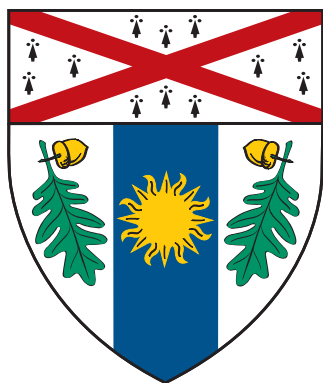


School of Forestry & Environmental Studies 2008–2009



BULLETIN OF YALE UNIVERSITY

Series 104 Number 6 July 25, 2008

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Application deadlines

Ph.D. Program January 2, 2009

Master's Programs January 5, 2009

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School of Forestry & Environmental Studies 2008–2009

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Calendar

FALL 2008

Aug. 7–9	TH–SA	Orientation for international students
Aug. 10	SU	Orientation for summer modules
Aug. 11–29	M–F	Training modules in technical skills
Sept. 2	T	Meeting with Dean Speth and academic orientation for first-year students (mandatory), 8:30–11 a.m. Course Expo, 12 noon
Sept. 3	W	Fall-term classes begin, 8:30 a.m.
Sept. 17	W	Course registration closes, 5 p.m.
Sept. 24	W	Add/Drop period ends, 5 p.m.
Oct. 24	F	Open house for prospective students
Nov. 21	F	Fall recess begins, 5:30 p.m. Open house for prospective students
Dec. 1	M	Classes resume, 8:30 a.m.
Dec. 5	F	Classes end, 5:30 p.m. Reading period begins Open house for prospective students
Dec. 15	M	Final examinations begin, 9 a.m.
Dec. 19	F	Final examinations end, 5:30 p.m. Winter recess begins

SPRING 2009

Jan. 5	F	Fall-term grades due
Jan. 12	M	Spring-term classes begin, 8:30 a.m.
Jan. 19	M	No classes. Martin Luther King, Jr. Day
Jan. 27	T	Course registration closes, 5 p.m.
Feb. 3	T	Add/Drop period ends, 5 p.m.
Mar. 6	F	Spring recess begins, 5:30 p.m.
Mar. 23	M	Classes resume, 8:30 a.m.
Apr. 27	M	Classes end, 5:30 p.m. Reading period begins
May 5	T	Final examinations begin, 9 a.m.
May 11	M	Final examinations end, 5:30 p.m.
May 18	M	Spring-term grades due for graduating students
May 25	M	University Commencement
May 29	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

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

Jeffrey Powell Koplan, B.A., M.D., M.P.H., Atlanta, Georgia (*June 2009*)

Margaret Hilary Marshall, B.A., M.Ed., J.D., Cambridge, Massachusetts (*June 2010*)

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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Vice President for Development

Ingeborg Theresia Reichenbach, Staatsexamen

Vice President for Finance and Administration

Shauna Ryan King, B.S., M.B.A.

Faculty and Administration

Faculty Emeriti

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

George Mason Furnival, M.F., D.F., J. P. Weyerhaeuser, Jr. Professor Emeritus of Forest Management

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

David Martyn Smith, M.F., Ph.D., Sc.D., Morris K. Jesup Professor Emeritus of Silviculture

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

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Mark S. Ashton, M.F., Ph.D., Morris K. Jesup Professor of Silviculture; Professor of Forest Ecology; and Director of School Forests

Gaboury Benoit, M.S., Ph.D., The Grinstein Class of 1954 Professor of Environmental Chemistry; Associate Dean for Research; Professor of Environmental Engineering; Director, Hixon Center for Urban Ecology; Director, Center for Coastal and Watershed Systems; and Director of Doctoral Studies

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

William Richard Burch, Jr., M.S., Ph.D., Frederick C. Hixon Professor of Natural Resource Management; Professor at the Institute for Social and Policy Studies; and Director, Urban Resources Initiative

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

†Lisa M. Curran, M.A., Ph.D., Professor of Tropical Resources and Director, Tropical Resources Institute

†Michael Roger Dove, M.A., Ph.D., Margaret K. Musser Professor of Social Ecology; Professor of Anthropology; and Coordinator, F&ES/Anthropology Degree Program

Daniel C. Esty, M.A., J.D., Hillhouse Professor of Environmental Law and Policy; Clinical Professor, Law School; Director, Yale Center for Environmental Law and Policy; and Director, Center for Business and the Environment at Yale

Thomas Eldon 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

Timothy G. Gregoire, Ph.D., J. P. Weyerhaeuser, Jr. Professor of Forest Management

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

Xuhui Lee, M.Sc., Ph.D., Professor of Forest Meteorology and Micrometeorology
 †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
 James E. Saiers, M.S., Ph.D., Professor of Hydrology
 Oswald J. Schmitz, M.Sc., Ph.D., Oastler Professor of Population and Community
 Ecology; Associate Dean for Academic Affairs; and Professor of Ecology and
 Evolutionary Biology
 David K. Skelly, Ph.D., Professor of Ecology and Professor of Ecology and
 Evolutionary Biology
 John Peter Wargo, Ph.D., Professor of Risk Analysis, Environmental Policy, and
 Political Science; Director, Environment and Health Initiative; and Co-Chair of
 the Environmental Studies Program, Yale College

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
 Sheila Olmstead, M.P.Aff., Ph.D., Associate Professor of Environmental Economics
 ‡Peter A. Raymond, Ph.D., Associate Professor of Ecosystem Ecology
 Karen Seto, Ph.D., Associate Professor
 Julie B. Zimmerman, Ph.D., Assistant Professor of Green Engineering and Assistant
 Professor of Chemical Engineering

Non-Ladder Faculty

Paul Anastas, Ph.D., Professor in the Practice of Green Chemistry; Senior Research
 Scientist in Chemical Engineering; and Lecturer, Department of Chemistry
 Shimon C. Anisfeld, Ph.D., Senior Lecturer and Research Scientist in Water Resources
 Environmental Chemistry
 Ellen Brennan-Galvin, Ph.D., Lecturer and Senior Research Scholar
 Richard Burroughs, Ph.D., Professor (Adjunct) of Coastal Science and Policy
 Ann E. 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 Gail Clark, M.S., Ph.D., Joseph F. Cullman 3rd Adjunct Professor 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

*On leave of absence, fall 2008

†On leave of absence, spring 2009

‡On leave of absence, 2008–2009 academic year

Helmut Ernstberger, Ph.D., Lecturer; Associate Research Scientist; and Analytical Laboratory Manager

Gordon T. Geballe, M.S., Ph.D., Associate Dean for Student and Alumni Affairs and Lecturer in Urban Ecology

Bradford S. Gentry, J.D., Senior Lecturer in Sustainable Investments; Research Scholar; Director, Center for Business and the Environment at Yale; and Director, Research Program on Private Investment and the Environment

John Grim, Ph.D., Senior Research Scholar and Senior Lecturer

Arnulf Grubler, Ph.D., Professor in the Field of Energy and Technology

Lloyd Irland, Ph.D., Lecturer and Senior Research Scientist

Anthony Leiserowitz, Ph.D., Research Scientist and Director of Strategic Initiatives

Reid J. Lifset, M.S., M.P.P.M., Associate Research Scholar; Associate Director, Industrial Environmental Management Program; and Editor-in-Chief, *Journal of Industrial Ecology*

Florencia Montagnini, M.S., Ph.D., Professor in the Practice of Tropical Forestry and Director of the Program in Tropical Forestry of the Global Institute of Sustainable Forestry

Jonathan D. Reuning-Scherer, Ph.D., Lecturer in Statistics

Thomas G. Siccama, Ph.D., Senior Lecturer

Mary Evelyn Tucker, Ph.D., Senior Research Scholar and Senior Lecturer

Courtesy Joint Appointments

Michelle Addington, Ph.D., Associate Professor, School of Architecture

James W. Axley, M.Arch., M.S., Ph.D., Professor of Architecture

Ruth Elaine Blake, M.S., Ph.D., Assistant Professor of Geology and Geophysics

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

Robert Eugene Evenson, Ph.D., Professor of Economics

Durland Fish, Ph.D., Professor of Epidemiology and Public Health

Willis Jenkins, Ph.D., Assistant Professor of Social Ethics, Divinity 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; Curator of Vertebrate Zoology, Peabody Museum

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 Engineering; and Director, Yale Center for Earth Observation

Karl Turekian, Ph.D., Benjamin Silliman Professor of Geology and Geophysics and
 Director, Institute for Biospheric Studies
 Ernesto Zedillo, Ph.D., Director, Yale Center for the Study of Globalization and
 Professor in the Field of International Economics and International Relations

**Visiting Faculty, Fellows, Adjunct Faculty, and
 Faculty with Primary Appointments Elsewhere**

Dale S. Bryk, M.A., J.D., Lecturer in Environmental Law
 Maureen Burke, M.B.A., Lecturer
 Douglas C. Daly, Ph.D., Associate Professor (Adjunct)
 Mary Beth Decker, Ph.D., Lecturer
 William Ellis, Ph.D., Senior Visiting Fellow; Lecturer; and Resident Fellow in
 Industrial Environmental Management
 James Fickle, Ph.D., Visiting Professor
 Emil H. Frankel, B.A., LL.B., Lecturer
 Lawrence Kelly, Ph.D., Associate Professor (Adjunct)
 Roy S. Lee, Ph.D., Professor (Adjunct)
 Lin Heng Lye, LL.M., Visiting Associate Professor
 James R. Lyons, M.F., Lecturer and Research Scholar
 James G. MacBroom, P.E., Lecturer in River Processes and Restoration
 David Mattson, Ph.D., Visiting Senior Research Scientist
 Fabian Michaelangeli, Ph.D., Assistant Professor (Adjunct)
 Arvid Nelson, Ph.D., Lecturer
 John R. Nolon, J.D., Visiting Professor
 Charles M. Peters, M.F.S., Ph.D., Associate Professor (Adjunct) of Tropical Ecology
 Stephen Ramsey, Senior Visiting Fellow and Lecturer
 Nicholas Robinson, Ph.D., Professor (Adjunct)
 Marjorie Shansky, J.D., Lecturer
 Dennis W. Stevenson, Ph.D., Professor (Adjunct) of Tropical Studies
 Fred Strebeigh, B.A., Senior Lecturer in Environmental Writing
 Simon S. C. Tay, Ph.D., Visiting Associate Professor (spring term)
 Charles Dana Tomlin, Ph.D., Visiting Professor
 Gerald Torres, J.D., Visiting Professor and McClasky Fellow (spring term)
 William Vance, Ph.D., Lecturer
 Helga Weisz, Ph.D., Visiting Associate Professor (fall term)
 Gary Yohe, Ph.D., Visiting Professor of Economics

Research Appointments

Daniel Abbasi, M.B.A., Research Affiliate
 Ruth Allen, Ph.D., Research Affiliate
 Donald E. Aylor, M.E.S., Ph.D., Research Affiliate in Biometeorology
 Mary K. Berlyn, Ph.D., Senior Research Scientist
 Frederick Herbert Bormann, M.A., Ph.D., Senior Research Scientist
 Ian Cameron, M.F., Research Affiliate
 Douglas A. Clark, Ph.D., Research Affiliate
 John Ehrenfeld, Sc.D., Senior Research Scholar
 Nina Eisenmenger, Ph.D., Research Affiliate

Michael Ferrucci, M.F., Research Affiliate
 Lauri K. Freidenberg, Ph.D., Associate Research Scholar
 Eva Garen, Ph.D., Research Affiliate
 Jefferson Hall, Ph.D., Research Affiliate
 A.L. Hammett III, Ph.D., Research Affiliate
 Ermelinda Harper, Ph.D., Research Affiliate
 Seiji Hashimoto, Ph.D., Visiting Fellow
 Harri Kalimo, Ph.D., Research Affiliate
 Laly Lichtenfeld, Ph.D., Research Affiliate
 Javier Mateo-Vega, M.A., Research Affiliate
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Mariann Adams, Administrative Assistant, Career Development

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William Walker, Administrative Assistant, Faculty Support
Bethany Zemba, M.P.A., Associate Director of Research and Postdoctoral Programs

Henry S. Graves Memorial Library

Carla Heister, M.A., M.S., Librarian
Fei Huang, B.S., Catalog Assistant
Adiba Nabizada, M.S., Library Services Assistant

A Message from the Dean

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

One of the central goals of our School today is nothing less than the building of a new interdisciplinary academic field called "environment." It is the rigorous scientific study of the interactions between human societies and the natural world. Knowledge generated in this new field becomes the basis for environmental management. Societies need a generation of professionals trained in environmental management, and we also need knowledge of the environment to infuse the traditional professions – business, law, science and engineering, medicine, and others – and to motivate a revolution in personal choice as each of us carries out daily life.

The School provides a broad-gauged educational experience that equips its graduates to assume influential roles in government, business, nongovernmental organizations, public and international affairs, journalism, research, and education. The faculty and I will continue to direct our teaching and research efforts to solve local, national, and global problems. Drawing on such considerations as those listed below, we will continue to evaluate and expand our existing programs.

- Human alterations of the biosphere have reached critical levels. As a result, nations face a new generation of global-scale environmental challenges, including climate change, ozone depletion, deforestation, loss of biological diversity, and the deterioration of agricultural resources. Meanwhile, challenges such as sustainable forest management and pollution abatement persist.
- Many solutions to today's environmental challenges lie outside the established environmental sector, and require a fusion of environmental and economic thinking and a willingness on the part of business, government, and environmental leaders to work together to integrate goals. Environmental objectives need to be incorporated into corporate planning, energy strategy, technology policy, R&D funding, tax policy, international trade and finance, development assistance, and other matters that once seemed far removed.
- Cooperation between developing and industrial countries is critical, with current progress hampered by a desperate shortage of trained personnel and human capacity.
- The increased awareness that environmental concerns are moving into the international arena will require that U.S. environmental policy be more in concert with other nations, thus giving birth to a new field of environmental diplomacy.

I hope and expect that those of you entering the School at this time as students will join me in shaping its future and exerting a positive influence on the prospects for environmental progress. I encourage you to use this bulletin as a means to explore how

F&ES can help facilitate your goals. Please visit our Web site (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.

James Gustave Speth

Carl W. Knobloch, Jr. Dean

*Sara Shallenberger Brown Professor in the Practice of
Environmental Policy and Sustainable Development*

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 1940 was the School's first head (and later, dean) and intellectual leader, Henry S. Graves. To Graves, graduate education, like that 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 cosponsored 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.

As Yale's Environment School heads into its second century, 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 envi-



ronmental management; policy, economics, and the law; urban ecology, environmental planning, design, and values; and coastal and watershed systems. Under the leadership of Dean James Gustave Speth, 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 serving as an active steward of our environment.



Paul T. Anastas



Shimon C. Anisfeld

Faculty Profiles

Paul T. Anastas Professor in the Practice of Green Chemistry, Lecturer in Chemistry, and Senior Research Scientist in Chemical Engineering. B.S., University of Massachusetts at Boston; M.A., Ph.D., Brandeis University. 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. Environmental Protection Agency 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 co-author 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 aims to understand human impacts on rivers and wetlands in coastal watersheds. He tries to answer questions such as these: How do tidal marshes maintain—or fail to maintain—their elevation in the face of sea level rise? How do high nutrient loads change above-ground and below-ground processes in salt marshes? What is the relationship between watershed land use and river pollutant loads? Can isotope methods be used to trace sources and sinks of pollutants? How does the temporal and spatial variability in river conditions impact water quality assessments? What is the degree of success—and what are the unintended consequences—of wetland restoration? How do cities metabolize water and nitrogen? His goal is to carry out integrated research that is both scientifically interesting and directly relevant to management. He teaches courses in water resources, coastal ecology, and environmental organic chemistry.

*Mark S. Ashton**Robert Bailis*

Mark S. Ashton 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. Field sites include 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 access to resources, causes and effects of poverty, and links among public health, social welfare, and environmental change in the developing world. He explores these issues principally, though not exclusively, in the context of energy resources. 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. He continues to work with Kenyan researchers to explore pathways to a more sustainable energy future for the country, and he is starting to explore the social dynamics of biomass energy systems, including modern biofuels, in other developing regions. In addition, he has embarked on two new research directions. One examines climate change adaptation in forest-dependent communities, and a second explores the benefit flows in carbon offset markets.



Michelle L. Bell



Gaboury Benoit

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 socio-economic 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, Associate Dean for Research, 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., Ph.D., Massachusetts Institute of Technology–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**Mark A. Bradford*

Graeme P. Berlyn E. H. Harriman Professor of Forest Management, Professor of Anatomy and Physiology of Trees, and Editor, *Journal of Sustainable Forestry*. B.S., Ph.D., Iowa State University; M.A. (honorary), Yale University. Professor Berlyn's interests are the morphology and physiology of trees and forests in relation to environmental stress. Leaves are the most responsive and vulnerable organs of trees, and Professor Berlyn studies 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. 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, 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 examines ecosystem carbon and nitrogen cycling. His research primarily focuses on understanding how global changes such as warming, nitrogen deposition, and elevated atmospheric carbon dioxide affect the size and turnover of soil carbon pools of differing sink strength. His approach involves field experimentation and observation, complemented by controlled-laboratory manipulations to tease apart competing mechanistic hypotheses. Current research emphases include testing whether the respiratory activity of the soil microbial biomass acclimates to elevated temperatures, whether the assumption of the functional equivalence of microbial communities across space is valid, and whether non-random tree species loss will alter the function-



Ellen Brennan-Galvin



William R. Burch, Jr.

ing of eastern U.S. forests. The overall goal of the 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. The 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. Her research focuses on a range of urban environmental issues, primarily in developing countries. Her current work ranges from the role of small-scale water providers to eco-sanitation to the linkages between alternative transportation systems, air pollution, and GHG emissions 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, Ms. Brennan-Galvin served on the National Academy of Science's Committee on Population, as well as on the Committee on the Geographic Foundation for Agenda 21. She also served on the NAS Panel that produced *Cities Transformed: Demographic Change and Its Implications in the Developing World* (2003). 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.

William R. Burch, Jr. Frederick C. Hixon Professor of Natural Resource Management; Professor at the Institution for Social and Policy Studies; and Director, Urban Resources Initiative. B.S., M.S., University of Oregon; Ph.D., University of Minnesota. Professor Burch has held research and management positions with the USDA Forest Service, USAID, and the Connecticut Department of Environmental Protection. From 1984 to 1996, he was retained by the National Park Service in a research position. His work on wildland recreation behavior was among the earliest, and it has expanded to include parks, biosphere reserves, and ecotourist regions in rural and urban areas in Asia, South America, and Europe, as well as in North America. His recent work on protected areas has been in Nepal, Bhutan, and the parks and open spaces of Baltimore. Professor Burch is



Ann Elizabeth Camp



Carol Carpenter

principal investigator of a six-year monitoring and evaluation project on the \$26 million restoration of Philadelphia's Fairmount Park system.

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. Other research interests include effects of fire and fire suppression on forest ecosystem dynamics and the impacts of invasive alien species (IAS) on forests. 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's teaching and research interests focus on the history and theory of environmental anthropology, the social science of sustainable development and conservation, applications of economic anthropology to environmental issues, and gender in agrarian and ecological systems. She 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. Her current interests include the implications of the economic and political invisibility of women's activities in agrarian households. She has a new volume published this year titled *Environmental Anthropology: An Historical Reader* (co-edited with Michael Dove, for Blackwell). She is a fellow of Calhoun College.



Benjamin Cashore

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. He has held positions as Assistant Professor, School of Forestry and Wildlife Sciences, Auburn University (1998–2001); postdoctoral fellow, Forest Economics and Policy Analysis Research Unit, University of British Columbia (1997–1998); and policy advisor to the leader of the Canadian New Democratic Party (1990–1993). 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 Prize for the best book on international environmental policy and politics. Published by Yale University Press in 2004, the book identifies the emergence of non-state market-driven global environmental governance, and compares its support within European and North American forest sectors. He has edited, with Fred Gale, Errol Meidinger, and Deanna Newsom, a sixteen-country analysis, *Confronting Sustainability: Forest Certification in Developing and Transitioning Societies*. His current efforts include a major international comparison (with Constance McDermott and Peter Kanowski) of twenty countries' domestic forest policy regulations (under provisional acceptance from CABI Press); 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. Professor Cashore is also co-editor of *Forest Policy for Private Forestry* (with L. Teeter and D. Zhang), CAB International; and co-author of *In Search of Sustainability: The Politics of Forest Policy in British Columbia in the 1990s* (with G. Hoberg, M. Howlett, J. Raynor, and J. Wilson) from the University of British Columbia Press. He is also author or co-author 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. Professor

*Marian R. Chertow**Susan G. Clark*

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 for their article “Globalization, Four Paths of Internationalization and Domestic Policy Change: The Case of Eco-forestry Policy Change 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 industrial ecology/industrial symbiosis, business/environment issues, waste management, and environmental technology innovation. Primary research interests are (1) the study of industrial symbiosis including geographically based exchanges of wastes, materials, energy, and water within networks of businesses; (2) the potential of industrial ecology in developing countries and specifically to underpin ideas of the proposed Circular Economy Law in China; (3) the application of innovation theory to the development of environmental and energy technology. Professor Chertow initiated a long-term study of industrial symbiosis in 2001 called “Puerto Rico: An Island of Sustainability,” geared to assessing the public and private benefits of cooperative business practices. Most recently, this work has expanded to China and India through the new Program on Industrial Ecology in Developing Countries. Prior to Yale, Professor Chertow spent ten years in environmental business and state and local government. She 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.

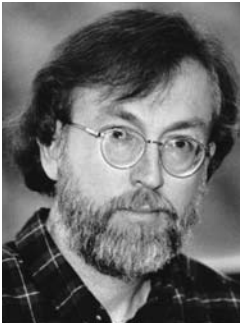
Susan G. Clark Joseph F. Cullman 3rd Professor (Adjunct) of Wildlife Ecology and Policy in Forestry & Environmental Studies and fellow in the Institution for Social and Policy Studies. B.S., Northeastern State College, Oklahoma; M.S., University of Wyoming; Ph.D., University of Wisconsin-Madison. Professor 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, aca-



Lisa M. Curran

demia, 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 just 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, Denver Zoological Foundation Conservation Award, Best Teacher from the students at the Yale School of Forestry & Environmental Studies, and 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* (co-edited, 1999), *Foundations of Natural Resources Policy and Management* (co-author, 2000), *The Policy Process: A Practical Guide for Natural Resource Professionals* (2002), *Conservation and Development in the Condor BioReserve, Ecuador* (co-author, 2004), and *Coexisting with Large Carnivores: Lessons from Greater Yellowstone* (co-author, 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.

