School of Forestry & Environmental Studies 2003–2004



BULLETIN OF YALE UNIVERSITY Series 99 Number 3 June 15, 2003 Bulletin of Yale University

Postmaster: Send address changes to Bulletin of Yale University, PO Box 208227, New Haven CT 06520-8227

PO Box 208230, New Haven CT 06520-8230 Periodicals postage paid at New Haven, Connecticut

Issued sixteen times a year: one time a year in May, November, and December; two times a year in June and September; three times a year in July; six times a year in August

Managing Editor: Linda Koch Lorimer Editor: David J. Baker Editorial and Publishing Office: 175 Whitney Avenue, New Haven, Connecticut Publication number (USPS 078-500)

The closing date for material in this bulletin was May 22, 2003. The University reserves the right to withdraw or modify the courses of instruction or to change the instructors at any time.

©2003 by Yale University. All rights reserved. The material in this bulletin may not be reproduced, in whole or in part, in any form, whether in print or electronic media, without written permission from Yale University.

Telephone Numbers

| 800.825.0330 | Prospective Students |
|--------------|------------------------------------|
| 203.432.5100 | General School Number |
| 203.432.5942 | General School Fax |
| 203.432.7297 | Admissions and Career Services Fax |

E-mail for prospective students: fesinfo@yale.edu *Web site:* www.yale.edu/environment/

Application deadlines

Ph.D. ProgramJanuary 2, 2004Master's ProgramsFebruary 1, 2004

Photo credits: Mark Ashton, Bill Burch, Joy Bush, Upik Djalins, Dunn Photographic Associates, Melissa Goodall, Michael Marsland, Jeffrey Morton, William Sacco, Josh Schachter, Harold Shapiro, Gale Zucker

The text has been printed on recycled paper.

School of Forestry & Environmental Studies 2003–2004

BULLETIN OF YALE UNIVERSITY Series 99 Number 3 June 15, 2003

YALE UNIVERSITY CAMPUS NORTH



Continued on next page



©Yale University. Mapis not to scale

Contents

Calendar 7 The President and Fellows of Yale University 8 The Officers of Yale University 9 Faculty and Administration 10 A Message to Prospective Students from Dean James Gustave Speth 17 Mission of the School of Forestry & Environmental Studies 18 History of the School of Forestry & Environmental Studies 19 Statement of Environmental Policy 21 Faculty Profiles 22 Degree Programs 43 Master's Degree Programs 43 Special Students 48 Doctoral Degree Programs 49 Focal Areas 52 Ecology, Ecosystems, and Biodiversity 52 The Social Ecology of Conservation and Development: Assessing Social and Environmental Change 53 Forestry, Forest Science, and the Management of Forests for Conservation and Development 53 Global Change Science and Policy 54 Environment, Health, and Policy 54 Industrial Environmental Management 55 Policy, Economics, and Law 55 Urban Ecology and Environmental Design 56 Water Science, Policy, and Management 57 Subjects of Instruction 59 List of Courses by Topic 59 Course Descriptions 63 F&ES Undergraduate Courses 97 Centers and Programs at the School of Forestry & Environmental Studies 101 Admissions: Master's Degree Programs 121 Preparation for Admission 121 English as a Second Language Training Requirement 122 Application Procedures 122 Admissions: Doctoral Degree Program 125 Application Procedures 125 Tuition, Fees, and Other Expenses 127 Tuition and Fees, 2003–2004 127 Registration 127 Part-Time Program 127

Continuous Registration 128 **Tuition Deposit** 128 Tuition Rebate and Financial Aid Refund Policies 128 Student Accounts and Bills 129 Master's Financial Aid, 2003–2004 130 Life at the School of Forestry & Environmental Studies 135 **Educational Facilities** 135 Publications 137 Student Organizations 138 Alumni/ae Association 138 Professional Development 139 University Services and Privileges 147 Housing 147 Dining at Yale 147 Security 148 Health Services for F&ES Students 148 Resource Office on Disabilities 151 Office of International Students and Scholars 152 The International Center 153 **Religious Resources** 153 Libraries 153 Computer Resources 154 Cultural and Recreational Opportunities 155 Enrollment 159 The Work of Yale University 169 Index by Course Number 171 Index of Courses by Faculty Name 175 F&ES Master's Project Courses 182 F&ES Independent Study Courses 183

Calendar

FALL 2003

| Aug. 9 | Sat. | Orientation for international students. | | | |
|----------|-------|---|--|--|--|
| Aug. 10 | Sun. | Orientation for summer modules. | | | |
| Aug. 11– | Mon | Training modules in technical skills. | | | |
| Aug. 29 | Fri. | (MonFri. of each week). | | | |
| Sept. 1 | Mon. | Labor Day. School closed. | | | |
| Sept. 2 | Tues. | Meeting with dean and Course Expo. | | | |
| Sept. 3 | Wed. | Fall-term classes begin, 8.30 A.M. | | | |
| Sept. 10 | Wed. | Course registration forms due. | | | |
| Oct. 1 | Wed. | Add/Drop period ends. | | | |
| Nov. 21 | Fri. | Fall recess begins, 5.30 P.M. | | | |
| Dec. 1 | Mon. | Classes resume, 8.30 A.M. | | | |
| Dec. 5 | Fri. | Classes end, 5.30 P.M. Reading period begins. | | | |
| Dec. 15 | Mon. | Final examinations begin, 9 A.M. | | | |
| Dec. 20 | Sat. | Final examinations end, 5.30 P.M. Winter recess begins. | | | |

SPRING 2004

| Jan. 12 | Mon. | Spring-term classes begin, 8.30 A.M. |
|---------|-------|---|
| Jan. 19 | Mon. | Martin Luther King Day. No classes. |
| Jan. 20 | Tues. | Course registration forms due. |
| Feb. 9 | Mon. | Add/Drop period ends. |
| Mar. 5 | Fri. | Spring recess begins, 5.30 P.M. |
| Mar. 22 | Mon. | Classes resume, 8.30 A.M. |
| Apr. 23 | Fri. | Classes end, 5.30 P.M. Reading period begins. |
| Apr. 26 | Mon. | Make-up class for Martin Luther King Day. |
| May 4 | Tues. | Final examinations begin, 9 м.м. |
| May 11 | Tues. | Final examinations end, 5 P.M. |
| May 24 | Mon. | University Commencement. |

The President and Fellows of Yale University

President

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

Fellows His Excellency the Governor of Connecticut, ex officio. Her 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 (June 2005). Benjamin Solomon Carson, Sr., B.A., M.D., D.M.S., Upperco, Maryland (June 2003). Gerhard Casper, LL.M., PH.D., LL.D., Atherton, California. Susan Crown, B.A., M.A., Chicago, Illinois. Charles Daniel Ellis, B.A., M.B.A., PH.D., New Haven, Connecticut. Holcombe Tucker Green, Jr., B.A., LL.B., Atlanta, Georgia. Maya Ying Lin, B.A., M.ARCH., D.F.A., New York, New York (June 2008). Linda Anne Mason, B.A., M.B.A., Belmont, Massachusetts (June 2004). The Rt. Rev. Victoria Matthews, B.A., M.DIV., TH.M., Edmonton, Alberta, Canada. Indra Nooyi, B.S., M.B.A., M.P.P.M., Greenwich, Connecticut. Barrington Daniel Parker, Jr., B.A., LL.B., Stamford, Connecticut. John Ennis Pepper, Jr., B.A., M.A., Cincinnati, Ohio. Theodore Ping Shen, B.A., M.B.A., Brooklyn Heights, New York (June 2007). Janet Louise Yellen, B.A., PH.D., Berkeley, California (June 2006).

The Officers of Yale University

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

Provost Susan Hockfield, B.A., PH.D.

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 Development Charles James Pagnam, B.S.

Vice President and Director of New Haven and State Affairs Bruce Donald Alexander, B.A., J.D.

Vice President for Finance and Administration Robert Loren Culver, B.A., M.A., M.P.A.

Faculty and Administration

Faculty Emeriti

| Frederick Herbert Bormann, M.A., | рн.д., Oastler | Professor E | meritus of F | orest Ecology. |
|------------------------------------|----------------|---------------|--------------|-----------------|
| George Mason Furnival, M.F., D.F., | J.P. Weyerhaet | user, Jr., Pr | ofessor Emer | ritus 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.

Susan Hockfield, PH.D., Provost of the University.

James Gustave Speth, M.LITT., J.D., Dean and Professor in the Practice of Environmental Policy and Sustainable Development.

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 of the Hixon Center for Urban Ecology, and Director of the 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.

- ‡Garry D. Brewer, м.s., рн.d., Frederick K. Weyerhaeuser Professor of Resource Policy and Management and Professor of Political Science, jointly appointed with the Yale School of Management.
 - William Richard Burch, Jr., M.S., PH.D., Frederick C. Hixon Professor of Natural Resource Management and Professor at the Institution for Social and Policy Studies; Interim Co-Director, Hixon Center for Urban Ecology.
 - Michael Roger Dove, M.A., PH.D., Margaret K. Musser Professor of Social Ecology and Professor of Anthropology.
- Daniel C. Esty, M.A., J.D., Professor of Environmental Law and Policy; Clinical Professor; Law School; Director of the Yale Center for Environmental Law and Policy; and Director of the Yale World Fellows Program.

^{*} On leave of absence, 2003-2004.

[‡] On leave of absence, spring 2004.

- 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 of the Center for Industrial Ecology.
- Timothy G. Gregoire, PH.D., J. P. Weyerhaeuser, Jr., Professor of Forest Management and Associate Dean for Academic Affairs.
- Stephen Robert Kellert, PH.D., Tweedy/Ordway Professor of Social Ecology and Co-Director of the Hixon Center for Urban Ecology.

†Xuhui Lee, м.sc., рн.d., Professor of Forest Meteorology and Micrometeorology.

- Robert Mendelsohn, PH.D., Edwin Weyerhaeuser Davis Professor of Forest Policy, Professor of Economics, and Professor, School of Management.
- Chadwick Dearing Oliver, M.F.S, PH.D., Pinchot Professor of Forestry and Environmental Studies and Director, Global Institute of Sustainable Forestry.
- ‡Oswald J. Schmitz, M.SC., PH.D., Professor of Population and Community Ecology, Director of Doctoral Studies, Director of the Center for Biodiversity Conservation and Science, and Professor of Ecology and Evolutionary Biology.

*David K. Skelly, рн. D., Professor of Ecology.

John Peter Wargo, PH.D., Professor of Risk Analysis, Environmental Policy, and Political Science, and Director, Environment and Health Initiative; Director of Undergraduate Studies, Environmental Studies Program, Yale College.

Ladder Faculty

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

- Benjamin Cashore, M.A., PH.D., Assistant Professor of Sustainable Forest Policy 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 of the Industrial Environmental Management Program.
- Lisa M. Curran, M.A., PH.D., Associate Professor of Tropical Resources and Director, Tropical Resources Institute.
- Erin T. Mansur, Ph.D., Assistant Professor of Environmental Economics, jointly appointed with the Yale School of Management.
- Kathleen McAfee, M.A., PH.D., Assistant Professor of Geography and Sustainable Development.
- Sheila Olmstead, M.P.AFF., PH.D., Assistant Professor of Environmental Economics. Peter A. Raymond, PH.D., Assistant Professor of Ecosystem Ecology.
- James E. Saiers, M.S., PH.D., Associate Professor of Hydrology.

Non-Ladder Faculty

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

Ann E. Camp, M.F.S., PH.D., Lecturer and Associate Research Scientist in Stand Dynamics and Forest Health.

^{*} On leave of absence, 2003-2004.

[†] On leave of absence, fall 2003.

[‡] On leave of absence, spring 2004.

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

Timothy W. Clark, M.S., PH.D., Professor (Adjunct) of Wildlife Ecology and Policy.

Paul Alexander Draghi, M.A., M.A., PH.D., Director of Information Technology 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 and Research Scholar; Interim Co-Director, Hixon Center for Urban Ecology; Co-Director of the Yale–UNDP Collaborative Program on the Urban Environment.
- Arnulf Grübler, PH.D., Professor in the Field of Energy and Technology.
- Reid J. Lifset, M.S., M.P.P.M., Associate Research Scholar, Associate Director of the 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.
- Robert Repetto, M.SC., PH.D., Professor in the Practice of Economics and Sustainable Development.
- Thomas G. Siccama, M.S., PH.D., Professor in the Practice of Forest Ecology and Director of Field Studies.

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 Scientist in Ecology and Evolutionary Biology.
- Michael Donoghue, PH.D., Professor of Ecology and Evolutionary Biology.
- Menachem Elimelech, PH.D., Professor of Environmental Engineering.
- Roger Ely, PH.D., Assistant Professor of Chemical Engineering.
- Robert Eugene Evenson, PH.D., Professor of Economics.
- Jonathan Feinstein, PH.D., Professor of Economics, School of Management.
- Mary Helen Goldsmith, PH.D., Professor of Molecular, Cellular, and Developmental Biology.
- 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 Nordhaus, PH.D., Sterling Professor of Economics.
- Jeffrey Powell, PH.D., Professor of Ecology and Evolutionary Biology.
- James C. Scott, Ph.D., Eugene Mayer Professor of Political Science; Professor of Anthropology; and Director of the Program in Agrarian Studies, Yale Center forInternational andArea Studies.
- Ronald B. Smith, PH.D., Professor of Geology and Geophysics and Mechanical Engineering and Director of the Yale Center for Earth Observation.
- Stephen C. Stearns, M.S., PH.D., Edward P. Bass Professor of Ecology and Evolutionary Biology.

