



2005 Taplin Environmental Lecture

Bruce Babbitt Offers Vision of Federal Land Use

Addressing the audience gathered for the 2005 Taplin Environmental Lecture in November, Bruce Babbitt, Secretary of the Interior under President Clinton, spoke about his recently published book, *Cities in the Wilderness* (Island Press, 2005). Calling the volume a “policy book,” Babbitt said it is based on his experience and touches a number of issues currently confronting the nation, including sprawl.

Acting Director of PEI and Professor of Ecology and Evolutionary Biology Stephen Pacala called Babbitt “a proponent of protecting the rights of all while balancing that with protecting the environment” in his introductory remarks. Among the events and accomplishments that involved the Department of the Interior when Babbitt was at the helm (1993-2001), are the spotted owl controversy, the Everglades Forever Act, and the return of wolves to Yellowstone.



Since its August release, *Cities in the Wilderness* has received positive reviews. Donna Seaman, writing for *Booklist*, states that it is a “refreshingly to-the-point and commonsensical account of the formulation of major land-use

initiatives and assessment of the thorny thicket of science and politics...”

Babbitt, a former governor of Arizona, said he was motivated to write the book from a sense of melancholy. As he reflected on his career, “The more melancholy I became.... We are still losing ground. For one acre protected, we are losing hundreds, even thousands [of acres] to sprawl, causing the destruction of coastlines, watersheds, rivers, and more. I thought, ‘we can’t go on like this.’”

Babbitt contends that sprawl is a reflection of American culture. “It began 200 years ago when George Washington built a canal to access his land in Virginia,” he said. “Canal projects then gave way to railroads, and then came the interstate highway system. In 2005, Congress approved \$315 billion for the construction of more highways...another instance of a single, advanced, unplanned case of land use. Two-hundred years after

PEI Names Kathy Burks Hackett as Associate Director

Katharine Burks Hackett '79 has been named associate director of PEI, effective February 1. She replaces Janet Gruschow who was named assistant to President Shirley Tilghman on January 1.

Burks Hackett received an AB in economics from Princeton in 1979 and an MBA in finance and accounting from Columbia in 1983. She has extensive experience in the financial services industry, including eight years with Dun and Bradstreet.

Kathy has devoted much of her energies during the past decade to local nonprofit and community organizations, providing them with strategic planning, managerial, financial, and economic expertise. Some of these agencies include Trinity Counseling Services, HiTOPS, the J. Seward Johnson Foundation, and local schools. She has been a Princeton University alumni volunteer for the Class of '79 and the National Annual Giving Campaign Committee, among others.

Welcome back to Princeton, Kathy!

WHAT'S IN THIS ISSUE:

Page 2

Finding Science in Art:
The Gates

Page 4

Beatrix Farrand Garden
at Graduate College is
Restored and Updated

Page 6

Visiting Environmental
Economist: Richard Tol

Page 7

Alumni Chat:
Suzy Friedman '94

Washington, we must think of a national land-use plan that is a little more robust than subsidizing development. This book outlines how to get from here to there.”

According to Babbitt, the solution to the problem of sprawl across the nation is to make federal grants to a state contingent upon the state’s having a land-use policy that will protect watersheds, native species, and open land. He explained that while the federal government is prohibited from mandating that states have land-use plans, it can impose conditions on grants.

This solution, he said, has established precedent in The Coastal Zone Management Act, which induces states to protect coast lines. He also pointed to the conditions placed on federal funding for highways—which resulted in an increase in the number of emergency exits and raising the legal drinking age to 21 throughout the country—as another example.

Babbitt believes that to achieve effective policy, there needs to be a partnership between local, state, and federal governments. “The idea of land-use policy

“Local governments can be flattened by the political power and money the developers have.”

as being a local matter is pure fiction,” he argued. “Local governments can be flattened by the political power and money the developers have.”

According to Babbitt, New Jersey is an interesting state to look at in terms of land-use policy. On one hand, he said, the state will be the first in the Union to reach build out. On the other, is New Jersey’s plan called the Pinelands Protection Act created in 1979 and credited to then-Governor Brendan Byrne ’49.

