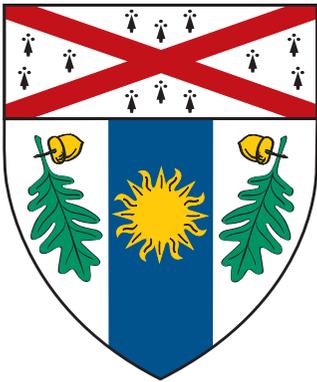


# School of Forestry & Environmental Studies

## 2010–2011



BULLETIN OF YALE UNIVERSITY

*Series 106 Number 12 August 20, 2010*

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Environmental Studies  
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# Calendar

## FALL 2010

Aug. 5–7	TH–SA	Orientation for international students
Aug. 8	SU	Orientation for summer modules
Aug. 9–26	M–TH	Training modules in technical skills
Aug. 30	M	Meeting with the dean and academic orientation for first-year students (mandatory), 9 a.m.–12 p.m., Burke Auditorium
Aug. 31	T	Course Expo, 9 a.m.
Sept. 1	W	Fall-term classes begin, 8:30 a.m.
Sept. 15	W	Course registration closes
Sept. 22	W	Add/Drop period ends
Nov. 19	F	Fall recess begins, 5:30 p.m.
Nov. 29	M	Classes resume, 8:30 a.m.
Dec. 3	F	Classes end, 5:30 p.m. Reading period begins
Dec. 13–17	M–F	Final examinations
Dec. 17	F	Winter recess begins, 5:30 p.m.

## SPRING 2011

Jan. 5	W	Fall-term grades due
Jan. 10	M	Spring-term classes begin, 8:30 a.m.
Jan. 17	M	No classes. Martin Luther King, Jr. Day
Jan. 25	T	Course registration closes
Feb. 1	T	Add/Drop period ends
Mar. 4	F	Spring recess begins, 5:30 p.m.
Mar. 21	M	Classes resume, 8:30 a.m.
Apr. 25	M	Classes end, 5:30 p.m. Reading period begins
May 3–9	T–M	Final examinations
May 16	M	Spring-term grades due for graduating students
May 23	M	University Commencement
May 27	F	Spring-term grades due for continuing students

# The President and Fellows of Yale University

## President

Richard Charles Levin, B.A., B.Litt., Ph.D.

## Fellows

Her Excellency the Governor of Connecticut, *ex officio*

His Honor the Lieutenant Governor of Connecticut, *ex officio*

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Edward Perry Bass, B.S., Fort Worth, Texas

Roland Whitney Betts, B.A., J.D., New York, New York

Jeffrey Lawrence Bewkes, B.A., M.B.A., New York, New York

Francisco Gonzalez Cigarroa, B.S., M.D., Austin, Texas (*June 2016*)

Peter Brendan Dervan, B.S., Ph.D., San Marino, California (*June 2014*)

Donna Lee Dubinsky, B.A., M.B.A., Portola Valley, California

Mimi Gardner Gates, B.A., M.A., Ph.D., Seattle, Washington (*June 2013*)

Paul Lewis Joskow, B.A., Ph.D., Locust Valley, New York

Neal Leonard Keny-Guyer, B.A., M.P.P.M., Portland, Oregon (*June 2015*)

William Irwin Miller, B.A., M.B.A., Columbus, Indiana (*June 2011*)

Indra Nooyi, B.S., M.B.A., M.P.P.M., Greenwich, Connecticut

Barrington Daniels Parker, B.A., LL.B., Stamford, Connecticut

Douglas Alexander Warner III, B.A., New York, New York

Margaret Garrard Warner, B.A., Washington, D.C. (*June 2012*)

Fareed Zakaria, B.A., Ph.D., New York, New York

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Ingeborg Theresia Reichenbach, Staatsexamen

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Graeme P. Berlyn, Ph.D., E. H. Harriman Professor of Forest Management; Professor of Anatomy and Physiology of Trees; and Editor, *Journal of Sustainable Forestry*

Benjamin Cashore, M.A., Ph.D., Professor of Environmental Governance and Political Science and Director, Program on Forest Policy and Governance

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Thomas E. Graedel, M.A., M.S., Ph.D., Clifton R. Musser Professor of Industrial Ecology; Professor of Chemical Engineering; Professor of Geology and Geophysics; and Director, Center for Industrial Ecology

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Xuhui Lee, M.Sc., Ph.D., Professor of Meteorology (on leave, fall 2010)

Robert Mendelsohn, Ph.D., Edwin Weyerhaeuser Davis Professor of Forest Policy; Professor of Economics; and Professor, School of Management

Chadwick Dearing Oliver, M.F.S., Ph.D., Pinchot Professor of Forestry and Environmental Studies and Director, Global Institute of Sustainable Forestry (on leave, fall 2010)

Peter A. Raymond, Ph.D., Professor of Ecosystem Ecology

James E. Saiers, M.S., Ph.D., Professor of Hydrology and Associate Dean for Academic Affairs

Oswald J. Schmitz, M.Sc., Ph.D., Oastler Professor of Population and Community Ecology and Professor of Ecology and Evolutionary Biology

David K. Skelly, Ph.D., Professor of Ecology; Associate Dean for Research; Professor of Ecology and Evolutionary Biology; and Director of Doctoral Studies

John P. Wargo, Ph.D., Professor of Environmental Policy, Political Science, and Risk Analysis; and Chair, Yale College Environmental Studies Major and Program

## Faculty Emeriti

Frederick H. Bormann, M.A., Ph.D., Oastler Professor Emeritus of Forest Ecology

William R. Burch, Jr., M.S., Ph.D., Frederick C. Hixon Professor Emeritus of Natural Resource Management

John C. Gordon, Ph.D., Pinchot Professor Emeritus of Forestry and Environmental Studies

Stephen R. Kellert, Ph.D., Tweedy/Ordway Professor Emeritus of Social Ecology

Thomas Siccama, Ph.D., Professor Emeritus in the Practice of Forest Ecology

William H. Smith, M.F., Ph.D., Clifton R. Musser Professor Emeritus of Forest Biology

### **Ladder Faculty**

Robert Bailis, M.S., Ph.D., Assistant Professor of Environmental Social Science

Michelle L. Bell, M.S.E., Ph.D., Associate Professor of Environmental Health

Mark A. Bradford, Ph.D., Assistant Professor of Terrestrial Ecosystem Ecology

Marian R. Chertow, M.P.P.M., Ph.D., Associate Professor of Industrial Environmental Management; Director, Program on Solid Waste Policy; and Director, Industrial Environmental Management Program

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Karen Hébert, Ph.D., Assistant Professor of Environmental Anthropology and Assistant Professor of Anthropology

Matthew J. Kotchen, Ph.D., Associate Professor of Environmental Economics and Policy

Karen Seto, Ph.D., Associate Professor in the Urban Environment (on leave, 2010–2011)

Nadine Unger, Ph.D., Assistant Professor of Climate Science

Julie B. Zimmerman, Ph.D., Assistant Professor of Green Engineering; Assistant Professor of Chemical Engineering; and Acting Director, Center for Green Chemistry and Green Engineering

### **Non-Ladder Faculty**

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Shimon C. Anisfeld, Ph.D., Senior Lecturer and Research Scientist in Water Resources and Environmental Chemistry

Ellen Brennan-Galvin, Ph.D., Lecturer and Senior Research Scholar

Richard Burroughs, Ph.D., Professor (Adjunct) of Coastal Science and Policy

Ann Elizabeth Camp, M.F.S., Ph.D., Senior Lecturer and Research Scientist in Stand Dynamics and Forest Health

Carol Carpenter, M.A., Ph.D., Senior Lecturer and Associate Research Scholar in Natural Resource Social Science and Adjunct Lecturer in Anthropology

Susan G. Clark, M.S., Ph.D., Joseph F. Cullman 3rd Professor (Adjunct) of Wildlife Ecology and Policy

Amity Doolittle, M.E.S., Ph.D., Lecturer and Associate Research Scientist

Paul Alexander Draghi, M.A., M.A., Ph.D., Director of Information Technology and Lecturer in Forest History

Helmut Ernstberger, Ph.D., Lecturer, Associate Research Scientist, and Analytical Laboratory Manager  
Gordon T. Geballe, M.S., Ph.D., Associate Dean for External and Alumni Affairs and Lecturer in Urban Ecology  
Bradford S. Gentry, J.D., Senior Lecturer in Sustainable Investments; Research Scholar; Director, Yale Center for Business and the Environment; and Director, Research Program on Private Investment and the Environment  
John Grim, Ph.D., Senior Lecturer and Senior Research Scholar  
Arnulf Grubler, Ph.D., Professor in the Field of Energy and Technology  
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Anthony Leiserowitz, Ph.D., Research Scientist and Director, Program on Strategic Initiatives  
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Rajendra K. Pachauri, Ph.D., Director, Yale Climate and Energy Institute, and Professor in the Practice of Sustainable Development  
Jonathan D. Reuning-Scherer, Ph.D., Lecturer in Statistics  
Mary Evelyn Tucker, Ph.D., Senior Lecturer and Senior Research Scholar

**Courtesy Joint Appointments**

Michelle Addington, Ph.D., Associate Professor, School of Architecture  
Ruth Elaine Blake, M.S., Ph.D., Professor of Geology and Geophysics  
Kelly Brownell, Ph.D., Professor of Psychology  
Adalgisa (Gisella) Caccone, M.S., Ph.D., Senior Research Scientist in Ecology and Evolutionary Biology  
David Cromwell, Ph.D., Professor (Adjunct), School of Management  
Michael Donoghue, Ph.D., Professor of Ecology and Evolutionary Biology  
Menachem Elimelech, Ph.D., Professor of Environmental Engineering  
Durland Fish, Ph.D., Professor of Epidemiology and Public Health, School of Medicine  
Willis Jenkins, Ph.D., Assistant Professor of Social Ethics, Divinity School  
Douglas A. Kysar, J.D., Professor of Law, Law School  
Brian P. Leaderer, Ph.D., Professor of Epidemiology and Public Health, School of Medicine  
William Mitch, Ph.D., Assistant Professor of Chemical Engineering  
William Nordhaus, Ph.D., Sterling Professor of Economics  
Jeffrey Powell, Ph.D., Professor of Ecology and Evolutionary Biology  
Richard Prum, Ph.D., William Robertson Coe Professor of Ecology and Evolutionary Biology, and Curator of Vertebrate Zoology, Peabody Museum of Natural History  
James C. Scott, Ph.D., Eugene Mayer Professor of Political Science; Professor of Anthropology; and Director, Program in Agrarian Studies, MacMillan Center for International and Area Studies

Kalyanakrishnan Sivaramakrishnan, Ph.D., Professor of Anthropology  
 Ronald B. Smith, Ph.D., Professor of Geology and Geophysics and Mechanical  
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 Karl Turekian, Ph.D., Benjamin Silliman Professor of Geology and Geophysics  
 Harvey Weiss, Ph.D., Professor of Near Eastern Archaeology  
 Ernesto Zedillo, Ph.D., Director, Yale Center for the Study of Globalization; and  
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Madhur Anand, Ph.D., Visiting Associate Professor  
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 Douglas C. Daly, Ph.D., Professor (Adjunct)  
 Mary Beth Decker, Ph.D., Lecturer  
 Matthew Eckelman, Ph.D., Lecturer  
 William Ellis, Ph.D., Senior Visiting Fellow; Lecturer; and Resident Fellow in  
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 Michael Ferrucci, M.F., Lecturer  
 James Fickle, Ph.D., Visiting Professor  
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 Katherine Kennedy, J.D., Visiting Lecturer in Law  
 Roy S. Lee, Ph.D., Professor (Adjunct)  
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# A Message from the Dean

In the century since its founding, the Yale School of Forestry & Environmental Studies has evolved from a pioneering professional school of forestry to perhaps the world's finest training ground for tomorrow's environmental leaders. Research and teaching have expanded to include not only forestry, but also the fundamental concerns that today constitute the challenge of environmental management.

The central goal of our School is to build interdisciplinary expertise focused on the environment and to train a new generation of leaders capable of tackling some of the most urgent and difficult issues of our time. These issues touch almost every aspect of people's lives; they transcend political boundaries; and they often bring into sharp focus fundamental questions about equality and justice, both nationally and internationally.

The need for a new focus on environmental management has never been more obvious or more important. At the same time that we seek to meet increased demand for food, energy, water, and the many other goods and services that are crucial for healthy and productive lives, we also face new global-scale environmental challenges. These problems, such as the continuing loss of biological diversity, the degradation of ecosystem services, and the growing importance of new kinds of pollution, as well as climate change, are an impediment to eradicating poverty, and they are also fundamentally international in nature. They can only be solved by cooperation among developing and industrial countries, and by leaders with a truly global perspective.

The core of our program at F&ES is thoughtful analysis and rigorous scientific study of the interactions between human societies and the natural world as a basis for sound environmental management. And because many of the solutions to today's environmental challenges lie outside the established environmental sector, our programs also reach into many other areas, from economics, business, and law to engineering and medicine.

By continuing to evaluate and enhance the programs that we offer, and by continuing to collaborate with others within and beyond Yale, we provide a broadly based educational experience that equips our graduates to assume influential roles in government, business, nongovernmental organizations, public and international affairs, journalism, research, and education.

Solutions to today's urgent environmental concerns will require a revolution in personal choice, a fusion of environmental and economic thinking, and an increased willingness on the part of business, government, and environmental leaders to develop shared goals that are truly sustainable over the long term. Our aim is to develop professionals trained in environmental management who can also wield influence in these broader arenas. Environmental thinking needs to be incorporated into corporate planning, energy strategy, technology policy, R&D funding, tax policy, international trade and finance, development assistance, and many other areas that once seemed far removed from traditional environmental concerns.

I hope and expect that those of you entering the School as students at this critical moment will have the energy and vision to help shape our collective environmental future both locally and globally. I encourage you to use this Bulletin to explore how F&ES can help facilitate your goals and build a foundation of knowledge and experience that will

equip you to help change the world by meeting the environmental challenges that affect all of our lives.

Please visit our Web site ([www.environment.yale.edu](http://www.environment.yale.edu)) to get an inside view of the dynamics and energy that will make F&ES an ideal place to continue your education.

Sir Peter R. Crane  
*Carl W. Knobloch, Jr. Dean*  
*School of Forestry & Environmental Studies*

# Mission of the School of Forestry & Environmental Studies

The Yale School of Forestry & Environmental Studies prepares new leaders and creates new knowledge to sustain and restore the long-term health of the biosphere and the well-being of its people.

We recognize that environmental challenges are increasingly international and seek to build a truly global school of the environment.

We believe that the human enterprise can and must be conducted in harmony with the environment, using natural resources in ways that sustain those resources and ourselves.

We believe that solving environmental problems must incorporate human values and motivations and a deep respect for human and natural communities.

We seek to integrate concern for Earth's ecosystems with the goal of achieving social equity.

We believe that a school of the environment must also be a school of sustainable development.

We find strength in our collegiality, diversity, independence, and commitment to excellence.

We educate women and men to guide human activity at the local, national, and global levels with a comprehensive understanding of the environmental, economic, and social consequences of their choices.

We create new knowledge in the science of sustainability and new methods of applying that knowledge to the challenge of environmental management, the restoration of degraded environments, and the pursuit of sustainable development.

We collaborate with all sectors of society to achieve fair and effective solutions to environmental problems.

For over one hundred years, first as a pioneering school of forestry, Yale has marshaled the expertise of diverse disciplines in the service of responsible stewardship of the environment. As the world's population grows and development accelerates, conserving the beauty, diversity, and integrity of the natural world becomes at once more important and more challenging.

We reaffirm our belief that such conservation is a practical and moral imperative.

# History of the School of Forestry & Environmental Studies

Yale University has played a leading role in the development of American conservation and natural resource management since the 1800s, when such Yale graduates as William Henry Brewer, Othniel C. Marsh, Clarence King, and George Bird Grinnell were deeply involved with the exploration of the West and the proper use of Western resources. In 1900 that tradition was strengthened further when the University established the Yale Forest School. The men responsible for establishing the School were Gifford Pinchot, B.A. 1889, LL.D. 1925, and Henry S. Graves, B.A. 1892, LL.D. 1940. Pinchot was the first American to receive professional forestry training in Europe, and Graves the second. As consulting foresters, and later from within the government's Division of Forestry, they carried out on private lands the first examples of forest management in the United States. The School was founded with a gift from the Pinchot family to ensure a continuing supply of professionals to carry out the work that lay ahead.

Pinchot, who became one of the leading figures in the administration of President Theodore Roosevelt, created the USDA Forest Service and served as its first chief. Credited with coining the phrase "conservation of natural resources," he defined conservation as the wise use of the Earth for the good of present and future generations.

Since its founding, it has been the School's mission to turn Pinchot's vision of conservation into educational and professional reality. Leading that quest until 1939 was the School's first head (and later, dean) and intellectual leader, Henry S. Graves. To Graves, graduate education, as in law and medicine, would define the new profession. Over the years, objectives have broadened, the mission has been interpreted differently, and methods of instruction have changed. Each decade has presented its singular challenges, and the School has responded vigorously to the leading problems of the day. In 1972 its name was changed to the School of Forestry & Environmental Studies, in formal recognition of the School's belief that it is concerned, in the broadest sense, with the scientific understanding and long-term management of ecosystems for human benefit.

During the academic year 2000–2001, the School of Forestry & Environmental Studies celebrated the achievements of its graduates and faculty and its first one hundred years of teaching and research with a series of centennial events. The School convened alumni/ae and friends from around the world for three days of celebration and discussion of the environmental challenges facing the world in coming decades. In addition, the School hosted eight major figures as centennial lecturers on critical global environmental issues, and co-sponsored a panel discussion featuring four preeminent environmental journalists with Yale's Poynter Fellows in Journalism program, the first such panel of Poynter Fellows to focus on environmental issues.

In its second century, the environment school's research and teaching are focused on the following broad areas: ecology, ecosystems, and biodiversity; environmental management and social ecology in developing societies; forest science and management; global change science and policy; health and environment; industrial environmental management; policy, economics, and the law; urban ecology, environmental planning,

design, and values; and coastal and watershed systems. Under the leadership of Dean Peter Crane, the School is determined to extend its scope to the greatest extent possible to meet the profound global environmental challenges the world faces in the twenty-first century.

# Statement of Environmental Policy

As faculty, staff, and students of the Yale School of Forestry & Environmental Studies, we affirm our commitment to responsible stewardship of the environment of our School, our University, the city of New Haven, and the other sites of our teaching, research, professional, and social activities. In the course of these activities, we shall strive to:

- reduce our use of natural resources;
- support the sustainable production of the resources we must use by purchasing renewable, reusable, recyclable, and recycled materials;
- minimize our use of toxic substances and ensure that unavoidable use is in full compliance with federal, state, and local environmental regulations;
- reduce the amount of waste we generate and promote strategies to reuse and recycle those wastes that cannot be avoided; and
- restore the environment where possible.

Each member of the School community is encouraged to set an example for others by being a steward of our environment.

## Faculty Profiles

**Paul T. Anastas** Teresa and H. John Heinz III Professor in the Practice of Chemistry for the Environment; Director of the Center for Green Chemistry and Green Engineering; and Lecturer in Chemistry. B.S., University of Massachusetts at Boston; M.A., Ph.D., Brandeis University. Professor Anastas is currently on leave, having been appointed by President Obama and confirmed by the U.S. Senate to serve as the assistant administrator for research and development at the U.S. Environmental Protection Agency (U.S. EPA). When in residence, Professor Anastas serves as the director of the Center for Green Chemistry and Green Engineering at Yale. From 2004 to 2006 he headed the Green Chemistry Institute in Washington, D.C. From 1999 to 2004 he was the assistant director for the environment in the White House Office of Science and Technology Policy. Trained as a synthetic organic chemist, he worked as an industrial consultant. He is credited with establishing the field of green chemistry during his time working for the U.S. EPA as the chief of the Industrial Chemistry Branch and as the director of the U.S. Green Chemistry Program. Professor Anastas has published widely on topics of science through sustainability, such as the books *Benign by Design*, *Designing Safer Polymers*, *Green Engineering*, and his seminal work with coauthor John Warner, *Green Chemistry: Theory and Practice*.

**Shimon C. Anisfeld** Senior Lecturer and Research Scientist in Water Resources and Environmental Chemistry. A.B., Princeton University; Ph.D., Massachusetts Institute of Technology. Mr. Anisfeld's research addresses the degradation and restoration of water resources, especially rivers and wetlands in coastal watersheds. Among his research questions are the following: How do tidal marshes maintain – or fail to maintain – their elevation in the face of sea level rise? What are the implications of marsh loss for biogeochemical processes? How do we find the right balance between withdrawing water for human uses and maintaining instream flows in rivers? What is the relationship between watershed land use and river pollutant loads? How effective are various practices in reducing the pollutant loads from urban stormwater? What is the degree of success – and what are the unintended consequences – of wetland restoration? His goal is to carry out research that is both scientifically interesting and relevant to management. He teaches courses in water resources, coastal ecology, and environmental organic chemistry.

**Mark S. Ashton** Morris K. Jesup Professor of Silviculture and Forest Ecology and Director of School Forests. B.S., University of Maine, College of Forest Resources; M.F., Ph.D., Yale University. Professor Ashton conducts research on the biological and physical processes governing the regeneration of natural forests and on the creation of their agroforestry analogs. In particular, he seeks a better understanding of regeneration establishment among assemblages of closely related trees. His long-term research concentrates on tropical and temperate forests of the Asian and American realms. His field sites within these regions were selected specifically to allow comparison of growth, adaptation, and plasticity within and among close assemblages of species that have evolved within forest climates with differing degrees of seasonality. Findings from these studies have theoretical implications for understanding the maintenance of diversity of tree species in forested ecosystems and the adaptability of forests to change in climate. The results of his research have been applied to the development and testing of silvicultural techniques

for restoration of degraded lands and for the management of natural forests for a variety of timber and nontimber products and services (water resources, carbon sequestration). Field sites include tropical forests in Sri Lanka and Panama, temperate forests in India and New England, and boreal forests in Saskatchewan, Canada.

**Robert Bailis** Assistant Professor of Environmental Social Science. B.S., Pennsylvania State University; M.S., Northwestern University; Ph.D., University of California at Berkeley. Professor Bailis's research interests focus on sustainability, resource use, and environmental change in the developing world. He explores these issues principally, though not exclusively, in the context of energy. He became interested in the intersection of energy, society, and environment while working as a teacher in the U.S. Peace Corps in a remote community in northwestern Kenya. He uses an interdisciplinary approach that places equal emphasis on qualitative and quantitative methods across a range of scales, from local to regional and global. One recent research project explored the social ecology of Kenya's charcoal commodity chain. In current work, Professor Bailis is working with Jenn Baka, a doctoral student in F&ES, to analyze the social and environmental sustainability of *Jatropha* production in India and Brazil. In addition, he supervises doctoral students researching climate change adaptation in forest-dependent communities in India, petroleum concessions in Peru, and benefit flows in carbon offset markets.

**Michelle L. Bell** Associate Professor of Environmental Health. B.S., Massachusetts Institute of Technology; M.S., Stanford University; M.S.E., Ph.D., Johns Hopkins University. Professor Bell addresses air pollution and human health through research that integrates several disciplines, including environmental engineering and epidemiology. Her research interests are the statistical analysis of the health impacts of air pollution episodes, the integration of meteorological and air quality modeling with human health research, and policy implications. A primary focus of her research is how changes in air pollution levels affect health response, such as hospital admissions and premature mortality. Representative projects include a national assessment of the mortality effects of ozone pollution, the relative toxicity of chemical components of ambient particle mixtures, health benefits from reduced air pollution in Latin American cities, impacts of air pollution on low birth weight, and heat-related mortality. Other work investigates how different subpopulations (e.g., based on socioeconomic status or race) are differentially affected by air pollution and the potential effects of climate change on air pollution and thereby on human health.

**Gaboury Benoit** Grinstein Class of 1954 Professor of Environmental Chemistry, Professor of Environmental Engineering, Director of the Hixon Center for Urban Ecology, and Director of the Center for Coastal and Watershed Systems. B.S., Yale University; M.S., Massachusetts Institute of Technology; Ph.D., MIT–Woods Hole Oceanographic Institution. Professor Benoit's research and teaching focus on the behavior, transport, and fate of chemicals in natural waters, soils, sediments, and biota. Two special areas of interest are nonpoint source pollutants and biogeochemistry of trace metals and radionuclides. Most of his research involves state-of-the-art analytical methods and carefully designed field sampling programs, with results verified by laboratory simulations or simple mathematical models. His research is conducted in a watershed context, and study sites include

freshwater and terrestrial systems, as well as estuarine and coastal environments. Five current research emphases are the use of modern clean techniques to investigate trace metals; micronutrient limitation by Cu and Co; sustainable land development; spatial and temporal variability of nonpoint source pollution; and human-environment interactions in urban areas. He is a fellow of Trumbull College.

**Graeme P. Berlyn** E. H. Harriman Professor of Forest Management, Professor of Anatomy and Physiology of Trees, and Editor of *Journal of Sustainable Forestry*. B.S., Ph.D., Iowa State University. Professor Berlyn's interests are the morphology, physiology, and ecology of trees and forests in relation to environmental stress. Leaves are the most responsive and vulnerable organs of trees, and Professor Berlyn and his students study the ways that leaf structure and function reveal the effects of environmental change such as global warming or altitudinal and latitudinal gradients. In addition, these studies can help determine the optimum range of habitats for individual species and thus be of use in reforestation and afforestation. Some of the techniques used to study these problems are: light processing by leaves in relation to environmental factors as measured by chlorophyll fluorescence, photosynthesis, spectral reflectance, absorption, and transmission; and image analysis of leaf and tree structure. Recently Professor Berlyn and his students have developed quantitative image analysis systems to aid their work. Their current approach is to analyze the stress and productivity of leaves and integrate this knowledge from the individual leaf to the tree crown to the forest canopy. Professor Berlyn has also pioneered in the development of organic biostimulants that can help plants resist insect, disease, and other environmental stressors while reducing fertilizer use. Thus the Berlyn lab focuses on how to measure the stress of plant life and also on how to ameliorate it. Students in the Berlyn lab are currently working on such topics as structural and functional change along elevational gradients in mountains; molecular control of sun/shade leaf phenotypic plasticity; historical ecology and ecophysiology of eastern white pine; response of tropical pioneer species to gaps in tropical forests; functional diversity of secondary succession plant communities within a tropical agricultural landscape in the Republic of Panama; and the role of antioxidants, stress vitamins, and mycorrhizas in organic biostimulants.

**Mark A. Bradford** Assistant Professor of Terrestrial Ecosystem Ecology. B.S., University of Exeter, U.K.; Ph.D., University of Exeter and Institute of Terrestrial Ecology, U.K. Professor Bradford's research primarily focuses on understanding how global change (e.g., climate warming) will affect plants, animals, and microorganisms in grasslands and forests, and what the consequences are for soil carbon storage. To understand how global change affects the organisms and carbon stores, he uses field experiments, field observation, and laboratory studies. Current projects include testing whether soils lose carbon as temperatures increase, accelerating climate warming; whether loss of tree species will affect the ecosystem services forests provide; and whether different microbial communities affect how much carbon is stored and nutrients made available for plant growth. The overall goal of his research is to provide the necessary mechanistic understanding required for reliable prediction of global change impacts on ecosystems, and their likely feedbacks to the climate system. His work is conducted in a variety of forested and grassland ecosystems in both the north and south of the eastern United States.

**Ellen Brennan-Galvin** Lecturer and Senior Research Scholar. B.A., Smith College; M.A., Ph.D., Columbia University. Ms. Brennan-Galvin's research deals with a range of urban environmental issues, primarily in developing country cities. Current work focuses on the present and future environmental impacts of alternative transportation and urban land use policies—such as air pollution, greenhouse gas emissions, and urban sprawl—resulting from the exponential growth in motor vehicles in all world regions. A major area of her research is the development of bus rapid transit systems (BRTs) in developing country cities. Prior to coming to Yale, she was chief of the Population Policy Section of the United Nations Population Division, where she worked for twenty-five years. She has conducted research on urban environmental issues and policies in more than twenty developing country cities in Asia, Africa, and Latin America and is the author of numerous case studies on mega-cities published by the United Nations. In recent years, she served on the National Academy of Sciences' Committee on Population, as well as on the NAS panel that produced *Cities Transformed: Demographic Change and Its Implications in the Developing World*. She was a fellow at the Woodrow Wilson International Center for Scholars in Washington, D.C. and a Population Council fellow at the Office of Population Research, Princeton University.

**Ann Elizabeth Camp** Senior Lecturer and Research Scientist in Stand Dynamics and Forest Health. B.S., Rutgers University; M.F.S., Yale University; Ph.D., University of Washington. Ms. Camp is interested in the dynamics of mixed species stands and the variables driving vegetation patterns at different hierarchical scales. Results of her research on sustainable patterns of late-successional and old forest habitats in fire-regulated landscapes have been widely incorporated in dry forest management and restoration efforts in the inland Northwest. Her research includes effects of biotic and abiotic disturbances on vegetation patterns at stand and landscape scales; and interactions among disturbance agents and vegetation patterns, especially the roles of insects and pathogens in creating forest structures important to wildlife. Courses taught or co-taught by Ms. Camp include Forest Stand Dynamics, Forest Ecosystem Health, Fire Science and Policy, Natural History and Taxonomy of Trees, Invasive Species Issues (with Mary Tyrrell), and Arctic, Alpine, and Boreal Ecosystems (with Graeme Berlyn). Prior to joining the F&ES faculty, Ms. Camp was a research forester with the U.S. Forest Service in eastern Washington.

**Carol Carpenter** Senior Lecturer and Associate Research Scholar in Natural Resource Social Science and Adjunct Lecturer in Anthropology. B.A., SUNY Binghamton; M.A., Ph.D., Cornell University. Ms. Carpenter is an environmental anthropologist whose teaching and research interests focus on the social science of sustainable development and conservation. Courses include the history of the theory of environmental anthropology, the anthropology of the global economy, and households, communities, and gender in agrarian and ecological systems, as well as the social science of development and conservation. Ms. Carpenter spent four years in Indonesia engaged in household and community-level research on rituals (including the ethnobotany of rituals) and social networks. She then spent four years in Pakistan working as a development consultant on social forestry and women in development issues for USAID, the World Bank, and the Asia Foundation, among others. She has held teaching positions at Syracuse University,

the University of Hawaii, and Hawaii-Pacific University, and a research position at the East-West Center, and has been teaching at Yale since 1998. Her current interests include applying contemporary understandings of power and capitalism to sustainable development and conservation. In 2007 she published *Environmental Anthropology: A Historical Reader* (coedited with Michael Dove, for Blackwell). She is a fellow of Calhoun College.

**Benjamin Cashore** Professor of Environmental Governance and Political Science and Director of the Program on Forest Policy and Governance. B.A., M.A., Carleton University; Ph.D., University of Toronto. Professor Cashore's research interests include the emergence of non-state, market-driven environmental governance; the impact of globalization, internationalization, and transnational networks on domestic policy choices; comparative environmental and forest policy development; and firm-level "beyond compliance" sustainability initiatives. His book *Governing through Markets: Forest Certification and the Emergence of Non-State Authority* (with Graeme Auld and Deanna Newsom) was awarded the International Studies Association's 2005 Sprout Award for the best book on international environmental policy and politics. The book is part of a large research effort aimed at understanding the emergence of non-state market-driven global environmental governance in developed and developing countries. His current efforts include a major international comparison (with Constance McDermott and Peter Kanowski) of twenty countries' domestic forest policy regulations (Earthscan); a comparative study on firms' responses to forest certification in the U.S. forest sector (with Auld, Prakash, and Sasser); and an analysis (with Bernstein) of the emergence of non-state market-driven global governance generally. He is also author or coauthor of several articles that have appeared in the *American Journal of Political Science*, *Global Environmental Politics*, *Governance*, *Policy Sciences*, the *Canadian Journal of Political Science*, *Regulation and Governance*, *Business and Politics*, *Forest Policy and Economics*, the *Journal of Forestry*, *Canadian Public Administration*, *Canadian-American Public Policy*, and the *Forestry Chronicle*, as well as chapters in several edited books. He is associate editor of the *Journal of Natural Resources Policy Research* and serves on the editorial boards of *Business and Politics*, *Forest Policy and Economics*, and the *Journal of Sustainable Forestry*. Professor Cashore was awarded (with Steven Bernstein) the 2001 John McMenemy Prize for the best article to appear in the *Canadian Journal of Political Science* in the year 2000: "Globalization, Four Paths of Internationalization and Domestic Policy Change: The Case of EcoForestry in British Columbia, Canada."

**Marian R. Chertow** Associate Professor of Industrial Environmental Management, Director of the Program on Solid Waste Policy, and Director of the Industrial Environmental Management Program. B.A., Barnard College, Columbia University; M.P.P.M., Ph.D., Yale University. Professor Chertow's research and teaching span the study of industrial ecology to understand resource flows through systems at different scales, public and private benefits of cooperative business practices, waste management, and environmental technology innovation. Primary research interests are the study of industrial symbiosis involving geographically based exchanges of materials, energy, water, and wastes within networks of businesses in the U.S., China, and India; the potential of industrial ecology in resource-poor emerging economies; and the application of innovation theory to the development of environmental and energy technology. Professor Chertow initiated a multiyear study in Hawaii applying industrial ecology tools to waste problems in Oahu

and to long-term resource sustainability questions on Hawaii Island in cooperation with the Kohala Center. Prior to Yale, she spent ten years in environmental business and state and local government and served as president of a waste infrastructure bonding authority. She was appointed to the U.S. EPA's National Advisory Council for Environmental Policy and Technology in 2010. She also serves on the founding faculty of the Master of Science in Environmental Management Program at the National University of Singapore, where she teaches Business and Environment, and she is a visiting professor at Nankai University's National Center for Innovation Research on Circular Economy in China.

**Susan G. Clark** Joseph F. Cullman 3rd Professor (Adjunct) of Wildlife Ecology and Policy, and Fellow in the Institution for Social and Policy Studies. B.S., Northeastern State College, Oklahoma; M.S., University of Wyoming; Ph.D., University of Wisconsin-Madison. Professor Clark's principal interests are interdisciplinary problem solving, decision making, governance, policy process, leadership, conservation biology, organization theory and management, natural resources policy, and the policy sciences. She has diverse experience in the NGO community, academia, and in the field practically, nationally, and internationally. She focuses her work on professional education and skill training for leadership, professionalism, and problem solving. She recently published *Ensuring Greater Yellowstone's Future: Choices for Leaders and Citizens* with Yale University Press. Professor Clark has received various awards, including the Outstanding Contribution Award from the U.S. Fish and Wildlife Service, the Presidential Award from the Chicago Zoological Society, the Denver Zoological Foundation Conservation Award, Best Teacher from the students at the Yale School of Forestry & Environmental Studies, and the Mentoring Award from the Society for the Policy Sciences. She is also a member of three species survival commissions of the IUCN-World Conservation Union. She was board president of the Northern Rockies Conservation Cooperative in Jackson, Wyoming, for almost twenty years and is now on the emeritus board. She is on the Executive Council of the Society for the Policy Sciences. She has written almost 400 publications, many on interdisciplinary problem solving. Her most recent books and monographs include *Averting Extinction: Reconstructing Endangered Species Recovery* (1997), *Carnivores in Ecosystems: The Yellowstone Experience* (coedited, 1999), *Foundations of Natural Resources Policy and Management* (coauthor, 2000), *The Policy Process: A Practical Guide for Natural Resource Professionals* (2002), *Conservation and Development in the Condor BioReserve, Ecuador* (coauthor, 2004), and *Coexisting with Large Carnivores: Lessons from Greater Yellowstone* (coauthor, 2005). Current projects focus on large carnivore conservation in western North America, polar bear and native peoples coexistence in Canada, and others. For more than thirty years she has dedicated herself to endangered species and biodiversity conservation and human sustainability in the United States, Australia, and elsewhere.

**Peter R. Crane** Carl W. Knobloch, Jr. Dean of the School of Forestry & Environmental Studies, and Professor of Botany. B.Sc. and Ph.D., University of Reading, U.K. Dean Crane's work focuses on the diversity of plant life: its origin and fossil history, current status, and conservation and use. From 1992 to 1999 he was director of the Field Museum in Chicago with overall responsibility for the museum's scientific programs. During this time he established the Office of Environmental and Conservation Programs and the Center for Cultural Understanding and Change, which today make up the Division of

Environment, Culture, and Conservation (ECCo). From 1999 to 2006 he was director of the Royal Botanic Gardens, Kew, one of the largest and most influential botanical gardens in the world. His tenure at Kew saw strengthening and expansion of the gardens' scientific, conservation, and public programs. Dean Crane was elected to the Royal Society (the U.K. academy of sciences) in 1998. He is a fellow of the American Academy of Arts and Sciences, foreign associate of the U.S. National Academy of Sciences, a foreign member of the Royal Swedish Academy of Sciences, and a member of the German Academy Leopoldina. He was knighted in the U.K. for services to horticulture and conservation in 2004. Dean Crane currently serves on the boards of the Global Crop Diversity Trust, the Chicago Botanic Garden, the Lady Bird Johnson Wildflower Center at the University of Texas, and the Gaylord and Dorothy Donnelley Foundation.

**Amity Doolittle** Lecturer and Research Scientist. Ms. Doolittle's research focuses on how control over and access to natural resources are defined, negotiated, and contested by communities and states. Her approach is interdisciplinary, combining perspectives from political ecology, anthropology, political science, and environmental history to explore property relations and conflicts over resources use. Her research explores difficult questions such as: Why and through what political, social, and economic processes are some people denied the basic right to a clean and safe environment? What are the social relations of production and power that contribute to these outcomes? And, most importantly, what can be done to correct these histories of inequality? Additional projects include exploring the influence of indigenous peoples on international climate change negotiations and the ways in which locally disempowered agriculturalists in Costa Rica can have their voices heard in natural resource management plans that affect their livelihoods. Research projects have taken her to Malaysian Borneo, Peru, Costa Rica, and Honduras. She teaches courses on political ecology, environmental justice, and qualitative research methods.

**Michael R. Dove** Margaret K. Musser Professor of Social Ecology; Professor of Anthropology; Director of the Tropical Resources Institute; Curator of Anthropology in the Peabody Museum of Natural History; coordinator of the joint doctoral degree program between F&ES and the Department of Anthropology; and member of the founding Steering Committee of Yale's Climate and Energy Institute. B.A., Northwestern University; M.A., Ph.D., Stanford University. Professor Dove's research focuses on the environmental relations of local communities, especially in South and Southeast Asia. Over the past thirty-five years, he has spent more than a dozen years in the field in Asia, carrying out long-term research on human ecology in Borneo and Java, developing government research capacity in Indonesia, and advising the Pakistan Forest Service on social forestry policies. His most recent books are *Conserving Nature in Culture: Case Studies from Southeast Asia* (coedited with P.E. Sajise and A. Doolittle, Yale Southeast Asia Program, 2005), *Environmental Anthropology: A Historical Reader* (coedited with C. Carpenter, Blackwell, 2007), *Southeast Asian Grasslands: Understanding a Folk Landscape* (editor, New York Botanical Gardens Press, 2008), *The Banana Tree at the Gate: The History of Marginal Peoples and Global Markets in Borneo* (Yale University Press, 2010), and *Complicating Conservation: Beyond the Sacred Forest* (coedited with P.E. Sajise and A. Doolittle, Duke University Press, 2010). He is currently working on a book on the

history of the anthropological study of climate change and another book (coauthored with D. Kammen) on “The Anthropology and Physics of Conservation and Development.” Research and teaching interests include the anthropology of climate change and the cultural and political aspects of natural hazards and disasters; political dimensions of resource degradation; indigenous environmental knowledge; contemporary and historical environmental relations in South and Southeast Asia; the study of developmental and environmental institutions, discourses, and movements; and the sociology of resource-related sciences. Professor Dove sits on the advisory boards of Yale’s Agrarian Studies Program, Council on South Asian Studies, Council on Southeast Asian Studies, and Jackson Institute for Global Affairs.

**Paul Alexander Draghi** Director of Information Technology and Lecturer in Forest History. B.A., University of Connecticut; M.A., M.A., Ph.D., Indiana University. Mr. Draghi’s teaching focuses on the intersection of myth, culture, psychology, and the environment. His research has included work with primary sources in Medieval Latin, Middle High and modern German, French, Sanskrit, Tibetan, Mongolian, and Bhutanese, and his previous work at Yale included the cataloguing of the Beinecke Library’s Tibetan Collection, one of the major collections of Tibetan blockprint and manuscript texts in the world. His current research involves work on the history and geography of hunting and forestry in Britain and German-speaking Europe. He is also principal investigator of OARE (Online Access to Research in the Environment), an international public-private consortium coordinated by Yale F&ES and UNEP that enables developing countries to gain access to one of the world’s largest collections of environmental science research.

**Daniel C. Esty** Hillhouse Professor of Environmental Law and Policy; Director of the Yale Center for Environmental Law and Policy; and Director of the Yale Center for Business and the Environment. B.A., Harvard University; M.A., University of Oxford; J.D., Yale University. Professor Esty is the author or editor of nine books and numerous articles on environmental policy issues and the relationships between environment and corporate strategy, competitiveness, trade, globalization, governance, and development. His most recent book, *Green to Gold: How Smart Companies Use Environmental Strategy to Innovate, Create Value, and Build Competitive Advantage*, argues that pollution control and natural resource management have become critical elements of marketplace success and explains how leading-edge companies have folded environmental thinking into their core business strategies. Prior to taking up his current position at Yale, Professor Esty was a Senior Fellow at the Peterson Institute for International Economics (1993–94), served in a variety of senior positions on the U.S. Environmental Protection Agency (1989–93), and practiced law in Washington, D.C. (1986–89). He spent the 2000–2001 academic year as a visiting professor at INSEAD, the European business school in Fontainebleau, France. In 2002 Professor Esty received the American Bar Association Award for Distinguished Achievement in Environmental Law and Policy for “pioneering a data-driven approach to environmental decision making” and developing the global Environmental Sustainability Index. He served four years as an elected Planning and Zoning Commissioner in his hometown of Cheshire, Connecticut. He sits on the boards of directors of Resources for the Future and the Connecticut Fund for the Environment.

**Alexander J. Felson** Assistant Professor, School of Forestry & Environmental Studies and School of Architecture. B.A., M.S., University of Wisconsin, Madison; M.L.A., Harvard Graduate School of Design; Ph.D., Rutgers University. Professor Felson is a landscape architect and ecologist. He is focused on the ecological design and planning of urban to rural settlements and land systems. His scholarly research and practice bring together ecological understanding with the built environment and socio-ecological components of the city and countryside. He integrates ecosystem services and public space into urban design to landscape-based projects in New York City and across the country. He seeks new ways of constructing biologically rich systems through research-based design and adaptive management. His design and planning work integrate basic and applied ecological research as a driver of the form, layout, and function of urban design, planning, and infrastructure projects. Professor Felson worked with Ken Smith Landscape Architect on projects including NY Public School 19 (built in 2003), the East River Marsh Planter, and the Santa Fe Railyard Park in New Mexico (built in 2008). The East River Marsh Planter proposes a public research tool that adaptively manages constructed salt marsh habitats on a site where 30,000 commuters walk by daily. As an associate and director of ecological design at EDAW|AECOM, he designed the New York City Million Trees project on parkland. He is now a principal investigator working with the NYC Parks Department to implement a large-scale urban forestry project to study carbon accumulation, sustainable management, and biodiversity. Working with a developer for his Ph.D., Professor Felson brought together academics and practitioners to implement a series of amphibian migration and larval density studies on vernal pools to inform the 900-unit master plan. His research results impacted road alignments, neighborhood layout, and housing lot locations for the 500-hectare site. Through other projects, including Governor's Island, the Presidio, the World Trade Center streetscapes, and the Beacon Institute, Professor Felson balances the concerns of developers, planning boards, communities, and regulators, and through consensus-building, works toward creative but feasible ecological design and planning strategies. In all cases, he aims both to drive an inventive new landscape architecture and to encourage responsible management of urban ecosystems. He has lectured widely and publishes on bridging ecological science with the design process. For his market-driven ecological design work, he was included among Crain's 40 Under 40: New York's Rising Stars Class of 2009.

**Gordon T. Geballe** Associate Dean for External and Alumni Affairs and Lecturer in Urban Ecology. B.A., University of California, Berkeley; M.S., Ph.D., Yale University. Applying the concepts of ecosystem ecology to the study of humans is the principal focus of Mr. Geballe's current interests. Cities can be analyzed as systems through which energy and material move. Of special interest to Mr. Geballe is the development of community organization, the role of formal and informal environmental education, and the identification of urban environmental issues. These topics are the focus of his teaching and numerous projects in New Haven. Mr. Geballe is currently teaching about and researching the role of international symposiums. In September 2003 he and students in his class attended the 5th World Parks Congress in Durban, South Africa. During spring 2004 the focus was on IUCN's World Conservation Congress, held in Bangkok, Thailand, in November 2004. At this meeting the students wrote, sponsored, and had

passed a resolution calling for IUCN and member organizations to support the careers of young professionals. Next, attention shifted to UNEP and its council meeting in Kenya in February 2005. Twenty-nine students and faculty attended the meeting and presented the course findings evaluating UNEP. Recently, this class studied and attended the climate treaty meeting in Copenhagen, Denmark. He is coauthor of the book *Redesigning the American Lawn: A Search for Environmental Harmony* (second edition, 2001). He is a fellow of Silliman College.

**Bradford S. Gentry** Senior Lecturer in Sustainable Investments and Research Scholar, Director of the Yale Center for Business and the Environment, and Director of the Research Program on Private Investment and the Environment. B.A., Swarthmore College; J.D., Harvard University. Mr. Gentry's work explores the opportunities for using private investment to improve environmental performance, looking both across and within particular sectors/problems. His cross-sectoral work focuses on the steps policy makers can take to help attract or drive more private investment into better environmental results, including providing information, removing market barriers, making polluters pay, and paying innovators. His sectoral work includes initiatives on land conservation, water protection, carbon markets, and clean energy. Projects in all of these areas are undertaken across a range of contexts from New Haven, to developing country megacities, to rural forest systems. He has written extensively on the links between private investment and environmental performance and is the editor and coeditor, respectively, of the books *Private Capital Flows and the Environment: Lessons from Latin America* and *Emerging Markets for Ecosystem Services: A Case Study of the Panama Canal Watershed*.

**Thomas E. Graedel** Clifton R. Musser Professor of Industrial Ecology, Professor of Chemical Engineering, Professor of Geology and Geophysics, and Director of the Center for Industrial Ecology. B.S., Washington State University; M.A., Kent State University; M.S., Ph.D., University of Michigan. Professor Graedel was elected to the U.S. National Academy of Engineering for "outstanding contributions to the theory and practice of industrial ecology, 2002." His research is centered on developing and enhancing industrial ecology, the organizing framework for the study of the interactions of the modern technological society with the environment. His textbook *Industrial Ecology*, coauthored with B. R. Allenby of AT&T, was the first book in the field, and its third edition is now in preparation. It, and his 2004 textbook, *Greening the Industrial Facility*, are used in F&ES courses of the same names. His current research interests include studies of the flows of materials within the industrial ecosystem and the development of analytical tools to assess the environmental characteristics of products, processes, the service industry, and urban infrastructures. He cochairs the Roundtable on Science and Technology for Sustainability for the U.S. National Academies and is a member of the International Panel for Sustainable Resource Management for the United Nations Environment Programme.

**Timothy G. Gregoire** J. P. Weyerhaeuser, Jr., Professor of Forest Management. B.S., Princeton University; Ph.D., Yale University. Professor Gregoire's research is directed to the application and methodological development of statistical techniques appropriate for forest and other environmental and ecological resources. One focus has been on probability sampling with particular reference to sampling techniques used in forest inventory

and ecological assessment. A second focus has been on statistical modeling of longitudinal and spatially correlated data with linear and nonlinear mixed models. The results of his research have been published widely in the forestry, ecology, and statistical literature. He is the coauthor of *Sampling Methods for Multiresource Forest Inventory*; coeditor of *Modelling Longitudinal and Spatially Correlated Data*; and senior author of *Sampling Strategies for Natural Resources and the Environment* (2008). Recent pursuits include investigations into the nature of statistical inference, changes to the active layer above permafrost on the Alaska tundra, sampling with segmented line transects, and laser altimetry to estimate above-ground biomass. Professionally, he has been a leader in organizations that promote the use of biometrics and environmental statistics. He is an elected fellow of the American Statistical Association; a former regional president of the International Biometric Society; an elected member of the International Statistical Institute; and the recipient of the Award in Forest Science granted by the Society of American Foresters. He is a section editor of the multivolume *Encyclopedia of Environmetrics*, an associate editor of *Silva Fennica*, and the deputy editor-in-chief for *Environmental and Ecological Statistics*, and he is former chair of the management committee of the *Journal of Agricultural, Biological, and Environmental Statistics*. He also serves on the board of directors of the Energy and Resources Institute–North America. He is a fellow of Morse College.

**John Grim** Senior Lecturer and Senior Research Scholar. B.A., St. John's University (Minnesota); M.A., Ph.D., Fordham University. Mr. Grim's courses in religion and ecology draw students from F&ES, Yale Divinity School, the Department of Religious Studies, ISPS, and Yale College. He is coordinator of the Forum on Religion and Ecology with Mary Evelyn Tucker, and with her editor of the ten-volume series *World Religions and Ecology*, from Harvard Divinity School's Center for the Study of World Religions, published by Harvard University Press. In that series he edited *Indigenous Traditions and Ecology: The Interbeing of Cosmology and Community* (Harvard, 2001). He has been a professor of religion at Bucknell University and at Sarah Lawrence College, where he taught courses in Native American and indigenous religions, world religions, and religion and ecology. His published works include *The Shaman: Patterns of Religious Healing Among the Ojibway Indians* (University of Oklahoma Press, 1983), the co-edited volume (with Mary Evelyn Tucker) *Worldviews and Ecology* (Orbis, 1994, 5th printing, 2000), and a *Daedalus* volume (2001) titled *Religion and Ecology: Can the Climate Change?* He is president of the American Teilhard Association. Recently he edited, with Mary Evelyn Tucker, Thomas Berry's last collection of essays, *The Christian Future and the Fate of Earth*, published by Orbis Books in 2009. They are also working on a volume for Island Press, "The Emerging Alliance of Religion and Ecology."