Lisa M. Curran Professor of Tropical Resources and Director of the Tropical Resources Institute. B.A., Harvard University; Ph.D., Princeton University. Professor Curran held a Mercer Post-doctoral Fellowship at Harvard University. She has spent over twenty-five years in the South and Southeast Asian tropics conducting scientific research, training, and outreach and policy studies. She has held diverse consultancy positions for several foundations, private sector conservation, and rural development organizations, as well as the U.S. Agency for International Development, the World Bank, and Asian Development Bank. Professor Curran served as a visiting research fellow at the East-West Center's



Michael R. Dove

Ecosystem & Governance Program, Aldo Leopold Leadership Fellow, and Marie Tharp Fellow at the Earth Institute of Columbia University. Currently she is a MacArthur Fellow (2007–2012), is on the External Faculty at the Santa Fe Institute (2003–2009), and serves on NASA's Earth Science Advisory Board, as well as governing boards of the Tropical Forest Foundation, the Forest Dialogue, and Forest Integrity Network under Transparency International's Corruption Watch Program. Her current interdisciplinary programs examine the effects of land use change, climate, drought, and fire on carbon dynamics and biodiversity, and impacts of governmental policies and industrial practices on ecosystems and rural livelihoods in Asia and Latin American tropical forests.

Michael R. Dove Margaret K. Musser Professor of Social Ecology, Professor of Anthropology, Curator of Anthropology in the Peabody Museum of Natural History, and Coordinator of the joint doctoral degree program between F&ES and the Department of Anthropology. 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 three decades, 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* (co-edited with P. Sajise and A. Doolittle, Yale Southeast Asia Program, 2005) and *Environmental Anthropology: A Historical Reader* (coedited with C. Carpenter, Blackwell, 2007). He has in press a book on the fire-climax grasslands of Southeast Asia (New York Botanical Garden), and he is currently completing books on folk dimensions of conservation in Southeast Asia (co-edited with P. E. Sajise and A. Doolittle, Duke University Press) and on the historic participation of remote Bornean tribes in global commodity production (Yale University Press). One of his principal current research projects, in collaboration with colleagues in Indonesia, focuses on the cultural and political aspects of natural hazards and disasters in Central Java. Another ongoing research activity, collaboratively conducted and published with members of the Dove/Carpenter doctoral lab, is a theoretical critique of key academic and policy concepts in conservation and development. Other research and teaching interests include the global circulation of environmental concepts; political dimensions of resource degradation; indigenous environmental knowledge; contem-



Paul Alexander Draghi

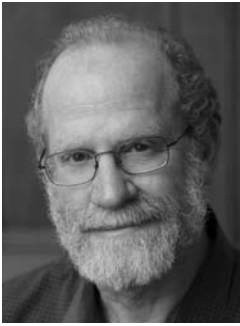


Daniel C. Esty

porary 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.

Paul Alexander Draghi Director of Information and Library Systems and Lecturer in Forest History. B.A., University of Connecticut; M.A., M.A., Ph.D., Indiana University. Mr. Draghi's teaching follows two main branches. The first involves the application of information technology to environmental research, communications, and problem-solving, and includes the use of database, modeling, simulation, and Geographic Information Systems (GIS), as well as a consideration of environmental semiotics. His second teaching focus is the cultural history of how humans in different civilizations and periods relate to nature, and in particular how they characterize individuals whose role is to mediate between nature and society in literature, art, folklore, and myth. Mr. Draghi's 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 of hunting and forestry in Britain and German-speaking Europe and the translation of an original Tibetan manuscript from the Beinecke Rare Book and Manuscript Library that deals with the classification, training, and care of horses in Inner Asia.

Daniel C. Esty Hillhouse Professor of Environmental Law and Policy; Director of the Yale Center for Environmental Law and Policy; and Director of the Center for Business and the Environment at Yale. 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



Gordon T. Geballe

Fellow at the 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). Professor Esty spent the 2000–01 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 Board of Directors of Resources for the Future and the Connecticut Fund for the Environment.

Gordon T. Geballe Associate Dean for Student 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. Mr. Geballe, with faculty and students, is also involved in projects in the People’s Republic of China. 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



Thomas E. Graedel

Bradford S. Gentry Senior Lecturer in Sustainable Investments and Research Scholar, Director of the Center for Business and the Environment at Yale, 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, including the books *Private Capital Flows and the Environment: Lessons from Latin America* and *Emerging Markets for Ecosystem Services: The Case 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*, co-written 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 for F&ES courses of the same names. His current 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 is a fellow of Pierson College.



Timothy G. Gregoire



John Grim

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*; co-editor of *Modeling Longitudinal and Spatially Correlated Data*; and senior author of *Sampling Strategies for Natural and Environmental Resources* (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 Forest Science Award 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 Research Scholar. B.A., St. John's University (Minnesota); M.A., Fordham University; Ph.D., Fordham University. His 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 pro-



Arnulf Grubler



Lloyd Irland

fessor 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 also president of the American Teilhard Association.

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 *Technological Forecasting and Social Change* and the *Journal of Industrial Ecology*. He has published widely as author, coauthor, or editor of nine books, three special journal issues, more than sixty 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 senior research scholar 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.

Lloyd Irland Lecturer and Senior 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. Mr. Irland served as a junior author of one section of the Millennium Ecosystem Assessment and participated in the U.S. National



Stephen R. Kellert



Xuhui Lee

Assessment on Climate Change. He has worked actively in the field of forest certification. He also has worked in forestry and professional ethics, and edited a major readings volume, *Ethics in Forestry*. His book *The Northeast's Changing Forests* is distributed by Harvard University Press. He recently completed an electronically published volume published by the School, titled *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, and Ukraine.

Stephen R. Kellert Tweedy/Ordway Professor of Social Ecology. B.A., Cornell University; Ph.D., Yale University. Professor Kellert's research has focused on science, policy, and management relating to the interaction of people and the natural environment. Current research projects include studies of the theory, science, and practice of restorative environmental design; the theory and application of the concept of biophilia; connecting human and natural systems especially in urban watersheds; and the biocultural basis for an ethic toward the natural world. His books published since 1993 include *Building for Life: Designing and Understanding the Human–Nature Connection* (2005), *Kinship to Mastery: Biophilia in Human Evolution and Development* (1997), *The Value of Life: Biological Diversity and Human Society* (1996), *The Biophilia Hypothesis* (co-edited with E. O. Wilson, 1993), *The Good in Nature and Humanity: Connecting Science, Religion, and Spirituality with the Natural World* (co-edited with T. Farnham, 2002), and *Children and Nature: Psychological, Sociocultural, and Evolutionary Investigations* (co-edited with P. H. Kahn, 2002). He is a fellow of Branford College, an ISPS scholar at the Institution for Social and Policy Studies, director of the Center for Bioethics, and a faculty affiliate at the Peabody Museum.

Xuhui Lee Professor of Meteorology. B.Sc., M.Sc., Nanjing Institute of Meteorology, China; Ph.D., University of British Columbia. Professor Lee's research concerns the states and principles that govern the exchanges of radiation, heat, water, and trace gases between vegetation and the atmosphere. His areas of interest include forest meteorology, boundary-layer meteorology, air quality, micro-meteorological instrumentation, and remote sensing. His current research projects focus on land-air exchange of water and carbon dioxide isotopes, greenhouse gas fluxes in forests and cropland, air motion in the atmospheric boundary layer, and mercury emission to the atmosphere.



Reid J. Lifset



Robert Mendelsohn

Reid J. Lifset Associate Research Scholar, Associate Director of the Industrial Environmental Management Program, 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 study of the environmental consequences of production and consumption. He is editor-in-chief of the *Journal of Industrial Ecology*, an international peer-reviewed bimonthly headquartered at and owned by Yale University and published by Wiley-Blackwell. In addition, he is associate director of the Industrial Environmental Management Program. Mr. Lifset's research focuses on the development of the field of industrial ecology, the application of industrial ecology to solid waste problems, and the evolution of extended producer responsibility (EPR). He is currently investigating the global life cycle of metals, the environmental implications of a shift to bio-based materials and fuels, and the application of industrial ecology in Asia, especially China. He has published extensively on EPR and on solid waste issues in academic and professional publications and is editor of the *Yale Working Papers on Solid Waste Policy*. He also serves on the Science Advisory Board of the US 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, non-timber 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**Chadwick Dearing Oliver*

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); 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; and the integration of ecological principles with economic, social, and policy factors in the design of sustainable land use schemes in humid tropical regions. 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); tropical plantation silviculture; and participatory projects for rural ecosystem restoration. In her research, she collaborates with institutions such as CATIE (Tropical Agriculture Research and Higher Education Center, Costa Rica), National University of Hidalgo, Mexico, as well as with universities in Costa Rica, Nicaragua, Panama, Argentina, and Brazil. Professor Montagnini has written more than ninety scientific articles for international journals, and six 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 and Director of the Global Institute of Sustainable Forestry. 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



Sheila Olmstead



Peter A. Raymond

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 decade 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, Turkey, Nepal, Japan, Thailand, Sweden, Finland, Russia, Ukraine, India, China, Ecuador, Germany, and France.

Sheila Olmstead Associate Professor of Environmental Economics. B.A., University of Virginia; M.P.Aff., University of Texas at Austin; Ph.D., Harvard University. Professor Olmstead's research and teaching interests are in the area of environmental and natural resource economics and policy, including both natural resource management and pollution control. Her area of primary research is water resource economics, including urban water demand management, market-based approaches to water conservation, drinking water quality regulation, access to drinking water among low-income populations, current and potential applications of water marketing and water quality trading, and the efficient allocation of water across sectors.

Peter A. Raymond Associate 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 biogeochemistry of natural systems. In particular, he is interested in carbon cycle science. Current research topics include the landscape controls on the watershed export of carbon, biogeochemical transformations in estuaries, the physics of air-sea CO₂ exchange, and determining the age and composition of carbon being transported from land to the ocean. His research often utilizes the watershed approach and natural isotopes to determine major sources, sinks, and ages of various carbon and nitrogen pools in the natural environment.

*James E. Saiers**Oswald J. Schmitz*

James E. Saiers Professor of Hydrology. 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, Associate Dean for Academic Affairs, 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



Thomas G. Siccama

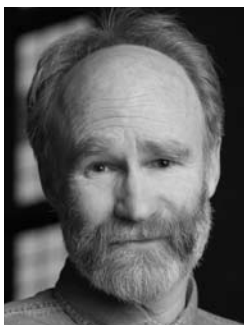
Karen C. Seto Associate Professor. B.A., University of California [Santa Barbara]; M.A., Ph.D., Boston University. Professor Seto's research is on the dynamics of land-use change. In particular, her work focuses on three broad themes: (1) monitoring, measuring, and forecasting urban form and growth patterns; (2) identifying and comparing the drivers of urban growth; and (3) analyzing the environmental and social consequences of land-use change and urban expansion. A geographer by training, her research provides an interdisciplinary evaluation of twenty-first-century urban growth dynamics by combining research approaches and conceptual frameworks from the fields of urban studies, geography, economics, and policy studies. She uses a combination of satellite remote sensing, socioeconomic and biophysical data, in-person field interviews, and a range of statistical and computational models to gain insight on the patterns and processes of urban land-use change. Her geographic region of specialization is China, where she has worked on urban development issues for more than ten years. More recently, she has had research projects in India, Vietnam, and Qatar. Professor Seto is co-chair of the Urbanization and Global Environmental Change Project of the International Human Dimensions Programme of Global Environmental Change (IHDP), and global thematic leader on Ecosystem Management Tools for the International Union for Conservation of Nature's (IUCN) Commission on Ecosystem Management. She is the executive producer of *10,000 Shovels: Rapid Urban Growth in China*, a short documentary film that highlights the unprecedented urban changes occurring in South China. Professor Seto is a recipient of the NASA New Investigator Program Award, NSF Career Award, and a National Geographic Research Grant.

Thomas G. Siccama Senior Lecturer. B.S., M.S., Ph.D., University of Vermont. Professor Siccama's interests involve trace element cycling in terrestrial ecosystems. In cooperation with the University of Pennsylvania, he is establishing baseline data on the accumulation of trace metals in the forest floor of the northeastern United States. He is also working on the suggested effects of environmental pollution on the growth of forest trees, especially in relation to pitch pine and red spruce, which are declining in the Northeast. Professor Siccama continues as an active participant in many aspects of the Hubbard Brook Experimental Watershed Ecosystem project in New Hampshire. He is also involved with natural areas documentation and land use planning.

*David K. Skelly**James Gustave Speth*

David K. Skelly Professor of Ecology and Professor of Ecology and Evolutionary Biology. 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.

James Gustave Speth Carl W. Knobloch, Jr. Dean and Sara Shallenberger Brown Professor in the Practice of Environmental Policy and Sustainable Development. B.A., Yale University; M.Litt., Oxford University; J.D., Yale University. From 1993 to 1999, Dean Speth served as administrator of the United Nations Development Programme and chair of the United Nations Development Group. Prior to his service at the United Nations, he was founder and president of the World Resources Institute; professor of law at Georgetown University; chairman of the U.S. Council on Environmental Quality; and senior attorney and cofounder, Natural Resources Defense Council. Throughout his career, Dean Speth has provided leadership and entrepreneurial initiatives to many task forces and committees aimed at combating environmental degradation. Among his awards are the National Wildlife Federation's Resources Defense Award, the Natural Resources Council of America's Barbara Swain Award of Honor, a 1997 Special Recognition Award from the Society for International Development, the Lifetime Achievement Award of the Environmental Law Institute, and the Blue Planet Prize. Publications include *The Bridge at the Edge of the World: Capitalism, the Environment, and Crossing from Crisis to Sustain-*



Fred Strebeigh



Mary Evelyn Tucker

ability; *Global Environmental Governance*; *Red Sky at Morning: America and the Crisis of the Global Environment*; *Worlds Apart: Globalization and the Environment*; and articles in *Foreign Policy*, *Foreign Affairs*, *Environmental Science and Technology*, the *Columbia Journal World of Business*, and other journals and books. Dean Speth has received honorary degrees from Middlebury College, the Vermont Law School, the College of the Atlantic, and Clark University.

Fred Strebeigh Senior Lecturer in Environmental Writing and Senior Lecturer, Department of English. B.A., Yale University. Fred 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.

Mary Evelyn Tucker Senior Lecturer. B.A., Trinity College; M.A., SUNY Fredonia; M.A., Fordham University; Ph.D., Columbia University. Ms. Tucker is co-founder and co-director 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 co-edited *Worldviews and Ecology* (Orbis, 1994), *Buddhism and Ecology* (Harvard, 1997), *Confucianism and Ecology* (Harvard, 1998),



John P. Wargo

Hinduism and Ecology (Harvard, 2000), and *When Worlds Converge* (Open Court, 2002). With Tu Weiming she edited two volumes on *Confucian Spirituality* (Crossroad, 2003, 2004). She also co-edited 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). 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 Harvard-Yenching Institute and 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 1997–2000 and is now a member of the Earth Charter International Council.

John P. Wargo Professor of Environmental Policy, Political Science, and Risk Analysis; Director of the Environment and Health Initiative; and Co-Chair of Environmental Studies Program and Major in Yale College. 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 law and regulation of these problems, and conducts research on childhood exposure to complex 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 U.S. His most recent book, *Green Intelligence*, to be published in 2008, compares the history of four serious and global environmental threats to children's health in the twentieth century: nuclear weapons testing, pesticides, hazardous sites, and particulate emissions. He identifies factors that inhibit the public's ability to identify and avoid dangerous exposures, while prescribing principles for cultivating societal "green intelligence." 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



Julie Beth Zimmerman

work suggests fundamental reforms of science and law necessary to identify and contain pesticide-related health risks. It won the American Association of Publishers award as the Best Scholarly Professional Book in Government and Political Science in 1998.

Julie Beth Zimmerman Assistant Professor of Green Engineering and of Chemical Engineering. 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 interest 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 represents 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 managed grants to academia and small businesses in the areas of pollution prevention and sustainability and launched EPA's P3 Aware program.



Degree Programs

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.). Each of the degrees will serve as preparation for either professional employment or doctoral study. Two-year master's programs normally require a minimum of four terms in residence, sixteen full courses (forty-eight credits), a summer internship, and completion of the training modules in Technical Skills in the summer just prior to the student's first term. For individuals with seven or more years of relevant professional experience, a one-year mid-career option is available for the Master of Environmental Management and Master of Forestry degrees.

Programs of study at the School are, by design, interdisciplinary. They involve application of a wide range of natural and social sciences to problems of natural resource and environmental management.

The required curricula leading to all master's programs are somewhat flexible to accommodate varying background preparations and career aspirations, and partially structured to ensure professional competence and maximum exposure to the unique diversity of the School and the other departments and professional schools at Yale. The one-year mid-career Master of Environmental Management and Master of Forestry programs have less structured curricula than the two-year programs. *In all cases, only work completed under the supervision of a Yale University faculty member is accepted as credit toward these degrees.*

Regardless of their goals or their previous training, most students entering the School are embarking on a transitional process in their education. Each student's program is determined in continuing consultation with faculty advisers who guide the student's learning experience from the first week at Yale until graduation. Each program of study is designed to be an extension of previous academic or professional achievement and should provide the student with specialized knowledge and analytical skills that are logical for the student's objectives and prospective contributions to his or her disciplines.

Programs of study leading to all degrees consist of formal courses, seminars, and individual and group projects. No formal thesis is required for the master's degrees, but all require a master's project.

Summer internships are an important component of the School's master's curricula and are required for all two-year master's students. Students pursue a variety of work and research projects in locations worldwide. The School provides significant assistance to students in helping them to identify meaningful internships.

Students interested in careers in research or teaching are advised to seek the Ph.D. in their field of major interest. A master's degree can provide important preparation for a Ph.D.

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 two courses per term and must complete the degree requirements in four years.

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; they are expected for all one-year midcareer degree program students. Waivers will be granted by the academic dean 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.

Master's Project and Independent Research Courses

All students in the M.E.M., M.E.Sc., and M.F.S. degree programs must enroll in one or more courses that officially fulfill degree requirements for a master's project. Course numbers for these project courses are provided near the end of this bulletin. These are distinct from courses that allow for independent study that is additional to, and not intended for, fulfillment of the project requirement of the individual's degree program. Project and independent research may be assigned three or more credits, and students may enroll in a sequence of one or more of these courses to complete their research.

Project and Independent Research courses can involve research in laboratory, field, or library, or analytical case studies designed to solve management problems. Typically, projects in the M.E.Sc. and M.F.S. degree programs will comprise intensive research of a scientific nature, whereas projects in the M.F. and M.E.M. degree programs will be more applied and aimed toward satisfying a particular management goal. Master's degree research often originates with the student, with input and advice from relevant faculty. M.E.Sc. and M.F.S. projects require an official faculty research adviser who oversees the research and with whom the student will work closely; the research adviser need not be the same as the student's academic adviser. Research for the two management degrees enables students or small groups to study relevant topics in a depth that is not always possible in regular courses. Management projects acquaint students with the literature dealing with localities, problems, and issues relevant to the management of forest and

environmental resources, and they provide a means of integrating and testing skills, knowledge, and judgment gained in formal course work. Master degree projects frequently have permitted students to make a significant contribution to local communities or to the academic literature.

Opportunities for other independent study are fulfilled through enrollment in independent study courses. Independent study courses are appropriate for all other non-project study or research in any master's degree program.

Master of Environmental Management

This degree is designed for students with primary interests in careers in environmental policy and analysis, stewardship, education, consulting, or management dealing with natural resource or environmental issues. The program requires course work in both the natural and social sciences, with a particular focus on the relationship among science, resource management, and policy. The ultimate purpose of the degree program is to prepare students to address complex ecological and social issues with scientific understanding and an ability to make sense of the underlying social and political context.

Students pursuing the M.E.M. degree must take seven courses in fulfillment of foundational training. With the guidance and approval of faculty advisers, each student selects courses in various categories to meet distributional requirements from a preapproved list of courses.

The foundational courses for the M.E.M. are divided into seven distributional knowledge categories. These categories represent the dimensionality of issues confronting current environmental management and represent the breadth of knowledge expected of leaders in environmental problem solving: (1) Earth and Climate Science; (2) Ecosystem Science and Biodiversity; (3) Sustainable Development and Social Ecology; (4) Economics; (5) Policy, Institutions, and Law; (6) Environmental Health and Urban and Industrial Ecosystems; (7) Information and Data Analysis. Each student, in consultation with the academic adviser, will also select an advanced study program for further course work—concluding his or her experience with a master's project or a term-long internship project (separate from the required summer internship). All students are expected to work with the adviser to build on their foundational training and tailor their advanced education to meet their unique career goals.

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 moving resource management to new levels of education using 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.

Two-year program 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. It is realized through the provision of an array of local, regional, national, and international trips to witness the practice of forestry in diverse settings. It is realized further through the provision of employment in the management of the Yale Forest and a host of internships offered through the auspices of the Global Institute for Sustainable Forestry and the Tropical Resources Institute. Finally, it is realized through the active program of 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). Founded in 1900 by Gifford Pinchot and six other pioneer foresters, SAF's 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 (forty-eight credits) is required for completion of this program.*

One-Year Midcareer Master's Degrees

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 in order to learn additional 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, it is incumbent on the applicant to explain how it has been satisfied by 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 on pages 140–41) are more likely to succeed in this competitive admission process.

The midcareer degree program is not an option 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 services 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 page 48) is expected, and the successful completion of 24 credits of course work and independent study is required. One year in residence is normally expected, as is initial enrollment at the start of the fall term.

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 toward basic and applied knowledge in any of the fields taught at F&ES, such as ecology, hydrology, economics, or policy. These degrees are intended to provide students a deeper disciplinary focus than the Management degrees, while holding to the core value of F&ES, that students be allowed flexibility in course election in order to meet their educational goals. The Master of Environmental Science is intended for students who wish to work broadly in environmental science fields. The Master of Forest Science is intended for students who wish to work in forest-related topics. The course of study 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. It is therefore expected that each student will identify and work with such an adviser no later than the end of his or her first term. The Master of Environmental Science and Master of Forest Science programs require the student to produce a “scholarly product.” This product may be in the form of a traditional master’s thesis or a paper submitted to a refereed journal. A minimum of two full years in residence and sixteen full courses is required for successful completion of this program.

Joint Master’s Degree Programs

The School of Forestry & Environmental Studies supports several curricula that work concurrently toward two degrees from different administrative units of Yale University. Opportunities for development of joint-degree programs exist with the School of Architecture, Divinity School, School of Engineering & Applied Science, Law School, School of Management, the 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 several 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 (3 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 semesters) at one school, the following academic year at the other school, and then split the final year between the two schools.

