactors of the Axel Axelson



Johnson Endowment for his outstanding research in global carbon management and the hydrogen

economy. Socolow has been invited to give the 2005 Axel Axelson Johnson Commemorative Lecture at the IVA in Stockholm on December 1.

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Additional information about the Institute and the Undergraduate Program in Environmental Studies is available on the Internet: <http://web.princeton.edu/sites/PEI>

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