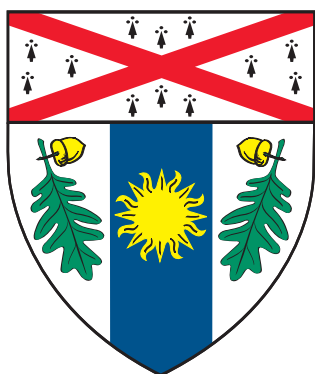


School of Forestry & Environmental Studies

2006–2007



BULLETIN OF YALE UNIVERSITY

Series 102 Number 3 June 15, 2006

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Telephone Numbers

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Web site: www.yale.edu/environment/

Application deadlines

Ph.D. Program January 8, 2007
Master's Programs January 8, 2007

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School of Forestry & Environmental Studies 2006–2007

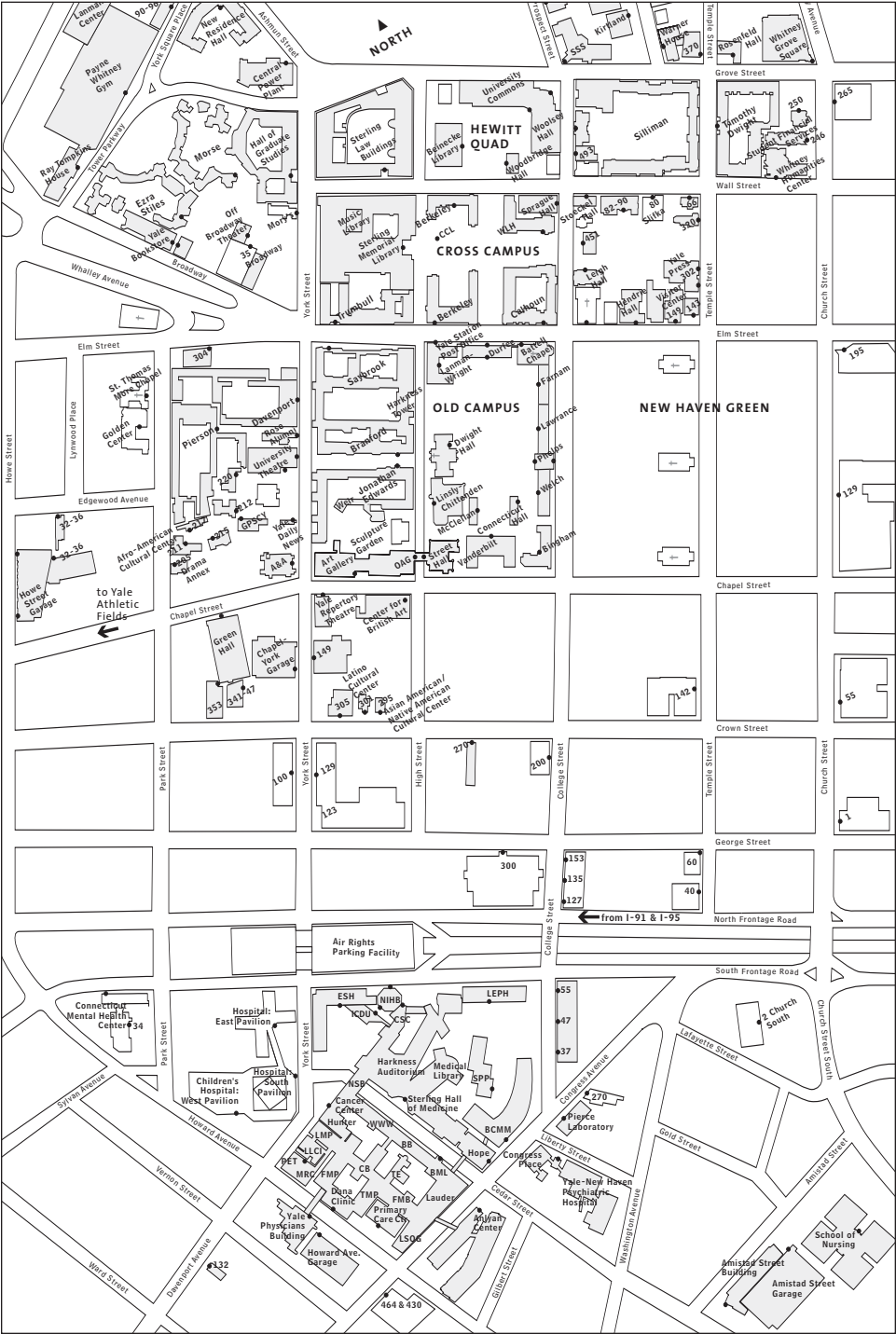
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YALE UNIVERSITY CAMPUS SOUTH & YALE MEDICAL CENTER



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Calendar

FALL 2006

Aug. 10–12	Thurs. – Sat.	Orientation for international students.
Aug. 13	Sun.	Orientation for summer modules.
Aug. 14–31	Mon. – Thurs.	Training modules in technical skills (weekdays; weekends are free).
Sept. 1	Fri.	Academic orientation for first-year students, 9 A.M. – 12 noon.
Sept. 5	Tues.	Meeting with the dean and Course Expo.
Sept. 6	Wed.	<i>Fall-term classes begin, 8.30 A.M.</i>
Sept. 13	Wed.	Course registration closes, 5 P.M.
Sept. 27	Wed.	Add/Drop period ends, 5 P.M.
Oct. 13	Fri.	Open House for prospective students.
Nov. 10	Fri.	Open House for prospective students.
Nov. 17	Fri.	Fall recess begins, 5.30 P.M.
Nov. 27	Mon.	Classes resume, 8.30 A.M.
Dec. 8	Fri.	Open House for prospective students.
Dec. 8	Fri.	<i>Classes end, 5.30 P.M.</i> Reading period begins.
Dec. 18	Mon.	Final examinations begin, 9 A.M.
Dec. 22	Fri.	Final examinations end, 5.30 P.M. Winter recess begins.

SPRING 2007

Jan. 16	Tues.	<i>Spring-term classes begin, 8.30 A.M.</i>
Jan. 23	Tues.	Course registration closes, 5 P.M.
Feb. 6	Tues.	Add/Drop period ends, 5 P.M.
Mar. 9	Fri.	Spring recess begins, 5.30 P.M.
Mar. 26	Mon.	Classes resume, 8.30 A.M.
Mar. 30	Fri.	Open House for admitted students.
Apr. 30	Mon.	<i>Classes end, 5.30 P.M.</i> Reading period begins.
May 8	Tues.	Final examinations begin, 9 A.M.
May 15	Tues.	Final examinations end, 5.30 P.M.
May 28	Mon.	University Commencement.

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*.

George Leonard Baker, Jr., B.A., M.B.A., *Palo Alto, California*.

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*.

Gerhard Casper, LL.M., PH.D., LL.D., *Atherton, California*.

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

Charles Daniel Ellis, B.A., M.B.A., PH.D., *New Haven, Connecticut*.

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

Maya Ying Lin, B.A., M.ARCH., D.F.A., *New York, New York (June 2008)*.

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 Daniel Parker, Jr., B.A., LL.B., *Stamford, Connecticut*.

Theodore Ping Shen, B.A., M.B.A., *Brooklyn Heights, New York (June 2007)*.

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

Fareed Zakaria, B.A., PH.D., *New York, New York*.

The Officers of Yale University

President

Richard Charles Levin, B.A., B.LITT., PH.D.

Provost

Andrew David Hamilton, B.SC., PH.D., F.R.S.

Vice President and Secretary

Linda Koch Lorimer, B.A., J.D.

Vice President and General Counsel

Dorothy Kathryn Robinson, B.A., J.D.

Vice President for New Haven and State Affairs and Campus Development

Bruce Donald Alexander, B.A., J.D.

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.*

Arthur W. Galston, PH.D., *Eaton Professor Emeritus of Botany in Molecular, Cellular, and Developmental Biology, Professor Emeritus of Forestry, and Lecturer in Political Science.*

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

William Edward Reifsnyder, M.F., PH.D., *Professor Emeritus of Forest Meteorology and Professor Emeritus of Public Health (Biometeorology).*

Charles Lee Remington, M.S., PH.D., *Professor Emeritus of Biology and Professor Emeritus of Forest Entomology 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.*

Board of Permanent Officers

Richard Charles Levin, B.LITT., PH.D., *President of the University.*

Andrew Hamilton, PH.D., F.R.S., *Provost of the University.*

James Gustave Speth, M.LITT., J.D., *Dean and Sarah Shallenberger Brown Professor in the Practice of Environmental Policy.*

Mark S. Ashton, M.F., PH.D., *Professor of Silviculture and Forest Ecology and Director of School Forests.*

Gaboury Benoit, M.S., PH.D., *Professor of Environmental Chemistry; Professor of Environmental Engineering; Co-Director, Hixon Center for Urban Ecology; and Director, Center for Coastal and Watershed Systems.*

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 Institution for Social and Policy Studies; and Director, Urban Resources Initiative.*

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, Yale World Fellows Program.*

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 and Co-Director, Hixon Center for Urban Ecology.*

Xuhui Lee, M.SC., PH.D., *Professor of Forest Meteorology and Micrometeorology and Director of Doctoral Studies.*

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., *Professor of Population and Community Ecology; Associate Dean for Academic Affairs; Director, Center for Biodiversity Conservation and Science; 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 Director of Undergraduate Studies, Environmental Studies Program, Yale College.*

Ladder Faculty

Robert Bailis, M.S., PH.D., *Assistant Professor of Environmental Social Science (Spring 2007).*

* Michelle L. Bell, M.S.E., PH.D., *Assistant Professor of Environmental Health.*

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

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

Erin T. Mansur, PH.D., *Assistant Professor of Environmental Economics and Assistant Professor of Economics in the School of Management.*

Sheila Olmstead, M.P.AFF., PH.D., *Assistant Professor of Environmental Economics.*

Peter A. Raymond, PH.D., *Assistant Professor of Ecosystem Ecology.*

Non-Ladder Faculty

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

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

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

* On leave of absence, fall 2006.

Ann E. Camp, M.F.S., PH.D., *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.*

Timothy W. 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, and Program Director, Tropical Resources Institute.*

Paul Alexander Draghi, M.A., M.A., PH.D., *Director of Information and Library Systems and Lecturer in Forest History.*

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; Co-Director, Yale-UNDP Collaborative Program on the Urban Environment; and Director, Research Program on Private Investment and the Environment.*

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

Lloyd Irland, PH.D., *Lecturer and Senior Research Scientist.*

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.*

Robert Repetto, PH.D., *Professor in the Practice of Economics and Sustainable Development.*

Jonathan D. Reuning-Scherer, PH.D., *Lecturer in Statistics.*

Thomas G. Siccama, PH.D., *Senior Lecturer.*

Courtesy Joint Appointments

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.*

Nathaniel Keohane, PH.D., *Assistant Professor of Economics, School of Management.*

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.*
- Ronald B. Smith, PH.D., *Professor of Geology and Geophysics and Mechanical Engineering; and Director, Yale Center for Earth Observation.*
- Stephen C. Stearns, M.S., PH.D., *Edward P. Bass Professor of Ecology and Evolutionary Biology.*
- 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; Professor in the Field of International Economics and International Relations; and Director, Yale Center for the Study of Globalization.*

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

- Diana Balmori, PH.D., *Lecturer in Landscape and Urban History.*
- Hooper Brooks, M.L.A., *Lecturer.*
- 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.*
- Pablo Martinez de Anguita d'Huart, PH.D., *Visiting Professor.*
- William Ellis, PH.D., *Resident Fellow in Industrial Environmental Management.*
- James Fickle, PH.D., *Visiting Professor.*
- Ramachandra Guha, PH.D., *Professor (Adjunct) and Leopold Fellow.*
- Andrew J. Henderson, PH.D., *Associate Professor (Adjunct).*
- Richard Jones, PH.D., *Senior Lecturer and Senior Research Scholar.*
- Lawrence Kelly, PH.D., *Assistant Professor (Adjunct).*
- Roy Lee, PH.D., *Professor (Adjunct).*
- Lye Lin Heng, 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., *Assistant Professor (Adjunct).*
- John R. Nolon, J.D., *Visiting Professor.*
- Michael Northrop, M.P.A., *Lecturer in Environmental Advocacy.*
- Josef Pacyna, PH.D., *Visiting Professor.*

Christine Padoch, PH.D., *Associate Professor (Adjunct)*.
 Charles M. Peters, M.F.S., PH.D., *Associate Professor (Adjunct) of Tropical Ecology*.
 Jerome Ringo, *McCluskey Fellow and Associate Research Scholar*.
 Nicholas Robinson, PH.D., *Professor (Adjunct)*.
 Dennis W. Stevenson, PH.D., *Professor (Adjunct) of Tropical Studies*.
 Fred Strebeigh, B.A., *Senior Lecturer in Environmental Writing*.
 Charles Dana Tomlin, PH.D., *Visiting Professor*.
 Mary Evelyn Tucker, PH.D., *Visiting Professor*.
 William Vance, PH.D., *Lecturer*.

Research Appointments

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*.
 John Ehrenfeld, SC.D., *Senior Research Scholar*.
 Michael Ferrucci, M.F., *Research Affiliate*.
 Durland Fish, PH.D., *Senior Research Scientist*.
 John Forgach, B.A., *Research Affiliate*.
 Lauri K. Freidenberg, PH.D., *Associate Research Scholar*.
 Eva Garen, PH.D., *Research Affiliate*.
 A.L. Hammett III, PH.D., *Research Affiliate*.
 Tracy Langkilde, PH.D., *Postdoctoral Fellow*.
 Laly Lichtenfeld, PH.D., *Research Affiliate*.
 Lu Zhi, PH.D., *Research Affiliate*.
 Daniel Muller, PH.D., *Associate Research Scientist*.
 Derek Murrow, M.E.M., *Research Affiliate*.
 Neung-Hwan Oh, PH.D., *Associate Research Scientist*.
 Michael A. Rechlin, PH.D., *Research Affiliate*.
 V. Alaric Sample, PH.D., *Research Affiliate*.
 R. Neil Sampson, M.P.A., *Research Affiliate*.
 Oliver Schabenberger, PH.D., *Research Affiliate*.
 Shangping Xu, PH.D., *Postgraduate Associate*.
 Yajie Song, PH.D., *Research Scholar*.
 Anitra Thorhaug, PH.D., *Research Affiliate*.
 Talbot Trotter III, *Associate Research Scientist*.
 Mark Twery, PH.D., *Research Affiliate*.
 Harry T. Valentine, PH.D., *Research Affiliate*.
 Seth Wilson, PH.D., *Research Affiliate*.
 Md. Nuruz Zaman, *Research Affiliate*.

Center and Program and Research Staff

Susan Rae Bolden, M.S., *Research Assistant.*

Jing Cao, M.A., *Data Coordinator/Statistician, Center for Industrial Ecology.*

Beverly Chevalier, B.A., *Administrative Associate, International Society for Industrial Ecology.*

Gary Dunning, M.F., *Executive Director, The Forests Dialogue.*

Melissa Goodall, M.S., *Associate Director, Center for Environmental Law and Policy.*

Edward Gordon, M.S., PH.D., *Journal Editor, Journal of Industrial Ecology.*

David Hobson, M.F., *Manager, School Forests.*

Jonas Karosas, *Laboratory Assistant.*

Christine Kim, *Research Associate, Center for Environmental Law and Policy.*

Martin Mador, M.E.M., *Research Associate.*

Jennifer McFadden, *Coodinator, Industrial Environmental Management.*

Kari Mull, B.S., *Research Assistant.*

Colleen Murphy-Dunning, M.S., *Center Director, Hixon Center for Urban Ecology, and Program Director, Urban Resources Initiative.*

Cheryl Myrup, M.L.S., *Assistant Editor, Journal of Industrial Ecology.*

P. Christopher Ozyck, B.S., *Greenspace Coordinator, Urban Resources Initiative.*

Justin Pegnataro, B.S., *Environmental Education Coordinator, Urban Resources Initiative.*

Barbara Reck, M.S.ENG., *Research Associate, Center for Industrial Ecology.*

Barbara Ruth, M.PHIL., *Coordinator, Global Institute for Sustainable Forestry.*

Martha McCormick Smith, M.E.M., *Program Director, Center for Coastal and Watershed Systems.*

Mary Tyrrell, M.B.A., M.F.S., *Executive Director, Global Institute of Sustainable Forestry, and Program Director, Program on Private Forests.*

Paul-Bendiks Walberg, M.B.A., *Deputy Director, Center for Biodiversity, Conservation, and Science.*

Administrative Staff

Daniel Abbasi, M.B.A., *Associate Dean for Public Affairs and Strategic Initiatives.*

Mariann Adams, *Administrative Assistant, Career Development.*

Mary Andrew, *Senior Administrative Assistant, Development.*

Elisabeth Barsa, B.A., *Senior Administrative Assistant, Doctoral Program.*

Pamela Brantley, *Administrative Assistant, Faculty Support.*

J. Alan Brewster, M.P.A., *Deputy Dean and Research Scholar.*

Deborah Broadwater, M.B.A., *Assistant Director of Career Development, Career Services.*

Jane Coppock, M.E.M., PH.D., *Assistant Dean and Editor, F&ES Publication Series.*

Irene Courtmanche, *Senior Administrative Assistant, Alumni Affairs and Public Affairs and Strategic Initiatives.*

Andrew Daly, *Coordinator, Development.*

Joanne E. DeBernardo, B.S., *Registrar and Director of Student Affairs.*

Timothy De Cerbo, *Administrative Assistant, Faculty Support.*

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Nancy DiLella, A.S., *Office Assistant, Facilities*.
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Christopher Galvin, M.A., *Coordinator, Public Affairs and Strategic Initiatives*.
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Eugénie I. Gentry, B.A., *Director of Development*.
Florence Grandelli, *Director of Human Resources and Payroll*.
Teena Marie Griggs, *Office Assistant, Business Office*.
Robert Hartmann, *Computer Support, Information Systems*.
Linda Jacobs, *Senior Administrative Assistant, Financial Aid*.
Angela Kuhne, M.A., *Assistant Director of Admissions*.
Jennith Liner, *Administrative Assistant, Faculty Support*.
Carmela Lubenow, *Financial Assistant, Business Office*.
Nancy Marino, *Office Assistant, Facilities*.
Catherine J. Marshall, M.P.A., *Senior Administrative Assistant 2, Dean's Office*.
Emly McDiarmid, M.F.S., *Director of Admissions*.
Eleanor Migliore, M.S., M.L.S., *Senior Administrative Assistant 2, Faculty Support*.
Kelly Molloy, *Senior Administrative Assistant, Information Systems*.
Pilar M. Montalvo, M.A., *Assistant Dean*.
William Moroz, *Computer and Information Systems Support Specialist*.
Roberta Mouheb, M.A., *Administrative Assistant, Faculty Support*.
Denise Mrazik, A.S., *Administrative Assistant, Business Office*.
Stanton C. Otis, Jr., M.ED., *Director of Career Development*.
Julio Patron, *Maintenance Assistant, Facilities*.
Sandra Phillips, *Financial Assistant III, Business Office*.
Shiva Prasad, B.S., *Computer and Information Systems Support Specialist*.
Sue Prasad, M.A., *Coordinator and ESL Tutor, Admissions/Registrar's Office*.
Ann Prokop, M.A., *Administrative Assistant, Faculty Support*.
Sally Richmond, M.A., *Senior Administrative Assistant, Dean's Office*.
Quetcy Rivas Maldonado, *Senior Administrative Assistant 2, Admissions*.
Constance L. Royster, J.D., *Associate Director of Development*.
Elnora Russell-Bell, M.B.A., *Assistant Administrator, Business Office*.
Dominic Scalia, *Facilities Manager*.
Kathleen Schomaker, M.E.S., M.PHIL., *Director of Alumni Affairs*.
Paul Smith, M.F.A., *Web Coordinator*.
Rosanne Stoddard, *Senior Administrative Assistant, Registrar's Office*.
Thomas Tuscano, M.B.A., *Director of Finance and Administration*.
Charles R. Waskiewicz, M.P.I.A., *Assistant Business Manager*.
Michèle Whitney, B.A., *Coordinator, Development Office*.
Bethany Zemba, M.P.A., *Director of Financial Aid*.

Henry S. Graves Memorial Library

Carla Heister, M.A., M.S., *Librarian.*

Adiba Nabizada, *Library Services Assistant.*

George Shao, *Library Services Assistant.*

A Message to Prospective Students from Dean James Gustave Speth

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 at our School today is nothing less than the building of a new academic field, an interdiscipline called "environment." It is the rigorous scientific study of the interactions between human societies and the natural world of the biosphere. 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 the knowledge of environment to infuse the traditional professions — business, law, science and engineering, medicine and so on — 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 solving 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 approaches different from those previously adopted. Progress now requires 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 (www.yale.edu/environment) to get an inside view of the dynamics and energy that will make F&ES an ideal place to continue your education.

Mission of the School of Forestry & Environmental Studies

The Yale School of Forestry & Environmental Studies prepares new leadership 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 both resources and ourselves.

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

We seek to integrate concern for Earth's ecosystems with equal concern for 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 effects 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 with 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 its 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 environmental 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.



Shimon C. Anisfeld



Mark S. Ashton

Faculty Profiles

Shimon C. Anisfeld, 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 like 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 stream and 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 resource management, coastal ecology, and environmental organic chemistry.

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



Robert Bailis



Michelle L. Bell

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 tropical forests in Sri Lanka and Panama, temperate forests in India and New England, and boreal forests in Saskatchewan, Canada.

Robert Bailis, UCAR Postdoctoral Fellow and Visiting Lecturer, fall 2006; Assistant Professor beginning spring 2007. B.S., Pennsylvania State University; M.S., Northwestern University; Ph.D., University of California at Berkeley. Mr. 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 current research project explores the social ecology of Kenya's charcoal commodity chain and works with Kenyan researchers and policy makers to develop a more sustainable energy future for the country. He recently teamed with colleagues at Berkeley and Harvard in a related study to develop quantitative models of public health effects and environmental impacts of residential energy use across sub-Saharan Africa. In addition, he is embarking on a new research effort with colleagues from Mexico's National University (UNAM) to explore vulnerability and adaptation to climate change among forest-dependent communities in Mexico's temperate and dry forest zones.