On 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 as follows:

1. School of Architecture – Master of Architecture: M.Arch. I, four years; M.Arch. II, three years.
2. School of Divinity – Master of Arts in Religion, three years; Master of Divinity, four years.
3. Law School (Yale Law School, Pace Law School, and Vermont Law School) – Juris Doctor, four years.
4. School of Management – Master of Business Administration, three years.
5. School of Public Health – Master of Public Health, three years.
6. Department of Economics, International Development and Economics program – Master of Arts, two and one-half to three years.
7. School of Engineering & Applied Science
8. International Relations (Graduate School of Arts & Sciences) – Master of Arts, two and one-half to three years.

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

SPECIAL STUDENTS

For those who do not wish to pursue a full-time degree program, F&ES offers the option of special student status. Applicants interested in this option *must follow normal admissions procedures and are expected to meet the regular admissions requirements*. There is no application deadline for special students; applicants can submit applications at any time. 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. 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 PROGRAMS

The Doctor of Philosophy (Ph.D.) degree is conferred through the Graduate School of Yale University. 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 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 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., 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 co-chaired by an F&ES ladder faculty member.

Students are required to take the Doctoral Student Seminar, Dooo5a, in the second term 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 two terms as teaching fellows, in partial fulfillment of their doctoral training.

A written and oral qualifying examination (or written comprehensive examination) must be passed in the student's area of interest and in such subordinate subjects as may be required by the student's doctoral committee and major professor. The student will be advised as to the nature and scope of the examination prior to or at the start of the term in which it is to be administered. *This examination must be completed before the start of the fifth term.* It includes a thesis proposal that must be defended before the student's doctoral committee and other interested faculty.

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 about specific problems or questions concerning the program.

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 technical mastery of the field as well as the ability to do independent scholarly work and to formulate conclusions that may modify or enlarge previous knowledge.

A guidance manual for preparing dissertations is available from the DDS. 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.

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.

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.

Some of these focal areas are new, and some have been at the heart of the School's mission for a century. At the core of each area is the goal of facilitating outstanding teaching, research, and outreach.

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, Lisa M. Curran, Gordon T. Geballe, Timothy G. Gregoire, John Grim, Stephen R. Kellert, Xuhui Lee, Peter A. Raymond, James E. Saiers, Oswald J. Schmitz, Thomas G. Siccama

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

THE SOCIAL ECOLOGY OF CONSERVATION AND DEVELOPMENT

This focal area developed out of the realization over the past generation that understanding the social, cultural, political, economic, and historic dimensions of the environment is as important to wise stewardship as is understanding its bio-physical dimensions. A distinguishing characteristic of this focal area is its special focus on the environmental relations of local communities, but students and faculty recognize that it is equally important to understand the ways that such local systems are entwined with extra-local, national, and global markets, politics, and ideologies. Special emphasis is placed on analyzing and

critiquing where necessary the orthodox approaches to conservation and development. Teaching and research in this focal area encompass communities, local and national governments, and NGOs, and address such topics as indigenous environmental knowledge, community-based conservation, protected area management, environmental justice, and environmental values, movements, and discourses. Specific courses are offered on such topics as tropical ecosystem dynamics and anthropogenic change; risk and property; society and natural resources; religion, values, and the environment; agrarian societies; sustainable development; energy issues in developing countries; environmental education; and natural resource management policy. Students in this focal area carry out summer research both within and outside the United States, with excellent on-campus financial support available for the social costs of the latter. This area is the focal point within F&ES for the joint doctoral degree program with Anthropology and the joint master's degree program with International Relations.

Faculty Michael R. Dove (Coordinator), Mark S. Ashton, Robert Bailis, Carol Carpenter, Benjamin Cashore, Susan G. Clark, Lisa M. Curran, Amity A. Doolittle, Paul A. Draghi, Gordon T. Geballe, John Grim, Stephen R. Kellert, Florencia Montagnini, James Gustave Speth, Mary Evelyn Tucker, John P. Wargo

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

Associated center Tropical Resources Institute

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

The Forest 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 non-timber 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 non-timber 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, Lisa M. Curran, 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, Thomas G. Siccama

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.

Through an interdisciplinary education curriculum, this area seeks to prepare students with the intellectual skills crucial for examining the major global change phenomena, their interactions with anthropogenic drivers, and the international policy and

management responses. Courses and seminars in this 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, Lisa M. Curran, Paul A. Draghi, William Ellis, Daniel C. Esty, Thomas E. Graedel, John Grim, Robert Mendelsohn, Peter A. Raymond, Oswald J. Schmitz, James Gustave Speth, Mary Evelyn Tucker

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 non-profits, 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, Sheila Olmstead, James E. Saiers

Courtesy joint appointment Brian P. Leaderer

INDUSTRIAL ENVIRONMENTAL MANAGEMENT

This focal area is centered on using principles of ecology to transform industry 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, as well as with co-operative strategies across firms. Geographically, faculty and students work on projects all over the world with additional focus in the Caribbean, Eastern and Western Europe, China, Japan, Hawaii, and Singapore. Course work in this focal area includes greening the industrial facility; 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

Visiting faculty Helga Weisz

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 Policy 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, Sheila Olmstead, James Gustave Speth, John P. Wargo, Julie Zimmerman

Courtesy joint appointments David Cromwell, Ernesto Zedillo

Visiting faculty Lye Lin Heng, Nicholas A. Robinson, Simon Tay, Gerald Torres, Gary Yohe

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

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 are 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 encourage 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, Ellen Brennan-Galvin, Mary Cadenasso, Marian R. Chertow, Gordon T. Geballe, Bradford S. Gentry, Thomas E. Graedel, Stephen R. Kellert, Karen Seto

Courtesy joint appointments Michelle Addington, James W. Axley

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 ground water, 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, Stephen R. Kellert, Jim MacBroom, Sheila Olmstead, Peter A. Raymond, James E. Saiers, Thomas G. Siccama, David K. Skelly, Julie 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 2008–2009 academic year.

The courses are arranged in the Bulletin by topic, and the first digit represents that topic area. The topic numbers are as follows: (1) Independent Project; (2) Master Project; (3) Ecology; (4) Environmental Education and Communication; (5) Forestry; (6) Physical Sciences; (7) Quantitative and Research Methods; (8) Social Sciences; (9) Interdisciplinary; (D) Doctoral Courses.

The second digit indicates which of the 7 M.E.M. requirements the course fulfills. The M.E.M. requirement numbers are as follows: (1) Earth, Atmospheric, and Climate Science; (2) Ecosystem Science and Biodiversity; (3) Sustainable Development and Social Ecology; (4) Economics; (5) Policy, Institutions, and Law; (6) Environmental Health and Urban and Industrial Ecosystems; (7) Information and Data Analysis; (o) Advanced Courses, M.E.Sc. required courses. (Advanced courses will not fulfill a core requirement; they will contribute to the depth of knowledge in advanced study areas.)

The third digit is either zero or 1. A zero indicates that there are no prerequisites; the 1 indicates that there are prerequisites.

The fourth and fifth digits go together and range from 01 to 99. These numerals are assigned by the registrar and indicate that there can be up to 99 courses in each of the topic areas.*

Project courses embrace 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, <http://environment.yale.edu/847/courses>.

*As an example, Methods of Ecosystem Analysis has been assigned the number 32001:

3 = Ecology (topic)

2 = Fulfills the Ecosystem Science and Biodiversity M.E.M. bin requirement

0 = No prerequisite

01 = Number assigned by the registrar

LIST OF COURSES BY TOPIC

Ecology

ECOSYSTEM ECOLOGY

[F&ES 32002b]	Tropical Ecosystem Dynamics and Anthropogenic Change	69
F&ES 32006a	Tropical Forest Ecology: The Basis for Conservation and Management	69
F&ES 32007a	Ecosystem Pattern and Process	69
[F&ES 30008b]	Topics in the Tropics	70
[F&ES 30009a]	Biogeography, Biodiversity, and Conservation	70
[F&ES 30010b]	Tropical Field Botany	70
F&ES 30121b	Biological Oceanography	70
[F&ES 30022a]	Field Ecology	70

WILDLIFE ECOLOGY AND CONSERVATION BIOLOGY

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COURSE DESCRIPTIONS

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

Ecology

ECOSYSTEM ECOLOGY

[F&ES 32002b, Tropical Ecosystem Dynamics and Anthropogenic Change 3 credits. This course has four major objectives: to introduce students to the major conceptual and theoretical questions and approaches in tropical terrestrial ecology; to compare and contrast tropical ecosystems for insights into the similarities and differences of specific regions; to integrate empirical studies on tropical ecosystem dynamics with management concerns; and to explore how anthropogenic change has altered tropical ecosystems. Current topics to be addressed in depth from an ecological perspective include land use and forest fragmentation; timber harvest and plantations; hunting and non-timber product extraction; and synergistic effects of climate, land use, fire, and ecological interactions. This course links an ecological understanding of terrestrial ecosystem dynamics at multiple spatio-temporal scales with problem solving and specific applications in major tropical biomes. Primary scientific literature supplements lectures and discussion. Participants complete a review paper, policy memoranda, and a final interdisciplinary grant proposal. Prerequisites: a basic course in ecology or equivalent. Three hours lecture and discussion. Lisa M. Curran]

F&ES 32006a, 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; non-timber forest products; plantation forestry: productivity and environmental services; community forestry; ecological and social aspects of agroforestry; rehabilitation of degraded tropical forest ecosystems. Three hours lecture. Florencia Montagnini

F&ES 32007a, Ecosystem Pattern and Process 4 credits. Ecosystem science provides a unique vantage point from which scientists can begin to understand complex adaptive systems. The basis of ecosystem science is to determine how patterns in biological processes emerge from interactions between organisms and the abiotic environment. This course introduces the ecosystem concept, investigates the structure and functioning of ecological systems, studies the response of systems to changing environmental conditions, and applies resulting knowledge to preservation and management issues. Presentation is balanced between terrestrial and marine/aquatic systems. Students must

take one of two field options. In the first a cross-section of northeastern ecosystems is visited and studied during a four-hour weekly field trip, assignments and discussions are qualitative, and students receive one credit. The second option is Field Ecology, which is a second three-credit course. Students taking Field Ecology can utilize their final project for both classes. Oswald J. Schmitz

[F&ES 30008b, Topics in the Tropics 2 credits. Seminar course with topics suggested by the faculty and selected by the students based on class interest. The aim is to discuss current papers, review methods, and discuss our research in progress around the selected topical focus. Students critique papers, discuss and debate methods, and offer their work in progress for group input. The course is graded credit/noncredit only. There are no written submissions or examinations. Lisa M. Curran]

[F&ES 30009a, Biogeography, Biodiversity, 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]

[F&ES 30010b, 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. NYBG Faculty: Lawrence Kelly, Fabian Michelangeli]

F&ES 30121b, Biological Oceanography 3 credits. This course explores a range of coastal and pelagic ecosystems and how these environments function as a coupled physical/biological system. Solar energy drives the structuring of the oceans in the vertical dimension, and the formation of both deep and surface currents. These currents are the means by which heat and material are redistributed, and are the determinants of where nutrients are available for support of primary production. The currents and other physical processes also determine the distribution and abundance of organisms from phytoplankton to fish and whales. This natural science course provides a foundation for those interested in the ecology of marine systems and in the management of coastal zones. Recommended prerequisite: college-level biology or ecology course. Three hours lecture. Mary Beth Decker

[F&ES 30022a, Field Ecology 3 credits. A field-based introduction to methodology used by ecologists in field studies. Descriptive studies, comparative analysis, modeling, and experimental approaches are explored using class or small-group projects relevant to major topics in ecology. After E&EB 122b and concurrently with or after E&EB 220a. Limited enrollment. Melinda Smith, David Post, Peter A. Raymond]

WILDLIFE ECOLOGY AND CONSERVATION BIOLOGY

[F&ES 32011a/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 33012a, 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 30013b/E&EB 326b/526b, Molecular Ecology 1 credit. This course provides an overview of the molecular genetic tools used to investigate ecological and evolutionary processes in natural populations. It is intended for undergraduates with basic knowledge of ecology, evolution, and genetics and for graduate students looking for an overview of the applications of molecular tools in ecology, evolution, and environmental sciences. The use of molecular markers is explored right through the hierarchy of life from studies of genetic individuality, parentage, kinship, population substructure, species boundaries, phylogenetics among species of different levels of similarity. Special topics include conservation genetics, microbial biology, ecological genomics, and environmental impact of genetically modified organisms. Adalgisa Caccone]

[F&ES 30114b/E&EB 660b, Wildlife Conservation 3 credits. The course introduces students to concepts related to gathering and applying scientific information for problem solving in wildlife conservation, including conducting management as adaptive scientific experimentation. The course explores conceptually the kinds of ecological knowledge needed for wildlife conservation, including how species behavior and life history evolves and ultimately how that shapes population demography. Students learn how to formalize that knowledge in a mathematical framework in order to support effective decision

making in conservation. Students learn how to apply the tools to real-world problem solving, such as population viability analysis, population viability in the face of habitat fragmentation and destruction, and bioreserves design. The course also deals with the ethics associated with applying scientific knowledge to solve conservation problems. Prerequisite: F&ES 32019 or 32007, and an undergraduate mathematics course. Three hours lecture and one hour discussion. Oswald J. Schmitz]

[F&ES 30016a/E&EB 375a/675a, **Molecular Ecology Seminar** 2 credits. The seminar focuses on molecular techniques commonly used in the past to address ecology/systematic related questions. The idea is to provide students with knowledge of all possible molecular techniques in the field, so that they can evaluate results in the literature and be able to choose the best technological tool to address a specific research question. The seminar is organized by techniques. In each session the technical aspects of a particular molecular method are discussed in detail, evaluating: (1) different protocols, (2) their limits and merits for different types of ecological and evolutionary questions, (3) the genetic assumptions inherent in each method, and (4) the analytical aspects of the interpretation of the results. The discussion includes actual case studies, which students are challenged to critically evaluate. The two final weeks are devoted to relating these molecular approaches to problems in conservation biology. Adalgisa Caccone]

[F&ES 30017a/E&EB 315La, **Molecular Systematics Laboratory** 3 credits. The course focuses on molecular techniques in evolutionary biology (DNA extraction, PCR, cloning, sequencing) and their application to field studies of natural history, population genetic structure, mating systems, paternity, and the historical analysis of lineages. The course consists of a series of lectures and independent research projects carried out by each student. Aside from the bench work, experimental design, statistical analysis of genetic data, and phylogenetic reconstruction within and among species are emphasized, illustrating how the disciplines of population biology and phylogenetic systematics increasingly overlap. The course revolves around a few class projects. Each student carries out his/her part of these projects; data gathered by all students is then combined and analyzed together. The primary objectives are to give students both a strong foundation in the systematics and conservation questions and issues that can be addressed with a molecular approach, and a working knowledge of the molecular tools necessary to address those issues. Both of these components are essential to the training of those individuals who will conduct research in these emerging and rapidly growing fields. Adalgisa Caccone]

[F&ES 30018b/E&EB 320b/620b, **Conservation Genetics Seminar** 3 credits. This seminar is intended to provide an introduction to conservation genetics for advanced undergraduate and graduate students. The goal is to provide students with an understanding of the importance of genetic diversity and the means for preserving it. Adalgisa Caccone]

F&ES 32019a/E&EB 365a/665a, Landscape Ecology 3 credits. This 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 landscape ecologists: species-area relationships, island biogeography, metapopulation theory, individual-based models, cellular automata, models of biodiversity, etc. The application of these concepts is addressed through consideration of species viability,

ecosystem management, and the design of nature reserves. 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. David K. Skelly

F&ES 30020b, 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 30024b/E&EB 617b, Topics in Evolutionary and Conservation Genetics 3 credits. The course includes discussion of original research from students and post-doctoral associates and reading and discussion of recently published papers in evolutionary and conservation genetics, with special emphasis on population-level questions. Discussion of experimental design, project feasibility, and presentation of preliminary data is stressed. It is intended for graduate students interested in research in these fields at various stages of their career. Open to advanced undergraduates by permission of the instructor. Adalgisa Caccone]

F&ES 30125b, Community Ecology 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 ecology including scaling from individual behavior to community dynamics, the link between biodiversity and system stability, alternative dynamic regimes, spatially extended systems, and metacommunities. Prerequisites: MATH 222a or 222b or equivalent; EEB 220a or equivalent. A course in calculus recommended. Oswald J. Schmitz

Environmental Education and Communication

F&ES 40002a, 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 for F&ES 40002a at <https://webpace.yale.edu/fes40002a>. Three-hour seminar and writing workshops. Enrollment limited to fifteen. Fred Strebeigh

F&ES 40004a, 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 D0005b, Doctoral Student Seminar 3 credits. This course is required for all doctoral students during their second term. The seminar teaches how to design and conduct research, communicate the results, and thrive as a doctoral student. Topics covered include reviewing the literature, managing references, selecting a thesis topic, choosing a thesis committee, writing a prospectus, finding research funding, taking comprehensive exams, conducting research, synthesizing data, writing a thesis and scientific papers, critically analyzing proposals and papers, and finding a job. Prerequisites: careful reading of the literature to select a thesis topic; good knowledge of Word, Excel, EndNote (a bibliography management program), a graphing program, and a statistics package. Gaboury Benoit

F&ES 40006a, Professional Communication Skills for Non-Native Speakers of English 3 credits. This course helps students to sharpen their language skills in professional communication. Course topics include accent reduction, language accuracy, writing styles, presentation skills, meeting participation, barriers to communication, and types of persuasion in multi-cultural 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

Forestry

FOREST BIOLOGY

[F&ES 52001b, Local Flora] 3 credits. A field course that studies the flora of the Northeast at various local ecosystems one afternoon each week. Students are required to make a labeled collection of woody plants, prepare brief written site descriptions of each eco-



system visited, and carry out a small project and write a paper related to the local flora. Four-hour field trip weekly. See <https://classes.yale.edu/fes220b>. Mark S. Ashton]

F&ES 50002b, 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 52003b, 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 50104b, 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. Sustainable agriculture and soil conservation. Reforestation of degraded lands: ecological and socioeconomic considerations. The use of plantations as accelerators of forest succession. Restoration of inland and coastal wetlands. Techniques to control invasive species. The fragmented forest landscape, connectivity and isolation. Agroforestry systems as a tool for recovery and conservation of biodiversity. Biological and economic enrichment of overlogged and secondary forests. Pasture degradation and restoration for productivity, sustainability, and biodiversity. Reclamation of mine spoils. Forest fires. 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 32007a or 32006a, or equivalent (check with instructor). Three hours lecture per week, three field trips. Florencia Montagnini

F&ES 53005b, Agroforestry Systems: Productivity, Environmental Services, and Rural Development 3 credits. 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; 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 students and discussion sessions deal with particular aspects of agroforestry of interest to students. Three hours lecture per week, two or three half-day field trips. Florencia Montagnini

F&ES 52006a/MCDB 660a, Structure, Function, and Development of Trees and Other Vascular Plants 3 credits. This first course in a four-course sequence 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. Wood and bark structure and formation in tropical and temperate trees are discussed from the standpoints of evolution and ecophysiology.

Plant cell types are discussed in the context of how they evolved and their molecular and structural adaptations in terms of strength, storage, and water and solute transport. Prerequisites: general biology or botany or the equivalent, or permission of the instructor. Graeme P. Berlyn

[F&ES 50107b, Research Methods in Anatomy and Physiology of Trees 4 credits. Advanced investigative techniques with emphasis on instrumentation, experimental design, execution, and analyses. After a series of class experiments and demonstrations are completed, each student selects a personal project under the direction of the instructor and prepares a minidissertation complete with literature review, materials and methods, results, and discussion. Weekly seminars and progress reports on the projects are required. Prerequisites: F&ES 52006a and 52008b and permission of the instructor. Four hours lecture/laboratory. Limited enrollment. Graeme P. Berlyn]

F&ES 52008b, Physiology of Trees and Forests 3 credits. Topics in mineral nutrition and cycling; mycorrhizas; symbiosis; nitrogen fixation; photosynthesis; water relations; ecophysiology; and the physiology of trees and forests, primarily at the individual tree level with extensions downward to the cellular and biochemical level and upward to the stand and ecosystem level. Other topics include the ecology and adaptation of species and forests, both temperate and tropical. Two one-and-one-half-hour lectures per week. Graeme P. Berlyn

F&ES 50010a,b, Forest Carbon Science 3 credits. This seminar is conducted each term. Experts from around the world are invited to present. Students are expected to actively engage with the visitors and to develop synthesis and review papers that are published as a monograph. The theme for the fall is the industrial ecology and life cycle analysis of forest-derived carbon in energy and wood product industries. For the spring the topic covers the management and manipulation of forests for carbon sequestration and storage. Mark S. Ashton, Thomas E. Graedel, Reid Leifset, Mary Tyrrell

FOREST MANAGEMENT

F&ES 50011b, Managing Resources 3 credits. The challenge of resource management is to provide the many commodity and non-commodity 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 technical tools for landscape (forest) management. The course covers managing an ecosystem with concerns about water; agriculture; grazing; wildlife; timber; recreation; people; and wind, fire, avalanche, and flood hazards. The class examines the basic issues and describes tools and techniques for analyzing and managing. A case study of a specific area is 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; water management models; carbon sequestration pools and changes; 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 52012a, 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; and 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. 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 has three objectives: (1) To give students 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) To give students an understanding of how to access and utilize information on global resources. (3) To give students 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 life styles, resource substitution and economics, consumption, recycling, and substitution patterns and potential changes (through lectures, readings, analyses, and case studies). Chadwick D. Oliver

F&ES 52013b, 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. 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 resources, timber and nontimber products, and landscape design. Recommended: some knowledge of soils, ecology, plant physiology, human behavior, and resource economics. Four hours lecture. One hour tutorial. Seven days fieldwork. Mark S. Ashton

F&ES 50114a, 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 52013b or 52016a; F&ES 32114b; F&ES 84002b; or permission of the instructor. Eight days fieldwork. Limited enrollment. Mark S. Ashton, Thomas G. Siccama

[F&ES 50115b, 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 52013b or 52016a; F&ES

32114b; F&ES 84002b; or permission of the instructor. Three hours lecture. Eight days fieldwork. Limited enrollment. Mark S. Ashton, Susan G. Clark]

F&ES 52016a, 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 50117b, 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 52013b or 52016a; F&ES 84001a or 84002b; or permission of the instructor. Next offered fall 2010. Mark S. Ashton]

[F&ES 50118a, 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 50119a,b, 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, Ann E. Camp

[F&ES 50020a, 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 50021a, 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 84002b or 86044a and F&ES 52013b or permission of the instructor. (F&ES 50011b and 52013b are very helpful.) Three hours lecture. Weekly problem sets. Lloyd Irland

F&ES 50023b, 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. Optional: Students can choose to participate in the Southern Forest and Forestry Field Trip for 1 additional credit. Michael Ferrucci