Christopher Timmins, PH.D., Assistant Professor of Economics.

Karl Turekian, PH.D., Benjamin Silliman Professor of Geology and Geophysics and Director of the Institute for Biospheric Studies. Eric Worby, PH.D., Assistant Professor of Anthropology.

Visiting Faculty Follows Adjunct Faculty and Faculty and

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

Michael Jeffrey Balick, PH.D., Professor (Adjunct) of Tropical Studies. Diana Balmori, PH.D., Lecturer in Landscape and Urban History. Helge Brattebo, PH.D., Visiting Professor of Industrial Ecology. Ellen Brennan-Galvin, PH.D., Lecturer and Senior Research Scholar. Dale S. Bryk, M.A., J.D., Lecturer in Environmental Law. Richard Burroughs, PH.D., Professor (Adjunct) of Coastal Science and Policy. James Carolan, A.B., M.A., J.D., Lecturer. Michael Conroy, PH.D., Senior Lecturer and Senior Research Scholar. Douglas C. Daly, PH.D., Associate Professor (Adjunct). Claire Doutrelant, PH.D., Visiting Fellow. William Ellis, PH.D., Senior Visiting Fellow. Michael Ferrucci, M.F., Lecturer in Forest Operations. John Forgach, B.A., McCluskey Fellow. Andrew J. Henderson, PH.D., Associate Professor (Adjunct). Lloyd Irland, PH.D., Lecturer and Senior Research Scientist. Richard Jones, PH.D., Senior Lecturer and Senior Research Scholar. Lu Zhi, PH.D., Associate Professor (Adjunct) of Wildlife Biology. Lye Lin Heng, LL.M. Visiting Associate Professor. James R. Lyons, M.F., Lecturer. James G. MacBroom, p.E., Lecturer in River Processes and Restoration. Pamela McElwee, PH.D., Lecturer. David McGrath, PH.D., Lecturer. Arvid Nelson, PH.D., Assistant Professor (Adjunct). Daniel Nepstad, PH.D., Lecturer in Tropical Ecology. John R. Nolon, J.D., Visiting Professor of Environmental Law. Michael Northrop, M.P.A., Lecturer in Environmental Advocacy. Ofer Ovadia, рн.д., Lecturer. Christine Padoch, PH.D., Associate Professor (Adjunct). Charles M. Peters, M.F.S., PH.D., Associate Professor (Adjunct) of Tropical Ecology. Jonathan D. Reuning-Scherer, PH.D., Lecturer in Statistics. James Salzman, PH.D., Visiting Professor. Dennis W. Stevenson, PH.D., Professor (Adjunct) of Tropical Studies. Fred Strebeigh, B.A., Lecturer in Environmental Writing. Andrew Willard, PH.D., Lecturer in Natural Resource Policy.

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. Dominika Anna Dziegielewska, PH.D., Postdoctoral Fellow. Bin Gao, PH.D., Postdoctoral Associate. James Grogan, PH.D., Postdoctoral Associate. A.L. Hammett III, PH.D., Research Affiliate. John Lenhart, PH.D., Postdoctoral Associate. Rachel Lombardi, PH.D., Associate Research Scientist. Mark McClure, ph.d., Research Affiliate. Daniel Muller, PH.D., Postdoctoral Associate. Kazuyoshi Okazawa, M.A., Research Affiliate. Linda Puth, PH.D., Postdoctoral Associate. Michael A. Rechlin, PH.D., Research Affiliate. V. Alaric Sample, PH.D., Research Affiliate. R. Neil Sampson, M.P.A., Research Scientist. Oliver Schabenberger, PH.D., Research Affiliate. Yajie Song, PH.D., Associate Research Scientist. Robert Stanton, B.S., Research Affiliate. Anitra Thorhaug, PH.D., Research Affiliate. Harry T. Valentine, PH.D., Research Affiliate. Philip M. Wargo, PH.D., Research Affiliate.

Center and Program Staff

Monica Araya, M.E.M., Project Director, Sustainable Americas, Yale Center for Environmental Law. Graeme Auld, Research Associate, Program on Forest Certification. Kimberly Awbrey, B.A., M.E.M., Co-Program Director, Tropical Resources Institute. Barbara Bamberger, B.S., M.A., M.E.M., Program Associate, Program on Forest Certification. Page Bertelsen, B.A., Coordinator, Yale Forest Forum. Marlen Bertram, DIPL.ENG., Research Associate, Center for Industrial Ecology. Beverly Chevalier, Coordinator, International Society for Industrial Ecology. Heather Crawford, B.A., M.S., Connecticut Sea Grant College Program. Amity Doolittle, B.A., M.E.S., PH.D., Co-Program Director, Tropical Resources Institute, and Lecturer in Resource Access and Development. Gary Dunning, B.S., M.F., Executive Director, Global Institute of Sustainable Forestry and Director, The Forests Dialogue. David Ellum, B.S., M.F., Research Coordinator, School Forests. Eden Enclona, M.ENG., M.E.M., Research Associate, CERA Project, Tropical Resources Institute.

Alexander Evans, B.S., M.F., Mapping and GIS Coordinator, School Forests. Alex Finkral, B.S., M.F., Manager, School Forests. Edward Gordon, M.S., PH.D., Assistant Editor, Journal of Industrial Ecology. Julie Jirikowic, B.S., Coordinator, Center for Industrial Ecology. Megan Mattox, B.S., Program Director, Program on Landscape Management. John McKenna, B.A., M.F.S., Research Associate, School Forests. Colleen Murphy-Dunning, B.S., M.S., Center Director, Hixon Center for Urban Ecology; Program Director, Urban Resources Initiative. Emily Noah, M.E.SC., Research Associate, Program on Forest Certification. P. Christopher Ozyck, B.S., Greenspace Coordinator, Urban Resources Initiative. MichellePortlock, B.A., ProgramCoordinator, Center for Industrial Ecology. Barbara Reck, M.S.ENG., Research Associate, Center for Industrial Ecology. Irene Ping Ren, M.B.A., Coordinator, Luce/Asia Project. Barbara Ruth, M.PHIL., Center Administrator, Center for Environmental Law and Policy. Martha McCormick Smith, A.B., M.E.M., Program Director, Center for Coastal and Watershed Systems. Robert Speed, Web Site Coordinator, Global Institute of Sustainable Forestry. Mary Tyrrell, M.B.A., M.F.S., Associate Director, Global Institute of Sustainable Forestry, and Program Director, Program on Private Forests. Mark Wishnie, B.S., M.F.S., Program Director ProRena, Tropical Resources Institute. Administrative Staff Mariann Adams, Administrative Assistant, Student Services. Elisabeth Barsa, B.A., Senior Administrative Assistant, Doctoral Program. Jane Beamon, Senior Administrative Assistant. Susan Rae Bolden, M.S., Research Assistant. J. Alan Brewster, B.A., M.P.A., Associate Dean for Management and Resources Resources and Associate Research Scholar. Jane Coppock, M.E.M., PH.D., Assistant Dean and Editor, F&ES Publication Series. Irene Courtmanche, Senior Administrative Assistant. Sarah Crowley, B.S., Financial Assistant. David DeFusco, B.S., Director of Communications. Ellen Denny, M.F.S., Research Assistant. Maureen A. Devlin, A.S., Registrar and Director of Student Affairs. Nancy DiLella, A.S., Office Assistant, Facilities. Carolyn T. Falls, B.A., Director of Financial Aid. Cynthia Figueroa, Office Assistant, Business Office. Nicole Freidenfelds, B.S., Laboratory Assistant. Eugénie I. Gentry, B.A., Development Officer. Jack A. Gold, M.A., Corporate and Foundation Relations Officer, Development Office. Florence Grandelli, Assistant Business Manager. Teena Marie Griggs, Mail Assistant.

Amanda Krug, B.A., Assistant Director of Career Development. Lisbet Kugler, B.SC., M.E.SC., Research Associate. Angela Kuhne, M.A., Senior Administrative Assistant. Tomas Lanner, в.s., Senior Administrative Assistant. Jennith Liner, Administrative Assistant. Carmela Lubenow, Financial Assistant. Catherine J. Marshall, B.M.ED., M.P.A., Senior Administrative Assistant. Emly McDiarmid, B.A., M.F.S., Director of Admissions. Jacqueline McNeil, Financial Assistant. Eleanor Migliore, M.S., M.L.S., Senior Administrative Assistant. Kelly Molloy, Senior Administrative Assistant. Pilar M. Montalvo, M.A., Executive Assistant to the Dean. William Moroz, Computer & Information Systems Support Specialist. Roberta Mouheb, M.A., Administrative Assistant. Steven Mylon, Lecturer and Research Associate. Arvid Nelson, Jr., Web Site Technician. Stanton C. Otis, Jr., M.ED., Director of Career Development. Julio Patron, Maintenance Assistant. Shiva Prasad, B.S., Computer & Information Systems Support Specialist. Ann Prokop, M.A., Administrative Assistant. Frederick E. Regan, B.A., Chief Development Officer. Quetcy Rivas Maldonado, Senior Administrative Assistant. Constance L. Royster, B.A., J.D., Associate Director of Development. Elnora Russell-Bell, B.S., Administrative Associate. Dominic Scalia, Facilities Manager. Kathleen Schomaker, M.E.S., M.PHIL., Director of Alumni Affairs. Margaret M. Seca, Administrative Assistant. Rosanne Stoddard, Senior Administrative Assistant. Frances Thornton, B.S., Computer & Information Systems Support Specialist. Thomas Tuscano, м.в.А., Director of Finance and Administration. Charles R. Waskiewicz, M.P.I.A., Assistant Business Manager. Michèle Whitney, B.A., Coordinator, Development Office.

Henry S. Graves Memorial Library

Judith Cummings, *Library Services Assistant*. Carla Heister, M.A.,M.S., *Librarian*.

A Message to Prospective Students from Dean James Gustave Speth

Over the one hundred years since its founding, the School of Forestry & Environmental Studies has evolved from a professional school of forestry of ten students and two faculty to perhaps the world's finest training ground for tomorrow's environmental leaders and managers. Research and teaching efforts have expanded to include not only forestry but also a wide set of concerns involving the interactions of human societies and natural systems.

As Yale's environment school enters its second century, students and faculty alike are reflecting on its history, with a critical eye to the future. The School's goal is to provide broad-gauged professional education 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 (http://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. Dr. Anisfeld's primary research interests lie in understanding human impacts on rivers and wetlands, especially in urban coastal settings. His goal is to carry out integrated research that has direct relevance to watershed management. Areas of particular interest include: effects of sea level rise and local hydrologic change on tidal marshes; the relationship between land use and nonpoint source loading of nutrients and pathogens; issues of sampling frequency for water quality monitoring and TMDL development; and the complex interactions among hydrologic regime, socioeconomic setting, water chemistry, and ecosystem health. In addition, Dr. Anisfeld is interested in evaluating the flows of water and nitrogen into and out of urban ecosystems, with the goal of reducing the environmental impacts of cities.

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 Asian tropical and American temperate forests. His field sites within these regions were selected specifically to allow comparison of growth, adaptation, and plasticity within and among close assemblages of species that have evolved within forest climates with differing degrees of seasonality. Findings from these studies have theoretical implications for understanding the maintenance of diversity of tree species in forested ecosystems and the adaptability of forests to climatic change. The results of his research have been applied to the development and testing of silvicultural techniques for restoration of degraded



Michelle L. Bell



Gaboury Benoit

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.

Michelle L. Bell, Assistant Professor. B.S., Massachusetts Institute of Technology; M.S., Stanford University; M.S.E., Ph.D., Johns Hopkins University. Professor Bell addresses air pollution and human health through research that integrates several disciplines, such as environmental engineering and epidemiology. She aims to combine her environmental engineering and public health background to examine the air pollution system from emissions to their impact on health. Her research interests are the statistical analysis of the health impacts of air pollution episodes, meteorological and air quality modeling, and policy implications. Her dissertation included analysis of the health impacts of the London smog of 1952. Her doctoral work involved tropospheric ozone modeling, which explored how changes in emissions of ozone precursors affect ambient air concentrations. She also analyzed the spatial and temporal compliance with regulatory standards and integrated air quality modeling systems with human health research.

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., Massa-chusetts 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 toxic contaminants, especially heavy 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. Three current research emphases are the use of modern clean techniques to investigate



Graeme P. Berlyn



Garry D. Brewer

trace metals whose concentrations or fluxes occur at very low levels; 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 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 aforestation. 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.

Garry D. Brewer, Frederick K. Weyerhaeuser Professor of Resource Policy and Management and Professor of Political Science, jointly appointed with the Yale School of Management. A.B., University of California at Berkeley; M.S., San Diego State University; Ph.D., Yale University. Professor Brewer is a policy scientist who assumed his current position at Yale in July 2001. He was first appointed to the faculty of the School of Man-



William R. Burch, Jr.

agement in 1974. In 1980 he joined the faculty of the School of Forestry & Environmental Studies, and became the first recipient of the Frederick K. Weyerhaeuser Chair from 1984 to 1990. He also occupied the Edwin W. Davis Chair from 1990 to 1991. Professor Brewer has served as Dean and professor of the University of Michigan's School of Natural Resources & Environment, professor at the Michigan Business School, and as Dean and member of the faculty at the University of California at Berkeley. Professor Brewer has served on and chaired numerous national and international panels and commissions, including those of the National Academy of Sciences, the International Institute for Applied Systems Analysis, the Department of Energy, the Nuclear Waste Technical Review Board, the American Association for the Advancement of Science, and Sweden's National Foundation for Strategic Environmental Research. He has received several awards for his work, including the 2000 Harold D. Lasswell Award from the Policy Studies Organization for "…contributing to our understanding of the substance and process of public policy."