Michelle L. Bell, Assistant 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



Gaboury Benoit



Graeme P. Berlyn

several disciplines, including environmental engineering and epidemiology. Her research interests are the statistical analysis of the health impacts of air pollution episodes, meteorological and air quality modeling, 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. Recent projects include analysis of the relationship between ambient ozone concentrations and mortality in ninety-five large U.S. centers, the health benefits of reduced air pollution levels in Latin American cities, and spatial and temporal compliance with regulatory standards. She teaches courses on environmental health and air pollution.

Gaboury Benoit, Professor of Environmental Chemistry, Professor of Environmental Engineering, Co-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. Four current research emphases are the use of modern clean techniques to investigate trace metals; micronutrient limitation by Cu and Co; spatial and temporal variability of nonpoint source pollution; and human-environment interactions in urban areas. He is a fellow of Trumbull College.

Graeme P. Berlyn, E.H. Harriman Professor of Forest Management, Professor of Anatomy and Physiology of Trees, and Editor, *Journal of Sustainable Forestry*. B.S., Ph.D., Iowa State University. Professor Berlyn's interests are the morphology and physiology of trees



Ellen Brennan-Galvin

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, response of tropical pioneer species to gaps in tropical forests, and the role of antioxidants, stress vitamins, and mycorrhizas in organic biostimulants.

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



William R. Burch, Jr.

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 and Professor at the Institution for Social and Policy Studies. 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 principal investigator of a six-year monitoring and evaluation project on the \$26 million restoration of Philadelphia's Fairmount Park system.

He conducted some of the original work on community/social forestry systems, which continues with work in Nepal, Thailand, China, and inner cities of the United States. Community forestry strategies for urban neighborhoods have been applied since 1989. Research on such efforts began in 1988 when Professor Burch became co-principal investigator of an EPA/NSF-funded water and watersheds project and an NSF-funded Long Term Ecological Study (LTER) in the Baltimore/Chesapeake region. There are twenty-two such projects in the United States and this project is one of the two that examine urban areas as ecosystems. In 2000, he was awarded a John Eadie fellowship by the Scottish Forest Trust to work with colleagues and institutions in the United Kingdom on community forestry/urban ecology issues.

His work in institutional development has included technical training and higher education curriculum development in South and Southeast Asia. Another area of research



Ann Elizabeth Camp



Carol Carpenter

and application has been in developing a unified ecosystem management approach that fully includes human behavioral variables. This work has used a watershed unit and a rural-urban gradient approach and has been conducted with an interdisciplinary team of collaborators. Initial work has been done in three watersheds in Baltimore, Maryland, since 1989 and is now carried forward by the LTER research.

Ann Elizabeth Camp, Lecturer and Associate 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 scientist 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



Benjamin Cashore

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 for sustainable development of the economic and political invisibility of women's activities in agrarian households. She is currently working on *Environmental Anthropology: An Historical Reader* (co-edited with Michael Dove, for Blackwell). She is a fellow of Calhoun College.

Benjamin Cashore, Associate Professor of Environmental Policy and Governance and Political Science, and Director, Program on Forest Certification. 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 adviser to the leader of the Canadian New Democratic Party (1990–1993). His new book (with G. Auld and D. Newsom), *Governing Through Markets: Forest Certification and the Emergence of Non-state Authority* (Yale University Press, 2004), won the 2005 International Studies Association's Harold and Margaret Sprout prize for the best book in international environmental policy and politics. The book identifies the global phenomenon of "non-state market driven" environmental governance, and compares its emergence in European and North American forest sectors. 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 *Governance*, *Policy Sciences*, the *Canadian*



Marian R. Chertow



Timothy W. Clark

Journal of Political Science, *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 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, Assistant 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 concern environmental management and policy as they relate to the private sector. Primary research interests are (1) the application of innovation theory to the development of environmental and energy technology and (2) the new field of industrial ecology, particularly the study of industrial symbiosis: geographically based exchanges of wastes, materials, energy, and water within networks of businesses. 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. She is the editor of *Thinking Ecologically: The Next Generation of Environmental Policy* with Daniel Esty (Yale University Press), to which she also contributed work on the relevance of industrial ecology to public policy. Prior to Yale, Professor Chertow spent ten years in environmental business and state and local government. She also serves on the faculty of the National University of Singapore, has led training for several groups of Chinese executives, and is a fellow of Jonathan Edwards College.

Timothy W. Clark, Professor (Adjunct) of Wildlife Ecology and Policy. B.S., Northeastern Oklahoma State College; M.S., University of Wyoming; Ph.D., University of Wisconsin-Madison. Professor Clark's primary goal in his research and teaching is to improve conservation of species and ecosystems at professional, scientific, organizational, and policy



Lisa M. Curran

levels. He has conducted field ecological and behavioral research on thirty-five mammals and other species. He is interested in natural resource policy and management and has conducted research and applied projects, for example, in the Greater Yellowstone Ecosystem to develop ecosystem management policy and in Australia to evaluate endangered species policy (most recently for koalas). He is currently researching conservation policy in Central America. His work involves building case studies, evaluating policies and programs, helping organizations to incorporate reliable science into management, helping students develop proficiency in the policy sciences method of research and problem solving, and working with a wide range of groups to improve conservation problem solving through workshops and other analytic exercises. He has worked in North America, Australia, Asia, and Central America. Recent books include *Averting Extinction: Reconstructing Endangered Species Recovery* (1997), *Carnivores in Ecosystems: The Yellowstone Experience* (1999, co-edited), and *Foundations of Natural Resources Policy and Management* (2000, co-edited). He is a fellow of Pierson College and has an appointment at the Institution for Social and Policy Studies.

Lisa M. Curran, Professor of Tropical Resources and Director of the Tropical Resources Institute. B.A., Harvard University; M.A., Ph.D., Princeton University. Professor Curran is interested in the mechanisms that underlie community structure and dynamics of tropical forests and how ecological interactions are altered by human activities. Her work aims to enhance equitable and responsible management of tropical forests by integrating knowledge of ecological processes in natural systems with the socio-political and economic realities as viewed by a diversity of users. Field research primarily in Indonesia has focused on long-term studies of the reproductive ecology, demography, and harvest of mast-fruiting *Dipterocarpaceae*, the most economically important family of tropical timber. Current research interests include: spatio-temporal scale of natural and anthropogenic processes and disturbance; plant-animal interactions, especially seed predation, herbivory, and seed dispersal; canopy tree demography, phenology, and regeneration; ecological role of ectomycorrhizae in ecosystems; and effects of government policies and



Michael R. Dove

logging practices on ecosystem management and biodiversity in Asia. Professor Curran spent more than twenty-five years in the South and Southeast Asian tropics conducting scientific research, training, and policy studies. She held a diversity of positions for UNESCO-MAB, several foundations, and nongovernmental conservation and rural development organizations, and has provided consultancies on multidisciplinary teams for the U.S. Agency for International Development, The World Bank, and Asian Development Bank. From 1996 to 2001 she was an assistant professor of ecological sustainability in the Department of Biology, School of Natural Resources & Environment and International Institute at the University of Michigan, where she received the Henry Russell Award, the university's highest honor. She has held a Mercer Postdoctoral Fellowship at Harvard, a Visiting Research Fellowship at the East-West Center's Ecosystem & Governance Program, Aldo Leopold Leadership Fellowship, and Fulbright Fellowship (Brazil). She is currently an External Faculty member of the Santa Fe Institute, Marie Tharp Fellow at the Earth Institute of Columbia University, 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 research projects in both Asian and South American tropics include the effects of land use change, climate, drought, and fire on carbon dynamics and biodiversity and the impact of multisectoral governmental policies and industrial practices (primarily logging and agribusiness) on ecosystem management and rural livelihoods in tropical frontiers.

Michael R. Dove, Margaret K. Musser Professor of Social Ecology, Professor of Anthropology, and Coordinator of the F&ES/Anthropology joint doctoral degree program. 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. He spent two years in a tribal longhouse in Borneo studying swidden agriculture, six years as a research adviser in Java studying the formation of government resource policy, and four years in Pakistan advising its Forest Service on social



Paul Alexander Draghi

forestry policies. His most recent book is *Conserving Nature in Culture: Case Studies from Southeast Asia* (co-edited with P. Sajise and A. Doolittle), and he is currently completing a reader on the history of environmental anthropology with Carol Carpenter. One of his current research projects focuses on the cultural and political aspects of natural hazards and disasters in Indonesia. Other research and teaching interests include biodiversity and society; human use of tropical forests and grasslands; the global circulation of environmental concepts; political dimensions of resource degradation; indigenous environmental knowledge; contemporary and historical environmental relations in South and Southeast Asia; the study of developmental and environmental institutions, discourses, and movements; and the sociology of resource-related sciences.

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



Gordon T. Geballe

Daniel C. Esty, Hillhouse Professor of Environmental Law and Policy; Director of the Yale Center for Environmental Law and Policy; and Director of the Yale World Fellows Program. B.A., Harvard University; M.A., University of Oxford; J.D., Yale University. Professor Esty's research interests cover a wide range of issues including new approaches to environmental regulation (such as market mechanisms and information strategies), environmental performance measurement and data-driven environmental decision making, trade and environment linkages, global environmental governance, environmental attitudes and political behavior, and corporate environmental strategy. He is the author or editor of a number of books, including *Green to Gold: How Smart Companies Use Environmental Strategy to Innovate, Create Value, and Build Competitive Advantage*; *Pilot 2006 Environmental Performance Index*; *Global Environmental Governance: Options and Opportunities*; *Greening the Americas: NAFTA's Lessons for Hemispheric Trade*; *Environmental Performance Measurement: The Global Report 2001–2002*; *Greening the GATT: Trade, Environment, and the Future*; *Thinking Ecologically: The Next Generation of Environmental Policy*; and *Regulatory Competition and Economic Integration*. He is a fellow of Jonathan Edwards College.

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



Bradford S. Gentry



Thomas E. Graedel

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, Senior Lecturer in Sustainable Investments and Research Scholar, Director of the Research Program on Private Investment and the Environment, and Co-Director of the Yale–UNDP Collaborative Program on the Urban Environment. B.A., Swarthmore College; J.D., Harvard University. Mr. Gentry's work explores the opportunities for using private investment to improve environmental performance. He works both across and within particular sectors/problems. His cross-sectoral work focuses on the steps policy makers can take to help develop opportunities for sustainable investments, including market frameworks, information systems, and shared investments/partnerships. His sectoral work is concentrated in three major areas — increasing private investment in the delivery of urban environmental services (particularly drinking water and sanitation), emerging markets for ecosystem services, and cleaner energy. Projects in all 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 book *Private Capital Flows and the Environment: Lessons from Latin America*.

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



Timothy G. Gregoire

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*, cowritten with B. R. Allenby of AT&T, was the first book in the field and is now in its second edition. 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, 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* and co-editor of *Modeling Longitudinal and Spatially Correlated Data*. Recent pursuits include investigations into the nature of statistical inference, changes to the active layer above permafrost on the Alaska tundra, and sampling with segmented line transects. 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; and the recipient of the Forest Science Award granted by the Society of American Foresters. He is a section editor of the multi-volume *Encyclopedia of Environmetrics*, an associate editor of *Silva Fennica*, and the deputy editor-in-chief for *Environmental and Ecological Statistics*, and he chairs 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.



Arnulf Grubler



Lloyd Irland

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), 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 Technology 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 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 most recent book is *The Northeast's Changing Forests*, distributed by Harvard University Press.



Stephen R. Kellert



Xubui Lee



Reid J. Lifset

Stephen R. Kellert, Tweedy/Ordway Professor of Social Ecology and Co-Director of the Hixon Center for Urban 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.

Xubui Lee, Professor of Meteorology and Director of Doctoral Studies. 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, 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



Erin T. Mansur



Robert Mendelsohn

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 quarterly headquartered at and owned by Yale University and published by MIT Press. 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.

Erin T. Mansur, Assistant Professor of Environmental Economics and Assistant Professor of Economics in the School of Management. B.A., Colby College; Ph.D., University of California, Berkeley. Professor Mansur's research and teaching focus on energy and environmental economics, specifically in the areas of electricity restructuring, incentive-based environmental regulation, and environmental implications of strategic behavior. His paper on *Environmental Regulation in Oligopoly Markets: A Study of Electricity Restructuring* examines the environmental effects of firms setting prices in restructured electricity markets. He has also written on the costs and benefits of the Clean Air Act Amendments, the environmental implications of retail deregulation in electricity, the responsiveness of electricity consumers to prices, the importance of contracts in restructured electricity markets, the impact of climate change on energy demand, and the effectiveness of public policies in reducing homelessness.

Robert Mendelsohn, Edwin Weyerhaeuser Davis Professor of Forest Policy, Professor of Economics, and Professor, School of Management. B.A., Harvard University; Ph.D., Yale



Florencia Montagnini

University. Professor Mendelsohn has concentrated his research on valuing the environment. His dissertation included an integrated assessment model of air pollution that could measure the damages of emissions. This work has been extended in recent years to greenhouse gases, where he has been trying to measure the impacts of climate change. Recently, he has returned to studying air pollution in the hope of measuring the marginal damages of emissions across the country. He has also worked on valuing natural ecosystems, from valuing nontimber forest products and ecotourism in tropical rainforests, to coral reefs in the Caribbean and Australia, to measuring recreation in the Pacific Northwest and Alaska. Professor Mendelsohn is a fellow of Ezra Stiles College.

Florencia Montagnini, Professor in the Practice of Tropical Forestry and Director of the Program in Tropical Forestry of the Global Institute of Sustainable Forestry. B.S., National University of Rosario, Argentina; M.S., Venezuelan Institute for Scientific Research (IVIC); Ph.D., University of Georgia. Professor Montagnini's research focuses on variables controlling the sustainability of managed ecosystems (e.g., primary and secondary forests, plantations, and agroforestry systems) in the tropics, with special emphasis on Latin America; the identification and quantification of ecological services provided by forests (biodiversity conservation, carbon fixing and storage); 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); and tropical plantation silviculture. In her research, she collaborates with institutions such as CATIE (Tropical Agriculture Research and Higher Education Center, Costa Rica), as well as with universities in Costa Rica, Nicaragua, Panama, Argentina, and Brazil. Professor



Chadwick Dearing Oliver



Sheila Olmstead

Montagnini has written more than eighty scientific articles for international journals, and four books on agroforestry systems and tropical forest ecology and management. She is a fellow of Saybrook College. She also holds honorary professorships at several universities in Latin America.

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 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, India, China, Ecuador, Germany, and France.

Sheila Olmstead, Assistant Professor of Environmental Economics. B.A., University of Virginia; M.P.Aff., University of Texas at Austin; Ph.D., Harvard University. Professor Olmstead's general 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 current area of primary research is the economics of water supply and demand, with a focus on urban settings. In particular, she is interested in measuring the effectiveness of various policy instruments, such as increasing block pricing and non-



Peter A. Raymond



Robert Repetto



James E. Saiers

price demand management programs, in dealing with urban water scarcity. Her long-term research interests include the determinants of access to clean drinking water among low-income populations in the United States and developing countries; efficiency losses due to economic underpricing of public water supply; and current and potential applications of water marketing and water quality trading.

Peter A. Raymond, Assistant 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 the carbon cycle within the coastal zone. His research utilizes the natural isotopes of carbon (^{13}C and ^{14}C) to determine major sources, sinks, and ages of various carbon pools in the natural environment. In order to conduct this research, Professor Raymond's lab has a ^{14}C clean lab component where he can cryogenically purify natural carbon samples for AMS analysis. Current research includes determining how carbon pools are transformed in estuaries, the physics of air-sea CO_2 exchange, and determining the age and composition of carbon being transported from land to the ocean.

Robert Repetto, Professor in the Practice of Economics and Sustainable Development. B.A., Harvard University; M.Sc., London School of Economics; Ph.D., Harvard University. Professor Repetto studies the economics of environmental protection, resource use, and sustainable development. His recent research has explored issues in the appropriate economic and financial accounting for environmental impacts and the role of information disclosure as a means of integrating environmental issues into market behavior. He has also written extensively on policy options with which to achieve simultaneous environmental and economic improvements. A forthcoming book seeks to understand the complex dynamics of environmental policy equilibrium and change.

James E. Saiers, Associate Professor of Hydrology. B.S., Indiana University of Pennsylvania; M.S., Ph.D., University of Virginia. Professor Saiers studies the circulation of water



Oswald J. Schmitz



Thomas G. Siccama

and the movement of waterborne chemicals in surface and subsurface environments. One element of his research centers on quantifying the effects that interactions between hydrological and geochemical processes have on the migration of contaminants in groundwater. Another focus is on the dynamics of surface water and groundwater flow in wetlands and the response of fluid flow characteristics to changes in climate and water management practices. His work couples field observations and laboratory-scale experimentation with mathematical modeling.

Oswald J. Schmitz, Professor of Population and Community Ecology, Associate Dean for Academic Affairs, Director of the Center for Biodiversity Conservation and Science, and Professor of Ecology and Evolutionary Biology. B.Sc., M.Sc., University of Guelph, Ontario; Ph.D., University of Michigan. Professor Schmitz's research examines the dynamics and structure of terrestrial food webs. His specific focus is on plant-herbivore interactions and how they are shaped by carnivores and soil-nutrient levels, both at the level of herbivore foraging ecology and plant-herbivore population dynamics. He is also examining how natural systems are resistant and resilient to natural and human-induced disturbances. His approach involves developing mathematical theories of species interactions in food webs and testing these theories through field experiments. The work deals with a variety of ecosystems and herbivore species, ranging from moose deer and snowshoe hare in northern Canadian forests to insects in New England old-field ecosystems.

Thomas G. Siccama, Professor in the Practice of Forest Ecology and Director of Field Studies. 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



David K. Skelly



James Gustave Speth

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, 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, Dean and Sarah 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.



Fred Strebeigh

Throughout his career, Dean Speth has provided leadership and entrepreneurial initiatives to many task forces and committees whose roles have been to combat environmental degradation, including the President's Task Force on Global Resources and Environment; the Western Hemisphere Dialogue on Environment and Development; and the National Commission on the Environment. 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 *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.

Fred Strebeigh, Senior Lecturer in Environmental Writing and 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.



John P. Wargo

John P. Wargo, Professor of Risk Analysis, Environmental Policy, and Political Science; Director of the Environment and Health Initiative; and Director of Undergraduate Studies, Environmental Studies Program, Yale College. B.A., University of Pennsylvania; M.L.A., University of Massachusetts, Amherst; Ph.D., Yale University. Professor Wargo's most recent work has focused on children's exposure to air pollution, especially diesel emissions. He has conducted extensive research on childhood vulnerability to complex mixtures of toxic substances, particularly pesticides. His research explores spatial, temporal, and demographic distribution of environmental health risks, providing a basis for evaluating past environmental and natural resource management policies, and for suggesting legal reform. *Our Children's Toxic Legacy: How Science and Law Fail to Protect Us from Pesticides*, a book published by Professor Wargo in 1996, presents a history of law governing pesticides and a history of scientific evidence of pesticide risks during the second half of the twentieth century. The work suggests fundamental reforms of science and law necessary to identify and contain health risks. It won the American Association of Publishers award as the Best Scholarly Professional Book in Government and Political Science in 1996. Professor Wargo has also conducted extensive research on the ecological basis of park and protected area management, concentrating on the Adirondack Park in New York, barrier islands within U.S. National Seashores, and UNESCO Biosphere Reserves. He is affiliated with the Yale–New Haven Teachers Institute, and works with urban primary and secondary school teachers in developing environmental curriculum units. He is a fellow of Branford College.



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 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 the School 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 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 pos-

sible 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. 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, Conservation International); (3) industry 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; (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 page 143) 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 50) 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 scientific research that contributes toward basic and applied knowledge. 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, Law School, School of Management, the School of Medicine’s Department of Epidemiology and Public Health, the Graduate School’s International Relations program, and the International and Development Economics program of the Graduate School’s Department of Economics. 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 residency at Yale and a minimum number of credit hours at the School of Forestry & Environmental Studies, dependent upon the degree program, are required. These courses must meet the curriculum requirements for one of the School’s degree programs. A minimum of one and one-half years (3 terms) is required at the School of Forestry & Environmental Studies.*

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. Law School — Juris Doctor, four years.
2. School of Medicine (Department of Epidemiology and Public Health) — Master of Public Health, three years.
3. School of Management — Master of Business Administration, three years.
4. Department of Economics, International Development and Economics program — Master of Arts, two and one-half to three years.
5. International Relations — Master of Arts, two and one-half to three years.
6. Divinity School — Master of Arts in Religion, three years.
7. School of Architecture — Master of Architecture: M.Arch. I, four years; M.Arch. II, three years.

For students interested in a joint environment/law degree, the School has joint-degree programs with Vermont Law School and the Pace University School of Law, in addition to the existing joint-degree program with Yale Law School. For questions about this and other joint-degree programs, please consult the Office of Admissions at F&ES.

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*. 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; environmental biophysics and meteorology; environmental chemistry; environmental ethics; environmental governance; environmental health risk assessment; environmental history; environmental law and politics; environmental and resource policy; forest ecology; hydrology; industrial ecology; industrial environmental management; plant physiology and anatomy; pollution management; population ecology; resource economics; energy and the environment, silviculture, social ecology; stand development, tropical ecology, and conservation; urban planning; water resource management; environmental management and social ecology in developing countries.

Requirements for the Doctoral Degree

All courses listed in this bulletin are open to students working for the doctoral degree. Other 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 first 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 of this program is threefold: (1) it combines the interdisciplinary character and possibilities of F&ES, especially in terms of bridging the social and natural sciences, with the disciplinary identity and strengths of the Anthropology department; (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 emphasis within F&ES on linking theory with policy and practice with the Anthropology department's strengths in theory. The combined doctoral degree offers its graduates great professional flexibility. They can apply for teaching positions as anthropologists and/or environmental scientists, and they have the cre-

dentials to apply for policy-oriented positions with international institutions as well as academic positions in teaching and research. For further information, contact the director of doctoral studies or the coordinator of the combined degree program.

NEW YORK BOTANICAL GARDEN

The School of Forestry & Environmental Studies has entered into an agreement with the New York Botanical Garden to offer a joint doctoral degree. For more information, please contact the director of doctoral studies.