Related to the Act is the Pinelands Comprehensive Management Plan (CMP), adopted in 1981 to direct growth to designated areas in the Pinelands, is considered one of the most advanced regional plans in the country. It protects thousands of acres of the ecologically-significant Pinelands through a combination of regional land use regulations and innovative tools like a regional transferable development rights (TDR) program that rewards landowners for protecting their land from sprawl.

Despite Babbitt’s melancholy feelings about the nation’s current situation, he is optimistic for what lies ahead. “I think we are now bouncing off the bottom. Every day of life must be an affirmation of the future.”

Finding Science in Art

Using The Gates to Advance Study on Wind and Seed Dispersal

Many tourists in Manhattan last winter experienced The Gates, the installation by Christo and Jeanne-Claude in Central Park. Some went to appreciate the art, some to ponder its significance. Princeton’s Professor Henry Horn went looking for science—and found it.

Professor Horn of the department of ecology and evolutionary biology (EEB) and a member of PEI’s associated faculty believed that The Gates could help him illustrate patterns of wind and understand the dispersal of windblown seeds. He took photographs, made observations and calculations, and was not disappointed. An article about his research, “Eddies at The Gates,” was published in the July 14, 2005 issue of *Nature*.

PEI News spoke to Professor Horn about how science and art came together to illuminate his research.

PEI: Would you explain your research and why you photographed The Gates?

HH: I made the trip to The Gates initially to get a visual example of wind currents to use in a lecture I give on the long-distance transport of wind-blown seeds.

The study of seed dispersal has important implications for understanding the way natural landscapes develop. When Ran Nathan* and I began this project, we knew that wind-blown seeds have various mechanisms that cause them to fall slowly and allow them to disperse a moderate distance. We thought that when a particular seed falls in a forest, it would have a chance of being dispersed far away only if it could somehow get above the forest, as winds within forest would naturally be slower due to obstruction by the trees. So the question became: Can a seed be caught by an up-draft that is faster than the rate of its fall in still air?

I constructed machinery to measure the rate of fall of seeds in still air. The machine has a seed-dropping shelf synchronized with a computer-driven stroboscopic camera. Working with Sarah Kaplan ’01, whose contribution became her undergraduate thesis and was published in 2001 in *Ecological Research*

(vol. 16, pp. 877-885), we gathered seeds from a tall tulip tree, from the ground below it, and from the roof of the even taller nearby building, the Hibben-Magic Apartments. Seeds on the roof must have been lifted from the tree by updrafts of higher velocity than their rates of fall in still air. So we expected that when Sarah measured the rates of fall of seeds in the lab, those from the roof would be a slower-falling selection compared to those from the tulip tree or the ground.

We got a big surprise. The spectra of falling velocities of seeds were nearly identical, from the roof, from the tree, and from the ground. So we learned it is not a particular subset of seeds that gets blown up above the forest under the usual winds. Rather, it's that under unusual circumstances all seeds can rise, and thus be candidates for long-distance dispersal.

To test this idea under more natural circumstances, we did the same sort of experiment from a scaffold tower at the Duke University Forest aided by Duke colleagues, professors Gabriel Katul and Roni Avisar and technician Suvi Thomas. We collected seeds from the ground and from bins on the towers above the level of the treetops. Although there is a slight tendency for the seeds gathered above the forest canopy to fall a little slower, their velocities in the lab span the same range as seeds gathered on the ground.

That led us to the idea that plants might have ways of 'choosing' wind conditions under which they release their seeds. In other words, the plant tends to hold its seeds in normal winds and release them into high winds. There are lots of observations one can make in natural history that support this notion. For example, ash and box elder trees have clusters of seeds that bend to shed light winds as a fusiform

airfoil. Only when the wind becomes sufficiently violent to shake the trailing edge of the airfoil are seeds torn off. Similarly, the puff-ball of a dandelion sheds in light winds, but breaks apart to release seeds in turbulent winds.