**Arnulf Grubler** Professor in the Field of Energy and Technology. M.Eng., Ph.D., Technical University of Vienna; Dr. Habil., Mining University at Leoben, Austria. Professor Grubler has been lead and contributing author for the Second, Third, and Fourth Assessment Reports of the Intergovernmental Panel on Climate Change (IPCC, co-recipient of the 2007 Nobel Peace Prize), and also serves on the editorial boards of *Carbon Management* and the *Journal of Industrial Ecology*. He has published widely as author, coauthor, or editor of ten books, three special journal issues, more than ninety peer-reviewed articles and book chapters, and over thirty additional professional papers in the domains of

(modeling of) technological change and diffusion, long wave theory, energy and transport systems, climate change, and resource economics. Professor Grubler also holds the position of acting program leader in the Transitions to New Technologies Program at the International Institute for Applied Systems Analysis (IIASA), Austria. His teaching and research focus on the long-term history and future of technology and the environment, with emphasis on energy, transport, and communication systems.

**Karen Hébert** Assistant Professor of Environmental Anthropology. B.A., Yale University; M.A., Ph.D., University of Michigan. Professor Hébert is a cultural anthropologist whose research examines the development and implications of changing forms of natural resource production and consumption. Her work is situated in resource-dependent communities in the subarctic North. She has conducted long-term ethnographic fieldwork in southwest Alaska, where she has analyzed historical and recent transformations in the region's salmon industry. Her research and teaching interests focus on issues of globalization and economic restructuring; the rise of market-driven policy paradigms and new modes of consumerism; the regulation of fisheries and agro-food systems; the production and experience of ecological risk and vulnerability; human-environment relations and sustainable livelihoods; and the sociocultural theory of environment and economy.

**Lloyd C. Irland** Lecturer and Senior Research Scientist. B.S., Michigan State University; M.S., University of Arizona; Ph.D., Yale University. Mr. Irland served with the U.S. Forest Service as a research economist before teaching at Yale for three years. He then served five years with the Department of Conservation, and five years as Maine's state economist. During these years in state government, he gained practical management experience as well as inside involvement in the legislative process. Since 1987 he has been consulting, mostly to industry but also to governments, trade groups, and environmental groups. He has been actively engaged with major land use and industrial competitiveness issues in the Northern Forest of New York and New England. In recent years his consulting has addressed biomass-based energy and forest carbon issues. Mr. Irland served as a junior author of one section of the Millennium Ecosystem Assessment and participated in the U.S. National Assessment on Climate Change. He has worked actively in the field of forest certification. His book *The Northeast's Changing Forest* is distributed by Harvard University Press. He also has worked in forestry and professional ethics, and edited a major readings volume, *Ethics in Forestry*. He recently completed an electronically published volume published by the School, *Professional Ethics for Natural Resource and Environmental Managers: A Primer*. His efforts on forest sustainability and policy have led to study tours and lecture visits to China, India, Germany, France, Greece, and Ukraine, which he recently visited as a Fulbright Senior Specialist. He is a fellow of the Society of American Foresters. In December 2009, he attended the UN Climate Summit, COP-15, in Copenhagen.

**Matthew J. Kotchen** Associate Professor of Environmental Economics and Policy. B.A., University of Vermont; M.S., University of Maine; M.S., Ph.D., University of Michigan. Professor Kotchen's research and teaching interests lie at the intersection of environmental and public economics. With the use of both theoretical and empirical methods, much of his work focuses on voluntary and information-based approaches to environmental

policy. Recent projects have investigated the effect of “green” markets on the provision of environmental public goods, participation in green-electricity programs, and voter referenda for open-space conservation. Ongoing research relates to climate and energy policy, daylight saving time, management of common-pool resources, corporate social responsibility, charitable fund raising, applied game theory, and interdisciplinary collaborations with ecologists and political scientists. Professor Kotchen is a faculty research fellow at the National Bureau of Economic Research (NBER) and has held previous positions at Williams College, University of California (Santa Barbara and Berkeley), Stanford University, and Resources for the Future (RFF).

**Xuhui Lee** Professor of Meteorology. B.Sc., M.Sc., Nanjing Institute of Meteorology, China; Ph.D., University of British Columbia. Professor Lee’s research and teaching concern the interactions among the terrestrial biosphere, the atmosphere, and anthropogenic drivers. His areas of interest include boundary-layer meteorology, air pollution meteorology, micro-meteorological instrumentation, remote sensing, carbon cycle science and policy, and China’s environmental management. His research activity also deals with greenhouse gas fluxes in the terrestrial environment, including forest, cropland, and manmade reservoir. Other ongoing projects deal with isotopic tracers in the cycling of carbon dioxide and water vapor, farmland management for carbon sequestration in China, and attribution of diurnal temperature range to biotic and abiotic perturbations. He is a guest professor in the Chinese Academy of Sciences and the editor-in-chief for the international journal *Agricultural and Forest Meteorology*.

**Anthony Leiserowitz** Research Scientist, Director of the Office of Strategic Initiatives, and Director of the Yale Project on Climate Change. B.A., Michigan State University; M.S., Ph.D., University of Oregon. Mr. Leiserowitz is an expert on American and international public opinion on global warming, including public perception of climate change risks, support and opposition for climate policies, and willingness to make individual behavioral change. His research investigates the psychological, cultural, political, and geographic factors that drive public environmental perception and behavior. He has conducted survey, experimental, and field research at scales ranging from the global to the local, including international studies, the United States, individual states (Alaska and Florida), municipalities (New York City), and with the Inupiaq Eskimo of Northwest Alaska. He also recently conducted the first empirical assessment of worldwide public values, attitudes, and behaviors regarding global sustainability, including environmental protection, economic growth, and human development. He has served as a consultant to the John F. Kennedy School of Government (Harvard University), the United Nations Development Programme, the Gallup World Poll, the Global Roundtable on Climate Change at the Earth Institute (Columbia University), and the World Economic Forum.

**Reid J. Lifset** Associate Research Scholar, Associate Director of the Industrial Environmental Management Program, Resident Scholar in Industrial Ecology, and Editor-in-Chief, *Journal of Industrial Ecology*. B.A., Swarthmore College; M.S., Massachusetts Institute of Technology; M.P.P.M., Yale School of Management. Mr. Lifset’s research and teaching focus on the emerging field of industrial ecology, the examination of the flow of materials and energy at various scales as part of the study and pursuit of sustainable

production and consumption. He edits the *Journal of Industrial Ecology*, an international peer-reviewed bimonthly headquartered at and owned by Yale University and published by Wiley-Blackwell. Mr. Lifset's research focuses on the development of the field of industrial ecology, the application of industrial ecology to solid waste problems, the environmental impact of biofuels, and the evolution of extended producer responsibility (EPR). He is investigating the global life cycle of metals and working with a consortium of electronics producers to generate research and craft a strategy to encourage individual producer responsibility for waste electrical and electronic equipment (WEEE). He is editor of the *Yale Working Papers on Solid Waste Policy* and a topic editor for industrial ecology for the *Encyclopedia of the Environment*. He also serves on the Science Advisory Board of the U.S. EPA.

**Robert Mendelsohn** Edwin Weyerhaeuser Davis Professor of Forest Policy, Professor of Economics, and Professor, School of Management. B.A., Harvard University; Ph.D., Yale University. Professor Mendelsohn has written over one hundred peer-reviewed articles and edited six books. The focus of his research has been the valuation of the environment. He has developed methods to value natural ecosystems including coral reefs, old-growth forests, nontimber forest products, ecotourism, and outdoor recreation. He has also developed methods to value pollution including emissions of criteria pollutants (such as particulates and sulfur dioxide) and hazardous waste sites. His most recent work values the impacts of greenhouse gases, including the effects of climate change on agriculture, forests, water resources, energy, and coasts. This research carefully integrates adaptation into impact assessment and has recently been extended to developing countries around the world. He has also been involved in studies of nonrenewable resources, forest management, and specifically carbon sequestration in forests. Professor Mendelsohn is a fellow of Ezra Stiles College.

**Florencia Montagnini** Professor in the Practice of Tropical Forestry and Director of the Program in Tropical Forestry of the Global Institute of Sustainable Forestry. B.S., National University of Rosario, Argentina; M.S., Venezuelan Institute for Scientific Research (IVIC); Ph.D., University of Georgia. Professor Montagnini's research focuses on variables controlling the sustainability of managed ecosystems (e.g., primary and secondary forests, plantations, and agroforestry systems) in the tropics, with special emphasis on Latin America; the identification and quantification of ecological services provided by forests (biodiversity conservation, carbon fixing and storage, and water production and quality); reforestation of degraded lands with native species, including mixed-species designs; tropical plantation silviculture; the use of biological enrichment techniques with species of economic value as a forest restoration tool; the integration of ecological principles with economic, social, and policy factors in the design of sustainable land use schemes in humid tropical regions; and the use of mechanisms of Payments for Environmental Services as tools to promote restoration and rural development. Projects that she is currently conducting include examining the role of native tree species in plantations and agroforestry systems in reclaiming degraded areas with species of economic value; the identification and quantification of ecological services provided by forests (biodiversity conservation, carbon sequestration, watershed protection); participatory projects for rural ecosystem restoration; and examining mechanisms of Payments

for Environmental Services in rural regions of Latin America. In her research, she collaborates with academic institutions such as CATIE (Tropical Agriculture Research and Higher Education Center, Costa Rica); private companies such as the Michelin tire company in Bahia, Brazil; as well as universities in Costa Rica, Panama, Mexico, Argentina, and Brazil. Professor Montagnini has written more than two hundred scientific articles for international journals, and seven books on agroforestry systems, tropical forest ecology and management, and ecological restoration. She is a fellow of Saybrook College. She also holds honorary professorships at several universities in Latin America. She teaches graduate-level courses in ecosystem restoration, tropical forest ecology, agroforestry, and soil conservation and management.

**Chadwick Dearing Oliver** Pinchot Professor of Forestry and Environmental Studies. B.S. (Forestry), University of the South; M.F.S., Ph.D., Yale University. Professor Oliver's initial research focused on the basic understanding of how forests develop and how silviculture can be applied to ecological systems most effectively. Much of this work is incorporated in a book he wrote entitled *Forest Stand Dynamics* (1990, and updated edition in 1996) with a former student as coauthor. He has continued this work; during the past decades he has also examined how this understanding can help resolve scientific, technical, and management issues at the landscape and policy levels. He is currently working on landscape approaches to forest management and is involved in the technical tools, the policies, the management approaches, and the educational needs. He is also examining global trade-offs among forest values and among the world's forest ecosystems. Professor Oliver has considerable experience advising public and private forest resource organizations in the United States and abroad. His work has taken him to all parts of the United States and to Canada, Mexico, many parts of Europe, Asia, and South America, and to Africa and Australia.

**Rajendra K. Pachauri** Director of the Yale Climate and Energy Institute; and Professor in the Practice of Sustainable Development. M.S., Ph.D., North Carolina State University. Professor Pachauri has chaired the Intergovernmental Panel on Climate Change (IPCC) since 2002 and has been chief executive of the Energy and Resources Institute (TERI) since 1982. He has been a leader in the global climate policy debate and played a major role in laying the groundwork for the 1997 Kyoto Protocol. He accepted the Nobel Peace Prize in 2007 on behalf of the IPCC, which shared the honor with former Vice President Al Gore. Under his leadership, TERI has become India's most prominent center for research and education in the field of sustainable development. He has published twenty-three books and more than one hundred academic articles, and has held numerous positions at academic and research institutes. In addition to having taught a term at the Yale School of Forestry & Environmental Studies as a Dorothy S. McCluskey Fellow in Conservation, he received an honorary degree from Yale in 2008. That same year, the government of India awarded him the Padma Vibhushan, one of the nation's highest civilian honors. The Yale Climate and Energy Institute will provide seed grants, support postgraduate study, sponsor conferences and workshops, and foster interdisciplinary research spanning from basic atmospheric science to public policy. Nearly one hundred Yale scientists, engineers, physicians, social scientists, and policy experts are involved in the new enterprise. Initial projects will focus on assessing the economic merits

and technological feasibility of mitigation options, forecasting climate variability and its impacts on water supplies, studying the spread of infectious diseases, searching for microbial-based alternative fuels, and the science and economics of carbon sequestration.

**Peter A. Raymond** Professor of Ecosystem Ecology. B.S., Marist College; Ph.D., College of William and Mary/Virginia Institute of Marine Science. Professor Raymond's research focuses on carbon cycle science. Current research topics include the landscape controls on the watershed export of carbon; transformations of carbon in streams, rivers, and estuaries; air-sea CO<sub>2</sub> exchange; and carbon dating.

**Jonathan D. Reuning-Scherer** Lecturer in Statistics. B.A./B.M. Oberlin College; M.A., M.M., Ph.D., Yale University. Mr. Reuning-Scherer has a joint appointment between the School of Forestry & Environmental Studies and the Department of Statistics, with a primary focus on teaching and advising students and faculty on the statistical aspects of their research projects. He is responsible for teaching yearly courses in introductory statistics and teaches regular courses in multivariate statistics, spatial statistics, experimental design, and data analysis. He serves on six to eight doctoral committees at any given time and consults weekly with students throughout the University. He has particular interest in multidirectional clustering algorithms, data analysis, and regression modeling.

**James E. Saiers** Professor of Hydrology and Associate Dean for Academic Affairs. B.S., Indiana University of Pennsylvania; M.S., Ph.D., University of Virginia. Professor Saiers studies controls on the distribution, quantity, and quality of freshwater. His research is intended to provide scientific knowledge needed to inform water management decisions for areas suffering from water scarcity and restoration plans for sites impacted by polluted groundwater and surface water. His research relies on experiments conducted in the laboratory and at field sites and on the development of computer models suitable for simulating hydrologic phenomena. Professor Saiers carries out this research in collaboration with graduate students, undergraduate students, and postdoctoral associates. His current students and postdocs are exploring various problems in surface and subsurface hydrology, including carbon cycling within forest soils, migration of contaminants in groundwater, sediment erosion and stream-sediment transport in rural watersheds, wetland hydrology, and climate-change effects on water availability and vegetation dynamics.

**Oswald J. Schmitz** Oastler Professor of Population and Community Ecology, and Professor of Ecology and Evolutionary Biology. B.Sc., M.Sc., University of Guelph, Ontario; Ph.D., University of Michigan. Professor Schmitz's research focuses on studying the linkage between two important components of natural systems: biodiversity and ecosystem services. These issues are examined using field experimentation guided by formal mathematical theory of species interactions. Both theory development and field research are aimed at identifying functionally unique groupings of predators and herbivores. These insights are used to explain how predator and herbivore species determine the species composition and productivity of plants in ecosystems, and ensuing ecosystem processes such as nutrient and carbon cycling. Research also focuses on elucidating how important environmental disturbances, such as global climate change and natural resource exploitation, alter the nature and strength of species interactions in ecosystems and ensuing ecosystem services. The scientific insights aid efforts to conserve vital services that

species in ecosystems provide to humankind. Professor Schmitz's research evaluates how to rethink conservation strategies by considering species as part of a natural portfolio with substantial investment opportunity. This portfolio represents a wealth of potential alternatives to contemporary technologically intensive and expensive approaches in environmental management.

**Karen C. Seto** Associate Professor in the Urban Environment. B.A., University of California, Santa Barbara; M.A., Ph.D., Boston University. A geographer by training, Professor Seto studies the human transformation of land and the links between urbanization and global change. Her research includes satellite remote sensing to characterize land use dynamics, forecasting urban growth, and examining the environmental consequences of land use change and urban expansion. Her current research areas include urbanization and agricultural land loss, climate change and urbanization, and sustainable development. Her geographic region of specialization is China, where she has worked on urban development issues for more than fifteen years. She also has research projects in India, Vietnam, and Qatar. Professor Seto is cochair of the Urbanization and Global Environmental Change project of the International Human Dimensions Programme on Global Environmental Change (IHDP). From 2002 to 2008, she was the remote sensing thematic leader for the International Union for Conservation of Nature (IUCN) Commission on Ecosystem Management, and she is a former member of the Scientific Steering Committee of the Monsoon Asia Integrated Regional Study (MAIRS) project. Professor Seto is executive producer of *10,000 Shovels: Rapid Urban Growth in South China*, a documentary film that highlights the urban changes occurring in China.

**David K. Skelly** Professor of Ecology, Associate Dean for Research, Professor of Ecology and Evolutionary Biology, and Director of Doctoral Studies. A.B., Middlebury College; Ph.D., University of Michigan. Professor Skelly is interested in understanding mechanisms structuring animal distributions and in developing the means to apply that understanding to conservation and management. His studies of amphibians have been directed at determining the causes of patterns such as the extinction and establishment of populations. In order to discover the links among landscape-level distributions, performance across environmental gradients, and the attributes of individual species, he has employed field and laboratory experiments in conjunction with long-term observations of populations and their environment. Current research includes an exploration of forest dynamics as a driver of amphibian population dynamics and rapid evolutionary responses to temperature change. Other projects include studies of urbanization and emergence of infectious disease, and an investigation of causes underlying developmental deformities of amphibians. Professor Skelly also holds appointments in the Department of Ecology and Evolutionary Biology and as a curator in the Yale Peabody Museum of Natural History. In 2003 he was awarded a Guggenheim Fellowship for his research on amphibian ecology and conservation.

**Fred Strebeigh** Senior Lecturer in Environmental Writing and Senior Lecturer, Department of English. B.A., Yale University. Mr. Strebeigh has written for publications including *American Heritage*, *Atlantic Monthly*, *Audubon*, *E: The Environmental Magazine*, *Legal Affairs*, *New Republic*, *Reader's Digest*, *Russian Life*, *Sierra*, *Smithsonian*, and *The New York*

*Times Magazine*. Topics on which he has published include the history and origins of nature writing; the influence of nature on artistic form; the role of the bicycle in China; educational exchange between China and the United States; pressures on the Antarctic treaty system; natural and social conditions in the Falkland Islands; traces of early man in southern Africa; saving whales from fishing nets off the coast of Newfoundland; the impact of environmental issues on the presidential election in 2004; and defending the world's largest system of scientific nature reserves in Russia. His teaching in 2004 received Yale's DeVane Medal, presented each year by Phi Beta Kappa to a member of the University's active faculty; and in 2009 at Yale Commencement, he received the Brodhead Prize for Teaching Excellence.

**Mary Evelyn Tucker** Senior Lecturer and Senior Research Scholar. B.A., Trinity College; M.A., SUNY Fredonia; M.A., Fordham University; Ph.D., Columbia University. Ms. Tucker is cofounder and codirector of the Forum on Religion and Ecology with John Grim. Together they organized a series of ten conferences on World Religions and Ecology at Harvard's Center for the Study of World Religions. They are series editors for the ten volumes from the conferences distributed by Harvard University Press. They are also editors for an eighteen-volume series on ecology and justice from Orbis Press. Ms. Tucker is the author of *Worldly Wonder: Religions Enter Their Ecological Phase* (Open Court Press, 2003), *Moral and Spiritual Cultivation in Japanese Neo-Confucianism* (SUNY, 1989), and *The Philosophy of Qi* (Columbia University Press, 2007). She coedited *Worldviews and Ecology* (Orbis, 1994), *Buddhism and Ecology* (Harvard, 1997), *Confucianism and Ecology* (Harvard, 1998), *Hinduism and Ecology* (Harvard, 2000), and *When Worlds Converge* (Open Court, 2002). With Tu Weiming she edited the two-volume *Confucian Spirituality* (Crossroad, 2003, 2004). She also coedited a *Daedalus* volume titled *Religion and Ecology: Can the Climate Change?* (2001). She edited Thomas Berry's *Evening Thoughts: Reflecting on the Earth as Sacred Community* (Sierra Club and University of California Press, 2006). She also edited Berry's *The Sacred Universe* (Columbia University Press, 2009) and *The Christian Future and the Fate of Earth* (Orbis Books, 2009). Ms. Tucker completed her doctorate in East Asian religions with a concentration in Confucianism in China and Japan. She is a research associate at the Reischauer Institute at Harvard. From 1993 to 1996 she held a National Endowment for the Humanities Chair. Since 1987 she has been a member of the Interfaith Partnership for the Environment at the United Nations Environment Programme (UNEP). She served on the International Earth Charter Drafting Committee from 1997 to 2000 and is now a member of the Earth Charter International Council. She is a fellow of Saybrook College.

**Nadine Unger** Assistant Professor of Climate Science. B.Sc., Ph.D., University of Leeds, U.K. Professor Unger investigates linkages between atmospheric chemistry and global change using numerical models of climate and air pollution. The major focus of her research is to understand human controls on global and regional climate through changes to atmospheric aerosol particles and reactive gases from energy use and agricultural activities. To aid in the development of smart climate policy and effective decision making, she uses a novel multi-pollutant approach that considers the net climate and public health impacts of specific socioeconomic sectors. Current research projects include the effects of aviation and tropical deforestation on climate change, and the net climate impacts

of world political regions. In related research, she examines the climate and air quality consequences of proposed mitigation scenarios and energy shifts. Interests include conversion of vehicle fleets to alternative fuels, the future of transportation in India, and geo-engineering strategies. Professor Unger's research encompasses ecosystem-atmosphere interactions with particular interest in the role of biogenic emissions of reactive gases from terrestrial vegetation in the climate system. Research activities include modeling the response of isoprene and monoterpene emissions to global change in future climates that feature human-induced land use change and regional afforestation/deforestation, and the assessment of air pollution impacts on terrestrial ecosystems and the resultant climate feedbacks.

**John P. Wargo** Professor of Environmental Policy, Political Science, and Risk Analysis; and Chair of the Yale College Environmental Studies Major and Program. B.A., University of Pennsylvania; M.L.A., University of Massachusetts, Amherst; Ph.D., Yale University. Professor Wargo's recent work has focused on legal strategies to control environmental threats to children's health including air pollution, pesticides, plastics, mercury, and endocrine-disrupting chemicals. He is expert in both the law and regulation of these hazards, and conducts research on women's and children's exposure to mixtures of toxic substances. Professor Wargo's doctoral students have examined law and environmental health problems in Tanzania, Thailand, South Africa, Denmark, Mexico, Israel, India, and many parts of the United States. His most recent book, *Green Intelligence*, published by Yale University Press in 2009, compares the history of five serious and global environmental threats to children's health in the twentieth century: nuclear weapons testing, pesticides, hazardous sites, vehicle particulate emissions, and hormonally active ingredients in plastics. Professor Wargo wrote *Our Children's Toxic Legacy: How Science and Law Fail to Protect Us from Pesticides*, published by Yale University Press in 1998, presenting a history of law and science governing pesticides with special attention to the vulnerability of infants and children. The book won the American Association of Publishers award as the Best Scholarly & Professional Book in Government and Political Science in 1998. He is also coauthor of *Ecosystems: Balancing Science with Management*, published by Springer-Verlag in 1998. He participated in several National Academy of Sciences committees, analyzing children's exposure to toxic substances. Professor Wargo has testified before both Senate and House Committees, and has been an adviser to the White House, the World Health Organization, the Food and Agriculture organization, the EPA, and USDA on threats to children's environmental health as well as policies that would offer greater protection. He also has written about parks and protected areas, and land use regulation.

**Julie B. Zimmerman** Assistant Professor of Green Engineering (jointly appointed to the School of Engineering & Applied Science). B.Sc., M.Sc., Ph.D., University of Michigan. Professor Zimmerman is also a visiting professor in the Department of Civil Engineering at the University of Virginia. Her research interests include green engineering, environmentally benign design and manufacturing, and the fate and impacts of anthropogenic compounds in the environment as well as appropriate water treatment technologies for the developing world. Professor Zimmerman's research is aimed at designing and developing innovative science, technology, and policy to advance sustainability. Through her

engineering research, she is working toward the next generation of products, processes, and systems based on efficient and effective use of benign materials and energy to advance sustainability. To enhance the likelihood of successful implementation of these next-generation designs, she studies the effectiveness and impediments of current and potential policies developed to advance sustainability. Together, these efforts represent a systematic and holistic approach to addressing the challenges of sustainability to enhance water and resource quality and quantity, to improve environmental protection, and to provide for a higher quality of life. Professor Zimmerman previously served as an engineer and program coordinator in the Office of Research and Development at the U.S. Environmental Protection Agency, where she launched EPA's P3 Award program.

# Master's Degree Programs

## TWO-YEAR MASTER'S DEGREE PROGRAMS

The School of Forestry & Environmental Studies offers four two-year master's degrees: the professionally oriented Master of Environmental Management (M.E.M.) and the Master of Forestry (M.F.), and the research-oriented Master of Environmental Science (M.E.Sc.) and Master of Forestry Science (M.F.S.). The master's degree programs vary in their level of prescription, but all are sufficiently flexible to accommodate the diverse academic backgrounds, professional experiences, and career aspirations of a large and vibrant student body. The program curricula draw from more than one hundred courses taught by fifty F&ES faculty, as well as from courses taught elsewhere at Yale. Each student's course of study is customized through consultation with a faculty adviser who guides the student's learning experience from the first week at Yale until graduation. The master's degree programs require a minimum of two years in residence, 48 credits of course work at Yale, a summer internship or research experience, and completion of the Training Modules in Technical Skills prior to the student's first term (see below).

### *Master of Environmental Management*

The Master of Environmental Management degree prepares students for careers in environmental policy and analysis, green business, design and planning, conservation and stewardship, education, consulting, or journalism. The program requires course work from the diverse perspectives of the natural and social sciences, with a focus on the complex relationship among science, management, and policy. The purpose of the program is to provide students with a scientific understanding of ecological and social systems that can be applied in a policy or management context. Students are also expected to hone their capacities as leaders and managers through summer internships, professional skills courses, and other opportunities.

The M.E.M. curriculum has recently been redesigned to ensure that F&ES graduates continue to be competitive in the ever-changing job market and ready to distinguish themselves as the next generation of leading environmental professionals. The redesigned M.E.M. consists of five main components: Foundations, Integrative Frameworks, Electives, Professional Skills, and a Capstone in applied problem solving.

#### FOUNDATIONS

Six Foundations courses in five subject areas – (1) biological and ecological sciences, (2) earth and atmospheric sciences, (3) environmental economics, (4) statistics, and (5) social and policy sciences – cover the essential knowledge and theory that every environmental manager should have, regardless of his or her intended areas of specialization. F&ES elective courses build on these Foundations in addressing long-standing and emerging environmental problems in the later stages of the curriculum. One course each is offered in areas 1–4. Students have a choice between two offerings in area 5.

Students are strongly encouraged to take a Foundations course in each of the five areas, as they cover concepts and principles that serve as starting points for F&ES's advanced elective offerings. A student may be exempted from a Foundations course in cases in

which a high level of proficiency in that subject area can be established. This proficiency should be determined through consultation with the student's academic adviser and, when appropriate, through discussion with the instructor of the Foundations course.

The Foundations courses are offered during the fall terms. Students are encouraged to take two or three Foundations courses during their first term and the remaining Foundations courses – those less central to their intended areas of specialization and hence less essential as prerequisites for their upper-level course selections – in their third term.

#### **INTEGRATIVE FRAMEWORKS**

The Integrative Frameworks courses explore the social, economic, political, and scientific interrelationships of some of today's most pressing environmental issues. These team-taught courses build on the Foundations courses by illustrating how practices, methodologies, and perspectives from multiple disciplines must be integrated to provide holistic answers to the challenges posed by environmental problems. Participation in the Integrative Frameworks courses will help students refine their goals and interests and illuminate gaps in understanding, which, in turn, will inform their decisions on advanced course work. Students are required to take one Integrative Frameworks course during either their first or second term.

#### **ELECTIVES**

The main body of the curriculum consists of elective courses that present advanced-level treatments of topics and disciplines. Students can choose from approximately 100 courses in developing expertise in an area of specialization relevant to their career goals, with the assistance of their adviser, the Career Development Office, and other mentors. Collectively, these courses explore the social, political, ecological, and physicochemical processes that affect freshwater, atmospheric, land, industrial, urban, and energy systems. Most elective courses assume student command of the knowledge and concepts covered in one or more of the Foundations courses and may list other courses as prerequisites.

#### **PROFESSIONAL SKILLS**

The Professional Skills component of the curriculum is intended to provide management, communications, and leadership training that is essential to success in environmental management and many other professions. Consisting of four 1-credit half-term courses, the optional Professional Skills Core lays a groundwork of professional training in project management, conflict resolution, communications, and financial management. These courses are supplemented by elective courses focusing on particular professional skills.

#### **CAPSTONE**

The final component of the M.E.M is a Capstone course or project focusing on applied problem solving, and relying on the application of knowledge, methodological approaches, and interpretive techniques gained from courses taken during the earlier stages of the M.E.M. To fulfill this requirement, students work alone or in groups on a faculty-supervised Capstone project. This may involve service to a client (e.g., a government agency, company, not-for-profit, or individual); applied, nonacademic approaches to exploring environmental problems, such as filmmaking, journalism, or community-based projects; or a research project that culminates with a paper suitable for publication

in a scientific or trade journal. The Capstone provides students with an opportunity to integrate academic study and research with real-world, hands-on problem solving. As the Capstone relies on integration of a body of knowledge, most Capstone courses have prerequisites.

### *Master of Forestry*

The Master of Forestry program is aimed at training professionals for administration and management of forest lands, and for mediating and resolving the conflicting values of society that concern forests and their associated ecosystems. Forest systems cover one-third of the terrestrial surface of the earth. More important than this expansive distribution, however, are the numerous and critically important values that forests provide to human societies. Currently the pressures of economic development, population growth, and energy use challenge the sustainability of forest values as never before in human history.

Since 1900, the Master of Forestry program has provided leadership in the education of professional foresters. It is the oldest continuing forestry program in the Western Hemisphere. Almost all the early foresters in North America had their roots at Yale. Graduates include such notables as Aldo Leopold, M.F. '09 and Starker Leopold, M.F. '38; the fathers of forest ecology and silviculture in North America (Clarence Korstian, M.F. '26; Harold Lutz, M.F. '27; Stephen Spurr, M.F. '40; David Smith, M.F. '46); and nine of the first twelve chiefs of the USDA Forest Service. This program is designed for individuals who want to be at the forefront of forest resource management and policy. The Master of Forestry curriculum is a truly interdisciplinary approach rooted in the biological basis of ecosystems.

For the past ten years Master of Forestry graduates have taken a variety of professional opportunities in forestry. Most start as general practitioners and management officers and with experience move through management to become policy makers and organizers. Employment can be characterized as follows: (1) government and public agencies (e.g., Environmental Protection Agency, U.S. Department of Agriculture Forest Service); (2) international development and conservation organizations (e.g., Food and Agriculture Organization, CARE, OXFAM, USAID, Winrock International, World Wildlife Fund, Conservation International); (3) industry, finance, and investment (e.g., World Bank, International Paper Co., John Hancock Insurance Co.); and (4) town planners, land trusts, and conservation organizations (e.g., The Nature Conservancy, Wilderness Society). An important proportion of graduates use the degree as preparation for advanced study in doctoral programs.

The broad objective of the two-year M.F. program is realized by requiring a multidisciplinary suite of formal course work coupled with a progressive synthesis of knowledge in a significant project. Course work is supplemented through the provision of an array of local, regional, national, and international trips to witness the practice of forestry in diverse settings. Real-world professional experience is provided through the Yale Forest and a host of internships offered through the auspices of the Global Institute for Sustainable Forestry and the Tropical Resources Institute. Additionally, the School hosts workshops, visiting speakers of national and international repute, and publications of the Yale Forest Forum.

The teaching objectives of the M.F. program are (1) to integrate knowledge about forests, natural resources, and society to form a sound basis for making management decisions; (2) to provide electives and other educational opportunities to specialize by focusing on a particular land use or management issue concerning forest ecosystem management; and (3) to provide opportunities for independent problem solving, critical thinking, and self-development. All core courses at F&ES are designated as natural, social, or quantitative science, and all students must take a mixture. The capstone course addresses management skills and, in particular, leadership. Flexibility of the choice of course within the required topic areas of the M.F. curriculum allows the student to tailor required courses to a desired specialization. Sample specializations have included community development and social forestry; protected areas management; extension and education; consulting and business; watershed health and restoration; tropical forest management; agroforestry; and industrial forest management.

The two-year program leading to the Master of Forestry degree as the first professional degree in forestry is accredited by the Society of American Foresters (SAF). The SAF was founded in 1900 by Gifford Pinchot and six other pioneer foresters, and its role as accrediting body for forestry in the United States is recognized by the U.S. Department of Education and the Council on Post-Secondary Accreditation. For this reason, the degree is widely accepted in other regions and countries with similar professional standards. In recent years there has also been a growing recognition of required professional licensing and registration for all resource managers in the United States, particularly in the Northeast and West Coast regions, or for individuals working in any of the federal agencies, e.g., U.S. Department of Agriculture Forest Service. In most of these states and agencies, resource management can be practiced only by individuals who have met certain educational and experience standards. An accredited professional degree is usually the first requirement. *A minimum of two full years in residence and sixteen full courses (48 credits) is required for completion of this program.*

### *Master of Environmental Science/Master of Forest Science*

The Master of Environmental Science and the Master of Forest Science degree programs are expressly designed for students wishing to conduct research that contributes to basic and applied knowledge in any of the fields taught at F&ES, such as ecology, hydrology, social ecology, economics, industrial ecology, or policy. These degrees are intended to facilitate a deeper disciplinary focus than the Management degrees, while allowing students the flexibility in course election that will allow them to meet diverse educational goals. The Master of Environmental Science is intended for students who wish to work broadly in different fields of environmental science. The Master of Forest Science is intended for students who wish to work in forest-related topics.

The course of study for both degrees includes formalized School-level training in the philosophy and practice of science. Training is provided through key courses in combination with extended project research and disciplinary and nondisciplinary electives. The scientific research required for this degree will be conducted in close collaboration with an F&ES faculty adviser. *Therefore students must have a commitment from a faculty adviser before being admitted to these degree programs.* The Master of Environmental Science and

Master of Forest Science programs require the student to produce a “scholarly product.” This product may take the form of a traditional master’s thesis or a paper submitted to a refereed journal.

### *Training Modules in Technical Skills*

All incoming master’s students participate in three weeks of summer modules, which impart field skills and techniques considered indispensable to students intending careers in environmental research, management, and policy. These modules are a necessary base for subsequent course work at the School of Forestry & Environmental Studies, provide an orientation to the School, and are offered only during the last three weeks of August.

These modules are *required* of all first-year master’s students enrolled in two-year programs as well as for all one-year midcareer degree program students. Waivers will be granted from one, two, or all of the modules only upon evidence of attainment of these skills through previous course work or professional experience. Course work is primarily in the field and covers three technical areas:

Module I: Urban Ecosystem Analysis—use of the urban areas as a point of study on the patterns and processes that drive urban ecosystems.

Module II: Ecosystem Measurement—sampling methods, research design, data reduction and analysis.

Module III: Land Measurement—surveying, aerial photography, GPS, remote sensing and mapping.

## ONE-YEAR MIDCAREER MASTER’S DEGREE PROGRAM

The midcareer M.E.M. or M.F. degree program is intended to permit practicing environmental and forest managers to build on their work experience and learn new skills that will enable them to pursue their career goals more effectively. To this end, those admitted into the program must have at least seven years of directly relevant professional experience in the environmental or forestry field that is sufficient to provide a corpus of experiential learning equivalent to one year of academic study at F&ES. So that the admissions committee may fairly judge each applicant’s work record in light of this requirement, an applicant must detail his or her career work experience. Relevant work experience is not the sole criterion for admission into this degree program; the breadth of prior academic training is also considered, and those applicants who are better prepared (see Preparation for Admission, in section on Admissions: Master’s Degree Programs) are more likely to succeed in this competitive admission process.

The midcareer degree program is not appropriate for persons seeking to make an abrupt change in the direction of their careers. Nor is it suitable for those who have acquired seven or more years of work experience that is tangentially related to environmental or forest management. Normally, voluntary service will not be considered equivalent to career experience needed for acceptance into this degree program.

The one-year midcareer Master of Environmental Management and Master of Forestry degree programs have less structured curricula than the two-year programs.

Attendance at the Training Modules (see Training Modules in Technical Skills, above) is expected, and the successful completion of 24 credits of course work and independent study is required. One year in residence is normally required, as is initial enrollment at the start of the fall term.

## JOINT MASTER'S DEGREE PROGRAMS

The School of Forestry & Environmental Studies supports several curricula that work concurrently toward two degrees from different academic units of Yale University. Opportunities for development of joint-degree programs exist with the School of Architecture, Divinity School, Law School, School of Management, School of Public Health, the Graduate School's International Relations program, and the International and Development Economics program of the Graduate School's Department of Economics. Joint-degree programs with Pace Law School and Vermont Law School constitute additional options. Applicants are urged to apply to both units at the same time. All of these programs are subject to the following general guidelines.

Applicants must apply to, and be accepted by, both units of the University according to normal admissions procedures. A minimum of one and one-half years (three terms) and 36 credits is required at the School of Forestry & Environmental Studies. For successful integration of the two programs, it is recommended that students spend a complete academic year (two terms) at one school, the following academic year at the other school, and then split the final year between the two schools.

Upon successful completion of the formal joint-degree program, the student will be awarded one of the four F&ES master's degrees, together with the joint degree. The joint-degree programs, sponsoring Yale academic units, and associated residency requirements (which are in addition to the three-term requirement of F&ES) are as follows:

1. School of Architecture: Master of Architecture I (five terms); Master of Architecture II (three terms).
2. Divinity School: Master of Arts in Religion (3 terms); Master of Divinity (five terms).
3. Schools of law (Yale Law School, Pace Law School, and Vermont Law School): Juris Doctor (five terms).
4. School of Management: Master of Business Administration (three terms).
5. School of Public Health: Master of Public Health (three terms).
6. International Relations (Graduate School of Arts and Sciences): Master of Arts (two to three terms).
7. Department of Economics, International Development and Economics program: Master of Arts (two to three terms).

For questions about the joint-degree programs, please consult the F&ES Office of Admissions at [fesinfo@yale.edu](mailto:fesinfo@yale.edu) or call 800.825.0330.

## PART-TIME PROGRAM

Students who wish to obtain a degree through the part-time option must complete the same curriculum as full-time students. Participants must enroll for at least two courses per term and must complete the degree requirements within four years of matriculation.

## **SPECIAL STUDENTS**

For those who do not wish to pursue a degree program, F&ES offers the option of special student status. Special students may be registered for a period as short as one term and may enroll in a minimum of one course or elect to take a full program of four courses per term. Special students are not eligible to participate in the summer Training Modules in Technical Skills. Under normal circumstances, no one may hold special student status for more than one academic year. No degree or certificate is granted for special student course work. Students will receive official transcripts recording course work completed.

# Doctoral Degree Program

The Doctor of Philosophy (Ph.D.) degree is conferred through the Yale Graduate School Arts and Sciences. Work toward this doctoral degree is directed by the Department of Forestry & Environmental Studies of the Graduate School, which is composed of the faculty of the School of Forestry & Environmental Studies. Doctoral work is concentrated in areas of faculty research, which currently encompass the following broad foci: agroforestry; biodiversity conservation; biostatistics and biometry; community ecology; ecosystems ecology; ecosystems management; energy and the environment; environmental anthropology; environmental biophysics and meteorology; environmental chemistry; environmental ethics; environmental governance; environmental health risk assessment; environmental history; environmental law and politics; environmental management and social ecology in developing countries; environmental and resource policy; forest ecology; green chemistry and engineering; hydrology; industrial ecology; industrial environmental management; plant physiology and anatomy; pollution management; population ecology; resource economics; silviculture, social ecology; stand development, tropical ecology, and conservation; sustainable development; urban ecology; urban planning; urban land cover change; urban geography; and water resource management.

## REQUIREMENTS FOR THE DOCTORAL DEGREE

All courses listed in this bulletin are open to students working for the doctoral degree. Additional courses are available in other departments – e.g., Anthropology; Chemistry; Ecology and Evolutionary Biology; Economics; Geology and Geophysics; Management; Mathematics; Molecular, Cellular, and Developmental Biology; Political Science; Sociology; and Statistics – and are listed in the bulletin of the Graduate School.

A doctoral committee will be appointed for each student no later than the student's second term in the program. The committee consists of a minimum of three faculty members from the Yale University community. When appropriate for their research areas, students are encouraged to suggest committee members from other universities. Doctoral students work under the supervision of their doctoral committees. The committee should be chaired or cochaired by an F&ES ladder faculty member.

Students are required to take the Doctoral Student Seminar, F&ES 900a, during the first year of their program.

Two Honors grades must be achieved before a student is eligible to sit for the qualifying examination. In addition, students are expected to serve four terms (10 hours per week) as teaching fellows, in partial fulfillment of their doctoral training.

A written and oral qualifying examination is required upon completion of the course requirements. Students are expected to take the examination by the end of their second year, although this can be extended to the third year in cases with appropriate extenuating circumstances. At the time of the qualifying examination, the student must present a prospectus of the research work proposed for the dissertation. Successful completion of the qualifying examination and submission of the prospectus will result in admission to candidacy.

The director of doctoral studies (DDS) of the School serves as director of graduate studies for the Department of Forestry & Environmental Studies of the Graduate School, administers the doctoral program, and may be consulted if questions arise.

Before beginning work, the student must secure approval from his or her committee and the DDS for a proposed program of study and for the general plan of the dissertation. Appropriate advanced work is required. Courses chosen should form a coherent plan of study and should support research work for the proposed dissertation.

The dissertation should demonstrate the student's mastery of his or her chosen field of study as well as the ability to do independent scholarly work and to formulate conclusions that may modify or enlarge previous knowledge.

Candidates must present themselves for the oral defense of the dissertation at such time and place as the student, the DDS, and the committee determine. Upon completion of the dissertation, the candidate must make unbound copies of the dissertation available to the faculty. Copies of the approved dissertation must be submitted to the Graduate School.

## COMBINED DOCTORAL DEGREE

### *Department of Anthropology*

The School of Forestry & Environmental Studies offers a combined doctoral degree with Yale's Department of Anthropology. The purpose and attraction of the degree are three-fold: (1) it combines the disciplinary identity and strengths of the Anthropology department with the interdisciplinary character and possibilities of F&ES, especially in terms of bridging the social and natural sciences; (2) it combines the strengths in ecological and environmental studies of F&ES with the social science strengths of the Anthropology department; and (3) it combines the Anthropology department's strengths in theory with the emphasis within F&ES on linking theory with policy and practice. The combined doctoral degree offers its graduates great flexibility when entering the marketplace: they can represent themselves as anthropologists and/or environmental scientists, as theoreticians and/or practitioners. They have the credentials to apply for policy-oriented positions with international institutions as well as academic positions in teaching and research. The academic program of each student in the combined-degree program is to some extent tailored specifically to his or her particular history, interests, and needs, but there are general guidelines that combined students can be expected to follow, and they are laid out here.

Prospective combined-degree students must initially apply either to Anthropology or to F&ES but not to both at the same time. However, in keeping with the current Yale Graduate School application process, they should indicate their interest in the combined degree by marking the application form appropriately. Once the student is accepted in the initially chosen doctoral program, the application file will be considered in the second program and a decision on the combined-degree application will be communicated by the Graduate School by the usual deadline for acceptance of admission offers. Such students will be allocated to their initially chosen program as their primary administrative home but will enter Yale as members of the combined-degree program. Being turned down for

entry into the combined-degree program at this point does not preclude re-application after arriving at Yale the following fall term. More detailed guidelines for the combined-degree program can be found on the F&ES Web site at [www.environment.yale.edu/prospective/Joint-Doctoral-Degrees](http://www.environment.yale.edu/prospective/Joint-Doctoral-Degrees).

### *New York Botanical Garden*

The School of Forestry & Environmental Studies offers a combined doctoral degree with the New York Botanical Garden, which is funded by the Lewis B. Cullman Fellowship. The objective is to train biological scientists to use an interdisciplinary approach to solving problems associated with tropical environments.

Areas of study include agroforestry and forest management, ecosystem analysis, economic botany, economic evaluation of tropical resources, ethnobotany, plant biodiversity and conservation, social processes affecting management of natural resources, tropical field studies, and tropical silviculture.

For more information about the combined doctoral degree, please contact the director of doctoral studies at 203.432.5146.

# Focal Areas

The Yale School of Forestry & Environmental Studies recognizes that institutionally it is as important to solve problems for local watersheds as it is to address issues related to global climate change. To address such a wide range of environmental challenges, the School of Forestry & Environmental Studies has identified nine focal areas that represent the scope and depth of environmental research conducted by the faculty of the School.

## ECOLOGY, ECOSYSTEMS, AND BIODIVERSITY

This focal area represents the School's collective scientific endeavor to understand both the interactions of living organisms with each other and the physical and chemical components of their surrounding environment, and the cause of changes in global patterns in species distribution and abundance. Meeting these challenges requires the integration of chemistry and biology, biophysics, physiology, genetics, behavior and evolution, mathematical modeling as well as sociology, anthropology, and policy. The goals of this area are to develop and make accessible the body of natural, social, and political scientific knowledge needed to improve our understanding of the complex interrelationships between humans and the rich diversity of organisms living in ecosystems, and to provide students with a comprehensive set of courses that will enable them to develop an integrated understanding of these issues.

Faculty in this focal area teach on a variety of subjects, including conservation biology; aquatic ecology; methods of ecosystem analysis; forest ecosystem health; human dimensions in the conservation of biological diversity; and management plans for protected areas. Undergraduate courses are also offered, including the study of ecology and environmental problem solving and the study of the local flora.

**Faculty** David K. Skelly (Coordinator), Mark S. Ashton, Graeme P. Berlyn, Mark A. Bradford, Ann E. Camp, Susan G. Clark, Peter Crane, Gordon T. Geballe, Timothy G. Gregoire, John Grim, Xuhui Lee, Peter A. Raymond, Oswald J. Schmitz

**Courtesy joint appointments** Adalgisa (Gisella) Caccone, Michael Donoghue, Jeffrey Powell, Richard Prum

## THE SOCIAL ECOLOGY OF CONSERVATION AND DEVELOPMENT

The overarching goal of work in this focal area is to bridge the divide in environmental studies between nature and culture, rich and poor, North and South; to carry out socially informed and community-oriented research on the linkages between environmental health and socioeconomic development, equity, and justice; so that conservation and development planning may better attain both conservation of the environment and enhancement of human rights and welfare.

This track is distinguished by a critical approach to conservation and development theory, which bridges theory and practice, and micro-level and macro-level, focusing on people, community, culture, gender, power, and politics from a cross-cultural

perspective. The emphasis is on conveying to students not a fixed knowledge base, but self-reflexive, critical, analytical skills. Attention also is paid to relations between the academy and society and to the concept of “sustainable education.”

Graduate courses are offered on such topics as adaptation to perturbation/disaster; agrarian society; anthropogenic change in tropical ecosystems; communities, households, society, and environment; consumption and the environment; energy issues and climate change in less developed countries; environmental justice and ethics; environmental movements and institutions; environmental/natural resource policy and politics; religion, values, archetypes, and the environment; social science research methods; sustainable development; and urban environments. Undergraduate courses are offered in environmental perception and environmental anthropology. Students in this focal area carry out summer research both within the United States and internationally, with excellent on-campus financial support available for the latter.

This focal area prepares student for jobs in the public sector as well as for further work in academia. A number of our students have gone on to doctoral programs in such fields as anthropology, geography, and sociology, as well as to law school and the Peace Corps. The majority of our students find jobs in NGOs working on conservation and development issues.

**Faculty** Michael R. Dove (Coordinator), Mark S. Ashton, Robert Bailis, Ellen Brennan-Galvin, Carol Carpenter, Benjamin Cashore, Susan G. Clark, Amity A. Doolittle, Paul A. Draghi, Gordon T. Geballe, John Grim, Karen Hébert, Anthony Leiserowitz, Florencia Montagnini, Chadwick D. Oliver, Karen Seto, Mary Evelyn Tucker, John P. Wargo

**Courtesy joint appointments** Willis Jenkins, James C. Scott, K. Sivaramakrishnan, Fred Strebeigh

**Associated centers/programs** Tropical Resources Institute, Agrarian Studies Program, Yale Climate and Energy Institute (YCEI)

## FORESTRY, FOREST SCIENCE, AND THE MANAGEMENT OF FORESTS FOR CONSERVATION AND DEVELOPMENT

The Forests and Forestry faculty group embraces a new, more holistic, and more practical concept of forest management. The group recognizes that forests worldwide produce multiple products and services from timber supply to water to wildlife habitat. Forestry seeks to manage these ecosystems to yield equitable social, environmental, and economic outputs across the landscape. Moving from a focus on timber to a more encompassing perspective requires many changes in the ways forestry is practiced and how forested ecosystems are managed.

This approach requires a thorough understanding of the entire forest ecosystem and how each component relates to the rest of the system. Science must not only predict outcomes in terms of future timber supplies but also in terms of effects on aquatic systems, wildlife, endangered species, recreation quality, and nontimber forest products. In particular, a better understanding must be gained of the temporal and spatial scale

and intensity of perturbations and natural fluctuations and the effects of anthropogenic change on natural systems. Because many of these relationships are poorly understood, forestry must adopt adaptive management techniques to test outcomes in the field and improve our understanding over time. New tools need to be developed that recognize the complex spatial and dynamic relationships across this system. These tools need to describe what is possible across different landscapes, how alternative outcomes can be produced, and over what time frame. This means modeling scenarios for better forest management assessments and the development of more refined decision support systems for generating management options and outcomes.

Foresters must learn how society weighs these alternative outcomes. How valuable are these different products and services? Which choice is socially preferred? Foresters must examine existing institutions and laws to understand whether they encourage optimal outcomes in forests across the world. Because various outcomes benefit different people, conflict is inherent in forest management. Conflict resolution, respect of property rights, and recognition of equity concerns must all become forestry skills.

Our view of forestry goes well beyond more traditional forms of management to embrace the very foundations of the social, ecological, and economical values of forests worldwide. This suggests a host of individual research projects for our faculty. Ecologists and silviculturalists need to explore natural regeneration, trophic food webs and community ecology, forest dynamics at stand and landscape levels, and the effectiveness of management. Statisticians need to expand traditional mensuration techniques focused on timber resources to quantify a broader array of relationships including effects on wildlife, water, and nontimber forest products. Modelers need to incorporate all these quantified relationships across space and across time for the entire ecosystem. Economists must expand valuation from what is currently understood to include this new broader array of goods and services. Social ecologists must engage in creative ways of integrating local knowledge into management, and in ways to empower local communities for managing forests for conservation and development. Managers must develop techniques to integrate all of this information so that socially preferred alternatives can be identified over time and space. Policy scientists and lawyers must propose new institutions and rights for forest governance and use and encourage preferred choices to be adopted across the landscape on both a domestic and an international scale. The Forests and Forestry faculty group at the School is on the cutting edge of this interdisciplinary research and the shift to holistic forestry. Not only are we conducting vital research in these areas now; we are also training the leaders of forestry for the future.