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, William R. Burch, Ann E. Camp, Timothy W. Clark, Lisa M. Curran, Gordon T. Geballe, Timothy G. Gregoire, Stephen R. Kellert, Xuhui Lee, Peter A. Raymond, James E. Saiers, Oswald J. Schmitz, Thomas G. Siccama

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; environmental values; agrarian societies; sustainable development; biomass energy; 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, William R. Burch, Carol Carpenter, Benjamin Cashore, Timothy W. Clark, Lisa M. Curran, Amity A. Doolittle, Paul A. Draghi, Gordon T. Geballe, Stephen R. Kellert, Florencia Montagnini, James Gustave Speth, John P. Wargo

Associated Center: Tropical Resources Institute

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

This faculty group embraces a new, more holistic, and more practical concept of forest management. The faculty recognizes that forests worldwide produce multiple products and services from timber supply to water to wildlife habitat. The group 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 forested ecosystems are managed.

In keeping with this approach, students are required to have a thorough understanding of the entire forest ecosystem and how each component relates to the rest of the system. Forestry must adopt adaptive management techniques to test outcomes in the field and improve our understanding over time. Students are trained to create modeling scenarios for better forest management assessments and the development of more refined decision support systems for generating management options and outcomes. They must then learn how society weighs these alternative outcomes, and must examine existing institutions and laws to understand whether they encourage optimal outcomes in forests across the world.

The faculty teach courses and seminars on such topics as biogeochemistry and pollution; the physiology of trees and forests; fire ecology; climate and life; sampling methodology and practice; natural resource economics; private investment and the environment; environmental law and policy; and management plans for protected areas.

Faculty: Mark S. Ashton (Coordinator), Graeme P. Berlyn, William R. Burch, Ann E. Camp, Benjamin Cashore, Timothy W. 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; patterns and processes in terrestrial ecosystems; domestic and global environmental governance; designing the ecocity; climate economics; and the global change agenda.

Faculty: Xuhui Lee (Coordinator), Garry D. Brewer, Ann E. Camp, Benjamin Cashore, Timothy W. Clark, Lisa M. Curran, Paul A. Draghi, William Ellis, Daniel C. Esty, Thomas E. Graedel, Erin T. Mansur, Robert Mendelsohn, Peter A. Raymond, Robert Repetto, Oswald J. Schmitz, James Gustave Speth

ENVIRONMENTAL HEALTH

This area explores the relationships between environmental hazards and human health. 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 hazardous substances in air, water, food, soil, and consumer products.

There are several themes around which students can focus their studies in this area, such as children's 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; 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 Yale Department of Epidemiology and Public Health. Courses and seminars offered include environmental health; foundations of environmental policy and politics; international environmental policy and law; and organic pollutants in the environment.

Faculty: John P. Wargo (Coordinator), Shimon C. Anisfeld, Michelle Bell, Gaboury Benoit, Graeme P. Berlyn, Garry D. Brewer, Florencia Montagnini, Sheila Olmstead, James E. Saiers

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, 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, Garry D. Brewer, Marian R. Chertow, William Ellis, Daniel C. Esty, Gordon T. Geballe, Arnulf Grubler, Reid J. Lifset, Erin T. Mansur, Robert Repetto

Associated Center: Center for Industrial Ecology

POLICY, ECONOMICS, AND LAW

This focal area was founded on the belief that natural resource and environmental policy should be based on cumulative knowledge about society and environmental processes. The faculty in this area teach students that the key to a great deal of environmental policy is the appropriate integration of the insights of many disciplines. There are three overarching themes that 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.

There are a wide range of courses that 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: Daniel C. Esty (Coordinator), Garry D. Brewer, Benjamin Cashore, Marian R. Chertow, Timothy W. Clark, William Ellis, Bradford S. Gentry, Reid J. Lifset, James R. Lyons, Erin T. Mansur, Robert Mendelsohn, Sheila Olmstead, Robert Repetto, James Gustave Speth, John P. Wargo

Associated Center: Yale Center for Environmental Law and Policy

URBAN ECOLOGY AND ENVIRONMENTAL DESIGN

This faculty group works under the premise that the ecological health and integrity of urban ecosystems have 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, there are a wide range of natural science, social science, and policy courses that 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: Stephen R. Kellert (Coordinator), Gaboury Benoit, Ellen Brennan-Galvin, William R. Burch, Mary Cadenasso, Marian R. Chertow, Gordon T. Geballe, Bradford S. Gentry, Thomas E. Graedel

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, William R. Burch, 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

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 academic year 2006–2007. The course numbering system has changed this year; the previous course numbers are indicated, following the course title, in parentheses in the list below.

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.

*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 32001b	Methods of Ecosystem Analysis (519b)	71
F&ES 32002b	Tropical Ecosystem Dynamics and Anthropogenic Change (528b)	71
[F&ES 33003b]	Seminar in the Conservation and Development of Amazonia (556b)	72
[F&ES 30004b]	Reconciling Development and Conservation on the Amazon Frontier: A Tropical Conservation Field Course (557b)	72
F&ES 32005b	Scientific Bases of Sustainable Agriculture (571b)	72
F&ES 32006a	Tropical Forest Ecology: The Basis for Conservation and Management (574a)	73
F&ES 32007a	Ecosystem Pattern and Process (575a)	73
F&ES 30008b	Topics in the Tropics (604b)	73
F&ES 30009a	Biogeography, Biodiversity, and Conservation (621a)	74
F&ES 30010b	Tropical Field Botany (623b)	74
F&ES 30121b	Biological Oceanography	74
F&ES 30022a	Field Ecology	74

WILDLIFE ECOLOGY AND CONSERVATION BIOLOGY

F&ES 32011a	Aquatic Ecology (509a)	74
[F&ES 33012a]	Species and Ecosystem Conservation: An Interdisciplinary Approach (520a)	75
[F&ES 30013b]	Molecular Ecology (526b)	75
F&ES 30114b	Wildlife Conservation (560b)	75
[F&ES 33015a]	Human Dimensions in the Conservation of Biological Diversity (565a)	75
[F&ES 30016a]	Molecular Ecology Seminar (578a)	76
F&ES 30017a	Molecular Systematics Laboratory (587a)	76
F&ES 30018b	Conservation Genetics Seminar (588b)	76
F&ES 32019a	Landscape Ecology (760a)	76
F&ES 30020b	Ecology Seminar (762b)	77

Environmental Education and Communication

[F&ES 43001a]	Issues and Approaches in Environmental Education (582a)	77
F&ES 40002a	Environmental Writing (583a)	77
F&ES 40004b	Archetypes and the Environment (745b)	77
F&ES D0005a	Doctoral Student Seminar (824a)	78
F&ES 40006a	Professional Communications Skills for Non-Native Speakers of English (995a)	78

Forestry

FOREST BIOLOGY

F&ES 52001b	Local Flora (505b)	78
F&ES 50002b	Fire: Science and Policy (524b)	78
F&ES 52003b	Forest Ecosystem Health (551b)	78
F&ES 50104b	Seminar in Ecological Restoration (584b)	79
F&ES 53005b	Agroforestry Systems: Productivity, Environmental Services, and Rural Development (592b)	79
F&ES 52006a	Anatomy of Trees and Forests (600a)	80
[F&ES 50107b]	Research Methods in Anatomy and Physiology of Trees (601b)	80
F&ES 52008b	Physiology of Trees and Forests (610b)	80
F&ES 50009b	Tree Biotechnology Issues (916b)	80

FOREST MANAGEMENT

F&ES 50011b	Managing Resources (602b)	81
F&ES 52012a	Global Resources and the Environment (605a)	81
F&ES 52013b	Principles in Applied Ecology: The Practice of Silviculture (700b)	82
F&ES 50114a	Management Plans for Protected Areas (701a)	82
[F&ES 50115b]	Rapid Assessments in Forest Conservation (702b)	82
F&ES 52016a	Forest Dynamics: Growth and Development of Forest Stands (703a)	82
F&ES 50117a	Analysis of Silvicultural Problems (704a)	82
[F&ES 50118a]	Seminar in Advanced Silviculture (705a)	83
F&ES 50119a,b	Field Trips in Forest Resource Management and Silviculture (708a,b)	83
F&ES 50020a	Invasive Species: Ecology, Policy, and Management (710a)	83
F&ES 50021a	Financial Analysis for Land Management (727a)	83
F&ES 50023a	Forest Management Operations for Professional Foresters (803a)	83

Physical Sciences

ATMOSPHERIC SCIENCES

F&ES 61001a	Marine, Atmospheric, and Surficial Geochemistry (603a)	84
F&ES 60102b	Alpine, Arctic, and Boreal Ecosystems (612b)	84
[F&ES 61003a]	Air Pollution (732a)	84
[F&ES 60004b]	Climate Change Seminar (834b)	84
F&ES 61005b	Climate and Life (868b)	84
F&ES 61006a	A Biological Perspective of Global Change (869a)	85

ENVIRONMENTAL CHEMISTRY

F&ES 60107a,b	Seminar in Applied Environmental Chemistry (502a,b)	85
F&ES 66008a	Organic Pollutants in the Environment (507b)	85

F&ES 60109b	Aquatic Chemistry (544b)	85
F&ES 61110a	Biogeochemistry and Pollution (545a)	86
F&ES 60011a	Air Pollution (Chemical Engineering Department) (596a)	86
F&ES 60012b	Water Quality Control (598b)	86

SOIL SCIENCE

F&ES 62013a	Introduction to Soil Science (530a)	86
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WATER RESOURCES

F&ES 65014b	Coastal Ecosystem Governance (515b)	86
F&ES 60015a	Coastal Vulnerability: Lessons Learned from New Orleans, the Gulf Coast Wetlands, and Hurricane Katrina. Can a Crisis Bring about Change?	87
F&ES 61016a	Water Resource Management (533a)	87
[F&ES 62017a]	Coastal Ecosystems: Natural Processes and Anthropogenic Impacts (536a)	87
[F&ES 61018a]	Environmental Hydrology (540a)	88
[F&ES 60119b]	Hydrologic Modeling (541b)	88
[F&ES 60020b]	Special Topics in Hydrology (542b)	88
F&ES 61021b	Hydrology and Water Resources (543b)	88
[F&ES 60022b]	Managing the Coastal Nutrient Problem: The Case of Long Island Sound (555b)	88
[F&ES 60123b]	Applied Hydrology (558b)	89
F&ES 61024a	River Processes and Restoration (829a)	89

Quantitative and Research Methods

F&ES 77001b	Remote Sensing: Observing the Earth from Space (506b)	89
F&ES 70002a	Research Methods (510a)	89
F&ES 70003a	Social Science Research Methods (513a)	89
F&ES 77004b	Econometrics	90
F&ES D0004a,b	Preparation for Research (529a,b)	90
[F&ES 77105a]	Seminar in Forest Inventory (622a)	90
F&ES 77006a	Sampling Methodology and Practice (711a)	90
F&ES 77107b	Applied Spatial Statistics	90
F&ES 77108b	Statistics for Environmental Sciences (713b)	90
F&ES 77009a	Introduction to Statistics in the Environmental Sciences (714a)	91
F&ES 77010a	Modeling Geographic Space (715a)	91
F&ES 77011b	Modeling Geographic Objects (716b)	91
[F&ES 77112b]	Statistical Design of Experiments (719b)	91
F&ES 77113b	Multivariate Statistical Analysis in the Environmental Sciences (844b)	91
F&ES 76014a	Business Concepts for Environmental Managers (810a)	92

*Social Sciences***ECONOMICS**

F&ES 80110b	Financial Markets and the Environment	92
F&ES 84001b	Economics of Pollution (733b)	92
F&ES 84002a	Economics of Natural Resource Management (734a)	92
F&ES 80103b	Valuing the Environment (737b)	93
F&ES 84004a	The Economics of Sustainable Development (842a)	93
F&ES 80105a	The Economics of the Climate Issue (843a)	93
F&ES 80106b	Energy Economics and the Environment (852b)	94
[F&ES 80107b]	Economics of Water Quality and Water Scarcity (863b)	94
F&ES D0163a	Doctoral Seminar in Environmental Economics	94

ENVIRONMENTAL POLICY

F&ES 80008b	Seminar on Leadership in Natural Resources and the Environment (503b)	95
F&ES 85009b	Seminar on Forest Certification (521b)	95
F&ES 85011a	Environmental Policy Analysis for an Unpredictable World (594a)	96
[F&ES 85012b]	Science and Politics of Environmental Regulation (725b)	96
F&ES 85013a	Environmental Politics and Policy (728a)	96
[F&ES 85014a]	Foundations of Environmental Policy and Politics (731a)	96
F&ES 80015b	Natural Resource Policy Practicum (739b)	96
F&ES 80116b	Emerging Markets for Ecosystem Services (763b)	97
[F&ES 80017b]	Public-Private Partnerships: Lessons from the Water Sector (766b)	97
F&ES 80018b	Seminar on Land Use Planning	97
F&ES 80019a	Entrepreneurial Business Planning	98
F&ES 80021b	International Organizations and Conferences (772b)	98
F&ES 80022a,b	Environmental Diplomacy Practicum (773a,b)	98
F&ES 85023a	Markets, Social and Environmental Certification, and Corporate Accountability (796a)	99
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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 32001b, Methods of Ecosystem Analysis. *3 credits.* This course exposes students to ecosystem-level questions; demonstrates field-data collection and laboratory analyses; emphasizes data manipulation on the microcomputer; and introduces professional data presentation techniques (plotting, transparencies, slides, Web design). Some projects chosen by students have large enough data sets to test hypotheses and develop publishable conclusions. Class sessions consist of a morning lecture and afternoon in field and laboratory. See <https://classes.yale.edu:444/fes519b>. Thomas G. Siccama.

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 33003b, Seminar in the Conservation and Development of Amazonia. 3 credits. The human enterprise is exploiting and substituting the world's tropical forests through a highly predictable process of frontier expansion and consolidation. Governance capacity and the prospect for natural resource conservation emerge only as the frontier boom economy goes "bust" and resources are largely depleted. In this seminar, we analyze the ecology, economics, and politics of Amazonia with the goal of learning to design robust, interdisciplinary approaches to the large-scale conservation of tropical forest ecosystems. We examine the biodiversity paradigm that dominates tropical conservation efforts today, the political constituencies (local, national, and international) in support of conservation and sustainable economies in Amazonia, and the emerging markets for ecological services performed by tropical forests (carbon storage, watershed function, biodiversity conservation). Finally, we review approaches to Amazon forest conservation in the context of scenarios of regional and global climate change. Lisa M. Curran, Daniel Nepstad, David McGrath.]

[F&ES 30004b, Reconciling Development and Conservation on the Amazon Frontier: A Tropical Conservation Field Course. 1 credit. The human enterprise is exploiting and substituting the world's tropical forests through a highly predictable process of frontier expansion and consolidation. In the typical sequence, geopolitical and economic policies drive frontier expansion into remote forest landscapes through investments in transportation systems and other infrastructure, and through fiscal incentives, stimulating "boom" economies of resource exploitation. Governance capacity and the prospect for forest conservation generally emerge only as the boom economy goes "bust" and the forests are already reduced to fragments. In this course, we examine the competing interests of private enterprise, environmental conservation, and social movements during three three-hour lecture/discussions in New Haven. We further explore the interactions among tropical frontier actors during a thirteen-day expedition along a portion of the Cuiabá-Santarém highway in east-central Amazonia (Brazil), which is slated for paving. Each student conducts an independent research project that draws on both the theoretical and field components of the course. Enrollment limited to twelve. Lisa M. Curran, Daniel Nepstad, David McGrath.]

F&ES 32005b/EVST 325b/MCDB 235b, Scientific Bases of Sustainable Agriculture. 3 credits. An exploration of the scientific bases of plant productivity in natural and agricultural systems worldwide, the ecological effects of modern intensive agriculture,

and the challenge of attaining a secure supply of food through ecologically sound and sustainable practices. Prerequisites: chemistry and a basic course in biology, ecology, or the equivalent. Seminar meets twice weekly for 1 hour 50 minutes each. Second period each week devoted to observation and discussion of plants in the laboratory and Marsh Botanical Garden. In addition to the regular class assignments, graduate students read and summarize relevant experimental work in the primary literature for the class as a whole. Other work includes short written reports, a midterm essay, and a final term paper on a relevant topic chosen by the student. Mary Helen Goldsmith.

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 (see course description, 30022a). Students taking Field Ecology can utilize their final project for both classes. Peter A. Raymond, Oswald J. Schmitz, Thomas G. Siccamo.

F&ES 30008b, Topics in the Tropics. *1 credit.* 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 trees. Students learn key characteristics for identification. We concentrate on those families that have high economic or ethnobotanic value. We also discuss distribution, habitat, and ecology. Different families or groups of families are covered by instructors from the New York Botanical Garden, all world-class experts in their respective families/groups. The course has a strong practical component, and instructors emphasize vegetative characters with which to identify families. The course includes a one-week field trip to Puerto Rico. NYBG Faculty

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. Prerequisite: college-level biology course. Recommended: college-level ecology course. Three hours lecture; field trips. 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, Thomas G. Siccama.

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 apply relevant conservation sciences and at the same time know explicitly about the organizational and policy settings in which they work. The course combines the problem-solving approaches of the conservation sciences with the policy sciences by surveying a range of policy and organizational contexts, theories, and techniques, using a variety of case studies. The role of the individual professional in these complex contexts is emphasized. Timothy W. Clark.]

[F&ES 30013b/E&EB 326b/E&EB 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 33015a, Human Dimensions in the Conservation of Biological Diversity. 3 credits. The course focuses on socioeconomic, psychological, and cultural issues in the management and conservation of biological diversity. Topics include biodiversity loss, endangered species, human/wildlife conflicts, utilization, parks and protected areas, attitudes and values, and legal and organizational structures. Issues involving the conservation of biological diversity in the United States and internationally are covered. Three hours. Stephen R. Kellert.]

[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, (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.

Environmental Education and Communication

[F&ES 43001a, Issues and Approaches in Environmental Education. *3 credits.* This course explores various approaches to influencing public understanding, appreciation, concern, and behavior toward the natural environment. Topics include definition and objectives of environmental education; theoretical foundations of learning and development; childhood experience of nature; formal, informal, and nonformal environmental education; issues-based environmental education; and international forms of environmental education. Stephen R. Kellert.]

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 on <https://classes.yale.edu/>. Three-hour seminar and writing workshops. Enrollment limited to fifteen. Fred Strebeigh.

F&ES 40004b, 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 Dooo5a, Doctoral Student Seminar. *3 credits.* This course is required for all doctoral students during their first two terms; the course is open to all doctoral students at later stages in their programs. The seminar brings together researchers from the natural and social sciences to enhance students' abilities to develop effective research proposals, to examine critically the positive and negative aspects of seminars and publications, and to present proposals and research results effectively. Xuhui Lee.

F&ES 40006a, Professional Communications 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, vocabulary range, writing style, presentation skills, and barriers to communication. 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 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 grammatical control and writing of 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 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 ecosystem 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>. Thomas G. Siccama.

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 primary forests, secondary forests, and degraded forestlands usually exist in a complex mosaic that is constantly changing. Each of these conditions, however, has characteristics that must be taken into account when developing restoration strategies. Topics include: Concepts and principles of landscape restoration. Types of disturbances, effects at the ecosystem level. Forest succession and ecosystem rehabilitation. Soil formation and development. Strategies for rehabilitation of soil's physical and chemical properties. Reforestation of degraded lands: functions, ecological and socioeconomic considerations. The use of plantations as catalyzers or accelerators of forest succession in degraded landscapes. Wetlands: inland and coastal restoration. Techniques to control invasive species. Agroforestry systems as a tool for recovery and conservation of biodiversity in managed landscapes. 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. In addition, seminar presentations by visitors and students and discussion sessions deal with particular aspects of landscape restoration. Prerequisite: F&ES 32007a or 32006a. Three hours lectures per week, three field trips. An optional field trip to Costa Rica to visit forest restoration projects in progress. 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. Topics include: Environmental variables in agroforestry: light and water. Soil productivity and sustainability in agroforestry. Nutrient cycling and nutrient use efficiency. 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. Environmental services of agroforestry: biodiversity conservation and carbon storage. Social functions of agroforestry: agroforestry as a tool for rural development. Agroforestry in semi-arid ecosystems. Agroforestry in the highlands. Agroforestry and fuelwood production. Agroforestry extension and education. Current trends in agroforestry research. 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, Anatomy of Trees and Forests. *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. Next offered spring 2008. 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 50009b, Tree Biotechnology Issues. *3 credits.* Changes in plant genetics have been hastened by domestication at the hands of farmers and plant breeders. Recently such changes have been rapidly advanced by biotechnologies. Genetically modified organisms (GMOs) have caught the attention of the scientific community, the private sector, regulatory agencies, and the general public. However, their adoption has not taken place without controversy. Major battles are being waged over genetically engineered crop plants. What is on the horizon for GMOs in forest and plantation trees and the products derived from them? This course examines the basic science, philosophy, and social and policy issues shaping the future of tree biotechnology. The course has four primary objectives: (1) To provide students with a firm understanding of the science behind GMOs. (2) To provide students with an understanding of decision making in the

GMO creation process. Discussions center on targeting traits, genetic interventions, selection and evaluation steps, multiplication, and release and introduction. (3) To provide students with an understanding of the assessment process to determine the relative safety of biotechnology, using case studies of biotechnology risks and risk assessment. (4) To provide students with an integrated understanding of the national and global policy and regulatory issues concerning plant biotechnology. Richard A. Jones.

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, 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 84002a; or permission of the instructor. Three hours lecture. Eight days fieldwork. Limited enrollment. Mark S. Ashton, Timothy W. 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 50117a, 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 84002a; or permission of the instructor. Mark S. Ashton.

[F&ES 50118a, Seminar in Advanced Silviculture. 2 credits. This course considers selected topics in silviculture for students with previous instruction in silviculture. Two 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 84002a 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 50023a, Forest Management Operations for Professional Foresters. 3 credits. This course covers the operational aspects of managing forestland, including a range of topics essential to the professional practice of forest management. The course focuses on operational aspects of regeneration, intermediate tending, and harvesting (planning,

layout, implementation, and post-operation evaluation), Best Management Practices, regulatory and wetlands considerations, and socio-economic dimensions of field operations. Included is a workshop on ethical and professional responsibilities of forest managers. Classes feature field trips to view forestry operations, including a five-day trip to an important timber-producing region of the northeastern United States early in the term. The course is limited to twenty students, with preference given to second-year students. Michael Ferrucci.