Turbulent winds often have coherent, rolling eddies, so that a wind-blown seed might 'surf' the updraft side of the eddy and be carried for as long and as far as the eddy remains coherent. To illustrate this

metaphor when I give talks about our work, I took pictures of eddies in the water of the Delaware River during the big flood that occurred on September 19, 2004. To visualize this idea further and more appropriately, I went to The Gates. I initially intended only to get photos to illustrate that moderate-sized wind puffs do exist. The Gates were made of hanging banners of fabric, and some of my photos show very clearly groups of adjacent banners being puffed by the wind, separated from other puffed groups by banners that are hanging slack.



The photo shows groups of seven and 11 consecutive Gates billowing in the wind. This suggests minimum eddy footprints of respectively seven and 11 times the 12-foot spacing of adjacent Gates. Sometimes such eddies would move along the line of Gates, and sometimes they would remain stationary for a minute or more. (Photo courtesy of Henry Horn.)

PEI: How did you incorporate this information into your work?

HH: I studied about 60

photographs that I took. From them, I could count the number of contiguous gates that were blowing in each puffed group. From those counts I could estimate the 'footprint' sizes of wind eddies. Measured footprints ranged up to 45 meters at wind speeds of about five meters per second. I could calculate a gust's lifespan from timed sequences of photos at a particular place, as the row of fabric panels rose and fell. Some gusts lasted for a minute or more. A seed surfing such gusts could travel a quarter of a kilometer or more. Many of my measurements are underestimates, since the edges of photos or the ends of sequences did not always include the end of a particular

eddy. Nevertheless these calculations provide a critical lower bound for our current understanding of how seeds might be dispersed over even longer distances.

PEI: What did you initially do with your analysis of the wind patterns at The Gates?

HH: I wrote up the story of “Eddies at The Gates” and the calculations as a playful piece coauthored with my alter egos, J. Chester Farnsworth and Sherman Sindie, and sent it to friends. As it turns out, many of them were very enthusiastic about it. One of those friends, Lord Robert May of Oxford, told me that I should take myself more seriously, and he passed a cleaned-up version of the manuscript to some of his friends. [Lord May was formerly Class of 1877 Professor of Zoology at Princeton. He moved to Oxford in 1988 and was appointed Chief Science Advisor to the Queen.] Thence the manuscript, shortened and rewritten in several transatlantic telephone calls, was eventually published under my name in *Nature*.

“The study of seed dispersal has important implications for understanding the way natural landscapes develop.”

PEI: What kind of feedback have you received on the article since it appeared?

HH: Among others, I have received inquiries from a Dutch science newspaper and the editor of the French version of Scientific American, asking to publish something about the next stage of this work. I have also received what can only be described as ‘fan mail,’ which, for a paper that is part art and part science, is very exciting.

PEI: Do you plan on continuing this research?

HH: There are so many directions I could take this project; I am a little leery of having too much of a conversation about it now, because I am not sure where it will go. I am mulling over doing something on a more manageable scale ... say, looking at a short scrubby field rather than a full forest, and using mini-gates made of discarded pantyhose. A simple video of a bubble machine might work. This project started out as fun, so why not make it fun at the end?

** [Editor’s note: In the course of his study on seed dispersal, Henry Horn collaborated with Ran Nathan.]*

The second article of a two-part series on the evolution of the campus environment

Beatrix Farrand Garden at Graduate College is Restored and Updated

The overgrown hollies have been cut back to clear walkways; the arbor restored, providing lovely shade; and resplendent flowers, planted in meticulously-edged garden beds, dazzle the eye. Wandering along paths at the Graduate College’s Wyman House garden in August, one feels uplifted.

The garden, originally designed by Beatrix Farrand in the early 1900s, was restored by the University in the spring of 2005 at the request of Graduate School Dean William Russel, a former member of PEI’s associated faculty, and his wife Priscilla. Wyman House is the official residence of the dean of the Graduate School. Mrs. Russel, an experienced and enthusiastic gardener, helps look after the gardens and grounds there. The restoration began in December 2004 and was completed in time for the May 2005 reunions.

Princeton Grounds Manager Jim Consolloy led the garden committee that selected New York City-based public garden designer Lynden B. Miller for the job. “Dan Casey, coordinating architect from the Office of the University Architect, and I were impressed with Miller. She has impeccable qualifications,” Consolloy said.