F&ES 50024b, 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, non-industrial 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 U.S. 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 61001a/GEOL 657a, Marine, Atmospheric, and Surficial Geochemistry 3 credits. Geochemical processes at the earth's surface, including the atmosphere, oceans, ice caps, and the upper layers of the crust, are investigated using radioactive, radiogenic, and light stable isotopes. Karl Turekian

F&ES 60102b, 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 52008b, 61006a, 52013b or the equivalent, or permission of the instructors. Graeme P. Berlyn, Ann E. Camp, Xuhui Lee, Mark S. Ashton

[**F&ES 61003a, Air Pollution** 3 credits. This course provides a basic scientific understanding of air pollution. It covers key air pollutants of concern, their sources, and their chemical transformation in the atmosphere. Students also learn how pollution moves through the atmosphere, including equations of state meteorology and atmospheric stability. Other topics include case studies of air pollution disasters, tropospheric ozone chemistry, particulate matter size distributions, air quality modeling, combustion, health impacts from air pollution, and study designs of air pollution and human health. Michelle Bell]

[F&ES 60004b, 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. Xuhui Lee]

F&ES 61005b, 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. Xuhui Lee

F&ES 61006a, 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

ENVIRONMENTAL CHEMISTRY

[F&ES 60107a,b, Seminar in Applied Environmental Chemistry 2 credits. A seminar exploring the chemical principles underlying the behavior of natural and anthropogenic materials in the environment. The object of the course is to sharpen students' understanding of environmental chemistry, but especially to enhance their ability to critically analyze technical literature, which can be useful in any field. All media are considered, but aquatic systems are emphasized. Both pristine and polluted environments are examined. Prerequisite: F&ES 61110a, which may be taken concurrently, or equivalent. Interested students must attend the first class meeting. Two-hour participatory discussion, class presentation, dinners. Gaboury Benoit]

F&ES 66008b, Organic Pollutants in the Environment 3 credits. An overview of the pollution problems posed by toxic organic chemicals, including petroleum products, pesticides, PCBs, dioxins, phthalates, chlorinated solvents, and others. No background in organic chemistry is required, but students with such background can also benefit from the course. The course aims to give students an understanding of the processes governing the environmental fate of organic pollutants (e.g., evaporation, bioconcentration, biodegradation) and how those processes apply to specific groups of chemicals in specific settings. We also discuss technologies for prevention and remediation of organic pollution, as well as issues related to various classes of organic chemicals (e.g., oil spill response, dioxin formation, pesticide choices). Several case studies are examined. Media covered include surface water, groundwater, soil, air, and biota. Three hours lecture, seven problem sets, one field trip. Shimon C. Anisfeld

F&ES 60109b/ENAS 640b/F&ES 344b, Aquatic Chemistry 4 credits. A detailed examination of the principles governing chemical reactions in water. Emphasis is on developing the ability to predict the aqueous chemistry of natural and perturbed systems based on a knowledge of their biogeochemical setting. Calculation of quantitative solutions to chemical equilibria. Focus is on inorganic chemistry, and topics include elementary thermodynamics, acid-base equilibria, alkalinity, speciation, solubility, mineral stability, redox chemistry, and surface complexation reactions. Illustrative examples are taken from the aquatic chemistry of estuaries, lakes, rivers, wetlands, soils, aquifers, and the atmosphere. A standard software package used to predict chemical equilibria may also be presented. Prerequisites: general chemistry, algebra, and F&ES 61110a or equivalent. Three hours lecture, frequent problem sets. Helmut Ernstberger

F&ES 61110a, 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 60011a/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 60012b/CENG 377b/ENVE 377b, Water Quality Control 3 credits. Study of the preparation of water for domestic and other uses and treatment of waste water 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, electrodialysis, reverse osmosis, activated carbon adsorption, and biological methods. Prerequisite: CENG 210a or permission of the instructor. L. Lee Wikstrom

F&ES 60027a/F&ES 443a, Analytical Chemistry 3 credits. An overview of analytical chemistry from an environmental perspective. 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, electrochemistry, and radiometric techniques. The analysis procedures are relevant to water, soil, sediment, 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. Problem sets. Prerequisites: CHEM 113/114 or equivalent. Helmut Ernstberger

SOIL SCIENCE

F&ES 62013a, Introduction to 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 to take this course. This course fulfills the science requirement of the M.S. curriculum at F&ES. Yale undergraduate students can take it with permission of the instructor. This course can be used as prerequisite for F&ES 50104b, Seminar in Ecological Restoration, and is also recommended as background for F&ES 53005b, Agroforestry Systems, Productivity, Environmental Services, and Rural Development. Florencia Montagnini, Thomas G. Siccama

WATER RESOURCES

F&ES 65014b, Coastal Ecosystem Governance 3 credits. This introduction to coastal management links human impacts on the environment with existing or proposed governance solutions for protection or restoration. Examples of single sector initiatives include wastewater treatment, wetlands, and dredging. For each topic the natural science underlying the issue is introduced and the responding governance system is evaluated. Regional management, a currently practiced alternative to single use management, is evaluated with respect to its effectiveness. To enhance regional management, coastal ecosystem governance is introduced as an emerging concept and practice. Particular attention is paid to institutions, program design, and implementation in this new context. Three-hour seminar, term project. Richard Burroughs

F&ES 60015a, Munson Series: Arctic Seas and Melting Ice: Bellweather of a Warmer World 1 credit (Credit/Fail). The impacts of a warmer world are now being felt in the Arctic. Sea ice cover is at record low levels, permafrost is melting, and coastal areas are being inundated by the sea. How do these changes affect coastal ecology, biogeochemical cycles, and human endeavors such as shipping, land claims, and resource extraction? In this lecture series course we consider the Arctic as an example for how climate-induced changes to the coastal environment have cascading effects on our world. Mary Beth Decker, Gaboury Benoit, Melinda Smith

F&ES 61016b, Water Resource Management 3–4 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; water scenarios and projections; water and human health; storm water 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 62017a, 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 61018b/ENAS 646b, Environmental Hydrology 3 credits. An introduction to the processes that govern the earth's hydrologic cycle. Topics include land-atmosphere interactions, movement of water in subsurface environments, contaminant transport in groundwater systems, streamflow generation, and surface-water flow dynamics in wetlands. Computer software packages are used to reinforce concepts presented in class. Three hours lecture, problem sets. James E. Saiers

F&ES 60119a /ENAS 647a, Hydrologic Modeling 4 credits. Application of computer models to solve problems related to water movement and chemical migration in surface and subsurface environments. Students gain an understanding of a broad range of hydrologic phenomena and learn to apply computer models appropriate for simulating (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. All aspects of the modeling process are covered, including model design, execution, calibration, and critical evaluation of model output. Three hours lecture. Prerequisites: F&ES 61018b or equivalent. James E. Saiers

F&ES 60020b, Special Topics in Hydrology 2 credits. This seminar centers on the discussion of issues at the forefront of hydrology. At the outset of the course, students identify a small set of topics that focus on important problems in hydrologic science and that also may have significant policy, management, and public health components. Suitable topics include, but are not limited to, climate change effects on water resources; waterborne infectious disease and water-related illness; linkages among water, carbon, and nutrient cycles; and human-induced variations in freshwater quality. Each class meeting involves the discussion of a group of closely related journal articles that fall under one of the student-identified topics. In addition to participating in class discussions and in selection of the journal articles, students write a term paper on one of the seminar themes. James E. Saiers

[F&ES 60123b, Applied Hydrology 3 credits. An intermediate-level treatment of surface and subsurface hydrology, with an emphasis on the application of computer models to address issues related to water quality, water supply, and restoration. The relationships between hydrologic variables and the movement of water and waterborne constituents in fluvial, wetland, and groundwater systems are explored. Three hours lecture, problem sets, field labs, and a team project. Prerequisite: F&ES 61018b or equivalent. James E. Saiers]

F&ES 61024a, 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 61018b or equivalent) is recommended. James G. MacBroom

[F&ES 60125a, Case Studies in Water Resources 3 credits. The freshwater problem, in its multiple dimensions, is one of the most important environmental and human health issues facing the world today. Among its manifestations are water scarcity for humans and ecosystems, inadequate human access to water and sanitation, water conflict, flooding, and degraded water quality. This course uses case studies to deepen our understanding of water resource management, and to address issues such as balancing different demands on water resources; the relationship between science and management; optimizing the distribution and timing of water use; constraints to improved water management; and evaluating the effectiveness of “soft path” approaches. Case studies are presented by the instructor, by outside lecturers, and by students. Three hours lecture, paper, presentation. Enrollment limited to twelve. Prerequisites: F&ES 60108b and F&ES 61016b. Shimon C. Anisfeld]

F&ES 60026a, Lecture Series on China’s Environment 1–3 credits. This lecture series explores the environmental ramifications of economic growth in China and the challenges to protect natural resources and preserve biodiversity. It discusses the science foundation for environmental decision making and strategies for engaging the government, private, non-government, and academic sectors in sustainable development. Leading experts in the environmental arena are invited from China to join the discussion with Yale faculty and students. Xuhui Lee

Quantitative and Research Methods

F&ES 77001a/ARCG 762a/G&G 562a, Remote Sensing: Observing 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 70002a, Research Methods 3 credits. Elementary principles of the philosophy and methods of science; research planning, including problem analysis and project planning; preparation, criticism, and oral presentation of study plans; communication of

research findings; limitations of research techniques; and structure of research organizations. Three hours lecture and student reports. David K. Skelly

F&ES 70003a, Social Science Research Methods 3 credits. The class surveys the array of theoretical and epistemological approaches used in social science research. Emphasis is placed on understanding how choices over methodology shape data collection and results, and the various qualitative and quantitative efforts currently being employed to address complex social phenomena. Participatory action research methodologies and survey methods are discussed in brief; the primary emphasis of the course is on qualitative research methods. Doctoral students and master's students doing research projects can use this course to develop their research project proposals. F&ES staff

F&ES 77004b/ECON 173b, Econometrics 3 credits. Classical regression and simultaneous equations models. Ray Fair

F&ES D0004a,b, Preparation for Research 1 credit. Preparation of dissertation prospectus and research plan for Ph.D. and D.F.E.S. candidates. Should be taken during the first year of doctoral studies. Xuhui Lee

F&ES 77105a, 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, 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 77006a. Limited enrollment. Timothy G. Gregoire

F&ES 77006a, 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 77107b, Introduction to 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]

F&ES 77108b, 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, weekly problem exercises. Prerequisite: a prior course in introductory statistics. Timothy G. Gregoire

F&ES 77009a, 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 77108b. There are weekly problem sets using MINITAB software, as well as a final project. This course assumes no prior knowledge of statistics; this course (or equivalent) is a prerequisite for more advanced F&ES statistics courses. Three hours lecture. Jonathan D. Reuning-Scherer

F&ES 77010b, 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 77011a, the course is oriented more toward the qualities of geographic space itself (e.g., proximity, density, or interspersed) 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 77011a, 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 77010b, 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 interspersed). Three hours lecture, problem sets, one class project. No previous experience is required. Dana Tomlin

F&ES 77112b, 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 77113b, 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 76014a/MGT 693a, Business Concepts for Environmental Managers 3 credits. The objectives of this course are to offer environmental managers a basic understanding of accounting systems to enable them to interpret financial data in corporate and governmental settings, to integrate traditional business concepts with those of sustainable environmental management, and to recognize the role of environmental management among the multiple interests within business negotiations. The first part of the course develops skill in financial accounting, and this knowledge is then applied to areas in environmental financial management, including budgeting, project finance, and valuation. William Ellis, Maureen Burke]

Social Sciences

ECONOMICS

F&ES 84001a, Economics of Pollution 3 credits. This course is designed to teach students how to think about managing pollution. It explains why market economies fail to manage pollution efficiently and how to design efficient regulations. The first part of the course reviews the economic theory of pollution control. The second part reviews integrated assessment and demonstrates how the economics and natural science need to be interwoven to obtain empirical estimates of the costs and damages of pollution. The final part of the course reviews existing legislation and discusses whether existing laws are efficient and how they could be amended. Robert Mendelsohn

F&ES 84002b, Economics of Natural Resource Management 3 credits. This course provides an introductory survey, from the perspective of economics, of issues regarding the use and management of natural resources. The course covers both conceptual and methodological topics and applications. The course uses microeconomics to study the management of renewable resources (water, fisheries, forests, and species) and nonrenewable resources (fossil fuel and minerals). We develop the basic theory required to understand the economic concept of efficiency. We then examine whether markets can or cannot be expected to allocate resources efficiently and what role government must play. We also develop an understanding of environmental benefit valuation techniques. The course focuses on practical management issues but also covers overarching principles such as sustainable growth and green accounting. Sheila Olmstead

[**F&ES 80103b, 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]

FES 80004b, The Economics of the Environment and Sustainable Development 3 credits. This course provides students with in-depth training using economic analysis to address environmental policies and management within the context of sustainable development. Concentrating attention on the special circumstances of non-OECD countries, students examine the relationship between and among various environmental policies and management strategies from efficiency and sustainability perspectives. The course covers a range of topics including reducing pollution, managing renewable resources, and consuming nonrenewable resources when these issues cast against competing and/or complementary objectives that are generated by multiple sources of social and economic stress—poverty, public health, globalization, etc. The two-way connection between environmental considerations and development goals provides the pervasive thread that guides the discussion. Gary Yohe

[**F&ES 80107b, Economics of Water Quality and Water Scarcity** 3 credits. This limited-enrollment seminar is a survey of selected issues in the economics of water resources management. The course is divided into two parts, the first focusing on water quality, and the second on water scarcity. Issues covered in the first part of the course may include: efficiency and cost-effectiveness of U.S. federal water quality regulations, including the Clean Water Act and the Safe Drinking Water Act; methods used by economists to value the benefits of water quality regulation, as well as specific applications of such methods; cost-effective approaches to water quality regulation, including effluent trading; and the current and potential role of economics in wetlands protection policies. In the second part of the course, we discuss issues such as: water allocation and water marketing; urban water demand and pricing; the economics of water conservation; and the trend of privatization of water supply. Specific topics subject to change each year. The seminar format requires substantial student input, and there is a heavy writing component. Class sessions include a mix of discussion of study questions related to assigned readings and/or formal cases, followed by student presentations on relevant topics. Prerequisite: F&ES 84001b, F&ES 84002b, or an equivalent microeconomics course. Sheila M. Olmstead]

[**F&ES 84040a, 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 and management classes. Robert Mendelsohn]

[F&ES Do163a, 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 80182b, The Economics of Climate Change 3 credits. This course explores economic issues involved in the formation of policies to deal with the problem of humanly induced climate change. After a brief review of the basic scientific issues, the course examines research into the economic impacts of climate change and economic approaches to deal with potentially unresolvable uncertainty regarding future emissions, associated natural impacts, and associated risks. The course also broadens its scope by examining the limitations of the economic paradigm in defining “key vulnerabilities” to climate change before turning to economic research into the costs of mitigating greenhouse gas emissions and the potential efficacy of adaptation. Thereafter, the course critically examines efforts to apply benefit-cost analysis to the design of climate policies, including considerations of equity and discounting of future values. Shortcomings here underscore the need to develop risk-management techniques supported by risk profiles calibrated in multiple metrics of consequence. The next section of the course focuses on policy design with particular attention paid to the relative efficacy of tax and trading approaches. The final section of the course compares the two major assessments of climate change authored over the past two years – the policy-relevant Fourth Assessment Report of the Intergovernmental Panel on Climate Change and the policy prescriptive Stern Review. The course closes with an examination of the Copenhagen agreement that will, during the spring of 2009, define international policy for the second commitment period under the United Nations Framework Convention on Climate Change. Gary Yohe

ENVIRONMENTAL POLICY

F&ES 80008b, 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 85009b, Seminar on Forest Certification 3 credits. This seminar-style course teaches students the basics of forest certification systems and their differences, their histories, and the theory behind certification as a tool for conservation. Students learn from the instructors as well as expert guest lecturers about the evolution, structure, and application of forest certification systems globally. The seminar explores case studies comparing both forest certification politics in different jurisdictions/countries, as well as on actual certified forests. Benjamin Cashore]

[F&ES 85011a, Environmental Policy Analysis for an Unpredictable World 3 credits. This course explores theories of domestic and international environmental policy making in order to understand better the processes through which policy change (and stability) occurs. The course examines traditional domestic and international public policy-making processes, and emerging institutions that seek to privatize environmental governance and restructure power relations among organized interests. The course examines these questions from comparative and international perspectives. Special attention is placed on the international-domestic nexus, and the effects of economic globalization and international governance on domestic policy change. Benjamin Cashore]

[F&ES 85012b, Science and Politics of Environmental Regulation 3 credits. This course explores the interplay among science, values, and power within diverse environmental decision contexts. Scientific uncertainty is examined as the focus of political conflict over appropriate levels of regulation. Regulation is used in its broadest sense, i.e., attempts to control human uses of natural systems. The course focuses on the underlying behavior of key actors as a foundation for evaluating the historical effectiveness of diverse regulatory regimes, domestic and international. The course includes case studies of many toxic substance and land use issues. Three-hour seminar. John P. Wargo]

F&ES 85013a, Environmental Politics and Policy 3 credits. This course provides an overview of environmental politics and policy. The relations among science, politics, and law are taught via case histories that include pesticides, parks and protected area management, endangered species, radionuclides, facility siting, air pollution, drinking water quality, food safety, hazardous site restoration, and vector-borne disease. The concepts of authority, democracy, risk, secrecy, security, equity, and justice guide the examination of political debate. In each case history, we explore the effectiveness of law and regulation. John P. Wargo]

[F&ES 85014a, Foundations of Environmental Policy and Politics 3 credits. This course examines theories of policy making and politics, applied to problems of environmental management. Theories of property rights, risk assessment, and decision making are explored and applied to problems in managing land use, air quality, water quality, food safety, hazardous site restoration, and vector-borne disease. Students take a final exam and prepare a research paper or project as the primary course requirements. Two lectures per week, one discussion section. John P. Wargo]

F&ES 80015b, 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 80116b, 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 eco-system 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, by analyzing the scientific, business, and policy aspects of land managers' decisions whether to manage their land to supply these emerging markets. Prerequisites: course work or experience in at least one of the following: silviculture, hydrology, business analysis/planning, or policy/law. Enrollment limited to twelve. Taught alternate years. Bradford S. Gentry, Mark Ashton, and guest lecturers

[F&ES 80017b, Public-Private Partnerships: Lessons from the Water Sector 3 credits. Governments around the world are finding that they cannot meet pressing environmental problems alone. Nor can they compel the private sector to take all the necessary actions. Increasingly, they are looking to partnerships with businesses, NGOs, and communities as a tool for improving environmental performance in many different sectors and contexts. Many of these partnerships are in the urban water sector. Private involvement in water is particularly controversial, however, raising fundamental issues about the roles of governments, businesses, and civil society in meeting basic human and environmental needs. In collaboration with the U.N. Development Program and universities around the world, this seminar explores the fundamentals of partnerships as a policy tool, as well as the opportunities and limits of its application in the urban water sector. Limited enrollment. Taught alternate years. Bradford S. Gentry]

F&ES 80019a/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, many 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 three teams of five students each, who want to write a business plan for their own real new startup company. Students enter their plans in the Y50K Business Plan Contest 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 fifteen, 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 80021a,b, International Organizations and Conferences 3 credits. This course, taught in the fall or spring 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 semester, 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. 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 80022a,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 through weekly seminars and internships at U.N. Missions in New York City. The weekly seminars discuss the functions of and decision-making process in the relevant international bodies regarding forestry, marine environment, fisheries, renewable resources, and the atmosphere. In the fall term, students are assigned to work as interns (12–15 hours per week) with U.N. Missions in New York to do research, draft papers, attend meetings, and develop specific projects on selected topics. During the spring term, students are required to submit a substantive research paper or project document. Students are evaluated on the basis of their performance; both participation and written research. Enrollment requires application, interview, and approval of Professor Roy S. Lee. Preference to students with practical experience in environmental issues. Roy S. Lee, Nicholas Robinson, Gordon T. Geballe

[F&ES 85023a, Corporate Social Responsibility 3 credits. This seminar course 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 government 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 that have arisen from research on CSR, and what they mean for whether, and how, CSR efforts might address enduring problems in ways that governments have been unable. Benjamin Cashore]

F&ES 86024b, 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 – air pollution, greenhouse gas emissions, 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 (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 costs and congestion pricing, and new technologies. Ellen Brennan-Galvin

F&ES 86025a, 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 also 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 83026a, 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 80027b, 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 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 80029a, Local Environmental Law and Land Use Practices 3 credits. This course explores the regulation by local governments of land uses in watershed 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. Marjorie Shansky

F&ES 85030a, 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 80031b, Transportation's Role in a Changing Economy 3 credits. This course focuses on the critical, but often-overlooked, impacts of the transportation sector on the nation's changing economy and patterns of growth, and on decision making by both public officials and private actors affected by these issues. The course seeks to provide students with insights into such matters as how the transportation system has shaped America's economy, living patterns, and quality of life; how global economic, demographic, and environmental changes are imposing themselves on transportation investment and operational decisions; and how transportation-related public agencies and private firms are being reshaped to address the economic and environmental realities of the twenty-first century. The stakeholders and constituencies in the transportation sector include both private and public actors, and the complicated interactions between decisions in both sectors are critical to the efficient operation of the economy and to the quality of our lives. Transportation-related decisions have substantial social, environmental, and community impacts that must be taken into consideration in long-term strategic planning for private firms and public agencies, and it is the goal of this course to expand students' understanding of these issues and their ability to analyze them. Grades in the course are based both on preparation and participation in class discussions, and on writing assignments. The class meets once each week during the term. Emil Frankel, Douglas Rae

F&ES 80032a, History of the Environment and Ecological Science 3 credits. In this seminar, students explore the tools of historical research and analysis and develop their writing skills. Students' work centers on practical applications of historical research, data analysis, and narrative so that students gain new power in problem analysis and narrative. After focusing on landscape, forest, and farm history from the earliest records, the seminar folds in the history of ecosystem analysis, forest science, and biologists' and ecologists' influence on political and economic theory. The dynamics of historical change in natural systems in response to management and ecological constraints tells more than the story of how the natural world emerges; it deepens our understanding of political and economic history and of human culture. The ecological orientation afforded by environmental history leads to more successful and ethical policymaking through its emphasis on context, on emergent processes, and on the central role of individuals and communities in environmental, political, and cultural system dynamics. Arvid Nelson

F&ES 85033b, 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. Daniel C. Esty

F&ES 80034a,b/LAW 20316/21321, Environmental Law 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. Dale Bryk