**Faculty** Mark S. Ashton (Coordinator), Graeme P. Berlyn, Mark A. Bradford, Ann E. Camp, Benjamin Cashore, Susan G. Clark, Peter R. Crane, Michael R. Dove, Paul A. Draghi, Bradford S. Gentry, Timothy G. Gregoire, Lloyd Irland, Xuhui Lee, Robert Mendelsohn, Florencia Montagnini, Chadwick D. Oliver, Oswald J. Schmitz

**Associated centers/programs** Global Institute of Sustainable Forestry, Tropical Resources Institute, Urban Resources Initiative, Center for Biodiversity Conservation

## GLOBAL CHANGE SCIENCE AND POLICY

The goal of this focal area is to address issues arising from major environmental changes that are impacting a substantial portion of the world. The faculty in this focal area are particularly interested in the arena of climate change science and policy and seek to generate new scientific knowledge of the interactions among the atmosphere, the biosphere, and their human dimensions, and to explore innovative approaches to reducing the threats to the global climate system. Courses and seminars that prepare students to conduct research in this focal area include observing the earth from space; a biological perspective of global change; patterns and processes in terrestrial ecosystems; domestic and global environmental governance; designing the ecocity; climate change seminar; and the global change agenda.

**Faculty** Xuhui Lee (Coordinator), Paul Anastas, Robert Bailis, Mark A. Bradford, Ann E. Camp, Benjamin Cashore, Susan G. Clark, Paul A. Draghi, William Ellis, Daniel C. Esty, Thomas E. Graedel, John Grim, Robert Mendelsohn, Peter A. Raymond, Oswald J. Schmitz, Mary Evelyn Tucker, Nadine Unger

**Courtesy joint appointments** Ruth Elaine Blake, Ronald B. Smith, Karl Turekian

## ENVIRONMENTAL HEALTH

The environmental health concentration is designed to encourage course work and research that explore relationships among environmental quality, human health, and public policy. This knowledge provides a basis for research on how the environment impacts health and for understanding the potential of law and policy to protect public health from environmental hazards.

There are several themes around which students can focus their studies in this area, such as exposure to hazardous substances; metals and the environment; exposure and risk assessment methods; land use, ecology, and vector-borne disease; air pollution and respiratory illness; agriculture, food safety, and human health; climate change and health; consumer products; and environmental health law and policy.

This area is the focal point within F&ES for the joint Master of Public Health program with the School of Public Health. Graduates of the environmental health focal area are employed in nonprofits, private industry, and government agencies, and have continued graduate work in doctoral programs, medical school, and law school.

**Faculty** John P. Wargo (Coordinator), Paul Anastas, Shimon C. Anisfeld, Michelle Bell, Gaboury Benoit, Graeme P. Berlyn, Florencia Montagnini, James E. Saiers

**Courtesy joint appointment** Brian P. Leaderer

## INDUSTRIAL ENVIRONMENTAL MANAGEMENT

This focal area is centered on using principles of ecology to transform society's use of resources through several research and teaching themes. An overarching theme in this area pertains to accounting for resource and product flows. The focus of materials accounting can be on a single element, a single resource, or on multiple resources

such as energy, water, and materials. Students and faculty apply this focus at different scales: from the facility level, to the inter-firm level, to a river basin or other regional site, and indeed globally. Other foci include technology and environment, energy and environmental systems, aligning corporate management and strategy with environmental improvement, and cooperative strategies across firms. Geographically, faculty and students work on projects all over the world, with special focus on the Caribbean, Western Europe, China, India, Hawaii, and Singapore. Course work that prepares students to conduct research in this focal area includes greening business operations; industrial ecology; theory and practice of urban ecology; business concepts for environmental managers; energy systems analysis; and environmental management and strategy.

**Faculty** Thomas E. Graedel (Coordinator), Shimon C. Anisfeld, Marian R. Chertow, William Ellis, Daniel C. Esty, Gordon T. Geballe, Arnulf Grubler, Reid J. Lifset

**Courtesy joint appointments** Menachem Elimelech, William Mitch

**Associated center** Center for Industrial Ecology

## POLICY, ECONOMICS, AND LAW

Natural resource and environmental policy should be based on our accumulated knowledge of social and environmental processes. The policy faculty teaches students that the key to environmental policy is the appropriate integration of the insights of many disciplines. Three overarching themes are the foundation of research and instruction by the policy group. First, the group advocates that an organized combination of natural and social science theory be used to guide environmental policy in the best service of society. Second, the group recognizes the importance of empirical analysis. Third, the group is involved in designing optimal and equitable programs to protect the environment. The governance of environmental protection is a central concern of the entire group.

A wide range of courses apply to this area, including Risk and Property; Integrated Resource Planning; Natural Resource Economics; Pollution Economics; Energy Economics; Valuing the Environment; Public-Private Partnerships for the Urban Environment; Environmental Protection Clinic; and Environmental Law and Policy.

**Faculty** Robert Mendelsohn (Coordinator), Paul Anastas, Benjamin Cashore, Marian R. Chertow, Susan G. Clark, William Ellis, Daniel C. Esty, Bradford S. Gentry, Reid J. Lifset, James R. Lyons, John P. Wargo, Julie B. Zimmerman

**Courtesy joint appointments** David Cromwell, Ernesto Zedillo

**Visiting and adjunct faculty** Lye Lin Heng, Douglas Gollin, Nicholas A. Robinson

**Associated centers** Yale Center for Environmental Law and Policy, Yale Center for Business and the Environment

## URBAN ECOLOGY AND ENVIRONMENTAL DESIGN

This faculty group works under the premise that the ecological integrity of urban ecosystems has a profound impact on urban health, productivity, and quality of life. They

believe that students must have a grounding in new theoretical and practical understanding, be prepared to carry out relevant research, and conduct innovative practices to gain the knowledge and tools necessary to foster healthy natural systems essential for the future well-being of the modern city.

Because this focal area is inherently interdisciplinary, a wide range of natural science, social science, and policy courses is relevant, depending on student interest and specialty. Students are recommended to take at least one course in each of the following areas: biological environmental sciences; physical environmental sciences; social environmental sciences; quantitative methods and mapping; architecture and engineering; and policy and law. The faculty also encourages students to take courses at F&ES and other parts of Yale with a particular reference to this area, such as urban anthropology; urban poverty and policy; the future of American cities; environmental aspects of the technological society; issues and approaches in environmental education; and sustainable and restorative environmental design.

**Faculty** Gaboury Benoit (Coordinator), Paul Anastas, James W. Axley, Ellen Brennan-Galvin, Marian R. Chertow, Alexander J. Felson, Gordon T. Geballe, Bradford S. Gentry, Thomas E. Graedel, Karen Seto

**Courtesy joint appointment** Michelle Addington

**Associated center** Hixon Center for Urban Ecology

## WATER SCIENCE, POLICY, AND MANAGEMENT

This focal area uses the watershed (stream or river basin) as its unit of analysis, instruction, and action. The global water crisis takes diverse forms, including water scarcity, polluted lakes and rivers, contaminated groundwater, spread of water-related diseases, and extinction of aquatic species. The complexity and interdisciplinary nature of these problems necessitate a collaboration of biologists, physical scientists, policy experts, economists, lawyers, and social scientists to design and execute effective restoration and management activities.

Key research and teaching questions include: How can environmental managers wisely protect and restore ecosystems even when they lack full scientific understanding; and how can scientists make their work as useful as possible to environmental managers, without sacrificing objectivity? These are highlighted through course work such as water resource management; aquatic chemistry; coastal ecosystem governance; aquatic ecology; environmental hydrology; water quality control; and water system economics.

**Faculty** Gaboury Benoit (Coordinator), Shimon C. Anisfeld, Richard Burroughs, Mary Beth Decker, Bradford S. Gentry, James G. MacBroom, Peter A. Raymond, James E. Sayers, David K. Skelly, Julie B. Zimmerman

**Associated center** Center for Coastal and Watershed Systems

# Subjects of Instruction

Courses offered by the School of Forestry & Environmental Studies are described below. The letters “a” and “b” following the course numbers indicate fall- and spring-term courses, respectively. Bracketed courses will not be offered during the 2010–2011 academic year. The course numbering system has changed this year; the previous course numbers are indicated in parentheses, following the course title in the list below.

Project courses involve individually assigned advanced field or laboratory work, or literature review, on topics of special interest to the student; credits and hours for these projects are determined for each student in consultation with the instructor.

Courses throughout the University are generally open to students enrolled in the School of Forestry & Environmental Studies, subject to limitations on class size and requirements for prerequisites.

**Note** For updated course listings, please see the School of Forestry & Environmental Studies Web site, [www.environment.yale.edu/courses](http://www.environment.yale.edu/courses).

## LIST OF COURSES BY TOPIC

### *Foundations*

F&ES 500a	Landscape Ecology (32019a)	63
F&ES 505a	Economics of the Environment (84040a)	63
F&ES 510a	Introduction to Statistics in the Environmental Sciences (77009a)	63
F&ES 515a	Physical Science for Environmental Problems	63
F&ES 520a	Society and Environment: Introduction to Theory and Method (83050a)	64
F&ES 525a	The Politics and Practice of Environmental and Resource Policy	64

### *Integrative Frameworks*

F&ES 600b	Linkages of Sustainability (90024a)	64
F&ES 610a	Science to Solutions: How Should We Manage Water?	65
F&ES 620b	Integrative Assessment	65

### *Capstone*

F&ES 950b	Life Cycle Assessment Practicum (90009b)	65
F&ES 951b	Managing the Global Carbon Cycle	66
F&ES 952b	Property Rights and Natural Resource Management	66

### *Ecology*

#### ECOSYSTEM ECOLOGY

[F&ES 730a]	Ecosystem Analysis (30127a)	66
F&ES 731b	Tropical Field Botany (30010b)	66

F&ES 732a	Tropical Forest Ecology: The Basis for Conservation and Management (32006a)	66
F&ES 733b	Ecosystem Pattern and Process (32007b)	67
F&ES 734a	Biological Oceanography (32121b)	67
[F&ES 735a]	Biogeography and Conservation (30009a)	67

#### WILDLIFE ECOLOGY AND CONSERVATION BIOLOGY

[F&ES 736b]	Ecology Seminar (30020b)	67
[F&ES 737a]	Biodiversity Conservation (30114a)	68
[F&ES 738a]	Aquatic Ecology (32011a)	68
[F&ES 739b]	Species and Ecosystem Conservation: An Interdisciplinary Approach (33012b)	68
F&ES 740b	Dynamics of Ecological Systems (30125b)	68

#### ENVIRONMENTAL EDUCATION AND COMMUNICATION

F&ES 745a	Environmental Writing (40002a)	69
F&ES 746a	Archetypes and the Environment (40004a)	69
F&ES 747a	Global Communication Skills (40006a)	69
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### *Forestry*

#### FOREST BIOLOGY

F&ES 650b	Fire: Science and Policy (50002b)	70
[F&ES 651b]	Forest Ecosystem Health (52003b)	70
[F&ES 652b]	Seminar in Ecological Restoration (50104b)	70
F&ES 653b	Agroforestry Systems: Productivity, Environmental Services, and Rural Development (53005b)	71
F&ES 654a	Structure, Function, and Development of Trees and Other Vascular Plants (52006a)	71
F&ES 656b	Physiology of Trees and Forests (52008b)	71
F&ES 671a	Natural History and Taxonomy of Trees (50025a)	72

#### FOREST MANAGEMENT

F&ES 657b	Managing Resources (50011b)	72
[F&ES 658a]	Global Resources and the Environment (52012a)	72
F&ES 659b	Principles in Applied Ecology: The Practice of Silviculture (52013b)	73
F&ES 660a	Forest Dynamics: Growth and Development of Forest Stands (52016a)	73
[F&ES 661b]	Analysis of Silvicultural Problems (50117b)	73
F&ES 662a	Seminar in Advanced Silviculture (50118a)	73
[F&ES 663a]	Invasive Species: Ecology, Policy, and Management (50020a)	73
F&ES 664a	Financial Analysis for Land Management (50021a)	74
F&ES 666a	Management Plans for Protected Areas (50114a)	74

[F&ES 667a]	Rapid Assessments in Forest Conservation (50115a)	74
F&ES 668b	Field Trips in Forest Resource Management and Silviculture (50119a,b)	74
F&ES 669b	Forest Management Operations for Professional Foresters (50023b)	75
F&ES 670b	Southern Forest and Forestry Field Trip (50024b)	75

### *Physical Sciences*

#### ATMOSPHERIC SCIENCES

F&ES 700b	Alpine, Arctic, and Boreal Ecosystems Seminar (60102b)	75
[F&ES 702b]	Climate Change Seminar (60004b)	75
F&ES 703b	Climate and Life (61005b)	76
[F&ES 704a]	A Biological Perspective of Global Change (61006a)	76
[F&ES 722b]	Boundary Layer Meteorology (60129b)	76

#### ENVIRONMENTAL CHEMISTRY

F&ES 706b	Organic Pollutants in the Environment (66008b)	76
F&ES 707b	Aquatic Chemistry (60109b)	76
[F&ES 708a]	Biogeochemistry and Pollution (61110a)	76
F&ES 743a	Environmental Chemical Analysis (60027a)	77
F&ES 773a	Air Pollution (Chemical Engineering Department) (60011a)	77
F&ES 777b	Water Quality Control (60012b)	77

#### SOIL SCIENCE

F&ES 709a	Soil Science (62013a)	77
[F&ES 723b]	Seminar in Soil Conservation and Management (60028b)	78

#### WATER RESOURCES

F&ES 710b	Coastal Governance (65014b)	78
[F&ES 712b]	Water Resource Management (61016b)	78
[F&ES 713a]	Coastal Ecosystems: Natural Processes and Anthropogenic Impacts (62017a)	79
F&ES 714b	Environmental Hydrology (61018b)	79
F&ES 719a	River Processes and Restoration (61024a)	79
[F&ES 724b]	Watershed Cycles and Processes (60022b)	79
F&ES 729b	Caribbean Coastal Development: Cesium and CZM (90116b)	80

### *Quantitative and Research Methods*

F&ES 550a/760a	Natural Science Research Methods (70002a)	80
F&ES 551a	Social Science Qualitative Research Methods (70003a)	80
F&ES 552b	Masters' Student Research Colloquium	80

[F&ES 726a]	Remote Sensing of the Earth from Space (77001a)	81
F&ES 751a	Sampling Methodology and Practice (77006a)	81
F&ES 753b	Regression Modeling of Ecological and Environmental Data (77108b)	81
F&ES 755b	Modeling Geographic Space (77010b)	81
F&ES 756a	Modeling Geographic Objects (77011a)	82
[F&ES 757b]	Statistical Design of Experiments (77112b)	82
F&ES 758b	Multivariate Statistical Analysis in the Environmental Sciences (77113b)	82
[F&ES 780a]	Seminar in Forest Inventory (77105a)	82
F&ES 781b	Applied Spatial Statistics (77107b)	82

## *Social Sciences*

### ECONOMICS

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F&ES 803b	Green Markets: Voluntary and Information Approaches to Environmental Management (80118b)	83
F&ES 804a	Economics of Natural Resource Management (84002b)	
F&ES 805b	Doctoral Seminar in Environmental Economics (Do163a)	83
F&ES 810b	Agriculture and the Environment (80085a)	83
F&ES 811b	Environment and Development: An Economic Approach (80018b)	84
F&ES 890a	Energy Markets Strategy (80186a)	84

### ENVIRONMENTAL POLICY

F&ES 807a	Environmental Management and Strategic Advantage (06112a)	84
[F&ES 808b]	International and Comparative Forest Policy and Governance (85009b)	85
[F&ES 809a]	Environmental Policy Analysis for an Unpredictable World (85011a)	85
F&ES 813b	Emerging Markets for Ecosystem Services (80116b)	85
F&ES 814a	Energy Systems Analysis (86025a)	86
[F&ES 815a]	The New Corporate Social Responsibility: Public Problems, Private Solutions, and Strategic Responses (85023a)	86
F&ES 818a	Technology, Society, and the Environment (83026a)	86
F&ES 819b	Strategies for Land Conservation (80027b)	87
F&ES 820a	Local Environmental Law and Land Use Practices (80029a)	87
[F&ES 821a]	Private Investment and the Environment: Legal Foundations and Tools (85030a)	87
F&ES 824a	Environmental Law and Policy (85033b)	88
F&ES 825a	International Environmental Law and Policy (85035a)	88

F&ES 826a	Foundations of Natural Resource Policy and Management (85036a)	88
F&ES 827b	Large-Scale Conservation: Integrating Science, Management, and Policy (83037b)	89
F&ES 828b	Comparative Environmental Law in Global Legal Systems (80041b)	89
F&ES 829a	International Environmental Policy and Governance (85068a)	90
F&ES 832a	Entrepreneurial Business Planning (80019a)	90
F&ES 834a,b	Environmental Protection Clinic (80034a,b)	90
F&ES 837b	Seminar on Leadership in Natural Resources and the Environment (80008b)	91
[F&ES 843b]	Readings in Environmental History (80080b)	91
F&ES 849b	Natural Resource Policy Practicum (80015b)	91
F&ES 850a	International Organizations and Conferences (80021a)	91
F&ES 851a,b	Environmental Diplomacy Practicum (80022a,b)	92
F&ES 852a,b	Business and the Environment Consulting Clinic (80046a,b)	92
[F&ES 853a]	Capitalism: Success, Crisis, and Reform (80075a)	92
F&ES 860b	Understanding Environmental Campaigns and Policy Making: Strategies and Tactics (80028b)	93
F&ES 895a	Management and the Environment: Issues and Topics	93

#### SOCIAL AND POLITICAL ECOLOGY

F&ES 831b	Society and Natural Resources (83049b)	93
F&ES 836a	Agrarian Societies: Culture, Society, History, and Development (80054a)	94
F&ES 838a	Producing and Consuming Nature	94
F&ES 839a	Social Science of Development and Conservation (83056a)	94
F&ES 840b	Advanced Readings: Social Science of Development and Conservation (80157b)	95
F&ES 845b	Energy Issues in Developing Countries (83064a)	95
F&ES 846b	Topics in Environmental Justice (83065b)	95
F&ES 848a	Climate Change: Impacts, Adaptation, and Mitigation (83072b)	96
F&ES 854b	Institutions and the Environment	96
[F&ES 856b]	Environmental Ethics (80063b)	97
[F&ES 857b]	Urbanization, Global Change, and Sustainability (80077b)	97
F&ES 858a	Environmental Theologies (80042a)	97
F&ES 859b	American Environmental History and Values	97
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[F&ES 862]	Advanced Seminar in Social and Political Dimensions of Climate Change	98

F&ES 869b	Disaster, Degradation, Dystopia: Social Science Approaches to Environmental Perturbation and Change (80176b)	98
[F&ES 872a]	Seminar on World Religions and Ecology (80070a)	99
[F&ES 875a]	Global Ethics and Global Problems (80043a)	99
F&ES 876a	Indigenous Religions and Ecology (80044a)	99
F&ES 877a	Anthropology of the Global Economy for Development and Conservation (80061a)	99
F&ES 878a	Anthropology of Climate and Climate Change: From Historic Origins to Current Debates	100
[F&ES 879b]	World Religions and Ecology: Asian Religions (80071b)	100
[F&ES 882b]	Households, Communities, Gender (for Development and Conservation) (83073b)	100
F&ES 892a	Introduction to Planning and Development (86048a)	101
<b>HEALTH AND ENVIRONMENT</b>		
F&ES 891a	Ecology and Epidemiology of Vector-Borne and Zoonotic Diseases (90004a)	101
F&ES 893b	Applied Risk Assessment (90003a)	101
F&ES 896a	Introduction to Toxicology (96005b)	101
F&ES 897b	Assessing Exposures to Environmental Stressors (96014b)	102
[F&ES 898b]	The Environment and Human Health (96017b)	102
<b>INDUSTRIAL ECOLOGY, ENVIRONMENTAL PLANNING, AND TECHNOLOGY</b>		
F&ES 816b	Transportation and the Urban Future (86024b)	102
F&ES 842a	Cities and Sustainability in the Developing World (86059a)	102
F&ES 883b	Advanced Seminar: Business Strategy and Industrial Ecology	103
F&ES 884b	Industrial Ecology (96007b)	103
F&ES 885b	Green Engineering and Sustainability (96018b)	103
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F&ES 888a	Ecological Urbanism (90122b)	103

## COURSE DESCRIPTIONS

At F&ES, new courses are often added after this bulletin is printed. Our Web site at [www.environment.yale.edu](http://www.environment.yale.edu) will have an updated list, as well as a list of environmental courses available in other departments at Yale.

### *Foundations*

**F&ES 500a/E&EB 365a/665a, Landscape Ecology** 3 credits. This foundations course is an introduction to the study of large-scale ecological patterns and processes. Landscape ecology is a relatively young, rapidly changing field. The topics covered reflect the diverse interests of ecologists: species-area relationships, island biogeography, metapopulation theory, individual-based models, cellular automata, models of biodiversity, etc. Throughout the course the emphasis is on when and how to integrate a spatial perspective into consideration of major ecological questions. Readings from the primary literature augment material covered in lectures. Students complete a project resulting in a manuscript on a landscape-related topic. Knowledge of the concepts and principles covered in Landscape Ecology is assumed for all other F&ES courses in ecology and is essential for informing many kinds of decisions regarding ecosystem management. David K. Skelly

**F&ES 505a, Economics of the Environment** 3 credits. This course provides students with in-depth training using economic analysis to address environmental policies and management. Students are exposed to tools that allow them to assess the efficiency of different environmental policies and management strategies. The course examines when markets manage the environment efficiently and when they fail. It covers a range of topics including preventing pollution, managing renewable resources, and consuming nonrenewable resources. It stresses the importance of science and values in making efficient choices. The course is a prerequisite for all advanced economics courses and provides knowledge that is fundamental to success in F&ES courses on resource management. Matthew J. Kotchen

**F&ES 510a, Introduction to Statistics in the Environmental Sciences** 3 credits. An introduction to probability and statistics with emphasis on applications in forestry and environmental sciences. Includes methods of graphical analysis, introduction of common probability distributions, and hypothesis testing. The final third of the course introduces the topics of regression and analysis of variance that are covered more thoroughly in F&ES 753b. There are weekly problem sets using MINITAB software, as well as a final project. This course is a prerequisite for all other statistics courses offered through F&ES, and it presents statistical methods used in many the School's courses in both the natural and social sciences. Three hours lecture. Jonathan D. Reuning-Scherer

**F&ES 515a, Physical Science for Environmental Problems** 3 credits. This foundations course seeks to provide students with the physical science foundation that they need in order to understand and manage environmental problems. The course covers basic concepts from the following disciplines: climatology, environmental chemistry, geology, hydrology, meteorology, oceanography, and soil science. Focus is on understanding both the underlying concepts and how they apply to real-world problems. Useful both as a

freestanding course and as a gateway to a wide spectrum of intermediate and advanced courses. Three hours lecture, weekly problem sets. Shimon C. Anisfeld

**F&ES 520a/ANTH 581a, Society and Environment: Introduction to Theory and Method** 3 credits. This is an introductory, graduate core course on the scope of social scientific contributions to environmental and natural resource issues. It is designed to be the first course for students who will be specializing in social science approaches as well as the last/only course for students who take only one course in this area. The approach taken in the course is inductive, problem-oriented, and case study-based. Section I presents an overview of the field and course. Section II deals with the way that environmental problems are initially framed. Case studies focus on placing problems in their wider political context, new approaches to uncertainty and failure, and the importance of how the analytical boundaries to resource systems are drawn. Section III focuses on questions of method, including the dynamics of working within development projects, and the art of rapid appraisal and short-term consultancies. Section IV is concerned with local peoples and the environment, with case studies addressing the myth of slash-and-burn cultivation, livestock and development discourse, and indigenous knowledge and its transformation. Section V presents lessons learned. The course is a foundations course for the M.E.M. curriculum, a required course in the curriculum for the joint F&ES/Anthropology doctoral program, and a prerequisite for some advanced F&ES courses. Three-hour lecture/seminar. Michael R. Dove

**F&ES 525a, The Politics and Practice of Environmental and Resource Policy** 3 credits. The purpose of this foundation course is to provide a survey of public policy theory and practice, as related to development and implementation of environmental and natural resource policy. The course examines theories of policy formation; the intricacies of the policy-making process; the history of natural resource and environmental policy; and applied techniques in policy analysis and evaluation. The course has been specifically designed to provide both a theoretical and practical introduction to natural resource and environmental public policy. Upon completion of the course, the student will understand the political environment within which public policy is formulated, including the role of ideas, science, and learning. Students also will be able to demonstrate basic technical competence in environmental public policy development and the implementation process. The course has been developed to accommodate biologists and other natural scientists and assumes no prior knowledge of political science or the policy-making process. Benjamin Cashore

### *Integrative Frameworks*

**F&ES 600b, Linkages of Sustainability** 3 credits, lecture and discussion. The Earth system is made up of interdependent components – land, water, energy, biota, and non-renewable resources, all of which have physical limits. Societies transform these resources into useable goods, and production and consumption cycles connect people and places across space and time. This team-taught course provides an overview of these linkages and explores their implications for applying and measuring the concept of sustainability. It examines the constraints to sustainability imposed by those linkages (e.g., the energy required to supply water), opportunities for their transformation, and challenges

of implementing sustainability across complex social and cultural systems. Benjamin Cashore, Oswald J. Schmitz, Karen Hébert, Thomas E. Graedel

**F&ES 610a, Science to Solutions: How Should We Manage Water?** 3 credits. While there are many different approaches to understanding and managing environmental problems, most involve three major steps: (1) describing/understanding the nature of the problem and its causes; (2) using technical, policy, social, and other management tools/processes to help address it; while (3) recognizing/making the value judgments embedded in each (what problems/data are “important”? what solutions are “best”?). The purpose of this introductory course is to illustrate how an M.E.M. student might integrate scientific understanding with management choices as part of an effort to address any particular environmental issue. Ideally, it should help students choose areas of specialization, as well as improve their ability to engage in integrative problem solving—both in their final term and after they graduate. The class is focused on water issues, but the integrative structure of the class could be used on other problems as well. The class is built around a case-study approach, in which the faculty bring their different perspectives to bear on understanding and addressing the issues raised in a diverse set of cases, including: the “dead zone” in the Gulf of Mexico; the New York City drinking water supply; Australia’s response to water scarcity; the Cochabamba “water wars”; and invasive species in the Great Lakes. Preference given to first-year M.E.M. students. Three hours lecture, one hour discussion. Shimon C. Anisfeld, Bradford S. Gentry, Peter A. Raymond, Julie B. Zimmerman

**F&ES 620b, Integrative Assessment** 3 credits. This course illustrates how to integrate the insights and models of different disciplines to address key environmental management questions facing society. Examples are drawn from across pollution and natural resource issues so that students can become familiar with a diverse set of issues. The course illustrates the merits of learning about the natural sciences, engineering, and economics in order to do environmental management. Robert Mendelsohn and faculty

### *Capstone*

**F&ES 950b, Life Cycle Assessment Practicum** Life Cycle Assessment (LCA) is an environmental modeling method that has become increasingly popular within business and academia for evaluating the environmental impacts of products or systems. LCA considers impacts along the entire life cycle, from production to consumption to disposal, and generally provides quantitative information for a range of different environmental issues. This is a practicum course, and students work on real projects with industry partners in order to achieve skills and training as analysts in this field. The course begins with a review of the intellectual foundation of LCA, the computational structure of the method, and the international standards that govern its use. Students then receive several hands-on training modules for SimaPro, a popular LCA software package, and work examples for model products and systems. Carbon and water footprinting are included as specific and growing subfields of LCA. This initial training prepares students to carry out their independent group projects over the remainder of the course. Regular project updates occur in class and individually with the instructor, and results are presented to industry partners at the end of the course. Prerequisite: F&ES 886a. Matthew Eckelman

**F&ES 951b, Managing the Global Carbon Cycle** 3 credits. Managing atmospheric CO<sub>2</sub> entails managing the global carbon cycle. This class starts with a short series of lectures on the processes and fluxes that make up the global carbon cycle. The remainder of the class takes a case-study approach to aspects of managing the global carbon cycle. Instructors and students critically evaluate portions of the global carbon cycle that are under stress or are part of the proposed portfolio for carbon management and sequestration. Peter A. Raymond, Robert Bailis

**F&ES 952b, Property Rights and Natural Resource Management** Rights to land and property are fundamental in most societies. Often secure land tenure is essential for the sustainable management of natural resources. Yet few natural resource managers understand the complexity of property rights, particularly in the developing world where there can be overlapping and competing land tenure regimes operating on any one piece of land. Around the world, ownership of, control over, and access to natural resources have meaning far beyond the traditional thinking of economic rationality and institutions of governance. Failure to understand the complex social relations embedded in property rights is a sure path to unsustainable use of natural resources. In this seminar we consider literature on the origins of Western property law, the fluidity in native customary law, the constraints and inequalities in legal pluralism, urban growth and property, and community and collective management of shared resources management. Our discussions include explorations into varying theoretical constructs of property as well as the applied implications (socially and ecologically) of different property systems. While the majority of our cases studies draw from the developing world, where possible we include discussions of property regimes in North America. Prerequisite: F&ES 551a, F&ES 831b, EVST 285, F&ES 520a, or F&ES 839a. Amity Doolittle

## *Ecology*

### ECOSYSTEM ECOLOGY

[**F&ES 730a/330b/E&EB 330a/EVST 330a, Ecosystem Analysis** 3 credits. An outdoors, hands-on overview of the study of ecosystems, how the structure of ecosystems develops (e.g., biodiversity), and how ecosystems function (e.g., process nutrients or pollutants). The impact of global changes, such as climate change and eutrophication, on ecosystem structure and function. Field-based group and independent projects focused on New England ecosystems. Peter A. Raymond, Melinda Smith]

**F&ES 731b, Tropical Field Botany** 3 credits. This course teaches students how to identify the most important tropical plant families, with an emphasis on woody taxa. Students learn key characteristics for identification. We concentrate on families that have high economic, ecological, or ethnobotanical importance. We also discuss distribution, habitat, and ecology. The course has a strong practical component, and instructors emphasize vegetative characters to identify families and higher-level taxa. The course includes a two-week field trip to Costa Rica over spring break. NYBG Faculty: Lawrence Kelly, Fabian Michelangeli

**F&ES 732a, Tropical Forest Ecology: The Basis for Conservation and Management** 3 credits. This course summarizes ecological knowledge on tropical forest ecosystems

and shows how this scientific basis can be used for forest management, conservation, and rehabilitation. Topics include importance of tropical forests: productive and environmental services; ecological characteristics of tropical forests; soils of the tropics: types, fertility, physical properties, and management; nutrient cycling; natural forest structure and composition; the forest microenvironment: light, temperature, and water; high-elevation forests and savannas; tree growth and reproductive ecology; plant species diversity; plant-animal interactions; effects of disturbance; forest succession and regeneration; management of primary and secondary forests; nontimber forest products; plantation forestry: productivity and environmental services; community forestry; ecological and social aspects of agroforestry; rehabilitation of degraded tropical forest ecosystems. In addition, discussion sessions and seminar presentations by students deal with particular aspects of tropical forest ecology/conservation/management of interest to students. Half-day field trips illustrate specific aspects of tropical forest ecology. This course has no prerequisites. Background in ecology or forestry is useful but not indispensable. This course fulfills the ecology/science requirement of the M.F.S./M.E.Sc. curriculum at F&ES. Yale undergraduate students can take it with permission of the instructor. This course is a prerequisite for FES 652b and is also recommended as background for FES 653b. Three hours lecture. Florencia Montagnini

**F&ES 733b, Ecosystem Pattern and Process** 3 credits. Introduction to ecosystem science. Topics cover the structure and functioning of ecological systems, their response to changing environmental conditions, and management of these responses and their consequences. The class covers both terrestrial and marine/aquatic systems. Peter A. Raymond, Mark Bradford

**F&ES 734a, Biological Oceanography** 3 credits. Exploration of a range of coastal and pelagic ecosystems. Relationships between biological systems and the physical processes that control the movements of water and productivity of marine systems. Anthropogenic impacts on oceans, such as the effects of fishing and climate change. Includes three Friday field trips. Enrollment limited to fifteen. Recommended prerequisite: college-level biology or ecology course. Three hours lecture. Mary Beth Decker

[**F&ES 735a, Biogeography and Conservation** 3 credits. This course is designed to apply the principles of systematics to historic and ecological biogeography and in turn apply these to the conservation of biodiversity. In doing so, consideration is given to the circumscription of terrestrial biomes and speciation and extinction models. Reconstruction of past geologic and climatic events as well as the impact of human activities is related to the current distribution of the biota. The use of this information as related to CITES legislation and the development of IUCN Action Plans is explored through case studies. Dennis W. Stevenson]

#### WILDLIFE ECOLOGY AND CONSERVATION BIOLOGY

[**F&ES 736b, Ecology Seminar** 1 credit. The ability to read and understand the literature is a critical skill. This seminar is structured to encourage participation in discussions of papers from the ecological literature. The specific papers to be read vary from year to year; however, each year we focus on papers that have made major contributions to the conceptual foundations of ecology. Many of the papers have direct or indirect relevance to

applied issues such as the conservation of species and ecosystems. Seminar responsibilities include active participation in weekly meetings and the leadership of one discussion. David K. Skelly]

[**F&ES 737a, Biodiversity Conservation** 3 credits. This course introduces students to concepts related to gathering and applying scientific information for problem solving in biodiversity conservation. The course explores conceptually the kinds of ecological knowledge needed for conserving the Earth's biota. Students also learn how to formalize that knowledge for effective decision making. Relevance to real-world problem solving is the central focus of the course, and students are exposed to numerous examples of applications throughout the term. Students also gain facility using the concepts and tools through written assignments and exams. The aim of the course is to provide students with a complement of concepts and tools that can be applied generally to environmental problem solving in biodiversity conservation. Prerequisite: F&ES 74ob. Oswald J. Schmitz]

[**F&ES 738a/E&EB 370a/670a, Aquatic Ecology** 4 credits. An intensive introduction to the ecology of populations and communities in freshwater systems. The aim of this class is to learn the concepts, patterns, and organisms important in lakes and streams along with the major techniques of information collection and analysis. Weekly field trips are used to gather data that form the basis of lab exercises and research projects. The course presumes familiarity with ecological concepts and terminology. Permission of the instructor required. David K. Skelly]

[**F&ES 739b, Species and Ecosystem Conservation: An Interdisciplinary Approach** 3 credits. The loss of global biodiversity is a major problem with profound repercussions for present and future human generations. Professional conservationists now living are the last generation that can prevent the extinction of large numbers of species and the disruption of large-scale ecosystem processes. Professionals must not only apply relevant conservation sciences to these problems, but also bring to bear explicit knowledge about the real-world organizational and policy settings in which they will work and expert skills in influencing those systems. The course combines the problem-solving approaches of the conservation sciences with those of the policy sciences by surveying a range of policy and organizational contexts, theories, techniques, and professional settings using a variety of case studies. We typically have guests who focus on contemporary challenges and offer successful cases from their own experience. Students learn an interdisciplinary analytic framework and apply it to a case of their choice. The role and problem-solving styles of the individual professional in these complex contexts are emphasized. Students must keep a journal. Active student participation is required as well as a presentation and a paper. The course positions students to work for many nongovernmental, governmental, and business organizations, assuming leadership and problem-solving positions. Enrollment limited to sixteen; application required. Susan G. Clark]

**F&ES 74ob, Dynamics of Ecological Systems** 3 credits. The course provides students in-depth understanding of theory on multiple species interactions and dynamics including predation, competition, food chain, and food web interactions. Considerable emphasis is placed on mathematical modeling to formalize ideas about how species interactions

structure ecological communities and to specify the appropriate focus of empirical research, study design, and data gathering. The course addresses contemporary issues in community and ecosystem ecology including scaling from individual behavior to community and ecosystem dynamics, the link between biodiversity and system stability, alternative dynamic regimes, spatially extended systems, and metacommunities. A course in calculus is recommended. Oswald J. Schmitz

#### ENVIRONMENTAL EDUCATION AND COMMUNICATION

**F&ES 745a, Environmental Writing** 1 credit, half term, or 3 credits, full term. Students in this course should plan to produce one full-length article, 3,000 to 4,000 words, that could appear in a wide-circulation magazine such as *Audubon*, *Atlantic*, *Sierra*, or *Smithsonian*. One-credit students begin a potentially publishable article; three-credit students complete a publishable article. Admission is by application, which must include a proposed writing topic, at the beginning of the term. For information on applying, please see the course information at <https://webspace.yale.edu/fes40002a>. Three-hour seminar and writing workshops. Enrollment limited to fifteen. Fred Strebeigh

**F&ES 746a, Archetypes and the Environment** 3 credits. This course explores the mythologies, literatures, arts, and folklore of a variety of cultures in search of archetypal characters whose role is to mediate between nature and society. Beginning with sources as early as *The Epic of Gilgamesh* and ending with contemporary film and media, the course seeks to examine and understand the ways in which diverse peoples integrate an awareness of their traditional and popular arts and cultures. The course makes use of works from a variety of languages, including Akkadian, Greek, Tibetan, Bhutanese, Chinese, German, French, and Italian, but all readings are available in English; students with reading abilities in foreign languages will be encouraged to examine primary sources wherever possible. The course includes visits to the Beinecke Rare Book and Manuscript Library, the Yale Center for British Art, and the Yale Art Gallery. Three hours lecture/discussion. Paul A. Draghi

**F&ES 747a, Global Communication Skills** 3 credits. This course helps students to sharpen their language and strategy in professional communication. Course topics include accent reduction, language accuracy, writing styles, presentation skills, meeting leadership, barriers to communication, and types of persuasion in multicultural contexts. We first address aspects of intelligibility, exploring how improved word choices and speech clarity affect audience understanding. We then look at the problem of comprehension and discuss strategies for increasing the student's ability to listen accurately and read efficiently. We also examine common difficulties and cultural differences in the arrangement of information, use of evidence, and academic argumentation. Several sessions are devoted to specific skills, such as negotiating agreements and writing research reports. The course meets for lecture (two hours), and students attend a weekly small group practicum (one hour). The practicum allows students to reinforce new communicative behaviors in oral and written assignments, while receiving feedback from peers and the instructor. As students polish their skills, they improve their ability to express ideas and to interact in both academic and professional contexts. William A. Vance

**F&ES 900a, Doctoral Student Seminar** 3 credits. This course provides an introduction to doctoral study at the School of Forestry & Environmental Studies. Students attend the seminar each week and then meet with the seminar speakers after their presentations. Weekly assigned readings support these discussions, which are used as a foundation to explore diverse approaches to formulating and addressing research questions. Students also work with their advisers to design an assignment to be completed during the term. Students may choose to write and submit a fellowship application (e.g., to NSF or EPA), carry out a literature review, or develop a collaborative research project. Students present their embryonic research ideas in class and use feedback from the group to further develop their ideas. Required of all doctoral students in their first term. David K. Skelly

## *Forestry*

### FOREST BIOLOGY

**F&ES 650b, Fire: Science and Policy** 3 credits. This course examines the ecological, social, and policy implications of forest and grassland fire. Topics include the historical and cultural role of fire, fire behavior, fire regimes, fire ecology, the use of fire in ecosystem restoration, fire policy in the United States and elsewhere, and controversies around suppressing fires and post-fire rehabilitation practices. Conditions permitting, the course also involves implementing a prescribed fire to achieve management goals in restoring meadow and oak savanna at Yale Myers Forest. Ann E. Camp

[**F&ES 651b, Forest Ecosystem Health** 3 credits. This course is an introduction to the biotic and abiotic agents affecting the health of forest ecosystems, including insects, pathogens, parasites, exotic invasive species, climate change, and acid deposition. The course emphasizes the ecological roles played by these agents, discusses how they affect the sustainability of forest ecosystems, and identifies when and how management can be used to return forests to healthier conditions. The course provides students with the necessary background to determine if stressors are negatively impacting management objectives, to identify the probable stress agents, and to decide what, if any, actions should be initiated to protect forests from further damage. The course includes several field trips. Ann E. Camp]

[**F&ES 652b, Seminar in Ecological Restoration** 3 credits. The purpose of this course is to summarize theoretical and practical ecological knowledge on how to restore or rehabilitate degraded landscapes. Degraded landscapes usually exist in a complex mosaic that is constantly changing. Each of these conditions has characteristics that must be taken into account when developing restoration strategies. Topics include: Concepts and principles of ecological restoration. Types of disturbances, forest succession, and ecosystem rehabilitation. Soil formation and development. Strategies for rehabilitation of soil's physical and chemical properties. Plantations as catalysts of forest succession in degraded landscapes. Agroforestry systems as a tool for recovery and conservation of biodiversity in managed landscapes. Biological and economic enrichment of overlogged and secondary forests. Mechanisms of pasture degradation and techniques to aid in pasture sustainability. Reforestation of degraded lands: productivity and preferences by farmers. Reclamation of mine spoils. Restoration of inland and coastal wetlands. Techniques to control invasive species. Reclamation after fire. Who does restoration? Community

participation and challenges to implementation of restoration projects. Monitoring and evaluation of restoration projects. In addition, seminar presentations by visitors and students and discussion sessions deal with particular aspects of restoration. Prerequisite: F&ES 732a, F&ES 733b, or equivalent (check with instructor). Three hours lecture per week, three field trips. Florencia Montagnini]

**F&ES 653b, Agroforestry Systems: Productivity, Environmental Services, and Rural Development** 3 credits. The course focuses on factors influencing sustainability of agroforestry systems, the role of agroforestry in rural development, and the environmental services that agroforestry can provide, such as biodiversity conservation, carbon sequestration, and restoration of degraded ecosystems. We start by learning the principles that we can use to understand agroforestry systems: environmental variables in agroforestry (light and water); soil productivity and sustainability in agroforestry; nutrient cycling and nutrient use efficiency. Then we learn how to design agroforestry systems: agroforestry components: multiple-purpose trees; nitrogen-fixing trees; economic aspects. Examples of subsistence-oriented and commercial agroforestry: shifting agriculture and improved fallows, home gardens, agrosilvopastoral systems, and alley-cropping. Specific types of agroforestry are more widely practiced, responding to ecological and socioeconomic conditions of each region: semi-arid ecosystems; highlands; temperate regions. Finally we focus on the functions that agroforestry can provide: environmental services: biodiversity conservation and carbon storage; climate mitigation; social functions: agroforestry as a tool for rural development; agroforestry and fuelwood production; current trends in agroforestry research and extension. In addition, seminar presentations by guest speakers and students and discussion sessions deal with particular aspects of agroforestry of interest to students. Prerequisite: F&ES 732a, F&ES 733b, or equivalent. Three hours lecture per week, two or three half-day field trips. Offered alternate years. Florencia Montagnini

**F&ES 654a/MCDB 660a, Structure, Function, and Development of Trees and Other Vascular Plants** 3 credits. This course focuses on two aspects of plant life: (1) basic processes that drive plant systems, such as fertilization, embryogeny, seed development, germination, seedling establishment, maturation, and senescence; and (2) basic structure and function of plants (such as root systems, leaf formation and development, height, and diameter growth). Differences between different groups of seed plants are analyzed from structural, functional, ecological, and evolutionary standpoints. Special attention is given to woody plants and their importance in the biosphere and human life. Coverage includes tropical, temperate, and boreal trees. Plant biology is discussed in the context of physiological and structural adaptations in terms of strength, storage, and water and solute transport. Prerequisite: general biology or botany or the equivalent, or permission of the instructor. Graeme P. Berlyn

**F&ES 656b, Physiology of Trees and Forests** 3 credits. Mineral nutrition and cycling; mycorrhizas; symbiosis; nitrogen fixation; light processing, photosynthesis, respiration; water relations including transpiration; ecophysiology; An introduction to alpine, arctic, and boreal ecosystems is also included. Two one-and-one-half-hour lectures per week. Graeme P. Berlyn

**F&ES 671a, Natural History and Taxonomy of Trees** 3 credits. Knowledge of tree species and the evolutionary and ecological relationships among them is essential to the study and management of forest ecosystems. This course provides an introduction to the systematics, evolution, biogeography, and autecology of woody plants, as well as patterns of human utilization (both modern and historical), with an emphasis on taxa of temperate North America. Regular field trips in the New Haven area as well as to the Yale Myers Forest acquaint students with the major species and habitats of southern New England forests. Ann E. Camp, Philip Marshall

#### FOREST MANAGEMENT

**F&ES 657b, Managing Resources** 3 credits. Resource sustainability requires knowing how to “get things done” with resources, whether one’s goal is policy, investment, or on-the-ground management. The challenge of resource management is knowing how to provide the many commodity and noncommodity objectives people demand from the terrestrial ecosystems across time and space. This management can be cost-effective and applicable to many places with the proper integration of management and social scientific knowledge. Students master the scientific basis, methods (and reasons for the methods), and techniques for management of various resources. The course covers managing an ecosystem with concerns about water, agriculture, grazing, wildlife, timber, recreation, people, and hazards of wind, fire, avalanche, and flood. The class examines the basic issues and describes tools and techniques for analyzing and managing. Case studies of specific areas are used for many of the analyses. The course covers systems concepts; decision analysis; area, volume, and other regulatory systems; silvicultural pathways; growth models; wind and fire hazard analyses; habitat and biodiversity analyses; carbon sequestration; payment for ecosystem services; cash flow; operations scheduling; portfolio management; monitoring; and continuous quality improvement and adaptive management. Class includes lectures and exercises in which students integrate these subjects. Chadwick D. Oliver

**[F&ES 658a, Global Resources and the Environment** 3 credits. The world’s climate, soils, water, plant and animal species, mineral and organic resources, and people are neither equally nor randomly distributed throughout the earth; each has changed and will continue to change. Both the distribution and change can be understood (at least to some extent) based on “uniform processes” that occur repeatedly throughout the world. Policies, investments, and on-the-ground management will be effective if the experts understand the global situation. And students can better understand behaviors of one aspect of the environment at one location if they have a global overview of many aspects and their behaviors and interactions. The course is intended to give students (1) an understanding of the present global distribution and changes with time of the resources, people, and other factors including climates, geomorphic areas, water, species, human communities and populations, agriculture, forest products, inorganic commodities, and energy; (2) an understanding of how to access and utilize information on global resources; and (3) an understanding of important issues and management approaches, including species protection and extinctions, resource depletion and sustainability, catastrophic events, soil and water maintenance and degradation, atmospheric change and carbon sequestration, populations and lifestyles, resource substitution and economics, consumption, recycling,

and substitution patterns and potential changes (through lectures, readings, analyses, and case studies). Chadwick D. Oliver]

**F&ES 659b, Principles in Applied Ecology: The Practice of Silviculture** 4 credits. The scientific principles and techniques of controlling, protecting, and restoring the regeneration, composition, and growth of natural forest vegetation and its plantation analogs worldwide. Analysis of biological and socioeconomic problems affecting specific forest stands and design of silvicultural systems to solve these problems. Applications are discussed for management of wildlife habitat, bioenergy and carbon sequestration, water resources, urban environments, timber and nontimber products, and landscape design. Recommended: some knowledge of soils, ecology, plant physiology, human behavior, and resource economics. Four to six hours lecture. One hour tutorial. Seven days field-work. Mark S. Ashton

**F&ES 660a, Forest Dynamics: Growth and Development of Forest Stands** 3 credits. This course introduces the study of forest stand dynamics – how the structure and composition of different forest types change over time (from regeneration to old growth). Understanding the dynamic nature of forest stands is important for creating and maintaining a variety of critical wildlife habitats on the landscape, managing for sustainable supplies of wood products and other forest values, or predicting the risks and managing the effects of natural and anthropogenic disturbances. Through lectures, discussions, and field trips we explore forest development processes and pathways, concentrating on the biological mechanisms driving forest structural change and the roles of natural and human disturbances in initiating and altering stand development trajectories. We make use of New England forests as living laboratories, while discussing how similar patterns and processes of forest development are played out in forests around the globe. Ann E. Camp

[**F&ES 661b, Analysis of Silvicultural Problems** 3 credits. An advanced course exploring the silvicultural options for problem stands. Problems can be both biological (fire, pathogens) and social (multiple value conflicts, property rights). Solutions are sought through synthesis and analysis of relevant literature for case studies. Quantitative silvicultural and economic techniques are used for comparative evaluation of solutions. Prerequisites: F&ES 659b or 660a; F&ES 804b; or permission of the instructor. Mark S. Ashton]

**F&ES 662a, Seminar in Advanced Silviculture** 3 credits. This course considers selected topics in silviculture or silvicultural-related courses. Students work through the peer-review publication process on data sets and projects in silviculture and applied forest ecology. Discussions involve rationale and hypothesis testing for a project. Data analysis techniques and reporting and interpretation of results. It is expected that manuscripts developed in the course are worthy of publication and that oral presentations are of a caliber for subject area conferences and meetings. Three hours lecture. Mark S. Ashton

[**F&ES 663a, Invasive Species: Ecology, Policy, and Management** 3 credits. Invasive species are disrupting both ecosystems and economies at all scales from local to global. A clear understanding of the nature of the problem, the ecology and biology of the invasive

species, the influence of globalization of trade, and advances in management strategies is critical for land managers, scientists, and policy makers. In this lecture/discussion/seminar we focus on current issues surrounding invasive species (both plants and animals) at various spatial and temporal scales in terrestrial, aquatic, and marine ecosystems. Emphasis is on the biology and ecology of invasive species along with a basic understanding of their economic impacts and public policy options to address prevention and management of invasive species. The course includes several local field trips with scientists and land managers. Ann E. Camp, Mary Tyrrell]

**F&ES 664a, Financial Analysis for Land Management** 3 credits. This course provides a framework and techniques to address financial decisions in forest, rangeland, and renewable resource management. Major topics include timber markets, basic investment analysis calculations (IRR, NPV, etc.), risk and selection of interest rates, inflation, taxation, forest finance, and resource valuation and appraisal. Techniques applicable to the individual tree, the stand, and the total property are presented. The course is oriented to applications for land management and not to theory. Includes an overview of the developing fields of carbon offsets, green payments, and conservation land acquisitions. A substantial applied course project is required. Prerequisites: F&ES 804b and F&ES 659b or permission of the instructor. (F&ES 657b and 659b are very helpful.) Three hours lecture. Weekly problem sets. Lloyd Irland

**F&ES 666a, Management Plans for Protected Areas** 6 credits. A seminar that comprises the documentation of land use history and zoning, mapping and interpretation, and the collection and analysis of socioeconomic, biological, and physical information for the construction of management plans. Plans are constructed for lands managed by the Nature Conservancy; Massachusetts Trustees of Reservations; private industrial and nonindustrial landowners; town land trusts; city parks and woodlands of New Haven, New York, and Boston; and the Appalachian Mountain Club. Prerequisites: F&ES 659b or 660a; F&ES 804b; or permission of the instructor. Ten days fieldwork. Limited enrollment. Mark S. Ashton

[**F&ES 667a, Rapid Assessments in Forest Conservation** 3 credits. An advanced interdisciplinary course concerned with assessing the protection and management of biologically diverse, complex forested ecosystems that produce various goods and services. Examples of independent case analyses concern landscape management of biogeographic regions in the Pacific Northwest, Ecuador, Costa Rica, Venezuela, Belize, central and southern Mexico, and the Panama Canal Watersheds. Students are encouraged to travel on extended class field trips to these regions. Prerequisites: F&ES 659b or 660a; F&ES 804b; or permission of the instructor. Three hours lecture. Eight days fieldwork. Limited enrollment. Mark S. Ashton]