William R. Burch, Jr., Frederick C. Hixon Professor of Natural Resource Management and Professor at the Institution for Social and Policy Studies; Interim Co-Director, Hixon Center for Urban Ecology. 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



Ann Elizabeth Camp

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 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 ruralurban 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. Dr. 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; interactions among disturbance agents and vegetation patterns, especially the roles of insects and pathogens in creating forest structures important to wildlife; and management alternatives for dense, marginally economic stands of small-diameter trees and consequences of different management practices on ancillary forest resources.



Carol Carpenter



Benjamin Cashore

Carol Carpenter, Lecturer and Associate Research Scholar in Natural Resource Social Science and Lecturer in Anthropology. B.A., SUNY Binghamton; M.A., Ph.D., Cornell University. Dr. Carpenter's teaching and research interests focus on theories of social ecology, social aspects of sustainable development and conservation, and gender in agrarian and ecological systems. She spent four years in Indonesia engaged in household and community-level research on rituals and social networks. She then spent four years in Pakistan working as a development consultant, primarily on social forestry issues, for USAID, the World Bank, and the Asia Foundation, among others. She has held teaching positions at Syracuse University, the University of Hawaii, and Hawaii-Pacific University, and a research position at the East-West Center. Her current interests involve the invisibility of women's economic activities in agrarian households and the implications of this invisibility for sustainable development. She is a fellow of Calhoun College.

Benjamin Cashore, Assistant Professor of Sustainable Forest Policy and Director, Program on Forest Certification. B.A., M.A., Carleton University; Ph.D., University of Toronto. Professor Cashore's research interests include globalization and the privatization of environmental governance (forest certification/eco-labeling); forest resource policies of Canada, the United States, and globally; the political economy of U.S./Canada forest products trade; and forest industry environmental/sustainability initiatives. He has held positions as a legislation/policy adviser to leaders of the Canadian New Democratic Party (1990-1993); research assistant to members of the Canadian Parliament (1987-1988); postdoctoral fellow, Forest Economics and Policy Analysis Research Unit, University of British Columbia (1997-1998); and Assistant Professor, School of Forestry and Wildlife Sciences, Auburn University (1998-2001). His new book, Governing Through Markets: Forest Certification and the Emergence of Non-state Authority (with Graeme Auld and Deanna Newsom), is forthcoming from Yale University Press. He is co-editor of Forest Policy for Private Forestry (with Teeter and Zhang), CAB International; and coauthor of In Search of Sustainability: The Politics of Forest Policy in British Columbia in the 1990s (with George Hoberg, Michael Howlett, Jeremy Raynor,



Marian R. Chertow



Timothy W. Clark

and Jeremy Wilson) from the University of British Columbia Press. He is also the author of several refereed journal articles 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, 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. Dr. Chertow's research and teaching concern environmental management and policy as they relate to the private sector. Primary research interests are the application of innovation theory to the development of environmental and energy technology and the study of industrial symbiosis: geographically based exchanges of wastes, materials, energy, and water within networks of businesses. She is the editor of *Thinking Ecologically: The Next Generation of Environmental Policy* (with Daniel Esty), to which she also contributed work on the relevance of industrial ecology to public policy, and the author of *Innovation and Environmental Technology*. Prior to Yale, Dr. Chertow spent ten years in environmental business and state and local government. She also serves on the faculty of the National University of Singapore 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 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



Lisa M. Curran

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, Associate Professor of Tropical Resources and Director, 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 logging practices on ecosystem management and biodiversity in Asia.



Michael R. Dove



Paul Alexander Draghi

Michael R. Dove, Margaret K. Musser Professor of Social Ecology and Professor of Anthropology, and Chair of the Yale Council on Southeast Asia Studies. B.A., Northwestern University; M.A., Ph.D., Stanford University. Professor Dove's research focuses on interaction between local communities, national governments, and global agencies concerning the use of natural resources. 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 forestry policies. Recent collaborative research, funded by the MacArthur Foundation, examines the impact of supra-community, institutional factors on biodiversity. Other research and teaching interests include: the global circulation of environmental concepts; new approaches to natural disaster and degradation; indigenous environmental knowledge; contemporary and historical environmental relations in South and Southeast Asia; the study of developmental and environmental institutions, discourses, and movements; and the sociology of resource-related sciences. Professor Dove is a fellow of Calhoun College.

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. Dr. 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. Dr. 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



Daniel C. Esty



Gordon T. Geballe

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, Professor of Environmental Law and Policy; Clinical Professor, Law School; 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 environmental policy issues. His recent work focuses on new approaches to environmental regulation, including the use of economic incentives and other market mechanisms, environmental performance measurement and the benefit of data-driven environmental decision making, environmental protection in the Information Age, environmental effects on competitiveness, the roles of nongovernment actors in environmental policy making, trade and environment linkages, global environmental governance, corporate environmental management, and environment and security. He is the author or editor of a number of books, including 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; Sustaining the Asia Pacific Miracle: Environmental Protection and Economic Integration; 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 Dr. Geballe's current interests. Cities can be analyzed as systems through which energy and material move. Of special interest to Dr. Geballe is the development of community organization, the role of formal and informal environmental education, and the identification



Bradford S. Gentry



Thomas E. Graedel

of urban environmental issues. These topics are the focus of his teaching and numerous projects in New Haven. Dr. Geballe, with faculty and students, is involved in projects in the People's Republic of China. Current research is in Ganzu Province in northwest China looking at water/people relationships in this arid region and forestry in Fujian Province. With colleagues in the U.S., Hong Kong, and China, he is cofounder of the Sustainable Development Leadership Program, an executive program for business, government, and academic leadership in 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; Interim Co-Director, Hixon Center for Urban Ecology; 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. The 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. The sectoral work is concentrated in two major areas – increasing private investment in (1) the delivery of urban environmental services (particularly drinking water and sanitation), and (2) sustainable forest use and management. Projects in both areas are undertaken across a range of contexts from New Haven, to developing country megacities, to wilderness 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.



Timothy G. Gregoire

National Academy of Engineering for "outstanding contributions to the theory and practice of industrial ecology, 2002." His research is centered on developing and enhancing industrial ecology, the organizing framework for the study of the interactions of the modern technological society with the environment. His textbook, *Industrial Ecology,* cowritten with B. R. Allenby of AT&T, was the first book in the field, and he has followed it with three others: *Design for Environment; Industrial Ecology and the Automobile;* and *Streamlined Life-Cycle Assessment.* 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 and Associate Dean for Academic Affairs. B.S., Princeton University; Ph.D., Yale University. Professor Gregoire's research is directed to the application and development of statistical methods for natural resources and environmental phenomena. One focus has been on probability sampling with particular reference to sampling techniques applied to individual trees. A second focus has been on statistical modeling of longitudinal and spatially correlated data. The results of his research have been published widely in the forestry, ecology, and statistical literature of both subject areas. He is the coauthor of Sampling Methods for Multiresource Forest Inventory and co-editor of Modeling Longitudinal and Spatially Correlated Data. Recent pursuits include the development of sampling methods to estimate recreation use, the nature of statistical inference, and calibration estimators with sample survey data. 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 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 multivolume Encyclopedia of Environmetrics and an associate editor of Silva Fennica, and he chairs the management of the Journal of Agricultural, Biological, and Environmental Statistics.



Stephen R. Kellert



Xuhui 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 basic values and perceptions relating to the conservation of biological diversity; the concept and practice of sustainable environmental design; the theory and application of the concept of biophilia; and connecting human and natural systems in especially urban watersheds. He has completed the following books since 1993: 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 currently writing another book, Ordinary Nature: Understanding and Designing Natural Diversity in Everyday Life. He is a fellow of Branford College, has an appointment at the Institution for Social and Policy Studies, and is a faculty affiliate at the Peabody Museum.

Xubui Lee, Professor of Forest Meteorology and Micrometeorology. 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, micrometeorological instrumentation, and remote sensing. His current research projects focus on surface-air exchange in nonideal conditions, the dynamics of air motion in vegetation, forest-water relations using isotopes, carbon sequestration by terrestrial ecosystems, 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.,


Erin T. Mansur

Swarthmore College; M.S., Massachusetts Institute of Technology; M.P.P.M., Yale School of Management. Mr. Lifset's research and teaching focus on the emerging field of industrial ecology, the study of the environmental consequences of production and consumption. He is editor-in-chief of the *Journal of Industrial Ecology*, an international 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 life-cycle environmental characteristics of the use of nonwood fiber for papermaking and of the environmental character of bio-based materials more broadly; flows and reservoirs of materials in the United States; and the environmental impact of e-commerce. He has published extensively on EPR and on solid waste issues in professional and academic publications and is editor of the Yale Working Papers on Solid Waste Policy. In the policy arena, his work focuses on waste prevention, market development for recycling and composting, siting conflict, and the implementation of EPR.

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, incentivebased environmental regulation, and environmental implications of strategic behavior. His paper on *Environmental Regulation in Oligopoly Markets: A Study of Electricity Restructuring* examines the welfare implications, including environmental effects, of firms exercising market power in the recently deregulated Pennsylvania, New Jersey, and Maryland wholesale electricity market. He has also written on the costs and benefits of the Clean Air Act Amendments, wealth transfers in restructured electricity markets, the responsiveness of electricity consumers to prices and conservation policies, and the effectiveness of public policies in reducing homelessness.



Kathleen McAfee



Robert Mendelsohn



Florencia Montagnini

Katbleen McAfee, Assistant Professor of Geography and Sustainable Development. B.A., Vassar College; M.A., Ph.D., University of California, Berkeley. Professor McAfee's interests center on the relationships among economic globalization, new institutions of global governance, and efforts toward more equitable sharing and sustainable use of natural resources. Her work on "Selling Nature to Save It?" analyzes problems of valuing and conserving biological variety and distributing environmental benefits and burdens in a world-market economy. Professor McAfee's recent research concerns new biotechnologies, intellectual property rights to genetic information and living organisms, and related challenges for food security, the conservation of food-crop biodiversity, and rural livelihoods. She is the author of *Storm Signals: Structural Adjustment and Development Alternatives in the Caribbean* (1991) and many articles on community development, gender, race, and social and environmental justice.

Robert Mendelsohn, Edwin Weyerhaeuser Davis Professor of Forest Policy, Professor of Economics, and Professor, School of Management. B.A., Harvard University; Ph.D., Yale University. For over two decades, Professor Mendelsohn has concentrated his research work 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 to acid rain and, most recently, to greenhouse gases. He has also worked on valuing natural ecosystems, from tropical rainforests in Latin America to temperate forests in the Pacific Northwest and Alaska. Professor Mendelsohn hopes to extend integrated assessment to ecosystem management. He is a fellow of Ezra Stiles College.

Florencia Montagnini, Professor in the Practice of Tropical 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 role of native tree species in plantations and agroforestry ecosystems in reclaiming degraded areas; the use of biological enrichment techniques with species of economic value as a forest restoration tool; and the integration of ecological principles



Chadwick Dearing Oliver



Sheila Olmstead

with economic, social, and human health factors in the design of sustainable land-use schemes for the rehabilitation of degraded lands in humid tropical regions.

Chadwick Dearing Oliver; Pinchot Professor of Forestry and Environmental Studies and Director, 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 update 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. 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, 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 Cavanagh'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-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



Robert Repetto

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 (13C and 14C) to determine major sources, sinks, and ages of various carbon pools in the natural environment. In order to conduct this research, Dr. Raymond's lab has a 14C 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 CO₂ 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. M.Sc., London School of Economics; Ph.D., Harvard University. Professor Repetto's area of expertise is environmental and resource economics. From 1998 to 2000, he held a Pew Fellowship in Marine Conservation at the Woods Hole Oceanographic Institution. Until 1998 he was vice president and senior economist at the World Resources Institute in Washington, D.C., where he wrote numerous books and monographs on environmental policy. He has served on EPA's Science Advisory Board and National Advisory Council on Environmental Policy and Technology, on the National Research Council's Board on Sustainable Development, and on many NRC committees. He has been a professor at the Harvard School of Public Health, a World Bank official working in Indonesia, an economic adviser in Bangladesh, a Ford Foundation staff economist in India, and an economic analyst in the Federal Reserve Bank of New York. He is currently a senior adviser at Stratus Environmental Consulting, Inc., in Boulder, Colorado. His work has been honored by the Society for Conservation Biology and the British Medical Association. His recent work on environment and finance was awarded the Moskowitz Prize for 2000.



James E. Saiers



Oswald J. Schmitz



Thomas G. Siccama

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 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, Director of Doctoral Studies, Director of the Center for Biodiversity and Conservation 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



David K. Skelly



James Gustave Speth

of environmental pollution on the growth of forest trees, especially in relation to pitch pine and red spruce, which are declining in the Northeast. Professor Siccama continues as an active participant in many aspects of the Hubbard Brook Experimental Watershed Ecosystem project in New Hampshire. He is also involved with natural areas documentation and land-use planning.

David K. Skelly, Professor of Ecology. A.B., Middlebury College; Ph.D., University of Michigan. Professor Skelly is interested in understanding the ecological mechanisms of 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 projects include an exploration of forest dynamics as a driver of amphibian population extinctions and an investigation of the role of infectious disease as a cause for amphibian deformities.