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. 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 are studied 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 66008a, Organic Pollutants in the Environment. *3 credits.* An overview of the pollution problems posed by synthetic organic chemicals (e.g., pesticides, PCBs, dioxins) and petroleum products. No previous background in organic chemistry is required, though 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 of how those processes apply to the pollution problems posed by specific groups of chemicals. We also discuss technologies for prevention and remediation of organic pollution, as well as issues related to specific classes of chemicals (e.g., oil spill response, pesticide choices). Several case studies are examined. Media covered include surface water, groundwater, soil, air, and biota. Three hours lecture, six problem sets, several field trips. Shimon C. Anisfeld.

F&ES 60109b/ENAS 640b, 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. Gaboury Benoit.

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.

SOIL SCIENCE

F&ES 62013a, Introduction to Soil Science. *3 credits.* 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. Two lectures a week. Four all-day Saturday field trips. See <https://classes.yale.edu:444/fes530a>. Thomas G. Siccama, Florencia Montagnini.

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, Coastal Vulnerability: Lessons Learned from New Orleans, the Gulf Coast Wetlands, and Hurricane Katrina. Can a Crisis Bring about Change? *1 credit (Pass/Fail)*. The Louisiana Gulf coast wetlands were already disappearing at an alarming rate before Hurricane Katrina hit the area last year, yet decision makers did not consider this area in crisis until the city of New Orleans was flooded. Since then, much attention has been focused on the environmental setting for this disaster, the collision of manmade and natural forces, and the solutions to secure a future for the area. This lecture series focuses on the vulnerable Gulf coastal environment and explores the question of how the natural and built environments can coexist among the formidable forces of rising seas, coastal degradation, and the mighty Mississippi River. In addition to learning about the various factors contributing to the crisis in this area, we look at other case(s) around the world where people inhabit vulnerable low-lying coastal areas threatened by storms and rising seas. Mary Beth Decker, Gaboury Benoit, Martha Smith.

F&ES 61016a, 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 water quantity and water 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 include global water resources and their spatial and temporal variability; water scarcity; residential, agricultural, and industrial water use; future water scenarios and projections; storm water management; human impacts on aquatic ecosystems; water quality control; water rights and conflict; the watershed framework; and restoration. Three hours lecture, several homework assignments, several field trips, one term project (for the 4-credit option). 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, and detrital pathways. 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. Next offered fall 2007. Shimon C. Anisfeld.]

[F&ES 61018a/ENAS 646a, 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 60119b/ENAS 647b, Hydrologic Modeling. 4 credits. Application of computer models to solve problems related to water movement and chemical migration in subsurface environments. Unsaturated and saturated flow phenomena are considered, and the role of geochemical and microbiological processes in chemical fate and transport is examined. Three hours lecture. Term project and presentation. Prerequisites: F&ES 61018a 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; water-borne infectious disease and water-related illness; linkages between 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 61021b, Hydrology and Water Resources. 3 credits. This course explores processes involving water and the effects of climate and anthropogenic activities on the quality, distribution, and availability of the world's water resources. The course has two objectives. The first is to provide students with knowledge of the governing principles of groundwater and surface-water hydrology. The second objective is to use this knowledge of hydrologic sciences to support the discussion of key water-resource issues, including water pollution and waterborne disease; municipal and irrigation water development; the impact of dams on the hydrologic cycle; and drinking water and wastewater treatment. Students are graded on the basis of three in-class exams and problem sets. There are no prerequisites for this course. James E. Saiers.

[F&ES 60022b, Managing the Coastal Nutrient Problem: The Case of Long Island Sound. 3 credits. As is the case for many coastal ecosystems, Long Island Sound suffers from excessive loading of nutrients, with hypoxia (low dissolved oxygen) as the primary symptom of this problem. This seminar covers the science, management, and policy of this issue, and examines what has and has not been achieved in more than a decade of addressing this problem. Enrollment limited to twelve. Next offered spring 2008. Shimon C. Anisfeld, Richard Burroughs, Timothy W. Clark, Peter A. Raymond.]

[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 61018a 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 61018a or equivalent) is recommended. James G. MacBroom.

Quantitative and Research Methods

F&ES 77001b/ARCG 762b/G&G 562b, 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 in their 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, Archaeology, 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.

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. Mark S. Ashton.

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. Amity Doolittle.

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, Applied Spatial Statistics. *3 credits.* An introduction to spatial statistical techniques with computer applications. Topics include spatial sampling, visualizing spatial data, quantifying spatial association and autocorrelation, interpolation methods, fitting variograms, kriging, and related modeling techniques for spatially correlated data. Examples are drawn from ecology, sociology, public health, and subjects proposed by students. Eight to ten lab/homework assignments and a final project. Enrollment is limited to twenty-five students, with preference given to those whose research suggests analysis using spatial statistics. Timothy G. Gregoire, Jonathan D. Reuning-Scherer.

F&ES 77108b, Statistics for Environmental Sciences. *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 77010a, 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 77011b, 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 77011b, 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 77010a, 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. Prerequisite: a prior course in introductory statistics. 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), principle components analysis, cluster analysis (hierarchical clustering, k-means), canonical correlation, multidimensional scaling, and factor analysis. Some analysis of multivariate spatial data may be included. 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. 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. Marian R. Chertow, William Ellis, Maureen Burke.

Social Sciences

ECONOMICS

F&ES 80110b/MGT 686, Financial Markets and the Environment. *3–4 credits.* This seminar explores methods by which financial markets incorporate environmental costs, risks, liabilities, and opportunities into financial valuations. Students develop their own valuation exercises and critique methodologies used by financial analysts and in equity, debt, banking, and insurance markets. Students in the seminar explore the role of information availability and asymmetries. The seminar emphasizes applications of financial analytical approaches and provides students with opportunities to question practitioners. Assignments are problem-based and include teamwork. Robert Repetto.

F&ES 84001b, Economics of Pollution. *3 credits.* This course is designed to teach students how to think about managing pollution. It explains why market economies produce pollution and why regulations are needed. Social solutions to the problem are explored, and students learn how to analyze the effectiveness of control alternatives and policies. Specific examples are discussed, including air and water pollution, acid rain, global warming, hazardous waste, and human waste. Erin T. Mansur.

F&ES 84002a, 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 first part of the course is an introduction to the principles of natural resource economics. We develop the basic theory required to understand the economic concept of efficiency, as well as conditions under which markets can and cannot be expected to allocate resources efficiently. Next, we develop an understanding of environmental benefit valuation techniques. The remaining three-quarters of class sessions are devoted to applying these theoretical concepts and methods to questions of managing both nonrenewable resources (oil and minerals) and renewable resources (water, fisheries, forests, and species). This applied portion of the course also includes class sessions on the economics of land use change, as well as macroeconomic topics like economic growth, sustainability, and green accounting. Important themes in

the course include the uses and limits of markets in natural resource management; measurement of the benefits of natural resource amenities like clean water and recreational public lands; economic and environmental implications of poorly defined property rights for resources like fisheries and groundwater; and economic definitions of sustainability. Sheila M. 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 84004a, The Economics of Sustainable Development. *3 credits.* This course first critically explores the concept of sustainable development, examining ecological and economic interpretations of “sustainability” and various issues in the concept of economic “development.” It then examines conditions for sustainability derived from neo-classical growth models, and methodologies and indicators used to measure progress toward sustainability. The course then studies important institutional, market and policy failures impeding progress toward sustainable development, along with measures that have been put in place to resolve these obstacles. In this section of the course students examine problems stemming from absent or insecure property rights and workable remedies. Students examine market failures and “externalities” from an economic perspective, including economically efficient pollution control, methods of valuing environmental damages, and the design of policy instruments to control environmental damages, including regulatory, tax, and trading approaches. This section of the course concludes by examining policy failures impeding sustainable development, such as perverse subsidies and rent-seeking behavior. The final section of the course examines issues related to “globalization,” trade and the environment, and international investment. Case material for the course is drawn from the U.S. and developing countries and a wide range of resource and environmental issues. Robert Repetto.

FES 80105a, The Economics of the Climate Issue. *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 uncertainty regarding possible impacts. The course then examines economic research into the costs of mitigating greenhouse gas emissions, with particular attention to such key determinants as backstop energy technologies, technological change, and carbon sequestration. 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. The next section of the course focuses on issues in the design of policies to mitigate greenhouse gas emissions, particularly tax and trading approaches, including the mechanisms of the Kyoto Protocol. The final section

of the course examines problems in devising international agreements that will be beneficial to all parties and hence voluntarily implemented. This section considers problems of “free-riding,” issue linkage, and enforcement of international climate agreements. Robert Repetto.

F&ES 80106b, Energy Economics and the Environment. *3 credits.* This advanced economics course examines energy issues as they pertain to the environment. The course begins with an overview of energy markets and an introduction to the economics of extracting nonrenewable resources. In the second section, the class looks into the environmental implications associated with energy and methods regulators use to correct for these market failures. In particular, we examine the economics of air pollution and climate change. The next part of the course covers investment in renewables. We discuss what regulations have been used to encourage investment and examine their effectiveness. The final section includes lectures on the economics of transportation (e.g., CAFE standards), and of energy conservation (e.g., DSM programs). Each week, the lecture covers the economics behind a particular energy issue and then is followed by a class discussion about a related case study or article. This course places an emphasis on economics methodology and is intended for students with some economics background. Erin T. Mansur.

[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 84002a, or an equivalent microeconomics course. Sheila M. Olmstead.]

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.



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. 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 con-

duct 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 three policy analysis projects during the term. Following an initial organizational meeting, student teams meet with the instructor once a week to provide updates on project. 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 ecosystem services pay the producers of the services, thus creating market incentives to sustain intact, biologically diverse areas. However, these experiments are in their infancy and raise a host of ethical, scientific, commercial, and policy questions. The purposes of this seminar are: (1) to understand these opportunities and their limits, by examining current scientific, commercial, and policy knowledge relevant to building markets for ecosystem services; and (2) to apply the lessons learned to actual properties, 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 80018b, Seminar on Land Use Planning. *1 credit.* This course showcases key elements of the field of planning with particular attention to land use planning. Over a series of ten two-hour sessions it provides a broad overview of current planning practice and theory with an emphasis on practice. It highlights a range of perspectives on urban, suburban, exurban, rural issues and their interconnections and local, regional, and national approaches to planning. It exposes students to the kinds of people who get involved in planning and the career or civic platforms from which they approach it. It examines what happens in the absence of good planning and policy as well as current

wisdom on best practices, policies, and successful outcomes. Some attention is also given to the thinking of skeptics about planning and opponents of land use regulation. There is a defined set of readings each week and a mix of outside speakers and student-led sessions. Because this is a one-credit course, there are no written or graded assignments. As such, all students are expected to complete all of the required readings in order to receive credit. Hooper Brooks, Gordon Geballe.

F&ES 80019a/MGT 618, 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 twenty-five, by permission of the instructor. David Cromwell.

F&ES 80021b, 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, Bangkok, Thailand 2004, 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. *6 credits (3 per term).* This yearlong course is designed for students who are interested in experiential learning of international negotiations on issues of the environment and sustainable development through various intergovernmental bodies at the United Nations. Students participate in weekly seminars to acquire knowledge of the United Nations system and of the functions of the relevant institutions involved in environmental negotiations and decision making, and to learn the major substantive and procedural issues raised in multilateral negotiations about forestry, marine environment, fisheries, renewable resources, and the

atmosphere. They also observe intergovernmental meetings and prepare research papers on selected topics. In addition, based on their qualifications and by special arrangement with country and observer missions, students are also assigned to work as interns with missions in New York; each student is expected to devote 12–15 hours per week to mission assignments. Their work may include research, drafting of papers, attending meetings, and developing specific projects on topics determined by the mission concerned. Students are expected to work in teams of three or four composed of law, forestry, and environment students selected from Pace Law School and F&ES. They should work closely with Professor Lee regarding their assignments with the missions and are required to make progress reports for purpose of supervision. Students' performance is evaluated on the basis of their participation in the weekly seminars, progress report, and the submission in May of a substantial research paper or project on a topic agreed upon by Professor Lee. Enrollment requires application, interview, and approval of instructors. Roy S. Lee, Nicholas Robinson, Gordon T. Geballe.

F&ES 85023a, Markets, Social and Environmental Certification, and Corporate Accountability. *1, 2, or 3 credits.* This course explores the changing expectations, tools, and impacts of corporate social and environmental accountability in the twenty-first century. Building from case studies of many dimensions of “corporate social responsibility” in the twentieth century, the course reviews the literature on all levels of “social and environmental risk” faced by companies in their markets, including costs of finance, insurance, and reputational protection. It reviews the emergence of “certification systems” for encouraging and rewarding the highest level of corporate social and environmental accountability, drawing examples from global forestry, ecotourism, agricultural commodity trade, mining, and finance. It explores the nature and effectiveness of “markets campaigns” as a tool for promoting corporate environmental accountability. The course features guest speakers from companies that have embraced the new mechanisms for corporate accountability and those that have resisted them, from NGOs that have promoted them, and academic experts who have analyzed them. Michael Conroy, Benjamin Cashore.

F&ES 86024b, Transportation and Urban Land Use Planning: Shaping the Twenty-First-Century City. *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 role 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, new technologies, and so forth. There is a field trip for about fifteen students to Shanghai during spring break. 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 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 land conservation organization. Limited enrollment; preference to second-year students. Bradford S. Gentry.

F&ES 80028b, Understanding Environmental Campaigns: Strategies and Tactics. *1–3 credits.* This is a course about the strategies and tactics used in successful environmental campaigns, taught from a practitioner’s perspective. Though this topic is neither well documented nor regularly taught, there is a tactical toolkit that can be learned. Many environmental campaigners learn on the job. For those students interested in pursuing careers in environmental policy making and advocacy, this course is designed to be one that can jumpstart professional development. In a fashion comparable to the case study method offered in business schools, this course examines six cases, all from the past five years, and seeks to discern lessons for best practice. No single environmental campaign is the same, and strategies and tactics are always evolving, but there are several key lessons that can be drawn from such campaigns and there is also value in understanding current best practice even if it is constantly evolving. The six case topics examined in class are protecting Alaska’s old-growth rainforests, conserving the Pine Barrens Watershed in Eastern Long Island, Home Depot’s decision to preference sustainably managed forest products, the Give Swordfish A Break Campaign, the Persistent Organic Pollutants (POPs) Treaty, and regulatory reform. Resource people who have played leadership roles in each of these efforts join us for class. The class examines each case, synthesizes lessons learned, and seeks to formulate a practical understanding of key strategies and tactics used to effect positive outcomes. Michael Northrop.

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. 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. *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). It concludes by examining efforts to use combinations of these legal tools to expand private investment in environmentally superior goods, services, and operations. Bradford S. Gentry.

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 narrative writing skills. After focusing on environmental history and how it furthers current problem solving, the seminar turns to the history of ecology and ecology's mixed influence on social and economic theory. Work centers on practical applications of historical research and analysis rather than the historical record, in the expectation that students will articulate their own narratives and gain increased power in problem analysis. History's analytic tools and perspectives offer social and natural scientists an excellent platform for establishing context and for making long-term projections. The ecological orientation afforded by historical analysis further leads to more successful and ethical policy making through its emphasis on context, on emergent processes, and on the central role of individuals in system dynamics. Arvid Nelson.

F&ES 85033a/LAW 20348, Environmental Law and Policy. *3 credits.* Introduction to the legal requirements and policy underpinnings of the basic U.S. environmental laws, including the Clean Water Act, Clean Air Act, and various statutes governing waste, food safety, 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 economic incentives and other market mechanisms, voluntary emissions reductions, regulatory negotiation, and public disclosure requirements. 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 Protection Clinic. *3 credits.* A clinical program with weekly class sessions, alternating between seminars and project team meetings. The Environmental Protection 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 85035b/LAW 20326, 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 85036b, Foundations of Natural Resource Policy and Management. 3 credits.

This research seminar focuses on the foundations of natural resource policy and management and is designed for students in any subfield of forestry and environmental studies, or in other disciplines. Comprehensive and integrated methods for thinking about and proposing solutions to problems in natural resource policy and management are explored. Students gain familiarity with the core methods of problem identification, clarification, and resolution and then apply these methods to particular issues in natural resource policy and management. Each student, alone or in collaboration, is responsible for researching a particular problem. Students circulate drafts of their papers to other seminar participants and lecture on and lead discussions of their topics in class sessions. Papers of sufficient quality may be collected in a volume for publication. The seminar is intended to complement, not duplicate, material in other courses in the School and at the University. Enrollment limited to sixteen; application required. Timothy W. Clark.

F&ES 83037b, Large-Scale Conservation: Integrating Science, Management, and Policy. 3 or 6 credits.

Environmental sustainability is an important societal goal, but figuring out how to achieve it at large scales has proven to be extremely challenging. Abundant trend data show that many species, ecosystems, and environmental systems are being overused, stressed, or degraded, thus undercutting the likelihood that we can reach sustainability. In addition, our institutions for science, management, and policy are not designed to address conservation at large scales. Over the last few decades there have been many management and policy initiatives to address large-scale conservation and resource use. Collectively, these efforts are a response to the growing awareness that many environmental problems can only be understood and addressed at large scales. All of these efforts are ambitious in scope. They are being undertaken or proposed at sub-national, national, international, or planetary levels. Each approach emphasizes different

goals and methods and engages different communities of practitioners, decision makers, and publics. This course (a mixed seminar and practicum) examines the conceptual and contextual basis for these efforts, compares and contrasts formulae being used (e.g., science, management, policy), explores themes (problem solving, change, organization, leadership, monitoring, 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. Extensive student participation is required throughout. Timothy W. 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 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, 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.

SOCIAL AND POLITICAL ECOLOGY

F&ES 83047a, Social Ecology, Community Forestry, and the Future of Place-Based Environmentalism. 6 credits.

This seminar explores the art and science of community-based field ecology as a means of providing a more participatory and therefore sustainable suite of policy, planning, design, and management strategies for protecting scarce system resources. Theoretical, conceptual, methodological, quantitative, and pragmatic field practices drive our approach. Primary attention is to the role of "open spaces" — trees, woodlands, forests, gardens, parks, and other protected and sacred places — in creating sustained development of community livelihoods, the enhancement

of diverse life styles, and the adaptive legacies held by local populations. This focal system is a stand-in for behavioral responses to other environmental issues and compels us to ask how we measure associated benefits and deficits along this gradient. This gradient is what the U.S. Forest Service calls a “forest opportunity spectrum” that runs from the inner city to the outer wildlands. We learn research concepts, techniques, and skills in measurement from the literature (Jane Jacobs, Emile Durkheim, Max Weber, Odum, et al.); from systematic field observation practices, public documents and other trace information; from long conversations with key informants; and most of all from solid, systematic study of covariation in associated biophysical resources as found in relevant biophysical journals. This is a field-based professional effort. It uses readings, reviews, exams, presentations, and the usual sorts of ways by which we capture the knowledge of others and make it our own. William R. Burch, Jr.

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.” Guests and students make presentations and carry out discussions each week. Student papers are required. Timothy W. Clark, William R. Burch, Jr.

F&ES 83050a/ANTH 581a, Society and Environment: Introduction to Theory and Method. *3 credits.* An introductory course on the social scientific contributions to the study of the environment and natural resources, designed as the first course for students who specialize in the social sciences as well as the only course for students who take just one course in this field. The approach taken is inductive, problem-oriented, and case-study-based. Subjects covered include the framing of environmental “problems,” social science field methods, rethinking environmental perturbation and change, and the environmental relations of local communities. The course offers students an opportunity to

develop analytic frameworks for past or proposed research projects. The course is a prerequisite for F&ES 80153b and F&ES 80157b. Three hours 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. 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. It examines key theoretical developments and current issues in social and political ecology and ecological anthropology, and attempts to place them in their historical and intellectual contexts. Topics discussed vary from year to year in response to ongoing debates in the field and global events, but in the past have included environmental conflict, the concepts of local agency and governmentality, re-thinking extractive reserves, converging theory in agriculture and medicine, the natural history of the Amazon, conservation in Papua New Guinea, ethnographic approaches to human-animal relations, and comparative method. Students are expected to use the course to develop their own research and writing. Prerequisite: F&ES 83050a or F&ES 83056a. Enrollment limited to twelve. Three hours lecture/seminar. Taught alternate years. 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. James C. Scott, Michael R. Dove, and other Yale faculty.

F&ES 83155b, Contemporary Environmental Challenges in Sub-Saharan Africa.

3 credits. The objective of this seminar is to provide students with in-depth insight into the dynamics of human-environment interactions in sub-Saharan Africa (SSA) in a collaborative and open discussion. Families, communities, and nations in the African region face an array of environmental challenges ranging from periodic drought and food insecurity to loss of biodiversity, conflict over resources, and persistent poverty. Moreover, many countries in the region are saddled with histories of colonial rule that defined human-environment relationships in the simplest terms, often posing direct causal links between traditional practices and environmental degradation while ignoring the complex interplay of social, biophysical, and geographical factors that contribute to environmental outcomes. Frequently, these discourses of crisis and change were transferred directly from colonial to post-colonial environmental policies, where they persist to this day. Throughout the course, we critically engage common perceptions of African environments, explore alternative theories, and seek deeper understandings of human-environment interactions in the region. The course is designed around six main themes: (1) environment, poverty, and development; (2) property rights and access to resources; (3) energy and environmental health; (4) risk and adaptation to natural hazards and climate change; (5) conservation, deforestation, and biodiversity; and (6) the environment as source of conflict and cooperation. Within each theme, we devote about one week to introducing the general concepts and a second week to discussing one or two in-depth case studies that illustrate the issue in detail. Student evaluations are based on participation and a course paper, which is presented to the class. Enrollment is limited to fifteen students. Robert Bailis.

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 politics of indigeneity, new directions in political ecology, the tsunami in Indonesia, the WorldWatch debate on conservation and indigenous people, 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-hour lecture/seminar. Enrollment limited to twelve. Taught alternate years. Next offered spring 2008. Carol Carpenter, Michael R. Dove.]