F&ES 85035a, 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 Robinson

F&ES 85036a, 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 83037b, 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 80041b, 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 Robinson

F&ES 80046a,b, Business and the Environment Clinic 3 credits. In this class students work as a team on a specific project for the University or 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 assisting in the development of a corporate environmental strategy or determining the impact of the pending carbon market on institutional operations at Yale. 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. 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 year at the School. Maureen Burke, Bradford Gentry

[F&ES 85068b, International Environmental Policy and Governance 3 credits. An examination of the emergence of global-scale environmental challenges, environmental diplomacy, and global environmental governance. Particular attention is given to the linked issues of climate change, deforestation, fisheries depletion, biodiversity loss, and desertification, and to the interplay of science and politics in framing policy responses to these issues. Permission of instructor not required. Benjamin Cashore]

F&ES 80075a/F&ES 270a/INRL 680a/MGT 697a, Capitalism and Its Critics 3 credits. Capitalism is arguably the most fundamental creation of the modern era: It has generated more wealth, steeper inequalities, greater disruption of the natural environment, longer lifespans, and faster rates of social change than had been seen in all of human history before about 1800. This course surveys some major contours of capitalist institutions, important variations over time and place, critical issues of legitimacy and practice, using ideas drawn from politics, literature, business management, and popular culture. Douglas W. Rae

F&ES 80078b/LAW 21581, Native American Law 3 credits. This course explores the evolving legal response to the presence of indigenous people in the United States. The responses have produced a relationship that implicates issues of federalism, the complex understanding of domestic colonialism, and international law, inter alia. Unfortunately, because of time constraints we cannot investigate the contemporary role of international law, especially international human rights law, in structuring the relationship of indigenous people to the state. Nonetheless, ideas from international law are foundational in the construction of a constitutional space for a people who were defined out of the polity at its construction. We consider the structure and implications of the legal relationship including its political instantiation in the trust doctrine. This necessarily entails consideration of ideas of sovereignty. We also consider the role of law (especially in

a precedent-driven system) that has to span wild swings in policy toward indigenous peoples that range from assimilation to extermination. Self-scheduled examination or paper option. Gerald Torres

F&ES 80079b, 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 seminal 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 policy 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. Note: The class has been developed for doctoral students and highly motivated master's students, including those working on M.E.Sc. degrees or those who plan to undertake doctoral studies. Owing to the intensive seminar format, the class is capped at twelve. Benjamin Cashore

F&ES 80080b/HIST 743b/AMST 839b, 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 80083b, Environmental Law and Governance: Global Concerns, Asian Challenges 3 credits. Seminar on Asian challenges in development, governance, and ecology in the context of international environmental law and policies and the search for sustainable development. Development perspectives and local and national environmental concerns in Asia are the focus, and the course examines and evaluates current approaches to compliance, capacity, and political will at the national and regional levels for Asian states. Simon Tay

SOCIAL AND POLITICAL ECOLOGY

F&ES 80038a, 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 the different ways of understanding native continuities in relationship with bioregions over time. Comparisons are also drawn between Native American traditions and different world religions. This course also highlights indigenous ways of knowing that focus on themes of sharing, holism, reciprocity, and personhood in the natural world. Mary Evelyn Tucker, John Grim

F&ES 80039b/RLST 119b, Bioethics, Health, and Human Flourishing 3 credits. This course explores bioethical issues that arise around the religious and social ideal of human flourishing, and what we should do as moral agents to help define and foster it. Ruth Purtillo

[F&ES 80042a, Environmental Theologies 3 credits. Christian responses to environmental problems vary as widely as Christian diversity. This course reads ecumenically to describe multiple strategies of theological response from around the world such as eco-justice, stewardship, ecofeminism, sacramental ecology, and creation spirituality. It outlines major Western approaches, as well as Eastern Orthodox, Anabaptist, liberation theology, womanist, and African Independent traditions. We assess how the environmental strategies reclaim, redeploy, or revise theological traditions, and how they frame and address environmental issues. Willis Jenkins]

[F&ES 80043a, Global Ethics and Sustainable Development 3 credits. Especially fitting for those with an interest in international relief and development, mission, and environmental or humanitarian advocacy, this seminar examines the contested concept of sustainable development and its role in attempts to establish globally shared priorities. Since the concept tries to integrate human rights, economic development, and ecological sustainability, readings include introductory theory in each area. Participants write independent research papers. Willis Jenkins]

F&ES 86048a/ARCH 903a, 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

F&ES 83049b, 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 and compared conceptual (theoretical) models about society and natural resources from policy sciences, social ecology, and other knowledge areas. The applied utility of each model was examined through cases as appropriate. The next seminar focuses on “Complex Sustainability Cases.” Additionally it has looked at “Bridging Local and Professional Knowledge in Environmental Sustainability” and “War and the Environment.” Most recently it examined “Human Dignity, Professionals, and Sustainability.” Guests and students make presentations and carry out discussions each week. Student papers are required. Susan G. Clark

F&ES 83050a/ANTH 581a, Society and Environment: Introduction to Theory and Method 3 credits. This is an introductory 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. The course is divided into five sections. Section I presents an overview of the field and course. Section II deals with the way 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 the question of indigenous knowledge and its transformation. Finally, Section V presents lessons learned. The course is a prerequisite for F&ES 80153b, F&ES 80157b and F&ES 80176a. Three-hour lecture/seminar. Enrollment limited to thirty. Michael R. Dove

[F&ES 80051b, Seminar on “Values of the Natural Environment” 2–3 credits. This course examines the way humans view and value the natural world. It considers values theory, varying environmental values, the biological and social bases of environmental values, and variations among cultural and demographic groups and by environmental feature. The course further examines the relation of environmental values to an ethic of conserving and protecting the natural environment, as well as methodologies for assessing environmental values, particularly non-economic approaches. Finally, the course connects an understanding of environmental values to policy and management issues involving the conservation of biological diversity, natural resource extraction, and development of the built environment. Stephen R. Kellert]

F&ES 80052a, Project in Ecosystem Management: General Applications Work should be within six areas – wildland recreation management, environmental protection and planning, environmental interpretation and planning, urban community forestry, social dimensions of tropical forestry development, and renewable energy systems. A detailed study plan and work schedule are required prior to acceptance. William R. Burch, Jr.

[F&ES 80153b/ANTH 610b, Society and Environment: Advanced Readings 3 credits. This is an advanced seminar on the social science theory of the relationship between society and environment, intended for students interested in research design and policy planning in this field. The course examines key theoretical developments and current issues in social/political/historical ecology and ecological anthropology. The aim of the course is to explore the wider social, historical, conceptual, and institutional contexts of resource use. The relationship between society and the environment is examined through both contemporary theory and ethnographic examples, drawing on the instructors' and students' own current research and writing. The course draws heavily on case study material from South and Southeast Asia, but addresses issues, methods, and theories of relevance throughout the world. The course is an opportunity for both students and instructors to plumb critical issues, place their work in its wider theoretical context, and develop research and writing projects. Prerequisite: F&ES 83050a or F&ES 83056a. Enrollment limited to twelve. Three-hour lecture/seminar. Taught alternate years. Next offered spring 2010. Michael R. Dove, Carol Carpenter]

F&ES 80054a/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 meaning-centered and historically grounded account of the transformation of rural societies. Four hours lecture plus discussion sections. K. Sivaramakrishnan and faculty

F&ES 83056a/ANTH 597a, Social Science of Development and Conservation 3 credits. This course is intended to provide a fundamental understanding of the social aspects involved in implementing sustainable development and conservation projects. 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. 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 play in sustainable development and conservation, in order to move toward more environmentally and socially sustainable projects and policies. A prerequisite for F&ES 80153b and F&ES 80157b. Three hours lecture/seminar. Carol Carpenter

F&ES 80157b/ANTH 598b, Social Science of Development and Conservation: Advanced Readings 3 credits. An advanced seminar on the social science theory of sustainable development and conservation, intended for students interested in research design and policy planning in this field. It traces the conceptual history of the ideas of progress and development from the colonial period through the present and examines how these ideas are used by the parties who fund, design, and manage development projects. Topics discussed vary from year to year in response to current debates and events, but in the past have included the idea of poverty, the politics of mapping, microcredit and the entrepreneurial subject, the tsunami in Indonesia, the WorldWatch debate on conservation, and the idea of community in the natural and social sciences. Students are expected to use the course to develop, and present in class, their own research and writing. Prerequisite: F&ES 83050a or F&ES 83056a. Three hours lecture/seminar. Enrollment limited to twelve. Carol Carpenter.

F&ES 86059a, 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 2 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. Ellen Brennan-Galvin

F&ES 80060b, Children and Nature: Evolutionary, Social-Psychological, and Practical Dimensions 3 credits. This course examines children's interest in and developmental dependence on natural systems and processes. Theoretical topics include the evolutionary and biological roots of children's relationship to nature; the role of nature in children's physical, emotional, intellectual, and moral development; children's experience of nature in modern society, particularly elements of its decline and impoverishment; the role of children's direct, indirect, and vicarious contact with nature in optimal maturation and development. Applied topics include designing children's educational, recreational, and residential environments; environmental education; the role of zoos, outdoor programs, museums, and other informal and organized experiences of nature. Requirements include interpretive commentaries, class presentations, final project, and presentation. Stephen R. Kellert

F&ES 86062b, Theory and Practice of Restorative Environmental Design 3 credits. This course examines the theory and practice of sustainable, green, or what is called here "restorative environmental design." The objective of restorative environmental design is to create a more compatible relationship between the human built and natural environments. Two basic objectives include avoiding, minimizing, and mitigating adverse impacts of modern design and development on natural systems and human health; and enhancing and promoting a positive and beneficial relationship between people and nature in the built environment. Low environmental impact topics include energy, resources, products, materials, wastes, landscape. Positive environmental impact or "biophilic" design issues focus on "organic" and "vernacular" design strategies. Stephen R. Kellert

F&ES 80063b/REL876b, Introduction to Environmental Ethics 3 credits. This course surveys major frameworks for understanding and responding to environmental problems. We consider the moral dimensions of issues like climate change, environmental racism, biodiversity loss, ecological restoration, and animal welfare in relation to key concepts and approaches, including: intrinsic value, nonanthropocentrism, social constructions of nature, environmental economics, ecofeminism, pragmatism, bioregionalism, deep ecology, and sustainability. Willis Jenkins

F&ES 83064a, 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, non-industrialized, 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. F&ES 86025a or equivalent is strongly recommended. Robert Bailis

F&ES 83065b, 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 80166a, Leaves, Livelihoods, and Landscapes: Ecology, Socio-Economics, and Politics of Development across Borneo 3 credits. Borneo has occupied a space of exoticism in our collective imagination ever since colonial explorers returned to the metropolis with stories of headhunters and the "wild man of the forest." More contemporary images of Borneo include massive forest fires and violent ethnic wars. Despite these images of "primitive" and wild jungles, the past two decades have brought unprecedented socio-economic and environmental change to Borneo. This interdisciplinary course explores the historical, bio-geographical, political, and socio-economic context of anthropogenic and natural change across the Bornean landscape. Each week students are introduced to basic concepts from the ecological and social sciences. These concepts are then applied to specific case studies in Borneo. We examine the interrelated issues of forest conversion, local livelihood practices, resource distribution and availability, and extractive industries coupled with political power and corruption and emerging democracy and decentralized management. By adopting multiple perspectives and using multiple lenses across nested scales of analyses, we seek to understand the dynamics of how the landscape influences anthropogenic resource use patterns and how resource use alters the landscape and the resulting synergies and feedbacks. Although Borneo is used as the specific context to explore these issues, comparisons and contrasts are also emphasized with other tropical

regions (e.g., tropical Latin America and Africa), and the conceptual issues should be applicable worldwide in a variety of situations. Lisa Curran, Amity Doolittle

[F&ES 80070a/REL 870a/RLST 872a, Seminar on World Religions and Ecology] 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 80071b/REL 817b/RLST 872b, World Religions and Ecology: Asian Religions 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 83072b, 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 socioeconomic 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. Robert Bailis

F&ES 83073b/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 80176a/ANTH 572a, Disaster, Degradation, Dystopia: Social Science Approaches to Environmental Perturbation and Change 3 credits. There is a 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. This advanced seminar is designed to review seminal works in this field and analyze some of the current theoretical debates. Topics covered include the relevance of the post-equilibrium shift in the natural and social sciences; the academic literature on the social dimension of natural disasters, illustrated with a case study of volcanic hazard; the discursive dimensions of environmental degradation, focusing on deforestation and other case studies; the discourse of global climate change, focusing on North-South dimensions; the current debate about the relationship between resource wealth and political conflict, focusing on the “green war” thesis, orientalist perspectives, and the case of tropical forest commodities; and alternative perspectives on sustainable environmental relations, based on interdisciplinary work and also work in the humanities. Prerequisite: F&ES 84056a/ANTH 597a, or F&ES 83050a/ANTH 581a, or F&ES 83073b/ANTH 582b. Three hours lecture/seminar. Enrollment limited to twenty. Michael R. Dove

F&ES 80077b, 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

Interdisciplinary

PROFESSIONAL AND ENVIRONMENTAL ETHICS

F&ES 90001a, Professional Ethics: Orientation to the Field 1 credit. This is a one-credit reading/discussion class. It requires several short written case notes to apply a simple set of ethics reflection guides that will be taught in opening sessions. It meets once a week. A short textbook is required, supplemented by short weekly case and related readings. The course concentrates on developing a clear understanding of what a profession is, what professional ethics codes mean, and how they may be applied in making ethical judgments about situations that arise in environmental and forest management and administration, as well as in scientific research. On completing this course, students will be familiar with the major problem areas of professional ethics and with a range of literature in the field. They will be able to understand and apply ethics codes of whatever professional societies they may enter when they graduate. Lloyd Irland

HEALTH AND ENVIRONMENT

[F&ES 96002b/PLSC 855b, Environmental Health Policy 3 credits. This course focuses on five types of environmental health problems. The first case is malaria, concentrating on the resurgence of drug-resistant strains in Southeast Asia, Latin America, and Western Africa. The second case explores age-related health risks from air pollution, especially small diameter particulate matter in urban centers, with cases considered in both the industrial and the developing world. The third case surrounds age-related risks from lead, especially the relative contribution of different contaminated media—air, water, food, and soil. The fourth case explores farmworker and childhood exposure to pesticides in the United States and abroad. The fifth case examines age and spatial distribution of breast and prostate cancer in Connecticut, considering variance in probable exposure to such different estrogenic environmental contaminants as DDT and PCBs. In each instance, the temporal, spatial, and demographic variances in the distribution of the problem are characterized to provide a basis for considering the effect of past policies—public and private—in promoting or diminishing the problem while providing a basis for considering policy reforms. John P. Wargo]

[F&ES 90003a/EHS 511a, Applied Risk Assessment I 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]

F&ES 96005b/EHS 503b, 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 96014a, 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 96017b/EHS 510b, 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

ENVIRONMENTAL MANAGEMENT AND TECHNOLOGY

[F&ES 96006a, Greening the Industrial Facility 4 credits. Industrial environmental managers need to be familiar with the technological processes by which modern society accomplishes its purposes, their potential to cause environmental damage, prospects for improvement, and anticipated change, and to do so in local, regional, and global perspectives. This course alternates lectures and field trips to provide an introduction to the environmental aspects of the production of materials, the manufacture of products, the construction of buildings and roadways, and the recycling of objects, components, and materials. Thomas E. Graedel]

F&ES 96007b/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. Thomas E. Graedel

F&ES 90108b, Advanced Industrial Ecology Seminar 3 credits. This research seminar pursues state-of-the-art investigation of inter-firm resource sharing in developing countries. Prerequisites are two completed industrial environmental management courses and/or special permission from the instructor. Thomas E. Graedel

FE&S 94110a/MGT 528a, Public and Private Management of the Environment This course explores environmental management from the perspectives of government regulators, private corporations, and nonprofit organizations. The first part of the course centers on innovative market-based approaches to environmental policy, such as tradable

pollution permits. We also consider a variety of market-driven initiatives outside the government sphere, including eco-labeling and the growing area of “ecosystem service markets.” In the second part of the course we focus on proactive corporate environmental strategies, examining a series of case studies on firms including DuPont, BP, and Starbucks. Can firms shape regulation to secure competitive advantage? Can firms earn cost savings by reducing their environmental impacts? What is the potential for product differentiation along environmental lines? What is the role of “socially responsible investment” in the environmental realm? In short, does it “pay to be green”? We also examine the role played by nonprofit organizations in influencing corporate environmental actions, whether by confrontation or collaboration. While this course is concerned with environmental strategy and policy, the tools we develop are useful to anyone interested in competitive strategy, corporate social responsibility, or the design of public policy. Erin Mansur

F&ES 96112a/MGT 688a, Corporate Environmental Management and Strategy 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 90116b, 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 second-year F&ES students, with others admitted as space permits. Students are selected in December of the preceding term. Gaboury Benoit

F&ES 96018b/ENVE 360b/ENAS 660b/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. Julie Zimmerman

F&ES 96019a/F&ES 380a, Greening Business Operations 4 credits. The course examines various industries from engineering, environmental, and financial perspectives. 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. Discounted cash flow analysis, 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 Zimmerman

F&ES 90020a, The Ecology of Society 3 credits. By “ecology of society” we mean the physical embeddedness of societies—that is, the biophysical interactions societies maintain with their natural environments and each other. This is an interdisciplinary course that should provide graduate students from diverse backgrounds with a basic understanding of and the ability to critically reflect upon the following issues: sustainable development, sustainability science, models of society-nature interaction; social metabolism, history, concept; climate change science and economics; land use, human appropriation of net primary production, ecological footprint; material flow analysis; the energetic industrial metabolism; trade and the environment; socio-ecological transitions, historical and contemporary; the future of the energy system; IPAT and STIRPAT. Helga Weisz

F&ES 90021a/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

F&ES UNDERGRADUATE COURSES

Ecology

ECOSYSTEM ECOLOGY

F&ES 221a/E&EB 230a, Field Ecology See F&ES 30022a for description.

F&ES 262a/EVST 262a, Ecology and Environmental Problem Solving A study of ecological principles and their potential application to problems in conserving biodiversity. Topics of study include the biosphere; organizational hierarchies and time scales; individual behavior in an evolutionary contest; ecology of species interactions; ecological complexity; and linkages among species and ecosystem functions. The lecture course is accompanied by laboratory and field exercises. Students learn to use basic ecological sampling methods and to apply these techniques to understanding of ecological patterns. Students conduct experiments to understand relations between biodiversity and ecosystem functions. Oswald J. Schmitz

F&ES 275a, Ecosystem Pattern and Process See F&ES 32007a for description.

F&ES 276La, Laboratory for Ecosystem Pattern and Process Field trips to interpret the ecosystem-level functions of a wide variety of natural landscapes. Must be taken concurrently with F&ES 275a. Oswald J. Schmitz

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 30125b for description.

[**F&ES 360b/E&EB 360b, Wildlife Conservation** See F&ES 32114b for description.]

F&ES 365a/E&EB 365a, Landscape Ecology See F&ES 32019a for description.

F&ES 370a/E&EB 370a, Aquatic Ecology See F&ES 32011a for description.

Forestry

FOREST BIOLOGY

F&ES 260a, Structure, Function, and Development of Trees and Other Vascular Plants See F&ES 52006a for description.

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

Physical Sciences

ENVIRONMENTAL CHEMISTRY

F&ES 307b/EVST307b, Organic Pollutants in the Environment See F&ES 66008a for description.

F&ES 344b, Aquatic Chemistry See F&ES 60009b for description.

F&ES 443a, Analytical Chemistry See F&ES 60027a for description.

WATER RESOURCES

F&ES 440b/EVST440b, Environmental Hydrology See F&ES 61018b for description.

Quantitative and Research Methods

GEOL 362b, Remote Sensing: Observing the Earth from Space See F&ES 77001b for description.

Social Sciences

ECONOMICS

F&ES 117a/ECON 117a, Microeconomics with Environmental Applications An introduction to microeconomics with an emphasis on topics relevant to the study of the environment, including externalities, regulations, public goods, and consumer-surplus analysis. May not be taken after ECON 108a or b, 110a, or 115a or b. Sheila Olmstead

ENVIRONMENTAL POLICY

[F&ES 245b, International Environmental Policy and Governance See F&ES 85068b 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 and Its Critics See F&ES 80075a for description.

INDUSTRIAL ENVIRONMENTAL MANAGEMENT

F&ES 300b, Technology and Environment An introduction to the environmental aspects of the production of materials, the manufacture of products, the construction of buildings and roadways, the provisioning of services, and the recycling of objects, components, and materials. Examination of the technological processes by which modern society accomplishes its purposes, their potential to cause environmental damage, and prospects for improvement, using local, regional, and global perspectives. Thomas E. Graedel

SOCIAL AND POLITICAL ECOLOGY

[F&ES 250b, **Values and Perception of the Natural Environment** See F&ES 80051b for description.]

F&ES 384a/ANTH 318a, Environmental Anthropology This is an undergraduate course 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 (Questioning the Dichotomy, How Cattle Problematize It), Ecology and Social Organization (Early Essays by Mauss and Steward, Beyond Steward, “Natural” Disasters), Methodological Debates (Defense of Swidden, Natural Science Models, Bounded and Balanced Community), the Politics of the Environment (Indigeneity, Campaigns and Collaborations), and Knowing the Environment (Sense of Place, Limits of Knowledge). 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—which is the ultimate aim of the course. No prerequisites. Carol Carpenter

FRESHMAN SEMINAR

F&ES 012, Urban Ecology in New Haven 1 credit. More than half the human population now lives in urban settings. This course uses the natural sciences, namely ecosystem ecology, landscape ecology, and industrial ecology, to understand how cities work and how they can become more sustainable. Lectures and readings develop an understanding of the basic principles, while guest lecturers, community projects, and field trips in New Haven allow for the application of theory to New Haven and to cities around the world. Gordon T. Geballe



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 is to incorporate interdisciplinary study of watersheds and adjacent coastal waters into academic life at Yale.

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.

The Center for Coastal and Watershed Systems 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. In addition to courses in the regular listing, the center sponsors courses and lectures in marine conservation.

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's office houses a growing library of reference materials, Geographic Information Systems (GIS) data, and computers dedicated to student project use. The summer training modules incorporate training in watershed field measurement techniques. In partnership with the Connecticut Sea Grant College Program, the center provides internships for students working on coastal restoration, preservation, and community outreach projects.

Recent student projects in the center include a survey of vegetation loss in the Quinipiac River tidal marsh; a comparative assessment of mercury levels in urban and suburban streams; a sediment quality investigation as part of a dam removal study; and using a rapid assessment method to evaluate salt marshes.