James Gustave Speth, Dean and 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 UN Development Group. Prior to his service at the UN, he was founder and president of the World Resources Institute; professor of law at Georgetown University; chairman of the U.S. Council on Environmental Quality; and senior attorney and cofounder, Natural Resources Defense Council.

Throughout his career, Dean Speth has provided leadership and entrepreneurial initiatives to many task forces and committees 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



John P. Wargo

America's Barbara Swain Award of Honor, the Keystone Center's National Leadership Award, a 1997 Special Recognition Award from the Society for International Development, the 1998 Leadership Award of the Alliance for United Nations Sustainable Development Programs, the Lifetime Achievement Award of the Environmental Law Institute, and the Blue Planet Prize. Publications include *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.

John P. Wargo, Professor of Risk Analysis, Environmental Policy, and Political Science, and Director, Environment and Health Initiative. 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 or other capstone experience.

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 optional for all one-year 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: plant identification – use of organismal identification keys, familiarization with the plant species of Southern New England.

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 Study Courses

Most master's students choose to enroll in one or more courses with a faculty adviser that officially fulfill degree requirements for a master's project. Project courses can involve research in laboratory, field, or library, or analytical case studies designed to solve management problems. Typically an idea for a project originates with the student. Project courses enable students or small groups to study relevant topics in a depth that is not always possible in regular courses. They afford the student interested in research an unusual opportunity to gain firsthand experience with the conduct and philosophy of independent inquiry. Introducing students to the literature dealing with localities, problems, or subjects with which they expect to be especially concerned in the future, projects provide a means of integrating and testing skills, knowledge, and judgment gained in formal courses. They have frequently 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.

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 eight courses in fulfillment of a core curriculum. Each student will also select an advanced study program for further coursework — concluding his or her experience with a master's project, a "capstone" course, or a semester-long internship project (separate from the required summer internship). With the guidance and approval of faculty advisers, each student selects core courses in various categories to meet distributional requirements from preapproved lists of courses. Each student also works with advisers to define educational pathways within one of nine advanced study areas that have been identified and defined by the F&ES faculty.

The core courses for the M.E.M. are divided into: (a) *Foundations* and (b) *Problem Solving and Policy Making*. The four *Foundations* course groups are: (1) physical sciences, (2) biological sciences, (3) social sciences, and (4) statistics and statistical methods. Each student must take at least one course in each of these disciplines, as well as one additional course in either the physical or biological sciences. *Problem Solving and Policy Making* is divided into three course groups: (1) economics, (2) decision analysis, and (3) policy making and institutions. Students are required to take at least one course in each course group.

Faculty teaching and research at the School of Forestry & Environmental Studies are divided into nine focal areas (see the chapter "Focal Areas," beginning on page 52), each of which serves as an advanced study area within the M.E.M. curriculum. These areas are: (1) Ecology, Ecosystems, and Biodiversity; (2) The Social Ecology of Conservation and Development: Assessing Social and Environmental Change; (3) Forestry, Forest Science, and the Management of Forests for Conservation and Development; (4) Global Change Science and Policy; (5) Environment, Health, and Policy; (6) Industrial Environmental Management; (7) Policy, Economics, and Law; (8) Urban Ecology and Environmental Design; and (9) Water Science, Policy, and Management. Each advanced study area offers one or more course "tracks" that students wishing to concentrate in the focal area should examine for guidance on what courses provide a foundation for professional success in a particular area. Each M.E.M. student is required to choose an Advanced Study Area and to take two or more courses from the area's specified course lists.

Master of Forestry

Master of Forestry programs are professional studies aimed at training practitioners of forestry for administration and management of forest lands, and for mediating and resolving the conflicting values of society that concern forests. Forest systems cover onethird 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 joined the kaleidoscope 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 (I) 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 Mid-Career Program. This degree program is restricted to selected individuals who have demonstrated competence during a minimum of seven years of responsible, full-time professional forestry experience. The degree requirements are met by satisfactorily completing a custom-designed two-term program of courses, seminars, and projects during one year in residence.

Professionals pursuing the one-year M.F. degree are interested in acquiring new skills, filling voids in their educational background, and broadening their perspectives. Their career objectives are in the general area of forest management and administration. Admission to this program will be granted by the Admissions Committee only to individuals who appear to be able to achieve the level of professional competence represented by the M.F. degree in one year of residence work. *A minimum of one year in residence and eight full courses is required for completion of this program*.

Master of Environmental Science

The Master of Environmental Science program is intended for students who seek a master's program with focus on disciplines within environmental natural and social science, most often as preparation for a research career or doctoral study. Each Master of Environmental Science curriculum will have three components: disciplinary and research project courses, research methods courses, and electives. The Master of Environmental Science program requires 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. A minimum of four research project courses is also required.

Master of Forest Science

The Master of Forest Science is intended for students who seek a master's program with focus on forest science, most often as preparation for a research career or doctoral study. Each Master of Forest Science curriculum will have three components: disciplinary and research project courses, research methods courses, and electives. The Master of Forest

Science program requires 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. A minimum of four research project courses is also required.

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 Divinity School, the Law School, the 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 is required at the School of Forestry & Environmental Studies.

On successful completion of the formal joint-degree program, the student will be awarded the Master of Forestry or the Master of Environmental Management, together with the joint degree as follows:

- 1. Law School Juris Doctor; four years.
- 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.

For students interested in a joint environment/law degree, the School has recently launched 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 admissions director at F&ES or the associate dean for academic affairs.

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.

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. The degree of Doctor of Forestry and Environmental Studies (D.F.E.S., formerly designated as the Doctor of Forestry degree) is conferred through the School of Forestry & Environmental Studies. In the 2003–2004 academic year, the D.F.E.S. program has merged with the Ph.D. program. The D.F.E.S. program will continue to exist until all its current students complete the program. No additional students will be admitted into the D.F.E.S. program. New students will be admitted into the Ph.D. program. 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.

Students are required to take the Doctoral Student Seminar, 824a, 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.

Joint 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 flexibility when entering the marketplace. They can represent themselves as anthropologists and/or environmental scientists, as theoreticians and/or practitioners. They have the credentials to apply for policy-oriented positions with international institutions as well as academic positions in teaching and research. For further information, contact the director of doctoral studies or the coordinator of the combined degree program.

NEW YORK BOTANICAL GARDENS

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

Focal Areas

The Yale School of Forestry & Environmental Studies recognizes that it is as important to solve problems for local watersheds as it is to address issues related to global climate change. Likewise, it is as important to coach tomorrow's leaders to get their hands dirty with fieldwork as it is to train them to analyze and formulate policy. To address the breadth and scope of such a wide range of environmental challenges, the faculty of the School of Forestry & Environmental Studies created nine focal areas through which to channel teaching and research.

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.

Each focal area has a core group of faculty as its keystone. These faculty members, led by a coordinator from the School's senior faculty, teach classes, guide students, and conduct research to meet the goals set forth by the mission statement of their focal areas. Most faculty are involved with more than one focal area.

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. This endeavor 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 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.

The faculty in this focal area teach a variety of graduate courses and seminars, including such issues as aquatic ecology; methods of ecosystem analysis; forest ecosystem health; wildlife conservation ecology; 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 a study of the local flora.

Faculty: Oswald J. Schmitz (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, Kathleen McAfee, Peter A. Raymond, James E. Saiers, Thomas G. Siccama, David K. Skelly

Associated Center: Center for Biodiversity Conservation and Science

THE SOCIAL ECOLOGY OF CONSERVATION AND DEVELOPMENT: ASSESSING SOCIAL AND ENVIRONMENTAL CHANGE

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 as understanding its bio-physical dimensions. This area focuses on the links between the resource-use systems of local communities and wider societies, between urban and rural, rich and poor, and less- and more-developed countries. A distinguishing characteristic of this area is its special focus on the environmental relations of local communities. But teaching and research in this 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.

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. The faculty teach courses and seminars on such topics as tropical ecosystem dynamics and anthropogenic change; risk and property; society and natural resources; environmental values; agrarian societies; the economics of sustainable development; and the foundations of natural resource management.

Faculty: Michael R. Dove (Coordinator), Mark S. Ashton, 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, Kathleen McAfee, Florencia Montagnini, Robert Repetto, 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.

Under 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, 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, Kathleen McAfee, Robert Mendelsohn, Peter A. Raymond, Robert Repetto, Oswald J. Schmitz, James Gustave Speth

ENVIRONMENT, HEALTH, AND POLICY

This area promotes research and teaching to understand relations between environmental hazards, development, and human health. This knowledge provides a basis for understanding the potential of law and policy to protect 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; expo-

sure and risk assessment methods; land use, ecology, and vector-borne disease; air pollution; respiratory illness; agriculture, food safety, and human health; school environmental health; environmental health law and policy.

This area is the focal point within F&ES for the joint master's degree program in Environmental Science, Management, and Public Health with the Department of Epidemiology and Public Health. Course and seminars offered include environmental hydrology; foundations of environmental policy and politics; international environmental policy and law; organic pollutants in the environment; and global environmental health.

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

Associated Center: Environmental Health Initiative

INDUSTRIAL ENVIRONMENTAL MANAGEMENT

This focal area is centered on using principles of ecology to transform industry through several research and teaching themes. One 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. Another major theme that is introduced to students addresses quantitative sustainability under the argument that in order to set sustainability as a target or goal for our industrial society, we must be able to quantify what that target or goal is.

The faculty and students in this area also work on the overarching theme of industrial ecology education for developing economies. This is seen in a major research project in Puerto Rico where preliminary investigative research has begun, using new ideas and tools of industrial ecology to examine the industrial systems of the island and to devise theoretical plans to reorient its economic development to include the notion of sustainability. Course work in this focal area includes environmental aspects of the technological society; industrial ecology; theory and practice of urban ecology; business concepts for environmental managers; and environmental management and strategy.

Faculty: Thomas E. Graedel (Coordinator), Shimon C. Anisfeld, Garry D. Brewer, Marian R. Chertow, William Ellis, Gordon T. Geballe, 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: Robert Mendelsohn (Coordinator), Garry D. Brewer, Benjamin Cashore, Marian R. Chertow, Timothy W. Clark, William Ellis, Daniel C. Esty, Bradford S. Gentry, Reid J. Lifset, Erin T. Mansur, Kathleen McAfee, 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 economic productivity and quality of life. They believe that students must be prepared to carry out pioneering research, have a grounding in new theoretical understanding, and conduct innovative practices in order 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 then encourage students to take courses at F&ES and other parts of Yale with a particular reference to this area, such as urban anthropology and global history; urban poverty and policy; the future of American cities; environmental aspects of the technological society; issues and approaches in environmental education; and ecological imagination and environmental design.

Faculty: Stephen R. Kellert (Coordinator), Diana Balmori, Gaboury Benoit, William R. Burch, Marian R. Chertow, Gordon T. Geballe, Bradford S. Gentry, Thomas E. Graedel

Associated Centers: Hixon Center for Urban Ecology, Center for Sustainable Environmental Design

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; marine protected areas; environmental hydrology; water quality control; and water system economics.

Faculty: Gaboury Benoit (Coordinator), Shimon C. Anisfeld, Richard Burroughs, Bradford S. Gentry, Stephen R. Kellert, 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 2002-2003.

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. Courses numbered 500 and above are graduate courses. The sequence of numbers does not reflect level of advancement.

LIST OF COURSES BY TOPIC

Ecology

ECOSYSTEM ECOLOGY

| F&ES 519b | Methods of Ecosystem Analysis | 63 |
|-------------|--|----|
| F&ES 528b | Tropical Ecosystem Dynamics and Anthropogenic Change | 63 |
| F&ES 556b | Seminar in the Conservation and Development of Amazonia | 64 |
| [F&ES 557b] | Reconciling Development and Conservation on the Amazon | |
| | Frontier: A Tropical Conservation Field Course | 64 |
| F&ES 574a | Tropical Forest Ecology and Management | 65 |
| F&ES 575a | Ecosystem Pattern and Process | 65 |
| F&ES 604b | Topics in the Tropics | 65 |
| [F&ES 621a] | Biogeography, Biodiversity, and Conservation | 65 |
| F&ES 623b | Tropical Field Botany | 66 |
| WILDLIFE E | COLOGY AND CONSERVATION BIOLOGY | |
| [F&ES 509a] | Aquatic Ecology | 66 |
| F&ES 520a | Species and Ecosystem Conservation: An Interdisciplinary | |
| | Approach | 66 |
| F&ES 560b | Wildlife Conservation Ecology | 66 |
| F&ES 565a | Human Dimensions in the Conservation of Biological | |
| | Diversity | 66 |
| [F&ES 578a] | Seminar in Molecular Approaches to Systematics, Conservation | ı |
| | Genetics, and Behavioral Ecology | 67 |
| F&ES 587a | Laboratory in Molecular Systematics | 67 |
| F&ES 588a | Seminar in Conservation Genetics | 67 |
| F&ES 760a | Landscape Ecology | 67 |
| [F&ES 762b] | Ecology Seminar | 68 |
| | | |

Environmental Education and Communication

| F&ES 582b | Issues and Approaches in Environmental Education | 68 |
|-------------|--|----|
| F&ES 583a | Environmental Writing | 68 |
| [F&ES 724a] | Information Management for Environmental Professionals | 68 |
| F&ES 745b | Archetypes and the Environment | 69 |
| F&ES 824a | Doctoral Student Seminar | 69 |