F&ES 83058b, Monitoring and Evaluation Techniques: Theory and Methods Applied to Ecosystem Rehabilitation/Community Revitalization Interventions. 4–6 credits. This course is an introduction, exploration, and application of performance-based tracking of interventions to repair ecosystems and to revitalize their associated human communities. The underlying assumption is that one cannot occur without the other. Our task is to test that notion with qualitative and quantitative measures of real-life cases. Seminar members are grouped into three interdisciplinary, peer learning, service-oriented professional teams according to different organizational scales and different ecological approaches. Readings from the literature and case studies such as Chicago Wild and diffusion of innovation literature guide our effort. Studies and cases from Web sites are analyzed; data sets are collected for study locales. These studies and data sets are one source of theory, methods, and data for application to an actual, client-driven field analysis and diagnostic report that each team carries out. Field trips are made to the study sites. A binding thread in this effort is an interest in the use of generic “outdoor/environmental education” approaches as critical means for developing local knowledge and practices for rehabilitation/revitalization design and to monitor and sustain the system. William R. Burch, Jr., Colleen Murphy-Dunning.

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 between 2000 and 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. In coming decades, in order to support sustainable national development, urban areas will need to ensure a healthful and attractive environment for their

rapidly expanding populations, while protecting natural resources and reducing harmful impacts on wider regions and later generations. 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. There is a field trip to Mexico City for about fifteen students at the end of the term. Ellen Brennan-Galvin.

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 “bio-philic” design issues focus on “organic” and “vernacular” design strategies. Stephen R. Kellert.

F&ES 83064a, Energy Issues in Developing Countries. 3 credits. This graduate seminar 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 recommended. Enrollment limited to fifteen students. 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 80067a, Ecology and Equity. This course provides a comparative, cross-cultural perspective on the environmental debate. The first part explores the history of environmentalism in different parts of the world. The cases studied include Wilderness Thinking in America, Gandhian agrarianism in India, and Green politics in Germany. The second part looks at the trajectory of environmental conflicts and ways of resolving them. We focus especially on the sectors of forestry, biodiversity conservation, and resource consumption. The course moves back and forth among the locality, the nation, and the globe. Ramachandra Guha.

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.

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. *2 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 96004b, 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 pollution, water-related disease, indoor and outdoor air, and agriculture. Other topics include environmental justice, case studies of environmental health disasters, waste disposal, risk, urbanization, and links between global warming and health. Michelle Bell.

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.

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 intersperses 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, Seminar in Industrial Ecology: Topic to Be Announced. *3 credits.* A capstone course to explore industrial ecology topics in clinical settings. Students work on specific projects that blend industrial ecology with related topics in environmental science, policy, and management. Past themes explored industrial ecology in China, urban sustainability, emerging technologies, and multi-scale industrial ecology. Limited enrollment based on clinical assignments. One three-hour class per week. Thomas Graedel and IEM faculty.

F&ES 96112b/MGT 688b, Corporate Environmental Management and Strategy. *3 credits.* The course focuses on understanding how adroit environmental management and strategy can enhance business opportunities and reduce environmental impact. The course seeks to analyze under what circumstances different competitive approaches are likely to be successful and to increase knowledge of programs, structures, and tools of environmental management. The course combines weekly lectures and class discussions on theory with sessions involving tools and applications. Marian R. Chertow.

[F&ES 94110b/MGT 528b, Public and Private Management of the Environment. *4 credits.* 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 nongovernmental initiatives, such as eco-labeling and certification. In the second part of the course, we focus on proactive corporate environmental strategies through a series of case studies. 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 will be useful to anyone interested in competitive strategy, corporate social responsibility, or the design of public policy. Prerequisite: Economic Analysis or the equivalent. Nathaniel Keohane.]

F&ES 90009a, Modern Capitalism and the Environment: Pathways to Sustainability. *3 Credits.* Can modern capitalism sustain the environment, and can the environment sustain modern capitalism? A fundamental question facing societies today is whether the

world economy as it now exists can be tamed to operate within constraints that protect and preserve natural assets. After examining some of the recent analyses of ongoing deterioration of natural assets, this seminar reviews from several perspectives the relationships among capitalism, growth, and the environment. It then critically analyzes a variety of prescriptions that have been offered to address this fundamental question. These prescriptions differ considerably in the degree of intervention or change proposed. Whether one urges modest adjustments to modern capitalism or deep change depends on the degree to which one believes today's economic and political system is seriously or irreparably destructive and also on the analysis offered of the underlying systemic problems. James Gustave Speth.

[F&ES 90011b, World Agriculture and the Environment. 3 credits. A seminar exploring the global environmental impacts of the production of food and fiber. Agriculture and ranching have more environmental impacts than any other human activity. This course explores the global impacts of agriculture on biodiversity, ecosystem functions, and climate change. Readings focus on the impacts of subsistence and commercial agriculture as well as the impacts of specific food and fiber crops such as sugar, cotton, soy, palm oil, and shrimp produced from aquaculture. There is an emphasis on the different tools used to reduce impacts — zoning and land use planning, certification and ecolabel programs, better management practices, private sector procurement requirements, conservation easements, and payments for environmental services. Participatory discussion, class presentation, and research paper required. Jason Clay.]

F&ES 90113b, Sustainable Development of Brownfield Sites. 3 credits. A seminar that investigates biophysical and design components of environmentally sound restoration and redevelopment of brownfield sites. A major portion of the course is the design of two brownfield redevelopment projects, one of which is the New Haven landfill. This course is coordinated with a studio course in the Architecture School; however, students are not expected to take both courses. Prerequisites: knowledge of basic principles of environmental chemistry, hydrology, earth science, or ecology. Three hours seminar class. Class projects. Gaboury Benoit, Diana Balmori.

F&ES UNDERGRADUATE COURSES

Ecology

ECOSYSTEM ECOLOGY

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

F&ES 262a/ENVST 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; ecologi-

cal 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 263La/EVST263La, Lab for Ecology and Environmental Problem Solving.

The course provides grounding in the principles of sampling and quantifying biodiversity and defining landscape-level patterns. Students are given the opportunity to execute experiments and run computer simulations that help to clarify the relationship between biodiversity and ecosystem function. Emphasis on quantitative aspects of sampling, analysis and modeling, and scientific communication through report writing. Oswald J. Schmitz.

F&ES 275a, Ecosystem Patterns and Processes. See F&ES 32007a for description.

F&ES 276La, Laboratory for Ecosystem Patterns and Processes. Field trips to interpret the ecosystem-level functions of a wide variety of natural landscapes. *Must be taken concurrently with F&ES 275a.* Thomas G. Siccama.

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, L. Kealoha Freidenburg.

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 220b, Local Flora. See F&ES 52001b for description.

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

F&ES 261Lb, Laboratory for Structure, Function, and Development of Vascular Plants.

Physical Sciences

ENVIRONMENTAL CHEMISTRY

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

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

WATER RESOURCES

F&ES 440a/EVST 440a, Environmental Hydrology. See F&ES 61018a 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. The most important areas of introductory microeconomics. Emphasis on topics most relevant to the study of the environment, including externalities, regulation, public goods, and consumer surplus analysis. May be substituted for ECON 110a or 115a or b as a pre-requisite for other Economics courses. Sheila Olmstead.

[**F&ES 230b/EVST 230b, Environmental Economics and Policy.** Basic economic analysis of environmental problems. Weighing the costs and benefits of major environmental issues. Problems include global warming, toxic waste, air pollution, wilderness protection, deforestation, and preserving biodiversity. Taught every other year. Next offered spring 2007. *For non-Economics majors.* Robert Mendelsohn.]

ENVIRONMENTAL POLICY

F&ES 245b, International Environmental Policy and Governance. See F&ES 85068b for description.

F&ES 255a/EVST 255a, 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.

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.]

FRESHMAN SEMINAR

F&ES 011a, China's Environmental Issues. *1 credit.* China, with one-sixth of the world's human population, has a rapidly expanding economy while its environment is deteriorating. This course investigates water, air, and agricultural issues in China today. Gordon T. Geballe.

DEVANE LECTURE COURSE

DEVN 190b/EVST 190b/PLSC360b, Modern Capitalism and Environment: Pathways to Sustainability or End of the Road? Discussion of whether the environment can sustain modern capitalism in an era when the world economy is poised to double and then double again within a half-century. Examination of major environmental trends and conditions, followed by a review of current thinking about the relationships among capitalism, growth, and the environment. Consideration of a variety of prescriptions that have been proposed to take economy and environment off collision course. James Gustave Speth.



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, non-governmental 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 Quinnipiac River tidal marsh; an 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 & POLICY

A joint undertaking with Yale Law School, the Center for Environmental Law & Policy seeks to advance fresh thinking and analytically rigorous approaches to environmental decision making — across disciplines, across sectors, and across 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 public policy making. Current center research projects are listed below. Web site: www.yale.edu/envirocenter.

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.

Environmental Performance Measurement

Aims to shift environmental decision making to firmer analytic foundations using environmental indicators and empirical data. In collaboration with the Center for International Earth Science Information Network at Columbia University and with the cooperation of the World Economic Forum and the Joint Research Centre of the European Commission, this project produces two periodically updated national environmental indices. The 2005 Environmental Sustainability Index (ESI) tracks 146 countries on 21 sustainability indicators. The Pilot 2006 Environmental Performance Index (EPI) assesses 133 countries on six key environmental policy categories in the context of the Millennium Development Goals (MDGs). Web site: www.yale.edu/epm.

Corporate Environmental Strategy

Examines the quest for corporate sustainability, analyzing the successes and failures of recent corporate “green” initiatives, with the aim of identifying the elements of a successful corporate environmental strategy. The overarching goal of this project is to foster a world of sustainable production and consumption by addressing one critical leverage point — the business world and its approach to environmental strategy. A primary goal is to reach a mainstream business audience with the message that environmental thinking will yield long-term competitive advantage.

Private International Finance and the Environment

Examines mechanisms for channeling private capital into environmentally beneficial investments and for ensuring that all development projects include appropriate environmental components. Private investment in many developing countries now vastly exceeds official foreign aid. To achieve sustainable development, these countries must set environmental as well as economic goals in the privatization of government-owned enterprises and the development of infrastructure projects, joint ventures, acquisitions, and technology transfers.

Environmental Attitudes Project

Scholarly and popular wisdom has long held that the considerable support Americans express for environmental protection does not translate into political and electoral support. This project asks whether this is true, and if so, why. One strand of the research centers on nationwide polling and seeks to establish what public environmental attitudes and priorities are — and how they change over time. A second strand looks empirically at the cognitive underpinnings of environmental attitudes. How do Americans understand environmental problems? Does the language used to discuss issues matter? A final research element explores how environmental issues play out in the electoral context, exploring, in particular, when pollution or natural resource management issues are raised in campaigns and what problems and approaches (e.g., messages) resonate with voters.

Environmental Governance: The Search for Best Practices

Explores what “good governance” means in a variety of environmental contexts — in the public, private, and civil sectors and at scales ranging from local to global. The consensus is that good governance is critical to sound policy making, but how this concept applies to environmental decision making is still being developed. Building on work being done in the disciplines of law, economics, natural science, and political science, this initiative aims to produce scholarly analysis and tools with policy application for government authorities, communities, NGO leaders, and corporate executives.

Global Environmental Governance

Seeks ways to revitalize the international environmental regime. This project aims to facilitate thinking on how to strengthen environmental cooperation in the face of global-scale threats. The goal is to contribute to more effective governance by developing a sound analytical foundation, expanding the policy dialogue, and creating a public policy network of interested individuals. Web site: www.yale.edu/gegproject.

Information Age Environmental Protection

Explores how Digital Age technologies are changing the way we approach and solve environmental problems. Recent advances in materials, systems, and energy technologies offer cost-effective ways to dramatically reduce environmental impact in industrial, commercial, and residential sectors. Meanwhile, advances in information and communications technology make it possible to rectify important market, institutional, and regulatory failures that have long hampered environmental progress. The Information Age project seeks to understand the collective impact of these innovations, and identify policy steps that can best allow society to leverage these technologies in the pursuit of environmental protection.

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 MIT Press and owned by Yale University, the *Journal of Industrial Ecology* is a peer-reviewed, multi-disciplinary quarterly designed to foster understanding and practice in industrial ecology and 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; (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 Yale–UNDP Public-Private Partnerships for the Urban Environment, the Urban Resources Initiative, the Program for Sustainable 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–UNDP Collaborative Program on the Urban Environment

The Yale–UNDP Collaborative Program was created in 1996 as one part of a larger UNDP Program on Public-Private Partnerships for the Urban Environment (PPPUE). The purpose is to collect, analyze, and disseminate lessons learned on using public-private partnerships (PPP) to improve the delivery of urban water, waste, and energy services in developing countries. The program helps address some of the most pressing public health and environmental issues facing the developing world, particularly the lack of access to clean drinking water and adequate sanitation services.

The partnership between Yale and UNDP grew out of UNDP's need to involve more private businesses in solving urban environmental issues and the School's research on how private investment can be used to improve environmental performance. The partnership builds on UNDP's network of over 130 offices in developing countries, as well as Yale's research and teaching.

The Yale–UNDP Collaborative Program is one part of a Global Learning Network (GLN) involving individuals and institutions around the world. The goal of the GLN is to serve as a worldwide focal point for partnership analysis, knowledge transfer, as well as local, regional, and global exchanges of experience. Its activities include:

- A Web page (www.undp.org/pppue) designed and written by PPPUE and Yale, containing: information on the PPPUE program; searchable databases; articles, research, and policy papers; materials for distance learning; links to related sites; information on PPP courses and events; and other facilities for information exchange among practitioners and experts.
- Publications, training materials, policy and research papers prepared by PPPUE personnel, faculty and graduate researchers at Yale, and other collaborators. Topics covered include the spectrum of public-private structures being used; the links between public-procurement requirements and PPP; the Clean Development Mechanism as a method for increasing private investment in developing countries; lessons learned about joint venture PPPs; methods for linking formal and informal providers of urban water and waste services; and many more. The vast majority of these materials are available on the Web site, and more are being added.
- A collaborative learning course designed and led by Yale personnel. Entitled "Using Public-Private Collaboration to Improve the Delivery of Urban Environmental Services in Developing Countries," the course pulls together the lessons learned to date in a thirteen-session seminar. Since 1999, over twenty universities from Africa, Asia, Latin America, and Central Europe have participated. Faculty at each of these institutions work with local students to explore the course content and see how it fits their local environmental priorities. Lecture notes, charts, and class summaries are posted on the PPPUE Web page, and Internet-based interactions are encouraged among students and faculty. Several collaborators have adapted the course materials for use with nonacademic audiences — precisely the desired result.

- Application of the lessons learned through work with UNDP country offices by PPPUE and Yale personnel. The information collected on PPP has been used by UNDP country office personnel in locations ranging from the Philippines, to China, Nepal, and Lebanon.

As the School continues to confront the challenges of a rapidly urbanizing world, the Yale–UNDP Collaborative Program adds an international component to the learning experience at F&ES.

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 interns have taught hands-on environmental education programs to more than 3,600 New Haven students in twenty-seven public schools. Our current environmental education initiative, Open Spaces as Learning Places, teaches New Haven elementary school students about environmental stewardship through exploration of open space sites in their communities. Topics include forest structure and dynamics, water cycles, nutrient cycling, wildlife biodiversity, and the connections between species and habitat diversity. Some highlights of the program include canoeing trips on the Mill, West, and Quinnipiac rivers, studies of aquatic life at local ponds, hiking trips through East and West Rock parks, and geologic inquiry at the historic Grove Street Cemetery,

the first private cemetery in the United States. In the Open Spaces program, students learn environmental stewardship through experiencing the work of their own 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 twenty 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 GLOBAL INSTITUTE OF SUSTAINABLE FORESTRY

Since its founding in 1901, 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, established in 2000 by the dean and a group of F&ES faculty members, 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. Forestry at Yale is broadly defined to include all aspects of forest management and conservation. 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.

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). Several times a year, the Global Institute convenes forums on significant issues in forest sustainability, with participants drawn from the widest possible array 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.

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.

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, a working definition of sustainable forestry, landscape and watershed management techniques and technical tools, and 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 in charge of the institute and many of its 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 fixing, and storage). 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 biodiversity of the surrounding landscape. Some of the subjects covered in this program are sustainable forest management, criteria and indicators, forest certification; reforestation with native and exotic species; plantation silviculture; ecosystem restoration; recovery and conservation of biodiversity; carbon sequestration by tropical forests and plantations; 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 on the relationships of physiology, morphology, and genetics of forest plants to silviculture and sustainable forestry. The main objectives 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.

Current research is focused around two projects, the first of which is 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 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 (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 to determine optimal habitats for native species for sustainable forestry.

The second ongoing 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.

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 sustaining private forests. The Program on Private Forests promotes 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 north-eastern United States.

Sustaining Family Forests Initiative. The Yale Program on Private Forests is leading a U.S. national collaboration of government agencies, industry, NGOs, certification systems, landowners, and academics organized to gain comprehensive knowledge about family forest owners. Using social marketing methods, the project is aimed at creating credible, useful information about the family forest 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 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. Students are involved in all aspects of the program, including planning and organizing forums and speaker series, and conducting research.



Yale Forest Forum

The Yale Forest Forum (YFF) serves as the dialogue and convening function of the institute. 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 be created: "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.

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

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 external organizations and universities. These relationships enrich the School and add 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, Law School, School of Management, the School of Medicine's Department of Epidemiology and Public Health, and the Graduate School's programs in International Relations, International Economics, and Development Economics. For further information on joint degrees, please refer to Joint Master's Degree Programs and Joint 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, 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. A growing Internet service makes catalogue data for more than one million of these specimens and objects available online at www.peabody.yale.edu. Workshops and laboratories in the fields of paleontology, archaeology, zoology, and evolutionary biology make the Peabody a working museum, where public exhibition, research, and teaching intersect.

The School of Forestry & Environmental Studies maintains a close association with the Peabody. The museum's director and curators provide support for a concentration in museology under the F&ES Master of Environmental Studies program. 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 non-governmental organizations. This new program is multidisciplinary, with the combined resources of seven of the University's faculties, and 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.

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 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 the TERI School of Advanced Studies, which was granted "Deemed-to-be-University" status by the government of India in 1998.

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.

TSINGHUA UNIVERSITY

Tsinghua University in Beijing is one of the leading universities in China. The School of Forestry & Environmental Studies and the Department of Environmental Sciences and Engineering at Tsinghua University are partners in the Environment and Sustainable

Development Leadership Program (ESDLP). ESDLP provides leadership training for municipal officials from cities throughout China. ESDLP offers mayors and other officials in charge of city planning, construction, and environmental protection an intensive six days of seminars on urban sustainable development trends, challenges, and opportunities; sustainable development in urban ecosystems; and the principles and methods of industrial ecology. The program starts at Tsinghua University in Beijing, then moves to Yale. Following the six days of seminars, the participants go on a ten-day study tour in the United States.

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.)

PREPARATION FOR ADMISSION

The School welcomes applications from individuals who have undergraduate degrees in the biological and physical sciences, engineering, social sciences, 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 permits students to take greater advantage of course work 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. For these reasons, 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.

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. The Committee on Admissions therefore favors applicants who have successfully completed the courses listed below before beginning a degree program at the School. 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 | c. political science |
| b. introductory economics
(micro and macro) | d. sociology |

Students who wish guidance in arranging their undergraduate programs in anticipation of graduate study at Yale are invited to correspond or consult with the Admissions staff.

APPLICATION REQUIREMENTS

Applicants must have a college or university bachelor's level degree and are required to provide the following materials:

1. a completed application form,
2. a résumé/curriculum vitae,
3. a personal statement discussing reasons for applying to F&ES and career plans (750-word maximum),
4. one official transcript from each college and/or university attended (all non-English transcripts must be accompanied by official English translations),
5. three letters of reference (academic and/or professional),
6. an official GRE/GMAT/LSAT score report (copies will not be accepted),
7. an official TOEFL score report if English is not a native or customary language of instruction (copies will not be accepted), and
8. the application fee (\$70 online, \$90 paper).

All application materials should be sent to the Office of Admissions, Yale School of Forestry & Environmental Studies, 205 Prospect Street, New Haven CT 06511-2509, U.S.A. (See Application Procedures for detailed instructions.)

All applicants must have satisfactory undergraduate records, 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. The School looks for students capable of making effective contributions to scientific knowledge or to professional service in addressing environmental problems. The School gives special weight to relevant experiences obtained subsequent to graduating from college. Clarity regarding professional career goals is a critically important part of the applicant's personal statement.

Faculty teams read all applications to the master's degree programs. The final decision on admission rests on an integrated assessment of all 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.gmat.org/gmac, or www.lsac.org. Official GRE and GMAT test results will be sent directly to the School by the testing services and generally take two to three weeks to arrive.

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). When taking the TOEFL, 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. Official test results will be sent directly to the School by the testing service and generally take two to three weeks to arrive.

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 the Yale School of Forestry & Environmental Studies. 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.

APPLICATION PROCEDURES

Application forms for admission to studies leading to the professional and research degrees of M.E.M., M.E.Sc., M.F., or M.F.S. may be acquired in several ways. The application form explains in detail the supporting documents required by the School.

1. Online application, available at <https://www.applyweb.com/apply/yalesf>.
2. Download an application form from our Web site at www.yale.edu/environment/admissions/masters_ap.pdf. The form should be mailed directly to the Office of Admissions, Yale School of Forestry & Environmental Studies, 205 Prospect Street, New Haven CT 06511-2509, U.S.A.
3. E-mail fesinfo@yale.edu for an application form and it will be mailed to you.
4. Call the Office of Admissions at 1.800.825.0330 to request the form.
5. Write directly to the Director of Admissions, Yale School of Forestry & Environmental Studies, 205 Prospect Street, New Haven CT 06511-2509, U.S.A.

The deadline for applications is January 8, 2007. Students are admitted only in the fall term (August/September).

Learning about F&ES

The Admissions Web site is full of information about the School, and hard copies of information may be requested at fesinfo@yale.edu. The best way to get to know the School is to come to New Haven to visit, if possible.

Three Open Houses for prospective students are held during the fall term (October, November, and December); a fourth is held in March for admitted students. The Open Houses are full-day programs, including breakfast and lunch. Participants meet faculty, students, and staff to learn about the mission and goals of the School, 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–January and April–May when school is in session. Prospective students will meet with members of the Admissions staff and current students. To register for an Information Session please e-mail us at fesinfo@yale.edu, or call the Office of Admissions at 1.800.825.0330. F&ES faculty and staff also conduct outreach events around the United States and abroad. Please visit the Admissions Web site at www.yale.edu/environment/admissions/ for our event schedule.

We encourage prospective students to visit campus at other times if they are unable to attend an Open House or Information Session. It is best to visit campus on 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 any classes of interest with no advance notice; the class schedule each term is posted on the “Registrar’s Office” page of our 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 as described above.