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 Center for Coastal and Watershed Systems and the Hixon Center for Urban Ecology, 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, inaccessible, and little understood by nearby residents; 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 the Center for Coastal and Watershed Studies at the Peabody Museum Field Station on the Long Island Sound in Guilford. The station provides central access to one of the country's most important estuaries.

CENTER FOR ENVIRONMENTAL LAW AND POLICY

A joint undertaking with Yale Law School, the 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, as listed below.

Environmental Governance

This program investigates how the principles of good governance can be applied in the context of environmental policy making. It builds on research being conducted at Yale in the disciplines of law, political science, natural science, and economics. Projects under this program area include Global Environmental Governance and the UNITAR-Yale Environment and Democracy Initiative.

Environmental Attitudes and Behavior

This program considers the way that people relate to the environment, what values they bring to bear, and what issues, words, and language connect to them. Projects under this program area include the Yale Environmental Poll and Climate Change Resonance.

Business, Economics, and Environment

This program seeks to explore the nexus of business and the environment. The goal of this work is threefold: (1) to integrate environment into corporate practices; (2) to help develop the requisite strategy for environment-related enterprises; and (3) to encourage environmental organizations and policy makers to adopt better management principles in support of environmental goals. This work is being conducted in conjunction with the Center for Business and the Environment at Yale. Projects under this program area include Corporate Environmental Strategy and Private International Finance and the Environment.

Data-Driven Decision Making

This program aims to shift environmental policy making onto firmer analytic foundations using indicators and statistics. The primary output of this work is the Environmental Performance Index, which gauges environmental policy results at the national scale. Environmental Performance Measurement is the primary project under this program area.

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.

For detailed information on the Center for Environmental Law and Policy, please visit www.yale.edu/envirocenter.

CENTER FOR BUSINESS AND THE ENVIRONMENT AT YALE

A collaboration between the School of Management (SOM) and the School of Forestry & Environmental Studies, the Center for Business and the Environment at Yale (CBEY) hosts the longest-standing M.B.A.-Environment degree program in the world. This three-year professional degree seeks to “prepare environmental leaders for business and

society to solve the problems that matter.” The focus of CBEY is to enhance student learning experiences, connect students and faculty to leading practitioners, and to deepen our understanding of the business-environment interface.

CBEY gets involved in a number of initiatives focused on research, education, and outreach including the organization of speaker series, management of real world consulting projects, supporting cutting edge faculty research, and creating new courses.

Faculty and students involved in the center work in five core areas:

- Environmental Finance and Economics
- Market Framework and Governance
- Corporate Strategy and Governance
- Industrial Ecology
- Investments in Land and Ecosystems

Activities in each of these areas bring together students, faculty, staff, policy experts, and practitioners from a wide-range of institutions around the world. The work in each of these areas is frequently focused on one or more of five environmental concentrations including:

- Climate Change
- Clean Energy
- Forest Ecosystems and Management
- Land Conservation
- Water

For more information about CBEY, go to www.yale.edu/cbey

CENTER FOR GREEN CHEMISTRY AND GREEN ENGINEERING AT YALE

The Center for Green Chemistry and Green Engineering at Yale seeks to advance the design, discovery, development, and implementation of products, processes, and systems that are more sustainable for humans and the biosphere. Through the Principles of Green Chemistry and Green Engineering, scientists, engineers, and policy makers at the School of Forestry & Environmental Studies, the Department of Chemistry, and the Department of Chemical Engineering are engaged to develop the next generation of science, technology, and policy that can meet environmental and economic goals simultaneously.

The center includes various research groups that conduct basic and applied research on a wide range of technical topics. The research foci of the center include:

- A heuristic framework for the design of safer chemicals
- Engineering systems that are inherently resilient
- Appropriate and sustainable technologies for the developing world
- Energy systems that are non-depleting and non-polluting
- Material transformations that are atom economical and non-toxic
- Valuation of “green” corporate behavior

Specifically, researchers associated with the center are looking at water purification technologies that do not rely on toxic disinfection agents, new bio-based polymers that are degradable and do not require toxic additives, new carbon-free energy technologies,

chemical synthesis that reduce or eliminate hazardous reagents and waste, new solvent systems for cleaning that are more benign for humans and the environment, and shareholder value of green marketing and behavior. The center is actively engaged in research and implementation both domestically and abroad including field sites along the US-Mexico border and in Africa.

In addition to basic research, the center also seeks to catalyze the implementation of these sustainable technologies by:

- Working directly with companies and industrial sectors: pharmaceuticals, cosmetics, electronics, chemicals.
- Developing policies at the state and federal level that will advance the practice of green chemistry and green engineering. Some of the states where the center has engaged include Michigan, California, Texas, and Connecticut.

The center also seeks to communicate the results of its work to the broader community outside of Yale, has developed a multi-media Web presence, and conducts conferences and symposia in the U.S. and around the world in China, Japan, Africa, India, and New Zealand.

CENTER FOR INDUSTRIAL ECOLOGY

The Center for Industrial Ecology (CIE) is dedicated to the 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 path-breaking research in industrial ecology
- Hosting of visiting national 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 multi-year research is being conducted primarily in Puerto Rico to establish the environmental and economic rationale for intra-industry exchange of materials, water, and energy; and (3) outreach and training focused on the environmental opportunities and challenges from the enormous expansion of Asian industrial activity with the aim of institutionalizing the understanding and use of industrial ecology in Asia.

Other research projects include (a) evaluation of the environmental consequences on a life-cycle basis of industrial production based on biologically sourced raw materials and residuals; (b) development of quantitative goals or targets for sustainability; and (c) evaluation of extended producer responsibility (EPR), including investigation of how, when, and why cities and other local government units might adopt EPR.

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, multi-disciplinary 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 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 Spring 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, the Program for Restorative Environmental Design, 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 both lecture series and conferences 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 internships 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 fifth graders at an inner-city elementary school who are learning how to assess the environmental attributes of their neighborhood. 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, Open Spaces as Learning Places environmental education 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 city-wide 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 focuses especially on vacant lots, which pose a current and future threat to the quality of life in New Haven. As in many northeastern and midwestern industrialized cities in the United States, these patches of urban land—each typically less than one acre, but together making up hundreds of acres across urban neighborhoods—create great gaps in the landscape: sinkholes where environmental, economic, and community potential is wasted. 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. Our current environmental education initiative, Open Spaces as Learning Places, teaches elementary school students about environmental stewardship through the exploration of six open space sites in their communities. Topics range from forest succession and food webs to watersheds and plate tectonics. Field components of the program include an exploration of the students' schoolyard, a visit to a local community greenspace, hiking through East or West Rock Park, a canoe trip on one of New Haven's three rivers, a study of aquatic life at Lake Wintergreen, and a geologic inquiry at the historic Grove Street Cemetery. In the Open Spaces program, students learn environmental stewardship through experiencing

the work of their neighbors—and conversely residents are encouraged to continue to build open spaces as they see their neighborhood children enjoying and learning science from their hard work.

Research The URI programmatic activities in environmental education and urban community forestry create rich research opportunities. For example, using data from the Community Greenspace sites, F&ES student Alexis Dinno initiated a community survey to determine the human health impacts of vacant land. Adrian Camacho investigated differences in biological communities found in different urban locations, using Greenspace sites for comparison against abandoned lots. Another Yale F&ES student, Lianne Fisman, researched how childrens' play behavior is affected by the design of schoolyards.

Urban forestry practices Over the past decade, URI has created several community and urban forestry training programs, including natural resource managers' training sessions (for municipal employees), a tree steward training program (for community leaders), and a street tree inventory training project (targeting local residents). These programs have created powerful learning experiences for Yale 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 and 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 to support and connect the initiatives of the Yale community in developing applied research, partnerships, and programs in the tropics. We support projects that aim to develop practical solutions to issues relating to conservation and management of tropical resources.

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 natural and social sciences and among government agencies, academia, and practitioners, enabling the formation of successful partnerships and collaborations among researchers, activists, and governments. 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. Through the institute's long-term presence in particular locations, TRI serves as a focal point for collaboration with local and international organizations to address particularly important and complex environmental challenges, and extends the School's educational and training activities to local partners.

Research

TRI administers an endowed fellowship program that supports more than thirty graduate students conducting research in the tropics each year; administers structured long-term research sites to address issues of environmental restoration, protected areas and watershed management, environmental policy and governance, forest fragmentation, community rights to natural resources, and biodiversity conservation in Panama, Sri Lanka, and Indonesia; and supports faculty research in Asia, Africa, and the Americas.

Education

TRI provides mentoring and training to graduate students in research design, proposal writing, and field methods; sponsors faculty-led courses, workshops, round table discussions, and guest speakers; and trains practitioners through its presence overseas.

With a grant from the Class of 1980, TRI has established a documentary video editing center. Documentary films provide a powerful medium by which students can communicate their research to a wide audience. Students who are interested can combine independent research projects with the production of a documentary video.

Outreach

TRI maintains memoranda of understanding and collaborative research partnerships with more than three dozen leading tropical research and education institutions worldwide, sponsors open public lecture series, assists educational institutions in tropical nations with natural resources curriculum development, cosponsors an annual conference with the International Society of Tropical Foresters, helps publish conference proceedings and assessments of tropical resource issues in the *Yale School of Forestry & Environmental Studies Bulletin Series* and the *Journal of Sustainable Forestry*, and hosts an institute Web site (www.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, and the *Agroforestry in Landscape Mosaics Working Paper Series*, which publishes the results of collaborative research between TRI and the World Agroforestry Centre.

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 to TRI. 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 Latin America and South and Southeast Asia, by offering short-term courses, workshops, conferences, and symposiums for policy makers and conservation practitioners in these regions. Additionally through this program, ELTI will work 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 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 constructively debate varying opinions. 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 but 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 both affecting and affected by forest policies, including those working in government, business, conservation, academia, and community-based organizations. Most forums include both 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 is 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 houses 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, academics, and business executives.

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

Mid-career short courses Weeklong courses in Forest Stand Dynamics for forestry practitioners are taught on the east coast at Yale, and on the west coast through the University of Washington. Newly offered executive short courses bring the latest thinking in sustainable forestry to business executives as well as forestry professionals. Executives Learning about Forestry and Foresters Becoming Executives are intensive one-week courses for professionals from around the world, working in the forestry sector.

Through the programs and Yale Forest Forum, the institute has undertaken several initiatives, including examination of forest fragmentation and land use change, the total cost impacts 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, 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 Institute programs; and an external advisory board. The main office and bulk of the work of the institute are housed 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, and 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 Yale 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 Yale 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 non-timber species used for medicinal, insecticidal, ornamental, craft, and construction purposes. There are also 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; carbon sequestration by tropical forests and plantations; recovery and protection of watershed services, including water volume and quality; and

conservation and management of non-timber forest products. Research projects are currently taking place in Latin America and Southeast Asia.

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. Originally called the Yale Program on Forest Certification, the program has been renamed to better reflect its broad focus 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 will maintain a strong focus on forest certification as one unique and potentially revolutionary policy approach that harnesses the power of the marketplace to encourage compliance with environmental and socially responsible standards.

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 at 230 Prospect Street. 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/forestcertification.

The Forests Dialogue

The Forests Dialogue (TFD) is a group of individuals from the private sector and civil society from diverse backgrounds and regions who are committed to the conservation and sustainable use of forests. Through a shared understanding of forest issues from their own discussions, members of The Forests Dialogue work together in a spirit of teamwork, trust, and commitment. They believe that their actions and relationships can help

catalyze a broader consensus on forest issues and encourage constructive, collaborative action by individual leaders that will improve the condition and value of forests.

Members of TFD participate as individuals, rather than organizational delegates, and they aim to speak for a diversity of perspectives. TFD processes and activities are transparent, complement the actions of others, and seek to advance progress by creating leadership cadres on key issues based on individuals with broader personal consensus. Currently, TFD is focusing on issues related to illegal logging, forest certification, intensive forest management, forests and poverty alleviation, conservation forestry, and identifying a vision for conservation and management of the world's forests.

GISF hosts the secretariat of TFD. Students have the opportunity to work with the secretariat to conduct background research on issues of interest to TFD and to assist the secretariat in dialogue planning and implementation.

Program on Forest Physiology and Biotechnology

The Program on Forest Physiology and Biotechnology (PFPB) focuses primarily on the relationships of physiology, morphology, and genetics of forest plants to silviculture and sustainable forestry. 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 and removal of pollutants is also a consideration.

Current research is focused around several projects, including the anatomical, physiological, and optical properties of leaves in relation to (a) light intensity and quality, (b) distribution in tree crowns, (c) nutrient status, and (d) ecology and silviculture. A goal of this work is to scale up from the leaf to the tree to the canopy and forest by interfacing reflectance and fluorescence and carbon uptake with hyperspectral data from high-resolution remote sensing. It is thought that these methods can provide reliable measurements of forest health. Ultimately, these signals may also identify distribution of species within forest canopies along with measurements of foliar function such as photosynthesis, and cellular phenotypic plasticity (for instance, cuticle thickness, epidermal properties, and palisade versus spongy mesophyll). Such evaluations can be useful in evaluating sustainability under a variety of site conditions. In conjunction with these approaches, we are cooperating on studies of the anatomy and physiology of trees in many different areas of the world (India, Panama, Sri Lanka, Costa Rica) to determine optimal habitats for native species for sustainable forestry.

Another long-term research project concerns the development and use of organic biostimulants to maintain optimum plant growth while reducing fertilizer requirements and increasing natural stress resistance with respect to water, disease, insects, and toxic substances. Graeme P. Berlyn was one of the originators of the biostimulant concept for amplifying plant growth and stress resistance. Current work involves adding beneficial microbes (or their byproducts) to the biostimulant such as mycorrhizas and organisms that 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, and glutathione) in tree leaves in order to alleviate stress and increase photosynthesis. This approach is also being worked on by genetically modifying plants to increase their internal production of antioxidants. The external application offers an advantage in that it has lower initial costs and can be easily terminated if problems develop.

The program is located in the Greeley Laboratory. There are numerous opportunities for students to be involved with the research taking place through the program.

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. To manage 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 College of Forest Resources Silviculture Laboratory and the USDA Forest Service. Its purpose is to develop the scientific basis, concepts, and tools needed to help forests 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 creating increased 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 forest products and environmental services. 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 piloted in the northeastern 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 owner population 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 housed 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 10,880 acres of forestland in Connecticut, New Hampshire, and Vermont, which are maintained as working forests. 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 (a) maintaining the long-term ecological health of forests despite biotic, abiotic, and societal pressures, and (b) 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 as a whole. 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; research on managing invasives in fire-dependent ecosystems; control of invasive plants to protect endangered species habitat; research on the economic costs of wildfire at the urban-wildland interface; 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 utility right of ways to reduce power outage complications resulting from tree failure from disease and/or storms. 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, the 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, Management, Medicine, and the Faculty of Engineering, 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.

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.

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.

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 thirty-five 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 streamwater chemistry; and with biological data from numerous ongoing studies. Cooperative research at Hubbard Brook has contributed to a better understanding of the northern hardwood 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 midlevel managers in corporations, institutions, and government and nongovernmental organizations. This new 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 over the last six years.

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. (See Degree Programs for more information.)

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. Three open houses for prospective students are held during the fall term (in October, November, and December); a fourth 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 course work, opportunities for research and applied projects, career development, and life at Yale.

Information sessions are held on Thursday mornings from 9 to 11 a.m. during the months of September through January when school is in session. Prospective students meet with members of the Admissions staff and current students. Please e-mail 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 <http://environment.yale.edu/8/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 on the "Academics" page of the F&ES Web site. 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.

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 is full of information about the School, and printed copies of information may be requested at fesinfo@yale.edu.

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, 203.432.5106 or 800.825.0330.

The priority deadline for Master's application consideration is January 5, 2009. Individual admissions files completed by this date are guaranteed to receive a review by the Admissions Committee. Applications and supplemental materials may be submitted after this date, but there is no guarantee that they will be considered by the Committee. Therefore we encourage serious applicants to submit all necessary materials to the Office of Admissions prior to the January deadline.

Previous applicants planning to reapply to F&ES must submit a new application form and current application fee, an updated résumé/curriculum vitae, transcripts depicting all academic work not included in the previous application, and one new recommendation letter. Admissions records including application forms and supplemental materials are held for two years by the Office of Admissions; therefore, files submitted prior to the fall 2007 admissions cycle are no longer available. Provided reapplication occurs within two admissions cycles, all previously submitted supplemental materials held by the Office of Admissions will be incorporated into the new application.

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 Committee on Admissions 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. introductory evolutionary biology	c. botany
b. introductory 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. introductory economics
(micro and macro)
 - c. political science
 - d. sociology

Students may contact the Admissions staff to receive guidance in arranging their undergraduate programs in anticipation of graduate study at Yale.

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 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). The submission of the recommendation form and a one (1) 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 application fee (\$70 online, \$90 paper).

All application materials should be sent to the Office of Master's Admissions, Yale School of Forestry & Environmental Studies, 205 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. Additionally, 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,

www.mba.com/mba, or 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 accordingly so that scores will arrive by the January 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. Additional information about TOEFL can be found by visiting www.toefl.org/index.html. Information about IELTS can be found by visiting 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 minimum TOEFL scores of 100 on the Internet test, 600 on the paper test, and 250 on the computer 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's Summer and Special Programs (or an equivalent program elsewhere).

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.

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's English as a Second Language (ESL) representative.

Admissions: Doctoral Degree Programs

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 natural resources such as forestry, or in a relevant discipline of the natural or social sciences such as biology, chemistry, economics, or mathematics.

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, 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, 2009. 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. Contact GRE-ETS, PO Box 6000, Princeton NJ 08541-7670; telephone, 609.771.7670; Web site, www.gre.org.

International applicants whose native language is not English and who have not studied for at least two years at a university where English is the primary language of instruction are required to present evidence of proficiency in English by satisfactorily completing the Test of English as a Foreign Language (TOEFL). Applicants should take the test no later than November, and no earlier than eighteen months prior to application. For information regarding registration, dates, and test centers, contact TOEFL/TSE Services-ETS, PO Box 6151, Princeton NJ 08541-6151; telephone, 609.771.7100; e-mail, toefl@ets.org; Web site, www.toefl.org.



Tuition, Fees, and Other Expenses

TUITION AND FEES, 2008–2009

Master's Programs

The 2008–2009 tuition for master's degrees (Master of Environmental Management, Master of Forest Science, Master of Environmental Science, and Master of Forestry) is \$28,400. 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 2008–2009, a single student should also anticipate expenses of \$1,200 for books and supplies, \$1,614 for health insurance, and living expenses of approximately \$12,926 for room and board.

Doctor of Philosophy Program

The tuition for the Ph.D. degree is \$30,500. Most doctoral students receive a School fellowship that covers the cost of their tuition and provides a stipend for the first five years of their program. Doctoral students must pay a nominal continuing registration fee for no more than four years thereafter.

For 2008–2009, students should also anticipate expenses of \$1,395 for books and supplies. A single student can expect living expenses of approximately \$16,215 (9 months) and \$21,624 (12 months).

REGISTRATION

All students in the master's programs must register for courses using the online registration system (available at 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 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 the Health Plan 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 while on continuous registration status. A fee of \$1,000 per term for this continuous registration is charged under this option.

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 for any reason during the first 60% of the term will be subject to a pro rata schedule which 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% point has earned 100% of the Title IV funds. In 2008–2009, the last days for refunding federal student aid funds will be November 10, 2008 in the fall term and March 30, 2009 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% of tuition will be rebated for withdrawals which occur on or before the end of the first 10% of the term September 12, 2008 in the fall term and January 21, 2009 in the spring term.
 - b. A rebate of one-half (50%) of tuition will be granted for withdrawals which occur after the first 10% but on or before the last day of the first quarter of the term September 27, 2008 in the fall term and February 6, 2009 in the spring term.
 - c. A rebate of one-quarter (25%) of tuition will be granted for withdrawals which occur after the first quarter of a term but on or before the day of midterm: November 1, 2008 in the fall term and March 4, 2009 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 the Unsubsidized Federal Stafford, Subsidized Federal Stafford loans, if any; then to Federal Perkins loan; next to any other Federal, State, private or institutional scholarships and loans; and, finally, any remaining balance to the student.
5. Loan recipients (Stafford, Perkins or YSL) who 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 electronically 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) are sent to all students who have activated their official Yale e-mail accounts and to all student-designated authorized payers. It is imperative that all students activate and 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 a late charge 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. The late charge will be imposed as follows:

<i>If fall-term payment in full is not received</i>	<i>Late charge</i>
by August 1	\$110
by September 1	\$220
by October 1	\$330
<i>If spring-term payment in full is not received</i>	<i>Late charge</i>
by December 1	\$110
by January 2	\$220
by February 1	\$330

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 \$110 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/. 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 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 20. 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.

MASTER'S FINANCIAL AID, 2008–2009

Policy and Procedures

The School offers financial aid packages that could include scholarships, student employment, and loans to students with demonstrated financial need. In order to be considered for financial aid, students must submit the required financial aid applications by Febru-



ary 15. 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 2008 for matriculation in fall 2009. New forms are available at the School's Web site, www.environment.yale.edu/about/Financial-Aid-Forms/, or from the Financial Aid Office anytime after November 15.

Yale College students applying for the Fifth Year Deferred program at F&ES apply for financial aid in the February before the term of enrollment; joint school applicants must apply for F&ES financial aid at the time of their application for admission to 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
- a School of Forestry & Environmental Studies Financial Aid Application
- a Family Support Form, available on the School Web site.

International students requesting financial aid must complete:

- a School of Forestry & Environmental Studies Financial Aid Application
- a Family Support Form, available on the School Web site.

SCHOLARSHIPS

Students who demonstrate financial need may receive a scholarship to cover a portion of the student budget. 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 meet the full cost of their education. In addition to School scholarships, there are several special scholarship awards. These scholarships range in amount and are awarded on the basis of need, professional promise, and other criteria specified by the donors who provide funding for these scholarships. Students are automatically considered for all scholarships by completing the School's Financial Aid Application and the FAFSA.