Forestry

FOREST BIOLOGY

| F&ES 505b | Local Flora | 69 |
|-----------|--|----|
| F&ES 524b | Fire: Science and Policy | 69 |
| F&ES 551b | Forest Health | 69 |
| F&ES 592b | Agroforestry in the Tropics: Sustainability and Services | 70 |
| F&ES 600a | Structure, Function, and Development of Higher Plants: | |
| | From Seed to Towering Tree | 70 |
| F&ES 601b | Research Methods in Anatomy and Physiology of Trees | 70 |
| F&ES 610b | Physiology of Trees and Forests: The Pathway to | - |
| | Understanding the World's Forests | 71 |

FOREST MANAGEMENT

| [F&ES 576b] | Botanical Resources of the Tropics | 71 |
|-------------|---|----|
| F&ES 602b | Forest Landscape Management | 71 |
| F&ES 605a | Sustainable Forestry: Biology and Management | 71 |
| F&ES 700b | Principles in Applied Ecology: The Practice of Silviculture | 72 |
| F&ES 701a | Management Plans for Protected Areas | 72 |
| [F&ES 702b] | Rapid Assessments in Forest Conservation | 72 |
| F&ES 703a | Growth and Development of Forest Stands | 72 |
| [F&ES 704a] | Analysis of Silvicultural Problems | 72 |
| F&ES 705a | Seminar in Advanced Silviculture | 73 |
| F&ES 708a,b | Field Trips in Forest Resource Management and Silviculture | 73 |
| F&ES 710a | Seminar on Invasive Species Biology and Ecology | 73 |
| F&ES 727a | Forest Financial Analysis | 73 |
| F&ES 803a | Forestry Operations for Resource Professionals | 73 |

Physical Sciences

ATMOSPHERIC SCIENCES

| F&ES 603a | Marine and Surficial Geochemistry | 74 |
|-------------|--|----|
| [F&ES 612b] | Seminar in Alpine, Arctic, and Boreal Ecosystems | 74 |
| F&ES 834b | Seminar on Climate Change Science and Policy | 74 |
| F&ES 868b | Climate and Life | 74 |
| [F&ES 869a] | A Biological Perspective of Global Change | 74 |
| | | |

ENVIRONMENTAL CHEMISTRY

| [F&ES 502a,b] | Critical Analysis of Scientific Literature: Applied | |
|-----------------|---|----|
| ESEC comb | Organia Bollutanta in the Environment | 74 |
| F&ES 5070 | Aquatic Chemistry | 75 |
| [E8-ES 544a | Biogeochemistry and Pollution | 75 |
| [F&ES 545a] | Air Dollution | 75 |
| FRES 590a | Water Quality Control | 70 |
| FRES 5980 | water Quarty Control | 70 |
| SOIL SCIENCE | | |
| F&ES 530a | Introduction to Soil Science | 76 |
| WATER RESOU | RCES | |
| F&ES 515b | Coastal Ecosystem Governance | 76 |
| F&ES 533b | Water Resource Management | 76 |
| F&ES 536a | Estuarine Ecology and Anthropogenic Impacts | 77 |
| F&ES 540a | Environmental Hydrology | 77 |
| [F&ES 541b] | Hydrologic Modeling | 77 |
| F&ES 542b | Hydrology Seminar | 77 |
| F&ES 550a | The Science and Policy of Eutrophication | 77 |
| F&ES 558b | Applied Hydrology | 78 |
| F&ES 829a | River Processes and Restoration | 78 |
| [F&ES 866b] | Caribbean Coastal Watershed Development: Science and Policy | 78 |
| Quantitative an | nd Research Methods | |
| F&ES 506b | Observing the Earth from Space | 78 |
| F&ES 510a | Research Methods | 78 |
| F&ES 513b | Social Science Research Methods | 79 |
| F&ES 529a,b | Preparation for Research | 79 |
| F&ES 622a | Seminar in Forest Inventory | 79 |
| F&ES 711a | Sampling Methodology and Practice | 79 |
| F&ES 713b | Statistics for Environmental Sciences | 79 |
| F&ES 714a | Introduction to Statistics in the Environmental Sciences | 80 |
| F&ES 715a | Modeling Geographic Space | 80 |
| F&ES 716b | Modeling Geographic Objects | 80 |
| F&ES 719b | Statistical Design of Experiments | 80 |
| F&ES 844b | Multivariate Statistical Analysis in the Environmental Sciences | 80 |

Social Sciences

ECONOMICS

| F&ES 733b | Economics of Pollution | 81 |
|-------------|---|----|
| F&ES 734a | Economics of Natural Resource Management | 81 |
| [F&ES 737b] | Valuing the Environment | 81 |
| F&ES 852b | Economics of Energy and the Environment | 81 |
| F&ES 863b | Economics of Water Quality and Water Scarcity | 82 |

ENVIRONMENTAL POLICY

| F&ES 503a | Seminar in Environmental and Natural Resource Leadership | 82 |
|-------------|--|----|
| F&ES 521b | Seminar on Forest Certification | 82 |
| F&ES 594a | Comparing Environmental Governance Across Countries: | |
| | Theory and Evidence | 82 |
| [F&ES 725b] | Science and Politics of Environmental Regulation | 83 |
| F&ES 731a | Foundations of Environmental Policy and Politics | 83 |
| F&ES 739b | Natural Resource Policy Practicum | 84 |
| F&ES 766b | Public-Private Partnerships: Lessons from the Water Sector | 84 |
| [F&ES 768b] | Business and Environment Leadership | 84 |
| F&ES 769a | Ecological Knowledge and Environmental Problem Solving | 84 |
| [F&ES 770b] | Scope of the Policy Sciences | 85 |
| F&ES 801a | Energy Systems Analysis | 85 |
| F&ES 802a | Technological Change and the Environment | 85 |
| F&ES 819a | Social and Environmental Dimensions of Biotechnology | 85 |
| F&ES 842a | The Economics of Sustainable Development | 86 |
| F&ES 843a | The Economics of Climate Change | 86 |
| F&ES 846b | Strategies for Land Conservation | 87 |
| F&ES 847b | Understanding Environmental Campaigns: Strategies and | |
| | Tactics | 87 |
| F&ES 848b | Comparative Environmental Law in Global Legal Systems | 87 |
| F&ES 851b | Local Environmental Law and Land-Use Practices | 88 |
| F&ES 853a | Private Investment and the Environment | 88 |
| F&ES 858a | History of the Environment and Ecological Science | 88 |
| F&ES 861a | Environmental Law and Policy | 89 |
| F&ES 864a,b | Environmental Protection Clinic | 89 |
| F&ES 870b | International Environmental Law and Policy | 89 |
| F&ES 886b | The Law of Biodiversity and Nature Conservation | 89 |
| F&ES 891b | Foundations of Natural Resource Policy and Management | 90 |
| HEALTH AND | ENVIRONMENT | |
| [F&ES 721b] | Environmental Health Policy | 90 |
| F&ES 722a | Assessing Exposures to Environmental Stressors | 91 |
| F&ES 726a | Applied Risk Assessment | 91 |
| INDUSTRIAL | ENVIRONMENTAL MANAGEMENT | |
| F&ES 500a | Greening the Industrial Facility | 91 |
| F&ES 501b | Industrial Ecology | 91 |
| F&ES 504a | Seminar in Industrial Ecology | 91 |
| F&ES 810a | Business Concepts for Environmental Managers | 91 |
| F&ES 812b | Environmental Management and Strategy | 92 |
| F&ES 905a | Public and Private Management of the Environment | 92 |
| | | |

SOCIAL AND POLITICAL ECOLOGY

| [F&ES 729b] | Environmental Ethics | 92 |
|-------------|--|----|
| [F&ES 743b] | Environment and Development: Dilemmas of Power and Place | 93 |
| F&ES 744a | Introduction to Planning and Development | 93 |
| F&ES 746b | Society and Natural Resources | 93 |
| F&ES 747a | Society and Environment: Introduction to Theory and Method | 93 |
| [F&ES 748b] | Environmental Values | 94 |
| F&ES 752b | Society and Environment: Advanced Readings | 94 |
| F&ES 753a | Agrarian Societies: Culture, Society, History, and Development | 94 |
| F&ES 757a | Sustainable Development and Conservation: Introduction | |
| | to Social Aspects | 94 |
| [F&ES 759b] | Sustainable Development and Conservation: Advanced Readings | 94 |
| [F&ES 761a] | Issues in Environment and Design | 95 |
| F&ES 767b | Monitoring and Evaluation Techniques, Theory, and | |
| | Methods Applied to Ecosystem Rehabilitation/Community | |
| | Revitalization Interventions | 95 |
| F&ES 795a | Cities and Sustainability in the Developing World | 96 |
| F&ES 839b | Development and Globalization | 96 |
| F&ES 884a | Ecological Imagination and Environmental Design | 96 |
| F&ES 908a | Global to Local Approaches for Developing Urban Ecosystem | |
| | Theory, Methods, and Applications | 97 |
| F&ES 912a | Seminar: Nature, Economy, and Society | 97 |

COURSE DESCRIPTIONS

At F&ES, new courses are often added after this bulletin is printed. Our Web site at http://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 519b,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, Ann E. Camp.

F&ES 528b, 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 approach 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 and 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 556b,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 557b, 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 students. Lisa M. Curran, Daniel Nepstad.]

F&ES 574a, Tropical Forest Ecology and Management. *3 credits.* The purpose of this course is to summarize ecological knowledge on tropical forest ecosystems, and to show how this scientific basis can be used for forest management, for conservation and rehabilitation, and for implementing other tree-based land utilization schemes such as plantation forestry and agroforestry. Topics to be covered include: Introduction: challenges of tropical forestry in the twenty-first century; environmentally friendly forestry systems for the humid tropics. Soils of the tropics: types, fertility, physical properties, and management. Natural forest structure and composition. The forest microenvironment: light, temperature, and water regimes. High-elevation forests and savannas. Tree growth and reproductive ecology; plant species diversity; plant-animal interactions. Nutrient cycling. Effects of disturbance; forest succession and regeneration. Management and utilization of primary and secondary forests. Plantation forestry: productivity and environmental services. Ecological aspect of agroforestry. Rehabilitation of degraded tropical forest ecosystems. Three hours lecture. Florencia Montagnini.

F&ES 575a, 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. A cross-section of northeastern ecosystems is visited and studied. The class generally consists of three hours of lecture and four hours of field work per week. There are weekly field trips, one weekend trip to New Hampshire, and one Saturday field trip to Fire Island National Seashore. See https://classes.yale.edu:444/fes275a/. Peter A. Raymond, Thomas G. Siccama.

F&ES 604b, Topics in the Tropics. *I 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 621a, 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 623b, 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.

WILDLIFE ECOLOGY AND CONSERVATION BIOLOGY

[F&ES 509a/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 5200,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 560b/E&EB 660b, Wildlife Conservation Ecology. *4 credits.* The study of wildlife ecology from an evolutionary ecological perspective to understand the behavior and life history of animals. The course explores how behavior and life history evolve and what factors ultimately shape population demography. The course examines behavioral and evolutionary ecological theories like optimal activity budgets; optimal foraging; and habitat choice in the context of age and stage-based models of population dynamics. The course links an understanding of animal behavior and life history to solving current conservation problems related to wildlife habitat loss and population viability. Three hours lecture and one hour discussion. Faculty.

F&ES 565a, Human Dimensions in the Conservation of Biological Diversity. *3 credits.* An examination of socioeconomic, cultural, and political 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 lecture. Terry Terhaar for Stephen R. Kellert.

[F&ES 578a/E&EB 375a/675a, Seminar in Molecular Approaches to Systematics, Conservation Genetics, and Behavioral Ecology. *2 credits*. The seminar focuses on molecular techniques that either have been commonly used in the past to address ecology/systematic related questions or have recently become available. 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 587a/E&EB 315La,Laboratory in Molecular Systematics.*3 credits*. This 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 is supposed to carry 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 588a/E&EB 320a/620a, Seminar in Conservation Genetics. *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 760a/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. Ofer Ovadia for David K. Skelly.

[F&ES 762b, 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 582b, Issues and Approaches in Environmental Education. *3 credits.* This course is intended for those with a career interest in environmental education. Topics include learning theory, environmental education curricula, content issues in environmental education, informal environmental education, interpretation, outdoor and experiential education, exhibitry, and mass media. Class presentations, final examination, and term project required. Stephen R. Kellert.

F&ES 583a,Environmental Writing. *I credit, balf 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 classes.yale.edu/fes583a/. Three-hour seminar and writing workshops. Fred Strebeigh.

[F&ES 724a, Information Management for Environmental Professionals. 3 credits. This course has four major objectives. First, it seeks to acquaint students with the principal resources at Yale in print-based, electronic, and visual media that are useful for research in all aspects of environmental studies, and to provide skills in using any necessary databases, indexes, catalogues, and finding aids that give access to these sources. Second, it presents an overview of important information resources on environmental topics that are available worldwide. Third, the course outlines the basics of effective writing and correct documentation of sources and demonstrates the use of bibliographic software packages (i.e., Endnote). Finally, the class provides the opportunity to explore the impact of critical thinking and information design on each student's research and writing interests. The course includes several visits to libraries and museums at Yale. Sev-

eral classes include panel discussions involving visitors from the F&ES faculty, the Yale library system, and other Yale departments. Three hours lecture/discussion/computer lab. Taught alternate years. Next offered fall 2004. Paul A. Draghi.]

F&ES 745b, **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 Yale Center for British Art and the Yale Art Gallery. Three hours lecture/discussion. Paul A. Draghi.

F&ES 824a, 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. Oswald J. Schmitz.

Forestry

FOREST BIOLOGY

F&ES 505b, Local Flora. *3 credits.* A field course which 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:444/fes220b/. Thomas G. Siccama.