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.

Admissions: Doctoral Degree Program

The doctoral program is designed to develop the broad knowledge, analytical powers, technical skills, and creative thinking demanded of leaders in environmental and natural resources disciplines. Applicants should hold a bachelor's or master's degree in a field related to 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 8, 2007. Before applying to the doctoral program, applicants are encouraged to discuss their career interest with one or more F&ES faculty members.

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, 2006 – 2007

Master's Programs

The 2006–2007 tuition for master's degrees (Master of Environmental Management, Master of Forest Science, Master of Environmental Science, and Master of Forestry) is \$25,800. 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 summer training modules in technical skills, 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 they take.

For 2006–2007, a single student should also anticipate expenses of \$1,130 for books and supplies, \$1,450 for health insurance, and living expenses of approximately \$11,220 for room and board.

A fee of \$900 is charged each participant in the training modules in technical skills. A single student in the module program should anticipate living expenses of approximately \$965 for a three-week period.

Doctor of Philosophy Program

The tuition for the Ph.D. degree is \$29,300. Most doctoral students receive a School fellowship that covers the cost of their tuition and provides a stipend for the nine-month academic year, for the first four years of their program. Doctoral students must pay a nominal continuing registration fee for no more than four years thereafter.

For 2006–2007, students should also anticipate expenses of \$1,025 for books and supplies. A single student can expect living expenses of approximately \$15,570 (9 months) and \$20,238 (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 typically the first week 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 \$250 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 2006–07, the last days for refunding federal student aid funds will be November 3, 2006 in the fall term and April 3, 2007 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 15, 2006 in the fall term and January 25, 2007 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 30, 2006 in the fall term and February 10, 2007 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: October 25, 2006 in the fall term and March 8, 2007 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

Beginning October 2006, Yale will no longer mail paper bills. The official means of communicating monthly financial account statements will be through the University's Internet-based system for electronic bill presentation and electronic 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. 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	an additional 110
by October 1	an additional 110

<i>If spring-term payment in full is not received</i>	<i>Late charge</i>
by December 1	\$110
by January 2	an additional 110
by February 1	an additional 110

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 \$20 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

Yale University eBill-ePay, the University's system for electronic bill presentment and electronic payment, 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. The student's bank account information is password protected and secure. The student receives a printable confirmation receipt. Students can make payments twenty-four hours a day, seven days a week, up to 4 P.M. on their due date and avoid late fees. (The eBill-ePay system will not be available

when the system is undergoing upgrade, maintenance, or repair.) Students have control over access to their account. A student can also authorize up to three people 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. We know from experience that payments made through such services arrive without proper account identification and always require manual processing that results in delayed crediting to the student's account, as well as resulting late fees and anxiety. Students should use Yale eBill-ePay to pay online.

Yale Payment Plan

The Yale Payment Plan is a payment service that allows students and their families to pay tuition, room, and board in eleven or twelve equal monthly installments throughout the year based on individual family budget requirements. It is administered for the University by Sallie Mae Business Office Solutions. To enroll by telephone, call 800.635.0120. The fee to cover administration of the plan is \$65. The deadline for enrollment is June 22. For additional information, please contact Sallie Mae Business Office Solutions at the number above or visit their Web site at www.tuitionpay.com.

Yale Charge Account Plan

Students who sign and return a Yale Charge Card Authorization form will be able to charge designated optional items and services to their student accounts, including toll calls made through the University's telephone system. The University may withdraw this privilege from students who do not pay their monthly bills on a timely basis. The authorization form is available at <http://yale.edu/sfas/financial/ChargeAccAuthBillAgree.pdf>.

MASTER'S FINANCIAL AID, 2006 – 2007

Policy and Procedures

The School offers a combination of scholarships, 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 February 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 2006 for matriculation in fall 2007. New forms are available at the School's Web site, www.yale.edu/environment/financial_aid, or from the Financial Aid Office anytime after November 15.

U.S. citizens requesting financial aid must complete:

- the Free Application for Federal Student Aid (FAFSA), available in public libraries and on the Web at www.fafsa.ed.gov,
- a School of Forestry & Environmental Studies Financial Aid Application, and 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, and 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. 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. 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
Strachan Donnelley Scholarship
Strachan and Vivian Donnelley Scholarship
Enid Storm Dwyer Scholarship
Edith and Johannes Fröndt Scholarship
Alexandra Goelet Scholarship
John S. Griswold Scholarship
Stuart H. Harrison Fellowship
M. Albin Jubitz Scholarship
Randall Katz Scholarship
John A. MacLean Scholarship
Josephine Merck Scholarship
Wendell A. Mottley Scholarship
Carl F. Norden Family Scholarship
Overhill Foundation
William Waxter Scholarship
Mason Willrich 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, or Georgia

GE Fund Environmental Scholars Program

Students from traditionally underrepresented communities

Corwith Hamill Scholarship

Fletcher Scholarship

Students from historically underrepresented communities

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 Fellowship

Preference given to women or students from historically underrepresented communities

SCHOLARSHIPS FOR INTERNATIONAL STUDENTS

Beinecke Scholarship

Evan Frankel Fellows

Students from developing countries

Abigail Disney and Pierre Hauser Scholarship

Goldman Scholarship

Students from Latin America, Middle East, Asia, or Africa

Victor L. Gonzalez Family Scholarship

Students of Puerto Rican origin or, secondarily, of Hispanic origin, seeking a degree in forestry or industrial environmental management

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

Wolfensohn Family Foundation

Students from developing countries

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

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

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

Grantbam Family Environmental Fellowship

Third-year student pursuing joint degrees with the School of Forestry & Environmental Studies and the Yale School of Management

Kroon Family Tercentennial Fund

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 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.yale.edu/environment/financial_aid. 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.yale.edu/seo. 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) are awarded to eighty F&ES students as part of financial aid. These positions pay \$13 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 are also available at the University. Each department makes its own hiring decisions; therefore, interested students must contact them directly. The typical salary is \$3,500 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 \$18,500 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. 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 GATE Y-Loan. Students who qualify can use this loan to cover up to the full cost of attendance, less any other financial aid received.

The GATE Y-Loan has a high approval rate for all students including international students and permanent residents and offers a competitive variable interest rate that changes on the first day of each quarter (January, April, July, October). The loan has no origination fees and offers a twenty-year repayment schedule as well as a six-month grace period after graduation or enrollment of less than half-time. The loan program also offers other incentives such as no payments during enrollment, no prepayment penalties, combined billing, and the ability to pay ahead while in repayment. More information about the GATE Y-Loan and the Program Authorization Form can be found at www.yale.edu/environment/financial_aid.

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 Family Support Form, which is available on the School Web site: www.yale.edu/environment/financial_aid. Both must be submitted by February 15. 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 Yale's preferred alternative loan, the GATE Y-Loan. The Y-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.yale.edu/environment/financial_aid). International students are also encouraged to seek support from their government, employer, or various international agencies.

Four scholarships will be offered to meet the full need of international students from Africa, Asia, and Latin America. All admitted students are automatically considered. Awards 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 Joint Japan/World Bank Scholarship Program for students from countries supported by the World Bank,
- 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, through the Russell E. Train Fellowships, 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).



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.

New F&ES Facility with Sustainable Design

With the generous support of the Kroon family (Richard Kroon, Yale College '64) and a number of other donors, F&ES has begun the design for construction of a new building to be located adjacent to Sage Hall. When completed, the new building will enable the School to consolidate most of its faculty and staff in a connected set of three buildings at the southwest corner of Science Hill. The new building is being 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.

The building 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 facility will realize the sustainability ideals of F&ES in built form, and provide an instructional tool for students and faculty. The new facility is intended to be a climate-neutral facility 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 receives some 650 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 on pages 181–182.

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 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, and are supplemented by an in-house CD-ROM resource, Wildlife and Ecology Studies Worldwide. 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 School owns and manages approximately 11,000 acres of forest land. The main goals of this ownership are to provide education, research, and professional opportunities for the faculty and students. The forest consists of eight tracts located in Connecticut, New Hampshire, and Vermont. A majority of the activity is concentrated on the *Yale-Myers Forest*, a contiguous parcel of 7,840 acres in northeastern Connecticut. Most of the School forests are mixed hardwoods (central hardwoods in the South and northern hardwoods in Vermont), but extensive stands of conifers exist, including some plantations. Almost all New England soil conditions are found on these lands from wetlands to droughty alluvial sand deposits.

The forests are used by faculty and students as laboratories for teaching and research. A member of the faculty serves as director, and all day-to-day management is carried out by students working as interns or managers. The forest is maintained as a working forest, which includes selling timber and other products from the land. Students working on the forest get experience as land managers, including such social aspects of management as relationships with neighbors and compliance with local and state regulations.

Much of the research on the forest involves experimentation on the effects of management, including harvesting, as well as a significant number of aquatic and terrestrial wildlife ecology research projects. Research opportunities are under the supervision of any faculty member of the School and include biological, silvicultural, wildlife, economic, legal, and social studies. Wildlife ecology, hydrology, and silviculture are current major emphases. The forest is used for doctoral research. Many students complete summer internships on the forest either as managers or as research assistants.

The forest is used for field trips in many courses, and workshops are frequently held on these lands on such topics as timber harvesting and prescribed burning. Students often do their independent projects on the forest or in conjunction with the management of these lands. Short courses and demonstrations held on the forest show management techniques in wetland areas, wildlife habitat manipulation, ecosystem restoration, and pathways of forest stand development.

Students working on the management of the forest use Geographic Information Systems as well as other databases to incorporate physical site characteristics (like topography and watercourses) with biological information (like the Continuous Forest Inventory system) and management information (like harvest maps). On the ground, students mark trees for thinning and harvest, lay out timber sales, conduct stand examinations and inventories, and maintain roads. In the office, students prepare tax documents, analyze data, prepare contracts, and write management plans.

In addition to the land controlled outright by the School, close working relationships exist with other forests that are used for education and research by faculty and students. The *Great Mountain Forest* in northwestern Connecticut (approximately 6,800 acres) is available to the School through the courtesy of Edward C. Childs, B.A. '28, M.F. '32, and his family. The lands of the South Central Connecticut Regional Water Authority (approximately 20,000 acres) in New Haven county are one of the oldest managed forests in the western hemisphere. The University also owns several ecological preserves (approximately 370 acres) 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 covering a wide range of environmental topics. Recent titles include *Americans and Climate Change: Closing the Gap between Science and Action*; *Confronting Sustainability: Forest Certification in Developing and Transitioning Countries*; *Agroecology and the Struggle for Food Sovereignty in the Americas*; *Livability and Smart Growth*; *Environmental Planning in Sub-Saharan Africa*; *The Industrial Platinum Cycle for Russia*; *Inventory and Analysis of Yale University's Greenhouse Gas Emissions*; and *Can the Anchor Hold? Rethinking the United Nations Environment Programme for the 21st Century*. For a complete listing of more than thirty titles, free downloadable PDFs of all publications since 1995, and ordering information for printed copies, go to www.yale.edu/environment/publications.

STUDENT ORGANIZATIONS

The School has many student-run interest groups. Current student groups include the student chapter of the American Water Resources Association (AWRA), Clarify our Goals, Visions, and Strategies (CLARITY), the Coalition for Agriculture, Food, and Environment (CAFÉ), the Doctoral Research and Teaching (DRAT), the Environment and Development Interest Group (EDSIG), Environmental Justice (EJ), the Faith Environment Religion Nature Spirituality Network, the Forestry Club (FC), the Forest

Stewards Guild, 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 (LASIG), Loggerrhythms (LOGS), the Multi-Ethnic Student Association (MESA), Other Voices – Alternative Perspectives on Environmental Problems (OV), 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 Society for Marine and Coastal Studies, the Student Advisory Committee (SAC), Special Trees in the Forest (STIF), the Western Resource Group (Westies), the Women in Environmental Leadership (WEL), the Yale Environmental Health Association (YEHA), and the Yale Environmental Law Association (YELA). 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.

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, with an Executive Council 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 Executive Council functions both as a committee of the whole and through several standing committees; officers of the Executive Council welcome inquiries from any F&ES alumni/ae who may wish to be considered for seats on the Executive Council 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 any inquiries or concerns.

PROFESSIONAL DEVELOPMENT

Career Development Office

The overall goal of the School's Career Development Office (CDO) is to assist students in charting a course that will lead them to a career fitting their interests, skills, and abilities. Our diverse resources and services enable users to learn about themselves, determine how their accumulated experiences will translate into meaningful career goals, and how to conduct effective job searches. To meet this goal, the office offers an extensive collection of resources and programs to help students set personal and career goals, assess the environmental, conservation, and natural resources market, network and conduct job searches, write resumes, interview, prepare grant proposals, seek internships, look for fellowships and other funding opportunities, and address other contemporary career-related issues. Alumni/ae seminars, career days, and recruiting fairs, as well as our worldwide alumni/ae network, provide students with an opportunity to make contacts and explore career possibilities. The CDO's Global eRecruiting Outreach (GeO) Program links students, alumni/ae, and employers through job and internship postings and on and off campus recruiting events; see <http://yalefesgeo.erecruiting.com/er>.

The Career Development Office has an extensive collection of informational aids describing federal, state, for-profit, and not-for-profit natural resource organizations and opportunities in the United States and around the world. The office subscribes to all the major job vacancy announcement publications in a format that is accessible to students and alumni/ae anywhere via the World Wide Web. The office's Web site at www.yale.edu/fescareers/ provides much additional career information to users, including activities of graduates six months following graduation, as well as details on each year's summer internship and research project activities. Salary information about recent graduates is also included. Students attending the School have the most important career resources available to them on a daily basis — faculty and fellow students. Individual professors provide a wealth of information and career assistance, and the School's student body represents an exceptional degree of experience and expertise. Students interacting with one another develop a lifetime resource of professional contacts.

The office is open to all master's and doctoral students and alumni/ae of the School of Forestry & Environmental Studies. Students' spouses and significant others may also use the service to assist their local job searches. Yale College students and other Yale graduate and professional students seeking environmental careers may also use many of the resources.

Internships/Summer Research

Internships and summer research have long been an important part of the educational program at Yale. They provide a unique opportunity to combine academic knowledge with practical experience, to enhance skills, and to gain professional confidence. Students are assisted by the Career Development Office, faculty, alumni/ae, and other students in their search for internships and summer research experiences. Attention is

given to students to help them locate opportunities that meet their individual needs and interests.

Given the School's strong ties with natural resource, environmental, and conservation organizations worldwide, internship and research possibilities are virtually unlimited. Typical internships/research projects occur between the first and second years of the program; occasionally internships/research projects last for longer periods of time. The following list shows the rich and diverse experiences that F&ES students had in a recent summer. Similarly impressive lists can be found on the Web at www.yale.edu/fescareers/cdostud_info.htm.

Summer 2005 Internships and Research Projects

NGOS AND OTHER NOT-FOR-PROFIT GROUPS

Alaska Conservation Foundation, Research Assistant, AK
 CARE Indonesia Health Program for Tsunami Affected Region, Researcher, Indonesia
 Casey Trees Endowment, Geographic Information Systems Team Leader, DC
 Center for Coastal Studies, Humpback Whale Research Intern, MA
 Defenders of Wildlife, Conservation Policy Intern, DC
 Ecotrust, Ecotrust Forests LLC Project Intern, OR
 Environmental Defense, Ocean Conservation Research Assistant, CA
 Environmental Entrepreneurship Group, Monitoring and Evaluation Intern, Peru
 Environmental Law Institute, Wetlands and Wildlife Habitat Migration Program Intern, DC
 Environmental Resources Trust, Program Analyst, DC
 Eyak Preservation Council, Environmental Outreach Intern, AK
 Greenbelt Alliance, East Bay Field Office Intern, CA
 Humane Society of the United States, Student Researcher in Urban Wildlife Program, CT
 IUCN – The World Conservation Union, Regional Environmental Economics Programme Intern, Sri Lanka
 Leelanau Conservancy, Land Protection Assistant, MI
 Model Forest Policy Program, Intern/Public Participation Researcher, VA
 Murie Center, Fellow/Intern Coordinator, WY
 Natural Resources Defense Council (NRDC), China Clean Energy Program Intern, NY
 Nature Conservancy (TNC), Japanese Stilt Grass Mapping and Management Researcher, WV
 Nature Conservancy (TNC), Global Climate Change Summer Associate, VA
 Nature Conservancy (TNC), Habitat Assessment Team Research Assistant, VA
 Nature Conservancy (TNC), Intern/Researcher, Panama
 Nature Conservancy (TNC), Government Relations Intern, VA
 Nature Conservancy (TNC), Marine and Coastal Programs Intern, Indonesia
 New England Fisheries Management Council, Ecosystem Approaches to Fishery Management Intern, MA

Northern Rockies Conservation Cooperative, Research Assistant, WY
Project for Public Spaces, Research Intern, NY
Residents' Committee to Protect the Adirondacks, Intern, NY
Rocky Mountain Institute, Intern, HI
Sierra Nevada Alliance, Land Use Program Assistant, CA
Sitka Center for Art & Ecology, Crowley Creek Collaboration, Summer Associate, OR

BUSINESS AND INDUSTRY

Asia Pacific Resources International Limited (APRIL), Sustainable Forestry Program
Intern, Singapore
Brightworks, Consultant — Sustainable Design, OR
GE Commercial Finance, Summer Associate, CT
GreenOrder, Summer Associate, NY
Herbert Newman and Partners, Architectural Designer, CT
International Copper Association, Researcher, Bulgaria
LifeScan, Inc., a Johnson & Johnson Company, Associate Marketing Manager Intern,
CA
McConnell Valdés, Summer Legal Associate, Puerto Rico
Mithun Architects + Designers + Planners, Research Intern, WA
Morgan Stanley, Utilities Group Associate, NY
Natsource LLC, Greenhouse Gas Credits Aggregation Pool Summer Associate, DC
Northern Sky News, Correspondent/Editor, ME
Shell Oil/Motiva Enterprises, Industrial Hygiene Intern, TX
United Illuminating, Electricity Generator Capacity Researcher, CT

EDUCATION

Alterra, Wageningen University, Water and Climate Researcher, Netherlands
International Plant Genetic Resources Institute, Intern, Italy
Oregon State University, Researcher, OR
University of Victoria, Society for Ecological and Coastal Research, Marine Research
Intern, Canada
University of Wisconsin-Madison, South East Asian Summer Studies Institute
Researcher, WI
Yale Center for Environmental Law and Policy, Research Assistant, CT
Yale University Forests, Forest Crew Member, CT (4)
Yale University, Urban Resources Initiative (URI), Community Greenspace Program
Forester, CT

GOVERNMENTAL AND PUBLIC SECTOR GROUPS

Alaska Fire Service, Research Manager, AK
Bureau of Land Management, Hydrology SCEP Intern, CO
Capitol Office of Congressman Frank Pallone, Fisheries, Ocean and Coastal Policy
Fellow, DC

City of Easton Planning and Economic Global Development Department, Intern, PA
Global Environment Facility (GEF), Bilateral Strategy/Climate Change Researcher,
DC

Global Environment Fund, Analyst, DC

Institute of Freshwater Fisheries, Northern Division, Road Crossing Impact on
Freshwater Fish Movement Researcher, Iceland

National Park Service/Student Conservation Association, Business Planning
Consultant, HI

National Renewable Energy Laboratory, Clean Cities Program Intern, CO

New York State Attorney General, Legal Intern, NY

North Dakota Department of Commerce, Coal Country Development Initiative
Intern, ND

Organization of American States, Building the Inter-American Biodiversity
Information Network, DC

Overseas Private Investment Corporation, Environmental Affairs Intern, DC

Tembe Elephant Park, Intern, South Africa

United Nations Development Program, Researcher, Costa Rica

United Nations Development Program, Environment Portfolio Unit, Intern,
Philippines

United Nations Relief Works Agency (UNRWA), Neirab Rehabilitation Project
Intern, Syrian Arab Republic

U.S. Environmental Protection Agency, Biologist, MA

U.S. Fish and Wildlife Service, Refuge Operations Specialist, PA

U.S. Government Accountability Office (GAO), Natural Resources and Environment
Analyst, MA

World Bank, Water & Sanitation Program Intern, DC

U.S. RESEARCH (NON-HOSTED)

Analysis of the Stocks and Discard Flows of Copper in New Haven, CT

Analysis of the Stocks and Discard Flows of Iron in New Haven, CT

Research on Frog Habitats in Northern California, CA

Controls on Above-Ground Productivity in Three Salt Marshes on Long Island
Sound, CT

Effects of Urban Storm Runoff on Riverine Mercury Pollution, CT

Kermit Was Wrong – It Is Easy Being Green, CT

Mercury Methylation Pathways in Connecticut Freshwater Systems, CT

Phytoremediation of Organo-Chlorine Molecules by Cucurbita Pepo, CT

Impacts of Biophilic Design, DC

NON-U.S. RESEARCH (NON-HOSTED)

Middle Path to Development: Understanding of the unique path to development as it
aims to balance modernization with preservation of the country's environment and
culture, Bhutan

- Qualitative Analysis of Future Feasibility of Ecotourism through Impact of Current Environment, Forest, Tourism and Development Policies of the Royal Government, Bhutan
- Forest Landscape Management in Yunnan, China
- Survey on Sustainable Growth in China's Major Cities, China
- Bird Species Composition in Living Fences, Costa Rica
- Water Sustainability in Biological Corridor: Assessing social and physical aspects within local communities, Costa Rica
- Chocolate Dreams: Sustainable alternative development strategies in Ecuador's Amazon rainforest, Ecuador
- Estimates of the Number, Age, and Size of the Forest Elephants in the BIA National Park, Ghana
- Forest Plantation Development and Alternative Livelihood Opportunities for Forest Fringe Communities: Case Studies – Yaya Forest Reserve, Sunyani Forest District, Brong-Ahafo Region and Worobong South Forest Reserve, Fanteakwa Forest District, Eastern Region, Ghana
- Examining Distribution and Reproductive Ecology of *Dicorynia Guianensis*' Potential for Sustainable Timber Harvest, Guyana
- Land Use and Water Chemistry in Primary Streams of the Western Himalaya, India
- An Analytical Approach to Measuring Carbon in Tropical Peat Swamp Forests: Impacts of land use and fire on storage and atmospheric emissions, Indonesia
- Quantifying Carbon Storage in Forest Ecosystems across West and South Kalimantan, Indonesia
- Emergence of Semi-Intensive Shrimp Aquaculture, Madagascar
- Socio-Economic Importance of Mangroves, Madagascar
- Watershed Protection for Ecosystem Services in the Makira Forest Area, Madagascar
- Social Landscape of the Namanga-Mangochi Road, Malawi
- Environmental Rights as Human Rights in South Asia, Nepal and Kashmir Valley
- Impact of Community Development Programs on Biodiversity Conservation among Support Zone Communities of Cross River National Park, Nigeria
- Comparisons of the Growth and Yield among Five Native Tree Species in Pure and Mixed Plantations at Las Lajas, Panama
- Physiological Ecology of Reforestation Species across a Climate Gradient, Panama
- Reforestation in the Tropics: Anatomy of native tree leaves across a climatic gradient, Panama
- Rehabilitating Abandoned Pastures in Panama: Control of the invasive exotic grass, *saccharum spontaneum*, through shading, Panama
- Role of Soil Biotic Factors in Plant Growth: A comparative study of two sites, Panama
- Variation of the Understorey Light Regime beneath the Canopy of Nine Native Species across a Rainfall Gradient, Panama
- Designing a conservation plan for the Huancabamba Mountain Range in the Andes, Peru

Review of Options for Conservation Finance: The Case Studies of the Peruvian Environmental Conservation Fund, PROFONANPE and the Caribbean Fund, Marfund, Peru, Guatemala
 Private Investment and Its Social Impacts, Philippines
 Assessing the Potential Impacts of a Greenspace Intervention in and around Orphanages in Kigali, Rwanda
 Transboundary Resource Management in the Lubombo Transfrontier Conservation Area, South Africa, Mozambique, Swaziland
 Fishing Industry in Lake Victoria: Reforming Shared Natural Resources' Governance, Tanzania
 Restoring Degraded Ecosystems and Economies in the Riverland of South Australia and in East Gippsland, Victoria and Australia

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 www.yale.edu/fescareers/cdostud_info.htm.