NAMED SCHOLARSHIPS FOR ALL STUDENTS

Jabe Blumenthal Scholarship
 Leland Burt Scholarship
 Leonard Carpenter Scholarship
 Elias and Ann Clark Scholarship
 Strachan Donnelley Scholarship
 Strachan and Vivian Donnelley Scholarship
 Enid Storm Dwyer Scholarship
 Edith and Johannes Fröndt Scholarship
 Boyd Evison Scholarship
 John S. Griswold Scholarship
 Stuart H. Harrison Fellowship
 M. Albin Jubitz Scholarship
 Marvin Klemme Fellowship Fund
 John A. MacLean Scholarship
 Wendell A. Mottley Scholarship
 Caroline Niemczyk Scholarship
 Carl F. Norden Family Scholarship
 Charles F. Wilson Memorial Fund
 Ray L. Wilson Scholarship Fund
 Frank Wisneski Scholarship

SCHOLARSHIPS FOR U.S. STUDENTS

Beinecke Scholarship
 Philip Laurance Buttrick Fund
 Preference given to students of Native American heritage
 Paul Douglas Camp Scholarship

Students interested in forestry, forest management, or the use of forest products; must be a resident of Virginia, North Carolina, South Carolina, Florida, Georgia, or Brazil

Vira I. Heinz Endowment Scholarship

Students from the State of Pennsylvania

Adelaide Hixon Endowment Scholarship

Students focusing on or with an interest in urban ecology or related urban environmental studies

Fred Krupp Scholarship in Environmental Studies

Students who intend to pursue a position with an American nongovernmental environmental organization upon graduation

John M. Musser Fellowships in Population and Environment

Candidates studying the relationship between human population and the use and management of the environment, with priority given to women and minority students

SCHOLARSHIPS FOR INTERNATIONAL STUDENTS

Beinecke Scholarship

Abigail Disney and Pierre Hauser Scholarship

Louise and David Ingalls Foundation

Rockefeller-Underhill Scholarship

Students from South or Central America studying tropical ecology

Rodney B. Wagner Class of 1954 International Scholarship Fund

Students from Bhutan or, secondarily, from Africa

SCHOLARSHIPS FOR ENVIRONMENTAL LEADERSHIP

Forrest Berkeley Conservation Scholars

Internship and scholarship support for students with a focus on land conservation

Sally Brown Scholars

Students with a concentration in climate change

Doris Duke Conservation Fellows

Students who are leaders in conservation

William Kunkler Scholarship

Students pursuing environmental engineering, industrial ecology, or environmental management/strategy

Leadership Scholars Fund

Students who are strong and active proponents of “giving back” to the School—as alumni/ae and as leaders in their professional field, their communities, and the larger environmental world

Gilman Ordway Family Scholarship Fund for Environmental Studies

Students who will give serious consideration to a career in environmental studies either with a nongovernmental private organization or in a government position devoted to national resource protection

Wyss Foundation Scholarship

Scholars program for conservation of the American West

SCHOLARSHIPS FOR JOINT-DEGREE STUDENTS AND YALE COLLEGE GRADUATES

Buchanan Family Scholarship

Preference given to students interested in business and environmental studies

Michael P. Dowling Scholarship

Students pursuing joint degrees with the School of Forestry & Environmental Studies and the Yale School of Management

John R. Hesse Scholarship

Yale College students pursuing the fifth-year master's at the School of Forestry & Environmental Studies and/or students pursuing the joint degree between the F&ES and the Yale School of Management

Kroon Environmental Studies Scholarship

Yale College graduates interested in pursuing an advanced degree in Forestry & Environmental Studies

Benjamin F. Stapleton Scholarship Fund

Joint Yale Law and F&ES students with financial need

Edward L. Strohbehn, Jr. Scholarship

Joint law degree students or students with an interest in environmental law and policy

John R. Twiss Student Conservation Association Fellowship

Preference given to students who are alumni/ae of the Student Conservation Association

Lyndel J. Wishcamper Scholarship

Fifth-year Yale College student completing a Master of Environmental Management degree

OUTSIDE FUNDING FROM FELLOWSHIPS AND SCHOLARSHIPS

Students are strongly urged to compete for outside fellowships and scholarships that can be used at Yale. 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/. 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. Outside awards may be matched with School awards up to combined levels that are no higher than the normal educational expense budget.

EMPLOYMENT OPPORTUNITIES

Student employment Opportunities are listed at the Student Employment Office at 246 Church Street, or on its Web site at www.yalestudentjobs.org. Positions are located throughout the University and the City of New Haven, with hourly rates of \$11 to \$15. A list of jobs at the School is available in late summer.

Student assistantships (work study) Assistantships are awarded to ninety F&ES students as a part of their financial aid packages. These positions pay \$15 per hour and vary from clerical work to research, editorial, or library work. A list of positions will be available in late summer for students who qualify.

Teaching fellowships Fellowships are also available at the University. Each department makes its own hiring decisions; therefore, interested students must contact them directly. The typical salary is \$4,000 per term.

LOANS

Yale University participates in two federal student loan programs: the Stafford program and the Perkins 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 students who demonstrate need beyond the level of a subsidized Stafford loan. While Stafford loans are available to all eligible borrowers, Perkins loans are limited by available funds. Graduate students are also eligible to borrow up to the cost of their education, less other financial aid received, through the Federal Graduate PLUS Loan program. For more details on these programs, refer to the government Web site at www.fafsa.ed.gov.

All Yale graduate students 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, less any other financial aid received.

More information about the Yale International Loan can be found at www.environment.yale.edu/about/Loans/.

International Student Financial Aid

In order to apply for financial aid from the School, international students must complete the School of Forestry & Environmental Studies Financial Aid Application and the Family Support Form, which are available on the School Web site: www.environment.yale.edu/about/Financial-Aid-Forms/. Both forms must be submitted by February 15 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. Another option to help finance a portion of the cost of education is the Yale International Student Loan. 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 (see www.environment.yale.edu/about/Loans/). International students are also encouraged to seek support from their governments, employers, or various international agencies.

Four scholarships are offered to meet the full 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 in order to cover all costs for two years. 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 with financial aid decisions. More information is available at the Web site of Yale's Office of International Students and Scholars (www.oiss.yale.edu).

LEAVE OF ABSENCE

A student who wishes or needs to interrupt his or her study temporarily may request a leave of absence. A leave of absence will normally be granted for special study or work related to the degree program, but may also be granted for personal, medical, and parental responsibilities. The general policies that apply to a leave of absence are:

1. Leave of absence application forms are available by contacting the registrar's office at Yale School of Forestry & Environmental Studies.
2. All leaves of absence must be approved by the Academic Dean. Medical leaves also require the recommendation of a physician; documentation will also be required prior to a student returning from a medical leave indicating the completion of successful treatment and the ability of being able to complete the program of study.
3. A student may be granted a leave of absence for one academic year, but an extension to a maximum leave of two years may be granted in exceptional circumstances.
4. A student on 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.
5. A student on leave of absence does not have to file a formal application for readmission. However, he or she must notify the registrar 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, the student must submit appropriate financial aid applications to Yale School of Forestry & Environmental Studies financial aid office by February 15 of the academic year preceding their readmission to determine eligibility.
6. A student on a leave of absence is not eligible for financial aid, including loans, or for the use of any University facilities normally available to registered students. A student is not eligible for coverage by Yale Health Plan (YHP) Basic or YHP Hospitalization/Specialty Coverage. Coverage terminates the day the leave is granted. In order to secure continuous coverage through YHP, a student must request enrollment in the YHP Affiliate Coverage and pay the premium prior to the beginning of the term for which the leave is taken. If a leave of absence is granted during the term, the student

must request YHP Affiliate Coverage enrollment within 30 days of the date the leave is granted. Applications are available from the YHP Member Services Department, 17 Hillhouse Ave. (203.432.0246), or can be downloaded from the YUHS Web site (www.yale.edu/uhs).

7. A student on leave of absence who does not return at the end of an approved leave, and does not request and receive an extension by the academic dean, is automatically dismissed from Yale School of Forestry & Environmental Studies.



SAGE-HALL



Life at the School of Forestry & Environmental Studies

EDUCATIONAL FACILITIES

Sage Hall, a four-story building located at 205 Prospect Street, is the headquarters of the School of Forestry & Environmental Studies. The building, the gift of William H. Sage, B.A. 1865, in memory of his son, DeWitt Linn Sage, B.A. 1897, was completed in 1923. The administrative offices and library 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 an 800-square-foot student lounge, appointed with a large table and comfortable couches, which students use for studying, special events, and weekly social events. The dean's office and some faculty offices are also located in Sage.

Bowers Auditorium is a room 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 Sachem 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 210, 230, and 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, the Doctoral Program Office, and the Development and Alumni/ae Office.

of the School. In addition, the buildings at 230 and 301 Prospect Street and 380 Edwards have a classroom each.

Kroon Hall – Yale’s Most Sustainable New Building

With the generous support of the Kroon family (Richard Kroon, Yale College ’64) and a number of other donors, F&ES is nearing completion of construction on a new building located adjacent to Sage Hall. Slated for completion in early 2009, Kroon Hall is the first step in the process of consolidating most of the School’s faculty and staff in a connected set of three buildings at the southwest corner of Science Hill. The new building was designed by Hopkins Associates of London, England, in association with Centerbrook Architects of Essex, Connecticut. The Hopkins-Centerbrook team was chosen after a careful review of twenty-four of the world’s leading sustainable design architects.

Kroon Hall will be Yale’s first comprehensive green facility and serve as a benchmark for the University as it moves toward sustainable design as a norm for new construction and operations. The building will realize the sustainability ideals of F&ES in built form, and provide an instructional tool for students and faculty. Kroon Hall is intended to be a climate-neutral building that seeks to harmonize the natural and human built environments. The building will serve as an inspirational model for others of what can be accomplished in the area of restorative environmental design.

Library

The Henry S. Graves Memorial Library at the School of Forestry & Environmental Studies is one of the oldest and largest collections of forestry, natural resource, and related publications in the world. 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 Library consist of more than 135,000 books, documents, technical reports, and serial publications dealing with forestry, forest science, natural resource management, and environmental sciences and management. The library subscribes to 150 journals, periodicals, and other serial publications. The greater portion of the library’s collection, comprising material dating from the eighteenth century to the 1960s and periodical backfiles, is housed in the Seeley G. Mudd Library, one block from Sage Hall. The more recent part of the collection is housed on the fourth floor of Sage Hall.

The library 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, and additional aid is available from reference librarians in the nearby Kline Science and Social Science libraries. Access to electronic databases covering environmental, forestry, and natural resource topics, such as CSA’s Environmental Science and Pollution Management Collection, Environment Complete, Wildlife and Ecology Studies Worldwide, and the Forest Science Database, is provided through the library’s Web site at www.library.yale.edu/science/subject/forestry.html. These research tools and others, on such subjects as international affairs, water, soils, fish, and wildlife, are accessible throughout the campus. As a part of Yale

University Library system, the F&ES Library participates in all library services offered to Yale patrons: paper-based, electronic, local, and through interlibrary loan services.

School Forests

The Yale School of Forestry and Environmental Studies owns 10,880 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 7,840-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 non-timber 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 both FSC and SFI.

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 four to six 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.

PUBLICATIONS

The School produces general-interest publications as well as publications about Yale-based work for the broad audience of environmental professionals in universities, government agencies, not-for-profit organizations, and private businesses. The School's general-interest publications include the biannual magazine *Environment: Yale*, the newsletter *Yale Environmental News* in cooperation with the Yale Institute for Biospheric Studies and the Peabody Museum of Natural History, and newsletters and bulletins from its centers and programs. On the professional side, the Yale F&ES Publication Series produces books, reports, and working papers based on environmental conferences, courses, and events at Yale of special interest. They cover a wide range of environmental subject areas, including biodiversity and ecosystems, climate change, environment and development, industrial ecology, land use and environmental planning, environmental law and policy, natural resource management, and water resources. As part of the School's commitment to environmental stewardship, the F&ES Publication Series is produced using a print-on-demand system, all publications are available as free downloadable PDFs, and bound copies are printed on 100 percent recycled paper. For a complete listing of more than fifty titles, free PDFs, and ordering information for printed copies, see www.yale.edu/environment/publications/.

STUDENT ORGANIZATIONS

The School has many student-run interest groups. Current student groups include the Asian SIG, the student chapter of the American Water Resources Association (AWRA), the Coalition for Agriculture, Food, and Environment (CAFÉ), the Climate Change SIG, the Coastal and Marine SIG, Disaster, Environment and Development (ENDEV), the Forestry Club (FC), 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 (LATIN), Loggerhythms (LOGS), the Multi-Ethnic Student Association (MESA), the Outdoor Rec, Religion/Ethics/Environment SIG (SPIRET), *SAGE* magazine, the Social and Community Oriented Practice for the Environment (SCOPE), the Social Ecology Interest Group, a student chapter of the Society of American Foresters (SAF), the Yale chapter of the Society for Conservation Biology, the Student Advisory Committee (SAC), the Western Resource Group (Westies). 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, maintaining electronic lists, organizing a first-year/second-year mentor program, holding a welcome reception prior to fall registration, planning holiday parties, conducting a spring auction, and holding weekly gatherings. Many groups also use such facilities as the Peabody Museum Field Station, with its associated salt marsh and seventeen-acre island, and the Yale Myers Forest.

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 journal *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 or 203.432.5108 with inquiries or concerns.

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' professional communications and interpersonal skills, specifically as they relate to effectively marketing themselves in conducting the job search and exploring further learning. Programs include:

- Succeed at Interviewing Workshop
- Salary Negotiations Workshop
- Applying for the Ph.D. Workshop
- How to Dress for the Interview Program
- Success Stories: Job and Internship Search Strategies
- Initiating the Informational Interview Workshop
- How to Work a Career Fair Workshop
- Writing the Cover Letter and Résumé Workshop

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. It is managed by student assistants under general guidance of the CDO and a faculty advisory committee. The PSM program also collaborates with SIGs 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 <http://environment.yale.edu/current/Employment-and-Summer-InternshipResearch-Projects-Data/>.

Summer 2007 Internships

NGOS AND OTHER NOT-FOR-PROFIT GROUPS

American Chestnut Foundation, Chestnut Restoration Breeding Program Regional Science Coordinator, PA
 Arghyam, Water Quality Intern, India
 Center for Research on Sustainable Agriculture Production Systems, Researcher, Colombia
 The Climate Group, Low-Carbon Economy Growth Research Intern, England
 Colorado Conservation Trust, Colorado Cooperative Properties Fund Research Associate, CO
 Community Preservation and Development Corporation, Real Estate Development Intern, DC
 Ecosystem Marketplace, Carbon and Water Quality Assistant, DC
 Environmental Defense, China's Mercury White Paper Research Intern, NY
 Environmental Defense, Climate & Air Program Research Intern, DC
 Environmental Defense, Farm Bill Intern, DC
 Environmental Grantmakers Association, Ecotourism Research Fellow, NY
 Fondo para Protección del Agua (FONAG), Consulting Researcher, Ecuador
 Forest Stewards Guild, Community Wood Energy Project Intern, VT
 Great Land Trust, Conservation Intern, AK
 Institute for Financial Management and Research – Centre for Development Finance, Green Ratings Project Intern, India
 IUCN, Adaptation to Climate Change in the Huascarán World Heritage Site Intern, Peru
 Japan Center for a Sustainable Environment and Society, Carbon Tax and Emission Trading Research Intern, Japan
 Kohala Center, Hawaii Island Sustainability Project Research Assistant, HI
 Natural Resources Defense Council (NRDC), Climate Change Communications Intern, DC
 Natural Resources Defense Council (NRDC), International Program Research Fellow, DC
 Natural Resources Defense Council (NRDC), Public Health Project Associate, China
 Natural Resources Defense Council (NRDC), Urban Program Law Intern, NY
 The Nature Conservancy/CT Department of Environmental Protection, Assessing Stressor-Response Relationships in Aquatic Ecosystems Researcher, CT
 The Nature Conservancy, Blue Water Certification Program Research Assistant, CO
 Online Access to Research in the Environment (OARE), Research Intern, Africa
 Public Policy Institute of California, Reconciling California's Environmental Goals Intern, CA
 Responsible Purchasing Network, Purchasing Guides Intern, MD
 Rivers Alliance of Connecticut, Researcher/Legal Policy Analyst, CT
 Sierra Club, Environmental Litigation Legal Clerk, CA

Sitka Conservation Society, Municipal Energy Conservation Intern, AK
 Society of Environmental and Economic Development, Air Quality Economics
 Researcher, Nepal
 Sonoran Institute, Land and Water Policy Program Researcher, AZ
 Southern Connecticut Regional Water Authority, Field Forester, CT
 Tata Energy Research Institute (TERI), Information Sharing Systems Researcher,
 India
 Tata Energy Research Institute (TERI), Greenhouse Gas Emissions Researcher, India
 Tata Energy Research Institute (TERI), Sustainable Pathways Researcher, India
 Trustees of Reservations, Conservation Collaboration Intern, MA
 Vermont Land Trust, Forester-Landowner Relations Intern, VT
 Wilderness Society, Forest Restoration Research Assistant, MT
 Wilderness Society, Public Policy Law Clerk, DC
 World Business Council for Sustainable Development, Energy & Climate Research
 Intern, Switzerland
 World Resource Institute, Climate and Energy Program Research Intern, DC
 World Wildlife Fund (WWF), Intern, Russia
 World Wildlife Fund (WWF), World Bank Global Forest Alliance Researcher, DC
 Yestermorrow, Natural Building, Architectural Design Intern, VT

BUSINESS AND INDUSTRY

Airtricity, Inc., Wind Energy Project Finance Intern, IL
 Beveridge & Diamond, Legal Associate, DC
 Beveridge & Diamond, Legal Associate, NY
 Buro Happold, Sustainability Team Member Dedicated to The Orange County Great
 Park, NY
 Cargill Inc., Environment, Health and Safety Business Unit, Intern Engineer, MN
 ENSR/AECOM, Air Quality Intern, CA
 General Electric, Corporate Environmental Program Intern, CT
 Google, Corporate Environmental Programs Intern, CA
 Grays Harbor Paper, Waste Reduction Intern, WA
 Haley & Aldrich, Environmental Scientist Intern, CA
 LeBoeuf, Lambe, Green & MaCrae, Energy Law Associate, NY
 Nestle Waters North America, ISO14001 Waste Water Disposal Coordinator, MA
 New Leaf Paper, Sustainability Research Intern, CT
 Noble Environmental Power, Legal Associate, CT
 Sealaska Corporation, Intern, AK
 Sive, Paget & Reisel, Legal Associate, NY
 SmithBarney, Research Associate for Socially Responsible Investing, CT
 Stonyfield Farm, Sustainable Packaging Intern, NH
 UTC-Chubb, Independent Audit Intern, Ireland

EDUCATION

Harvard University, Research Assistant, Forest-to-Atmosphere Carbon and Water
 Exchange, MA

Institute for Energy and the Environment, Researcher, Anaerobic Digesters for Energy, VT
 Teton Science School, Environmental Education Intern, WY
 Yale University, Center for Coastal and Watershed Systems, Researcher, Change Patterns of Chlorophyll and CDOM, CT
 Yale University Forests, Forestry Apprentice, CT (4)
 Yale University, Office of Strategic Initiatives, Research Assistant, CT
 Yale University, Urban Design Workshop, Sustainable Design Intern, CT
 Yale University, Urban Resources Initiative (URI), Community Greenspace Program Forester, CT (5)

GOVERNMENT AND PUBLIC SECTOR GROUPS

California Attorney General, Summer Honors Program, Legal Intern, CA (2)
 California Public Utilities Commission, Renewable Portfolio Standard Team Intern, CA
 National Aeronautics and Space Administration (NASA) Ames Research Center, Waste Reduction Intern, CA
 Overseas Private Investment Corporation/Model Forestry Policy Program, Environmental Risk Measurement Researcher, DC
 Philadelphia Water Department, Office of Watersheds, Ecosystem Restoration Unit Intern, PA
 Singapore Ministry of Environment and Water Resources, Climate Risk Assessment Intern, Singapore
 Tonga Ministry of Lands, Natural Resources and the Environment Intern, Tonga
 United Nations Development Programme (UNDP), Carbon Emissions Reduction and the Second National Communication Report Intern, Barbados
 United Nations Development Programme (UNDP), Climate Change Intern, NY
 United Nations Development Programme (UNDP), Global Environmental Facility Small Grants Program Intern, NY
 United Nations Environment Programme (UNEP) Risoe Centre on Energy, Climate & Sustainable Development (URC) Intern, Denmark
 United Nations HABITAT Programme, Municipal Development Land Tenure Project Researcher, Mexico
 United Nations Institute for Training & Research (UNITAR), Action plan training on the Stockholm Convention in Sierra Leone, Switzerland
 United Nations Institute for Training & Research (UNITAR), Capacity Building for PCB Elimination Researcher, Ghana
 United Nations Institute for Training & Research (UNITAR), Chemicals, Waste and Environmental Governance Researchers, Switzerland (4)
 U.S. Department of Agriculture (USDA) Forest Service, District Planner, WA
 U.S. Environmental Protection Agency (EPA), Office of International Environmental Policy Legal Intern, DC
 World Bank, Consultant for Technical Assistance to the FLEG Initiatives in Central America, Nicaragua
 Yonkers Corporation Counsel, Urban Environment and Development Research Intern, NY

U.S. RESEARCH (NON-HOSTED)

Attitudes towards large carnivores on the Wind River Reservation, WY
 Awareness and Perceptions of Green Architecture, CT
 Cobalt Speciation in Freshwater, CT
 Ecological health pre- and post- dam removal in the Penobscot River watershed, ME
 Effect of Nutrient Loading on Carbon Dynamics in Long Island Sound Salt Marshes, CT
 Effect of the presence of two different kinds of spiders with different predation behavior on mate choice and reproductive output on grasshoppers, CT
 Factors affecting adoption of integrated pest management on conventional Midwestern farms, MN
 Isolating some of the maximum temperature boundaries that define photosynthetic parameters in which C₃, C₄ and facultative CAM species live, CT
 Potential for public health to inform conservation planning and land-use decision-making in the Berkshires, MA
 Urban white-tailed deer populations, CT

NON-U.S. RESEARCH

Adaptations and Attitudes of Malay-Muslim Teenagers to Economic Development and Technological Change, Thailand
 Agricultural Water Allocation: Irrigated Water in Pakistan, Pakistan (2)
 Comparison of Soil Properties beneath Plantations of *Azadirachta indica* and *Phoenix dactylifera*, NIGERIA
 Contribution of Sacred Forests to Riparian Forest Cover along the Ouémé and Okpara Rivers, Benin
 Drivers and Barriers of Industrial Symbiosis in TEDA, China
 Economic Assessment of Community Based Conservation in the Morogoro District, Tanzania
 Economic Impact of Sea Level Rise on Coastal Towns, Malaysia
 Edge effects on native vegetation establishment in Caribbean Pine Plantation, Sri Lanka
 Effects of a shade-grown coffee contract system on household economies in Cusuco National Park, Honduras
 Factors Influencing Fuel Extraction Processes in the Mangroves of the Saloum Biosphere Reserves, Senegal
 Feeding Ecology of Seabirds, Canada
 Identifying, contacting, and interviewing stakeholders involved in watershed management at Baikal, Russia
 Impact of the invasive liana, *Sericothachys scandens*, on forest composition and recovery of the Grauer's gorilla in the Kahuzi-Biega National Park, Congo
 Land-use trajectories, social ecology and household economies, Honduras
 Native Forests Protected Areas Management Plan, Uruguay
 Patterns of Forest Establishment along the Boreal Forest, Steppe ecotone, Mongolia
 Potential Carbon Sequestration in Western Kenyan Agroforestry Systems, Kenya
 Removal of organic pollutants from the water using naturally occurring minerals of Kenyan origin, Kenya

Short Messaging System in Rural Areas, Colombia

Soil CO₂ Emission Fluxes in organic peat soils of the West Kalimantan, Indonesia

Strengths and weaknesses of the current conservation model in the Paso de la Danta,
Costa Rica

What is Wilderness? A Study From Tourism, Guatemala

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

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 <http://environment.yale.edu/current/Employment-and-Summer-InternshipResearch-Projects-Data/>.