F&ES 524b, 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 551b, Forest 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 592b, Agroforestry in the Tropics: Sustainability and Services. *3 credits*. Focuses on factors influencing sustainability of agroforestry systems in tropical regions of developing countries and on the environmental services that agroforestry can provide, such as biodiversity conservation, carbon sequestration, and restoration of degraded ecosystems. Topics include the following: Environmental variables in agroforestry: light and water. Soil productivity and sustainability in agroforestry components: multiple-purpose trees, nitrogen-fixing trees. Economic aspects. Examples of susbsistence-oriented and commercial agroforestry: improved fallows, home gardens, agrosilvopastoral systems, and alley-cropping. Environmental services of agroforestry: biodiversity conservation and carbon storage. Agroforestry as a tool for development. Agroforestry extension and education. Current trends in agroforestry research. In addition, seminar presentations by students deal with particular aspects of agroforestry of interest to students. Florencia Montagnini.

F&ES 600a/MCDB 660a, Structure, Function, and Development of Higher Plants: From Seed to Towering Tree. *3 credits.* This first course focuses on two aspects of plant life: (1) basic processes that drive plant systems such as fertilization, embryogeny, seed development, germination, seedling establishment, maturation, and senescence; and (2) basic structure and function of plants such as root systems, leaf formation and development, height, and diameter growth. Differences between different groups of seed plants are analyzed from structural, functional, ecological, and evolutionary standpoints. Special attention is given to woody plants because they have both primary and secondary plant bodies and because of 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. Graeme P. Berlyn.

F&ES 601b, Research Methods in Anatomy and Physiology of Trees. *4 credits.* Advanced investigative techniques with emphasis on instrumentation, experimental design, execution, and analysis. After a series of class exercises 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 600a and 610b. Permission of the instructor required. Four hours lecture/laboratory. Offered on demand. Graeme P. Berlyn.
F&ES 610b, **Physiology of Trees and Forests: The Pathway to Understanding the World's Forests**. *3 credits.* Topics in 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. Topics covered include the ecology and adaptation of species, mineral nutrition, root structure and function, symbioses, nitrogen fixation, photosynthesis, water relations, respiration, bioenergetics, growth analysis, and environmental physiology and adaptation of forests, both temperate and tropical. Two one-and-one-half-hour lectures per week. Graeme P. Berlyn.

FOREST MANAGEMENT

[F&ES 576b, Botanical Resources of the Tropics. *3 credits*. This course addresses the botany, utilization, and economics of tropical plants used by people in the past and at present. The lecture and laboratory sessions provide an opportunity to learn about plants employed for food, fuel, construction materials, spices, perfumes, stimulants, narcotics, medicines, poisons, fatty oils and waxes, gums and resins, and rubber and other latexes. The ecological impacts of exploiting these resources are also considered, and different ways to enhance the sustainability of tropic forest exploitation are examined. Three hours combined lecture and laboratory. NYBG Faculty.]

F&ES 602b, Forest Landscape Management. *3 credits.* The challenge of forest management is to provide the many objectives people demand from the forest 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 briefly covers systems concepts, decision analysis, the dynamic nature of forests, silvicultural pathways, scheduling operations, portfolio management, monitoring, and continuous quality improvement. Students use the Landscape Management System (LMS) and companion technical tools to integrate these subjects by developing (and simulating implementation of) a management plan on actual forest landscapes. Chadwick D. Oliver.

F&ES 605a,Sustainable Forestry: Biology and Management. *3 credits.* Forests potentially cover 30 percent of the earth's land surface, and most people live in, farm, and get water from these potentially forested ecosystems. This course examines the biological, socioeconomic, and management conditions of the world's forests relative to the many values people want from the forest. The course gives an overview of the condition of the world's forests and related resources and their consumption, and forms the basis for forest resource management and policy considerations in specific areas. Each of the seven Montreal Process "criteria of sustainable forestry" is examined from the natural and social science perspectives; these criteria include biodiversity, commodities, forest health, soil and water conservation, carbon sequestration, socioeconomic conditions, and the infrastructure to provide these. Course includes lectures, guest speakers, and projects. Chadwick D. Oliver.

F&ES 700b, 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 701A, 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 700b or 703a; F&ES 560b; F&ES 734a or permission of the instructor. Eight days fieldwork. Limited enrollment. Mark S. Ashton, Thomas G. Siccama, Timothy W. Clark.

[F&ES 702b,Rapid Assessments in Forest Conservation. 3 credits. An advanced interdisciplinary course concerned with protecting and maintaining the biological diversity of complex forested ecosystems while producing various goods and services. Examples of independent case analyses concern landscape management of biogeographic regions in the Pacific Northwest, Ecuador, 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 700b or 703a; F&ES 560b; F&ES 734a; or permission of the instructor. Three hours lecture. Eight days fieldwork. Limited enrollment. Next offered spring 2005. Mark S. Ashton, Timothy W. Clark.]

F&ES 703a, Growth and Development of Forest Stands. *3 credits.* This course introduces the study of forest stand dynamics – how the structure of different forest types changes over time. 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 and laboratory projects we explore forest development processes and pathways, concentrating on some key 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 704a, 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 700b or 703a, F&ES 733b or 734a; or permission of instructor. Next offered fall 2004. Mark S. Ashton.]

F&ES 705a, 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, Ann E. Camp.

F&ES 708a,b, Field Trips in Forest Resource Management and Silviculture. I credit. Seven- to nine-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 710a,Seminar on Invasive Species Biology and Ecology. 3 credits. The seminar focuses on current issues surrounding invasive species (both plants and animals) at several spatial and temporal scales. While the biology and ecology of invasive species are emphasized, the economics and policy implications of invasive species are also addressed. Ann E. Camp.

F&ES 727a, Forest Financial Analysis.*3 credits.* This course provides a framework and techniques to address financial decisions in forest management. Major topics include: timber markets, forest capital analysis and budgeting, risk and selection of interest rates, inflation, taxation, analysis of tradeoffs between timber and nonmarket resources, forest finance, and forest valuation and appraisal. Includes an overview of the developing fields of carbon offsets, green payments, and conservation land acquisitions in relation to forest finance. A substantial applied course project is required. Prerequisites/corequisites: F&ES 734a and F&ES 700b or permission of instructor. (F&ES 602b helpful.) Three hours lecture. Weekly problem sets. Lloyd Irland.

F&ES 803a, Forestry Operations for Resource Professionals. *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. Chadwick D. Oliver, Michael Ferrucci.

Physical Sciences

ATMOSPHERIC SCIENCES

F&ES 603a/GEOL 657a, Marine 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 612b, Seminar in 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 highelevation and high-latitude forests are studied through lectures, guest lectures and discussions, student seminars, and field experience. One and one-half hours lecture weekly plus field trip. Student contributions are one or more seminars and a term paper. Prerequisites: F&ES 610b, 869a, 700b or the equivalent, or permission of the instructors. Next offered spring 2005. Graeme P. Berlyn, Xuhui Lee, Mark S. Ashton.]

F&ES 834b, Seminar on Climate Change Science and Policy. 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 868b, 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 and human bioclimatology, air quality, air resources (wind and solar energy), and climate change. Three hours lecture. Problem sets. Xuhui Lee.

[F&ES 869a, 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, with special attention to the role of the terrestrial biosphere in pollution deposition, photochemical smog, UVB radiation, greenhouse gas sources/sinks, and global warming. Students also establish familiarity with quantitative tools for analysis of global change impacts on the terrestrial ecosystems. Three hours lecture. Lab sessions/reports, term paper/presentation, and field trips. Xuhui Lee.]

ENVIRONMENTAL CHEMISTRY

[F&ES 502a,b, Critical Analysis of Scientific Literature: Applied Environmental Chemistry. *2 credits*. An advanced 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 545a, which may be taken concurrently, or equivalent. Interested students must attend the first class meeting. Twohour participatory discussion, class presentation, dinners. Students may take this course more than once, space permitting. Gaboury Benoit.]

F&ES 507b,Organic Pollutants in the Environment. *3 credits.* An overview of the pollution problems posed by synthetic organic chemicals (e.g., pesticides, PCBs, PAHs) and petroleum products. The course is appropriate both for students with no background in organic chemistry and for those who have taken college organic chemistry. The first two weeks are spent in a quick introduction to the language of organic chemistry, which provides those who have little chemistry background with the basic tools needed to "decode" organic structures. 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 both surface and ground water. Three hours lecture, five problem sets, field trips. Shimon C. Anisfeld.

F&ES 544a,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 545a or equivalent. Three hours lecture, frequent problem sets. Steve Mylon for Gaboury Benoit.

[F&ES 545a,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 596a/CENG 373a/ENVE 373a,Air Pollution. *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 598b/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. Sheryl Stuart.

SOIL SCIENCE

F&ES 530a, 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 515b, 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 sewerage, wetlands, and dredging. For each topic the natural science underlying the issue is introduced and the responding governance system is evaluated. Ecosystem management, a new approach and practice, informs pending issues such as nonpoint source control and requires a much broader scientific and social diagnosis to develop effective solutions. The course concludes with a discussion of the promises and challenges for ecosystem management of coastal environments. Prerequisite: F&ES 536a or equivalent. Richard Burroughs.

F&ES 533b, Water Resource Management. *3 credits.* An examination of water resource issues at scales ranging from global to local. 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 the scientific understanding of problems and the management tools available for moving toward solutions. Topics include: water scarcity, water use projections, human impacts on aquatic ecosystems, water quality control, water law, the watershed framework, and restoration. Three hours lecture, one term project, field trips. Prerequisites: F&ES 540a and F&ES 545a, or instructor's permission. Shimon C. Anisfeld.

F&ES 536a, Estuarine Ecology and Anthropogenic Impacts. *3 credits.* An examination of the natural processes controlling coastal ecosystems (primarily estuaries and tidal marshes), and the anthropogenic perturbations to these processes. The course covers a wide range of important processes, with greatest detail given to nutrient cycling and the controls on — and fate of — primary production. Perturbations covered range from local to global, and include nutrient enrichment, hypoxia, sea level rise, invasive species, and wetland filling. Three hours lecture, several field trips. Shimon C. Anisfeld.

F&ES 540a,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 541b,Hydrologic Modeling. 3 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 540a or equivalent. James E. Saiers.]

F&ES 542b,Hydrology Seminar. *2 credits.* A seminar exploring current research topics in hydrology. An integrative analysis of hydrological, geochemical, and biological processes is emphasized. A theme for the seminar is chosen by consensus of the students during the first class meeting. Students may take this course more than once. James E. Saiers.

F&ES 550a, The Science and Policy of Eutrophication. 3 credits. Large enrichments of anthropogenic nutrients to estuaries and the coastal ocean can stimulate large deleterious phytoplankton blooms that alter the structure and function of coastal water bodies. The eutrophication problem and strategies for ecosystem restoration have been a primary focus of scientists, managers, and policy makers for past decades. Interesting system-specific responses to nutrient loading and policy and management strategies that need to cross local, state, and even country jurisdictions provide challenges to the eutrophication problem. This course begins with a set of lectures to introduce students to the science and policy of the eutrophication problem and discusses past/present management models that strive to restore coastal systems to normal function by controlling nutrient loading. Students then interact with experts from around the country who present case studies on the eutrophication problem from different coastal systems. Finally, the class ends with student presentations which draw on and integrate the case studies, in order to recommend a strategy for dealing with nutrient enrichment on both national and regional scales. Peter A. Raymond, Shimon C. Anisfeld, Richard Burroughs, and Mary Beth Decker.

F&ES 558b, 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 540a or equivalent. James E. Saiers, James G. MacBroom.

F&ES 829a, River Processes and Restoration. *3 credits.* This course studies the geophysical processes of natural rivers with emphasis on qualitative and quantitative aspects of fluid 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 540a or equivalent) is recommended; beginning in 2003 it will be required. James G. MacBroom, assisted by Laura Wildman.

[F&ES 866b, Caribbean Coastal Watershed Development: Science and Policy. *3 credits.* Investigation of the environmental impacts of development in coastal watersheds of a typical Caribbean island. Emphasis on coral reefs and other near-shore ecosystems. The course is co-taught by Benoit and a visiting lecturer, so emphasis changes from year to year. In general, links are made between policies and social forces promoting growth, their influence on the landscape, consequent accelerated erosion, and final effects on downstream ecosystems. Opportunities for GIS and remote sensing activities. One-week field trip to Roatan, Honduras. Weekly lecture, readings, group or individual project. Taught only in alternate years. Gaboury Benoit and a visiting lecturer.]

Quantitative and Research Methods

F&ES 506b/G&G 562b, **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 510a,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. Ofer Ovadia.

F&ES 513b,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. Doctoral students and master's students doing research projects can use this course to develop their research project proposals. Pam McElwee.

F&ES 529a,b, Preparation for Research. 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. Faculty.

F&ES 622a,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; the use of remote sensing data and GIS in forest inventory planning; forest inventory and consulting; the generation of forest inventory estimates at various scales of concern; acquisition of forest inventory data from Internet databases. Readings are assigned on a weekly basis and discussed during the seminar. A familiarity with the precepts and vernacular of probability sampling or statistics is presumed. Prerequisite: F&ES 711a. Limited enrollment. Timothy G. Gregoire.

F&ES 711a,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 basis for inference in survey sampling. Natural, ecological, and environmental resource applications of sampling are emphasized, with particular focus upon the sampling of forest-related resources. Sample designs to be studied include simple random; systematic; unequal probability; fixed- and variable-radius plot; and 3P/Poisson. Line-intersect and importance-sampling variants of probability proportional to size designs are also covered. Weekly and biweekly problem sets requiring the use of a computer spreadsheet. Timothy G. Gregoire.