Summary data from the Class of 2005 master's graduates: 26 percent entered the not-for-profit sector; 24 percent entered the public sector/government; 19 percent went into business; and 13 percent are working in education or have gone on for further degrees. The remaining 18 percent are seeking employment or have not yet reported.



University Services and Resources

A GLOBAL UNIVERSITY

In celebrating the Yale Tercentennial in 2001, President Richard C. Levin gave special weight to “Yale’s intention to become a truly global institution” by building on existing relationships and international activity. Since that time, the University has made great strides to intensify and broaden its efforts in the international arena. Exchanges of students, faculty, researchers, and fellows have grown significantly. Programs of study and research across the University increasingly incorporate international subject matter. To enhance all its initiatives in this direction, the administration has created a number of organizations and other specialized resources.

The most recently established organizational unit, inaugurated in 2003–2004, is the Office of International Affairs, which serves as an administrative resource to support the international activities of all schools, departments, offices, centers, and organizations at Yale; to promote Yale and its faculty to international audiences; and to increase the visibility of Yale’s international activities around the globe. Web site: www.yale.edu/oia.

The Office of International Affairs joins a range of other institutional resources, including:

Yale Center for International and Area Studies (YCIAS), the University’s principal agency for encouraging and coordinating teaching and research on international affairs, societies, and cultures; www.yale.edu/ycias.

Yale Center for the Study of Globalization, which draws on the rich 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, while helping to enrich debate through workshops, conferences, and public programs; www.ycsg.yale.edu.

Office of International Students and Scholars (OISS); www.oiss.yale.edu. See the description on page 180.

Yale World Fellows Program, which hosts twelve to eighteen Fellows from outside the U.S. each year for a term of concentrated study and close contact on the Yale campus; www.yale.edu/worldfellows.

For additional information: “Yale and the World” is a compilation, on the Yale Web site, of resources for international students, scholars, and other Yale affiliates interested in the University’s global initiatives: <http://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 4:30 P.M., Monday through Friday.

Applications for 2006–2007 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 203.432.0177.

The University's Off-Campus Housing service, limited to current or incoming members of the Yale community, is located at 155 Whitney Avenue, 3d floor, and is open from 8:30 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 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 graduate meal plan offers meal service at the Hall of Graduate Studies and Commons Dining Hall for ten meals per week, plus four guest passes per year, and "Eli Bucks" to be spent at the client's leisure. Additional Eli Bucks can be purchased at a discount through Yale University Dining Services. A favorite choice, Eli Bucks operate as a declining balance and are accepted in all campus locations in lieu of cash.

Yale University Dining Services 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: A&A Penthouse at the School of Architecture, Divinity School Café on Prospect Street, the Café at Kline Biology Tower, Donaldson Commons at the School of Management, and Durfee's, a traditional convenience store offering coffee, snacks, and sandwiches among other items. For students choosing to dine in any of Yale's residential college dining rooms, "all-you-care-to-eat" meals are offered for one low price for breakfast, lunch, and dinner.

Payment for these meals can be arranged by securing a Yale charge account from the Office of Student Financial Services at 246 Church Street. Inquiries concerning food services should be addressed to Yale University Dining Services, 246 Church Street, PO Box 208261, New Haven CT 06520-8261; telephone 203.432.0420. Dining Services can also 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/uhs.

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 Hygiene. 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/uhs/for_students/student_hb/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/uhs) 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 or students paying less than half tuition 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/uhs) 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 leaves 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/uhs). 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/uhs). 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: 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, 2006. 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 monthly international coffee hours, daily English conversation groups, 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 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.

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 resources of Yale University serve all students, faculty, and staff. These resources are the University Chaplaincy (located on the lower level of Bingham Hall on Old Campus); the Church of Christ in Yale University, 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 nondenominational ministries; and student religious groups such as the Baha'i Association, the Yale Hindu Council, and the Muslim Student Association. Additional information is available at www.yale.edu/chaplain.

LIBRARIES

The Yale University Library consists of the central libraries — Sterling Memorial, Cross Campus, 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 page 162). 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 celebrating the fiftieth anniversary of the opening of the Louis I. Kahn building with a complete renovation, reopening in late 2006. Gallery programming remains active, with permanent and collection exhibitions in the Egerton Swartwout building.

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. Kiphuth Exhibition Pool; the Brady Squash Center, a world-class facility with fifteen international-style courts; the Adrian C. Israel Fitness Center, a state-of-the-art exercise and weight-training complex; the Brooks-Dwyer Varsity Strength and Conditioning Center; the Colonel William K. Lanman, Jr. Center, a 30,000-square-foot space for recreational/intramural play and varsity team practice; the Greenberg Brothers Track, an eighth-mile indoor jogging track; 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 and summer memberships at reasonable fees are available for faculty, employees, postdoctoral and visiting fellows, alumni, and student spouses.

The David S. Ingalls Rink, the Sailing Center in Branford, the Yale Outdoor Education Center (East Lyme, Connecticut), the Yale Tennis Complex, the Yale Polo and Equestrian Center, and the Golf Course at Yale are open to faculty, students, employees, students' spouses, and guests of the University at established fees. Up-to-date information on hours and fees 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 forty-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, 2006

Jennifer Anne Adler (B.A. Northwestern Univ.), California.
Tehmina Akhtar (B.A. Mount Holyoke Coll.), New York.
Jessica Miriam Albietz (B.S. Georgetown Univ.), California.
Aravinda Joy Ananda (B.A. Yale Univ.), Massachusetts.
Krista Breen Anderson (B.S. Bates Coll.), Massachusetts.
Eric Daniel Annes (B.A. Connecticut Coll.), New York.
Imelda Venzuela Bacudo (B.A. Univ. Philippines), Philippines.
Saima Pervaiz Baig (M.B.A. Southeastern Univ., Karachi Campus), Pakistan.
Megan Elizabeth Baroni (B.A. Syracuse Univ.), Connecticut.
Lisa Christine Bassani (B.A. Univ. Michigan), New Jersey.
Alice Campbell Bond (B.A. Univ. Georgia), Georgia.
Daniel Martin Braden (B.A. Dartmouth Coll.), New Hampshire.
Ellen LeAnne Brown (B.A. Univ. Illinois), Illinois.
Patricia Ndah Buah (B.Sc. Univ. Ghana), Ghana.
David Ellison Butman (B.A. Connecticut Coll.), Massachusetts.
Catherine Yejee Byun (B.A. Yale Univ.), Wisconsin.
Mohamad Abdullatif Chakaki (B.S., B.A. George Washington Univ.), Syria.
Ying Chi (B.S. East China Normal Univ.), China.
Fuphan Chou (B.A. Yale Univ.), New Jersey.
Min Li Choy (B.S. Univ. California [Berkeley]), California.
Dylan James Craven (B.A. Univ. Virginia), Washington.
James Brewster Cronan (B.S. Univ. Vermont), Massachusetts.
Jessica Lynn Darling (B.A. Univ. Colorado [Boulder]), Minnesota.
Rishiraj Das (B.S. Univ. California [Berkeley]), India.
Radhika Dave (B.S. Coll. of William and Mary), India.
Elizabeth Scholes Deliso (B.A. Coll. of the Atlantic), Arizona.
Reilly Renshaw Dibner (B.A. Yale Univ.), California.
Diana Hristova Dimitrova (B.Sc., M.Sc. Univ. Sofia), Bulgaria.
Konstantine Andreas Drakonakis (B.S. Univ. Vermont), Connecticut.
Oliver Okey Oji Enuoh (B.Sc. Univ. Calabar), Nigeria.
Eliza Huger Eubank (B.A. Univ. Colorado [Boulder]), South Carolina.
Debora Lyn Fillis (B.S. Boston Coll.), New York.
Erin Regina Flanagan (B.S.F.S. Georgetown Univ.; M.B.A. Univ. Virginia), New York.
Wendy Francesconi (B.A. Hunter Coll.), Colombia.
Jennifer Frankel-Reed (B.S. Willamette Univ.), Washington.
Ross Paul Geredien (B.S. Univ. Maine), Pennsylvania.
Alicia Loudon Gray (B.A. Lewis and Clark Coll.), Massachusetts.
Kaitlin Anne Gregg (B.A. Middlebury Coll.), New Hampshire.

- Jose Gonzalo Griebenow (B.S. Univ. Ricardo Palma; M.E.Sc. Univ. Nacional Agraria-La Molina), Peru.
- Ann Jennifer Grodnik (B.A. Univ. Vermont), Indiana.
- Jesse Muir Grossman (B.A. Carleton Coll.), Washington, D.C.
- Gudmundur Ingi Gudbrandsson (B.S. Univ. Iceland), Iceland.
- Katherine Elizabeth Hamilton (B.A. Univ. Michigan), Ohio.
- Maren Lissa Haus (B.A. Wake Forest Univ.), New Jersey.
- Emily Jeanette Hicks (A.B. Princeton Univ.), Texas.
- Stephanie Lasha Horn (B.S. Alabama A&M Univ.), Alabama.
- Eve Rachel Hornstein (B.A. Boston Univ.), Connecticut.
- Alexander Steven Hovani (B.S. Univ. Michigan), New York.
- Drena Marie Howard (B.S. South Carolina State Univ.), North Carolina.
- Yukiko Ichishima (B.A. Keio Univ.), Japan.
- Caley Ronald Johnson (B.A. Univ. Colorado), Colorado.
- Daniel Hutchins Jones (B.A. Yale Univ.; PH.D. Indiana Univ.), Kentucky.
- Kyle Elizabeth Jones (B.S. Univ. Michigan), Michigan.
- Jennifer Anne Karanian (B.S. Colorado State Univ.), Colorado.
- Laura Danielle Kiernan (B.S. Cornell Univ.), New Jersey.
- Taek Joo Kim (B.A. Korea Univ.), South Korea.
- Jayoung Koo (B.A. Korea Univ.; M.L.A. Seoul National Univ.), South Korea.
- Linda Anne Kramme (B.A. Bucknell Univ.), Washington.
- Radha Sharaschandra Kuppalli (B.A. American Univ.), Virginia.
- Virginia Rheutan Lacy (B.A. Univ. Virginia), South Carolina.
- Wei-Chien Lai (B.S. National Taiwan Normal Univ.; M.S. National Central Univ.), Taiwan.
- Hugo Sergio Lam (ENG.FOR. Univ. Nacional Agraria), Nicaragua.
- Danielle Brant Wirth Larson (B.A. Yale Univ.), New York.
- Deanna Nicole Lekas (B.S. Univ. Michigan), Michigan.
- Luisa Fernanda Lema Velez (B.S. Univ. Antioquia; ENG.FOR. Univ. Nacional de Colombia), Colombia.
- Melanie Pecora Loftus (B.A. Yale Univ.), Virginia.
- Rita Lohani (B.A., M.B.A. Clark Univ.), Nepal.
- Alison Kelly Macalady (B.A. Carleton Coll.), Colorado.
- Ikuko Matsumoto (B.A. Kyobe Gakuin Univ.), Japan.
- Jennifer Claire McKnight (B.A. Hobart and William Smith Coll.), New York.
- Mary Kathleen McNealy (A.B. Princeton Univ.), New Jersey.
- Christopher Ryan Meaney (B.S. Univ. New Hampshire), Connecticut.
- Madeleine Suzanne Meek (B.A. Yale Univ.), New York.
- Caren Tracy Mintz (B.A. Williams Coll.), New Jersey.
- Yuko Miyata (B.A. Yokohama National Univ.), Japan.
- Hatsy Harriet Moore (B.A. Connecticut Coll.), Rhode Island.

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 Shuichi Ozawa (B.A. Waseda Univ.), Japan.
 Krupa Bharatan Patel (B.A. Smith Coll.), New Hampshire.
 Daniel Piotto (B.E. São Paulo State Univ.), Brazil.
 Octavio Pires, Jr. (B.A. Faculdade de Belas Artes de São Paulo), Brazil.
 Anil Pokhrel (B.ENG. Tribhuvan Univ.), Nepal.
 Tiffany McCormick Potter (B.S. Univ. Vermont), Connecticut.
 Sarah Patricia Price (B.SC. Univ. British Columbia), Canada.
 Perrine Punwani (B.S. George Washington Univ.), Ohio.
 Dhyana Shanti Quintanar Solares (B.A. Bryn Mawr Coll.), Mexico.
 Alison Ashley Rau (B.A. Bowdoin Coll.), Connecticut.
 Jason Nathaniel Rauch (SC.B., B.A. Brown Univ.), Maine.
 Alexis Eva Montalvo Ringwald (B.A. Yale Univ.), California.
 Daniel W. Ross (B.A. Vassar Coll.), New York.
 Nicole Starr Rousmaniere (B.A. Harvard Univ.), Colorado.
 Patricia Nicole Ruby (B.S. Ursinus Coll.), New Jersey.
 Rebecca Dawn Sanborn (B.A. Williams Coll.), New Hampshire.
 Jill Suzanne Savery (B.A. Univ. California [Berkeley]), California.
 Catherine Ann Schloegel (B.A. Vassar Coll.), Colorado.
 Alicia Marie Senauer (B.A. Smith Coll.), Minnesota.
 Alexander Frederick Shenkin (B.S. Univ. California [San Diego]; M.ENG. Univ. Colorado [Boulder]), California.
 Benjamin Aaron Shepherd (B.S. Northland Coll.), Ohio.
 Caroline Bates Simmonds (B.A. Cornell Univ.), Pennsylvania.
 Myra Mildred Sinnott (B.S. Univ. Massachusetts [Amherst]), Massachusetts.
 Markelle Evangeline Smith (B.S. Univ. Vermont), Michigan.
 Robert Mason Smith (B.A. Univ. Pennsylvania), Massachusetts.
 Manuel Antonio Somoza (B.S. Univ. Puerto Rico [Mayaguez]), Puerto Rico.
 Kevin Martin Tidwell (B.A. Rice Univ.), Oregon.
 Jeanne Braha Troy (B.A. Bryn Mawr Coll.), Virginia.
 Andrey Gueorguiev Voynov (B.A. Franklin and Marshall Coll.), Bulgaria.
 James Shawn Walker (B.S. Phillips Univ.; M.A. Univ. Kansas [Lawrence]), Kansas.
 Yue Wang (B.S. Beijing Forestry Univ.), China.
 Chimi Wangmo (B.A. Sherubtshe Coll.), Bhutan.
 Kristen Elizabeth Welsh (B.A. Tufts Univ.), Massachusetts.
 Alexandra Rae Williamson (B.A. Columbia Univ.), Maryland.
 Qian Xue (B.S. Peking Univ.), China.
 Larissa Laura Yocom (B.A. Pomona Coll.), Washington.
 Christina Lassy Zarrella (B.S. Saint Joseph Coll.), Connecticut.
 Yeqing Zheng (B.S. Tsinghua Univ.), China.
 Xizhou Zhou (B.A. Yale Univ.), China.

DOCTORAL DEGREES CONFERRED, DECEMBER 2005

Michael Gabriel Booth (B.S. Principia Coll.), Illinois.

Christiane Ehringhaus (Dipl. Univ. Bayreuth [Germany]; M.Sc. Florida International Univ.), Germany.

Eva Jennine Garen (B.A. Union Coll.; M.E.S. Yale Univ.), Connecticut.

Richard J. Karty (B.A. Brown Univ.), Missouri.

Laly Laing Lichtenfeld (B.S. Univ. Richmond; M.F.S. Yale Univ.), New Jersey.

Robert Baxter Powell (B.A. Univ. North Carolina; M.E.M. Yale Univ.), North Carolina.

Halla Maher Qaddumi (B.A. Univ. Texas; M.S.C. London School of Economics), Texas.

Roy Kenneth Schiff (B.S. Univ. Rochester; M.S. Univ. Washington), Virginia.

John Douglas Tuxill (B.A. Williams Coll.; M.S. Univ. Wisconsin [Madison]), New Hampshire.

Julie Lynn Velasquez Runk (B.A. Grinnell Coll.; M.E.M. Duke Univ.), Michigan.

DOCTORAL DEGREES CONFERRED, MAY 2006

Mónica Araya (B.A., M.A. Univ. Nacional; M.E.M. Yale Univ.), Costa Rica.

Alissa Anne Hamilton (B.A. Yale Univ.; LL.B. Univ. Toronto; M.E.S. Yale Univ.), Canada.

Haiying Hu (B.S., M.S. Peking Univ. [China]), China.

Pradeep Kurukulasuriya (M.S. Univ. Aberdeen; M. Phil. Univ. Cambridge; M.E.S. Yale Univ.), Sri Lanka.

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Sung-No Niggol Seo (B.A. Seoul National Univ.; M.E.Sc. Yale Univ.), Korea.

Jeffrey MacAdam Sigler (B.A., M.S. Univ. Virginia), Virginia.

Marc Stern (B.S. Cornell Univ.; M.E.Sc. Yale Univ.), New Jersey.

STUDENTS WORKING TOWARD MASTER'S DEGREES, 2006

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Anamaria Aristizabal (B.A. Mount Holyoke Coll.), Colombia.

Heather C. Arrowood (B.S. Univ. Wisconsin [Madison]), Wisconsin.

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Erin Argyle Barnes (B.A. Univ. Virginia), Oregon.

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- Olivia Lorillard Cowley (A.B. Harvard Univ.), Rhode Island.
Christopher Preston Craig (B.S. Yale Univ.; M.S. Univ. Connecticut [Storrs]), Connecticut.
- Joel Evan Creswell (B.A. Macalester Coll.), Oregon.
Bridgid Theresa Curry (B.S. Univ. Notre Dame), Pennsylvania.
Galbadrakh Davaa (M.S. Central European Univ.), Mongolia.
Derrick Arness Dease (B.S. Colorado State Univ.), Colorado.
Aja Kateri DeCoteau (B.A. Dartmouth Coll.), Washington.
Tomas Alfredo Delgado (M.B.A. Fundacion del Tucuman; M.ARCH. Univ. Nacional Tucuman), Argentina.
- David Douglas DeVoght (B.S. Michigan State Univ.), Michigan.
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- Beth Jamie Feingold (B.A. Vassar Coll.), Pennsylvania.
Cassie Leigh Flynn (B.A. Bowdoin Coll.), Washington, D.C.
Oscar Enrique Franco (B.S. Pontifica Univ. Catolica; M.S. Univ. Nacional Agraria-La Molina), Peru.
- Manisha Gangopadhyay (B.A. Smith Coll.), New York.
Todd Michael Gartner (B.S. Univ. Maryland [College Park]), Maryland.
Andrea Elise Gelatt (B.A. Grinnell Coll.), Washington, D.C.
Valentina Luisa Giannini (M.A. Polytechnic [Milan, Italy]), Italy.
Rachel S. Goldwasser (B.A. Dartmouth Coll.), Washington, D.C.
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Rachelle Kathryn Gould (B.A. Harvard-Radcliffe Coll.), California.
Denise Antonia Grab (B.S. Univ. California [Berkeley]), California.
David Richmond Griffith (B.A. Bowdoin Coll.), Montana.
Rachel Bara Gruzen (B.A. Yale Univ.), New York.
Kate Lambert Harrison (B.A. Vassar Coll.), Connecticut.
Ellen Booth Hawes (B.A. Brown Univ.), Massachusetts.
- Allen Joel Hershkowitz (B.A., M.PHIL., PH.D. City Coll. New York [CUNY]), New York.
Marc Adam Hiller (B.A. Emory Univ.), Connecticut.
Rachel Virginia Holmes (B.S. Rutgers Univ. [Cook Coll.]), New Jersey.
Meleah Nelson Houseknecht (B.A. Vassar Coll.), Massachusetts.