Summary data from the class of 2007 master's graduates six months after graduation (110 out of 125 total reporting): 10 percent entered the private not-for-profit sector; 12 percent entered the public sector/government; 34 percent went into the private for-profit sector; 6 percent are working in education; and 17 percent have gone on for further study. Eight percent have reported that they are seeking employment and 13 percent have not yet reported.



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 “The Internationalization of Yale: The Emerging Framework,” which is available online at www.world.yale.edu/pdf/Internationalization_of_Yale.pdf.

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. (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 pages 175–76 in this bulletin and 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. (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. (www.ycsg.yale.edu)

The Yale World Fellows Program hosts eighteen 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. (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. (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 2008–2009 are available as of April 1 online and can be submitted directly from the Web site (www.yale.edu/graduatehousing). 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, tel. 203.432.2167, fax 203.432.4578. For more apartment information, contact grad.apts@yale.edu, tel. 203.432.8270, fax 203.432.4578.

The University's Off-Campus Housing service, limited to current or incoming members of the Yale community, is located at Helen Hadley Hall, 420 Temple Street, and is open from 9 a.m. to 3:30 p.m., Monday through Friday. The listings may also be accessed from any computer at Yale at www.yale.edu/offcampushousing.

DINING AT YALE

Yale University Dining Services (YUDS) 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 for ten meals per week, plus six bonus meals per year and \$75 per semester in points to eat either on campus or at selected local restaurants. Nonresident students may purchase a *5 Lunch Plan* with three bonus meals, good Monday through Friday.

YUDS 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 155 Whitney Avenue, Triple E's at Payne Whitney Gymnasium, and Durfee's Convenience Store at 200 Elm Street. 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, lunch, and/or dinner and require the diner to be accompanied by a host from that college.

Inquiries concerning food services should be addressed to Yale University Dining Services, 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.

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

Yale University Health Services (YUHS) is located on campus at 17 Hillhouse Avenue. YUHS 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 twenty-three-bed inpatient care facility (ICF), a round-the-clock urgent care clinic, and such specialty services as allergy, dermatology, orthopedics, and a travel clinic. YUHS also includes the Yale Health Plan (YHP), a health coverage option that coordinates and provides payment for the services outlined above, as well as for emergency treatment, off-site specialty services, inpatient hospital care, and other ancillary services. YUHS's services are detailed in the *YHP Student Handbook*, available through the YHP Member Services Department, 203.432.0246, or on the YHP Web site at 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 YHP Basic Coverage. YHP 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 Urgent Care.

Students on leave of absence or on extended study and paying less than half tuition are not eligible for YHP Basic Coverage but may enroll in YHP Student Affiliate Coverage. Students enrolled in the Division of Special Registration as nondegree special students or visiting scholars are not eligible for YHP Basic Coverage but may enroll in the YHP 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 YHP 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 YHP Member Services Department. Enrollment applications for the YHP Student Affiliate Coverage, Billed Associates Plan, or Fee-for-Service Program are available from the YHP Member Services Department.

All students are welcome to use specialty and ancillary services at YUHS. Upon referral, YHP will cover the cost of these services if the student is a member of YHP Hospitalization/Specialty Coverage (see below). If the student has an alternate insurance plan, YHP will assist in submitting the claims for specialty and ancillary services to the other plan and will bill through the Office of Student Financial Services for noncovered charges and services.

Health Coverage Enrollment

The University also requires all students eligible for YHP Basic Coverage to have adequate hospital insurance coverage. Students may choose YHP 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.

YHP HOSPITALIZATION/SPECIALTY COVERAGE

For a detailed explanation of this plan, see the *YHP Student Handbook*, which is available online at www.yale.edu/yhp/pdf/studenthb.pdf.

Students are automatically enrolled and charged a fee each term on their Student Financial Services bill for YHP 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 September 1 through August 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, YHP 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 August 31.

Waiving the YHP Hospitalization/Specialty Coverage Students are permitted to waive YHP Hospitalization/Specialty Coverage by completing a waiver form that demonstrates proof of alternate coverage. Waiver forms are available from the YHP Member Services Department. It is the student's responsibility to report any changes in alternate insurance coverage to the YHP Member Services Department. Students are encouraged to review their present coverage and compare its benefits to those available under the YHP. 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 YHP Hospitalization/Specialty Coverage but later wish to be covered must complete and send a form voiding their waiver to the YHP 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. YHP premiums will not be prorated.

YHP STUDENT TWO-PERSON AND FAMILY PLANS

A student may enroll his or her lawfully married spouse or same-gender domestic 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 the YHP Basic Coverage and the YHP Hospitalization/Specialty Coverage. YHP Prescription Plus Coverage may be added at an additional cost. Coverage is not automatic and enrollment is by application. Applications are available from the YHP Member Services Department or can be downloaded from the YUHS Web site (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.

YHP 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 YHP Student Affiliate Coverage, which includes services described in both the YHP Basic and the YHP Hospitalization/Specialty Coverage. Prescription Plus Coverage may also be added for an additional cost. Applications are available from the YHP Member Services Department or can be downloaded from the YUHS Web site (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.

YHP PRESCRIPTION PLUS COVERAGE

This plan has been designed for Yale students who purchase YHP Hospitalization/Specialty Coverage and student dependents who are enrolled in either the Two-Person Plan, the Student Family Plan, or Student Affiliate Coverage. YHP Prescription Plus Coverage provides protection for some types of medical expenses not covered under YHP Hospitalization/Specialty Coverage. Students are billed for this plan and may waive this coverage. 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. For a detailed explanation, please refer to the *YHP 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 YHP Hospitalization/Specialty Coverage and/or YHP Prescription Plus Coverage. The student will not be eligible for any YHP benefits, and the student's YHP 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 YHP 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 YHP Student Affiliate Coverage.

Leaves of absence Students who are granted a leave of absence are eligible to purchase YHP Student Affiliate Coverage during the term(s) of the leave. If the leave occurs during the term, YHP Hospitalization/Specialty Coverage will end on the date the leave is granted and students may enroll in YHP 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 YHP Hospitalization/Specialty Coverage will be applied toward the cost of Affiliate Coverage. Coverage is not automatic and enrollment forms are available at the YHP Member Services Department or can be downloaded from the YUHS Web site (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 YHP Hospitalization/Specialty Coverage and YHP Prescription Plus Coverage. They may purchase YHP Student Affiliate Coverage

during the term(s) of extended study. This plan includes services described in both the YHP Basic and the YHP Hospitalization/Specialty Coverage. Coverage is not automatic and enrollment forms are available at the YHP Member Services Department or can be downloaded from the YUHS Web site (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 YHP, please refer to the *YHP Student Handbook*, available from the YHP Member Services Department, 203.432.0246, 17 Hillhouse Avenue, 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, 2008. 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 YHP 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 30. 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 in William L. Harkness Hall (WLH), Rooms 102 and 103. Access to the Resource Office is through the Cross Campus entrance to WLH. Office hours are Monday through Friday, 8:30 a.m. to 4:30 p.m. Voice callers may reach staff at 203.432.2324; TTY/TDD callers at 203.432.8250. The Resource Office may also be reached by e-mail (judith.york@yale.edu) or through its Web site (www.yale.edu/rod).

OFFICE OF INTERNATIONAL STUDENTS AND SCHOLARS

The Office of International Students and Scholars (OISS) coordinates services and support to 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, postdocs, 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 hosts and as English conversation partners. Interested individuals should contact OISS at 203.432.2305.

OISS maintains an extensive Web site (www.oiss.yale.edu) 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. The *ISPY E-Group* is an interactive list of over 300 members to connect spouses, partners, and families at Yale. To subscribe to any list, send a message to 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 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, 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 about the International Center, call 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, and the Muslim Student Association. 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.

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 (described on pages 158–59). Second largest among the university libraries in the United States, the Yale Library contains more than 11.7 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 catalogue, which provides electronic access to 5 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.

COMPUTER RESOURCES

The mission of the Office of Information and Library Systems 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. Because of the growing availability of wireless access throughout the Yale campus, students are encouraged to purchase laptops with wireless capability.

The School maintains several facilities that offer computing capabilities to students on a 24-hour-a-day, seven-day-a-week basis. The Student Cluster, located in Sage 39, contains twenty IBM personal computers, a high-speed printer capable of producing double-sided output, and a color laser printer. The GIS Lab, located next door in Sage 31, contains seventeen IBM computers and two high-speed printers. All computers in both

rooms access the Web, the Yale e-mail server, and the F&ES file server, which is used by students to store large files, and by faculty to distribute course materials to students. A third facility at Greeley Labs contains six IBM PCs configured for GIS and computational applications.

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.

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), a newspaper printed weekly during the academic year, 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 www.yale.edu/opa/yb&c.

The Yale Peabody Museum of Natural History contains collections in anthropology, mineralogy, oceanography, paleontology, and some aspects of geology.

The Yale University Art Gallery is known worldwide for its collections of American art, the Jarves Collection of early Italian paintings, the finds excavated at the ancient Roman city of Dura-Europos, the Société Anonyme Collection of early-twentieth-century European and American art, and most recently the Charles B. Benenson Collection of African art. The gallery is both a collecting and an educational institution, and all

activities are aimed at providing an invaluable resource and experience for the Yale and New Haven communities. Admission is free, and the gallery is open to the public six days a week.

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. These include concerts presented by students and faculty of the School of Music, the Department of Music, the Yale Concert and Jazz bands, the Yale Glee Club, the Yale Symphony Orchestra, and other undergraduate singing and instrumental groups. In addition to graduate recitals and ensemble performances, the School of Music features the Philharmonia Orchestra of Yale, the Chamber Music Society at Yale, the Duke Ellington Series, the Horowitz Piano Series, New Music New Haven, Yale Opera performances and public master classes, and the Faculty Artist Series. The Institute of Sacred Music sponsors Great Organ Music at Yale, the Yale Camerata, the Yale Schola Cantorum, 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, Palace Theater, 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. Kipthut 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; 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, the Yale Polo and Equestrian Center, 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 at all these recreational facilities can be obtained from the Sport and Recreation Office (203.432.1431). Please check the Yale Athletics Web site

(<http://yalebulldogs.collegesports.com>) for more information concerning any of these recreational facilities and programs.

Approximately fifty-five club sports and outdoor activities come under the jurisdiction of the Office of Outdoor Education and Club Sports. Many of these activities are open to graduate and professional school students. Yale faculty, staff, and alumni, and nonaffiliated groups may use the Yale Outdoor Education Center (OEC). The center consists of two thousand acres in East Lyme, Connecticut, and includes overnight cabins and campsites, a pavilion and dining hall, and a waterfront area with a supervised swimming area, 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 season extends from the third weekend in June through Labor Day and September weekends. For more information, telephone 203.432.2492 or visit the Web page at <http://yalebulldogs.collegesports.com> (click on Sports Rec, then on Outdoor Education).

Throughout the year, Yale University 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, 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 <http://yalebulldogs.collegesports.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, 2008

Obinna Lebechukwu Aduba (B.S. Univ. Nigeria [Nsukka]), Nigeria
Angelica Maria Afanador Ardila (B.S. Antioquia School of Engineering), Colombia
Agha Ali Akram (B.S. Lahore Univ. Management Science), New York
Devorah Ancel (B.A. Washington Univ. [Mo.]; J.D. Vermont Law School), Wisconsin
Avery Christian Anderson (B.A. Hamilton Coll.), New York
Georgia Basso (B.S. Univ. Delaware), California
Joshua Aries Berman (B.A. Yale Univ.), Massachusetts
Genevieve Edwards Labarth Biggs (B.A. Vanderbilt Univ.), California
Emmanuel Robert Blankson (B.S. Univ. Ghana), Ghana
Jessica Erin Boehland (B.A. Oberlin Coll.), Vermont
Gerald Wallace Bright (B.S. Howard Univ.), Pennsylvania
Sara Bushey (B.A. Occidental Coll.), Maryland
Rayna Hake Caldwell (B.S. Spalding Univ.), New York
Margaret Woolsey Carmalt (B.A. Univ. Colorado [Boulder]), Wisconsin
Natalie Claire Ceperley (B.A. Grinnell Coll.), Illinois
Hin Shing Duncan Cheung (B.A. Yale Univ.) Connecticut
Anton Aleksandar Chiono (B.A. Willamette Univ.), Oregon
Zachary David Christie (B.A. Duke Univ.), California
Christopher Ernest Clement (B.S. Univ. North Carolina [Chapel Hill]),
North Carolina
Marcia Joan Cleveland (B.A. Wellesley Coll.), Maine
Vincent William Conti (B.A. Univ. Connecticut [Storrs]), Massachusetts
Kimpton Matthew Cooper (B.S. Tuskegee Inst.), Texas
Caitlin Carey Cusack (B.A. Coll. Holy Cross), Massachusetts
Michael Allan Davies (B.S. Rochester, Univ.), New York
Kara Natalie DiFrancesco (B.S. Univ. Virginia), North Carolina
Obidimma Chukwunonso Ezezika (B.S. Univ. Lagos), Georgia
Jorge Rafael Figueroa (B.A. Univ. Rochester), New York
Joshua Joseph Gange (B.A. New Coll. Florida), Florida
Andrea Elise Gelatt (B.A. Grinnell Coll.), DC
Bella Gordon (B.A. Univ. Chicago), New York
Poorva Gupta (B.S. Univ. Delhi), India
Nigel Thomas Gurnett (B.S. Endicott Coll.), Massachusetts
Ezekiel Jon Hausfather (B.A. Grinnell Coll.), Netherlands
Kristin Lynn Hesser (B.S. Principia Coll.), Texas
Frank Patrick Holmes (B.A. Colorado Coll.), Colorado
Lauren Ashlee Hopkins (B.A. Coll. Charleston [S.C.]), Vermont
Thomas Mattson James (B.S. Univ. Washington), Montana
Olivia Hogan Kaplan (B.A. Yale Univ.), Connecticut
Shanti Karanjit (B.S. Kathmandu Univ.), New York
Mark Benedict Kasinskas (B.A. Central Connecticut State Univ.), Connecticut
Lucas Porter Knowles (B.A. Yale Univ.), Arkansas

Scott Robert Laeser (B.S. Univ. Wisconsin [Madison]), Wisconsin
 Daniel J Leistra (B.A. Amherst Coll.), South Dakota
 James Edwin Leslie (B.A. Brown Univ.), Massachusetts
 Jennifer Ann Lewis (B.A. Bryn Mawr Coll.), North Carolina
 Jing Li (B.S. Peking Univ.), China
 Xuanyi Li (B.E.D. Peking Univ.), China
 Innocent Bauma La Mathan Liengola (B.S. Univ. Kisangani), Dem. Republic of the
 Congo
 Yi-Wen Lin (B.S. National Taiwan Univ.), Taiwan, Republic of China
 Qi Feng Lin (B.S. Nat'l Univ of Singapore), Singapore
 Angela Felicia Lott (B.A. Univ. Georgia [Athens]), Maryland
 Andrew James Mackie (B.S. State Univ. New York [Geneseo]), New York
 Mira Lee Manickam (B.A. Brown Univ.), New Jersey
 Naoko Maruyama (B.A. Tokyo Univ. Agriculture & Technology), Japan
 Beth Phyllis Wanjiru Mburu (B.S. Nairobi Univ.), Kenya
 Jennifer Ann McIvor (B.A. Florida Atlantic Univ.), Nebraska
 Kyle Kitson Meister (B.A. Univ. Michigan [Ann Arbor]), Massachusetts
 Adam Murphy Melnick (B.S. Muhlenberg Coll.), New York
 Jihoon Min (M.S. Seoul National Univ.; B.E. Seoul National University), Republic of
 Korea
 Baruani Idd Mshale (B.S. Univ. of Dar Es Salaam [Tanzania]), United Republic of
 Tanzania
 Stuart Cameron Murray (B.B.A. Univ. Western Ontario), Canada
 Tamara Muruetagoiena (B.A. Washington State Univ.; M.B.A. European School of
 Business), New York
 Maung Moe Myint (M.S. Asian Institute of Tech), Thailand
 John Whitney Nixon (B.A. Dartmouth Coll.), Maryland
 Jennie Cross Nolon (B.S. Cornell Univ.), New York
 Matthew Robert Oden (B.S. Univ. California [Berkeley]), Vermont
 Daniel Robert Peerless (B.A. Hanover Coll.), Florida
 Cornelia Cooper Pinchot (B.A. Oberlin Coll.), Pennsylvania
 Sergio Roberto Pineda (B.A. Univ. de Los Andes), Colombia
 Samuel Pearsall Price (B.E. McGill Univ.), Quebec
 Tingting Quan (B.A. Beijing Foreign Studies Univ.), China
 Micha Louise Rahder (B.A. Reed Coll.), Oregon
 Paula Bridget Randler (B.S. Univ. South Carolina [Columbia]), South Carikuba
 Catherine Frances Miner Rawson (B.A. Bates Coll.), Vermont
 Korinti Zofia Recalde (B.A. Boston Univ.), Massachusetts
 Michael John Robertson (B.A. Univ. of Cambridge), England
 Jeffrey Curtis Ross (B.S. Montana, Univ.), Montana
 Edan Rotenberg (B.A. Univ. Toronto), Canada
 Angela Colleen Rutherford (A.B. Dartmouth Coll.), Idaho
 Jeramy Alice Shays (B.A. Principia Coll.), Connecticut
 Yuliya Shmidt (B.A. Univ. California [Santa Cruz]), California
 Mark Stritzel Sloan (B.S. Univ. British Columbia), Canada
 Ashly Peyton Smith (B.S. Univ. Washington), Wisconsin

Jamie Michelle Spivey (B.S. Washington State Univ.), Washington
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Dr. Rajendra K. Pachauri, speaking at the 2008 F&ES Commencement. Dr. Pachauri is director-general of The Energy and Resources Institute (TERI) and chairman of the Intergovernmental Panel on Climate Change (IPCC); recipient of a Doctor of Humane Letters honorary degree in 2008 from Yale; recipient of the Nobel Peace Prize in 2007; and McCluskey Fellow at F&ES in 2000. [Photo: Peter Otis]

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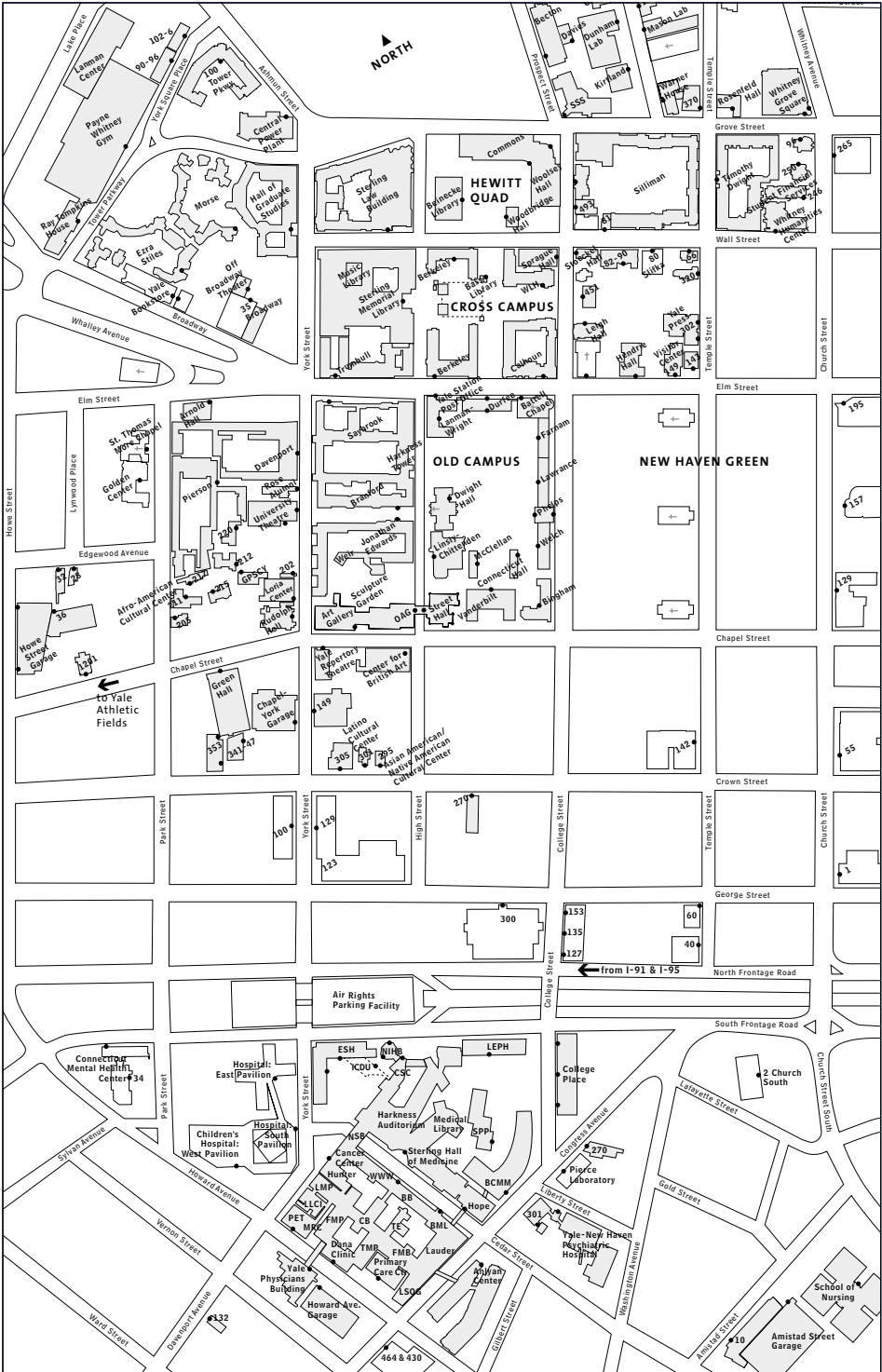
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