**F&ES 668b, Field Trips in Forest Resource Management and Silviculture** 1 credit. Seven- to twelve-day field trips to study the silviculture and forest management of particular forest regions. In previous years, classes have visited Slovenia, Germany, Austria, the United Kingdom, British Columbia, and, in the United States, the southern Coastal Plain and Piedmont, and the Allegheny, Appalachian, Adirondack, and Green mountains. Mark S. Ashton

**F&ES 669b, Forest Management Operations for Professional Foresters** 2 or 3 credits. The operational aspects of managing forestland are taught, including topics essential to the professional practice of forest management. Operational aspects of regeneration, intermediate tending, and harvesting (planning, layout, implementation, and post-operation evaluation), best management practices, regulatory and wetlands considerations, and socioeconomic dimensions of field operations are the focus. The ethical and professional responsibilities of forest managers who are responsible for land-altering activities are also considered. The course includes considerable field time to help students utilize their existing knowledge about forests to rapidly assess stands and land parcels with respect to the planning and implementation of on-the-ground treatments. Classes feature local field trips to view forestry operations and to develop and refine field skills. Prerequisites include any silviculture courses. Optional: students can choose to participate in the Southern Forest and Forestry Field Trip for 1 additional credit. Michael Ferrucci

**F&ES 670b, Southern Forest and Forestry Field Trip** This course augments our forestry curriculum by providing a forum for viewing and discussing forestry and forest management with practitioners. The trip provides forestry and other interested students with an opportunity to experience the diversity of forested ecosystems and ownership objectives ranging from intensively managed pine plantations to restoration and protection of endangered habitats. Students discuss forest management issues—including forest health, fragmentation, policy, law, and business perspectives—with landowners and managers from large industries, nonindustrial private landowners, TIMOs, federal and state land managers, NGOs, and forestry consultants. We also tour sawmills, paper mills, and other kinds of forest products processing facilities, active logging operations, and, weather permitting, participate on prescribed fires. Not least, we experience the unique cultures, food, and hospitality of the southeastern United States. The course can be taken for 1 credit by any student at F&ES or combined with the 2-credit Forest Operations course for 3 credits. Ann E. Camp

## *Physical Sciences*

### ATMOSPHERIC SCIENCES

**F&ES 700b, Alpine, Arctic, and Boreal Ecosystems Seminar** 3 credits. Biogeoclimatic analysis of these systems worldwide with special attention to biogeography, biometeorology, physiology, histology, morphology, autecology, and silviculture of high-elevation and high-latitude forests through lectures, guest lectures and discussions, student seminars, and field experience. One and one-half hours lecture weekly. Student contributions are one or more seminars and a term paper. Prerequisites: F&ES 656b, or permission of the instructors. Graeme P. Berlyn, Ann E. Camp, Xuhui Lee, Mark S. Ashton

[**F&ES 702b, Climate Change Seminar** 2–3 credits. An advanced seminar that explores current topics in global climate change, including scientific evidence for global warming, climate change impacts on natural ecosystems and the human society, and policy and management options for mitigating climate change. Meetings are divided between student presentation, invited lecture, and panel debate on selected hot issues. Preference

is given to second-year students, but first-year students with background and interest in the subject area are also encouraged to participate. Presentation/literature critique/term paper. Prerequisite: F&ES 703b or F&ES 704a. Xuhui Lee]

**F&ES 703b, Climate and Life** 3 credits. A descriptive overview of the earth's atmospheric environment. The basic principles of climatology and meteorology and their application to the environment are discussed. Topics include climate elements, energy flow in the atmosphere, atmospheric motions, effect on agricultural systems, climatological impact on forest resources and animal habitats, urban climate, human bioclimatology, air quality, air resources (wind and solar energy), and climate change. Three hours lecture. Problem sets. Group project. Xuhui Lee

[**F&ES 704a, A Biological Perspective of Global Change** 3 credits. The course aims to promote understanding of the interface between major aspects of global change and the biospheric systems. Special attention is given to the biological significance of ozone layer depletion, anthropogenic and natural causes of photochemical smog, acid rain, sources and sinks of greenhouse gases, and impact of global warming on the terrestrial biosphere. Three hours lecture and discussion. Term paper/presentation/literature critique. Xuhui Lee]

[**F&ES 722b, Boundary Layer Meteorology** 3 credits. This course examines the interactions between the atmosphere and the earth's surface. Students gain an understanding of the surface energy and radiation balance, air motion in the atmospheric boundary layer, land surface parameterization for climate models, and field research methods. Three hours lecture and discussion. Data analysis/term paper/presentation. Permission of the instructor required. Xuhui Lee]

#### ENVIRONMENTAL CHEMISTRY

**F&ES 706b, Organic Pollutants in the Environment** 3 credits. An overview of the pollution problems posed by toxic organic chemicals, including petroleum, pesticides, PCBs, dioxins, chlorinated solvents, and emerging contaminants. Processes governing the environmental fate of organic pollutants, e.g., evaporation, bioconcentration, sorption, biodegradation. Technologies for prevention and remediation of organic pollution. Will not be taught in academic year 2011–2012. Shimon C. Anisfeld

**F&ES 707b/344b/ENAS 640b, Aquatic Chemistry** 4 credits. A detailed examination of the principles governing chemical reactions in water. Emphasis on developing the ability to predict the aqueous chemistry of natural, engineered, and perturbed systems based on a knowledge of their biogeochemical setting. Calculation of quantitative solutions to chemical equilibria. Focus on inorganic chemistry. Topics include elementary thermodynamics, acid-base equilibria, alkalinity, speciation, solubility, mineral stability, redox chemistry, and surface complexation reactions. Prerequisites: general chemistry, algebra, and F&ES 708a or equivalent. Three hours lecture, weekly problem sets. Gaboury Benoit

[**F&ES 708a, Biogeochemistry and Pollution** 3 credits. A descriptive overview of baseline biogeochemistry and the nature and behavior of pollutants in the environment. The course is designed to aid future environmental professionals who may find it necessary to make decisions based on chemical data. It is geared to the nonspecialist who needs

to establish familiarity with various classes of pollutants and the chemical, biological, and physical processes that control their transport and fate. Topics include the periodic characteristics of the elements, fundamental classes of chemical reactions in the environment, critical analysis of chemical data, sampling techniques, analytical methods, natural biogeochemical controls on environmental chemistry, as well as detailed examination of contaminants of special interest like acid precipitation, nutrients, and sewage. Recommended: college-level general chemistry. Three hours lecture. One class project, problem sets, midterm, final exam. Optional field trips. Gaboury Benoit]

**F&ES 743a/443a, Environmental Chemical Analysis** 3 credits. An overview of techniques and instrumentation used for the chemical analysis of environmental samples. Theory is taught together with hands-on practical skills through a combination of weekly lectures and labs. Focus is on the principles for quantitative analysis of nutrients, major ions, trace metals, and trace organics. Techniques include titrations, spectrophotometry, chromatography, spectroscopy, and electrochemistry. The analysis procedures are relevant to water, soil, sediment, plants, and air analysis. Individuals currently engaged in or interested in lab-based research should benefit most from the course. Enrollment limited to twelve. Two hours lecture and three hours lab. Prerequisites: CHEM 113/114 or equivalent. Helmut Ernstberger

**F&ES 773a/CENG 373a/ENVE 373a, Air Pollution (Chemical Engineering Department)** 3 credits. Kinetics, thermodynamics, and transport of chemical reactions of common air pollutants including suspended particulate matter. The role of surface chemistry and transport phenomena in air pollution. Pollutant dispersion modeling. Technology available to prevent or control air pollutants is discussed in conjunction with their physics, chemistry, and design and performance characteristics. Prerequisite: CENG 210a or permission of the instructor. Faculty

**F&ES 777b/CENG 377b/ENVE 377b, Water Quality Control** 3 credits. Study of the preparation of water for domestic and other uses and treatment of wastewater for recycling or discharge to the environment. Topics include processes for removal of organics and inorganics, regulation of dissolved oxygen, and techniques such as ion exchange, electro dialysis, reverse osmosis, activated carbon adsorption, and biological methods. Prerequisite: CENG 210a or permission of the instructor. L. Lee Wikstrom

#### SOIL SCIENCE

**F&ES 709a, Soil Science** 3 credits. This course offers an introduction to the fundamental concepts of soil science. Soil topics are presented in relation to natural and managed ecosystems with emphasis on soil processes and their relationship to plant productivity. Topics of current interest in relation to soil science, management, and conservation in natural and managed landscapes. Two lectures a week. Three field trips. This course has no prerequisites. Background in ecology or forestry is useful but not indispensable. This course fulfills the science requirement of the M.S. curriculum at F&ES. Open to Yale College students with permission of the instructor. This course can be used as prerequisite for F&ES 652b and is also recommended as background for F&ES 653b. This course is a prerequisite for F&ES 723b. Mark Bradford

**[F&ES 723b, Seminar in Soil Conservation and Management** 1, 2, or 3 credits. Soils are important to food security, providing food, fiber, and shelter for humans and terrestrial wildlife. Soils are also important sinks of atmospheric carbon, more so than the aboveground terrestrial vegetation for many types of ecosystems. Worldwide, soils are constantly impacted by unsustainable management practices in agriculture, forestry, and other human activities, as well as climate change. However, sustainable techniques geared to increasing soil conservation can mitigate or reverse detrimental effects on soils. This is an advanced course in soil science, and enrolling students are expected to have sufficient background such as graduate or undergraduate courses in Soil Science. The course offers one or two introductory lectures to refresh and update key concepts as needed: soil formation, classification, soil physical factors; organic matter and nutrients. The rest of the seminar is devoted to lectures and discussion sessions on more advanced topics, including rehabilitation of degraded soils through reforestation; soil sustainability in natural forest management and plantation forestry; soils as a sink for atmospheric carbon; carbon sequestration in pastures and forests; soil changes in shifting agriculture; soil changes during forest succession; soil productivity in agroforestry; soil erosion control; organic farming; mycorrhizae and organic biostimulants; wetland soils; urban soils; soil contaminants and bioremediation. Guest speakers include soil scientists from the USDA Natural Resources Conservation Service (NRCS) among others. We meet once a week for three hours. At each meeting, lectures are followed by discussion of relevant articles provided by the instructor or students. This class may be taken for one, two, or three credits. One-credit students attend all classes and seminars, and are expected to lead one discussion section. Two-credit students are expected to participate in lectures and discussions, lead a discussion session, and give an oral seminar on a relevant topic of interest. Three-credit students have similar requirements as two-credit students, and they write a term paper on a relevant subject of their choice. Field trips: wetlands (marshes) in Branford/Guilford, organic farm, among others. Prerequisite: undergraduate- or graduate-level soils class such as F&ES 709a. *Florencia Montagnini*]

## WATER RESOURCES

**F&ES 710b, Coastal Governance** 3 credits. Effective coastal management requires that an understanding of natural systems be incorporated into policy in a manner that reflects human values. This course describes policy frameworks that have been used or proposed and applies them to current topics. Examples are drawn from uses (energy development, wastewater treatment, wetland protection, dredging), management techniques (spatial planning, zoning, protected areas), and emerging practices in areas such as ecosystem-based management (watershed/bay systems, fisheries). Case studies focus on how information from the natural sciences is used in policy design and execution as observed in current law governing land and water resources. Sector-based and spatial management are contrasted with ecosystem-based management to demonstrate both the content of policy frameworks and how they evolve in response to changes in society. Three hours seminar, term project. *Richard Burroughs*

**[F&ES 712b, Water Resource Management** 3 credits. An examination of water resource issues at scales ranging from local to global. The course looks at multiple dimensions of the water problem, including both human and ecosystem impacts; both quantity and

quality issues; and both science and management. The course aims to give students a diversity of tools to use in managing water resource problems. Theory is illustrated through a variety of case studies. Topics covered include global water resources and their spatial and temporal variability; water scarcity; residential, agricultural, and industrial water use; impacts of climate change; water and human health; stormwater management; dams; human impacts on aquatic ecosystems; water quality; water rights and conflict; the watershed framework; and restoration. Three hours lecture, several homework assignments, several field trips. Shimon C. Anisfeld]

**[F&ES 713a, Coastal Ecosystems: Natural Processes and Anthropogenic Impacts** 3 credits. An examination of the natural processes controlling coastal ecosystems and the anthropogenic threats to the health of these systems. Focus is primarily on tidal marshes and estuarine open-water systems. The course covers a wide range of important physical, chemical, and ecological processes, with greatest detail given to nutrient cycling, primary production, detrital pathways, and marsh accretion. Anthropogenic impacts covered range from local to global, and include nutrient enrichment, hypoxia, sea-level rise, invasive species, marsh drowning, and wetland filling. Three hours lecture, several field trips. Shimon C. Anisfeld]

**F&ES 714b/ENAS 646b, Environmental Hydrology** 3 credits. An intermediate-level treatment of surface and subsurface hydrology that involves application of computer models to address issues relating to water quality, water supply, and restoration. Students gain an understanding of a broad range of hydrologic phenomena, including (1) rainfall runoff in forested watersheds, (2) chemical transport in streams, (3) surface-water flow in wetlands, (4) groundwater-flow dynamics, and (5) contaminant migration through drinking-water aquifers. James E. Saiers

**F&ES 719a, River Processes and Restoration** 3 credits. This course studies the geophysical processes of natural rivers with emphasis on qualitative and quantitative aspects of fluvial morphology; the course addresses channel dynamics, urban rivers, human impacts on rivers, and climate change. It also addresses restoration of degraded rivers, including dechannelization, dam removal, sediment transport, aquatic habitat improvements, and naturalistic design. Students learn to inspect, classify, identify, and measure river features. Quantitative analyses of river hydraulics and morphology are performed to predict river reactions to human activities and watershed change. The class includes class lectures, readings, problem sets, field labs, and a team project. A previous course in hydrology (F&ES 714b or equivalent) is recommended. James G. MacBroom

**[F&ES 724b, Watershed Cycles and Processes** 3 credits. This course explores abiotic and biotic controls on the cycling of water and chemicals within watershed systems. Students gain an understanding of the coupled roles of climate, hydrology, and biogeochemistry in regulating the fate of nutrients, carbon, and pollutants in watersheds. The class also features six guest lectures on issues at the forefront of watershed science. Upon successful completion of the course, students have acquired scientific knowledge that is relevant to interpreting watershed-based observations and to informing watershed-management decisions. Peter A. Raymond, James E. Saiers]

**F&ES 729b, Caribbean Coastal Development: Cesium and CZM** 3 credits. A field-intensive seminar exploring human-ecosystem interactions at the land-sea interface in the Caribbean, with St. Thomas, Virgin Islands, as the study site. Many tropical islands are undergoing rapid, uncontrolled development, placing severe local stress on several unique and vulnerable ecosystem types. In addition, human-induced environmental changes on scales up to global also impose stresses. This course examines the normal functioning of these ecosystems, scientific methods to evaluate and characterize ecosystem condition and processes, how human activities interfere with natural cycles in biophysical systems, and what management and policy tools can be applied to reduce impacts. An organizing framework for the course is the close coupling of coastal watersheds and adjacent marine ecosystems, especially coral reefs. A major part of the course is a one-week field trip to St. Thomas in the U.S. Virgin Islands during spring break. We also meet twice each week before the break to discuss readings and arrange logistics. Student presentations and projects. Class enrollment is limited to eight, and priority is given to F&ES students, with others admitted as space permits. Students are selected in December of the fall term. Gaboury Benoit

### *Quantitative and Research Methods*

**F&ES 550a/760a, Natural Science Research Methods** 3 credits. The course prepares students to design and execute an intensive research project. It covers elementary principles and philosophy of science; research planning, including preparation, criticism, and oral presentation of study plans; communicating research findings; limitations of research techniques; the structure of research organizations; and professional scientific ethics. Oswald J. Schmitz

**F&ES 551a, Social Science Qualitative Research Methods** 3 credits. A broad introduction to issues of social sciences research methods and design. Emphasis in the readings and lectures is placed on qualitative methods, although consideration is given to both quantitative and qualitative approaches to research. No prior knowledge of methodology or statistics is expected or assumed. The course is intended both for doctoral students who are in the beginning stage of their dissertation research, and for master's students developing research proposals for their thesis projects. The course covers the basic techniques for collecting, interpreting, and analyzing qualitative data. During the term we explore three interrelated dimensions of research. One focuses on the theoretical foundations of science and research, another focuses on the various methods available to researchers for data collection and analysis, and finally we complete exercises in the practical application of various methods. The course differs from others on research design in that it is decidedly interdisciplinary in nature (including drawing on literature from anthropology, geography, political science, and sociology) and it consciously addresses the unique nature of social science research within environmental studies. One significant premise underlies this class: some of the most important questions addressed in environmental studies have such complex solutions that traditional positivist scientific approaches have limited application. Amity Doolittle

**F&ES 552b, Masters' Student Research Colloquium** 1 credit. One of the most important aspects of scientific research involves the communication of research findings to the

wider scientific community. Therefore, second-year M.E.Sc. and M.F.S. students are required to present the results of their faculty-supervised research as participants in the Masters' Student Research Colloquium, a daylong event held near the end of the spring term. Student contributors participate by delivering a 15-minute oral presentation to the F&ES faculty and student body or by presenting a research poster in a session open to the F&ES community. Students receive a score of pass or fail for this effort. James E. Saiers

**[F&ES 726a/ARCG 762a/EMD 548a/G&G 562a, Remote Sensing of the Earth from Space]** 3 credits. Course topics include the spectrum of electromagnetic radiation, satellite-borne radiometers, data transmission and storage, computer image analysis, and merging satellite imagery with GIS. Applications to weather and climate, oceanography, surficial geology, ecology and epidemiology, forestry, agriculture, and watershed management. Preference to students in F&ES, Geology and Geophysics, Epidemiology, Anthropology, and Studies in the Environment. Prerequisites: college-level physics or chemistry, two courses in geology and natural science of the environment or equivalents, and computer literacy. Ronald B. Smith, Xuhui Lee, Mark S. Ashton, Karen Seto]

**F&ES 751a, Sampling Methodology and Practice** 3 credits. This course is intended to provide a fundamental understanding of the principles of statistical sampling, alternative estimators of population parameters, and the design basis for inference in survey sampling. Natural, ecological, and environmental resource applications of sampling are used to exemplify numerous sampling strategies. Sample designs to be studied include simple random; systematic; unequal probability, with and without replacement; stratified sampling; sampling with fixed-radius plots; horizontal point sampling; and line intercept. The Horvitz-Thompson, ratio, regression, and other estimators are introduced and used repeatedly throughout the course. Three hours lecture. Weekly and biweekly problem sets requiring the use of a computer spreadsheet. Timothy G. Gregoire

**F&ES 753b, Regression Modeling of Ecological and Environmental Data** 3 credits. This course in applied statistics assists scientific researchers in the analysis and interpretation of observational and field data. After considering the notion of a random variable, a few frequently encountered discrete and continuous distributions are examined in greater detail, with specific emphasis on the Gaussian distribution and the role of the central limit theorem. The statistical properties of linear transformations and linear combinations of random data are established. The foregoing serves as a foundation for the major topics of the course, which explore the estimation and fitting of linear and nonlinear regression models to observed data. Three hours lecture. Statistical computing with R, weekly problem exercises. Prerequisite: a prior course in introductory statistics. Timothy G. Gregoire

**F&ES 755b, Modeling Geographic Space** 3 credits. An introduction to the conventions and capabilities of image-based (raster) geographic information systems (GIS) for the analysis and synthesis of spatial patterns and processes. In contrast to F&ES 756a, the course is oriented more toward the qualities of geographic space itself (e.g., proximity, density, or interspersion) than the discrete objects that may occupy such space (e.g., water bodies, land parcels, or structures). Three hours lecture, problem sets, one class project. No previous experience is required. Dana Tomlin

**F&ES 756a, Modeling Geographic Objects** 3 credits. This course offers a broad and practical introduction to the nature and use of drawing-based (vector) geographic information systems (GIS) for the preparation, interpretation, and presentation of digital cartographic data. In contrast to F&ES 755b, the course is oriented more toward discrete objects in geographical space (e.g., water bodies, land parcels, or structures) than the qualities of that space itself (e.g., proximity, density, or interspersion). Three hours lecture, problem sets, one class project. No previous experience is required. Dana Tomlin

[**F&ES 757b, Statistical Design of Experiments** 3 credits. Principles of design for planned experiments, coupled with methods of analysis of experimental data. The course is applications-oriented using the results of established theory. The nuances, strengths, and weaknesses of a number of classical designs are discussed. These include completely randomized design, block designs, and split plot designs. The analysis of data from these designs is treated at length. This course also deals with the question of sample size estimation. Students may use R or SAS for the completion of assignments. Prerequisite: a prior course in introductory statistics. Jonathan D. Reuning-Scherer or Timothy G. Gregoire]

**F&ES 758b, Multivariate Statistical Analysis in the Environmental Sciences** 3 credits. An introduction to the analysis of multivariate data. Topics include multivariate analysis of variance (MANOVA), principal components analysis, cluster analysis (hierarchical clustering, k-means), canonical correlation, multidimensional scaling ordination methods, discriminate analysis, and structural equations modeling. Emphasis is placed on practical application of multivariate techniques to a variety of natural and social examples in the environmental sciences. Students are required to select a dataset early in the term for use throughout the term. There are regular assignments and a final project. Extensive use of computers is required. Prerequisite: a prior course in introductory statistics. Three hours lecture/discussion. Jonathan D. Reuning-Scherer

[**F&ES 780a, Seminar in Forest Inventory** 2 credits. An advanced seminar that explores the design and implementation of forest inventory. Topics are varied to meet the interest of the class, but generally include the evolution and current status of broad regional and national inventories in the United States and abroad. Each week readings are assigned from primary sources that document the development of, and motivation for, various sampling methods for forest inventory. These include fixed and variable radius plot sampling, 3P sampling, double sampling for stratification in forest inventory, sampling with partial replacement, and line intersect sampling. Time and interest permitting, there is discussion of some newer, more specialized methods such as Monte Carlo methods and randomized branch sampling. A familiarity with the precepts and vernacular of probability sampling or statistics is presumed. Prerequisite: F&ES 751a. Limited enrollment. Timothy G. Gregoire]

**F&ES 781b, Applied Spatial Statistics** 3 credits. An introduction to spatial statistical techniques with computer applications. Topics include spatial sampling, visualizing spatial data, quantifying spatial association and autocorrelation, interpolation methods, fitting variograms, kriging, and related modeling techniques for spatially correlated data. Examples are drawn from ecology, sociology, public health, and subjects proposed by

students. Four to five lab/homework assignments and a final project. The class makes extensive use of the R programming language as well as ArcGIS. Timothy G. Gregoire, Jonathan D. Reuning-Scherer

## *Social Sciences*

### ECONOMICS

**F&ES 802b, Valuing the Environment** 3 credits. This quantitative course demonstrates alternative methods used to value environmental services. The course covers valuing pollution, ecosystems, and other natural resources. The focus of the course is on determining the “shadow price” of nonmarket resources that have no prices but yet are considered valuable by society. Taught every other year. Three hours lecture. Robert Mendelsohn

**F&ES 803b, Green Markets: Voluntary and Information Approaches to Environmental Management** 3 credits. Two observations provide motivation for this seminar. First, voluntary and information-based approaches to environmental management are becoming increasingly common. Environmental managers should thus be familiar with the approaches, along with their advantages and limitations. Second, students, advocates, and managers are often searching for ways outside of formal regulatory contexts to promote more pro-environmental behavior. There exists a sizable academic literature on the subject, but rarely is it covered in courses on environmental management. Readings span economics, psychology, and political science. Class occasionally has a lecture format, but for the most part, we have structured discussion, rotating responsibility for presentation and critique. Matthew J. Kotchen

**F&ES 804a, Economics of Natural Resource Management** 3 credits. This course uses economic theory and empirical evidence to address three general areas of the environment: pollution control, nonrenewable resource extraction, and renewable resource management. The course teaches students how to apply economics to real-world problems. The pollution section discusses the theoretical and empirical problem of regulating pollution, including solid waste, air pollution, and global warming. The nonrenewable resource section focuses on how to consume a resource of limited size over time with applications to fossil fuels, metals, and minerals. The renewable resource section covers management of water, land, and ecosystems. Students should have a good grasp of microeconomics before taking this class. Robert Mendelsohn

**F&ES 805b, Doctoral Seminar in Environmental Economics** 3 credits. This course critically examines a set of recent and also famous papers in environmental and resource economics. The purpose of each paper, its method, results, and conclusions are all discussed. The course is intended to prepare students for a career in economic research. Robert Mendelsohn

**F&ES 810b, Agriculture and the Environment** 3 credits. Within the United States and across the globe, agriculture is the major source of human impacts on land and water, as well as a significant contributor to greenhouse gas emissions. This class uses economic tools and concepts to examine the connections between agriculture and the environment. The class discusses the relationships between agriculture and forest clearing, land

degradation, soil erosion, water pollution, biodiversity loss, and climate change. It also considers the relationships between agricultural productivity growth and environmental quality, and it touches on the impacts of agricultural policies and international trade. The course assumes that students have previously taken a course on economics at F&ES and have a familiarity with basic economic tools and concepts. Prerequisite: F&ES 804a. Douglas Gollin

**F&ES 811b, Environment and Development: An Economic Approach** 3 credits. This class examines the relationships between environment and development from the perspective of economics. We use economic tools and concepts to answer a set of questions about these relationships. In what ways can economic growth lead to improvements in environmental quality? In what ways is growth likely to generate environmental damage? How do policies alter the balance between human prosperity and environmental health? Can they lead to simultaneous improvements in both? To what extent are bad environmental outcomes the result of economic growth itself, and to what extent do they stem from market failures or institutional failures? This is an advanced economics class. Students are expected to have taken an economics class at F&ES already and to be familiar with basic economic tools. Prerequisite: F&ES 804a. Douglas Gollin

**F&ES 890a/MGT 820a, Energy Markets Strategy** 1.5 credits. In the past thirty years, energy markets have changed from quiet, often heavily regulated areas of the business landscape to some of the most dynamic markets in the world economy. Regulation of oil, natural gas, motor fuel, and electricity markets has been reduced dramatically in the United States and in many other countries. Electricity deregulation swept the industrialized and developing world, but it is now associated with the 2000–2001 California electricity crisis and the 2001–2002 Enron scandal. Oil prices have reached record levels with great uncertainty about where they are headed. Drawing on the tools of economics, we study the business and public policy issues that these changes have raised. Topics include the political economy of deregulation, competition in wholesale electricity markets, market power and antitrust, and the transportation of energy commodities. We examine the economic determinants of industry structure and evolution of competition among firms in these industries, investigate successful and unsuccessful strategies for entering new markets and competing in existing markets, and analyze the rationale for and effects of public policies in energy markets. Students play strategy games to learn about the oil and electricity industries. They simulate OPEC countries in the oil industry and for-profit firms in a restructured electricity market. The students solve for the collusive equilibria in the setting of a nonrenewable resource and develop their own strategies given that monitoring oil production is imperfect. They consider how to operate in electricity markets given that there are capacity constraints, inelastic demand, and lack of storage. Arthur Campbell

#### ENVIRONMENTAL POLICY

**F&ES 807a/MGT 688a, Environmental Management and Strategic Advantage** 3 credits. This course focuses on understanding the policy and business logic for making environment and sustainability a core element of corporate strategy and management systems. Students are asked to analyze how and when environmental thinking can be translated

into competitive advantage. The course combines lectures, case studies, and class discussions on management theory and tools, legal and regulatory frameworks shaping the business-environment interface, and the evolving requirements for business success (including how to deal with diverse stakeholders, manage in a world of transparency, and handle rising expectations related to corporate social responsibility). Daniel C. Esty, Stephen Ramsey

**[F&ES 808b, International and Comparative Forest Policy and Governance** This class adapts existing classes on forest certification to comprise all of the public policy, international relations, comparative, and institutional analysis covered by the instructor's research and teaching efforts. Focus on assessing the most promising policies and institutions for governing global forest degradation. Benjamin Cashore]

**[F&ES 809a, Environmental Policy Analysis for an Unpredictable World** 3 credits. The purpose of this course is to understand and apply theories of the policy-making processes. The course takes an analytical approach to policy analysis, attempting to understand better the policy climate in which we operate. The course also distinguishes the two dominant methods of policy analysis today: understanding forest policies and why they have developed ("analysis of" policy); and applied techniques in policy analysis that are used to prescribe rationally a particular policy choice over competing alternatives ("analysis for" policy). These approaches to policy analysis are explored for their benefits and limitations in efforts to develop enduring policy and institutional approaches to environmental management. Students are required to critically assess differing evaluation techniques for a world that is often unpredictable and in which many key values defy quantification. By the end of the course students should be able to (1) understand the dominant theories of the policy-making process, (2) develop sophisticated explanations of forest policy change and stability, and (3) understand, apply, and critically analyze scientific "analysis of policy" approaches. Throughout the course, we address the following questions: What are the major theories of public policy formation? Who are the major actors in the forest policy arena, and within what institutional and ethical framework(s) do they operate? What tools are available for the development and implementation of public policy? Benjamin Cashore]

**F&ES 813b, Emerging Markets for Ecosystem Services** 3 credits. The modern economy consumes many ecosystem services without paying for their production: forested areas protect water resources; plants sequester carbon; intact ecosystems protect biodiversity and its associated services (potential pharmaceuticals, existence value, etc.). In response, a growing number of experiments are under way to make consumers of ecosystem services pay the producers of the services, thus creating market incentives to sustain intact, biologically diverse areas. However, these experiments are in their infancy and raise a host of ethical, scientific, commercial, and policy questions. The purposes of this seminar are (1) to understand these opportunities and their limits, by examining current scientific, commercial, and policy knowledge relevant to building markets for ecosystem services; and (2) to apply the lessons learned to actual properties or questions by analyzing the scientific, business, and policy aspects of these issues. Prerequisite: course work or experience in at least one of the following: silviculture, business analysis/planning, or policy/law. Enrollment is limited. Bradford S. Gentry, Mark Ashton, and guest lecturers

**F&ES 814a, Energy Systems Analysis** 3 credits. This lecture course offers a systems analysis approach to describe and explain the basics of energy systems, including all forms of energy (fossil and renewable), all sectors/activities of energy production/conversion, and all end-uses, irrespective of the form of market transaction (commercial or noncommercial) or form of technology (traditional as well as novel advanced concepts) deployed. Students gain a comprehensive theoretical and empirical knowledge base from which to analyze energy-environmental issues as well as to participate effectively in policy debates. Special attention is given to introducing students to formal methods used to analyze energy systems or individual energy projects and to discuss traditionally less-researched elements of energy systems (energy use in developing countries; energy densities and urban energy use; income, gender, and lifestyle differences in energy end-use patterns) in addition to currently dominant energy issues such as climate change. Active student participation is required, including presentations in class and completion of problem sets. Invited external speakers complement topics covered in class. Arnulf Grubler

**[F&ES 815a, The New Corporate Social Responsibility: Public Problems, Private Solutions, and Strategic Responses** 3 credits. This seminar assesses the proliferation of policy innovations aimed at promoting and encouraging “corporate social responsibility” (CSR). We define CSR broadly to include the diverse range of self- and civil regulation, voluntary instruments, private authority, and non-state market driven (NSMD) initiatives that have emerged in the last fifteen years to engage firms directly, rather than working through traditional governmental process. Examples include firm-level initiatives, industry codes, product codes, third-party certification, ethical brands and labels, and “clean” investment funds. The course reviews the growing literature on these phenomena that now exists within political science, management, economics, sociology, environmental studies, and law. Our aim is to reflect on the broad array of scholarship on emergence and institutionalization of CSR innovations questions. While the class is interested in assessing the strategic advantage that CSR might bring firms, our emphasis is on whether, and how, CSR initiatives might address enduring policy problems where traditional governmental approaches have been ineffective. The course is organized into four components. First, we review and assess the different types of CSR or “private” policy instruments vying for firm-level support and distinguish them from traditional governmental mechanisms. Second, we discuss what is meant by “effectiveness” and the different ways of measuring success. Third, we assess the assumptions behind different theoretical frameworks about what types of CSR innovations firms are more likely to support, if any, and why. Fourth, we turn to empirical evidence to assess existing theories of support, and what this means for understanding support and effectiveness of CSR. This section draws on a variety of empirical methods including guest speakers from the world of CSR, analysis of large-N analyses on support, as well as detailed historical and comparative case studies. Benjamin Cashore]

**F&ES 818a, Technology, Society, and the Environment** 3 credits. This seminar addresses technology’s dual role as both source and remedy of global environmental change. The seminar first discusses conceptual and theoretical aspects of technological change from an interdisciplinary perspective including social science, history, economics, engineering, as well as management theory. Examples of technological change and its environmental

impacts in agriculture, industries, and the service economy are addressed through case studies. Questions discussed include: Why are some technological innovations successful (e.g., cell phones) while others (e.g., fast breeder reactors) are not? What determines rates of change in the adoption of new technologies and how can these be accelerated? How many people can the earth feed? Is dematerialization actually occurring, and why? What are the implications of the Internet's digital North-South divide, and what are strategies to overcome it? Active student participation is an essential ingredient of the seminar; students participate in seminar debates, perform case studies in home assignments, and also write a (short) final term paper on a mutually agreed-upon topic. Arnulf Grubler

**F&ES 819b, Strategies for Land Conservation** 3 credits (or audit). This is a professional seminar on private land conservation strategies and techniques, with particular emphasis on the legal, financial, and management tools used in the United States. The seminar is built around presentations by guest speakers from land conservation organizations. Speakers are assigned topics across the land conservation spectrum, from identification of target sites, through the acquisition process, to ongoing stewardship of the land after the deal is done. The tools used to protect land are discussed, including the basics of real estate law, conservation finance, and project/organization management. Students are required to undertake a clinical project with a local land conservation organization. Enrollment limited to twenty; preference to second-year students if limit reached. Bradford S. Gentry

**F&ES 820a, Local Environmental Law and Land Use Practices** 3 credits. This course explores the regulation by local governments of land uses in urban, rural, and suburban areas and the effect of development on the natural environment. The course helps students understand, in a practical way, how the environment can be protected through effective regulation at the local level. It introduces students to federal, state, and regional laws and programs that affect watershed protection and to the laws that delegate to local governments primary responsibility for decision making in the land use field. Theories of federalism, regionalism, states' rights, and localism are studied. The history of the delegation of planning and land use authority to local governments is traced, leading to an examination of local land use practices particularly as they relate to controlling development in and around watershed areas. Course participants engage in empirical research working to identify, catalogue, and evaluate innovative local laws that successfully protect environmental functions and natural resources, and the manner in which towns, particularly on the coast, incorporate climate change into their planning and regulations. Nearby watersheds are used as a context for the students' understanding of the strengths and weaknesses of local planning and regulation. Attention is paid, in detail, to how the development of the land adversely affects natural resources and how these impacts can be mitigated through local environmental regulations. The course includes examination of the state and local response to climate change, sea-level rise, growth management, alternatives to Euclidean zoning, low-impact development, brownfields redevelopment, and innovative land use strategies. Marjorie Shansky

**[F&ES 821a, Private Investment and the Environment: Legal Foundations and Tools** 3 credits. As environmental problems become harder to regulate and public funds

available for environmental protection decline, more people are looking to private investment as a tool for improving environmental performance. This course explores the legal aspects of these initiatives, both opportunities and limits. It starts with an analysis of the goals of private investors—as a way to target efforts to change their decisions. It then moves to a review of the legal frameworks within which investors operate (property and tax law), as well as the legal tools that investors use to order their activities (contract law) and that governments use to address market failures (liability, regulation, information, and market mechanisms). The course concludes by examining efforts to use combinations of these legal tools to expand private investment in environmentally superior goods, services, and operations. Students are asked to use an issue about which they care as the focus for their class projects. Bradford S. Gentry]

**F&ES 824a/LAW 20348, Environmental Law and Policy** 3 credits. Introduction to the legal requirements and policy underpinnings of the basic U.S. environmental laws, including the Clean Water Act, Clean Air Act, and various statutes governing waste materials and toxic substances. This course examines and evaluates current approaches to pollution control and resource management as well as the “next generation” of regulatory strategies, including information disclosure requirements, market mechanisms, and incentives to drive innovation. Mechanisms for addressing environmental issues at the local, regional, and global levels are also considered. Donald Elliott

**F&ES 825a, International Environmental Law and Policy** 3 credits. An introduction to international environmental law and policy. After reviewing the rise of the international environmental agenda, the course concentrates on how societies have responded to global-scale environmental challenges, including deforestation, biodiversity loss, desertification, climate change, ozone depletion, toxic substances, and the loss of living marine resources. The principal response to date has been in the area of international environmental law and policy, where a major new field of law and diplomacy has opened up and new multilateral institutions have been created. This first attempt at global environmental governance is surveyed and critically evaluated. Alternatives are examined. The main text for the course is a law casebook, David Hunter, Durwood Zaelke, James Salzman, *International Environmental Law and Policy* (University Casebook Series, 2002). Nicholas A. Robinson

**F&ES 826a, Foundations of Natural Resource Policy and Management** 3 credits. This course offers an explicit interdisciplinary framework that is genuinely effective in practical problem solving. It overcomes the routine ways of thinking and solving conservation problems common to many NGOs and government organizations by explicitly developing more rigorous and effective critical-thinking skills. By simultaneously addressing rational, political, and practical aspects of real-world problem solving, the course helps students understand and offer solutions to the policy problems of managing natural resources. The approach we use requires several things of students (or any problem solvers): that they be contextual in terms of social and decision-making processes; that they use multiple methods and epistemologies from any field that helps in understanding problems; that they strive to be both procedurally and substantively rational in their work; and, finally, that they be clear about their own standpoint relative to the problems

at hand. The approach used in this course draws on the oldest and most comprehensive part of the modern policy analytic movement—the policy sciences—which is growing in its applications worldwide today. The course includes a mix of critical thinking, philosophical issues, history, as well as issues that students bring in. Among the topics covered are human rights, scientific management, decision making, community-based approaches, governance, common interest, sustainability, and professionalism. In their course work students apply the basic concepts and tools to a problem of their choice, circulating drafts of their papers to other seminar participants and lecturing on and leading discussions of their topics in class sessions. Papers of sufficient quality may be collected in a volume for publication. Active participation, reading, discussion, lectures, guests, and projects make up the course. The seminar supports and complements other courses in the School and at the University. Enrollment limited to sixteen; application required. Susan G. Clark

**F&ES 827b, Large-Scale Conservation: Integrating Science, Management, and Policy** 3 or 6 credits. Environmental sustainability and human dignity are important societal goals, but figuring out how to achieve them on large scales—geographic, temporal, and in terms of complexity—has proven to be extremely challenging. Abundant trend data show that many species, ecosystems, and other environmental and human systems are being overused, stressed, or degraded, thus undercutting the likelihood that we can reach sustainability and human rights for all. In addition, our institutions for science, management, and policy are not designed to address sustainability challenges on these scales. Over the last few decades numerous management and policy initiatives have been put forward to address large-scale resource use, including single and multiple use, parks and protected areas, ecosystem management, bioregional planning, integrated conservation and development, transboundary approaches, and adaptive governance. This course (a mixed seminar and practicum) explicitly uses an interdisciplinary framework to examine the conceptual and contextual basis for these efforts; compares and contrasts their scientific, management, and policy components; explores themes of leadership, problem solving, decision making, governance, change, and learning; and surveys cases from three arenas (terrestrial, aquatic, and marine). The course takes a problem-oriented, contextual, and multi-method approach that offers students conceptual, practical, and professional benefits. It includes readings, lectures, discussions, workshops, exercises, oral presentations, guest speakers, individual and small-group assignments, and possibly a field trip and group project. In past years the course took a field trip to the Connecticut River system to evaluate region-wide conservation efforts, organized an international workshop focused on the Yellowstone to Yukon initiative, and assisted a major U.S. NGO plan for transboundary projects along the U.S.-Canadian border. Extensive student participation is required throughout. Susan G. Clark

**F&ES 828b, Comparative Environmental Law in Global Legal Systems** 2 credits. This course examines environmental law in the various legal systems of the world—from the common and civil law traditions to socialist laws, customary law, and Islamic law. In particular, environmental law and case studies from a number of countries are examined, including Australia, Canada, China, Europe, New Zealand, the United States, Singapore, and the states of Southeast Asia. The objective is to understand the scope and evolution

of national environmental law through the patterns of legislative, administrative, and judicial decision making in the various legal regimes. The systems of central/unitary governments are contrasted with those of federal systems. As corporations engage in the same manufacturing activities around the world, it is important that corporate managers and their legal advisers understand how these activities are regulated in the different legal systems. Additionally, as earth's natural systems are integrated throughout the biosphere, the effectiveness of one nation's environmental laws is complemented or undermined by the efficacy of another nation's comparable laws. Students are examined by a written paper that is a comparative study of some aspect of environmental law, involving at least two jurisdictions. Lye Lin Heng, Nicholas A. Robinson

**F&ES 829a/245a/EVST 245a/PLSC 146a, International Environmental Policy and Governance** 3 credits. The development of international environmental policy and the functioning of global environmental governance. Critical evaluation of theoretical claims in the literature, the reasoning of policy makers, the hypotheses of the instructor, and students' own suppositions. Introduction to analytical and theoretical tools used to examine and assess environmental problems. An emphasis on climate, forestry, and fisheries as case studies. Designing innovative mechanisms for global environmental governance. Benjamin Cashore

**F&ES 832a/MGT 618a, Entrepreneurial Business Planning** 3 credits. Entrepreneurship is all about starting and running one's own business. In order to focus thinking and to help assemble the needed people and financial resources, most entrepreneurs write a business plan for their new venture. One of the best ways to learn how to write a business plan is to learn by doing—a real plan for a real new venture. The work is hands-on, learn-by-doing in nature. Entrepreneurs should be flexible thinkers and highly motivated, with a large capacity for work. They must be persistent and able to thrive in an unstructured environment. Entrepreneurs should be confident self-starters with the ability to take the initiative, overcome obstacles, make things happen, and get things done. This course is for six teams of five students each, who write a business plan for their own real new startup company. Students enter their plans in the Yale Venture Challenge sponsored by the Yale Entrepreneurial Society. The scope of the work includes doing in-depth market, product, and competitor research; creating a strategy for a sustainable business; and writing and presenting a professional-quality plan (including a financial model and deal structure). Enrollment limited to thirty, by permission of the instructors. There is an information session in September explaining how to apply for this course; date TBA. David Cromwell, Maureen Burke

**F&ES 834a,b/LAW 20316/21321, Environmental Protection Clinic** 3 credits. A clinical program with weekly class sessions, alternating between seminars and project team meetings. The Environmental Law Clinic is designed to introduce students to several major environmental policy questions and a variety of methods of advocating for environmental improvement. Students work in small interdisciplinary teams (with students from the Law School and occasionally other parts of the Yale community), ten to twelve hours per week, for a single client organization, such as a local, national, or international environmental organization, a community group, or a local, state, or national governmental

entity. Students work on a specific project or series of projects that involve environmental law and policy issues, and that may include litigation, drafting legislation, organizing community action, developing media campaigns, participating in stakeholder working groups, and developing policy proposals. Students may propose projects and client organizations, subject to approval by the instructor. Katherine Kennedy

**F&ES 837b, Seminar on Leadership in Natural Resources and the Environment** 3 credits. This seminar explores the qualities, characteristics, and behaviors of leaders in the fields of natural resources, science, and management. Through lectures, guest speakers, and individual and team projects, students analyze the attributes of leadership in individuals and organizations. They examine leaders and organizations and develop skills and techniques for leading and for assessing various organizations' leadership strengths and weaknesses. The class travels to Washington, D.C., and meets with leaders in the policy, environmental, industry, and information segments. Through this experience, students have the opportunity to assess their own leadership capabilities and identify means to improve them. Chadwick D. Oliver

[**F&ES 843b/AMST 839b/HIST 743b, Readings in Environmental History** 2 credits. Readings and discussion of key works in environmental history, predominantly drawing from U.S. historiography. The course explores and compares different explanations for historical environmental change, including ecological, economic, political, cultural, and social interpretations. Paul Sabin]

**F&ES 849b, Natural Resource Policy Practicum** 3 credits. This practicum provides opportunities for students to participate in the analysis and development of current issues/policies affecting natural resources in the United States and to learn about contemporary issues affecting natural resources and the environment. Students are organized into teams and assigned a number of current policy issues for analysis and discussion. The identified issues originate from discussions with staff of national environmental organizations, Congressional offices, and federal natural resource agencies that serve as "clients" for the purposes of this practicum. Students are required to communicate directly with the organizations and individuals seeking policy analysis assistance, to conduct research and interdisciplinary analysis of the subject, to prepare a report and recommendations for the identified client, and to brief the client on the product of their analysis. Each team is responsible for a minimum of two policy analysis projects during the term. Following an initial organizational meeting, student teams meet with the instructor once a week to provide updates on projects and to discuss current national and international issues and concerns affecting natural resources and the environment. James R. Lyons

**F&ES 850a, International Organizations and Conferences** 3 credits. This course, taught in the fall term, focuses on an international conference or symposium and the organization that sponsors the event. Both theoretical and clinical approaches are used. The course studies the mission of the organization and the role of the conference. Students prepare individual and group papers suitable for presentation at the conference. Every attempt is made to have the students participate in the conference, even if it occurs in the next term, but attendance is not guaranteed. The class has studied and participated in the 5th World Parks Congress, Durban, South Africa, 2003; the World Conservation

Congress in Bangkok, Thailand, 2004, and in Barcelona, Spain, 2008; and the UNEP Council Meeting, Nairobi, Kenya, 2005. In 2009, 30 students participated in the COP 15 in Copenhagen, Denmark. This course is co-taught with an advanced doctoral student or visiting faculty member who brings knowledge of the specific organization and subject matter being studied. Gordon T. Geballe

**F&ES 851a,b, Environmental Diplomacy Practicum** 3 credits per term. This course aims to provide experiential learning of environmental and sustainable development issues at the international level. Students are required to participate in weekly seminars at F&ES and internships at U.N. Missions in New York City (minimum one day per week). Weekly discussions focus on the decision-making process in the relevant international bodies regarding climate change, forestry, marine environment, fisheries, and renewable resources. Students are expected to conduct research and present findings on these and related topics. Work of internships at the U.N. Missions of Small Island Developing States and Least Developed Countries in New York involves research, drafting papers, attending meetings, and/or developing specific projects on selected topics, and starts in mid-September. Students are also required to prepare a substantive research paper or project document on topics of their choice at the end of the term. Enrollment requires application, interview, and approval of Professor Lee. Roy S. Lee, Gordon T. Geballe

**F&ES 852a,b, Business and the Environment Consulting Clinic** 3 credits. In this class, students work as a team on a specific project for an external organization. It provides students with an opportunity to apply their knowledge of business and environmental issues to real-life situations. It also provides a unique opportunity for students to manage a real-life consulting client engagement. Examples of projects include (1) developing a corporate sustainability scorecard for an organization's suppliers; (2) researching the market opportunity for a new environmentally friendly product or service; and (3) recommending operational improvements around energy usage, waste disposal, etc. The intent is to provide a "capstone" experience, calling for the application of skills and tools learned from previous classes. Class times alternate between team meetings and lectures. Lectures address topics such as project management, environmental science and technology issues, business evaluation and financial valuation, and influencing environmental policy, and include guest speakers from organizations tackling environmental issues. The clinic is open to both F&ES and SOM students. Prerequisites for F&ES students applying to the clinic are at least one of the following courses (or equivalent experience): F&ES 50021a, Financial Analysis for Land Management; F&ES 80019a, Entrepreneurial Business Planning; F&ES 85030a, Private Investment and the Environment; F&ES 96006a, Greening the Industrial Facility; F&ES 96112a, Corporate Environmental Management and Strategy; or F&ES 94110a, Public and Private Management of the Environment. SOM students need to have completed their first term at the School. Maureen Burke

**[F&ES 853a/270a/INRL 680a/MGT 697a, Capitalism: Success, Crisis, and Reform** 3 credits. Examination of capitalism as it functions in practice, with extensive use of business cases. The role of capitalism in generating wealth and innovation is unprecedented in history. Negative consequences of capitalist development such as radical inequality,

disruption of the natural environment, and intermittent social crises. Background ideas from thinkers such as Adam Smith, Karl Marx, Joseph Schumpeter, Alfred Chandler, and Milton Friedman. Douglas W. Rae]

**F&ES 860b, Understanding Environmental Campaigns and Policy Making: Strategies and Tactics** 3 credits. This course taught from a practitioner's perspective helps the student to understand how the advocacy community operates to advance policy making in the environmental arena by exposing students to well structured case examples from the environmental policy-making world of the past decade. Michael Northrop

**F&ES 895a/MGT 684a, Management and the Environment: Issues and Topics** 3 credits. This course provides a basic introduction to both problems and opportunities that face managers today and well into the future. Issues included in the course are some essentials of environmental science—including a discussion of the ecological and public health viewpoints and their contrasts with the economic one; environmental politics—with illustrations of special-interest influences, public perceptions, successful bargaining, negotiating, and conflict resolution; and several emerging environmental management approaches and movements—including “green boards” and accounting, industrial ecology, and other techniques designed to improve sustainability. Several more comprehensive approaches such as those seeking a “Triple Bottom Line,” “The Natural Step,” or a life “Beyond Gray Pinstripes” are also described. The long forecasting horizons associated with many environmental issues, measured in decades, centuries, and sometimes longer, require different methods and procedures than those usually encountered in management curricula. An introduction to scenarios, long-range planning, and modeling tools and techniques is provided. Garry Brewer

#### SOCIAL AND POLITICAL ECOLOGY

**F&ES 831b, Society and Natural Resources** 1–3 credits. This research seminar explores the relationship between society and natural resources. Although the specific topic of the seminar varies from year to year, the consistent underlying theme is an examination of how societies organize themselves, use natural resources, and affect their environment. In past years, the seminar focused on energy and the environment, interdisciplinary problem solving, and other topics. The seminar overall looks at people seeking values using natural resources through institutions. This relationship (people, values, natural resources, and institutions) has been extensively written about and discussed in diverse fields. The last seminar examined the relationship of human dignity as a universal value goal, professionalism and practice, and sustainability as an applied notion. Other versions of the seminar have looked at conceptual (theoretical) models about society and natural resources from policy sciences, social ecology, political ecology, and other knowledge areas. Still other seminars focused on “Bridging Local and Professional Knowledge in Environmental Sustainability” and “War and the Environment.” The next seminar may be on “environmental psychology” or another topic of interest to students and the instructor, as yet to be determined. Guests and students make presentations and carry out discussions each week. Readings, active participation, and student papers are required. Susan G. Clark