Miller is the landscape consultant to Columbia University and Stony Brook State University of New York. She has designed gardens for The New York Botanical Garden, Bryant Park, and many other public places in New York and will soon teach the first course in urban landscape to be offered at New York University. A member of the board of the Central Park Conservancy, she is also director of Central Park’s Conservatory Garden.

Before Miller began the restoration work on the graduate school garden, Consolloy forwarded her material on Farrand, the University’s landscape architect for the first half of the 20th century, including an article on Farrand that appeared in the fall 2004 *PEI News*. “I wanted to show her that the University was still interested in Farrand’s work. At the same time, we asked her to think outside the box and come up

with some new ideas,” he said.

According to Miller, “The opportunity to work at Princeton was very exciting for me both personally and professionally: personally, because of my Princeton background [Miller’s father Alan Breed was a member of the Class of ’32 and her son Gifford Miller ’92 was the seventh generation of the family to graduate from the University]; and professionally, because it meant following my all-time heroine, Beatrix Farrand. I have long studied and admired Farrand’s work.”

Consolloy reports that “When we first saw [Miller’s] plans, we were impressed. The changes she suggested were refreshing and it was obvious that it was a good idea to update the garden’s design after so many years.” The goal was not, he said, “to copy Beatrix Farrand down to the last plant. We took what we liked out of the original design and made some changes.”

The decision not to replace Farrand’s garden plant for plant was made for a number of reasons. Many of the plants Farrand used are no longer available, having been replaced by new and improved varieties. The Russels requested that the rose bushes be replaced. Farrand used roses because they blossomed and were glorious at commencement. For the rest of the year,



plants that flourish in each of the four seasons.

“When I came to Princeton, Jim showed me all of the original Farrand plantings that still exist on campus.” recalls Miller. “To create the new design for the Wyman House Garden, we moved the sundial to the center of the garden and surrounded it with four vertical evergreens from Farrand’s original design. I know Farrand would have liked that.” Like Farrand, Miller selected plants that are relatively easy to maintain.

According to Consolloy, many people were involved in the project including Albert Pearson, assistant grounds manager in charge of special projects and contract support and John Wisniewski, who is the supervisor of University gardens and estates and the horticulturist in charge of planting. Pearson made sure the infrastructural changes to the garden were properly installed and that Miller’s plan was followed. Wisniewski consulted with Miller on changes to the planting details. His crew maintains the garden and grounds at the Graduate College. In addition, Mrs. Russel and Dan Casey were both instrumental members of the garden planning committee.

The restoration was financed by alumni contributions to a University landscape fund designated



Wyman Garden before its restoration (left), following the restoration (right). (Photos courtesy of Jim Consolloy.)

however, “they looked mangy and were hugely high-maintenance,” says Miller. Farrand’s motivation for designing the garden this way had a great deal to do with the way the campus was used at the time. She chose plants and flowers that would be at their peak during the academic year as the campus was essentially shut down over the summer. Today the campus is used all year long and the restored garden includes

for this kind of project, explains Consolloy. “Looking at the restored garden now, we can see what a truly wonderful gift the alumni have given all of us at the University.”

The Wyman House garden adjoins the Graduate College dormitory at the intersection of College and Springdale roads in the Borough of Princeton. It is open to the University community.

Visiting Environmental Economist Works with PEI Faculty on the Economics of Climate Change

An anonymous gift given to PEI to increase collaborations between economics, environmental sciences, and engineering professors supported a fellowship this past fall. The fellowship, the fourth funded by the gift, enabled visiting environmental economist Richard Tol to work in collaboration with PEI professors on the economics of climate change. Tol's semester-long fellowship ended in February.

Tol arrived at Princeton from Hamburg University in September and worked primarily with PEI Interim Director and Professor of Ecology and Evolutionary Biology, Stephen Pacala, and Professor of Mechanical and Aerospace Engineering, Robert Socolow. In addition to research, he taught an undergraduate course in environmental economics.

Tol is the Michael Otto Professor of Sustainability and Global Change in the departments of geosciences and economics, and director of the Sustainability and Global Change research unit at the Centre for Marine and Climate Studies of Hamburg University. He is also a principal researcher at the Institute for Environmental Studies of the Vrije Universiteit in Amsterdam and an adjunct professor at the department of engineering and public policy of Carnegie Mellon University.