Jason Wade Insdorf (B.S. Florida State Univ.), New York.
 Laura Brooke Jensen, (B.A. Univ. California [Santa Barbara]), California.
 Ruoting Jiang (B.S. Nanjing Univ.), China.
 Charlotte Kaiser (B.A. Harvard-Radcliffe Coll.), Washington, D.C.
 Olivia Hogan Kaplan (A.A. Simons Rock Bard Coll.; B.A. Yale Univ.), Connecticut.
 Mark Benedict Kasinskas (B.A. Central Connecticut State Univ.), Connecticut.
 Alder Keleman (B.A. Scripps Coll.), Washington.
 Rosalie E. Kerr (B.A. Dartmouth Coll.), Massachusetts.
 Choony Kim (B.A. Chonnam National Univ.), South Korea.
 Christopher J. Kral (B.A. Coll. Holy Cross), Washington, D.C.
 Jennifer Shannon Krencicki (B.A. Univ. California [Berkeley]), California.
 Punit Sanjay Lalbhai (B.S. Univ. California [Davis]), India.
 Kevin Alan Lauterbach (B.S. Univ. California [San Diego]), Washington.
 Collin Joseph Law (B.A. Columbia Univ.), West Virginia.
 Lei Lei (B.E. Nanjing Univ.; M.S. Brigham Young Univ. [Provo]), Utah.
 Daniel J. Leistra (B.A. Amherst Coll.), South Dakota.
 Maya Leonard-Cahn (B.A. Oberlin Coll.), California.
 James Edwin Leslie (B.A. Brown Univ.), Massachusetts.
 Abigail Leigh Letzter (B.A. Knox Coll.), Illinois.
 Jennifer Ann Lewis (B.A. Bryn Mawr Coll.), North Carolina.
 Xuanyi Li (B.S. Peking Univ.), China.
 Michael James Lichtenfeld (B.A. Colorado Coll.), Connecticut.
 Adolfo Vinicio Linares (B.S. Forestry National Institute), Guatemala.
 Matthew Alan Malone (B.S. Stanford Univ.), Colorado.
 Mira Lee Manickam (B.A. Brown Univ.), New Jersey.
 David Manor (B.A. Tel Aviv Univ.), Israel.
 Susan Mary Marriott (B.S. Michigan State Univ.), New York.
 Cynthia May (A.B. Dartmouth Coll.), Vermont.
 John Bailey McCallum (B.A. Williams Coll.), Colorado.
 James Brian McConaghie (B.A. Oberlin Coll.), Michigan.
 Jennifer Claire McKnight (B.A. William Smith Coll.), Virginia.
 Christopher P. McManus (A.A. Rockland Community Coll.; B.S. Georgetown Univ. [Washington, D.C.]), New York.
 Arthur Dehon Middleton (B.A. Bowdoin Coll.), South Carolina.
 Anna Hartung Milkowski (B.A. Harvard Univ.), New York.
 Glen William Mirmina (B.S. Worcester Polytechnic Inst.; M.S., M.B.A. New Haven Univ.), Connecticut.
 Beth Litwin Moore (B.A. Duke Univ.), Washington, D.C.
 Teresa Colleen Morgan (B.A. Tulane Univ.), Connecticut.
 Hannah Virginia Murray (B.A. Harvard-Radcliffe Coll.), Massachusetts.
 Tamara Muruetagoiena (B.A. Washington State Univ.; M.B.A. European School Univ. Business Studies), New York.

- Kathryn Joanne Neville (B.S. Queens Univ.), Massachusetts.
- James Frederick Nordgren (B.A. St. Lawrence Univ.; M.B.A. Pennsylvania Univ.), New York.
- Rugemeleza Albert Kamuharwa Nshala (LL.B. Univ. Dar es Salaam; LL.M. Harvard Univ.), Tanzania.
- Melody Esiawonam Ocloo (B.S. Univ. Ghana), Ghana.
- Tina Leonard O'Connell (B.A. Univ. Wisconsin [Madison]), Washington, D.C.
- Stephanie Paige Ogburn (B.S. South Carolina Univ. [Columbia]), Delaware.
- Kevin Patrick Ogorzalek (B.A. Duke Univ.), Illinois.
- Jules Theo Opton-Himmel (B.A. Wesleyan Univ.), New York.
- Suzanne Elise Oversvee (B.A. Whitman Coll.), Washington, D.C.
- Yves Constantino Paiz Merino (B.A. Universidad de San Carlos de Guatemala), Guatemala.
- Sarah Beth Percy (B.A. Middlebury Coll.), Virginia.
- Elizabeth Anne Pickett (B.A. Univ. California [Berkeley]), Hawaii.
- Cornelia Cooper Pinchot (B.A. Oberlin Coll.), Pennsylvania.
- Pedro Piris Cabezas (B.A. Universidad Nacional de Education a Distancia), Spain.
- Judith Carleton Preston (B.A. Skidmore Coll.; M.S. Univ. Vermont), Connecticut.
- Matthew Dale Quinlan (B.A. Yale Univ.), Washington.
- Nathan Zane Reagle (B.S. Pennsylvania State Univ.), Pennsylvania.
- Camille Maria Rebelo (B.S. Imperial Coll.), Kenya.
- Laura Beth Robertson (B.S. SUNY [Binghamton Univ.]), New York.
- Krishna Bahadur Roka (B.S., M.S. Tribhuvan Univ.), Nepal.
- Edan Rotenberg (B.A. Toronto Univ.), Canada.
- Amanda Beth Sahl (B.F.A. Franklin & Marshall Coll.), Pennsylvania.
- Alark Saxena (B.S. Barkatullah Univ. [Bhopa]; M.A. Indian Inst. of Forest Management), India.
- Mackenzie Spring Schoonmaker (B.A. SUNY [Purchase Coll.]), New York.
- Maria Mercedes Seidler (B.A. Missouri Southern State Coll.; M.A. Pittsburg State Univ.; J.D. Univ. Tulsa), Oklahoma.
- Christopher William Serjak (B.S. Stanford Univ.), California.
- Evelyn Xiomara Silva (B.A. Queens Coll.), Honduras.
- Vanitha Sivarajan (B.A., B.S. Univ. Illinois [Urbana-Champaign]), Illinois.
- Sara Elizabeth Smiley Smith (B.A. Middlebury Coll.), Connecticut.
- Jun Song (B.S. Fudan Univ.), New York.
- Deborah Chaplin Spalding (B.A. Tufts Univ.; M.T.S. Harvard Univ.; M.B.A. Univ. California), Connecticut.
- Nalin Kumar Srivastava (B.A. Indian Inst. of Technology [Kharagpur]), India.
- Vanessa Eliot-Hudson Stewart (B.S. Stanford Univ.), California.
- Colleen Robin Sullivan (B.S. Vermont Univ.), Connecticut.
- Nadav Elan Tanners (B.A. Swarthmore Coll.), New York.
- Christopher Gordon Thompson (B.A. Middlebury Coll.), Washington.
- Cherise Elisabeth Udell (B.A. Univ. California [Berkeley]), California.

Jinlong Wang (B.S. Life Science School, Shandong Univ.), China.
 Sonam Wangchuck (B.S. Eastern Forest Rangers College; M.S. Univ. Reading), Bhutan.
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 Rebecca Janet Watters (B.A. St. Lawrence Univ.), Massachusetts.
 Justin P. Westrum (B.A. Bard Coll.), Montana.
 Austin Flint Whitman (B.A. Dartmouth Coll.), Pennsylvania.
 Brandon Clark Whitney (B.S. North Carolina State Univ.), North Carolina.
 Dahvi Anna Wilson (B.A. Brown Univ.), California.
 Rachel Susan Wilson (B.A. Claremont McKenna Coll.), Oregon.
 Kathryn Anne Woodruff (B.A. Univ. California [Los Angeles]), California.
 Tenley Elizabeth Wurglitz (B.A. Bowdoin Coll.), Maryland.
 Changming Yan (B.A. Jilin Univ.; M.A. Ohio Univ. [Athens]), New York.
 Johanna Avery Zetterberg (B.A. Pomona Coll.), California.
 Xinwei Zhang (B.A. Fudan Univ.), China.
 Hanqian Zhang (B.E. Beijing Forestry Univ.), China.

STUDENTS WORKING TOWARD DOCTORAL DEGREES

Doctor of Forestry and Environmental Studies

Harry Robert Bader (B.A. Washington State Univ.; J.D. Harvard Univ.), Nebraska.

Doctor of Philosophy

David Lionel Roy Affleck (B.S.F., M.S. Univ. British Columbia [Canada]), Canada.
 Cintra Cady Agee (B.A. Hunter Coll.; M.E.M. Yale Univ.), New York.
 Nicole Michele Ardoin (B.B.A. James Madison Univ.; M.S. Univ. Madison [Stevens Point]), Virginia.
 Rebecca Ashley (B.A. Colgate Univ.; M.E.Sc. Yale Univ.), Vermont.
 Weslynne Ashton (B.S. Massachusetts Inst. of Technology), Trinidad.
 Graeme Stewart Auld (B.S. Univ. British Columbia [Canada]; M.S. Auburn Univ.), Canada.
 Cristina Marie Balboa (B.A. Univ. Michigan [Ann Arbor]; M.S. Johns Hopkins Univ.), Washington, D.C.
 Jennifer Kakareka Balch (B.A. Princeton Univ.), Pennsylvania.
 Rebecca Titus Barnes (B.A. Oberlin Coll.; M.S., M.P.A., Indiana Univ. [Bloomington]), New York.
 Brandon Tristan Barton (B.S. Univ. Idaho; M.S. Univ. Central Florida), Idaho.
 Seth Binder (B.S. Georgetown Univ.; M.S. London School of Economics), New Jersey.
 Maura Bozeman (B.S. Virginia Polytechnic Inst. and State Univ.; M.S. Utah State Univ.), Virginia.
 Janette Patricia Bulkan (B.A. Univ. Manitoba [Canada]; M.A. Univ. Texas), Guyana.
 Marina Campos (B.S., M.S. Univ. São Paulo [Brazil]), Brazil.
 Curt Della Valle (B.S. Univ. Connecticut; M.E.M., M.P.H. Yale Univ.), Connecticut.
 David Scot Ellum (B.S. North Carolina State Univ.; M.F. Yale Univ.), Connecticut.

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 Brent Regan Frey (B.S. Univ. Winnipeg [Canada]; M.S. Univ. Alberta [Canada]),
 Canada.

Edgardo Gonzalez (B.S. Univ. Puerto Rico; M.F. Yale Univ.), Puerto Rico.

Uromi Manage Goodale (B.Sc. Univ. Colombo; M.F.S. Yale Univ.), Sri Lanka.

Achim Halpaap (B.Sc. Univ. Bonn [Germany]; M.A. Univ. Oregon), Germany.

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Aaron Hohl (B.S. John Carroll Univ.; M.E.M. Duke Univ.), Ohio.

Manja Peterson Holland (B.A. Carleton Coll.; M.S. Cornell Univ.), Michigan.

Shafqat Hussain (B.A. Indiana Univ. [Pennsylvania]; M.Sc. Univ. Hull [United
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Maria Hristova Ivanova (B.A. Mount Holyoke Coll.; M.A., M.E.S. Yale Univ.), Bulgaria.

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Holly Patricia Jones (B.S. Univ. California [Santa Cruz]), Iowa.

Diana Karwan (B.S. Univ. Michigan [Ann Arbor]; M.E.Sc. Yale Univ.), Michigan.

Kyounghee Kim (B.S. Yonsei Univ. [South Korea]; M.S. Seoul National Univ. [South
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Olaf Kuegler (Dipl. Albert-Ludwigs Univ. [Germany]), Germany.

Kelly Elizabeth Levin (B.A., M.E.S. Yale Univ.), New York.

David J. Liptak (B.S. Univ. Connecticut; M.S. Univ. New Haven; M.F.S. Yale Univ.),
 Connecticut.

Philip Marshall (B.S. Cornell Univ.; M.E.Sc. Yale Univ.), New York.

Helen Mills Poulos (B.S., B.A. Pepperdine Univ.; M.S. Pennsylvania State Univ.),
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	Seminar in Industrial Ecology: Topic TBA	F&ES 90108b
Gregoire, Timothy	Applied Spatial Statistics	F&ES 77107b
	Sampling Methodology and Practice	F&ES 77006a
	Seminar in Forest Inventory	[F&ES 77105a]
	Statistical Design of Experiments	[F&ES 77112b]
	Statistics for Environmental Sciences	F&ES 77108b
Grim, John	Seminar on World Religions and Ecology	F&ES 80070a
	World Religions and Ecology: Asian Religions	F&ES 80071b
Grubler, Arnulf	Energy Systems Analysis	F&ES 86025a
	Technology, Society, and the Environment	F&ES 83026a
Guha, Ramachandra	Ecology and Equity	F&ES 80067a
IEM Faculty	Seminar in Industrial Ecology: Topic TBA	F&ES 90108b
Irland, Lloyd	Financial Analysis for Land Management	F&ES 50021a
	Professional Ethics: Orientation to the Field	F&ES 90001a

Jones, Richard	Tree Biotechnology Issues	F&ES 50009b
Kellert, Stephen	Human Dimensions in the Conservation of Biological Diversity	[F&ES 33015a]
	Issues and Approaches in Environmental Education	[F&ES 43001a]
	Seminar on “Values of the Natural Environment”	[F&ES 80051b]
	Theory and Practice of Restorative Environmental Design	F&ES 86062b
Keohane, Nathaniel	Public and Private Management of the Environment	[F&ES 94110b]
Lee, Roy	Environmental Diplomacy Practicum	F&ES 80022a,b
Lee, Xuhui	A Biological Perspective of Global Change	F&ES 61006a
	Alpine, Arctic, and Boreal Ecosystems	F&ES 60102b
	Climate and Life	F&ES 61005b
	Climate Change Seminar	[F&ES 60004b]
	Doctoral Student Seminar	F&ES D0005a
	Preparation for Research	F&ES D0004a,b
	Remote Sensing: Observing the Earth from Space	F&ES 77001b
Lye Lin Heng	Comparative Environmental Law in Global Legal Systems	F&ES 80041b
	Natural Resource Policy Practicum	F&ES 80015b
MacBroom, James	River Processes and Restoration	F&ES 61024a
Mansur, Erin	Economics of Pollution	F&ES 84001b
	Energy Economics and the Environment	F&ES 80106b
McGrath, David	Reconciling Development and Conservation on the Amazon Frontier: A Tropical Conservation Field Course	[F&ES 30004b]
	Seminar in the Conservation and Development of Amazonia	[F&ES 33003b]
	Doctoral Seminar in Environmental Economics	F&ES D0163a
Mendelsohn, Robert	Valuing the Environment	F&ES 80103b
	Agroforestry Systems: Productivity, Environmental Services, and Rural Development	F&ES 53005b
	Introduction to Soil Science	F&ES 62013a
	Seminar in Ecological Restoration	F&ES 50104b
	Tropical Forest Ecology: The Basis for Conservation and Management	F&ES 32006a
Montagnini, Florencia		

Murphy-Dunning, Colleen	Monitoring and Evaluation Techniques: Theory and Methods Applied to Ecosystem Rehabilitation/Community Revitalization Interventions	F&ES 83058b
Nelson, Arvid	History of the Environment and Ecological Science	F&ES 80032a
Nepstad, Daniel	Reconciling Development and Conservation on the Amazon Frontier: A Tropical Conservation Field Course	[F&ES 30004b]
	Seminar in the Conservation and Development of Amazonia	[F&ES 33003b]
Northrop, Michael	Understanding Environmental Campaigns: Strategies and Tactics	F&ES 80028b
NYBG Faculty	Tropical Field Botany	F&ES 30010b
Oliver, Chadwick	Global Resources and the Environment	F&ES 52012a
	Managing Resources	F&ES 50011b
	Seminar on Leadership in Natural Resources and the Environment	F&ES 80008b
Olmstead, Sheila	Economics of Natural Resource Management	F&ES 84002a
	Economics of Water Quality and Water Scarcity	[F&ES 80107b]
Post, David	Field Ecology	F&ES 30022a
Raymond, Peter	Biological Oceanography	F&ES 30121b
	Ecosystem Pattern and Process	F&ES 32007a
	Field Ecology	F&ES 30022a
	Managing the Coastal Nutrient Problem: The Case of Long Island Sound	[F&ES 60022b]
Repetto, Robert	Financial Markets and the Environment	F&ES 80110b
	The Economics of Sustainable Development	F&ES 84004a
	The Economics of the Climate Issue	F&ES 80105a
Reuning-Scherer, Jonathan	Applied Spatial Statistics	F&ES 77107b
	Introduction to Statistics in the Environmental Sciences	F&ES 77009a
	Multivariate Statistical Analysis in the Environmental Sciences	F&ES 77113b
Robinson, Nicholas	Comparative Environmental Law in Global Legal Systems	F&ES 80041b
	Environmental Diplomacy Practicum	F&ES 80022a,b
	International Environmental Law and Policy	F&ES 85035b
Saiers, James	Applied Hydrology	[F&ES 60123b]
	Environmental Hydrology	[F&ES 61018a]
	Hydrologic Modeling	[F&ES 60119b]
	Hydrology and Water Resources	F&ES 61021b
	Special Topics in Hydrology	[F&ES 60020b]

Schmitz, Oswald	Ecosystem Pattern and Process	F&ES 32007a
	Wildlife Conservation	F&ES 30114b
Scott, James	Agrarian Societies: Culture, Society, History, and Development	F&ES 80054a
Shansky, Marjorie	Local Environmental Law and Land Use Practices	F&ES 80029a
Siccama, Thomas	Ecosystem Pattern and Process	F&ES 32007a
	Field Ecology	F&ES 30022a
	Introduction to Soil Science	F&ES 62013a
	Local Flora	F&ES 52001b
	Management Plans for Protected Areas	F&ES 50114a
	Methods of Ecosystem Analysis	F&ES 32001b
Skelly, David	Aquatic Ecology	F&ES 32011a
	Ecology Seminar	F&ES 30020b
	Landscape Ecology	F&ES 32019a
Smith, Martha	Coastal Vulnerability: Lessons Learned from New Orleans, the Gulf Coast Wetlands, and Hurricane Katrina	F&ES 60015a
Smith, Melinda	Field Ecology	F&ES 30022a
Smith, Ronald	Remote Sensing: Observing the Earth from Space	F&ES 77001b
Speth, James Gustave	Modern Capitalism and the Environment: Pathways to Sustainability	F&ES 90009a
Stevenson, Dennis	Biogeography, Biodiversity, and Conservation	F&ES 30009a
Strebeigh, Fred	Environmental Writing	F&ES 40002a
Tomlin, Dana	Modeling Geographic Objects	F&ES 77011b
	Modeling Geographic Space	F&ES 77010a
Tucker, Mary	Seminar on World Religions and Ecology	F&ES 80070a
Evelyn	World Religions and Ecology: Asian Religions	F&ES 80071b
Turekian, Karl	Marine, Atmospheric, and Surficial Geochemistry	F&ES 61001a
Tyrrell, Mary	Invasive Species: Ecology, Policy, and Management	F&ES 50020a
Vance, William	Professional Communications Skills for Non-Native Speakers of English	F&ES 40006a
Wargo, John	Environmental Health Policy	[F&ES 96002b]
	Environmental Politics and Policy	F&ES 85013a
	Foundations of Environmental Policy and Politics	[F&ES 85014a]
	Science and Politics of Environmental Regulation	[F&ES 85012b]
Wikstrom, L. Lee	Water Quality Control	F&ES 60012b

F&ES Master's Project Courses

<i>Faculty</i>	<i>Master's Project F&ES Course Number</i>
Anisfeld, Shimon	2010
Ashton, Mark	2020
Bell, Michelle	2035
Benoit, Gaboury	2040
Berlyn, Graeme	2050
Brennan-Galvin, Ellen	2055
Brewer, Garry	2060
Bryk, Dale	2085
Burch, William	2070
Burroughs, Richard	2080
Camp, Ann	2100
Carpenter, Carol	2110
Cashore, Benjamin	2120
Chertow, Marian	2130
Clark, Timothy	2140
Curran, Lisa	2150
Doolittle, Amity	2158
Dove, Michael	2160
Draghi, Paul	2170
Ellis, William	2175
Esty, Daniel	2180
Evenson, Robert	2190
Geballe, Gordon	2200
Gentry, Bradford	2210
Graedel, Thomas	2230
Gregoire, Timothy	2240
Grubler, Arnulf	2243
Irland, Lloyd	2246
Kellert, Stephen	2250
Keohane, Nathaniel	2255
Lee, Xuhui	2260
Lifset, Reid	2270
Lyons, James	2280
MacBroom, James	2290
Mansur, Erin	2300
Mendelsohn, Robert	2320
Montagnini, Florencia	2330
Nelson, Arvid	2332

Nolon, John	2336
Oliver, Chadwick	2340
Olmstead, Sheila	2350
Raymond, Peter	2354
Reuning-Scherer, Jonathan	2380
Saiers, James	2390
Schmitz, Oswald	2400
Siccama, Thomas	2410
Skelly, David	2420
Smith, Ronald	2430
Speth, Gustave	2440
Strebeigh, Fred	2450
Tomlin, Dana	2460
Wargo, John	2470

F&ES Independent Study Courses

<i>Faculty Name</i>	<i>Independent Study F&ES Course Number</i>
Anisfeld, Shimon	1010
Ashton, Mark	1020
Bell, Michelle	1035
Benoit, Gaboury	1040
Berlyn, Graeme	1050
Brennan-Galvin, Ellen	1055
Bryk, Dale	1085
Burch, William	1070
Burroughs, Richard	1080
Butler, William	1083
Caccone, Adalgisa	1090
Camp, Ann	1100
Carpenter, Carol	1110
Cashore, Benjamin	1120
Chertow, Marian	1130
Clark, Timothy	1140
Curran, Lisa	1150
Doolittle, Amity	1158
Dove, Michael	1160
Draghi, Paul	1170
Ellis, William	1175
Esty, Daniel	1180
Evenson, Robert	1190
Geballe, Gordon	1200
Gentry, Bradford	1210
Graedel, Thomas	1230
Gregoire, Timothy	1240
Grubler, Arnulf	1243
Irland, Lloyd	1246
Kellert, Stephen	1250
Keohane, Nathaniel	1255
Lee, Xuhui	1260
Lifset, Reid	1270
Lyons, James	1280
MacBroom, James	1290
Mansur, Erin	1300
Mayer, Enrique	1318
Mendelsohn, Robert	1320

Montagnini, Florencia	1330
Nelson, Arvid	1332
Nepstad, Daniel	1334
Nolon, John	1336
Oliver, Chadwick	1340
Olmstead, Sheila	1350
Peters, Charles	1360
Raymond, Peter	1364
Reuning-Scherer, Jonathan	1380
Saiers, James	1390
Schmitz, Oswald	1400
Scott, James	1403
Siccama, Thomas	1410
Skelly, David	1420
Smith, Ronald	1430
Speth, Gustave	1440
Strebeigh, Fred	1450
Tomlin, Dana	1460
Wargo, John	1470

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For all other matters related to admission to the School of Forestry & Environmental Studies, please telephone the Admissions Office, 800.825.0330 or 203.432.5138, or e-mail fesinfo@yale.edu

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