F&ES 713b, Statistics for Environmental Sciences. *3 credits.* This course in applied statistics assists scientific researchers in the analysis and interpretation of both experimental and observational data. After considering statistical and graphical summaries of data, the notion of a random variable, distributional properties, parameter estimation, and testing are reviewed. 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 major topics of the course are estimation and inference with linear and nonlinear regression models. Three hours lecture. Statistical computing, weekly problem exercises. Prerequisite: introductory statistics. Timothy G. Gregoire.

F&ES 714a, 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 713b. 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 715a,Modeling Geographic Space. *3 credits.* An introduction to the conventions and capabilities of image-based geographic information systems (GIS) for the analysis and synthesis of spatial patterns and processes. In contrast to F&ES 716b, the course is oriented more toward the qualities of geographic space itself (e.g., proximity, density, or interspersion) than the discrete objects that may occupy such space (e.g., water bodies, land parcels, or structures). Three hours lecture, problem sets, one class project. No previous experience is required. Faculty.

F&ES 716b, **Modeling Geographic Objects**. *3 credits*. This course offers a broad and practical introduction to the nature and use of drawing-based geographic information systems (GIS) for the preparation, interpretation, and presentation of digital cartographic data. In contrast to F&ES 715a, the course is oriented more toward discrete objects in geographical space (e.g., water bodies, land parcels, or structures) than the qualities of that space itself (e.g., proximity, density, or interspersion). Three hours lecture, problem sets, one class project. No previous experience is required. Faculty.

F&ES 719b, Statistical Design of Experiments. *3 credits.* Principles of design for planned experiments, coupled with method 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 844b, 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.

Social Sciences

F&ES 733b,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. Three hours lecture. Robert Mendelsohn.

F&ES 734a, 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 threequarters 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 737b, Valuing the Environment. *3 credits*. This quantitative course demonstrates alternative methods used to value environmental services. The course covers valuing pollution, ecosystems, and other natural resources. The focus of the course is on determining the "shadow price" of nonmarket resources that have no prices but yet are considered valuable by society. Taught every other year. Three hours lecture. Robert Mendelsohn.]

F&ES 852b, Economics of Energy and the Environment. *3 credits.* Energy markets throughout the world are being deregulated. Simultaneously, environmental regulators of energy companies are drawing on economic principles more often by using incentive-based environmental regulation. This advanced economics course considers the economic structure and environmental impacts of energy markets including oil, natural gas, gasoline, and electricity. In the context of these markets, we discuss the rationale for and effects of economic and environmental policies. Topics include promoting effective competition, financial tools of energy markets, methods of environmental protection, energy conservation issues, the role and implementation of renewable resources, and expected future energy supplies. Erin T. Mansur.

F&ES 863b, Economics of Water Quality and Water Scarcity. 3 credits. This limitedenrollment 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 733b, F&ES 734a, or an equivalent microeconomics course. Sheila M. Olmstead.

ENVIRONMENTAL POLICY

F&ES 503a,Seminar in Environmental and Natural Resource Leadership. *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, leadership skills, and the role of scientists in leadership and management decision. Leaders from many areas make presentations to the class describing their leadership experiences in the field, reflecting on the qualities and characteristics that each associates with leadership, and assessing the challenges facing the next generation of environmental and natural resource leaders. Guest speakers come from government, business, private nonprofit organizations, philanthropy, academia, and the U.S. Congress. Through this experience, students have the opportunity to assess their own leadership capabilities and identify means to address deficiencies. Chadwick D. Oliver.

F&ES 521b, 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 594a, Comparing Environmental Governance Across Countries: Theory and Evidence. *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 725b,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 731A, 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 739b, 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 conduct research and interdisciplinary analysis of the subject, to prepare a report and recommendations for the identified client, and to brief the client on the product of their analysis. Each team is responsible for a minimum of 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 766b, 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. This is particularly true in the water sector, both urban and rural. Private involvement in the water sector 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 water sector. Particular attention is paid to urban water services. Limited enrollment; preference to first-year students. Bradford S. Gentry.

[F&ES 768b/MGT 687b, Business and Environment Leadership. 3 credits. During the last decade, business and environmental leaders began to realize that understanding one another and working together, while unaccustomed and often difficult, offer many tangible benefits. The course focuses on the lives and experiences of such leaders, several of whom pioneered Yale's joint M.B.A./M.E.M. degree program. Professional pathways, career development, challenges in the workplace, and many other topics are explored. Emergent opportunities as well as common problems are considered. Specific attention is given to differences that exist in the views, values, and cultures of the business and environmental worlds. Garry D. Brewer.]

F&ES 769a/MGT 689a, Ecological Knowledge and Environmental Problem Solving. *3 credits.* The "heart" of the course is a distillation of core ecological concepts and their translation into an accessible framework. The framework guides both scientists and decision makers through a series of steps and questions that allow them to frame environmental problems in a realistic way. The first half of the course concludes with increasingly complex cases that familiarize one with the approach. The remainder of the course focuses on specific environmental issues of current and continuing interest. Class members work in groups to confront these topics as scientists and decision makers might in actual circumstances. Topics may vary, although the following are illustrative: risk assessment and communication, fisheries management, offshore oil and gas exploration and development, nuclear waste disposal, and global warming and climate change. Garry D. Brewer.

[F&ES 770b/MGT 676b, Scope of the Policy Sciences. 3 credits. Emphasizing a systematic and comprehensive approach to the study of policy, this course concentrates on a general sequence of decision comprised of six distinct, interrelated phases of the "life" of a policy or problem. The course has served as a foundation upon which other substantive policy courses and work have been built. Furthermore, it works to integrate theory with practice in a variety of substantive fields. Garry D. Brewer.]

F&ES 801a, Energy Systems Analysis. *3 credits.* This lecture course offers a systems analysis approach to describe and explain 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. The evolution of energy systems is reviewed from a historical as well as futures (scenarios) perspective. Special attention is given to traditionally lesser-researched elements of energy systems (energy use in developing countries; urban energy use; income, gender, and lifestyle differences in energy end-use patterns). Particular emphasis is also given to market externalities and market failures characteristic of energy systems and a discussion of their policy implications. I credit for field trips. Arnulf Grübler.

F&ES 802a, Technological Change and the Environment. *3 credits.* This seminar addresses technology's dual role as both source and remedy of global environmental change. The seminar discusses both conceptual and theoretical aspects of technological change (one-third) as well as examples of technological change and its environmental impacts in agriculture, industries, and the service economy (two-thirds). Questions addressed 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 reporting on assigned readings, empirical "fact finding missions," and policy roundtable discussions are essential ingredient of the seminar. Arnulf Grübler.

F&ES 819a, Social and Environmental Dimensions of Biotechnology. 3 credits. This course addresses economic, environmental, legal, and social-justice dimensions of new biotechnologies and agricultural alternatives in the context of globalization. We ask

whether and how crop genetic engineering may or may not be key to reducing hunger and rural poverty and mitigating the negative environmental effects of industrialized agriculture. We briefly survey genetic engineering science and applications, then consider different views about the benefits and risks of genetically altered organisms for people, ecosystems, and biodiversity. We look at the political economy of biotech research, the changing structure of the "life industry," and the effect of patents on living things and scientific knowledge. We examine why biotechnology, intellectual property, and bio-prospecting are at the center of international disputes among developing and industrialized countries. We explore the effects of ideas about biotechnology and how scientific concepts and practices are shaped by the socioeconomic contexts in which science is carried out: How does biotechnology discourse – for example, the metaphor of the "genetic code" - affect public opinion and policy? What is known, and what remains unknown, now that human, animal, and plant genomes are being mapped? Finally, we look at alternatives or complements to genetic engineering that may make agriculture more productive and ecologically and socially sustainable, and we consider the role of new social movements in developing these alternatives. Readings, lectures, student presentations, guest lectures, and class discussions address controversial choices faced by scientists, public officials, farmers, consumers, NGOs, and global governance agencies. Some background social ecology and ecology and basic biology/genetics is helpful but not essential. Kathleen McAfee.

F&ES 842a, The Economics of Sustainable Development. *3 credits.* Exploration of interpretations and definitions of sustainable development with attention to indicators and measures of progress. The course emphasizes the principal economic obstacles to sustainable development, the policy options available with which to overcome such obstacles, and recent experience – largely in developing countries – in attempting to apply such policies. Among these obstacles are institutional, market, and government policy failures. Each is studied across several resource sectors, such as agriculture, forestry, and fisheries. The course also examines issues surrounding the role of international development institutions in overcoming these obstacles. It is assumed that students in the course will have varying levels of prior preparation in economics. Robert Repetto.

F&ES 843a, The Economics of Climate Change. *2 credits*. This weekly seminar examines key issues in the economic analysis of the climate change problem. Topics include the economic evaluation of climate change damages, the treatment of risk and uncertainty in evaluating impacts, the benefit-cost approach to forming climate change mitigation policies, the choice of policy instruments for controlling greenhouse gas emissions, the economics of carbon sequestration, the design of carbon emission trading systems, the "double dividend" debate in climate policy, equity and efficiency issues in international burden-sharing, and issues in seeking voluntary international agreements. Enrollment limited to fifteen students. Participating students are expected to assume significant responsibilities in the seminar. Robert Repetto.

F&ES 846b,Strategies for Land Conservation. *I or 3 credits.* This is a professional seminar on land conservation strategies and techniques – with particular emphasis on the legal and financial tools used in the United States. Its focus is on practical approaches for achieving land conservation objectives, as well as the professional skills necessary to apply those tools. The seminar is built around presentations by guest speakers from land conservation organizations, who describe their work, present case studies, and answer questions from the students. The speakers' topics are designed to explore the details of land conservation finance, and tax incentives. Creative partnerships for conservation are explored, from negotiating with landowners to generating public support. One-credit and a limited number of three-credit project options are available. Enrollment limited to second-year students or a maximum of twenty-five. Bradford S. Gentry.

F&ES 847b, 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 the Kyoto Protocol, 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, and the Persistent Organic Pollutants (POPs) Treaty. 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 affect positive outcomes. Michael Northrop.

F&ES 848b, Comparative Environmental Law in Global Legal Systems. *3 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 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. Lye Lin Heng.

F&ES 851b,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. John R. Nolon.

F&ES 853a, Private Investment and the Environment. *3 credits.* This class explores the opportunities and limits of using private investment to improve environmental performance. It has two parts: (a) an examination of the links between private investment and environmental performance, including the motivations of private investors, and the roles of governments, businesses, and civil society in environmental protection; and (b) an exploration of the approaches now being used to attract – or drive – private investment into better environmental performance, including information, regulatory, and partnership approaches. Examples from around the world are used to illustrate the main issues. In 2003, the class is taught jointly by a U.S. lawyer and a Brazilian banker. Students are expected to produce substantial research papers on a topic of their choice. Prerequisites: Environmental Law and Policy, or Business Concepts for Environmental Managers, or equivalent. Bradford S. Gentry, John Forgach (McCluskey Fellow).

F&ES 858a, 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 861a/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 864a,b, 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 870b/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). James Gustave Speth, James Salzman.

F&ES 886b/LAW 21423, The Law of Biodiversity and Nature Conservation. 2 credits. This seminar examines how the law regulates the living environment and attempts to satisfy the very different and deeply held expectations within society over the proper uses of wildlife and plants, ranging from hunting and commercial harvesting to conservation and preservation. The first classes lay a foundation for how to think about management of living resources, considering the different values of living resources, how these values have changed over time, the issue of who owns wildlife, and the various means of overcoming common pool problems. The next set of classes examines the legal regimes protecting specific living resources, including fisheries, whaling, endangered species, and biological diversity. We also consider the role of international trade law in promoting nature conservation. The last set of classes shifts from a species-specific approach to consider ecosystem management, focusing on forestry, rangelands, and the management and design of national parks. A number of classes examine these issues through the use of case studies and in-depth problem exercises. Enrollment limited to eighteen students. Paper required. James Salzman.

F&ES 891b, 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, Andrew R. Willard (Law).

HEALTH AND ENVIRONMENT

[F&ES 72 rb/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 722a/EHS 508a, Assessing Exposures to Environmental Stressors.** *2 credits.* This course examines human exposures to environmental stressors, as it applies to environmental epidemiology and risk assessment. Indirect and direct methods of assessing exposures are reviewed, and case studies are presented. Brian P. Leaderer.

F&ES 726a/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.

INDUSTRIAL ENVIRONMENTAL MANAGEMENT

F&ES 500a,Greening the Industrial Facility. *3 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 501b, 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, Marian R. Chertow.

F&ES 504a, Seminar in Industrial Ecology. *3 credits.* A seminar exploring current research topics in industrial ecology. An overall theme for the seminar is chosen by consensus during the first class meeting. Attendance restricted to twelve students; preference given to doctoral and second-year M.E.M. students. One three-hour class per week. Each student writes and presents a term paper. Students may take this course more than once. Marian R. Chertow, Thomas E. Graedel.

F&ES 810a/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.

F&ES 812b/MGT 688b, 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. Enrollment limited to eighteen. Marian R. Chertow.