PEI: What circumstances led you to Princeton?

RT: I came here at the invitation of David Bradford. While at Princeton, I finished a paper he and I started a while ago, in which we looked at the effect of worldwide liability for the impacts of climate change on international climate. We used a Nash bargaining solution, a hybrid of cooperative and non-cooperative game theory, and contrasted the situation in which countries only care about climate change impacts on their own economies and the situation in which countries are liable for the damage they do to others.

[Editor's note: The late David Bradford, who died in February 2005, was a professor of economics and public affairs in the Woodrow Wilson School and a PEI faculty member.]

PEI: Please describe the work you did here.

RT: The work involved four components: how energy use relates to the structure of the economy; data assimilation for economic models; fire; and international climate policy. I work on how human systems and natural systems interact.

For example, if we look at current large-scale dynamic vegetation models, they assume all fires are set by lightning, while in reality, 99 percent of fires are set by humans. We tried to change these models to reflect these sorts of issues. We started by constructing a statistical model, building on work by others on a small scale and expanding this to a large scale.

PEI: What are some of the other changes you incorporated in your model?

RT: We constructed a model of structural change in the economy—that is, the shift away from agriculture to manufacturing to services. We estimated this model



Richard Tol

with long-term data using data assimilation, a powerful technique used by oceanographers and the like, but ignored by economists. The resulting model is superior in explaining past energy use and carbon dioxide emissions. It is a sounder basis for future projections.

PEI: What are some of the weaknesses in current economic models?

RT: A problem with current economic models is they are typically national models. A regional economic theory has not yet been developed. One of the reasons I wanted to come to Princeton is that Paul Krugman [professor of economics and international affairs at the Woodrow Wilson School] has developed regional economic models that actually work.

PEI: What did you most hope to accomplish during your stay?

RT: One of the reasons I came to Princeton was to form new relationships and continue them once I return to Germany. I primarily saw my visit as a way to start many new projects and finish a few. This fellowship was about establishing cooperation. Besides the papers to be finished, there is the possibility of further collaboration on the transition to a zero-carbon economy.

Alumni Chat: Suzy Friedman '94

Staff Scientist and Policy Analyst, Environmental Defense



After navigating her way across the country on a bicycle, Suzy Friedman '94 set her sights on an environmentally-centered career. The zeal that helped her pedal over the Rockies also propelled her to become a staff scientist and policy analyst with Environmental Defense (ED). ED is a national organization, headquartered in New York City, which brings together experts in science, law, and economics to take on environmental issues that affect oceans, air, natural resources, the livability of the man-made environment, and the myriad of species that inhabit the earth. Friedman has been with ED for nearly five years.

PEI: Please describe your course of study at Princeton and the professional experience which led you to ED.

SF: I graduated from Princeton in 1994 with a B.A. in history and a certificate in environmental studies. After biking cross country, I settled in Washington, D.C. to pursue a career in the environment. After a year as an intern at The Nature Conservancy, I moved on to a media position at the Union of Concerned Scientists (UCS). During my time at UCS, I completed an M.S. in environmental sciences at Johns Hopkins University. After two-and-a-half years at UCS, I took a job as outreach coordinator at American Rivers. Three years later, I moved on to ED to work on agriculture conservation issues. My work there is divided between state

and national agriculture conservation policy, including the Farm Bill, and place-based project work with groups of farmers and other local partners.

“While it is important to stay true to your goals and principles, failure to listen to others is a roadblock to progress on conservation issues.”

PEI: Please explain the nature of your work.

SF: My work involves collaborating with farmers, researchers, and local partners to develop and implement conservation projects in priority locations, including the Chesapeake Bay, the Lake Champlain watershed, and the state of Wisconsin. The majority of these projects involve owners of animal operations—most frequently, dairy farmers. The projects help advance and fund efforts to improve nutrient-use efficiency, to reduce runoff to water sources and to improve management of manure and litter. The policy aspect of my work focuses on seeking increased funding for agriculture conservation programs that assist farmers with voluntary efforts to protect and enhance natural resources.

PEI: What are some of your goals at Environmental Defense?