**F&ES 836a/ANTH 541a/HIST 965a/PLSC 779a, Agrarian Societies: Culture, Society, History, and Development** 3 credits. An interdisciplinary examination of agrarian societies, contemporary and historical, Western and non-Western. Major analytical perspectives from anthropology, economics, history, political science, and environmental studies are used to develop a historically grounded account of the transformation of rural societies. Four hours lecture plus discussion sections. James Scott, Michael McGovern, Elisabeth Wood

**F&ES 838a/ANTH 517a, Producing and Consuming Nature** 3 credits. This intermediate to advanced seminar brings together readings in social theory with ethnographic case studies to examine the changing means by which elements of the natural world are drawn into circuits of production, exchange, and consumption. How do environmental goods become conceptualized as natural resources for human ends, and, more specifically, remade into commodities that circulate in global markets? The course explores efforts to rethink classical theories of economic processes in light of shifting forms of natural resource transactions and use. Topics examined include agrarian and fisheries transformations; the rise of green consumerism and product certification regimes; and the market valuation of ecosystem goods and services. Course texts are drawn from anthropology and related disciplines, like cultural geography, sociology, and science and technology studies. Basic knowledge of social science is a prerequisite. Karen Hébert

**F&ES 839a/ANTH 597a, Social Science of Development and Conservation** 3 credits. This course is designed to provide M.E.M., M.E.Sc., and doctoral students with the opportunity to master the essential social science literature on sustainable development and conservation. Social science makes two contributions to the practice of development and conservation. First, it provides ways of thinking about, researching, and working with social groupings—including rural households and communities, but also development and conservation institutions, states, and NGOs. This aspect includes relations between groups at all these levels, and the role of power in these relations. Second, social science tackles the analysis of the knowledge systems that implicitly shape development and conservation policy and impinge on practice. In other words, we analyze communities but also our own ideas of what communities are. We also examine our ideas about sustainable development and conservation. Finally, we attempt to look at development and the institutions that implement it from the perspective of communities. The emphasis throughout is on how these things shape the practice of sustainable development and conservation. Case studies used in the course have been balanced as much as possible between Southeast Asia, South Asia, Africa, and Latin America; most are rural and third world (largely due to the development and conservation focus). The course includes readings from all non-economic social sciences. Readings are equally focused on conservation and development. The goal of the course is to stimulate students to apply informed and critical thinking (which means not criticizing others but questioning our own underlying assumptions) to whatever roles they may come to play in sustainable development and conservation, in order to move toward more environmentally and socially sustainable projects and policies. The course is also designed to help students shape future research by learning to ask questions that build on but are unanswered by

the social science theory of conservation and development. A prerequisite for F&ES 840b. Three hours lecture/seminar. Carol Carpenter

**F&ES 840b/ANTH 598b, Advanced Readings: Social Science of Development and Conservation** 3 credits. An advanced seminar on the social science theory of sustainable development and conservation, designed as an M.E.M. capstone course and to provide theory for M.E.Sc. and doctoral students to use to place their own work in a wider theoretical context in analyzing and writing up their research. The course traces the conceptual history of the social science theory of sustainable development and conservation, focusing on theories of discursive power, governmentality, and capitalism. It examines relations between these theories, alternative theories, and how this history influences the field. The course covers the works of Michel Foucault most relevant to development and conservation, important social scientists who have used Foucault's ideas (e.g., James Ferguson, Timothy Mitchell, Tania Li), alternative theories of power (e.g., James Scott), applications of Foucault's ideas to development (e.g., Akhil Gupta, Michael Watts), applications of Foucault's ideas to the environment (e.g., Arturo Escobar, Arun Agrawal, Timothy Luke, Bruce Braun), early theorists of capitalism (Karl Marx, Georg Simmel, Karl Polanyi, Raymond Williams), political ecologists and socialist ecologists who apply Marxism to the environment (Eric Wolf, James O'Connor), Foucault and others on disciplined labor (e.g., E.P. Thompson, Aiwa Ong), and writers on the environmental effects of the transition to capitalism (Tania Li, Anna Tsing). Students are expected to use the course to develop, and present in class, their own research and writing. Prerequisite: F&ES 520a or F&ES 839a. Three hours lecture/seminar. Enrollment limited to twelve. Carol Carpenter

**F&ES 845b, Energy Issues in Developing Countries** 3 credits. This graduate course is designed to provide students with an opportunity to explore the interrelationships among energy, environment, economic development, and social welfare in developing countries. Throughout the course, we consider the role that people, industries, and state institutions play in supplying and consuming energy-based resources in countries of sub-Saharan Africa, Latin America, and much of Asia. The goal of the course is to understand the many ways in which energy is used by the majority of the world's population and to examine some of the tensions that exist among environmental sustainability, economic growth, and quality of life within the context of non-Western, nonindustrialized, and/or industrializing populations. Class meetings consist of a short lecture followed by discussion; therefore reading and participation are critical components of the course and students are evaluated based on their contributions to the discussion. Students are strongly encouraged to have prior knowledge of basic energy issues. Robert Bailis

**F&ES 846b, Topics in Environmental Justice** 3 credits. In this seminar we explore global environmental issues from a perspective that foregrounds questions of social justice. The field of environmental justice asks for fair treatment of all people regardless of race, ethnicity, gender, economic capacity, national origin, and education level with respect to environmental politics and their implementations. In this and other aspects, the environmental justice perspective differs from traditional environmental philosophies in that it seeks to combine a concern for the natural world with a consciousness of ethnic, class, and

gender discrimination. From this vantage point it is argued that throughout the world there are marked and increasing disparities between those who have access to clean and safe resources and those who do not. This course is based on two fundamental premises: All individuals and communities, regardless of their social or economic conditions, have the right to a clean and healthy environment; and there is a connection between environmental exploitation, human exploitation, and social justice. With these premises as a starting point, we first define “What is environmental justice?” Then we turn to more difficult questions such as: Why and through what political, social, and economic processes are some people denied this basic right to a clean and safe environment? The course draws on both international and domestic case studies. Amity Doolittle

**F&ES 848a, Climate Change: Impacts, Adaptation, and Mitigation** 3 credits. This is an interdisciplinary graduate course designed for students who are familiar with the basic science of climate change and the international negotiations that have occurred since the drafting of the United Nations Framework Convention on Climate Change (UNFCCC) in 1992. The course draws on diverse fields ranging from economics to international relations and energy systems analysis. We examine climate change from an international perspective, with particular emphasis placed on the world’s developing countries. The course opens with a brief review of the latest scientific findings, the most recent developments in climate change policy, and an overview of common tools that analysts use to examine the climate question. We then devote roughly half of the term to examining climate change impacts and adaptation and half to mitigation. In looking at impacts and adaptation, we examine social and biophysical vulnerabilities to environmental change and explore the policies and measures that have been proposed to minimize the impacts of climate change. In examining mitigation, we discuss technological options, policies, and socio-economic impacts of mitigative measures. The course has a mixed lecture-discussion format. Participation during discussion is strongly encouraged and is incorporated in student evaluations. In addition, there are several guest speakers and potentially one field trip to the United Nations. Course enrollment limited to 25. Robert Bailis

**F&ES 854b, Institutions and the Environment** 3 credits. One of the most critically important questions facing those seeking to promote environmental stewardship of the world’s biosphere is to understand better what types of local, domestic, global, and non-state institutions might best promote meaningful and enduring environmental problem solving. The purpose of this seminar is to review key works in political science and related disciplines on institutions to assess their direct or indirect implications for environmental governance and effectiveness. The course assesses perspectives from rational choice, historical, and sociological institutionalism that have permeated comparative public scholarship; the treatment of institutions with international relations literature; the attention that common property scholars have placed on understanding the development of local institutions; and the emergence and proliferation of private governance institutions. We are curious about understanding the theoretical underpinnings and scholarly debates about how support for such systems occurs. We also assess the various theories against empirical evidence that assess their support and influence ameliorating key resource and environmental problems. Benjamin Cashore

**[F&ES 856b/REL 876b, Environmental Ethics** 3 credits. This course surveys major ethical frameworks for understanding and responding to environmental problems. It examines key concepts and approaches, including intrinsic value, nonanthropocentrism, social constructions of nature, economic consequentialism, virtue, ecofeminism, pragmatism, place ethics, and deep ecology. We test those concepts in relation to specific issues, including climate change, environmental justice, biodiversity loss, ecological restoration, and animal welfare. Willis Jenkins]

**[F&ES 857b, Urbanization, Global Change, and Sustainability** 3 credit seminar. The conversion of land surface to urban uses is one of the most profound human impacts on the global biosphere. Urban growth and associated changes in human activities on the land (land use) and in the physical attributes of earth's surface (land cover) have profound environmental consequences, including local and regional climate change, loss of wildlife habitat and biodiversity, soil erosion, and a decrease in ecosystem services. Aggregated globally, these effects constitute the most significant human impacts on the functioning of earth as a system. The impacts of urban growth and land-cover change will affect both earth's biosphere and the quality of human life for generations to come. The interactions between human and ecological systems influence social marginalization and the vulnerability of people and places. This seminar examines the interactions and relationships between urbanization and global change at local, regional, and global scales. Topics include urban land-cover change, cities and local climate, urban vulnerability, urban diets and the challenges for agriculture, and the spatial evolution of cities. Karen Seto]

**F&ES 858a/REL 768a, Environmental Theologies** 3 credits. This course interprets theological responses to environmental problems and examines major tensions in the relation of Christianity and ecology. Reading theological strategies of environmental response – including ecojustice, stewardship, creation spirituality, and ecofeminism – the seminar examines how communities rethink their traditions as they interpret and address environmental problems. Because those theological communities include Catholic (including magisterial and liberationist), Protestant (including evangelical and anabaptist), and Eastern Orthodox, the course develops a cohesive overview of Christianity's changing relationship to its ecological context. Willis Jenkins

**F&ES 859b, American Environmental History and Values** 3 credits. The purpose of this course is to provide an overview of major figures, ideas, and institutions in American environmentalism. The course explores the development of environmental awareness in America as distinct historical strands with diverse ethical concerns. It begins with an examination of Native American perspectives on land and biodiversity. We then focus on writings from Thoreau and Emerson to explore early American voices in the discourse on “nature.” To investigate the emergence of conservation and forest management, readings are selected from Pinchot, Muir, and Leopold. The beginnings of urban and park planning are considered in relation to these positions on the management of nature. Next, the environmental movements from the 1960s onward are surveyed in readings from the social sciences and humanities. We then explore the major debates in environmental ethics and the broader reach for global ethics. Writings celebrating biodiversity are

examined along with the emergence of conservation biology as an example of engaged environmental scholarship. Finally, new efforts to widen the interdisciplinary approaches toward environmental issues are introduced in investigating world religions and ecology as well as cosmology and ecology. John Grim, Mary Evelyn Tucker

**F&ES 861a, American Indian Religions and Ecology** 3 credits. This course focuses on the North American continent from the standpoint of religion and ecology. A cultural-historical method is also used in conjunction with comparative-thematic and worldview approaches. These approaches emphasize embodied knowledge as a way of understanding native continuities in relationship with bioregions over time. Comparisons are also drawn between Native American traditions, and the concept of “lifeway” is developed as central to the course. In highlighting indigenous ways of knowing, the course focuses on conceptual metaphors of sharing, holism, reciprocity, and personhood. These modes of indigenous metaphoric thought are examined in terms of diverse rituals and oral statements describing the natural world. Mary Evelyn Tucker, John Grim

[**F&ES 862b, Advanced Seminar in Social and Political Dimensions of Climate Change** 3 credits. This seminar explores advanced topics in social and political aspects of climate change. Topics vary from year to year and may include societal impacts of climate change, vulnerability and adaptation, ethics and justice, economics, international relations, or climate change mitigation strategies. Students work individually or in small groups and focus intensively on a single topic for the term. When possible, the topic(s) that students work on are derived from real projects and developed in conjunction with outside organizations that are actively working on climate-related issues. Each year, the course may involve a trip to the annual climate change negotiations (COP XX). There, students have an opportunity to see how the topics that they studied are debated at the highest level of global environmental governance. Students also have a chance to attend numerous side events, where civil society groups, multilateral organizations, and the private sector converge to discuss the latest developments in climate policy. Students may have an opportunity to present at these events. Robert Bailis]

**F&ES 869b/ANTH 572b, Disaster, Degradation, Dystopia: Social Science Approaches to Environmental Perturbation and Change** 3 credits. This is an advanced seminar on the long tradition of social science scholarship on environmental perturbation and natural disasters, the relevance of which has been heightened by the current global attention to climate change. The course is divided into three main sections. The first consists of central questions and debates in the field: social dimensions of natural disasters; the discursive dimensions of environmental degradation, focusing on deforestation; and the current debate about the relationship between resource wealth and political conflict, focusing on the “green war” thesis. The second section focuses on anthropological and interdisciplinary approaches to climate change and related topics, encompassing canonical anthropological work on flood and drought; cyclones, El Niño, and interannual cycles; ethno-ecology; and risk. Additional lectures focus on interdisciplinary work. The final section of the course consists of the classroom presentation of work by the students and Teaching Fellow. Prerequisite: F&ES 520a or F&ES 882b. Three-hour lecture/seminar. Enrollment limited to twenty. Michael R. Dove

**[F&ES 872a/REL 870a/RLST 872a, Seminar on World Religions and Ecology** 3 credits. This seminar explores the understanding of the emerging relationships of world religions to our global environmental crisis. Both the problems and the promise of these relationships are acknowledged. Religions are containers of symbolic language that often evoke nature's processes and reflect nature's rhythms. For many years science, engineering, policy, and law alone were considered indispensable for understanding and resolving environmental problems. We now have abundant knowledge from these disciplines about environmental issues, but still not sufficient will to change human behavior. Religion, spirituality, ethics, and values can make important contributions to address complex environmental issues. This course explores those contributions. Mary Evelyn Tucker, John Grim]

**[F&ES 875a, Global Ethics and Global Problems** 3 credits. Especially fitting for those with an interest in international relief and development, and environmental or humanitarian advocacy, this seminar examines attempts to establish globally shared priorities for addressing global social problems. Readings include defenses and criticisms of human rights, human capacities, economic development, and sustainability, as well as charters proposing a shared global ethic. Participants write papers on a global problem related to their own experience or research interests. Willis Jenkins]

**F&ES 876a/REL 810a/RLST 875a, Indigenous Religions and Ecology** 3 credits. This course explores how particular indigenous peoples relate to local bioregions and biodiversity. Opening with an examination of such terms as *indigenous*, *religion*, and *ecology*, the course investigates religious studies and ethnography related to small-scale societies and the many ways in which they relate to local bioregions and biodiversity. The course examines indigenous ethnic diversity and cultural relationships to place, and the ways values associated with physical places are articulated in symbols, myths, rituals, and other embodied practices. The emphasis on place and religious ecology in this course illustrates what indigenous peoples could bring to studies in environmental culture. Finally, this course necessarily involves questions of environmental justice, namely, the imposition of environmentally damaging projects on a people whose voice in decision making is diminished or eliminated. John Grim

**F&ES 877a/ANTH 561a, Anthropology of the Global Economy for Development and Conservation** 3 credits. This seminar explores topics in the anthropology of the global economy that are relevant to development and conservation policy and practice. Anthropologists are often assumed to focus on micro- or local-level research, and thus to have limited usefulness in the contemporary, global world of development and conservation policy. In fact, however, they have been examining global topics since at least the 1980s, and little current anthropological research is limited to the village level. More importantly, the anthropological perspective on the global economy is unique and important. This course examines the topics that make up this perspective, including how the rural, third-world household engages with the global economy (and how we understand the hybrid and multiple aspects of contemporary household economies); how the gendered division of labor and power over the allocation of labor plays out when migrant labor is added to the picture; how microcredit (the primary development solution to poverty)

differs from traditional savings associations, and its variable effects across cultures; how capitalism dis-embedded economy from society, producing an “immoral” economy (and the history of theories of the moral economy); how property rights and the efforts to retain them shape indigenous livelihoods and the division of labor, as parks and private property claim land; how “nature” is commoditized, and how this creates poverty as well as the degradation of natural resources; and finally, what the capitalist frontier in the third world looks like, and how it reshapes landscapes and societies. Readings for the course come from the subfields of environmental anthropology, economic anthropology, the anthropology of development, and the anthropology of gender. No prerequisites. Three hours lecture/seminar. Carol Carpenter

**F&ES 878a/ANTH 504a, Anthropology of Climate and Climate Change: From Historic Origins to Current Debates** 3 credits. This is a seminar on the history of anthropological approaches to the study of climate and climate change. It begins with an overview of classical works and early anthropology on the broad relationship between climate and culture, including insights from the arts and letters. The second section concerns the impact of climatic perturbation and change on society, focusing on issues of resilience vs. vulnerability, adaptation vs. collapse, and the politics of climate disasters. Section three deals with social systems of knowledge pertaining to climate, including ideologies of climate in particular societies, national politics and the circulation of climate knowledge, and the current politics of science of climate change involving the global North and South. The final section of the course focuses on questions of methodology, in particular perspectives from ethno-climate, comparative study, and the unique status of islands, and special questions raised about the role of the scholar in studying climate. The readings are largely case-study based and are drawn from the draft of a reader on this topic that the instructor is preparing for publication. No prerequisites. Two-hour lecture/seminar. Enrollment limited to twenty. Taught in alternate years. Michael R. Dove

**[F&ES 879b/REL 817b/RLST 872b, World Religions and Ecology: Asian Religions]** 3 credits. This course explores the various ways in which religious ideas and practices have contributed to cultural attitudes and human interactions with nature. Examples are selected from Hinduism, Buddhism, Confucianism, and Daoism. The course examines such topics as symbols, images, and metaphors of nature in canonical texts; views of the divine as transcendent to the world; the indwelling of the sacred in the earth; the ethics of using and valuing nature; ritual practices that link humans to the natural world; and cosmology as orienting humans to the world and embedding them in place. Mary Evelyn Tucker, John Grim]

**[F&ES 882b/ANTH 582b, Households, Communities, Gender (for Development and Conservation)]** 3 credits. The implementation of development and conservation projects involving people requires an understanding of households, communities, and gender; unfortunately, policy is laden with mistaken assumptions about these social units. This course examines both the anthropology of households, communities, and gender, and common assumptions about them in development and conservation. Economic and political aspects of relations within these units are intimately linked, and are examined together. Important global variations in the structure of households, communities, and

gender exist, and are explored in the course. The structure of households, communities, and gender in any particular locality influences the economic and political relation with its region, nation, and the world system – with essential implications for development and conservation. The course aims to study local social units in order to understand their importance for regional, national, and global development and conservation. The goal is to encourage future policy makers and implementers to examine their assumptions about society, and to think more critically about the implications of these social units (and their variations around the world) for development and conservation. No prerequisites. Three hours lecture/seminar. Carol Carpenter]

**F&ES 892a/ARCH 4021a, Introduction to Planning and Development** 3 credits. This course demonstrates the ways in which financial and political feasibility determine the design of buildings and the character of the built environment. Students propose projects and then adjust them to the conflicting interests of the financial institutions, real estate developers, civic organizations, community groups, public officials, and the widest variety of participants in the planning process. Subjects covered include housing, commercial development, zoning, historic preservation, parks and public open space, suburban subdivisions, planned communities, and comprehensive plans. Alexander Garvin

#### HEALTH AND ENVIRONMENT

**F&ES 891a/EMD 572a, Ecology and Epidemiology of Vector-Borne and Zoonotic Diseases** 3 credits. Diseases transmitted to humans by arthropods (vector-borne) or animal reservoirs (zoonotic) constitute the majority of globally (re)emerging infectious diseases. The purpose of this course is to explore factors underlying the risk to humans of acquiring vector-borne and zoonotic diseases (VBZD) like malaria, dengue, West Nile virus, Lyme disease, rabies, hantavirus, and so on. Students learn how human risk for these diseases can be described and predicted by understanding the ecology of vectors and reservoirs and the factors allowing for maintenance and transmission of pathogens. The course utilizes a combination of lectures, discussion of primary literature, practical exercises on risk mapping, and guest speakers. Maria Diuk-Wasser

**F&ES 893b/EHS 511b, Applied Risk Assessment** 3 credits. This course introduces students to the nomenclature, concepts, and basic skills of quantitative risk assessment (QRA). The goal is to provide an understanding necessary to read and critically evaluate QRA. Emphasis is on the intellectual and conceptual basis of risk assessment, particularly its dependence on toxicology and epidemiology, rather than its mathematical constructs and statistical models. Specific cases consider the use of risk assessment for setting occupational exposure limits, establishing community exposure limits, and quantifying the hazards of environmental exposures to chemicals in air and drinking water. Jonathan Borak and Cheryl Fields

**F&ES 896a/EHS 503a, Introduction to Toxicology** 3 credits. This course introduces students to the concepts and nomenclature of toxicology. Emphasis is placed on the absorption, distribution, metabolism, and elimination of foreign toxic materials. The goal is to provide a fundamental understanding of important toxicological principles and their relevance to the more general study of human health. The course utilizes case studies

that require students to apply their knowledge of toxicologic concepts and processes to refine issues and solve problems in epidemiology and public health. The course includes a series of guest lectures by prominent content experts who illustrate the importance of general toxicological principles as applied to specific classes and types of toxicants and exposures. Jonathan Borak, Cheryl Fields

**F&ES 897b/EHS 508b, Assessing Exposures to Environmental Stressors** This course examines human exposure to environmental stressors as it applies to environmental epidemiology and risk assessment. Indirect and direct methods of assessing exposures are reviewed and case studies are presented. Brian Leaderer

[**F&ES 898b/EHS 585b, The Environment and Human Health** 3 credits. This course provides an overview of the critical relationships between the environment and human health. The class explores the interaction between health and different parts of the environmental system including water, indoor and outdoor air, environmental justice, and occupational health. Other topics include exposure assessment, case studies of environmental health disasters, links between climate change and health, and integration of scientific evidence on environmental health. Students learn about current key topics in environmental health and how to critique and understand scientific studies. The course incorporates lectures and discussion. Michelle Bell]

#### INDUSTRIAL ECOLOGY, ENVIRONMENTAL PLANNING, AND TECHNOLOGY

**F&ES 816b, Transportation and the Urban Future** 3 credits. The focus of this course is on the environmental impacts of alternative transportation and urban land use policies, taught from a policy maker's perspective. It begins with a historical overview, examining the profound changes in the structure of cities following the advent of the automobile. The course then focuses on present and future environmental impacts—such as air pollution, greenhouse gas emissions, and urban sprawl—resulting from the exponential growth in motor vehicles, particularly in developing country cities, and examines alternative scenarios for mitigating these impacts. Additional topics include the future of public transit in the United States and the differing approaches to transportation and land use planning in various European cities; in-depth case studies of the success stories in urban transit in the developing world, particularly in regard to bus rapid transit systems (BRTs) (e.g., Bogotá and Curitiba); and the range of options for transporting the two billion new urban inhabitants to be added to the world's cities in the next quarter-century. The course also examines policies to create compact, regional cities through the integration of transportation and land use planning, and focuses on next and future steps, including congestion pricing, and development of low-carbon fuel infrastructure and advanced vehicle technologies. Active student participation is required, including individual class presentations and a final group project. Ellen Brennan-Galvin

**F&ES 842a, Cities and Sustainability in the Developing World** 3 credits. Most population growth in the twenty-first century will occur in the urban areas of the developing world, which are expected to increase by two billion inhabitants by 2030. Urban living poses environmental hazards, which affect the current population and especially the poor, through immediate, local impacts on health and safety. It also causes environmental

degradation, with longer-term, wider-area, and intergenerational consequences. Variations in the incidence and relative severity of a range of environmental problems across cities at different levels of development suggest differences in priorities for action. The massive new investment in the capital stock of cities required for the doubling of urban population by 2030 will be critical to environmental outcomes. Using a number of city case studies, the course highlights local solutions, as well as new technologies for monitoring, planning, and managing urban growth. Active student participation is required, including individual class presentations and a final group project. Ellen Brennan-Galvin

**F&ES 883b, Advanced Seminar: Business Strategy and Industrial Ecology** 3 credits. This research seminar investigates industries and industrial companies in which economic success is tied to efficient and effective resource availability and use. Prerequisites: two completed industrial environmental management courses, four business courses, and/or special permission from the instructor. Marian R. Chertow

**F&ES 884b/ENAS 645b, Industrial Ecology** 3 credits. Industrial ecology is an organizing concept that is increasingly applied to define the interactions of today's technological society with natural and altered environments. Technology and its potential for change are central to this subject, as are implications for government policy and corporate response. The course discusses how industrial ecology serves as an environmentally related framework for technology, policy, and resource management in government and society. Marian R. Chertow, Thomas E. Graedel

**F&ES 885b/ENAS 660b/360b/ENVE 360b, Green Engineering and Sustainability** 3 credits. This course focuses on a green engineering design framework, the Twelve Principles of Green Engineering, highlighting the key approaches to advancing sustainability through engineering design. The class begins with discussions on sustainability, metrics, general design processes, and challenges to sustainability. The current approach to design, manufacturing, and disposal is discussed in the context of examples and case studies from various sectors. This provides a basis for what and how to consider when designing products, processes, and systems to contribute to furthering sustainability. The fundamental engineering design topics to be addressed include toxicity and benign alternatives, pollution prevention and source reduction, separations and disassembly, material and energy efficiencies and flows, systems analysis, biomimicry, and life cycle design, management, and analysis. Matthew Eckelman

**F&ES 886a/380a, Greening Business Operations** 4 credits. The course examines various industries from engineering, environmental, financial perspectives, and emphasizes increasingly detailed analyses of corporate environmental performance. Methods are drawn from operations management, industrial ecology, and accounting and finance to investigate industrial processes, the potential to pollute, and the environmental and business implications of various sustainability approaches. Life cycle assessment and environmental cost accounting are typical tools that are taught; the class also involves several field trips to companies. Thomas E. Graedel, Julie B. Zimmerman, Marian R. Chertow

**F&ES 888a, Ecological Urbanism** 3 credits. This course lays the groundwork for students from the School of Architecture and F&ES to collaboratively explore and define

ecologically based urban design. The course consists of three phases—an overview, a research and analysis phase, and a production phase. During phase one, students review existing urban ecological data and current methods for analyzing urban ecosystems on multiple scales. Students also study precedents for ecological urbanism such as manufactured nature, green infrastructure, and landscape urbanism as well as broader ecological concepts applied to coupled human-natural systems. During phase two, interdisciplinary teams select urbanization processes as case studies and work together focusing on history, invention, ad hoc growth, planning, and design. Students identify existing urban data on their case studies and seek innovative strategies to generate further data. Teams work to define their case studies in terms of urban ecology. During the final segment, students build on their site analysis exercises to generate urban design proposals. Proposals are ecologically driven and explore options for the kinds of urban forms or aesthetics that result from integrating ecological data and analysis with city planning and design. Alexander J. Felson

## F&ES UNDERGRADUATE COURSES

### *Ecology*

#### ECOSYSTEM ECOLOGY

**F&ES 275a, Ecosystem Pattern and Process** See F&ES 740a for description.

#### WILDLIFE ECOLOGY AND CONSERVATION BIOLOGY

**F&ES 315a/E&EB 115a, Conservation Biology** An introduction to the basic ecological and evolutionary principles underpinning efforts to conserve the earth's biodiversity. These principles are then examined in the context of efforts to halt the rapid increase in disappearance of both plants and animals. Case studies are examined in detail. While some sociological and economic issues are discussed, the emphasis is on the biological aspects of these crucial problems. Jeffrey Powell

**F&ES 340b, Community Ecology** See F&ES 740b for description.

**F&ES 365a/E&EB 365a, Landscape Ecology** See F&ES 500a for description.

[**F&ES 370a/E&EB 370a, Aquatic Ecology** See F&ES 738a for description.]

### *Forestry*

#### FOREST BIOLOGY

**F&ES 260a, Structure, Function, and Development of Trees and Other Vascular Plants**  
See F&ES 654a for description.

[**F&ES 261Lb, Laboratory for Structure, Function, and Development of Trees and other Vascular Plants**]

### *Physical Sciences*

#### ENVIRONMENTAL CHEMISTRY

**F&ES 307b/EVST 307b, Organic Pollutants in the Environment** See F&ES 706b for description.

**F&ES 344b, Aquatic Chemistry** See F&ES 743b for description.

**F&ES 443a, Environmental Chemical Analysis** See F&ES 743a for description.

#### WATER RESOURCES

[**F&ES 440b/EVST440b, Environmental Hydrology** See F&ES 714b for description.]

### *Quantitative and Research Methods*

**F&ES 290a/EVST 290a, Geographic Information Systems** 3 credits. This course introduces students to the use of digital geographic information-processing tools and techniques for the preparation, presentation, and interpretation of cartographic data in a variety of settings associated with environmental science and management. It offers practical instruction on compiling, editing, and adjusting digital maps; displaying those maps in two, three, and four dimensions; analyzing geospatial patterns and processes; and developing specialized data-processing capabilities. Weekly seminar sessions and intervening computing assignments lead to the development of individually selected student projects. Readings are in the form of heavily illustrated lecture notes distributed online. No previous experience is required. Dana Tomlin

**GEOL 362b, Remote Sensing of the Earth from Space** See F&ES 726a for description.

### *Social Sciences*

#### ENVIRONMENTAL POLICY

[**F&ES 245b, International Environmental Policy and Governance** See F&ES 829b for description.]

**F&ES 255b/EVST 255b, Environmental Politics and Law** This course explores the politics, policy, and law associated with attempts to manage environmental quality and natural resources. Themes of democracy, liberty, power, property, equality, causation, and risk are examined. Case histories include air quality, water quality and quantity, pesticides and toxic substances, land use, agriculture and food, parks and protected area, and energy. John P. Wargo

**F&ES 270a/EP&E 371a/INTS 330a/PLSC 270a, Capitalism: Success, Crisis, and Reform** See F&ES 853a for description.

#### SOCIAL AND POLITICAL ECOLOGY

**F&ES 285a/EVST 285a, Political Ecology: Nature, Culture, and Power** An advanced seminar on the relationship between society and the environment, specifically focusing on literature from the growing field of political ecology. Rather than focusing on the supposedly closed relationship between a society and their ecosystem (as human ecologists tend to) or solely on events occurring in the larger political economy and their effect on the environment, practitioners of political ecology try to explain environmental conflicts in terms of the particularities of place, culture and history. The nuances of local-level details are set in relation to larger events occurring in the broader political economy since both local and nonlocal factors influence the decisions of a resources user. The field is predicated on the assumption that our environmental problems are often common, but

their causes are complex and changing; therefore solutions must be specific to time and place. Amity Doolittle

**F&ES 384a/ANTH 382a/EVST 345a, Environmental Anthropology: From Historic Origins to Current Debates** This is an upper-division undergraduate seminar on the history of the anthropological study of the environment. It is organized around a number of key, persisting themes in the field, including the nature-culture dichotomy, ecology and social organization, methodological debates, the politics of the environment, and knowing the environment. Each theme is examined through writings that are theoretically important but also readable, interesting, and relevant. Readings are grouped to stimulate critical thinking and good discussion about anthropology and the environment. The core text for the course is *Environmental Anthropology* (Dove and Carpenter, eds., 2007, Wiley-Blackwell), written especially for this course. No prerequisites. Two-hour lecture/seminar. Enrollment limited to twenty. Michael R. Dove/Carol Carpenter (alternate years)

#### FRESHMAN SEMINAR

**F&ES 012, Urban Ecology in New Haven** 1 credit. Methods of ecosystem ecology, landscape ecology, and industrial ecology, applied to questions of how cities work and how they can become more sustainable. Guest speakers, community projects, and field trips in New Haven. Application of theory to New Haven and to cities around the world. Gordon T. Geballe

**F&ES 330b/E&EB 330a/EVST 330a, Ecosystem Analysis** 3 credits. An outdoors, hands-on overview of the study of ecosystems, how the structure of ecosystems develop (e.g., biodiversity), and how ecosystems function (e.g., process nutrients or pollutants). The impact of global changes, such as climate change and eutrophication, on ecosystem structure and function. Field-based group and independent projects focused on New England ecosystems. Peter A. Raymond, Melinda Smith

# Centers and Programs at the School of Forestry & Environmental Studies

Teaching, research, and outreach at the Yale School of Forestry & Environmental Studies are greatly enhanced by the Centers and Programs, which have been initiated by faculty through the years. The Centers and Programs, each with a different concentration, are a key component of a student's learning experience. They allow students to gain hands-on clinical and research experience by sponsoring student internships and projects, coordinating faculty research in areas of common interest, and creating symposia, conferences, newsletters, and outreach programs.

Centers and Programs are funded primarily through private foundations, nongovernmental organizations, state and federal agencies, international granting agencies, and private corporations. The nature and number of Centers and Programs evolve over time, reflecting faculty and student interest. Under the current organizational structure, each program falls under the umbrella of a center, which enables further collaboration and resource sharing.

## CENTER FOR COASTAL AND WATERSHED SYSTEMS

Coastal and watershed systems are an integral part of the environment and an essential aspect of a holistic approach to environmental studies. The mission of the Center for Coastal and Watershed Systems (CCWS) is to incorporate interdisciplinary study of watersheds and adjacent coastal waters into academic life at Yale. Beginning in fall 2010 and for the immediate future, CCWS will be operating with a faculty director and student assistant, but without a staff director. During this period, CCWS activities will be curtailed.

The small fraction of the earth's surface occupied by the land-sea margin is enormously important to the environment and to society. A majority of the world's population inhabits watersheds located within fifty miles of the coast, making these complex, fragile ecosystems especially vulnerable to human impact. The near-shore region includes some of the most unusual and diverse ecosystems, from salt marshes and coral reefs to mangrove forests and river deltas. The coastal zone supports the world's richest fisheries and sustains significant recreational industries. The growing recognition of the importance and value of coastal and water resources has found expression in an increasing emphasis on public and private research programs.

CCWS promotes interdisciplinary studies and the education of professionals in the management of the special resources of terrestrial and aquatic ecosystems in the coastal region. Because ecological and social structure and function are inextricably linked, neither can be adequately comprehended nor effectively managed in isolation. The center emphasizes studies that help us elucidate the complex, poorly understood, but crucial ways in which human and biophysical systems shape each other. Several courses are available to students with an interest in coastal and watershed issues

School faculty and students conduct physical, biological, and social research in local watersheds and educational outreach programs for the community. Three coastal watersheds in south central Connecticut—the Quinnipiac, Mill, and West rivers—are often

the focus of long-term faculty and student research. The work of the center on these watersheds includes community planning for habitat restoration of degraded urban rivers, studies of nonpoint source pollution, and research on the relation between watershed environmental health and human community performance and effectiveness.

The center can assist students working or proposing to work on coastal restoration, preservation, and community outreach projects with scientific advice and guidance for obtaining project funding. The center has long experience working with Connecticut Sea Grant College, the Sounds Conservancy, and other funding agencies to obtain support for student research.

Recent student projects in the center include measurement of the carbon flux in a local tidal marsh system; a comparative assessment of mercury levels in urban and suburban streams; a sediment quality investigation as part of a dam removal study; and evaluating storm water inputs to ponds in a city park.

### *Urban Watershed Program*

The Urban Watershed Program promotes faculty and student research on the unique relationships, impacts, and demands of watersheds in urban areas. Jointly administered by the Hixon Center for Urban Ecology and the Center for Coastal and Watershed Systems, the program combines the interests and resources of the two centers.

Watersheds in urban areas encounter unique stresses, while sharing common characteristics and following natural laws of all water systems. Urban watersheds are often polluted, heavily engineered, and little understood by nearby residents. Stream courses are often transferred to pipes running underground. Population density exacerbates stresses on waterways.

As cities emerge from a period when they ignored their rivers and harbors, new relationships are being developed with adjacent waterways. Past practices that marginalized waterscapes from the urban environment are being reevaluated. Now, with more attention to urban environmental quality, there is a greater understanding of the vital role waterways play as sources of open space, transportation, recreation, and habitat.

The Urban Watershed Program promotes the interdisciplinary science and policy studies of these waterways. A convenient study site is offered in the greater New Haven area through the established relationships of the Center for Coastal and Watershed Systems and the Hixon Center for Urban Ecology.

### *Coastal Field Station*

A research facility is available to students and faculty of the School of Forestry & Environmental Studies at the Peabody Museum Field Station on Long Island Sound in Guilford. The station is a thirteen-mile drive east of Yale and provides centrally located access to one of the country's most important estuaries. The station includes a boat ramp, dock, deep-water moorings, and small boats. There is also a simple laboratory within the field station building, Beattie House. Nearby research lands available to F&ES students include an island (Horse Island), coastal pond (Guilford Pond), and salt marsh complex (the Richards Property). Along with the field station, these are all part of the Center for Field Ecology, sponsored by the Yale Institute for Biospheric Studies.

## YALE CENTER FOR ENVIRONMENTAL LAW AND POLICY

A joint undertaking with Yale Law School, the Yale Center for Environmental Law and Policy seeks to advance fresh thinking and analytically rigorous approaches to environmental decision making—across disciplines, sectors, and boundaries.

The center supports a wide-ranging program of teaching, research, and outreach focused on local, regional, national, and global pollution control and natural resource management issues. These efforts involve faculty, staff, and student collaboration aimed at shaping both academic thinking and policy making in the public, private, and NGO sectors. The center is currently focused on four program areas and an environmental protection clinic, as outlined below.

### *Environmental Performance Measurement*

This program aims to shift environmental policy making onto firmer foundations using data-driven indicators and statistics. The program's primary product is the biennial Environmental Performance Index. The 2010 Environmental Performance Index ranks 163 countries on twenty-five performance indicators tracked across ten policy categories covering both environmental public health and ecosystem vitality. These indicators provide a gauge at a national government scale of how close countries are to established environmental policy goals.

### *Environmental Attitudes and Behavior*

Our work within this program seeks to explore citizens' attitudes about the environment and how such attitudes translate into action. Work products from this program include polls, workshops, and focus groups to evaluate the effectiveness of environmental messages. We are currently testing which climate change messages and messengers resonate best with different target audiences.

### *Environmental Law and Governance*

This program examines how the principles of good governance can be applied in the context of environmental policy making. We conduct our research with partners at the College of William & Mary and address the disciplines of law, political science, natural science, and economics. We aim to facilitate thought and action for strengthening environmental policy making at all scales.

### *Innovation and Environment*

Our research for this program explores fresh and creative public policy tactics for addressing environmental issues with a focus on policy incentives that drive private-sector innovation in renewable energy development, energy efficiency, and other areas critical to sustainability.

### *Environmental Protection Clinic*

The center also coordinates an environmental protection clinic that undertakes long-term projects for clients (environmental groups, government agencies, community organizations, and private sector enterprises) staffed by interdisciplinary teams of law and environmental studies students. Projects include legislative drafting, litigation, multiparty negotiation, and policy development and focus on topics ranging from environmental justice to sustainable agriculture to global warming.

For detailed information on the Yale Center for Environmental Law and Policy, please visit <http://envirocenter.research.yale.edu>.

### YALE CENTER FOR BUSINESS AND THE ENVIRONMENT

The Yale Center for Business and the Environment provides a focal point for education, research, and outreach to advance business solutions to global environmental problems. The center focuses on (1) helping fold environmental thinking into business practice, (2) bringing business management principles into environmental organizations, and (3) fostering the creation of green businesses, products, and services.

The center joins the strengths of two world-renowned graduate schools—the Yale School of Management (SOM) and the Yale School of Forestry & Environmental Studies (F&ES)—together with a network of internal and external thought leaders at the business-environment interface. Professors, students, alumni, guest scholars, and affiliates of each school contribute to the center’s mission through an integrated set of activities that address business approaches to the world’s most significant environmental issues. Our work spans perspectives in finance, innovation, marketing, operations, and strategy on issues involving energy, water, carbon, forests, environmental health and safety, development, and policy.

The center’s activities include, but are not limited to:

- Providing support for the three-year joint M.B.A.–Environment degree program and advancing joint programs between F&ES and SOM
- Organizing an annual conservation finance camp for conservation professionals
- Supporting research activities including seminars in forest carbon and environmental economics, fellowships in corporate environmental management and strategy, and the development of case studies
- Coordinating speaker series and prizes on environmental markets and finance and environmental entrepreneurship
- Facilitating networks like the Renewable Energy and International Law Network

Activities in each of these areas bring together students, faculty, staff, policy experts, and practitioners from a wide range of institutions around the world.

For more information about the Yale Center for Business and the Environment, go to [www.yale.edu/cbey](http://www.yale.edu/cbey).

## CENTER FOR GREEN CHEMISTRY AND GREEN ENGINEERING AT YALE

The mission of the Center for Green Chemistry and Green Engineering at Yale is to advance sustainability by catalyzing the effectiveness of the Green Chemistry and Green Engineering community. Green Chemistry and Green Engineering represent the fundamental building blocks of sustainability. Working in these disciplines, chemists and engineers are creating the scientific and technological breakthroughs that will be crucial to the future success of the human economy.

The Center for Green Chemistry and Green Engineering at Yale works to stimulate and accelerate these advances. Guided by four core operating principles—(1) Insist on scientific and technical excellence and rigor, (2) Focus on generating solutions rather than characterizing problems, (3) Work with a diverse group of stakeholders, and (4) Share information and perspectives broadly—we seek to accomplish four key objectives:

- Advance the science.
- Prepare the next generation.
- Catalyze implementation.
- Raise awareness.

The center concentrates on five focus areas, outlined below.

**Research** The center supports and advances research in Green Chemistry and Green Engineering (GC&GE), a critical component to building the community, designing and discovering innovative solutions, and achieving a sustainable future. The center serves as a catalyst to both Yale and the greater GC&GE communities for discipline-specific and cross-disciplinary research collaborations focused on key areas of GC&GE within science, technology, and policy for sustainability.

**Policy and outreach** The center engages in policy, communication, and outreach initiatives that raise awareness of—and support for—GC&GE. In this dialogue the center engages with a wide network of stakeholders, including NGOs, industry, academia, and government, as well as local communities and the general public.

**Education** A robust educational program is an essential element of the center. Center activities are focused on educating undergraduate and graduate students in the principles and practice of GC&GE. The center also serves the wider academic community by providing opportunities for faculty training and by developing and disseminating GC&GE curriculum materials.

**International collaborations** GC&GE are rapidly spreading through both industrialized nations and the emerging economies. In all regions, the center engages with the network of scientists, engineers, policy makers, business people, and public health and environmental experts focused on sustainability science on behalf of the greater good.

**Industrial collaborations** GC&GE can only provide meaningful impact on the challenges of global sustainability when implemented on a large scale. For this reason, collaboration with industry is a key part of the center's work. Direct engagement creates a dialogue that informs industry of the latest research breakthroughs in the field of sustainable science

and technology. Likewise, such engagement informs academic researchers on industry's most important concerns. This dialogue facilitates a direct line for implementation of these innovations.

## CENTER FOR INDUSTRIAL ECOLOGY

The Center for Industrial Ecology (CIE) is dedicated to the development and promotion of research, teaching, and outreach in industrial ecology. The field is focused on the concept that an industrial system should be viewed not in isolation from its surrounding systems, but in concert with them. It is a systems approach that seeks to optimize the total materials cycle from virgin material, to finished material, to component, to product, to obsolete product, and to ultimate disposal. The field is sometimes termed "the science and technology of sustainability."

Among the programs and goals of the center are the following:

- Conducting pathbreaking research in industrial ecology
- Hosting of visiting domestic and international scholars in industrial ecology
- Master's, doctoral, and postdoctoral study programs in industrial ecology

Major foci include (1) the Stocks and Flows Project, in which investigators are evaluating current and historical flows of specific materials, estimating the stocks available in different types of reservoirs, and evaluating the environmental implications; (2) the Industrial Symbiosis Project, in which multiyear research is being conducted in Pennsylvania, the Tianjin Economic-Technological Development Area (TEDA) in China, and the Nanjangud Industrial Area outside Mysore, India, to establish the environmental and economic rationale for intra-industry exchange of materials, water, and energy; and (3) the Program on Industrial Ecology in Developing Countries, which adapts industrial ecology theory and practice to the realities faced in industrializing countries related to problems of energy access, water quality and quantity, waste and material management, and global warming.

Other research projects include (a) urban and industrial metabolism projects in collaboration with the National University of Singapore for study of high-density development in Asian cities and with the Kohala Center on Hawaii island for a long-term study of human impacts on land and development, and (b) evaluation of extended producer responsibility (EPR), including investigation of how, when, and why cities and other local government units might adopt EPR and the conditions necessary for the implementation of individual producer responsibility.

### *Journal of Industrial Ecology*

CIE is home to a highly regarded international journal. Published by Wiley-Blackwell and owned by Yale University, the *Journal of Industrial Ecology* is a peer-reviewed, multidisciplinary bimonthly on industry and the environment that is aimed at both researchers and practitioners in academe, industry, government, and advocacy organizations. It is indexed in Science Citation Index Expanded (ISI), and it is the official journal of the International Society for Industrial Ecology.

### *Industrial Environmental Management Program*

The Industrial Environmental Management (IEM) program at Yale aims to equip students with an integrated set of skills with which to tackle the complex, multifaceted environmental problems facing industrial and corporate managers. Within the master's program, IEM students take courses in natural science, social science, and quantitative methods, followed by courses in environmental policy and management. The core intellectual framework for IEM is industrial ecology.

An active Industrial Environmental Management and Energy Student Interest Group sponsors field trips to industrial sites, on-campus talks by visiting managers, and symposia on current topics of interest. In addition, each year the IEM Lecture Series hosts speakers from industry who give presentations and meet with students.

### *Program on Solid Waste Policy*

The program has two principal goals: (1) to inform contemporary policy discussions about solid waste and materials management by applying the methods and findings of social and environmental science; and (2) to develop workable policy solutions that address the impediments to safe, cost-effective solid waste management and the complexities of comprehensive materials and life-cycle management.

## HIXON CENTER FOR URBAN ECOLOGY

The Hixon Center for Urban Ecology provides an interdisciplinary forum for scholars and practitioners to work collaboratively on integrated research, teaching, and outreach to improve our understanding and management of urban environmental resources within the United States and around the globe.

The ecological health and integrity of urban ecosystems have a profound impact on urban economic productivity and quality of life. Pioneering research, new theoretical understanding, and innovative practice will be required to provide the knowledge and tools necessary to foster healthy natural systems essential for the future well-being of the modern city. This need has never been greater than today, when a majority of the world's population either resides in or is rapidly migrating to urban areas.

To accomplish its mission, the center builds upon and strengthens the work of several programs at the School, including the Urban Resources Initiative and the Urban Watershed Program.

The Hixon Center has a strong focus on collaboration within the School, across the University, and beyond. The center sponsors lecture series as a means to disseminate ideas and information concerning the critical issues confronting urban ecosystems and related research required for the foreseeable future.

The Hixon Center also supports Yale faculty scholarly research or initiatives focusing on aspects of environmental science, conservation, policy, or management in an urban context. In addition, the center supports student fellowships based upon their research proposal's connection to current Hixon Center research, the outreach potential of that research, and its relevance to the continued study of urban ecology. The center will continue to build the urban environmental focus at Yale while strengthening the School's urban dimension, creating new models and approaches for addressing urban environmental changes.

### *Yale Program on Strategies for the Future of Conservation*

The purpose of the Yale Program on Strategies for the Future of Conservation is to support the efforts of the Maine Coast Heritage Trust, the Land Trust Alliance, and similar private organizations to develop and apply new, innovative strategies for land conservation by linking the convening, research, and teaching activities at the Yale School of Forestry & Environmental Studies ever more closely to the needs of the land conservation community.

Established by a gift from Forrest Berkley and Marcie Tyre, the program has two parts:

- Sponsoring student internships and research projects (through the Berkley Conservation Scholars program), to bring the passion, experience, and creativity of Yale graduate students to bear on these issues; and
- Convening workshops and other conversations across sectors and perspectives in the search for new approaches to expanding the resources applied to land conservation in the United States.

Berkley Conservation Scholars are students of high potential who receive funding for their research and professional experiences at the cutting edge of land conservation. Support is available during both the school year and the summer, creating a virtual “R&D Department” for the U.S. land conservation community. Berkley Conservation Scholars play a critical role in helping to bring together practitioners and academics in the search for new conservation tools.

The Program on Strategies for the Future of Conservation is a major extension of F&ES’s continuing efforts to enhance the effectiveness of land conservation. Working with an advisory group of land conservation leaders, the program hosts workshops, training programs, and other activities around the themes of engaging new communities in conservation; expanding the conservation toolkit; and ensuring the permanence of conservation gains.

### *Urban Resources Initiative*

The Urban Resources Initiative (URI) is a not-for-profit/university partnership dedicated to community participation in urban ecosystem management. A substantial body of learning suggests that sustainable urban ecosystem management depends on the meaningful participation of local residents. Those who know local conditions and whose daily actions influence the health and quality of urban ecosystems must play a central role in designing and implementing rehabilitation strategies. Sustainable natural resource management and conservation cannot be achieved by technical, scientific solutions alone. Conservation efforts, especially in urban areas where people represent a significant element of the ecosystem, must emphasize social revitalization alongside environmental restoration.

Yale’s URI program draws on these essential elements to facilitate community participation in urban ecosystem management. “Community” is defined quite broadly: it includes the group of neighborhood leaders with whom interns work to restore abandoned lands near their homes. Community is a group of teens who are learning how to assess the tree canopy of their city. Community is the staff and leadership of city agencies

who have the responsibility and resources to become the environmental stewards of their city. URI's approach responds to and engages all of these communities.

URI offers a number of clinical learning opportunities that allow F&ES students to gain real-world practice in their field. Listening to local concerns and developing environmental programs in cooperation with schools, neighborhood groups, and city agencies are the cornerstones of our work. Through these programs F&ES students can apply theory learned in the classroom with supervised clinical training to enrich their academic work while making a real contribution to the New Haven community. These programs include the Community Greenspace program, Green Skills, environmental education/job training program, research opportunities, and training in urban forestry practices.

**Community Greenspace** Each summer F&ES students work as community foresters as part of the Community Greenspace program, a citywide initiative to revitalize New Haven's neighborhoods by restoring vacant lots, planting street trees and front yards, and building community. Each intern works with community groups to develop restoration goals and design an implementation strategy for the summer. The interns help neighbors conduct an inventory of existing trees, select and prepare sites for new plantings, and plant perennials, shrubs, and trees.

The Greenspace program is an opportunity for Yale students to learn urban forestry practices within a community-driven process. Neighbors initiate the process by identifying their environmental priorities in their community. URI looks to the local experts—the people who live in inner-city neighborhoods—as partners in defining and then assessing, designing, implementing, and sustaining urban restoration sites.

**Environmental education** Since 1991 URI education interns have taught hands-on environmental education programs to New Haven public school students. URI staff and interns have taught 1,700 elementary school students about environmental stewardship by exploring open space sites in New Haven using our Open Spaces as Learning Places curriculum. The pond and river units of this curriculum (repackaged as Watersheds as Learning Places) was officially incorporated into the district-wide science curriculum for the City of New Haven in the 2009–2010 academic year. Now students in every sixth-grade classroom have the opportunity to learn about watersheds as they canoe New Haven's rivers and explore local ponds.

URI's newest environmental education program creates opportunities for teens to learn about New Haven's tree canopy and to gain practical job skills. Launched in 2007, our Green Skills program creates an opportunity to address a critical predicament—a growing deficit in New Haven's street tree canopy that can be countered by a career development program bringing together Yale and high school interns. Our goals are to improve New Haven's street tree canopy by engaging urban high school students in the planting effort, thereby providing them with job skills and mentoring opportunities in environmental careers, and fostering a sense of environmental stewardship.

**Research** URI activities provide valuable research opportunities in community organizing and development, urban forestry management, environmental education and monitoring, and evaluation of community-managed ecosystems. Some examples of student research activities are a community survey to determine human health impacts of vacant

lands; measurement of biological communities found in Greenspace sites and abandoned lots; and measurement of how children's behavior at play is affected by the design of schoolyards. Most recently, URI and partners at the U.S.D.A. Forest Service, and the University of Vermont Spatial Analysis Laboratory have carried out a satellite imagery analysis of New Haven's tree canopy cover. This analysis served as a basis for the City of New Haven's Mayor launching an aggressive tree-planting campaign.

**Urban forestry practices** Over the past two decades, URI has created several community and urban forestry training programs, including training sessions for natural resource managers (for municipal employees), a tree stewardship training program (for community leaders), and a street tree inventory training project (for local high school students). These programs have created powerful learning experiences for F&ES students as well as for the target audience. Students gain expertise in developing and implementing training programs across a broad spectrum of topics and audiences. They also work with and learn from experienced mentors from F&ES and local, state, and federal forestry agencies.

## TROPICAL RESOURCES INSTITUTE

The mission of the Tropical Resources Institute is to provide a forum for the research and educational initiatives of F&ES in particular and the Yale community in general concerning the global tropics.

TRI was created in 1983 to strengthen the School's involvement in the management of tropical resources. The institute recognizes that the problems surrounding the management of tropical resources are rapidly increasing in complexity, while demands on those resources are expanding exponentially. Emerging structures of global environmental governance and local conflicts over land use and environmental conservation require new strategies and leaders able to function across diversity of disciplines and sectors, and at local and global scales. TRI aims to build linkages across the natural and social sciences and also aims to straddle theory and practice. TRI seeks to train students to be leaders in this new era, leveraging resources, knowledge, and expertise among governments, scientists, NGOs, and communities to provide the information and tools this new generation will require to equitably address the challenges ahead.

TRI serves as the nexus within the Yale School of Forestry & Environmental Studies through which faculty and students conduct interdisciplinary research and outreach activities throughout the tropics. Within the broader Yale community, TRI serves as a clearinghouse for research and educational activities pertaining to tropical countries, societies, and environments.

**Research** TRI administers an endowed fellowship program that supports several dozen graduate students, at both master's and doctoral levels, conducting natural and social science research in the tropics each year. Following the mission of TRI, these projects are typically interdisciplinary in nature and cover a wide diversity of issues that surround the management and conservation of tropical resources.

TRI also administers the Compton Fellowship program, which supports research by master's and doctoral students from Sub-Saharan Africa and Latin America. Student projects focus on environment and sustainability with linkages to the fields of peace and

security (conflict management) and population and reproductive health. The objective is to produce graduates who are able to contribute to the conservation of natural systems and appropriate development for long-term sustainability.

**Education** TRI provides mentoring and training to graduate students in research design, proposal writing, and field methods; and sponsors workshops, roundtable discussions, and guest speakers; and trains practitioners through its presence overseas.

TRI hosts an annual presentation seminar series for TRI and Compton Fellows. This forum, open to the Yale community, offers students a chance to present their research findings and to receive feedback on their research projects during the academic year.

**Outreach** TRI supports partnerships with international organizations in many tropical areas in order to create innovative research opportunities for F&ES students. TRI actively works to build strong networks among organizations, scholars, and international institutions to facilitate research and the dissemination of knowledge. Furthermore, TRI sponsors public lectures, supports an annual conference with the International Society of Tropical Foresters, distributes its *Bulletin* to an international mailing list of more than 1,200, and hosts an institute Web site ([www.environment.yale.edu/tri](http://www.environment.yale.edu/tri)). In 2004, TRI became a voting member of the World Conservation Congress.

**Publications** TRI publishes *Tropical Resources: The Bulletin of the Tropical Resources Institute*, an annual journal of student research. Each spring, the *Bulletin* is sent to a mailing list of more than 1,200 people and institutions, and can also be read online at [www.environment.yale.edu/tri/bulletin](http://www.environment.yale.edu/tri/bulletin). This student-driven publication highlights the research work of TRI and Compton Fellows. Most years, approximately one dozen students submit articles from a wide range of field research experiences.

## FORUM ON RELIGION AND ECOLOGY AT YALE

The Forum on Religion and Ecology at Yale is the largest international multireligious project of its kind. With its conferences, publications, and Web site (<http://fore.research.yale.edu>), it is engaged in exploring religious worldviews, texts, and ethics in order to broaden understanding of the complex nature of current environmental concerns. The forum recognizes that religions need to be in dialogue with other disciplines (e.g., science, economics, policy, gender studies) in seeking comprehensive solutions to both global and local environmental problems. The cofounders and codirectors of the forum and the series editors for the *World Religions and Ecology Series* are John Grim and Mary Evelyn Tucker.

The forum arose from a series of ten conferences on the world's religions and ecology held at Harvard, which resulted in ten volumes distributed by Harvard University Press. Several of these volumes have been translated into other languages, including Chinese. One of the principal objectives of the forum was to help to create a new field of study that may assist environmental policy.

Ten years ago, religion and ecology was neither a field of study nor a force for transformation. Over the last decade, a new field of study has emerged within academia with courses being taught at colleges and high schools across North America and in some universities in Europe. Canada and Europe now have their own forums and Australia

is planning one. Moreover, a new force of religious environmentalism is growing in churches, synagogues, temples, and mosques around the world. Now every major religion has statements on the importance of ecological protection, and hundreds of grassroots projects have emerged. The Forum on Religion and Ecology has played an active role in these developments.

The work of the Forum on Religion and Ecology at Yale includes:

**Joint master's degree program at Yale** The Yale School of Forestry & Environmental Studies (F&ES) and Yale Divinity School (YDS) offer a joint master's degree program in religion and ecology. It is aimed at students who wish to integrate the study of environmental issues and religious communities in their professional careers and for those who wish to study the cultural and ethical dimensions of environmental problems. The joint degree is supported by co-appointed faculty and by the forum.

This degree program provides an opportunity to study in two independent schools at Yale University, each with its own integrity. Students work toward both a Master of Environmental Management (M.E.M.) degree at F&ES and either a Master of Arts in Religion (M.A.R.) or Master of Divinity (M.Div.) at YDS. Within these schools, they are encouraged to take courses in environmental ethics and in religion and ecology. Students have the opportunity to work with faculty in both schools, as well as with a number of co-appointed faculty members.

This joint degree in religion and ecology is the first program of its kind in North America. It aims to attract students to a growing field of study with far-reaching implications for the future of the Earth community. The Interdisciplinary Center for Bioethics at Yale and the Religious Studies department in the Graduate School of Arts and Sciences enhance the degree program.

**Publications** The forum has helped to create a new field of research and teaching in religion and ecology that has implications for environmental policy.

- With its scholarly network it published the ten-volume *World Religions and Ecology Series* from Harvard.
- It has supported the first journal in the field, *Worldviews: Global Religions, Culture, and Ecology*.
- It produced a *Daedalus* volume, *Religion and Ecology: Can the Climate Change?*, which was the first discussion of world religions and the ethics of climate change.
- The forum's founders have also served as editors for the twenty-volume *Ecology and Justice Series* from Orbis Books.
- The encyclopedia *The Spirit of Sustainability* (Berkshire Publishers, September 2009) edited by Willis Jenkins of Yale Divinity School and Whitney Bauman of Florida International University was also a project of the forum.
- The forum has edited a number of volumes by the late cultural historian Thomas Berry: *The Sacred Universe* (Columbia University Press, 2009), *The Christian Future and the Fate of Earth* (Orbis Books, 2009), *Evening Thoughts* (Sierra Club Books, 2006), and *The Great Work* (Random House, 1999).

**Conferences** The forum has organized many conferences, including "Renewing Hope: Pathways of Grassroots Religious Environmentalism" (F&ES and YDS, Spring 2007), The Forum on Religion and Ecology's 10th Anniversary Symposium (Yale Club of New

York, Fall 2008), and the Thomas Berry Memorial (Cathedral of St. John the Divine, New York City, Fall 2009). The forum cosponsored the conference “Environmental Dis/locations: Environmental Justice and Climate Change” (F&ES & YDS, Spring 2010). It has also assisted in organizing the Thomas Berry Award and Lecture since 1998.

In addition, the forum participates in interdisciplinary conferences, both national and international, that are policy oriented. These include conferences with the United Nations Environment Programme (UNEP); United Nations Educational, Scientific and Cultural Organization (UNESCO); the International Union for Conservation of Nature (IUCN); the Dialogue of Civilizations; the Earth Dialogues led by Gorbachev; the Earth Charter; the Religion, Science, and the Environment Symposia, led by the Greek Orthodox Patriarch, Bartholomew; and the Parliament of World Religions.

**Web site** The forum’s Web site is a world-class international site for research, education, engagement, and outreach in the field of religion and ecology. It contains detailed information on the world’s religions and their ecological contributions, including introductory essays, annotated bibliographies, selections from sacred texts, environmental statements from religious communities, and engaged projects of religious grassroots environmental movements. To facilitate interdisciplinary dialogue, there are resources that address environmental issues related to ethics, economics, policy, gender, and evolutionary and ecological sciences. To enhance teaching, the site includes syllabi, lists of educational videos and CD-ROMs, links to programs and institutions related to environmental education, and a variety of other resources for educators. The site provides current information on news, publications, and events related to world religions and ecology. This is available in a monthly online newsletter that is distributed to some 9,000 people.

**Films** The forum was a principal adviser for the film *Renewal: Inspiring Stories from America’s Religious Environmental Movement* and organized a conference at Yale for its premiere in 2007. The forum is working with cosmologist Brian Swimme on a major film project, *Journey of the Universe*, directed by David Kennard (director of the *Cosmos* series with Carl Sagan). The project will include a film, book, educational series, curricular materials, and Web site.

## THE ENVIRONMENTAL LEADERSHIP AND TRAINING INITIATIVE

In April 2006 the Environmental Leadership and Training Initiative (ELTI) was launched, thanks to a generous grant donated by Arcadia. For the execution of the project, F&ES has partnered with the Center for Tropical Forest Science (CTFS) at the Smithsonian Tropical Research Institute (STRI) in Panama. The mission of the program is to enhance environmental management and leadership capacity in the tropics by offering cutting-edge learning and networking opportunities aimed at improving biodiversity conservation and human welfare. Through complementary, applied, action-oriented training and leadership-building activities, ELTI aims to serve as a platform to promote and affect on-the-ground biodiversity conservation efforts.

ELTI was created to significantly strengthen biodiversity conservation in tropical forest regions, specifically in South and Southeast Asia and Latin America, by offering

short-term courses, workshops, conferences, and symposiums for policy makers and conservation practitioners in these regions. Additionally through this program, ELTI works on fostering professional development through post-training event opportunities for participants, enabling them to further strengthen their understanding of particular conservation issues and their capacity to address specific environmental threats or concerns. ELTI involves faculty, staff, and students from F&ES, in addition to research scientists from STRI, in various aspects of the program.

## THE GLOBAL INSTITUTE OF SUSTAINABLE FORESTRY

Since its founding in 1900, the Yale School of Forestry & Environmental Studies has been in the forefront in developing a science-based approach to forest management and in training leaders to face their generation's challenges to sustaining forests.

The School's Global Institute of Sustainable Forestry continues this tradition in its mission to integrate, strengthen, and redirect the School's forestry research, education, and outreach to address the needs of the twenty-first century and a globalized environment. The Global Institute fosters leadership through dialogue and innovative programs, creates and tests new tools and methods, and conducts research to support sustainable forest management worldwide.

Forestry at Yale is broadly defined to include all aspects of forest management and conservation. The Global Institute works primarily through faculty-led programs and partnerships with other Yale centers and forestry institutions in the United States and abroad. Students participate as research assistants, interns, and School Forests field crew; are encouraged to take on high levels of leadership in planning activities and events; and regularly contribute to published documents that emerge from program activities. An External Advisory Board, made up of international leaders in the field of forestry, provides a connection to those who are involved in the more practical aspects of protecting, restoring, and managing the world's forests.

The Global Institute coordinates the School's participation in regional, national, and international forestry events such as the Society of American Foresters' Conventions and the World Forestry Congresses and coordinates activities with other institutions throughout the world.

**Research** Through its research programs, the Global Institute brings world-class scholarship to bear on the challenges facing the world's forests. Programs represent the diverse interests and expertise of the F&ES faculty, who conduct applied research in both ecological and social dimensions of forests and forestry.

**Yale Forest Forum (YFF)** The Yale Forest Forum (YFF) serves as the dialogue and convening function of the Global Institute of Sustainable Forestry. YFF was established in 1994 by a diverse group of leaders in forestry to focus national attention on broader public involvement in forest policy and management in the United States. In an attempt to articulate and communicate a common vision of forest management to diverse stakeholders, the first initiative of YFF was to convene the Seventh American Forest Congress (SAFC). After a series of local roundtables, the SAFC culminated in a 1,500-person citizens' congress in Washington, D.C. The principles discussed during the congress remain

part of YFF's core philosophy of how forest policy discussions should take place: "collaboratively, based on the widest possible involvement of stakeholders."

YFF's activities are centered on bringing individuals together for open public dialogues to share experiences, explore emerging issues, and debate varying opinions constructively. In that light YFF sponsors many issues forums and leadership seminars throughout the academic year. YFF forums and seminars not only focus on emerging issues in forest management, they also give students exposure to leaders in the NGO, industry, landowner, and government sectors in sustainable forestry. YFF publishes the *YFF Review* to disseminate to a wide audience the outcomes and lessons learned from its work.

Several times a year, the Global Institute convenes forums on significant issues in forest sustainability, with participants drawn from the widest possible range of individuals who affect and are affected by forest policies, including those working in government, business, conservation, academia, and community-based organizations. Most forums include a formal panel presentation, open to the public, and a workshop session. They provide an opportunity for diverse interests to meet and exchange ideas and have led to ongoing dialogue concerning forestry problems and solutions.

Integral to the work of YFF and the development of many forums are student input and assistance.

**Publications** Global Institute publications, along with the Web site, are the primary means of communicating the work of the institute. The *YFF Review* series includes summaries of forums, workshops, internships, fellowships, seminars, and conferences. Faculty and staff research on selected forest issues is disseminated through working papers and research reports. Publications are available in both print and on the Web site. The institute also sponsors publication of the *Journal of Sustainable Forestry*.

**YFF leadership seminar series** The Global Institute's weekly lunchtime talks allow students and other members of the F&ES community to interact informally with individuals actively working in forestry and conservation. Speakers have included, among others, forest practitioners; forest landowners; government scientists and policy makers; community activists; authors and journalists; leaders of local, national, and international conservation organizations; academicians; and business executives.

**Yale F&ES courses and seminars** Global Institute faculty teach a wide array of graduate courses and seminars that explore the scientific underpinnings and policy implications of sustainable management of the world's forests.

**Midcareer short courses** Weeklong courses in Forest Stand Dynamics for forestry practitioners are taught on the West Coast in partnership with the University of Washington and the University of British Columbia. Executive short courses bring the latest thinking in sustainable forestry to business executives and forestry professionals. Both "Executives Learning about Forestry" and "Foresters Becoming Executives" are intensive one-week courses for professionals from around the world who work in the forestry sector.

Through the programs and Yale Forest Forum, the Global Institute has undertaken several initiatives, including examination of forest fragmentation and land use change, the

total cost of forest wildfires, the impact of forest certification, rural community viability, tropical forest restoration, a working definition of sustainable forestry, landscape and watershed management techniques and technical tools, management of mixed hardwood forests, conservation priority setting, forest health indicators, and forest health issues such as natural disturbance regimes and invasive species.

The Global Institute of Sustainable Forestry is governed by the dean of the School, a faculty director, an executive director, professional program staff, a group of faculty advisers, many of whom lead Global Institute programs, and an external advisory board. The main office is located in Marsh Hall.

### *Program in Tropical Forestry*

The mission of the Program in Tropical Forestry is to become a world leader in research, education, information dissemination, promotion of sustainable forest management, plantation silviculture, and restoration of degraded ecosystems throughout the tropics. The program activities are carried out by Yale School of Forestry & Environmental Studies (F&ES) faculty, in collaboration with colleagues from academic institutions in the tropics. The program is closely linked to F&ES Tropical Resources Institute (TRI), sharing the overall philosophy of its mission but with a more focused approach toward tropical forestry research, education, and knowledge dissemination.

The program seeks to expand the work of Yale faculty, students, and staff by conducting research; offering relevant courses, seminars, and workshops; and promoting cooperation among faculty and students from F&ES and collaborating institutions worldwide. Courses in tropical forestry, agroforestry, tropical ecology, ecosystem restoration, and silviculture are taught by faculty at F&ES. Forum and roundtable discussions are also part of the program's information outreach.

The challenges that tropical forestry faces in the twenty-first century are very well known. In the early 1990s the total area of deforested and degraded tropical land surpassed the area of mature tropical forests. Similar trends persist in the current century. Tropical forestry is confronted with the task of finding strategies to alleviate pressure on remaining forests and techniques to enhance forest regeneration and restore abandoned lands, using productive alternatives that can be attractive to local communities. In addition, sustainable forestry in tropical countries must be supported by adequate policies to promote and maintain specific activities at local and regional scales.

Research by faculty of the Global Institute of Sustainable Forestry and collaborators in tropical countries includes sustainable management of natural forests and their biodiversity, and the identification and quantification of ecological services provided by forests (biodiversity conservation, carbon sequestration, watershed protection). The design of systems of diversified forest management also involves studies on the ecology and management of nontimber species used for medicinal, insecticidal, ornamental, craft, and construction purposes. There also are projects on reforestation of degraded lands with native species, including mixed-species designs. These systems can encourage natural regeneration in their understories, contributing to the recovery of plant and animal biodiversity of the surrounding landscape. Some of the subjects covered in this program are ecosystem restoration; management of secondary forests and enrichment planting;

reforestation with native species; plantation silviculture; recovery and conservation of plant and animal biodiversity; conservation and management of nontimber forest products; carbon sequestration by tropical forests and plantations; recovery and protection of watershed services, including water volume and quality; evaluation and quantification of ecosystems services; systems and policies for Payments for Environmental Services (PES) as tools to promote restoration, conservation, and rural development; community forestry projects; and productivity and environmental services of agroforestry systems.

### *Program on Forest Policy and Governance*

The mission of the Yale Program on Forest Policy and Governance is to document, research, teach, and conduct outreach to foster innovations in sustainable forestry management and policy. It is a core program within the Global Institute of Sustainable Forestry in the Yale School of Forestry & Environmental Studies. The program focuses on all forms of state and non-state policy and governance, from domestic forest policy to global intergovernmental negotiations, to market-based systems for promoting sustainable forest management.

The program focuses on three interrelated efforts:

1. Research designed to understand the development of state and non-state forest policies and their impacts on sustainable forestry. Our research is organized around five key themes: comparative forest policy and governance, from the local to the global level; the dynamics of legitimacy among state and non-state governance systems; the development and impacts of forest certification and other market-based instruments in developing countries; the environmental and social effects of certification; and market supply dynamics.
2. Teaching and training on forest governance and policy. Our teaching includes undergraduate and graduate courses on international forest policy and governance, including a comprehensive seminar on forest certification and training on how to conduct certification audits.
3. Outreach activities to the broader forestry community. The program hosts a number of visitors to speak at Yale, as well as attending the key certification and sustainable forest policy conferences globally.

The program is housed on the fourth floor of Sage Hall. Students have the opportunity to work as researchers and/or assist in the coordination of program activities and certification assessment training. Our office includes a comprehensive reference database of nearly 10,000 sources including seminal journal articles and historical information relating to certification programs throughout the world, which we make available to students and faculty at Yale.

For details see [www.yale.edu/ypfpg](http://www.yale.edu/ypfpg).

### *The Forests Dialogue*

The Forests Dialogue (TFD) is an autonomous organization, with a Secretariat based at F&ES. TFD was created in 1998 to provide international leaders in the forest sector with an ongoing, multi-stakeholder dialogue (MSD) platform and process focused on

developing mutual trust, a shared understanding, and collaborative solutions to challenges in achieving sustainable forest management and forest conservation around the world. The Secretariat has been based at Yale since 2000.

The goal of TFD is to reduce conflict among stakeholders over the use and protection of vital forest resources. Over the last ten years, TFD has brought together more than 2,000 diverse leaders to work through eight compelling forest issues. Current TFD initiatives to address these issues include: Assessing Country-Level REDD Readiness Processes; Promoting Investment in Locally Controlled Forests; and Implementing “Free, Prior, and Informed Consent” on the ground. TFD utilizes the MSD model to progress from building trust among participants to achieving substantive, tangible outcomes. A primary reason for TFD’s success is that participants are committed to advocate for and work to implement those consensus-based outcomes.

TFD is governed by a Steering Committee composed of a diverse group of individuals representing key stakeholder perspectives from around the world. TFD hires F&ES students as interns each term to work with the Secretariat and Steering Committee members. Internship duties include background research, Secretariat support, dialogue planning, and implementation.

### *Program on Forest Physiology and Biotechnology*

The Program on Forest Physiology and Biotechnology (PFPB), under the leadership of Professor Graeme Berlyn, focuses primarily on the relationships of physiology, morphology, ecology, and genetics of forest plants to silviculture, sustainable forestry, forest carbon, and climate change. The main objectives of the biotechnology initiative are to analyze ecosystem impacts of biotechnology from biological, technical, and cultural perspectives; to evaluate strategies to minimize possible deleterious effects in these several dimensions; and to organize forums for discussion of the role of genetic techniques in forest health and forest tree improvement in ways that do not represent biological hazard to the future forests of the world. The use of genetically modified trees for restoration, increased forest productivity and carbon sequestration, and removal of pollutants is also a prime consideration.

Current work involves antioxidants, which inhibit pathogenesis and increase the natural resistance of the plant using chemical signaling to stimulate the production of protective compounds and protective tissues. Efforts are under way to improve the antioxidant systems (superoxide dismutase, ascorbic acid, glutathione, nitric oxide) in tree leaves in order to alleviate stress and carbon sequestration.

The program is located in the Greeley Laboratory, but the program’s research involves many arctic, alpine, boreal, temperate, and tropical biomes. There are numerous opportunities for students to be involved with the research.

### *Program on Landscape Management*

Forest ecosystems can be defined at a variety of scales—a stand, a landscape, a region, a continent. At all scales, they are dynamic—constantly changing from one condition to another. Managing forest ecosystems requires an understanding and appreciation of the biological, social, and economic dynamics of forest ecosystems. Past attempts to manage

at the individual stand scale proved difficult, since stands exist naturally in a variety of structures, and each structure provides different values. To provide all values, all structures need to be maintained by different stands across the landscape. This is the basis of the landscape approach to forest management.

The Landscape Management System (LMS) at the School of Forestry & Environmental Studies is a cooperative project with the University of Washington, the USDA Forest Service, and other organizations throughout the world. Its purpose is to develop the scientific basis, concepts, and tools needed to help people manage forests to provide the wide range of values people want—including commodities, wildlife habitat, fire safety, employment, and carbon sequestration. These values are best provided by coordinating the dynamic changes of forests across a landscape, rather than by trying to provide each or all values continuously on a single area.

The Program on Landscape Management is housed in Greeley Laboratory. Students have a range of opportunities to work with the program, from technical development of the modeling software to field data collection and synthesis.

### *Program on Private Forests*

The Program on Private Forests is engaged in education and research on the status and management of private forestlands, focusing on land use change dynamics, ownership trends, and demographics affecting private lands in the United States.

Growing populations and burgeoning global economies are increasing demands for forest products and services, thereby placing intense pressures on the world's forests. It is a considerable challenge to supply the demand for products and services while maintaining healthy, viable forests. Much of the pressure will be on private forests. For example, of the roughly 747 million acres of forest in the United States, almost 60 percent—430 million acres—is privately owned. These private lands provide the majority of the country's environmental services and forest products. It is estimated that 89 percent of the timber harvested in the United States comes from private lands, an increase from 76 percent in the 1970s.

Yale's historic role as a convener of diverse stakeholders and a facilitator and adviser to "unexpected coalitions" makes it a potent advocate and force for conservation and stewardship of private forests and for promoting dialogue and intelligent assessment of issues related to sustainable forestry on private lands. Combining the academic and research expertise at Yale with the practical experience of private sector leaders, we work to find innovative ways to bring various stakeholder communities together and to move toward a more sustainable future. Through our research, forums, and publications, we provide landowners and the public with topical, scientifically based information so that they can make more informed decisions. There are three major initiatives:

**Dynamic Models of Land Use Change** We are developing analytic tools and techniques to assist community leaders, conservation organizations, and citizens to understand and predict land use change dynamics, in particular changes in forested lands. The research into forest fragmentation patterns and dynamics, done in collaboration with the State University of New York College of Science and Forestry, is being conducted in the north-eastern United States.

**Sustaining Family Forests Initiative** The Yale Program on Private Forests is leading a U.S. national collaboration of government agencies, industry, NGOs, certification systems, landowners, and academics organized to gain comprehensive knowledge about family forest owners. Using social marketing methods, the project is aimed at creating credible, useful information about the family forest owners for those who wish to create a climate in which forest owners can easily find the information and services they desire to help them conserve and manage their land.

**Southern Hardwood Forest Research Initiative** The goal of this research project is to advance the understanding and management of hardwood forests in the southern United States. Research questions are designed to address the needs of private landowners focused on forest management on productive sites that are managed for timber as well as other ecosystem values.

The Program on Private Forests is located in Marsh Hall. Students have the opportunity to participate in all aspects of the program activities, including research, forums, workshops, and outreach.

### *School Forests*

The Yale School of Forestry & Environmental Studies owns and manages 10,900 acres of forestland in Connecticut, New Hampshire, and Vermont. Maintained as working forests deriving income from timber and other products, the School Forests provide educational, research, and professional opportunities for the students and faculty of the School; they are used as a laboratory for teaching, management, and research.

### *Program on Forest Health*

The Program on Forest Health is engaged in education, research, and dissemination of scientific information to inform policy decisions affecting the health of forested ecosystems and landscapes. We emphasize maintaining the long-term ecological health of forests despite biotic, abiotic, and societal pressures, and developing management solutions for sustaining and restoring healthy forests and the communities that depend on them.

Increasingly, forests face multiple stresses from insect outbreaks, invasive species, wildfires, disease, pollution, fragmentation, natural disturbances, and human impacts. In the face of these threats, forest managers are challenged to maintain forest ecosystems that provide environmental services, economic return, and recreational and aesthetic value to landowners and society. Good scientific information about emerging problems and complex interactions is crucial to ensure that management decisions today do not compromise the long-term health of forests.

Combining Yale's academic and research expertise with the practical experience of private sector leaders, we bring diverse stakeholder communities together to develop innovative management strategies and solutions to forest health problems, while promoting interdisciplinary assessments of critical forest health issues. Our research, forums, and publications provide policy makers and the public with topical, scientifically based information. We offer courses, seminars, and workshops for students and stakeholders and for public awareness. Graduate-level courses in forest health, fire science and policy, and

invasive species are taught as part of the School of Forestry & Environmental Studies curriculum.

Projects include forums, seminar series, workshops, and publications on threats and effects of invasive species, and research on forest health indicators, managing invasives in fire-dependent ecosystems, control of invasive plants to protect endangered species habitat, and use of prescribed fire to achieve forest management goals. Research on fire effects on forest vegetation and the converse—the effects of forest composition and structure on fire behavior—is being undertaken in the “sky islands” of West Texas and Mexico, as well as in boreal Alaska. A recent project resulted in the development of a decision support system for managing trees along public utilities’ rights of way to reduce power outage complications that result from tree failure due to disease and storms. We are participating in a statewide collaboration to monitor forest health in Connecticut and to derive a set of forest health indicators for tracking changes due to stressors, such as increasing forest fragmentation and climate change. Students are involved in all aspects of the program, including planning and organizing forums and speaker series and conducting research.

## PARTNERSHIPS

The School of Forestry & Environmental Studies is a multidisciplinary learning center with tremendous resources, both within and outside the School. The School is engaged in partnerships that range from alliances with other Yale programs and schools to formal agreements with many external organizations and universities. These relationships enrich the School and add important dimensions to the F&ES learning experience.

### *Within Yale*

Students of the School of Forestry & Environmental Studies often take advantage of the faculty and resources of other schools and departments within the Yale system. F&ES has several types of arrangements that enable students to fully benefit from the University.

The School has joint-degree agreements with the School of Architecture, Divinity School, School of Engineering & Applied Science, Law School, School of Management, School of Public Health, and the Graduate School’s programs in International Relations and International Development Economics. For further information on joint degrees, please refer to Joint Master’s Degree Programs and Combined Doctoral Degree.

The School has also cultivated relationships with key faculty members of other divisions of the University who have research and teaching interests that overlap with the School’s foci. These faculty hail from the schools of Architecture, Engineering & Applied Science, Management, and Medicine, as well as the departments of Geology and Geophysics, Ecology and Evolutionary Biology, Economics, and Anthropology, among others. For a full list of the faculty with joint appointments, see Courtesy Joint Appointments.

## YALE INSTITUTE FOR BIOSPHERIC STUDIES

Established in May 1990, the Yale Institute for Biospheric Studies (YIBS) serves as a key focus for Yale University’s research and training efforts in the environmental sciences. YIBS is committed to the teaching of environmental studies to future generations and

provides physical and intellectual centers for research and education that address fundamental questions that will inform the ability to generate solutions to the biosphere's most critical environmental problems. There are currently eight YIBS Research Centers: Center for Earth Observation; Center for Eco-Epidemiology; Center for the Ecology and Systematics of Animals on the Verge of Extinction (ECOSAVE); ECOSAVE Molecular Systematics and Conservation Genetics Laboratory; Center for Field Ecology; Center for Human and Primate Reproductive Ecology; Center for the Study of Global Change; and Earth System Center for Stable Isotopic Studies. The School's current interests are most closely aligned with the Centers for Earth Observation, Eco-Epidemiology, Molecular Systematics and Conservation Genetics, Field Ecology, and Stable Isotopic Studies. For full information on the Yale Institute for Biospheric Studies and its associated centers, please refer to the YIBS Web site, [www.yale.edu/yibs](http://www.yale.edu/yibs).

#### YALE PEABODY MUSEUM OF NATURAL HISTORY

The Yale Peabody Museum of Natural History, founded in 1866, contains one of the great scientific collections in North America. Numbering more than eleven million objects and specimens, the collections are used for exhibition and for research by scholars throughout the world. Each year, an increasing number of specimens from the collection are available online at [www.peabody.yale.edu](http://www.peabody.yale.edu).

The mission of the Peabody Museum is to advance understanding of earth's history through geological, biological, and anthropological research, and by communicating the results of this research to the widest possible audience through publication, exhibition, and educational programs.

Fundamental to this mission is stewardship of the museum's collections, which provide a remarkable record of the history of the earth, its life, and its cultures. Conservation, augmentation, and use of these collections become increasingly urgent as modern threats to the diversity of life and culture continue to intensify.

The museum's collections are a major component of the research and teaching activities of the Peabody and Yale. The curators and staff are engaged in contributing new knowledge based on the museum's research materials. All collections are used in undergraduate and graduate teaching and research, as well as in public programs and exhibitions. The Yale Peabody Museum fills many important roles on the Yale University campus, particularly as it has expanded its role in the community and the region, thereby offering a "front door" to the University for the general public.

In 1995, a formal collaboration was established among the Peabody Museum, the Yale Institute for Biospheric Studies, and the School of Forestry & Environmental Studies. This environmental partnership recognizes the Peabody Museum as a resource and catalyst for interdisciplinary research on the earth's history and environment, and seeks to strengthen the intellectual ties between the museum and other groups with a shared interest in environmental research at Yale. The School of Forestry & Environmental Studies maintains a close association with the Peabody. Among other activities involving F&ES faculty, staff, and students, the Peabody Field Station in Guilford, Connecticut, is used collaboratively for research on coastal and estuarine systems.

## *External Partnerships*

The School of Forestry & Environmental Studies has partnership agreements with numerous local, national, and international organizations beyond the Yale campus. The following are a few examples of these arrangements.

### **HUBBARD BROOK**

The Hubbard Brook Ecosystem Study in New Hampshire is a long-term multidisciplinary investigation of the structure, function, and interactions among atmospheric, terrestrial, and aquatic ecosystems. Proposed in 1960 by F.H. Bormann and started in 1963, Hubbard Brook is one of the oldest Long-Term Ecological Research sites supported by the National Science Foundation. As such, the facility has functioned as a national center and attracted investigators from a spectrum of biological and physical sciences. Faculty and students from F&ES continue to be active participants at “the Brook.”

F&ES Professor Emeritus F. Herbert Bormann and Gene E. Likens founded the Hubbard Brook Ecosystem Study. Today the School’s students and faculty benefit from more than forty years of data and hands-on clinical experience. The Hubbard Brook ecosystem provides collaborators with background data drawn from long-term records of climate, hydrology, precipitation, and stream-water chemistry; and with biological data from numerous ongoing studies. Cooperative research at Hubbard Brook has contributed to a better understanding of the northern forested ecosystem. The Hubbard Brook investigators are achieving the most fundamental aspect of ecosystem studies – the integration of data into a functioning scheme of ecosystem behavior through time.

### **NATIONAL UNIVERSITY OF SINGAPORE**

The National University of Singapore is a top research university with a far-reaching faculty and a multinational student body. The university offers a Master of Science in Environmental Management that provides environmental management education for senior and mid-level managers in corporations, institutions, and government and nongovernmental organizations. This program is multidisciplinary, with the combined resources of seven of the university’s faculties, as well as international, drawing on the expertise of established environmental agencies and institutions both locally and globally.

In 2001 the Yale School of Forestry & Environmental Studies entered into an official agreement with the National University of Singapore to share scientific, academic, and technical resources; exchange faculty and students; and cooperate in research, outreach, and conferences. There has been an active faculty exchange.

### **NEW YORK BOTANICAL GARDEN**

The School of Forestry & Environmental Studies has enjoyed a reciprocal relationship with the Graduate Studies Program at the New York Botanical Garden for many years. Begun in 1896, the Botanical Garden program currently enrolls several dozen students who are carrying out studies in systematic and economic botany at field sites around the world. The program’s expertise spans the spectrum of both systematic and economic botany. It is operated in conjunction with several other academic institutions, including the Yale School of Forestry & Environmental Studies.

The resources of the New York Botanical Garden include one of the largest botanical libraries in the world, with more than 1.25 million accessions, an herbarium with over six million specimens and 10,000 species of living plants housed in several greenhouses, as well as an electron microscope, environmental chambers, and instrumentation for radiobiological, biochemical, anatomical, molecular, phytochemical, chemosystematic, numerical taxonomy, and vegetational studies.

#### **THE ENERGY AND RESOURCES INSTITUTE**

The Energy and Resources Institute (TERI), a not-for-profit organization in New Delhi, India, was founded in 1974. Over the years, TERI has expanded from its initial purpose of documentation and information dissemination to become a dynamic and flexible organization with a global vision and a local focus. Twenty-five years ago, the institute initiated research projects in the fields of energy, environment, and sustainable development. Today, TERI is an internationally recognized center for research and outreach, and this reputation is rapidly being enhanced by the educational opportunities offered by TERI University.

The School of Forestry & Environmental Studies entered into an official agreement with TERI in 2001, whereby each organization agreed to support the other's faculty and student activities, thus expanding the resources of both learning institutions while fostering international relationships.

#### **EXTERNAL JOINT-DEGREE PROGRAMS**

The Yale School of Forestry & Environmental Studies also has joint-degree agreements with the Pace University School of Law and the Vermont Law School. Further information on these programs is available through the admissions office.

# Admissions: Master's Degree Programs

The School of Forestry & Environmental Studies offers four two-year master's degrees: the professionally oriented Master of Environmental Management (M.E.M.) and Master of Forestry (M.F.), and the research-oriented Master of Environmental Science (M.E.Sc.) and Master of Forest Science (M.F.S.). For individuals with seven or more years of relevant professional experience, a one-year midcareer option is available for the Master of Environmental Management and Master of Forestry degrees.

## LEARNING ABOUT F&ES

The best way to get to know the School is to come to New Haven to visit, if possible before submitting an application. Two open houses for prospective students are held during the fall term; another is held in April for admitted students. The open houses offer full-day programs, including breakfast and lunch. Participants meet faculty, students, and staff to learn about the mission and goals of the School, degree requirements and courses, opportunities for research and applied projects, career development, and life at Yale. Please check our Web site for information: [www.environment.yale.edu](http://www.environment.yale.edu). Click on *prospective students*.

Information sessions are held on Thursday mornings from 9 to 11 a.m. during the months of September through December when school is in session. Prospective students meet with members of the Admissions staff and current students. Please e-mail [fesinfo@yale.edu](mailto:fesinfo@yale.edu) or call 800.825.0330 to register for an information session. F&ES faculty and staff also conduct outreach events around the United States and abroad. The Admissions event schedule is posted at [www.environment.yale.edu/admissions](http://www.environment.yale.edu/admissions).

We encourage prospective students to visit campus at other times if they are unable to attend an open house or information session. Please note that no visits will be scheduled during March because of the admissions decision-making process. It is best to visit campus on a Monday through Thursday if possible. Few classes are held on Fridays, which are generally reserved for field trips and research. Visitors are welcome to sit in on classes of interest with no advance notice; the class schedule each term is posted at [www.environment.yale.edu/currentstudents](http://www.environment.yale.edu/currentstudents). Feel free to contact directly any faculty member whose work is of interest to you; e-mail is best. We do not conduct formal interviews. To schedule a visit, please contact us at [fesinfo@yale.edu](mailto:fesinfo@yale.edu).

Finally, we will be pleased to correspond with you about the School by e-mail, or you may schedule a telephone conversation with our Admissions staff. The Admissions Web site, [www.environment.yale.edu/admissions](http://www.environment.yale.edu/admissions), is full of information about the School.

## APPLICATION PROCEDURES

The application form for admission to the F&ES professional and research master's degrees (M.E.M., M.E.Sc., M.F., or M.F.S.) may be acquired online at <https://apply.environment.yale.edu/apply>. This form includes complete instructions for the application requirements.

Questions concerning admission or the application process should be directed to [fesinfo@yale.edu](mailto:fesinfo@yale.edu), or 800.825.0330.

The priority deadline for master's application consideration is December 15, 2010. Completed individual admissions files postmarked by midnight on this date are guaranteed to receive a review by the Admissions Committee. Application materials may be submitted after this date, but there is no guarantee that they will be acted upon this year. Therefore we encourage serious applicants to submit all required items to the Office of Admissions prior to the December 15 deadline.

Previous applicants planning to reapply to F&ES must submit a new application form and current application fee, an updated résumé/curriculum vitae, and transcripts depicting all academic work not included in the previous application. Admissions records including application forms and supplemental materials are held for two years by the Office of Admissions. Provided reapplication occurs within two admissions cycles, all required materials previously submitted to the Office of Admissions will be incorporated into the new application. Documents submitted prior to the fall 2009 admissions cycle are no longer available.

## PREPARATION FOR ADMISSION

The School welcomes individuals from a variety of undergraduate backgrounds including the biological and physical sciences, engineering, social sciences, mathematics, humanities, or interdisciplinary programs. A disciplinary focus with some interdisciplinary breadth is valuable. Introductory course work in the biological and physical sciences, the social sciences, and college mathematics allows students to take greater advantage of courses at the graduate level. Students with adequate undergraduate breadth also have better access to graduate course offerings in other professional schools and departments of the University.

Experience has demonstrated the special value of a short list of selected courses that provide a good foundation for all master's programs in the School. Therefore the Admissions Committee favors applicants who have successfully completed a combination of the courses listed below before beginning a degree program at the School. For this reason, it is highly recommended that applicants have at least (a) two college courses in mathematics, (b) two college courses in the biological sciences, (c) two college courses in the physical sciences, and (d) two college courses in the social sciences. The specific courses listed under each distribution area are judged to be most suitable for helping students gain the maximum benefit from Yale course offerings.

1. College mathematics – two courses selected from:
 

a. calculus	c. linear algebra
b. statistics	d. discrete mathematics
2. Biological science – two courses selected from:
 

a. evolutionary biology	c. botany
b. ecology	d. zoology
3. Physical science – two courses selected from:
 

a. general chemistry	c. geology/earth science
b. general physics	d. hydrology/soil science

4. Social science – two courses selected from:
  - a. anthropology
  - b. economics (micro and macro)
  - c. political science
  - d. sociology

AP courses will be accepted provided they are recorded on the college transcript.

## APPLICATION REQUIREMENTS

Candidates for admission must hold a four-year baccalaureate degree or an equivalent international degree, and are required to provide the following materials:

1. A completed online application form.
2. A résumé/curriculum vitae.
3. A personal statement discussing career plans and the reasons for applying to F&ES (600-word maximum).
4. One official transcript or mark sheet from each college and/or university attended. Non-English transcripts must be accompanied by official/certified English translations. A certified translation of the diploma certificate must also be provided if the transcript does not include the date of graduation and the type of degree awarded.
5. Three letters of reference (academic and/or professional). Submission of the recommendation form and a one-page letter is expected.
6. An official GRE, GMAT, or LSAT score report (copies will not be accepted).
7. An official TOEFL or IELTS score report if English is not a native or customary language of instruction (copies will not be accepted).
8. The \$80 application fee.

Note: Additional documents beyond those listed above will not be reviewed and may be discarded at the end of the admissions cycle.

All application materials should be sent to the Office of Master's Admissions, Yale School of Forestry & Environmental Studies, 195 Prospect Street, New Haven CT 06511-2509, U.S.A.

All applicants must hold a bachelor's-level degree and demonstrate satisfactory academic achievement, but there are no arbitrary standards or cutoffs for test scores or grade-point averages. Letters of reference from individuals who can evaluate the applicant's scholarship, professional activities, leadership skills, and career goals are especially valuable. Letters from undergraduate professors and/or professional supervisors are preferred. The School looks for students capable of making effective contributions to scientific knowledge or to professional service in addressing environmental problems. Special weight is given to relevant experiences obtained subsequent to graduation from college. Clarity regarding professional career goals is a critically important part of the applicant's personal statement. Faculty review teams read the applications submitted to the master's degree programs. Final admissions decisions rest on an integrated assessment of the components described above.

When taking the Graduate Record Examination (GRE) or Graduate Management Admissions Test (GMAT), applicants should indicate the School's Institution Code Number 3996 or 3TJ-WT-45; no department code is necessary. Applicants taking the Law School Admissions Test (LSAT) must contact the Office of Admissions for special

instructions. For further information, please visit the following Web sites: [www.gre.org](http://www.gre.org), [www.mba.com/mba](http://www.mba.com/mba), or [www.lsac.org](http://www.lsac.org). Official GRE and GMAT test results will be sent directly to the School by the testing services and generally arrive two to three weeks after the examination date. Please plan ahead so that scores will arrive by the December 15, 2010, application deadline.

## ENGLISH AS A SECOND LANGUAGE TRAINING REQUIREMENT

Applicants for whom English is not a native or customary language of university instruction must take the Test of English as a Foreign Language (TOEFL) or the International English Language Testing System (IELTS). When taking either test, applicants should indicate the School's Institution Code Number 3996; no department code is necessary. We will be accepting scores only from the Internet test this year. We will no longer accept the computer and paper tests. Additional information about TOEFL can be found by visiting [www.ets.org/toefl](http://www.ets.org/toefl). Information about IELTS can be found by visiting [www.ielts.org](http://www.ielts.org). Official test results will be sent directly to the School by the testing service and generally take two to three weeks to arrive.

We require a minimum TOEFL score of 100 on the Internet test. A minimum score of band 7.0 is required for the IELTS.

The Admissions Committee may require as a condition of acceptance that applicants for whom English is a second language, whose undergraduate degree work has not been conducted in English, or whose application suggests such a need, complete a six-week instructional program in written and spoken English conducted by Yale Summer Session.

This program begins in late June, preceding the summer training modules in technical skills, and includes fourteen hours per week of language instruction as well as general orientation to the United States, New Haven, and Yale University. For information about this program, which is available to all matriculating students, please contact the Yale English Language Institute, PO Box 208355, New Haven CT 06520-8355, U.S.A., or visit their Web site at [www.yale.edu/eli](http://www.yale.edu/eli).

Applicants are required to submit official copies of their academic records in English along with an explanation of the associated scoring and/or grading systems. During the application review process, international applicants may receive a phone call from the Office of Admissions' English as a Second Language (ESL) representative.

# Admissions: Doctoral Degree Program

The doctoral program is designed to develop the broad knowledge, analytical powers, technical skills, and creative thinking demanded of leaders in environmental and natural resources disciplines. Applicants should hold a bachelor's or master's degree in a field related to their intended program of study as expressed in the application.

## APPLICATION PROCEDURES

The Doctor of Philosophy (Ph.D.) degree is administered jointly by the School of Forestry & Environmental Studies and the Yale Graduate School of Arts and Sciences.

Applications for the Ph.D. program can be obtained from the Web site of the Yale Graduate School of Arts and Sciences at [www.yale.edu/graduateschool/admissions/index.html](http://www.yale.edu/graduateschool/admissions/index.html), or by contacting the Yale Graduate Admissions Office, 320 York Street, New Haven CT 06511; telephone, 203.432.2771. The application deadline for the Ph.D. program is January 2, 2011. Doctoral education involves a close pairing between the student and a faculty adviser. Before applying to the doctoral program, applicants must identify and contact one or two faculty members who would serve as their major advisers if accepted to the program.

The Graduate Record Examination (GRE) general test is required of all applicants. For additional information on the GRE, please visit their Web site, [www.gre.org](http://www.gre.org).

The Test of English as a Foreign Language (TOEFL) is required of all applicants whose native language is not English. This requirement is waived only for applicants who will have received a baccalaureate degree, or its international equivalent, prior to matriculation at Yale, from a college or university where English is the primary language of instruction. If you do not qualify for a waiver but have taken the TOEFL within the last two years, you will need to have your TOEFL scores released to the Yale Graduate School of Arts and Sciences (code 3987). If your scores can no longer be released, you will need to take the test. The International English Language Testing System (IELTS) may be substituted for the TOEFL. For additional information and the latest updates on the TOEFL and IELTS, please visit their Web sites at [www.ets.org/toefl](http://www.ets.org/toefl) and [www.ielts.org](http://www.ielts.org).

# Tuition, Fees, and Other Expenses

## TUITION AND FEES, 2010–2011

### *Master's Programs*

The 2010–2011 tuition for master's degrees (Master of Environmental Management, Master of Forest Science, Master of Environmental Science, and Master of Forestry) is \$30,400. Tuition for special students is based on the number of courses taken. The School reserves the right to revise tuition as it deems appropriate. Tuition does not include the required University hospitalization insurance fee, or materials fees charged by other schools and departments in the University.

Two-year master's students must pay full tuition for two years, regardless of the number of courses taken.

For 2010–2011, a single student should also anticipate expenses of \$1,200 for books and supplies, up to \$1,852 for medical coverage, living expenses of approximately \$13,198 for room and board for nine months, and \$250 for the Student Activities Fee.

### *Doctor of Philosophy Program*

The 2010–2011 tuition for the Ph.D. program is \$33,500. Most doctoral students receive a School fellowship that covers the cost of their tuition and provides a twelve-month stipend for the first five years of their program. In 2010–2011 the stipend is \$26,000. Doctoral students must pay a nominal continuing registration fee for no more than three years thereafter. In 2010–2011 the continuing registration fee is \$720.

For 2010–2011, a single student can expect living expenses of approximately \$18,920 for twelve months.

## REGISTRATION

All students in the master's programs must register for courses using the online registration system (available at [www.yale.edu/sis](http://www.yale.edu/sis)) within the normal shopping period. The shopping period is the first two weeks of classes for the fall and spring terms (see academic calendar). A penalty of \$25 will be charged for late registration.

International students are required to complete a nonacademic registration at the Office of International Students and Scholars prior to their regular academic registration.

## PART-TIME PROGRAM

The charge per term for part-time students is 25 percent of tuition for one course, 50 percent for two courses, 75 percent for three courses, and full tuition for four or more courses.

## CONTINUOUS REGISTRATION

Master's degree students who wish to pursue their research through a six-month or one-year internship are permitted to do so and are considered enrolled on a full-time basis (student is entitled to continue membership in Yale Health and defer student loans). Upon return, the student will register as a full-time student and pay tuition for the period

needed to complete his/her degree requirements. Students may not register for regular course work, or work as a teaching assistant, while on continuous registration status. The fee for continuous registration is \$1,000 per term.

## TUITION DEPOSIT

Upon acceptance of admission, a deposit of \$500 payable directly to the Yale School of Forestry & Environmental Studies is required to hold a place in the entering class. If a decision is made not to matriculate, the deposit will not be refunded.

## TUITION REBATE AND FINANCIAL AID REFUND POLICY

On the basis of the federal regulations governing the return of federal student aid (Title IV) funds for withdrawn students, the rebate and refund of tuition are subject to the following policy.

1. For purposes of determining the refund of federal student aid funds, any student who withdraws from the School of Forestry & Environmental Studies for any reason during the first 60 percent of the term will be subject to a pro rata schedule that will be used to determine the amount of Title IV funds a student has earned at the time of withdrawal. A student who withdraws after the 60 percent point has earned 100 percent of the Title IV funds. In 2010–2011, the last days for refunding federal student aid funds will be October 29, 2010, in the fall term and March 28, 2011, in the spring term.
2. For purposes of determining the refund of institutional aid funds and for students who have not received financial aid:
  - a. 100 percent of tuition will be rebated for withdrawals that occur on or before the end of the first 10 percent of the term (September 10, 2010, in the fall term and January 19, 2011, in the spring term).
  - b. A rebate of one-half (50 percent) of tuition will be granted for withdrawals that occur after the first 10 percent but on or before the last day of the first quarter of the term (September 25, 2010, in the fall term and February 4, 2011, in the spring term).
  - c. A rebate of one-quarter (25 percent) of tuition will be granted for withdrawals that occur after the first quarter of a term but on or before the day of midterm (October 20, 2010, in the fall term and March 2, 2011, in the spring term).
  - d. Students who withdraw for any reason after midterm will not receive a rebate of any portion of tuition.
3. The death of a student shall cancel charges for tuition as of the date of death, and the bursar will adjust the tuition on a pro rata basis.
4. If the student has received student loans or other forms of financial aid, rebates will be refunded in the order prescribed by federal regulations; namely, first to Federal Unsubsidized Direct Loans, if any; then to Federal Subsidized Direct Loans, if any; then to Federal Perkins Loans; Federal Direct Graduate PLUS Loans; next to any other federal, state, private, or institutional scholarships and loans; and, finally, any remaining balance to the student.