SF: My goals at ED include helping to advance improved conservation on farms in ways that are economi-

cally viable so as to both protect the environment and enhance the economic viability of agriculture. Few people understand agriculture these days, despite the fact that agriculture occupies more than half of the nation's lands and plays a critical role not only in food and fiber production, but also in natural resource conservation.

PEI: Did the ENV Program have an impact on your career choice and goals?

SF: The ENV Program gave me the grounding in environmental science and policy I needed to embark on my career in environmental issues.

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

SF: Keep an open mind. Too often, people engaged in environmental issues choose a side and refuse to reach out to non-traditional partners or those viewed as “the enemy.” While it is important to stay true to your goals and principles, failure to listen to others is a roadblock to progress on conservation issues.

Information on Environmental Defense and the projects Friedman works on is available online at <http://www.environmentaldefense.org/article.cfm?contentid=4158>.

PEI Faculty Awards

Stephen Pacala, professor of ecology and evolutionary biology and acting director of PEI, was named a fellow of the American Association for the Advancement of Science in January 2006. Pacala was recognized for “development of the soundest and most influential forest growth simulator available, providing the foundation for a new generation of integrated atmosphere-biosphere models.”

Francois Morel and **Michael Celia** received awards from the American Geophysical Union in December 2005. Morel, PEI director and professor of geosciences, received the Maurice Ewing Medal for his contributions to deep-sea science. He was also elected as a Fellow of the Geophysical Union. Celia, chair of the department of civil and environmental engineering, received the American Geophysical Union’s 2005 Hydrology Section Award, given annually “for outstanding and creative contributions to the hydrologic sciences.”

Burton Singer, professor of demography and public affairs, was named a member of the Institute of Medicine of the National Academies in October 2005.

CEBIC Undergraduate Summer 2006 Research Fellowship

The Center for Environmental Biogeochemistry (CEBIC) of the Princeton Environmental Institute announces a competitive summer 2006 undergraduate research fellowship program for students who are U.S. citizens, typically in their sophomore and junior years, to pursue research at any of the participating laboratories:

Bates College, Maine
McGill University, Montreal, Quebec, Canada
Princeton University, New Jersey
Rutgers University, New Jersey
University of California at Santa Barbara, San Diego or Santa Cruz, California
University of British Columbia, Vancouver, British Columbia, Canada
Woods Hole Oceanographic Institute, Massachusetts.

Students concentrating in chemistry, molecular biology, geosciences, ecology and evolutionary biology, and civil and chemical engineering, as well as in other environmental sciences are encouraged to apply.

Interested students must consult the CEBIC web page (<http://www.princeton.edu/~cebic/people.html>) to identify areas of research and contact a CEBIC investigator to discuss your research proposal.

The eight-week summer fellowship will provide a \$3200 stipend. Some travel allowance may be available for students who accept a position at a university other than their home institution. Travel must be arranged on a US airline.

Deadline for application: March 1, 2006.

Submit a one-page proposal identifying the professor with whom you have consulted and would like to work, what you could contribute to the research, and what you plan to learn from the experience.

Send the proposal, via email if possible, with your name, mailing and email addresses, telephone number, school, class year, department, and the names and telephone numbers of two references to:

Anne Catena
Princeton Environmental Institute
132 Guyot Hall, Princeton University
Princeton, NJ 08544
Email: acatena@princeton.edu
609-258-6615

For more information about PEI contact: Katharine Burks Hackett, Associate Director, Guyot Hall, Princeton University, Princeton, NJ 08544-1003
Telephone: (609) 258-5985 Email: khackett@princeton.edu

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

If you would like to receive **PEI News** via email, please fill out this coupon and return it to: PEI, Guyot Hall, Princeton University, Princeton, NJ 08544-1003, or send an email to chpeters@princeton.edu



PEI News is published three times a year by the Princeton Environmental Institute, Guyot Hall, Princeton University, Princeton, NJ 08544-1003
Telephone (609) 258-5985
<http://web.princeton.edu/sites/PEI>

Staff Writer and Editor: C.H. Peters
chpeters@princeton.edu

Consulting Editor: J.M. Scharfstein

Design: ChingFoster

Name	Affiliation	
Address	Phone	Email
Comments		