5. Recipients of federal and/or institutional loans who graduate or withdraw are required to have an exit interview before leaving Yale. Students leaving Yale receive a mailing from Student Financial Services with an exit packet and instructions on completing this process.

## STUDENT ACCOUNTS AND BILLS

Student accounts, billing, and related services are administered through the Office of Student Financial Services, which is located at 246 Church Street. The telephone number is 203.432.2700.

### *Bills*

Yale University's official means of communicating monthly financial account statements is through the University's Internet-based system for electronic billing and payment, Yale University eBill-ePay.

Student account statements are prepared and made available twelve times a year at the beginning of each month. Payment is due in full by 4 p.m. Eastern Standard Time on the first business day of the following month. E-mail notifications that the account statement is available on the University eBill-ePay Web site ([www.yale.edu/sis/ebep](http://www.yale.edu/sis/ebep)) are sent to all students at their official Yale e-mail addresses and to all student-designated authorized payers. It is imperative that all students monitor their Yale e-mail accounts on an ongoing basis.

Bills for tuition, room, and board are available to the student during the first week of July, due and payable by August 1 for the fall term; and during the first week of November, due and payable by December 1 for the spring term. The Office of Student Financial Services will impose late fees of \$125 per month (up to a total of \$375 per term) if any part of the term bill, less Yale-administered loans and scholarships that have been applied for on a timely basis, is not paid when due. Nonpayment of bills and failure to complete and submit financial aid application packages on a timely basis may result in the student's involuntary withdrawal from the University.

No degrees will be conferred and no transcripts will be furnished until all bills due the University are paid in full. In addition, transcripts will not be furnished to any student or former student who is in default on the payment of a student loan.

The University may withhold registration and certain University privileges from students who have not paid their term bills or made satisfactory payment arrangements by the day of registration. To avoid delay at registration, students must ensure that payments reach Student Financial Services by the due dates.

### *Charge for Rejected Payments*

A processing charge of \$25 will be assessed for payments rejected for any reason by the bank on which they were drawn. In addition, the following penalties may apply if a payment is rejected:

1. If the payment was for a term bill, a \$125 late fee will be charged for the period the bill was unpaid.

2. If the payment was for a term bill to permit registration, the student's registration may be revoked.
3. If the payment was given to settle an unpaid balance in order to receive a diploma, the University may refer the account to an attorney for collection.

### *Yale University eBill-ePay*

There are a variety of options offered for making payments. Yale University eBill-ePay is the preferred means for payment of bills. It can be found at [www.yale.edu/sis/ebep](http://www.yale.edu/sis/ebep). Electronic payments are easy and convenient—no checks to write, no stamps, no envelopes, no hassle. Payments are immediately posted to the student's account. There is no charge to use this service. Bank information is password-protected and secure, and there is a printable confirmation receipt. Payments can be made twenty-four hours a day, seven days a week, up to 4 p.m. Eastern Standard Time on the due date to avoid late fees. (The eBill-ePay system will not be available when the system is undergoing upgrade, maintenance, or repair.) Students can authorize up to three authorized payers to make payments electronically from their own computers to the student's account using Yale's system.

Use of the student's own bank payment service is not authorized by the University because it has no direct link to the student's Yale account. Payments made through such services arrive without proper account identification and always require manual processing that results in delayed crediting of the student's account, late fees, and anxiety. Students should use Yale eBill-ePay to pay online. For those who choose to pay by check, remittance advice with mailing instructions is available on the Web site.

### *Yale Payment Plan*

The Yale Payment Plan (YPP) is a payment service that allows students and their families to pay tuition, room, and board in ten equal monthly installments throughout the year based on individual family budget requirements. It is administered by the University's Office of Student Financial Services. The cost to enroll in the YPP is \$100 per contract. The deadline for enrollment is June 18. For additional information, please contact Student Financial Services at 203.432.2700 and select "Press 3" from the Main Menu. The enrollment form can be found online in the Yale Payment Plan section of the Student Accounts Web site: [www.yale.edu/sfas/financial/accounts.html#payment](http://www.yale.edu/sfas/financial/accounts.html#payment).

## MASTER'S FINANCIAL AID, 2010 – 2011

### *Policy and Procedures*

The School offers financial aid packages that could include scholarships, student employment, and loans to students with demonstrated financial need. To be considered for financial aid, new and returning students must submit the required financial aid applications by the stated deadline (see F&ES financial aid Web site for requirements). The level of funding for each student is determined at the time of admission; therefore, it is critical that all financial aid application deadlines are met. Students must apply for aid each year; however, the amount of aid will remain the same in the second year as long as there is demonstrated financial need and the student remains in good academic standing.

Financial aid materials are updated annually, incorporating new regulations, changes in eligibility requirements, and other pertinent information. New financial aid applications are available in November of the year prior to matriculation—November 2010 for matriculation in fall 2011. New forms are available on the School's Web site, [www.environment.yale.edu/about/Financial-Aid-Forms](http://www.environment.yale.edu/about/Financial-Aid-Forms), after November 1.

Yale College students applying for the Fifth Year Deferred program at F&ES apply for financial aid in the March before the term of enrollment; joint school applicants must apply for F&ES financial aid at the time they apply for admission to F&ES. If awarded scholarships at the time of admission, the scholarship award remains the same when the student matriculates at F&ES.

U.S. citizens requesting financial aid must complete:

- the Free Application for Federal Student Aid (FAFSA), available on the Web at [www.fafsa.ed.gov](http://www.fafsa.ed.gov)
- the School of Forestry & Environmental Studies online Financial Aid Application

International students requesting financial aid must complete:

- the School of Forestry & Environmental Studies online Financial Aid Application

## SCHOLARSHIPS

Students who demonstrate financial need may receive a scholarship to cover a portion of the student budget, which includes estimated costs for tuition, living expenses, books/supplies, and health insurance. Because funds are limited, scholarships are awarded to the top admissions candidates with demonstrated financial need who complete their applications by the stated deadlines. In combination with employment and loans, these students can often meet the full cost of their education. A majority of our scholarship budget is funded by private donors. Students are automatically considered for all named scholarships by completing the School's Financial Aid Application and the FAFSA. The named scholarships are *not* in addition to any general scholarship a student receives in his/her financial aid award package. Students meeting the criteria for a specific named scholarship are matched after students decide to enroll and accept the financial aid offer.

We are delighted to recognize here the generosity of the donors who have helped make the following scholarships possible.

## NAMED SCHOLARSHIPS

Beinecke/FES Scholarship #1

Beinecke/FES Scholarship #2

Jabe Blumenthal Scholarship

Forrest Berkeley Conservation Scholars

Sara Shallenberger Brown Scholarship

Leland H. Burt ('30 B.S.) Endowed Scholarship Fund

Philip Laurance Buttrick (M.F. 1911) Fund

Paul Douglas Camp Memorial Scholarship Fund

Leonard G. Carpenter (B.A. 1924) Scholarship Fund

Elias and Ann Clark Scholarship

Class of 1980 Scholarship Fund

Abigail Disney and Pierre Hauser Scholarship  
 Strachan Donnelley Scholarship  
 Strachan and Vivian Donnelley Endowed Scholarship Fund  
 Michael P. Dowling Scholarship  
 Doris Duke Conservation Fellows  
 Enid Storm Dwyer Scholarship Fund  
 Boyd Evison Scholarship Fund  
 Edith and Johannes Fröndt Scholarship Fund  
 John S. Griswold (B.A. 1937) Scholarship Fund  
 H. Stuart Harrison (B.A. 1932) Fellowship Fund  
 Vira I. Heinz Endowment Scholarship  
 John and Catha Hesse Fund  
 Adelaide Hixon Endowed Scholarship Fund  
 Joseph M. Hixon III FES Scholarship  
 Jacqueline C. and John R. Hullar Scholarship Fund  
 Stephen and Betty Kahn Scholarship Fund  
 Marvin Klemme (M.F. 1935) Fellowship Fund  
 Kroon Environmental Studies Scholarship Fund  
 Fred Krupp Scholarship in Environmental Studies  
 Leadership Scholars Fund  
 John A. MacLean Scholarship  
 Preston R. Miller Jr. '71 F&ES Scholarship Fund  
 John M. Musser Fellowship  
 Caroline P. Niemczyk Scholarship  
 Carl F. Norden Family Scholarship Fund  
 Gilman Ordway (B.A. 1947) Family Scholarship Fund for Environmental Studies  
 Rockefeller-Underhill Scholarship for Tropical Conservation  
 Benjamin F. Stapleton, Jr. (LL.B. 1942) Scholarship Fund  
 John R. Twiss (1960) Student Conservation Association Fellowship  
 Rodney B. Wagner Class of 1954 International Scholarship Fund  
 Charles F. Wilson (B.A. 1939) Memorial Fund  
 Ray L. Wilson Scholarship Fund  
 Frank & Lynne Wisneski F&ES Scholarship Fund  
 Wyss Foundation Scholarship

#### OUTSIDE FUNDING FROM FELLOWSHIPS AND SCHOLARSHIPS

Students are strongly urged to compete for outside fellowships and scholarships that can be used at Yale. We encourage applicants to apply for these scholarships before being admitted. Over 350 outside scholarships are listed in the Outside Scholarship Excel Database located on the School's Web site: [www.environment.yale.edu/about/Outside-Scholarship-Resources](http://www.environment.yale.edu/about/Outside-Scholarship-Resources). In addition to financial advantages, a student who receives an award in a national competition earns genuine distinction. In the past, F&ES students have been recipients of awards from the Environmental Protection Agency, the National Science Foundation, the Robert and Patricia Switzer Foundation, the Leopold Schepp Foundation, and the Institute of International Education (Fulbright), among others.

Enrolled students can compete for fellowships offered by the Heinz Family Foundation to support master's project research. In addition, the Doris Duke and Wyss Conservation Fellowships are available to enrolled students for awarding in the second year of their master's degree. Some outside awards may be matched with School awards up to combined levels that are no higher than the normal educational expense budget.

#### EMPLOYMENT OPPORTUNITIES

Ninety to one hundred F&ES student assistantships (work-study) are also available to F&ES students based on financial eligibility. These positions pay \$15 per hour and vary from clerical work to research, editorial, or library work. A list of positions is available in late summer for students who are eligible (noted in financial aid award letter).

Student employment opportunities are listed on the Student Employment Office (SEO) Web site at [www.yalestudentjobs.org](http://www.yalestudentjobs.org). Positions are located throughout the University and the city of New Haven, with hourly rates of \$11 to \$15. The Web site job listings for F&ES positions are updated in late summer.

Teaching Fellowships are also available at the University. Each department makes its own hiring decisions; therefore, interested students must contact the departments directly. The typical salary is approximately \$4,000 per term. The Financial Aid Office does not manage teaching fellowships.

#### LOANS FOR U.S. CITIZENS AND PERMANENT RESIDENT STUDENTS

Yale University participates in the federal Direct Student Loan programs: the Direct Loan program, the Perkins program, and the Graduate PLUS Loan program. To qualify, a student must be a U.S. citizen or permanent resident and meet certain requirements determined by the FAFSA.

Graduate students are eligible to borrow up to \$20,500 in Stafford loans, of which up to \$8,500 may be subsidized by the federal government. Perkins loans, capped at \$6,000, are available to second-year students who demonstrate need beyond the level of a subsidized Stafford loan. While Direct Loans are available to all eligible borrowers, Perkins loans are limited by available funds. Graduate students are also eligible to directly borrow up to the cost of their education, less other financial aid received, through the Federal Direct Graduate PLUS Loan program. Students must apply directly to a lender for the Direct Graduate PLUS Loan (form available on the F&ES Financial Aid Forms Web page). For more details on these programs, refer to the government Web site at [www.fafsa.ed.gov](http://www.fafsa.ed.gov), the 2010–2011 F&ES Financial Aid Fact Sheet, or the Financial Aid staff

#### LOANS FOR INTERNATIONAL STUDENTS

All international graduate students at Yale are eligible to apply for Yale's preferred alternative loan, the Yale International Student Loan. Students who qualify can use this loan to cover up to the full cost of attendance (single student budget), less any other financial aid received. The Yale International Loan has a high approval rate for international students and offers a low interest rate with no payments while a student is in school. More information is available at [www.environment.yale.edu/about/Loans](http://www.environment.yale.edu/about/Loans).

## *International Student Scholarships*

In order to apply for financial aid from the School, international students must complete the School of Forestry & Environmental Studies online Financial Aid Application, which is available on the School Web site, [www.environment.yale.edu/about/Financial-Aid-Forms](http://www.environment.yale.edu/about/Financial-Aid-Forms). This must be submitted by the stated deadline to be considered for a financial aid award. The Financial Aid Office offers scholarships and employment opportunities to as many international students as our resources will allow; however, most students need additional support. International students are also encouraged to seek support from their governments, employers, or various international agencies.

Four scholarships are offered to meet full or partial need of international students from Africa, Asia, and Latin America. All admitted students are automatically considered for these awards, which are based on the strength of the applicant's admissions material. The School also has agreements with a number of international organizations to provide matching funds. Students are encouraged to contact organizations such as:

- the Muskie Program administered by the Open Society Institute (a Soros foundation) for students from countries once belonging to the former Soviet Union
- the LASPAU program for students from Latin America and the Caribbean
- the Institute for International Education Fulbright program, which supports educational exchanges that strengthen understanding and communication between the United States and over 140 countries
- the World Wildlife Fund, which invests in the academic training of conservationists in Africa, Asia, and Latin America
- the ATLAS program for African students

International students must certify full funding for their entire two-year course of study before visa documents can be issued. Instructions and forms are mailed in May after an admitted student accepts the offer of admission (in April). More information is available at the Web site of Yale's Office of International Students and Scholars ([www.oiss.yale.edu](http://www.oiss.yale.edu)).

## LEAVE OF ABSENCE

Students are expected to follow a continuous course of study at the School of Forestry & Environmental Studies. However, a student who wishes or needs to interrupt his or her study temporarily may request a leave of absence. There are three types of leave—personal, medical, and parental—all of which are described below. The general policies that apply to a leave of absence are:

1. Any student who is contemplating a leave of absence should see the director of student services to discuss the necessary application procedures.
2. All leaves of absence must be approved by the director of student services and the associate dean for academic affairs. Medical leaves also require the written recommendation of a physician on the staff of Yale Health, as described below.
3. A student may be granted a leave of absence of one to two years. Any leave approved by the director of student affairs and the associate dean for academic affairs will be for a specified period.

4. International students who apply for a leave of absence must consult with OISS regarding their visa status.
5. A student on a leave of absence may complete outstanding work in courses for which he or she has been granted extensions. He or she may not, however, fulfill any other degree requirements during the time on leave.
6. A student on a leave of absence is not eligible for financial aid, including loans; and in most cases, student loans are not deferred during periods of nonenrollment.
7. A student on a leave of absence is not eligible for the use of any University facilities normally available to enrolled students.
8. A student on leave of absence may continue to be enrolled in Yale Health by purchasing coverage through the Student Affiliate Coverage plan. In order to secure continuous coverage from Yale Health, enrollment in this plan must be requested prior to the beginning of the term in which the student will be on leave. If a leave of absence is granted during the term, the student must request Yale Health Affiliate Coverage enrollment within thirty days of the date when the leave is approved. Coverage is not automatic; enrollment forms are available from the Member Services Department of Yale Health, 203.432.0246, or can be downloaded from the Yale Health Web site ([www.yale.edu/uhs](http://www.yale.edu/uhs)).
9. A student on a leave of absence does not have to file a formal application for readmission. However, he or she must notify the director of student services in writing of his or her intention to return at least eight weeks prior to the end of the approved leave. In addition, if the returning student wishes to be considered for financial aid, he or she must submit appropriate financial aid applications to the School's financial aid office to determine eligibility.
10. A student on a leave of absence who does not return at the end of an approved leave, and does not request and receive an extension from the dean, is automatically dismissed from the School.

**Personal leave of absence** A student who wishes or needs to interrupt study temporarily because of personal exigencies may request a personal leave of absence. The general policies governing all leaves of absence are described above. A student who is current with his or her degree requirements is eligible for a personal leave after satisfactory completion of at least one term of study. Personal leaves cannot be granted retroactively and normally will not be approved after the tenth day of a term.

To request a personal leave of absence, the student must apply in writing before the beginning of the term for which the leave is requested, explaining the reasons for the proposed leave and stating both the proposed start and end dates of the leave, and the address at which the student can be reached during the period of the leave. If the director of student services and the associate dean for academic affairs find the student to be eligible, the leave will be approved. In any case, the student will be informed in writing of the action taken. A student who does not apply for a personal leave of absence, or whose application for a leave is denied, and who does not register for any term, will be considered to have withdrawn from the School.

**Medical leave of absence** A student who must interrupt study temporarily because of illness or injury may be granted a medical leave of absence with the approval of the director of student services and the associate dean for academic affairs, on the written

recommendation of a physician on the staff of Yale Health. The general policies governing all leaves of absence are described above. A student who is making satisfactory progress toward his or her degree requirements is eligible for a medical leave any time after matriculation. The final decision concerning a request for a medical leave of absence will be communicated in writing by the director of student services.

The School of Forestry & Environmental Studies reserves the right to place a student on a medical leave of absence when, on the recommendation of the director of Yale Health or the chief of the Department of Mental Health and Counseling, the dean of the School determines that the student is a danger to self or others because of a serious medical problem.

A student who is placed on medical leave during any term will have his or her tuition adjusted according to the same schedule used for withdrawals (see Tuition Rebate and Refund Policy). Before re-registering, a student on medical leave must secure written permission to return from a Yale Health physician.

**Leave of absence for parental responsibilities** A student who wishes or needs to interrupt his or her study temporarily for reasons of pregnancy, maternity care, or paternity care may be granted a leave of absence for parental responsibilities. The general policies governing all leaves of absence are described above. A student who is making satisfactory progress toward his or her degree requirements is eligible for parental leave any time after matriculation.

Any student planning to have or care for a child is encouraged to meet with the director of student services to discuss leaves and other short-term arrangements. For many students, short-term arrangements rather than a leave of absence are possible. Students living in University housing units are encouraged to review their housing contract and the related policies of the Graduate Housing Office before applying for a parental leave of absence. Students granted a parental leave may continue to reside in University housing to the end of the academic term for which the leave was first granted, but no longer.

## U. S. MILITARY LEAVE READMISSIONS POLICY

Students who wish or need to interrupt their studies to perform U.S. military service are subject to a separate U.S. military leave readmissions policy. In the event a student withdraws or takes a leave of absence from the School of Forestry & Environmental Studies to serve in the U.S. military, the student will be entitled to guaranteed readmission under the following conditions:

1. The student must have served in the U.S. Armed Forces for a period of more than thirty consecutive days;
2. The student must give advance written or verbal notice of such service to the director of student services and the associate dean for academic affairs. In providing the advance notice the student does not need to indicate whether he or she intends to return. This advance notice need not come directly from the student, but rather, can be made by an appropriate officer of the U.S. Armed Forces or official of the U.S. Department of Defense. Notice is not required if precluded by military necessity. In all cases, this notice requirement can be fulfilled at the time the student seeks readmission, by submitting an attestation that the student performed the service.

3. The student must not be away from the School to perform U.S. military service for a period exceeding five years (this includes all previous absences to perform U.S. military service but does not include any initial period of obligated service). If a student's time away from the School to perform U.S. military service exceeds five years because the student is unable to obtain release orders through no fault of the student or the student was ordered to or retained on active duty, the student should contact the director of student services to determine if the student remains eligible for guaranteed readmission.
4. The student must notify the School within three years of the end of his or her U.S. military service of his or her intention to return. However, a student who is hospitalized or recovering from an illness or injury incurred in or aggravated during the U.S. military service has up until two years after recovering from the illness or injury to notify the School of his or her intent to return.
5. The student cannot have received a dishonorable or bad conduct discharge or have been sentenced in a court-martial.

A student who meets all of these conditions will be readmitted for the next term, unless the student requests a later date of readmission. Any student who fails to meet one of these requirements may still be readmitted under the general readmission policy but is not guaranteed readmission.

Upon returning to the School, the student will resume his or her education without repeating completed course work for courses interrupted by U.S. military service. The student will have the same enrolled status last held and with the same academic standing. For the first academic year in which the student returns, the student will be charged the tuition and fees that would have been assessed for the academic year in which the student left the institution. Yale may charge up to the amount of tuition and fees other students are assessed, however, if veteran's education benefits will cover the difference between the amounts currently charged other students and the amount charged for the academic year in which the student left.

In the case of a student who is not prepared to resume his or her studies with the same academic status at the same point where the student left off or who will not be able to complete the program of study, the School of Forestry & Environmental Studies will undertake reasonable efforts to help the student become prepared. If after reasonable efforts, the School determines that the student remains unprepared or will be unable to complete the program, or after the School determines that there are no reasonable efforts it can take, the School may deny the student readmission.

# Life at the School of Forestry & Environmental Studies

## EDUCATIONAL FACILITIES

Kroon Hall, the new ultra-green home of F&ES, expresses in physical form the School's best traditions, values, and aspirations. The building achieves its remarkable energy savings from a host of design elements and technical strategies molded to fit the building's New England weather and climate. Located in the area of the University known as Science Hill, Kroon Hall is named for the family of benefactor and Yale College alumnus Richard Kroon, B.A. 1964. With its high barrel-vaulted gable ends, simple lines, and curved rooftop, Kroon Hall is a modernist blend of cathedral nave and Connecticut barn.

The \$33.5 million building was designed by Hopkins Architects of Great Britain in partnership with Connecticut-based Centerbrook Architects and Planners, and has been awarded the highest rating—platinum—in the green-building certification program, Leadership in Energy and Environmental Design (LEED). Kroon Hall provides 58,200 square feet and is designed to use 50 percent less energy than a comparably sized modern building. Its tall, thin shape and east-west orientation play a big role in heating and cooling. The lowest floor is set into a hillside, with only its south side exposed, providing thermal insulation, minimizing northern exposure, and increasing the amount of natural light that enters the building from adjacent courtyards. The long south facade maximizes solar gain during the winter, and red cedar louvers covering glass facades on the east and west ends keep out unwanted heat and glare. The building's shape, combined with the glass facades, enables daylight to provide much of the interior's illumination. Light and occupancy sensors dim artificial lighting when it is not needed.

Kroon Hall provides office space for seventy-five faculty and staff members and features three classrooms. The 125-seat Burke Auditorium is used for lectures and classes, and commands beautiful views of West Rock and the David S. Ingalls Rink across the street. The Knobloch Environment Center is meant for socializing, but students have also embraced it as a study space. The Ordway Learning Center on the ground floor also has ample space for quiet study.

A 100-kilowatt rooftop array of photovoltaic panels provides 25 percent of the electricity, and Renewable Energy Certificates have been purchased to provide the rest, reducing to zero the greenhouse gas emissions from Kroon Hall's operation. Four 1,500-foot-deep wells use the relatively constant 55-degree (F) temperature of underground water for heating and cooling, replacing the need for conventional boilers and air conditioning. Four solar panels embedded in the southern facade provide hot water. Exposed concrete walls and ceilings provide thermal stability by retaining heat in winter and cold in summer. Instead of air being forced through overhead ducts, an energy-saving displacement ventilation system moves warm and cool air through an air plenum and multiple diffusers in elevated floors. Low-velocity fans in the basement keep the air circulating throughout the building. In winter, the ventilation system also transfers the heat from exhaust to incoming fresh air, and in summer, air handling units spray water on incoming fresh air, reducing its temperature by up to 18 degrees through evaporation. In mild weather,

Kroon's occupants assist in the ventilation by opening windows in response to an electronic, color-coded prompt system.

A rainwater-harvesting system channels water from the roof and grounds to a garden in the south courtyard, where aquatic plants filter out sediment and contaminants. The gray water, held in underground storage tanks, is used for irrigation and pumped back into Kroon for flushing toilets. The system is designed to save 500,000 gallons of potable city water annually and to reduce the burden on city sewers by lessening the amount of storm runoff. Half of Kroon Hall's red oak paneling—15,000 board feet—came from the 7,840-acre Yale Myers Forest in northern Connecticut, which is managed by the School. The building's pale yellow exterior, composed of sandstone from Ohio, echoes other Yale buildings. The north and south courtyards were constructed to create a community from disparate buildings on Science Hill. The south courtyard, landscaped by Olin Studio of Philadelphia, is a raised platform, with a green roof of soil one foot deep and surrounded by twenty-five varieties of native plantings. Underneath the courtyard is a service node, centralizing all pickups for trash and recycling and deliveries for the southwest corner of Science Hill and accessible by a single driveway off Sachus Street.

Sage Hall, a four-story building located at 205 Prospect Street and a gift of William H. Sage, B.A. 1865, in memory of his son, DeWitt Linn Sage, B.A. 1897, was completed in 1923. Administrative, doctoral program, development, alumni, and program offices of the School are housed in Sage Hall, along with three classrooms. Sage Hall is home to a microcomputer center for students, with thirty-seven IBM computers, each with GIS capabilities. Sage also houses a 490-square-foot student lounge, appointed with a large table and comfortable couches, which students use for studying, special events, and weekly social events. Bowers Auditorium is designed to handle large lectures and seminars as well as small group projects. Bowers, which has a seating capacity of over 110 with tables and chairs, was built onto Sage Hall in 1931 with funds provided by the bequest of Edward A. Bowers, B.A. 1879.

Facilities for research and instruction in silviculture, natural resource and forest economics, forest policy, and biometry are in Marsh Hall at 360 Prospect Street in the Marsh Botanical Garden. This large, four-story mansion was originally the residence of Professor Othniel C. Marsh, B.A. 1860, a distinguished paleontologist and Western explorer of the nineteenth century. He bequeathed the building to the University in 1899, and for twenty-five years it housed the entire Forest School. Marsh Hall was designated a National Historic Landmark by the United States Department of the Interior in 1965.

The William B. Greeley Memorial Laboratory at 370 Prospect Street, named in honor of William Buckhout Greeley, M.F. 1904, is a one-story building with a classroom and seven laboratories for work in ecosystem ecology, environmental chemistry, wood anatomy and developmental morphology, soils, plant and wildlife ecology, tree physiology, forest microbiology, and forest pathology. Adjacent to the Greeley lab is a 3,800-square-foot greenhouse, which is used for hands-on learning and research. Greeley Laboratory and its greenhouse were built in 1959 with funds from the forest industries, the John A. Hartford Foundation, and other benefactors.

The Class of 1954 Environmental Science Center at 21 Sachus Street is dedicated to the Class of 1954 in honor of the \$70 million the class donated in 2000 to support new science buildings and other major University priorities. It is an interdisciplinary

facility built by the University with the aim of further fostering leadership in teaching and research of science and engineering. The building was designed to encourage collaboration among faculty and students pursuing environmental studies. Four natural science faculty members from F&ES have their laboratories in the Environmental Science Center, which also houses research laboratories for the Yale Science Departments of Ecology and Evolutionary Biology, Geology and Geophysics, and Anthropology as well as the Yale Institute for Biospheric Studies.

The restored former residences at 301 Prospect Street and 380 Edwards Street house the offices of many of the School's faculty and staff, as well as doctoral student offices; each building has a classroom.

### *Library Collection*

The Henry S. Graves Memorial Library Collection for the School of Forestry & Environmental Studies, one of the oldest and largest collections of forestry publications in the world, is located in the Kline Science Library in Kline Biology Tower. It is named in honor of the School's first dean, who purchased the initial collection of German forestry books and continued to support a strong library serving the School's graduate forestry program.

Current holdings in the Graves Collection consist of more than 100,000 books, documents, technical reports, and serial publications dealing with forestry, forest science, natural resource management, and environmental sciences and management. The collection receives more than 100 journal, periodical, and other serial publication titles. Older materials in the Graves Collection are housed in both the Seeley G. Mudd Library and the Library Shelving Facility. All materials are accessible through the Yale Library electronic catalog, ORBIS.

The Graves Collection is committed to acquiring whatever books and journals are needed to support the School's teaching and research activities. In addition, students have access to the enormous holdings of the Yale University Library, described below.

Reference and information services are provided locally, with the F&ES librarian having an office in Kroon Hall, while additional aid is available from reference librarians in the nearby Kline Science and Social Science libraries. Access to electronic databases covering the wide range of subjects of interest within the School (e.g., Environmental Science and Pollution Management Collection, CAB Abstracts, BIIOSIS, and Web of Science) is provided through the library's Web site at [www.library.yale.edu/science/subject/forestry.html](http://www.library.yale.edu/science/subject/forestry.html). These research tools and others, on such subjects as international affairs, water, soils, fish, wildlife, policy affairs, and law, are accessible throughout the campus. As a part of Yale University Library system, the Graves Collection participates in all library services offered to Yale patrons: paper-based, electronic, local, and through interlibrary loan services.

### *Computer Resources*

The mission of the Office of Information Technology is to support all aspects of computing for every member of the Yale School of Forestry & Environmental Studies, and to provide training in the fundamental use of computers in educational and administrative applications. Because it is our policy to focus on supporting individuals rather than

specific user configurations, we use and support multiple platforms, including IBM/Windows, Apple Macintosh, and Sun/Unix. Students are encouraged, but not required, to bring their own computers, and they may contact the director of Information Technology for advice on the selection of appropriate hardware and software. We currently encourage strongly the purchase of Apple Macintosh laptop computers. Because of the growing availability of wireless access throughout the Yale campus, students are encouraged to purchase laptops with wireless capability.

The F&ES IT department (F&ES-IT) maintains a student computing cluster in Sage 39, which has recently been upgraded with twenty-eight iMac computers, which feature 21.5-inch displays, Nvidia 9400 video cards, 3.06 GHz Intel Core 2 Duo processors, and 4 GB of system RAM. The cluster iMacs run in both Macintosh OS and in Windows 7-64 bit OS with Bootcamp.

The student printing room in Sage 38 contains three high-capacity black-and-white printers and two high-capacity color printers. Additional wireless student printing is available in the Ordway Learning Center with one high-capacity black-and-white printer, and five e-mail/printing stations are also available to students at the Ordway Learning Center. These computers are iMacs with 20-inch displays, 2.26 Core 2 Duo processors, and 2 GB RAM.

F&ES-IT also loans, on a one- to two-week basis, laptop computers, GIS units, digital cameras, walkie-talkies, and compact audio recorders.

Information Technology Services (ITS) is the central organization at Yale for the support of all educational and administrative computing. It offers support to all members of the Yale community. The Yale library is also very active in the integration of information resources in digital format. Students and faculty have online access to a comprehensive variety of journals and databases, and the Sterling Memorial Library Map Collection now employs a full-time GIS librarian who is available to assist students in obtaining and working with GIS datasets to support their work in any part of the globe.

The School participates in two centers of the Yale Institute for Biospheric Studies that have established specialized computing facilities. These are the Center for Earth Observation (CEO) and the Center for Computational Ecology (CCE).

The CEO provides its users with access to an SGI Challenge 1 Server and hard-disk archive with nine SGI workstations; four SGI workstations in the four sponsoring departments, including one in Marsh Hall; network connections to any Unix-based workstation on campus; a ten-user license for Earth Resource Mapper, a multipurpose software package for image analysis; and a small but growing collection of Landsat MSS and TM data and GOES weather satellite data. A small staff of consultants assists users in the selection, procurement, and analysis of satellite images.

The CCE, housed in Osborne Memorial Laboratory, has a full-time computer programmer to assist in developing programs for research at the center. The center has seven state-of-the-art workstations to facilitate development of computational software and ecological simulation programs.

Faculty members have also developed many special computer applications for their projects, and some of these are available for student use in the Sage computing facilities.

## *School Forests*

The Yale School of Forestry & Environmental Studies owns 10,900 acres of forestland in Connecticut, New Hampshire, and Vermont that are managed by the School Forests Program. The program manages seven discrete forests that were donated to the School between 1913 and 1986 that range in size and geography from the 75-acre Crowell Ravine in Vermont to the 7,860-acre Yale Myers Forest in Connecticut. The composition of the Yale Forests reflects a latitudinal gradient ranging from a central hardwood cover type in Connecticut to a northern hardwood cover type in New Hampshire and Vermont. Extensive stands of pine and hemlock exist in both regions. The area encompassed by the forests includes almost all of the topographical and soil conditions, site classifications, and cover types found in New England.

The management goals of the Yale Forests are to provide educational, research, and professional opportunities for the faculty and students and to serve as an asset to the School's investment portfolio. Faculty and students use the Yale Forests as a laboratory for teaching, management, demonstration, and research. While a member of the faculty serves as director and a University staff member serves as the manager, graduate students working as interns or coordinators carry out the bulk of the on-the-ground management and administration. The forests are maintained as working forests, and thus the tasks include selling timber and nontimber forest products from the land. The Yale Myers Forest is the largest and most heavily utilized parcel managed by the School Forests Program and is certified by the Forest Stewardship Council.

Students working on the Yale Forests receive training that covers aspects of forest ecology, silviculture, forest operations, and sociology in order to prepare them for careers as foresters and land managers. Every summer six to eight students are chosen for the apprentice forester program at the Yale Forests, which includes hands-on training in maintenance of infrastructure, property boundary research and delineation, timber inventories, and the design and implementation of silvicultural prescriptions. Several students from the apprentice program are selected to work for the School Forests Program the following academic year, where they receive additional training in geographical information systems (GIS) and in the administrative aspects of forest management.

Research performed at the Yale Forests is conducted under the supervision of any faculty member of the School and encompasses forest ecology, silviculture, aquatic and terrestrial wildlife ecology, hydrology, and economic, legal, and social studies. The forest is used for both doctoral and master's student research, the latter performed either as an independent project or in conjunction with student involvement with existing forest management.

The Yale Forests are used for both academic field trips and workshops held for professional or community organizations. Field trip and workshop topics include forest certification, wildlife habitat manipulation, ecosystem restoration, prescribed fire management, timber harvesting best management practices, silvicultural research, and pathways of forest stand development.

In addition to the forestland owned and managed by the School, close working relationships exist with other forests that are also used for education and research by faculty and students: the 6,800-acre Great Mountain Forest in northwestern Connecticut is available to the School through the courtesy of Edward C. Childs, B.A. '28, M.F. '32, and

his family; and the 20,000-acre forestland owned and managed by the South Central Connecticut Regional Water Authority in New Haven County is one of the oldest managed forests in the western hemisphere. The University also owns approximately 370 acres of ecological preserves that are available to faculty and students.

## COMMUNICATIONS

The School's major communications vehicles include its Web site, the award-winning online magazine *Yale Environment 360*, the general interest magazine *Environment: Yale*, press releases issued by the Communications Office, *Yale Environmental News*, the F&ES Publication Series, newsletters and reports from the School's centers and programs, and a student-run magazine, *Sage*.

The School's Web site gives the most comprehensive view of the School's faculty, staff, and students, curriculum and courses, centers and programs, and current events. Accessible at [www.environment.yale.edu](http://www.environment.yale.edu).

*Yale Environment 360* features reporting, analysis, and opinion on global environmental issues from leading writers, scientists, policy makers, and journalists in the field. Launched in 2008, *Yale Environment 360* has established a broad global audience and received numerous awards and honors, including the 2010 National Magazine Award for Digital Media for Best Video. Accessible at [www.e360.yale.edu](http://www.e360.yale.edu).

The Communications Office publicizes faculty and student research and School-sponsored events through the production of *Environment: Yale* magazine, video, and press releases. For more information about the School, contact David DeFusco, director of communications, at 203.436.4842 or [david.defusco@yale.edu](mailto:david.defusco@yale.edu), or visit the Web site at [www.environment.yale.edu](http://www.environment.yale.edu).

*Yale Environmental News*, a newsletter, is published in cooperation with the Yale Institute for Biospheric Studies and the Peabody Museum of Natural History. Accessible at [www.yale.edu/yibs/yen\\_current.html](http://www.yale.edu/yibs/yen_current.html).

The Yale F&ES Publication Series issues books, reports, and working papers based on environmental conferences, courses, and events at Yale of special interest to professional colleagues in NGOs, government agencies, and private business. The School has published work by its faculty and students in this format since 1912. For a complete listing of titles, free pdf downloads of all publications, and ordering information for printed copies, see [www.environment.yale.edu/publications](http://www.environment.yale.edu/publications).

For newsletters and reports of the individual programs and centers, see their Web sites, accessible through the main F&ES Web site at [www.environment.yale.edu](http://www.environment.yale.edu).

*Sage Magazine* is a student-produced publication, issued twice a year, containing a mix of reporting, short features, editorials, art, and prose. Accessible at [www.sagemagazine.org](http://www.sagemagazine.org).

## STUDENT ORGANIZATIONS

The School has many student-run interest groups. Current student groups include the 100% Club/Outdoor Rec, Asia (ASIA) SIG, the Coalition for Agriculture, Food, and Environment (CAFÉ), the Climate Change SIG, Environmental Justice at Yale (EJAY), Environmental Arts & Media, Environmental Publishing & Communications (EPC),

the Forestry Club (FC), Fresh & Salty SIG, Greening the Vote (GTV), International Environmental Governance (IEG), the Industrial Environmental Management and Energy Group (IEME), a student chapter of the International Society of Tropical Foresters (ISTF), the Land Use Coalition at Yale (LUCY), the Latin American SIG (La SIG), the Multi-Ethnic Student Association (MESA), NRG, Risk Reduction, Adaptation and Disaster Student Interest Group (RRAD), SCOPE, Out in the Woods, Ethnobotany and Economic Botany Student Interest Group (STIGMA), Students for Urban Design Sustainability (StUDS), Walk the Talk (WTT), Westies, Yale Environment Women (YEW), Yale Environmental Health Group, International Development and Environment (IDE), a student chapter of the Society of American Foresters (SAF), the Yale chapter of the Society for Conservation Biology (CONBIO), and the Student Advisory Committee (SAC). The activities of these groups include sponsoring guest and student lectures, organizing field trips, sponsoring workshops, organizing social events, holding conferences, interacting with regional divisions of their respective societies, collaborating with the City of New Haven to hold conferences and workshops, planning holiday parties, conducting a spring auction, and holding weekly gatherings.

## FUNDING FOR MASTER'S STUDENT PROJECTS AND ACTIVITIES

Master's students often seek funding for scholarship, research, professional activities, and social events. Sometimes the request is for individual activity, sometimes on behalf of a group. Our School and Yale University have many funds to which students can apply. Among the most useful are the Master's Student Travel fund to support attendance at a conference or symposium at which a student is giving a talk; MacMillian Center for International and Area Studies, which can help bring international visitors to Yale for a lecture or a conference; grants and contracts to faculty and centers for research; and the School's Student Affairs Committee (SAC), which supports activities by our many student interest groups (SIGs).

## ALUMNI/AE ASSOCIATION

Alumni/ae of the School are organized into an active body known as the Yale School of Forestry & Environmental Studies Alumni Association, led by a board that holds regular meetings at the School to conduct the business of the association. The association also hosts regional gatherings around the country and around the world, especially at annual meetings such as those of the Land Trust Alliance, the Ecological Society of America, and the Society of American Foresters. The board functions both as a committee of the whole and through several standing committees; officers of the board welcome inquiries from any F&ES alumni/ae who may wish to be considered for seats on the board or any of its standing committees. Standing committees oversee nominations of officers and of Distinguished Alumnus Award recipients, host the annual reunion and regional gatherings, and assist staff with the Annual Fund and other fund-raising initiatives. The School Web site, an emerging set of shared interest Web sites, and the magazine *Environment: Yale* keep alumni/ae throughout the world in touch with each other and with the School.

The F&ES Alumni Association is also affiliated with the Association of Yale Alumni (AYA), serving all alumni/ae of Yale University. The F&ES Office of Alumni Affairs works directly with the AYA on several critical services for F&ES alumni/ae including the Virtual Yale Station (e-mail forwarding), Online Alumni Directory (secure access contact database), and the Yale Career Network (professional profiles). Alumni/ae are encouraged to contact the Office of Alumni Affairs at [alumni.fes@yale.edu](mailto:alumni.fes@yale.edu).

## PROFESSIONAL DEVELOPMENT

### *Career Development Office*

The overall goal of the School's Career Development Office (CDO) is to equip students with excellent job search skills and assist them in charting a course leading to a professional career fitting their interests, skills, and abilities. Our diverse resources and services enable users to learn about themselves, determine how their accumulated experiences translate into meaningful career goals, and conduct effective job searches.

CDO conducts programs and provides Web-based resources geared toward supporting the development of students' career and job search skills. Programs include:

- Introduction to Environmental Careers and the Job Market
- Presentation Skills
- How to Work a Career Fair
- Success Stories: Job and Internship Search Strategies
- Writing the Personal Statement
- Applying for the Ph.D. Workshop
- Using Optimal Resume
- Using GeO: eRecruiting at F&ES
- Business Etiquette for International Students Seeking Jobs in the U.S.
- How to Dress for the Interview
- How to Launch an International Career
- Cover Letter Writing for International Students
- Writing the Cover Letter
- Writing the Résumé
- Salary Negotiations
- Interview Skills
- Networking
- Mock Interviews with the Experts
- Job Search Discussion Groups

In addition, along with a faculty advisory committee, CDO oversees the Professional Skills Module (PSM) Program, coordinated by student assistants.

The Professional Skills Module Program of F&ES aims to equip students with the professional skills needed to succeed in careers as foresters, resource managers, and environmentalists. The PSM program also collaborates with student interest groups and other units within the School to deliver programs of mutual interest. Students are encouraged to submit suggestions throughout the year.

The PSM program covers eight major skill areas: computer skills, project skills, interpersonal skills, business skills, leadership skills, research skills, communication skills, and technical skills.

### *Internships and Summer Research*

Internships and summer research have long been an important part of the educational program at Yale. They provide a unique opportunity to combine academic knowledge with practical experience, to enhance skills, and to gain professional confidence.

Students are assisted by the Career Development Office, faculty, alumni/ae, and other students in their search for internships and summer research experiences. Attention is given to students to help them locate opportunities that meet their individual needs and interests.

Given the School's strong ties with natural resource, environmental, and conservation organizations worldwide, internship and research possibilities are virtually unlimited. Typical internships/research projects occur between the first and second years of the program; occasionally internships/research projects last for longer periods of time. The following list shows the rich and diverse experiences that F&ES students had in a recent summer. Similarly impressive lists can be found on the Web at [www.environment.yale.edu/current/Employment-and-Summer-InternshipResearch-Projects-Data](http://www.environment.yale.edu/current/Employment-and-Summer-InternshipResearch-Projects-Data).

### *Summer 2009 Internships*

#### NGOS AND OTHER NOT-FOR-PROFIT GROUPS

ACOANA, Caracas, Researcher, Venezuela  
 African People and Wildlife Fund, Researcher, Africa  
 Asian Rural Institute, Working Visitor, Asia  
 Bonneville Environmental Foundation, Intern, Ore.  
 Center for Clean Air Policy, Research Intern, Washington, D.C.  
 Center for International Forestry Research, Intern, Brazil  
 Centro Agronomico Tropical de Investigacion y Ensenanza (CATIE), Research Intern, Costa Rica  
 CIFOR, Consultant, Indonesia  
 Eastern Oregon Agricultural Research Center, Researcher, Ore.  
 Economic Institute, Research Intern, Washington, D.C.  
 Environmental Defense Fund (EDF), Research Intern, Calif.  
 Environmental and Energy Study Institute, Communications Intern, Washington, D.C.  
 Finca Project, Research Intern, Costa Rica  
 Friends of the Earth Middle East, Research Intern, Israel  
 Global Green New Orleans, Intern, La.  
 Glynwood Center, Intern, N.Y.  
 Green Press Initiative, Intern, N.Y.  
 Innovations for Poverty Action, Research Assistant, Philippines  
 International Institute of Sustainable Development (IISD), Research Intern, Switzerland

International Union for Conservation of Nature, Associate, Ecuador  
Japan Environmental Management Association for Industry, Researcher/Assistant,  
Japan  
Kheti Virasat Mission, Women's Campaign Intern, India  
Kohala Center, Socioecological Researcher, Hawaii  
Make It Right, Intern, La.  
Mass Audubon, Coordinator, Mass.  
Mercy Corps, Intern, Colombia (2)  
Mercy Corps, Research Intern, Indonesia  
Mercy Corps, Intern, Nepal  
Mercy Corps, Research Intern, Nepal  
Mountain Association for Community Economic Development, Intern, Ky.  
Natural Resources Defense Council (NRDC), Research Fellow, China  
Natural Resources Defense Council (NRDC), U.S. Climate Policy Intern,  
Washington, D.C.  
Natural Resources Defense Council (NRDC), Cameron Speth Fellow,  
Washington, D.C.  
The Nature Conservancy, Watershed Restoration Intern, Ore.  
The Nature Conservancy, Research Intern, N.Mex.  
The New Orleans Institute, Research Intern, La.  
OCT, Cooperativa Oficinas Caboclas do Tabajós, Intern, Brazil  
Oregon Zoo, Assistant Coordinator for Education and Research, Ore.  
Pacific Crest Trail Association, Research Intern, Calif.  
Pennsylvania Horticultural Society, Tree Vitalize Intern, Researcher, Pa.  
Riverkeeper, Intern, N.Y.  
Sierra Club, Intern, Tenn.  
Smithsonian Tropical Research Institute, Research Intern, Panama (3)  
Surfrider Foundation, Ecosystem Based Management and Economic Analysis  
Internship, Ore.  
TERI, The Energy Research Institute, Intern, India (3)  
TFD, The Forests Dialogue, Program Coordinator, Conn.  
Urban Resources Initiative, Urban Community Forester, Conn.  
Urban Resources Initiative, Community Forester, Conn.  
Urban Resources Initiative, Urban Foodshed Collective Coordinator, Researcher,  
Conn.  
The World Bank, Intern, Washington, D.C.  
World Resources Institute, Intern, Washington, D.C (2)  
World Wildlife Fund (WWF), Protected Area Degazettement, Downgrading, and  
Downsizing (PADDD) Intern, Washington, D.C.  
World Wildlife Fund for Nature (WWF), Volunteer, Thailand

#### **BUSINESS AND INDUSTRY**

Beveridge & Diamond PC, Summer Associate, Washington, D.C.  
E2 Inc., Associate Consultant, Conn. and Va.  
Intel Corporation, EHS Engineering Intern, Mass.

International Paper, EHS&S Intern, Va.  
 Lundberg Family Farm, Intern, Calif.  
 Marks & Spencer, Intern, United Kingdom  
 Perkins + Will, Research Associate in Green Chemistry for Laboratory Design, Ga.  
 Puget Sound Energy, Green Communities Intern, Wash.

## EDUCATION

Aprovecho Education Center, Eco-forestry Apprentice, Intern Coordinator,  
 Community Researcher, Ore.  
 Australian National University, Visiting Scholar, Researcher, Australia  
 Chinese Academy of Sciences, Researcher, China  
 Coweeta Hydrologic Laboratory, Researcher, N.C.  
 Jewish Farm School, Agroforestry Education Intern, N.Y.  
 Journal of Industrial Ecology, Management, Editorial Associate, Conn.  
 Kathmandu Medical University, Research, Nepal  
 National University of Singapore, Research Assistant, Singapore  
 Oxford University, Fellow; International Alliance of Research Universities, United  
 Kingdom  
 Peking University, Researcher, China  
 Peking University, Independent Work, China  
 Technische Universität Berlin and ALBA AG, Researcher, Intern, Germany  
 University of Hawaii at Hilo, Researcher, Hawaii  
 University of Rhode Island, Greenspace Intern, Conn.  
 University of Rhode Island, Community Forester, Conn.  
 University of Vermont, Researcher, Vt.  
 Yale School of Forestry & Environmental Studies, Global Institute of Sustainable  
 Forestry, Researcher, Conn.  
 Yale School of Forestry & Environmental Studies, Intern, Conn.  
 Yale University, Intern, Conn.

## GOVERNMENT AND PUBLIC SECTOR GROUPS

Connecticut Department of Environmental Protection, Summer Intern, Conn.  
 Food and Agriculture Organization, Researcher, Italy  
 New Haven City Government, Presidential Public Service Fellow, Summer Intern,  
 Conn.  
 New York City's Mayor's Office, Sustainability Intern, N.Y.  
 NOAA Fisheries Service Northeast Regional Office, Environmental Specialist, Mass.  
 North Cascades National Park Service Complex, Research Intern, Conn. and Wash.  
 Overseas Private Investment Corporation, Intern, Washington, D.C.  
 United Nations Development Programme (UNDP), Carbon Finance Intern, Peru  
 United Nations Educational, Scientific, and Cultural Organization (UNESCO),  
 Intern, N.Y. (2)  
 United Nations Environment Programme (UNEP), Intern, Afghanistan  
 United Nations Environment Programme (UNEP), Fellow, N.Y. and Mexico  
 U.S. Environmental Protection Agency (EPA), Research Intern, Washington, D.C.

U.S. Department of Agriculture, (USDA), Economist, Washington, D.C.  
U.S. Department of Agriculture and Resources for the Future, Biological Scientist Intern, Washington, D.C.  
U.S. Forest Service, Wilderness and Education Initiatives Intern, Washington, D.C.  
U.S. Forest Service, Policy Analyst, Washington, D.C.  
U.S. Forest Service, Researcher, Conn.  
U.S. Geological Survey (USGS), Intern, S.Dak. (2)  
U.S. Geological Survey (USGS), Researcher, Ariz.  
U.S. Senator of New Mexico, Tom Udall, Intern, Washington, D.C.  
White House Council on Environmental Quality, Communications and Legislative Intern, Washington, D.C.  
The World Resources Institute, Office of Ecosystem Services & Markets, Biological Scientist Intern, Washington, D.C.  
Yellowstone National Park/USGS Interagency Grizzly Bear Study Team, Researcher, Mont., Wyo., Idaho

#### INDEPENDENT NON-U.S. RESEARCH (NON-HOSTED)

Analysis for the Use of Personal Computer Recycle-Flow to Understand E-waste Metal Recovery, Indonesia  
Analysis of the Israeli Cleantech Industry and Lessons for Policy Makers on the Potential for Regional Industrial Clusters to Globally Diffuse Sustainable Technology, Israel  
Assess the Effects of Transnational Advocacy on Indigenous Mobilization in Panama, Panama  
Assess the Health Risks Posed by the Consumption of Bacterially Contaminated Drinking Water and Develop Strategies for Enhancing the Safety of Water Supply, Fiji  
Assess the Impact of Overfishing on Predatory Reef Fish in Bonaire and Implications for Reef Health, Netherland Antilles  
Carbon Assessment of Jatropha Plantation to Examine Land Use Change Implications, Brazil, India  
Community-Based Wildlife Management: Working on Incentives, Tanzania  
Community Perspectives and Adaptations, Sumatra, Indonesia  
Conduct Ethnographic Research on the Sustainability Practices of the Philippine Igorots, Philippines  
Environmental Design Strategies of Ecovillages and Applications for Sustainable Urban Development, N.Y., Australia, Scotland  
Evaluation of Climate Change Adaptation Policy and Practice in the Republic of Kenya, Kenya  
Evaluation of the Development of Hangzhou Based on a Sustainability Model to Determine Reason for Change in Current Conditions, China  
Medical Waste Management, Kenya  
Preliminary Environmental Assessment of the Coastal Zone of Vatukoula and Tavua and the Unmitigated Effects of the Local Gold Mine, Fiji

- Research on the Domestication of Acai (*Euterpe oleracea*) in Home Gardens of the Amazon Estuary, Brazil
- Research on the Social Conflicts and Environmental Issues in the Mt. Everest Nature Reserve Zone, China
- Research on the Tribal Rights and Tiger Conservation in the Nilgiri Hills, India

#### INDEPENDENT U.S. RESEARCH (NON-HOSTED)

- Alderman of New Haven Candidate, Best Practices Research of Cities in United States, Conn.
- Analyze the Concentration of Nitrate and Phosphate in the Marsh Water, Researcher, Conn.
- Assess the Indoor Air Quality of Homes with Infants, Conn.
- Calibrate the Linear Regression Model of Above-Ground Biomass, Conn.
- Conduct Research on Behavioral Economics and Climate Change Belief Formation, Conn.
- Determination If Experimental Results are Predictive of Natural Species Assemblages in Connecticut Meadow Systems, Conn.
- Determine Implications of Differential Damage Among Species Following Ice Storms in Mixed Species Forests of Southern New England, Conn.
- Develop Spreadsheet Modeling for Solar Collectors as a Tool for Solar System Designers, Intern, Conn.
- Efficiency of Wet Pond Best Management Practices in Removal of Nitrogen from Connecticut Storm Water, Conn.
- Exploring the Impacts of *Microstegium vimineum* Invasion on Forest Soil Carbon Stocks Across an Urbanization Gradient, N.C.
- Sustainability Assessment of Constructed Wetlands, Conn.

The above list was compiled by the Career Development Office, Yale School of Forestry & Environmental Studies. For more information, please contact Peter Otis, Director; telephone, 203.432.8920; e-mail, [peter.otis@yale.edu](mailto:peter.otis@yale.edu)

The School and its students would like to thank donors, host organizations, and supervisors for making these valuable professional experiences possible.

### *Immediately Following Graduation*

Each year our graduates enjoy employment success in environmental science, policy, and management within the United States and around the world, or they pursue admission for further academic study. Details including salary information can be found on the most recent as well as previous classes at [www.environment.yale.edu/current/Employment-and-Summer-InternshipResearch-Projects-Data](http://www.environment.yale.edu/current/Employment-and-Summer-InternshipResearch-Projects-Data).

Summary data from the class of 2009 master's graduates six months after graduation (97 reporting): 27 percent entered the NGO not-for-profit sector; 27 percent entered the public sector/government; 23 percent went into the private for-profit sector; 4 percent are working in education; and 19 percent have gone on for further study.

# University Services and Resources

## A GLOBAL UNIVERSITY

In a speech entitled “The Global University,” Yale President Richard C. Levin declared that as Yale enters its fourth century, its goal is to become a truly global university—educating leaders and advancing the frontiers of knowledge not simply for the United States, but for the entire world:

“The globalization of the University is in part an evolutionary development. Yale has drawn students from outside the United States for nearly two centuries, and international issues have been represented in its curriculum for the past hundred years and more. But creating the global university is also a revolutionary development—signaling distinct changes in the substance of teaching and research, the demographic characteristics of students, the scope and breadth of external collaborations, and the engagement of the University with new audiences.”

Yale University’s goals and strategies for internationalization are described in a report entitled “International Framework: Yale’s Agenda for 2009 to 2012,” which is available online at [www.world.yale.edu/framework/index.html](http://www.world.yale.edu/framework/index.html).

International activity is coordinated by several University-wide organizations in addition to the efforts within the individual schools and programs.

Launched in 2003–2004, the Office of International Affairs supports the international activities of all schools, departments, offices, centers, and organizations at Yale; promotes Yale and its faculty to international audiences; and works to increase the visibility of Yale’s international activities around the globe. See [www.yale.edu/oia](http://www.yale.edu/oia).

The Office of International Students and Scholars is a resource on immigration matters and hosts orientation programs and social activities for the University’s international community. See description in this bulletin and [www.oiss.yale.edu](http://www.oiss.yale.edu).

The Whitney and Betty MacMillan Center for International and Area Studies is the University’s principal agency for encouraging and coordinating teaching and research on international affairs, societies, and cultures. See description in this bulletin and [www.yale.edu/macmillan](http://www.yale.edu/macmillan).

The Yale Center for the Study of Globalization draws on the intellectual resources of the Yale community, scholars from other universities, and experts from around the world to support teaching and research on the many facets of globalization, and to enrich debate through workshops, conferences, and public programs. See [www.ycsg.yale.edu](http://www.ycsg.yale.edu).

The Yale World Fellows Program hosts fifteen emerging leaders from outside the United States each year for an intensive semester of individualized research, weekly seminars, leadership training, and regular interactions with the Yale community. See [www.yale.edu/worldfellows](http://www.yale.edu/worldfellows).

For additional information, the “Yale and the World” Web site offers a compilation of resources for international students, scholars, and other Yale affiliates interested in the University’s global initiatives. See [www.world.yale.edu](http://www.world.yale.edu).

## HOUSING

The Graduate Housing Department has dormitory and apartment units for a small number of graduate and professional students. The Graduate Dormitory Office provides dormitory rooms of varying sizes and prices for single occupancy only. The Graduate Apartments Office provides unfurnished apartments consisting of efficiencies and one-, two-, and three-bedroom apartments for singles and families. Both offices are located in Helen Hadley Hall, a graduate dormitory at 420 Temple Street, and have office hours from 9 a.m. to 4 p.m., Monday through Friday.

Applications for 2010–2011 are available as of April 1 online and can be submitted directly from the Web site ([www.yale.edu/gradhousing/incoming/application.html](http://www.yale.edu/gradhousing/incoming/application.html)). For new students at the University, a copy of the letter of acceptance from Yale will need to be submitted to the address on the application form. The Web site is the venue for graduate housing information and includes procedures, facility descriptions, floor plans, and rates. For more dormitory information, contact [grad.dorms@yale.edu](mailto:grad.dorms@yale.edu), tel. 203.432.2167, fax 203.432.4578. For more apartment information, contact [grad.apts@yale.edu](mailto:grad.apts@yale.edu), tel. 203.432.8270, fax 203.432.4578.

The Yale Off-Campus Housing Service is available to the Yale community. A new system has been designed to allow incoming affiliates to the University access to the online database by visiting the Web site at [www.yale.edu/offcampushousing](http://www.yale.edu/offcampushousing). The use of your University NetID allows you immediate access to search the listings. Those who do not have their NetID can set themselves up as guests by following the simple instructions. For answers to questions, please e-mail [ofc@yale.edu](mailto:ofc@yale.edu) or call 203.432.9756.

## DINING AT YALE

Yale Dining (YD) has tailored its services to meet the particular needs of graduate and professional school students by offering meal plan options that allow flexibility and value. The *Any 10 Meal Plan* offers meal service at the Hall of Graduate Studies dining hall and University Commons. It provides ten meals per week, plus six bonus meals per year and \$75 per term in points to be used for additional meals during the week or at our retail locations on campus. Nonresident students may purchase a *5 Meal Plan* with three bonus meals, good Monday through Friday.

YD locations are a popular option for all members of the Yale community. In addition to Commons and the Hall of Graduate Studies, the following retail locations are available: Divinity School Café on Prospect Street, the Café at Kline Biology Tower, Donaldson Commons at the School of Management, Marigolds at the School of Medicine, the Thain Family Café at Bass Library, Triple E's at 221 Whitney Avenue, Triple E's at Payne Whitney Gymnasium, Durfee's Convenience Store at 200 Elm Street, and uncommon at Commons. For students and staff choosing to dine in any of Yale's residential college dining rooms, "all-you-care-to-eat" meals are offered at one affordable price for breakfast (\$5), lunch (\$10.25), and/or dinner (\$13.25) and require the diner to be accompanied by a host from that college.

Inquiries concerning food services should be addressed to Yale Dining, 246 Church Street, PO Box 208261, New Haven CT 06520-8261; tel. 203.432.0420. More information can be found on the Web at [www.yale.edu/dining](http://www.yale.edu/dining).

## SECURITY

As with most universities in urban settings, the security of persons and property is a primary concern of the School of Forestry & Environmental Studies. The University police and the fire marshal, in cooperation with the police and fire services of the city of New Haven, strive constantly to maintain a safe environment for the Yale community. At an orientation session during the summer modules, incoming students receive detailed information on emergency communications, personal safety tips, and other ways to protect themselves, equipment, and buildings.

## HEALTH SERVICES FOR F&ES STUDENTS

The new Yale Health Center opens on campus at 55 Lock Street in late summer 2010 (until then, services will be provided at the 17 Hillhouse Avenue location). The center is home to Yale Health, a not-for-profit, physician-led health coverage option that offers a wide variety of health care services for students and other members of the Yale community. Services include student medicine, gynecology, mental health, pediatrics, pharmacy, laboratory, radiology, a seventeen-bed inpatient care facility (ICF), a round-the-clock acute care clinic, and specialty services such as allergy, dermatology, orthopedics, and a travel clinic. Yale Health coordinates and provides payment for the services provided at the Yale Health Center, as well as for emergency treatment, off-site specialty services, inpatient hospital care, and other ancillary services. Yale Health's services are detailed in the *Yale Health Student Handbook*, available through the Yale Health Member Services Department, 203.432.0246, or online at [www.yale.edu/yhp](http://www.yale.edu/yhp).

### *Eligibility for Services*

All full-time Yale degree-candidate students who are paying at least half tuition are enrolled automatically for Yale Health Basic Coverage. Yale Health Basic Coverage is offered at no charge and includes preventive health and medical services in the departments of Student Medicine, Internal Medicine, Gynecology, Health Education, and Mental Health & Counseling. In addition, treatment for urgent medical problems can be obtained twenty-four hours a day through Acute Care.

Students on leave of absence or on extended study and paying less than half tuition are not eligible for Yale Health Basic Coverage but may enroll in Yale Health Student Affiliate Coverage. Students enrolled in the Division of Special Registration as nondegree special students or visiting scholars are not eligible for Yale Health Basic Coverage but may enroll in the Yale Health Billed Associates Plan and pay a monthly premium. Associates must register for a minimum of one term within the first thirty days of affiliation with the University.

Students not eligible for Yale Health Basic Coverage may also use the services on a fee-for-service basis. Students who wish to be seen fee-for-service must register with the Member Services Department. Enrollment applications for the Yale Health Student Affiliate Coverage, Billed Associates Plan, or Fee-for-Service Program are available from the Member Services Department.

All students who purchase Yale Health Hospitalization/Specialty Coverage (see below) are welcome to use specialty and ancillary services at Yale Health Center. Upon

referral, Yale Health will cover the cost of specialty and ancillary services for these students. Students with an alternate insurance plan should seek specialty services from a provider who accepts their alternate insurance.

### *Health Coverage Enrollment*

The University also requires all students eligible for Yale Health Basic Coverage to have adequate hospital insurance coverage. Students may choose Yale Health Hospitalization/Specialty Coverage or elect to waive the plan if they have other hospitalization coverage, such as coverage through a spouse or parent. The waiver must be renewed annually, and it is the student's responsibility to confirm receipt of the waiver form by the University's deadlines noted below.

#### YALE HEALTH HOSPITALIZATION/SPECIALTY COVERAGE

For a detailed explanation of this plan, see the *Yale Health Student Handbook*, which is available online at [www.yale.edu/yhp/handbooks/documents/student\\_handbook](http://www.yale.edu/yhp/handbooks/documents/student_handbook).

Students are automatically enrolled and charged a fee each term on their Student Financial Services bill for Yale Health Hospitalization/Specialty Coverage. Students with no break in coverage who are enrolled during both the fall and spring terms are billed each term and are covered from August 1 through July 31. For students entering Yale for the first time, readmitted students, and students returning from a leave of absence who have not been covered during their leave, Yale Health Hospitalization/Specialty Coverage begins on the day the dormitories officially open. A student who is enrolled for the fall term only is covered for services through January 31; a student enrolled for the spring term only is covered for services through July 31.

**Waiving Yale Health Hospitalization/Specialty Coverage** Students are permitted to waive Yale Health Hospitalization/Specialty Coverage by completing an online waiver form at [www.yhpstudentwaiver.yale.edu](http://www.yhpstudentwaiver.yale.edu) that demonstrates proof of alternate coverage. It is the student's responsibility to report any changes in alternate insurance coverage to the Member Services Department. Students are encouraged to review their present coverage and compare its benefits to those available under Yale Health. The waiver form must be filed annually and must be received by September 15 for the full year or fall term or by January 31 for the spring term only.

**Revoking the waiver** Students who waive Yale Health Hospitalization/Specialty Coverage but later wish to be covered must complete and send a form voiding their waiver to the Member Services Department by September 15 for the full year or fall term, or by January 31 for the spring term only. Students who wish to revoke their waiver during the term may do so, provided they show proof of loss of the alternate insurance plan and enroll within thirty days of the loss of this coverage. Yale Health premiums will not be prorated.

#### YALE HEALTH STUDENT TWO-PERSON AND FAMILY PLANS

A student may enroll his or her lawfully married spouse or civil union partner and/or legally dependent child(ren) under the age of nineteen in one of two student dependent plans: the Two-Person Plan or the Student Family Plan. These plans include services

described in both Yale Health Basic Coverage and Yale Health Hospitalization/Specialty Coverage. Yale Health Prescription Plus Coverage may be added at an additional cost. Coverage is not automatic and enrollment is by application. Applications are available from the Member Services Department or can be downloaded from the Web site ([www.yale.edu/yhp](http://www.yale.edu/yhp)) and must be renewed annually. Applications must be received by September 15 for full-year or fall-term coverage, or by January 31 for spring-term coverage only.

#### YALE HEALTH STUDENT AFFILIATE COVERAGE

Students on leave of absence or extended study, students paying less than half tuition, or students enrolled in the Eli Whitney Program prior to September 2007 may enroll in Yale Health Student Affiliate Coverage, which includes services described in both Yale Health Basic and Yale Health Hospitalization/Specialty Coverage. Prescription Plus Coverage may also be added for an additional cost. Applications are available from the Member Services Department or can be downloaded from the Web site ([www.yale.edu/yhp](http://www.yale.edu/yhp)) and must be received by September 15 for full-year or fall-term coverage, or by January 31 for spring-term coverage only.

#### YALE HEALTH PRESCRIPTION PLUS COVERAGE

This plan has been designed for Yale students who purchase Yale Health Hospitalization/Specialty Coverage and student dependents who are enrolled in either the Two-Person Plan, the Student Family Plan, or Student Affiliate Coverage. Yale Health Prescription Plus Coverage provides protection for some types of medical expenses not covered under Yale Health Hospitalization/Specialty Coverage. Students are billed for this plan and may waive this coverage. The online waiver ([www.yhpstudentwaiver.yale.edu](http://www.yhpstudentwaiver.yale.edu)) must be filed annually and must be received by September 15 for the full year or fall term or by January 31 for the spring term only. For a detailed explanation, please refer to the *Yale Health Student Handbook*.

### *Eligibility Changes*

**Withdrawal** A student who withdraws from the University during the first ten days of the term will be refunded the premium paid for Yale Health Hospitalization/Specialty Coverage and/or Yale Health Prescription Plus Coverage. The student will not be eligible for any Yale Health benefits, and the student's Yale Health membership will be terminated retroactive to the beginning of the term. The medical record will be reviewed, and any services rendered and/or claims paid will be billed to the student on a fee-for-service basis. At all other times, a student who withdraws from the University will be covered by Yale Health for thirty days following the date of withdrawal or to the last day of the term, whichever comes first. Premiums will not be prorated or refunded. Students who withdraw are not eligible to enroll in Yale Health Student Affiliate Coverage.

**Leaves of absence** Students who are granted a leave of absence are eligible to purchase Yale Health Student Affiliate Coverage during the term(s) of the leave. If the leave occurs during the term, Yale Health Hospitalization/Specialty Coverage will end on the date the leave is granted and students may enroll in Yale Health Student Affiliate Coverage. Students must enroll in Affiliate Coverage prior to the beginning of the term during which the leave is taken or within thirty days of the start of the leave. Premiums paid for Yale

Health Hospitalization/Specialty Coverage will be applied toward the cost of Affiliate Coverage. Coverage is not automatic and enrollment forms are available at the Member Services Department or can be downloaded from the Web site ([www.yale.edu/yhp](http://www.yale.edu/yhp)). Premiums will not be prorated or refunded.

**Extended study or reduced tuition** Students who are granted extended study status or pay less than half tuition are not eligible for Yale Health Hospitalization/Specialty Coverage and Yale Health Prescription Plus Coverage. They may purchase Yale Health Student Affiliate Coverage during the term(s) of extended study. This plan includes services described in both Yale Health Basic and Yale Health Hospitalization/Specialty Coverage. Coverage is not automatic and enrollment forms are available at the Member Services Department or can be downloaded from the Web site ([www.yale.edu/yhp](http://www.yale.edu/yhp)). Students must complete an enrollment application for the plan prior to September 15 for the full year or fall term, or by January 31 for the spring term only.

For a full description of the services and benefits provided by Yale Health, please refer to the *Yale Health Student Handbook*, available from the Member Services Department, 203.432.0246, 55 Lock Street, PO Box 208237, New Haven CT 06520-8237.

### *Required Immunizations*

**Measles (rubeola) and German measles (rubella)** All students who were born after December 31, 1956, are required to provide proof of immunization against measles (rubeola) and German measles (rubella). Connecticut state law requires two doses of measles vaccine. The first dose must have been given after January 1, 1969, *and* after the student's first birthday. The second dose must have been given after January 1, 1980. These doses must be at least 30 days apart. Connecticut state law requires proof of one dose of rubella vaccine administered after January 1, 1969, *and* after the student's first birthday. The law applies to all students unless they present (a) a certificate from a physician stating that such immunization is contraindicated, (b) a statement that such immunization would be contrary to the student's religious beliefs, or (c) documentation of a positive blood titer for measles and rubella.

**Meningococcus (meningitis)** All students living in on-campus housing must be vaccinated against meningococcal disease. The law went into effect in September 2002, meaning that all returning students who plan to live in University housing must be immunized or show proof of immunization within the last five years. Students who are not compliant with this law will not be permitted to register for classes or move into the dormitories for the fall term, 2010. Please note that the State of Connecticut does not require this vaccine for students who intend to reside off campus.

*Note:* Students who have not met these requirements prior to arrival at Yale University must receive the immunizations from Yale Health and will be charged accordingly.

## RESOURCE OFFICE ON DISABILITIES

The Resource Office on Disabilities facilitates accommodations for undergraduate and graduate and professional school students with disabilities who register with and have

appropriate documentation on file in the Resource Office. Early planning is critical. Documentation may be submitted to the Resource Office even though a specific accommodation request is not anticipated at the time of registration. It is recommended that matriculating students in need of disability-related accommodations at Yale University contact the Resource Office by June 4. Special requests for University housing need to be made in the housing application. Returning students must contact the Resource Office at the beginning of each term to arrange for course and exam accommodations.

The Resource Office also provides assistance to students with temporary disabilities. General informational inquiries are welcome from students and members of the Yale community and from the public. The mailing address is Resource Office on Disabilities, Yale University, PO Box 208305, New Haven CT 06520-8305. The Resource Office is located at 35 Broadway (rear entrance), Room 222. Office hours are Monday through Friday, 8:30 a.m. to 4:30 p.m. Voice callers may reach staff at 203.432.2324; fax at 203.432.8250. The Resource Office may also be reached by e-mail ([judith.york@yale.edu](mailto:judith.york@yale.edu)) or through its Web site ([www.yale.edu/rod](http://www.yale.edu/rod)).

## OFFICE OF INTERNATIONAL STUDENTS AND SCHOLARS

The Office of International Students and Scholars (OISS) coordinates services and support for Yale's international students, faculty, staff, and their dependents. OISS assists members of the Yale international community with all matters of special concern to them and serves as a source of referral to other University offices and departments. OISS staff provide assistance with employment, immigration, personal and cultural adjustment, and family and financial matters, as well as serve as a source of general information about living at Yale and in New Haven. In addition, as Yale University's representative for immigration concerns, OISS provides information and assistance to students, staff, and faculty on how to obtain and maintain legal status in the United States, issues the visa documents needed to request entry into the U.S. under Yale's immigration sponsorship, and processes requests for extensions of authorized periods of stay, school transfers, and employment authorization. All international students and scholars must register with OISS as soon as they arrive at Yale, at which time OISS will provide information about orientation activities for newly arrived students, scholars, and family members. OISS programs, like the international coffee hours, Community Friends hosting program, daily English conversation groups and conversation partners program, U.S. culture workshops, and receptions for newly arrived graduate students, postdoctoral associates, and visiting scholars, provide an opportunity to meet members of Yale's international community and become acquainted with the many resources of Yale University and New Haven. OISS welcomes volunteers from the Yale community to serve as local hosts for international students and as English conversation partners. Interested individuals should contact OISS at 203.432.2305.

OISS maintains an extensive Web site ([www.yale.edu/oiss](http://www.yale.edu/oiss)) with useful information for students and scholars prior to and upon arrival in New Haven. As U.S. immigration regulations are complex and change rather frequently, we urge international students and scholars to visit the office and check the Web site for the most recent updates.

International students, scholars, and their families and partners can connect with OISS and the international community at Yale by subscribing to the following e-mail lists. OISS-L is the OISS electronic newsletter for Yale's international community. *YaleInternational E-Group* is an interactive list through which over 3,000 international students and scholars connect to find roommates, rent apartments, sell cars and household goods, find companions, and keep each other informed about events in the area. Spouses and partners of international students and scholars will want to get involved with the organization called International Spouses and Partners at Yale (ISPY), which organizes a variety of programs for the spouse and partner community. To subscribe to any list, send a message to [oiss@yale.edu](mailto:oiss@yale.edu).

Housed in the International Center for Yale Students and Scholars at 421 Temple Street, the Office of International Students and Scholars is open Monday through Friday from 8:30 a.m. to 5 p.m., except Tuesday, when the office is open from 10 a.m. to 5 p.m.; tel. 203.432.2305.

## INTERNATIONAL CENTER FOR YALE STUDENTS AND SCHOLARS

The International Center for Yale Students and Scholars, located at 421 Temple Street, across the street from Helen Hadley Hall, offers a central location for programs that both support the international community and promote cross-cultural understanding on campus. The center, home to the Office of International Students and Scholars (OISS), provides a welcoming venue for students and scholars who want to peruse resource materials, check their e-mail, and meet up with a friend or colleague. Open until 9 p.m. on weekdays during the academic year, the center also provides office and meeting space for student groups, and a space for events organized by both student groups and University departments. In addition, the center has nine library carrels that can be reserved by academic departments for short-term international visitors. For more information, call 203.432.2305 or visit the center at 421 Temple Street.

## RELIGIOUS RESOURCES

The religious and spiritual resources of Yale University serve all students, faculty, and staff. These resources are coordinated and/or supported through the University Chaplaincy (located on the lower level of Bingham Hall on Old Campus); the Yale University Church at Battell Chapel, an open and affirming church; and Yale Religious Ministry, the on-campus association of clergy and nonordained representatives of various religious faiths. The ministry includes the Chapel of St. Thomas More, the parish church for all Roman Catholic students at the University; the Joseph Slifka Center for Jewish Life at Yale, a religious and cultural center for students of the Jewish faith; Indigo Blue: A Center for Buddhist Life at Yale; several Protestant denominational ministries and non-denominational ministries; and student religious groups such as the Baha'i Association, the Yale Hindu Council, the Muslim Student Association, and many others. Hours for the Chaplain's Office during the academic term are Monday through Friday, 8:30 a.m. to 5 p.m., as well as evenings Sunday through Thursday, 5 to 11. Additional information is available at [www.yale.edu/chaplain](http://www.yale.edu/chaplain).

## LIBRARIES

The Yale University Library consists of the central libraries—Sterling Memorial, Bass, Beinecke Rare Book and Manuscript, Seeley G. Mudd—and thirty school and department libraries and special collections, including the Henry S. Graves Memorial Library Collection (described in the previous chapter). Second-largest among the university libraries in the United States, the Yale Library contains approximately 13 million volumes. The collections of all these libraries and their numerous services are available to students, and their use is actively encouraged.

In 1989, the University Library introduced Orbis, its online public catalog, which provides electronic access to more than 10 million records identifying books, journals, and other library materials. In addition to bibliographic information, the system can inform users about books on order, being catalogued, or on loan.

Libraries in the Yale system which are most closely allied to the interests of Forestry & Environmental Studies students include Kline Science Library, the Government Documents Center, and the Geology, Social Science, Engineering, and Law libraries. Books requested by F&ES students from these other libraries are delivered by an express service to the Forestry library within one working day.

## CULTURAL AND RECREATIONAL OPPORTUNITIES

### *Cultural Opportunities*

Two sources of information about the broad range of events at the University are the *Yale Bulletin & Calendar (YB&C)* newspaper and the Yale Calendar of Events, an interactive calendar that can be found online at <http://events.yale.edu/opa>. The YB&C, which also features news about Yale people and programs, is available without charge at many locations throughout the campus and is sent via U.S. mail to subscribers; for more information, call 203.432.1316. The paper is also available online at <http://opa.yale.edu/bulletin>.

The Yale Peabody Museum of Natural History contains collections in anthropology, mineralogy, oceanography, paleontology, and some aspects of geology.

Founded in 1832, when patriot-artist John Trumbull donated more than 100 of his paintings to Yale College, the Yale University Art Gallery is the oldest college art museum in the United States. Today the gallery's encyclopedic collection numbers more than 185,000 objects ranging in date from ancient times to the present day. These holdings comprise a world-renowned collection of American paintings and decorative arts; outstanding collections of Greek and Roman art, including the artifacts excavated at the ancient Roman city of Dura-Europos; the Jarves, Griggs, and Rabinowitz collections of early Italian paintings; European, Asian, and African art from diverse cultures, including the recently acquired Charles B. Benenson Collection of African art; art of the ancient Americas; the Société Anonyme Collection of early-twentieth-century European and American art; and Impressionist, modern, and contemporary works. The gallery is currently embarking on the next phase of its expansion project, which includes the renovation of the Swartwout building and Street Hall, the two historic structures adjacent to the recently renovated Kahn building. The gallery is both a collecting and an educational institution, and all activities are aimed at providing an invaluable resource and experience

for Yale faculty, staff, and students, as well as for the general public. Learn more from the gallery's Web site: <http://artgallery.yale.edu>.

The Yale Center for British Art houses an extraordinary collection of British paintings, sculpture, drawings, and books given to the University by the late Paul Mellon, Yale Class of 1929.

There are more than eighty endowed lecture series held at Yale each year on subjects ranging from anatomy to theology, and including virtually all disciplines.

More than four hundred musical events take place at the University during the academic year. In addition to recitals by graduate and faculty performers, the School of Music presents the Yale Philharmonia, the Chamber Music Society at Yale, the Duke Ellington Jazz Series, the Horowitz Piano Series, New Music New Haven, Yale Opera, and concerts at the Yale Collection of Musical Instruments. Undergraduate organizations include the Yale Concert and Jazz bands, the Yale Glee Club, the Yale Symphony Orchestra, and numerous other singing and instrumental groups. The Department of Music sponsors the Yale Collegium, productions of new music and opera, and undergraduate recitals. The Institute of Sacred Music presents Great Organ Music at Yale, the Yale Camerata, the Yale Schola Cantorum, the Yale Voxtet, and numerous special events.

For theatergoers, Yale and New Haven offer a wide range of dramatic productions at the University Theatre, Yale Repertory Theatre, Yale Cabaret, Long Wharf Theatre, and Shubert Performing Arts Center.

### *Recreational Opportunities*

The Payne Whitney Gymnasium is one of the most elaborate and extensive indoor athletic facilities in the world. This complex includes the 3,100-seat John J. Lee Amphitheater, the site for many indoor varsity sports contests; the Robert J. H. Kiphuth Exhibition Pool; the Brady Squash Center, a world-class facility with fifteen international-style courts; the Adrian C. Israel Fitness Center, a state-of-the-art exercise and weight-training complex; the Brooks-Dwyer Varsity Strength and Conditioning Center; the Colonel William K. Lanman, Jr. Center, a 30,000-square-foot space for recreational/intramural play and varsity team practice; the Greenberg Brothers Track, an eighth-mile indoor jogging track; the David Paterson Golf Technology Center; and other rooms devoted to fencing, gymnastics, rowing, wrestling, martial arts, general exercise, and dance. Numerous physical education classes in dance (ballet, jazz, modern, and ballroom), martial arts, yoga and pilates, aerobic exercise, and sport skills are offered throughout the year. Yale undergraduates and graduate and professional school students may use the gym at no charge throughout the year. Academic term and summer memberships at reasonable fees are available for faculty, employees, postdoctoral and visiting fellows, alumni, and student spouses.

During the year various recreational opportunities are available at the David S. Ingalls Rink, the McNay Family Sailing Center in Branford, the Yale Outdoor Education Center in East Lyme, the Yale Tennis Complex, and the Golf Course at Yale. Students, faculty, employees, students' spouses, and guests of the University may participate at each of these venues for a modest fee. Up-to-date information on hours and specific costs can be obtained from the Sport and Recreation Office, 203.432.1431. Please check the Yale

Athletics Web site ([www.yalebulldogs.com](http://www.yalebulldogs.com)) for more information concerning any of these recreational facilities and programs.

Approximately fifty club sports come under the jurisdiction of the Office of Outdoor Education and Club Sports. Most of the teams are for undergraduates, but a few are available to graduate and professional school students. Yale undergraduates, graduate and professional school students, faculty, staff, and alumni/ae may use the Yale Outdoor Education Center (OEC), which consists of 1,500 acres surrounding a mile-long lake in East Lyme, Connecticut. The facility includes overnight cabins and campsites, a pavilion and dining hall available for group rental, and a waterfront area with supervised swimming, rowboats, canoes, and kayaks. Adjacent to the lake, a shaded picnic grove and gazebo are available to visitors. In another area of the property, hiking trails surround a wildlife marsh. The OEC runs seven days a week from the fourth week of June through Labor Day. For more information, telephone 203.432.2492 or visit the Web page at [www.yalebulldogs.com](http://www.yalebulldogs.com) (click on Recreational Choices, then on Outdoor Education Center).

Throughout the year, Yale graduate and professional school students have the opportunity to participate in numerous intramural sports activities. These seasonal, team-oriented activities include volleyball, soccer, and softball in the fall; basketball and volleyball in the winter; softball, soccer, ultimate, and volleyball in the spring; and softball in the summer. With few exceptions, all academic-year graduate-professional student sports activities are scheduled on weekends, and most sports activities are open to competitive, recreational, and coeducational teams. More information is available from the Intramurals Office in Payne Whitney Gymnasium, 203.432.2487, or online at [www.yalebulldogs.com](http://www.yalebulldogs.com).

### *City and Countryside*

Only a short bike ride away from the center of New Haven lies the countryside of a state that is over one-half forest land. Farms, parks, lakes, trails, beaches, and nature preserves all await the student seeking to spend a few hours away from his or her studies. Although much of New Haven's countryside has been marred by sprawl, like most American cities, beautiful land still remains close to town.

The most spectacular local features are the region's traprock ridges, the largest being East Rock, West Rock, and the Sleeping Giant. All three of these have been preserved as parks. East Rock and West Rock actually extend into New Haven, and their rusty-orange cliffs form a dramatic backdrop for the city. Sleeping Giant lies a pleasant ninety-minute bicycle ride from town.

New Haven is also surrounded by water supply forests. For a small annual fee, the Water Authority's twenty thousand acres of woods, traprock ridges, lakes, and streams are open for hiking, cross-country skiing, and fishing.

Tucked away in pockets off the main corridors of development lie some of the country's most fertile farmland. The Central Valley of New England, in which New Haven is situated, was once famous for its tobacco, onions, potatoes, apples, and seed growers. The remaining acres are now mostly in dairy farms and pick-your-own orchards, providing the region with rural scenery and fresh produce.

Farther out from the city, the land gets progressively hillier and less inhabited. The most dramatic region of the state is the Northwest Highlands of Litchfield County, where

the School maintains its Great Mountain Forest Camp. Just a two-hour drive from New Haven, the Northwest Highlands boast the Appalachian Trail, New England's largest caves, a portion of the Taconic Mountains, and the vibrant fall colors of the Litchfield Hills.

But there is no need to travel so far to experience nature's bounty. New Haven itself is fortunate to have five major parks, including Edgewood Park, designed by Frederick Law Olmsted, designer of Central Park in New York City and also much of Boston's and Chicago's park systems. Seventeen percent of New Haven is parkland, a figure that few cities in the world can match.

With so much nature near at hand and foot, New Haven comes close to maintaining the elusive ideal balance of the convenience and culture of the city with the pleasures of the countryside.

# Enrollment

## MASTER'S DEGREES CONFERRED, 2010

Daniella Aburto Valle (B.S. Univ. Toronto), Mexico  
Abigail Lee Adams (B.A. Dartmouth Coll.), Mont.  
Lauren Elizabeth Adams (B.A. Boston Univ.), Ohio  
Saalem Tilahun Adera (B.A. Virginia Univ.), Ore.  
Berkley Erin Adrio (B.A. Yale Univ.), Calif.  
Aislinn Kit-Sahn Affinito (B.A. Duke Univ.), Calif.  
Emily Ann Alcott (B.S. William Smith Coll.), N.Y.  
Neda Arabshahi (B.S. Univ. Wisconsin [Madison]), Wis.  
Michael J. Asaro (B.S. Merrimack Coll.), Mass.  
Kathryn Au (B.A. Yale Univ.), Mass.  
Christopher Rathgeb Aung (B.S. Cornell Univ.), N.Y.  
Sarah Catherine Bahan (A.B. Harvard Univ.), Idaho  
Jennifer Ashley Baldwin (B.S. Tufts Univ.), Mass.  
Lauren Margaret Barredo (B.A. American Univ.), Conn.  
Luke Harbour Bassett (B.A. Emory Univ.; M.A.R. Yale Univ.), W.Va.  
Paul Timothy Beaton (B.S. Univ. North Carolina [Asheville]), N.C.  
Emily Jane Biesecker (B.A. Yale Univ.), Ind.  
Michael Jay Blazewicz (B.S. Univ. Vermont), Vt.  
Benjamin Z. Blom (B.A. Colgate Univ.), Mass.  
Andrew Gustav Bostrom (B.S. Univ. Minnesota [Twin Cities]), N.J.  
Martin Bouda (B.A. Univ. Pennsylvania), Czech Republic  
Hugh Clement Addokwei Brown (B.S., M.B.A. Kwame Nkrumah Univ. of Science and Technology), Ghana  
Jesse Brodie Burkhardt (B.A. Portland State Univ.), Ore.  
David Nathaniel Burns (B.A. Bates Coll.), Pa.  
Margaret Elizabeth Byerly (B.S. Randolph-Macon Woman's Coll.), Tex.  
Peter Joseph Caligiuri (B.A. Univ. Portland), Ore.  
Matthew Conway Carroll (B.A. Coll. of the Atlantic), N.J.  
Samantha Severn Carter (B.A. George Washington Univ.), Calif.  
Cayetano Luis Casado Gomez-Guillamon (B.E. Universidad de Cordoba), Spain  
Chelsea Megan Chandler (B.A. Univ. California [Berkeley]), Calif.  
Hui Wen Cheng (B.S. Univ. North Carolina [Chapel Hill]), Taiwan  
Ziyan Chu (B.S. Zhejiang Univ. of Technology), China  
William Michael Collier Jr. (B.S. Univ. Georgia [Athens]), Ga.  
Tamar Maia Cooper (B.A. Barnard Coll.), Conn.  
Stella J. M. Cousins (B.S. Stanford Univ.), Calif.  
Kristofer R. Covey (B.A., B.S. SUNY Coll. [Potsdam]), N.Y.  
Owen Edward David (B.A. Brown Univ.), Calif.  
Henry Scott DeBey (B.A. Univ. Calif. [Los Angeles]), Calif.  
Eric Michael Desatnik (B.S. Ohio Univ. [Athens]), Ohio  
Xiaoyan Du (B.A., B.S. Peking Univ.), China

Marlyse Corallo Duguid (B.S. Univ. Connecticut [Storrs]), Conn.  
 Ashley Elizabeth DuVal (B.S. Univ. California [Berkeley]; M.A. Columbia Univ.), Calif.  
 Francis Eugene Eaton (B.S. Northern Arizona Univ.), Utah  
 Justin Matthew Elicker (B.A. Middlebury Coll.), N.Y.  
 Francisco J. Espinoza Magri (B.A. Universidad de Chile), Chile  
 Changxin Fang (B.A. Smith Coll.; M.A. Univ. Utah), Md.  
 Javier Fernández Vega (B.E. Inst. Tecnológico Costa Rica), Costa Rica  
 Sarah Elizabeth Brandzel Fierce (B.A. Dartmouth Coll.), Mass.  
 Mary E. Fischer (B.A. Univ. Dayton), Colo.  
 Eric Daniel Fournier (B.S. Bucknell Univ.), Calif.  
 J. Walter Freiberg IV (B.A., M.A. Wesleyan Univ. [Conn.]), Mass.  
 Kathryn Anne Freund (B.A. Pomona Coll.), Ore.  
 Thomas Stillwell Gibbons (B.A. George Washington Univ.), Ohio  
 Julie Johnson Goodness (B.A. New York Univ.), Mass.  
 Carmen R. Guerrero Perez (B.S. Univ. Michigan [Ann Arbor]), Okla.  
 Anobha Gurung (B.A. Univ. Colorado [Denver]), Colo.  
 Zahid Ullah Hamdard (B.S., M.S. Univ. Peshawar), Afghanistan  
 Katie Marie Hawkes (B.A. Univ. Pennsylvania), Hawaii  
 Frederica Rachel-Maria Helmiere (B.A. Dartmouth Coll.), Md.  
 Jacob R. Holzberg-Pill (B.A. Brandeis Univ.; M.A. Harvard Univ.), Mass.  
 Adrian Corin Horotan (B.S. Acad. of Economics; M.B.A. INSEAD), Romania  
 Xiaoting Hou (B.A. Fudan Univ.), China  
 Jennifer Burlingame Hoyle (B.S. Yale Univ.), Mass.  
 Lisa Marie Hummon (B.S. Univ. Maryland [College Park]), Md.  
 Tal Ilany (B.F.A. Carnegie Mellon Univ.), Calif.  
 Jacob O. Iversen (B.A. Univ. California [Davis]), Calif.  
 Emily Joy Jack-Scott (B.A. Yale Univ.), Pa.  
 Kasey Rae Jacobs (B.S. Long Island Univ. [Southampton]), N.Y.  
 Claire Martine Jahns (B.A. Oberlin Coll.), Ill.  
 Meng Ji (B.S. Peking Univ.), China  
 Jordan Elisabeth Jobe (B.S. Univ. Washington), Wash.  
 Nathan Christopher Karres (B.S. Coll. Santa Fe; M.A. Univ. Washington), Calif.  
 Kathayoon Azra Khalil (B.A. Claremont McKenna Coll.), Ore.  
 Sudarshan Chandra Khanal (B.S., M.S. Tribhuvan Univ.), Nepal  
 Timothy Daniel Kramer (B.A. Univ. Iowa), Iowa  
 Roopa Seethalakshmi Krithivasan (B.A. Univ. Chicago), India  
 Jonathan Christian Labozzetta (B.A. New York Univ.), N.Y.  
 Leif Andrew Linden (B.S. Univ. Calif. [Los Angeles]), Calif.  
 Eliot Alexander Logan-Hines (B.A. Evergreen State Coll.), Tex.  
 Judith Lynne Logback (B.S. Beloit Coll.), Kans.  
 Sarah Ann Lowery (B.A. Lafayette Coll.), Pa.  
 Yu-Ching Lu (B.S. National Taiwan Univ.), Taiwan  
 Lucy Kishemele Magembe (B.S. Univ. Dar Es Salaam; M.S. Univ. Florida), Tanzania  
 Catherine Elizabeth Manzo (B.S. Columbia Univ.), Mass.

Robert Aram Marks (A.B. Harvard Univ.), Ind.  
 Annie Marissa Matsler (B.S. Oregon State Univ.), Ore.  
 Nashaat Munir Mazrui (B.S. Nairobi Univ.), Kenya  
 Heather Lee McCarthy (B.A. Middlebury Coll.), Mass.  
 Qian Meng (B.S. Renmin Univ. [China]), China  
 Frances Claire Moore (A.B. Harvard Univ.), United Kingdom  
 Masashi Morimoto (B.S., M.S. Kyoto Univ.), Japan  
 Kimberly Foster Mowery (B.A. Brown Univ.), Conn.  
 Jacob George Munger (B.A. Brown Univ.), N.Y.  
 Jason Paul Nerenberg (B.S. Univ. Maryland [College Park]), Conn.  
 Stephanie Margaret Niall (B.S. Univ. Melbourne), Australia  
 Caitlin Madrona O'Brady (B.A. Colorado Coll.), Ore.  
 John Barry O'Wrill (B.S. Northland Coll.), Mass.  
 Gillian Sarah Paul (B.A. Cornell Univ.), Va.  
 Thomas John Paul (B.S. State Univ. New York), N.Y.  
 Brent Ellison Peich (B.A. Wesleyan Univ. [Conn.]), Conn.  
 Tyra Michelle Pendergrass (B.S. Howard Univ.), N.C.  
 Sabina Devi Pendse (B.A. Univ. Pennsylvania), Mexico  
 Huijia Phua (B.S. National Univ. Singapore), Singapore  
 Marissa Jean Ramirez (B.S. Yale Univ.), N.Y.  
 Eric H. Roberts (B.S. Wake Forest Univ.), Pa.  
 Fauziah Fakhrunnisa Rochman (B.S. Gadjah Mada Univ.), Indonesia  
 Tatjana Rosen (M.S. Bard Coll; LL.M. Harvard Univ. Law School; J.D. Univ. degli  
 Studi di Milano), Italy  
 Anna Ruth Pickett (B.A. Oberlin Coll.), Ohio  
 Fauna Samuel (B.S. Univ. Idaho; M.S. Univ. Colorado [Boulder]), Idaho  
 Meredith Jaye Sattler (B.A. Vassar Coll.), Calif.  
 Erin Elizabeth Savage (B.S. Univ. Washington), Wash.  
 Irene Hoagland Scher (B.A. Yale Univ.), Wash.  
 Elizabeth Anderson Scherer (B.A. Colby Coll.), Conn.  
 Stella Zucchetti Schons (B.A. Univ. Estadual de Campinas), Brazil  
 J. Michael Sesko (B.A. Colby Coll.), Conn.  
 Hsin Tien Shiao (B.S. Univ. Michigan [Ann Arbor]; M.S. Northwestern Univ.),  
 Taiwan  
 Janna Shub (B.S. Technion-Israel Inst. of Technology), Israel  
 Shannon Noelle Siart (B.A. Coll. Wooster), Ariz.  
 Jessica Rachel Siegal (B.A. Boston Univ.), Conn.  
 Monica Ann Skeldon (B.S. Brown Univ.), Fla.  
 Keith Malmot Stagg (B.A. Whitman Coll.), N.Mex.  
 Christopher Neal Starkey (B.Arch. Rice Univ.), Ga.  
 Hiroshi Sugano (B.S. Shizuoka Univ.), Japan  
 Eliezeri Sungusia (B.S. Sokoine Univ. of Agriculture), Tanzania  
 Zhao Tang (B.A. Univ. Chicago), China  
 Toshitake Tanuma (B.S. Univ. South), Japan  
 Elizabeth Ayame Thomas (B.A. Claremont McKenna Coll.), Calif.

Marian Ahn Thorpe (B.A. Brown Univ.), Wash.  
 Matthew Charles Thurston (B.A. Franklin & Marshall Coll.), Tex.  
 John-Frederick Thye (B.S. Cornell Univ.), N.Y.  
 Kristin Carroll Tracz (B.A. Univ. Virginia), Va.  
 Meredith Sauvalle Trainor (B.A. Hobart & William Smith Coll.), N.J.  
 Harikrishnan Venugopalan Nair Radhamoni (B.S. Kerala Agricultural Univ.), India  
 Ranran Wang (B.S. Nanjing Univ.), China  
 Alexandra N. Whitney (B.F.A. Art Inst. Chicago; M.A. Univ. Chicago), Mass.  
 Kyle Wayne Williams (B.A., B.S. Hope Coll.), Mich.  
 Rae Jackson Wynn-Grant (B.S. Emory Univ.), Va.  
 Jianan Xin (B.S. Sichuan Univ.; M.S. Chinese Acad. of Science), China  
 Lesley Lynne Yen (B.A. Wellesley Coll.), Mass.  
 Seth Zeren (B.A. Williams Coll.), Calif.

### DOCTORAL DEGREES CONFERRED, DECEMBER 2009

Nicole Michele Ardoin (B.B.A. James Madison Univ.; M.S. Univ. Madison [Stevens Point]), Va.  
 Cristina Marie Balboa (B.A. Univ. Michigan [Ann Arbor]; M.S. Johns Hopkins Univ.), Washington, D.C.  
 Katrina Jessoe (A.B. Princeton Univ.; M.E.S.M. Univ. California [Santa Barbara]), Calif.  
 Kelly Elizabeth Levin (B.A., M.E.S. Yale Univ.), N.Y.  
 Steven Alan Wallander (B.A. Hobart Coll.; M.S. Pratt Inst.), Colo.  
 Hui-Ju Wu (LL.B. National Taiwan Univ.; LL.M. Univ. California [Berkeley]; M.F.S. Yale Univ.), Taiwan

### DOCTORAL DEGREES CONFERRED, MAY 2010

Rebecca Ashley Asare (B.A. Colgate Univ.; M.E.Sc. Yale Univ.), Vt.  
 Brandon Tristan Barton (B.S. Univ. Idaho; M.S. Univ. Central Florida), Idaho  
 Curt Della Valle (B.S. Univ. Connecticut; M.E.M., M.P.H. Yale Univ.), Conn.  
 Holly Patricia Jones (B.S. Univ. California [Santa Cruz]), Iowa  
 Jason Nathaniel Rauch (Sc.B. Brown Univ.; M.E.Sc. Yale Univ.), Maine  
 Alvaro Redondo Brenes (B.Sc. Technological Inst. Costa Rica; M.F.S. Yale Univ.), Costa Rica  
 Han Shi (B.Eng., M.Eng. Tsinghua Univ. [China]), China  
 Qiong Juliana Wang (B.A. Beijing Foreign Studies Univ. [China]; M.A. Yale Univ.), China

### STUDENTS WORKING TOWARD MASTER'S DEGREES

Michele Lisa Abbene (B.S. Loyola Univ. [Louisiana]), N.Y.  
 Adenike Sade Adeyeye (B.A. Yale Univ.), Md.  
 Natalie Lyn Allan (B.A. Dartmouth Coll.), Calif.  
 Margaret Wilde Arbuthnot (A.B. Princeton Univ.), Washington, D.C.  
 Naina Arora (B.A. Univ. Washington), Wash.

Julianne Baker Gallegos (B.S. Latina Univ. Costa Rica), Costa Rica  
 Bidisha Banerjee (B.A. Yale Univ.), Kans.  
 Rachel Malka Barr (B.COM., McGill Univ.), Va.  
 Lucien Abraham Bouffard (B.S. Southern Conn. State Univ.), Conn.  
 Nasser Camilo Brahim (B.A. Florida International Univ.), Tex.  
 Andrew Hudson Breck (B.A. Wesleyan Univ. [Conn.]), Conn.  
 Lauren Elisabeth Brooks (B.S. Marshall Univ.), W.Va.  
 Jason Minton Brown (B.A. Brigham Young Univ.), Calif.  
 Kyra Rachelle Busch (B.A. Indiana Univ. [Bloomington]), Ind.  
 Stephanie Caius Carlisle (B.A. Wesleyan Univ. [Conn.]), Tex.  
 Kate Carman (B.A. Oregon State Univ.), Conn.  
 Temperance Louise Carter (B.E. Univ. Michigan [Ann Arbor]), Mich.  
 Eliza Frances Cava (B.A. Swarthmore Coll.), Conn.  
 Charlotta Mary Wilhelmina Chan (B.A. Univ. California [Los Angeles]), Calif.  
 Thomas Robert Chase (M.A. Wesleyan Univ. [Conn.]), N.H.  
 Xiaojiao Chen (B.A. Renmin Univ. [China]), China  
 Esther Sekyoung Choi (B.S. Univ. California [Berkeley]), Calif.  
 Erin D. Clark (B.A. Colby Coll.), Conn.  
 George Michael Collins (A.B. Harvard Univ.), Ill.  
 James Robert Collins (B.A. Yale Univ.), N.Y.  
 Diana Gail Connett (B.A. Univ. Chicago), Ind.  
 Christopher Platt Cooke (B.S. New York Univ.), N.Y.  
 Meredith Anne Cowart (B.A. Wesleyan Univ. [Conn.]), Vt.  
 Adriane Mariah Cromer (B.S. Univ. Georgia [Athens]), Conn.  
 Ian Taylor Cummins (A.B. Occidental Coll.), Calif.  
 Stuart M. DeCew (B.A. Colorado Coll.), Conn.  
 Guilherme Medeiros DePaula (B.S. Pontificia Univ. Católica; M.B.A. Univ. North  
 Carolina [Chapel Hill]), Brazil  
 Erin M. Derrington (B.A. Univ. Washington), Wash.  
 Selin Devranoglu (B.A. Connecticut Coll.), Turkey  
 Sangay Thinley Dorji (B.A. Sherubtse Coll.; M.B.A. Assumption Univ.), Bhutan  
 Marshall Douglas Duer-Balkind (B.A. Oberlin Coll.), Conn.  
 Elyzabeth Adrienne Earnley (B.A. Trinity Univ. [Texas]), Tex.  
 Alisha Eisenstein (B.A. Trinity Univ. [Texas]), Tex.  
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# YALE UNIVERSITY CAMPUS SOUTH & YALE MEDICAL CENTER





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*For all other matters related to admission to the School of Forestry & Environmental Studies, please telephone the Admissions Office, 800.825.0330 or 203.432.5138, or e-mail [fesinfo@yale.edu](mailto:fesinfo@yale.edu).*

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