F&ES 905a/MGT 528, Public and Private Management of the Environment. 4 units. This course explores the management of the environment and natural resources from the perspectives of private corporations, government regulators, and nonprofit organizations. A major theme is the consideration of various approaches to environmental protection: from conventional command and control regulation, to innovative marketbased instruments such as tradeable emissions permits, to "demand-side" approaches such as product labeling, to voluntary "green business" practices by private firms. As its title suggests, the course examines environmental policies in both the public and private realms. The first part of the course, comprising lectures and case discussions, employs the analytical framework of economics to understand the genesis of environmental problems and sketch the public policies that can help solve them. How should regulators design environmental policy? What should be the role of cost-benefit analysis in determining the level of environmental protection? How have markets for environmental protection been established in the real world, to tackle issues ranging from sulfur dioxide pollution to endangered species habitat? The second part of the course uses a series of case studies to develop an understanding of corporate and nonprofit environmental strategy. In the private sector, what opportunities exist for innovative environmental policies that preserve or even enhance the corporate bottom line? How do concerns about the environment fit into corporate competitive strategy? What obligations do private companies have toward the environment and natural resources? Finally, what role can nonprofit organizations play in influencing public policy and shaping corporate practices? Prerequisite: Economic Analysis or the equivalent. Nathaniel Keohane.

SOCIAL AND POLITICAL ECOLOGY

[F&ES 729b/REL 870b, Environmental Ethics. *3 credits.* This course addresses contemporary ethical issues involved in sustaining the environment, and historical and contemporary perspectives on humanity and nature. The course aims to facilitate an integrated scientific, philosophical, religious, and spiritual understanding of current environmental issues. It is an interdisciplinary course; hence it aims to facilitate interdisciplinary dialogue and research. Its goals include the development of ethical positions relevant to environmental policy making. Permission of instructor required. Stephen R. Kellert, Margaret Farley.] [F&ES 743b/PLSC 367b/ANTH 417b/EP&E 452b,Environment and Development: Dilemmas of Power and Place. 3 credits. An intensive, comparative investigation of conservation and development as they are conceptualized and practiced in specific regions of Africa and Asia. Examination of the interrelated concepts of modernity, rationality, postcolonialism, power and knowledge, and governmentalism, through analyses focused on the history, ethnography, and ecology of these regions. Arun Agrawal, Rebecca Hardin, Eric Worby, Estienne Rodary.]

F&ES 744a/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 746b, Society and Natural Resources. I-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 747a/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 752b and F&ES 759b. Three hours lecture/seminar. Enrollment limited to thirty. Michael R. Dove.

[F&ES 748b, Environmental Values. 3 credits. This course explores the meaning and, when possible, the measurement of diverse environmental values including utilitarian, scientific, aesthetic, naturalistic, symbolic, ethical, and spiritual values. The course also examines variations in these values among societal groups distinguished by education, income, occupation, age, gender, race, ethnicity, geography, and culture. Case studies are reviewed, emphasizing the importance of understanding and assessing environmental values in environmental policy and management. Stephen R. Kellert.]

F&ES 752b/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. The course examines key theoretical developments and current issues in social/political/historical ecology and ecological anthropology. Topics discussed include conceptions of nature and culture, discourses of environmental degradation and restoration, and structural and post-structural theory. The course attempts to place current debates about human-environment relations in their historical and theoretical context. Students are expected to use the course to develop their own research and writing. Prerequisite: F&ES 747a or F&ES 756b or F&ES 757a. Enrollment limited to twelve. Three hours lecture/seminar. Taught alternate years; next offered spring 2005. Michael R. Dove, Carol Carpenter.

F&ES 753a/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. Two-hour lecture and two-hour seminar. Michael R. Dove, Robert Harms, and other campus-wide faculty.

F&ES 757a/ANTH 597a, Sustainable Development and Conservation: Introduction to Social Aspects. *3 credits*. This course provides a fundamental understanding of the social aspects involved in implementing sustainable development and conservation projects. Social science has two things to contribute 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. Second, social science tackles the analysis of the knowledge systems that implicitly shape development and conservation policy and impinge on practice. The goal of the course is to stimulate students to apply informed and critical thinking 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 752b and F&ES 759b. Three hours lecture/seminar. Carol Carpenter.

[F&ES 759b/ANTH 598b, Sustainable 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, looking at both public expressions appearing in publications and underlying discourses. It also examines the response by local communities to development projects and compares development and conservation rationales with alternative local rationales. Finally, the linkage between the development project and the academy is examined. Students are expected to use the course to develop their own research and writing. Prerequisite: F&ES 747a or F&ES 757a. Enrollment limited to twelve. Three-hour lecture/seminar. Taught alternate years. Carol Carpenter, Michael R. Dove.]

[F&ES 761a,Issues in Environment and Design. 3 credits. This course is being offered in collaboration with the School of Architecture. It offers an ecological examination of the activity of architects and seeks to give future architects and ecologists an understanding of each others' goals. Leading designers of communities, buildings, and the landscape have been increasingly concerned with environmental challenges that shape the built environment. This course investigates the positions, methods, and projects of the most promising of these designers. Students review the perspectives and practices of a select group of designers and undertake design exercises in a term-long project related to the designers' activities. The course meets in a seminar for one and one-half hours and a studio for three hours every other week. Alternating weeks feature public lectures by leading designers, who also participate in design reviews. Written critical reviews of selected readings, case study presentations of built projects, and completion of a design project are required. Enrollment is limited to sixteen students, eight each from Architecture and F&ES. Stephen R. Kellert, James W. Axley.]

F&ES 767b, 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 795a, 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 2.1 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. Ellen Brennan-Galvin.

F&ES 839b, Development and Globalization. 3 credits. Five centuries of globalization have produced a world characterized by great inequalities among and within nations: a central problem for sustainable development. Part 1 of this course concerns the reshaping of the world since 1492: how structures established during colonialism contribute to poverty and unsustainable resource use; how deep-rooted cultural patterns affect the way people in different places and social positions interact with the natural world. Part 2 examines postcolonial development as a project of governments, international agencies, academic analysts, and activists. We assess theories and outcomes of modernization, marginality, dependency, import substitution and export-led growth, and "anti-development" arguments. Part 3 addresses the material dimensions of today's world-market economy: where are resources produced and consumed, and with what human and ecological consequences? What are the linkages among commodity trade, capital mobility, labor migration, food insecurity, environmental degradation, and debt? What theories help us understand the current phase of globalization? Part 4 covers institutions of economic and environmental governance: the origins and evolution, and the human and eco-economic impacts of the World Bank and the IMF. We discuss contradictions of the WTO and recent global environmental treaties, and the roles of social movements and NGOs in restructuring and re-imagining sustainable development. This course may be elected to satisfy the M.E.M. social science requirement. It also offers opportunities for experienced students to explore classic and new literature and to do country-specific background research for master's or doctoral projects. Kathleen McAfee.

F&ES 884a, Ecological Imagination and Environmental Design. *3 credits.* This course explores the integration of ecological values, issues, and processes with the design of commercial, residential, educational, and recreational facilities. It considers ways of capturing in the human built environment various physical, material, aesthetic, intellectual, and emotional benefits of nature. Lecture, discussions, and projects. Stephen R. Kellert.

F&ES 908a,Global to Local Approaches for Developing Urban Ecosystem Theory, Methods,and Applications. 3–6 credits. This course examines classic and current theories of urban pattern and process. The trends and issues for a variety of international urban regions provide context. The techniques of cross-discipline measures and the application of community-based strategies for policy, planning, and management interventions serve as a base for professional action. Extensive readings in the literature, lectures by experts, field trips, and specific field project tasks in the New Haven/New York areas structure the learning process. A core of the theory and findings comes from the emerging data sets of the NSF-Long Term Urban Ecosystem Studies in Baltimore. Also, the lessons learned from over a decade of action research in Baltimore and New Haven inform the course. A focal interest is exploring the critical role that cities must play in ensuring a sustainable global future. William R. Burch, Jr., Colleen Murphy-Dunning.

F&ES 912a, Seminar: Nature, Economy, and Society. 3 credits. The emergence of environment as a major focus of science and governance has stimulated profound rethinking in economics and the social sciences, and in agencies such as the World Bank, about the relationship between nature and society. While many agree that the natural world must be taken into account in trade, development, and regulatory policy, there are deep differences about how to do so. This seminar samples a range of recent, influential writing in environmental economics, political economy, political ecology, and anthropology and considers the policy implications of contrasting theoretical approaches. Must nature earn its own right to exist in a global market economy? Are privatization and market exchange of natural resources the best way to foster their optimal use? Does the treatment of natural resources as commodities increase or lesson equality and sustainability in the distribution of environmental benefits and burdens? Do the discursive practices of ecological modernization promoted by global environmental institutions foster "biology as an accumulation strategy" at the expense of people and nature? Do new economic approaches take account of the place-specificity, bio-complexity, and social embeddedness of natural resources? Is it possible to devise measurements of environmental values that are applicable worldwide? A prerequisite is any of the following: F&ES 725b, 733b, 734a, 737b, 743b, 746b, 747a, 748b, 752b, 753a, 756b, 757a, 759b, 768b, 794a,b, 819a, 839b, or permission of the instructor. Kathleen McAfee.

F&ES UNDERGRADUATE COURSES

Ecology

ECOSYSTEM ECOLOGY

F&ES 262a/EVST 262a, Ecology and Environmental Problem Solving. A study of ecological principles and their potential application to problems in conserving biodiversity. Topics of study include: the biosphere; organizational hierarchies and time scales; individual behavior in an evolutionary contest; ecology of species interactions; ecological complexity; and linkages among species and ecosystem functions. The lecture course is accompanied by laboratory and field exercises. Students learn to use basic ecological

sampling methods and to apply these techniques to understanding of ecological patterns. Students conduct experiments to understand relations between biodiversity and ecosystem functions. Oswald J. Schmitz.

F&ES 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 575a 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, David K. Skelly, Stephen C. Stearns.]

F&ES 360b/E&EB 360b, Wildlife Conservation Ecology. See F&ES 560b for description.

F&ES 365a/E&EB 365a,Landscape Ecology. See F&ES 760a for description.

[F&ES 370a/E&EB 370a, Aquatic Ecology. See F&ES 509a for description.]

Forestry

FOREST BIOLOGY

F&ES 220b, Local Flora. See F&ES 505b for description.

F&ES 260a, Structure, Function, and Development of Trees. See F&ES 600a for description.

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

Physical Sciences ENVIRONMENTAL CHEMISTRY **F&ES 344a,Aquatic Chemistry.** See F&ES 544a for description.

Quantitative and Research Methods

GEOL 362b, Observing the Earth from Space. See F&ES 506b for description.

Social Sciences

ECONOMICS

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 2004. *For non-Economics majors.* Robert Mendelsohn.

ENVIRONMENTAL POLICY

F&ES 245b, International Environmental Policy and Governance. 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.

F&ES 255b/EVST 255b, Environmental Politics, Policy, 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 prvisioning 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. This course examines the way humans view and value the natural world. The biological and cultural bases for these values are explored, including historical, social, and ethical expression and their role in human motivation and behavior. The topic is related to current environmental issues including loss of biological diversity and environmental pollution. Next offered spring 2005. Stephen R. Kellert.]



Centers and Programs at the School of Forestry & Environmental Studies

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

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

CENTER FOR BIODIVERSITY AND CONSERVATION SCIENCE

The loss of biological diversity is one of the greatest threats facing society today. As we move into the twenty-first century, humanity is witnessing an unprecedented period of extinction. From Sri Lanka to the Western Ghats of India and from the uplands of Amazonia to the Pacific Northwestern United States, a staggering loss of species diversity and habitat is threatening both the integrity of natural systems and the health of human systems. In today's society, priority conservation areas — those fragile and vital ecosystems threatened with the most severe loss of biodiversity — require more than the traditional, biological approach to protect species and their habitat. Multidimensional in scope, these problems require solutions that draw on the expertise of professionals from various disciplines. In recognition of the scale and dimension of this global threat, the Yale School of Forestry & Environmental Studies created the Center for Biodiversity and Conservation Science.

The goal of the Center for Biodiversity and Conservation Science is to foster the most advanced scientific research in the field and bring this knowledge to bear on solving environmental problems that exist on a human scale. The faculty of the School of Forestry & Environmental Studies, and other leading academic, nonprofit, and scientific organizations, work collaboratively across various disciplines to address complex problems that threaten conservation and the loss of biodiversity. By examining the natural, social, economic, and often political nature of these issues, the center offers creative, cutting-edge solutions to biodiversity problems in ways that allow for the protection of the ecological integrity of natural systems while incorporating the social and economic needs of local communities.

Yale's Center for Biodiversity and Conservation Science is comprised of three research areas that work to maintain global biodiversity and ecosystem health: Ecology and Conservation Biology; Conservation Policy; and Human Dimensions.

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 currently 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 projects. The summer training modules incorporate an optional day-long training session in coastal watershed field studies. 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 minimum stream flow for fish habitat; a quantification of stream restoration on a watershed scale; an assessment of conservation priorities in a Connecticut watershed using remote sensing and GIS; and a design investigation for a fishway installation.

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 stresses unique to the urban environment, while sharing common characteristics and following natural laws of all water systems. Urban watersheds are often polluted, heavily engineered, inaccessible, and little understood by nearby residents; population density exacerbates stresses on waterways.

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

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

Coastal Field Station

A research facility is available to the Center for Coastal and Watershed Studies at the Peabody Museum Field Station on the Long Island Sound in Guilford. The station provides central access to one of the country's most important estuaries.

CENTER FOR ENVIRONMENTAL LAW AND POLICY

A joint undertaking with Yale Law School, this center seeks to engage students in dealing with real-world legal and policy issues. It coordinates an environmental protection "clinic" that undertakes term-long projects for clients (environmental groups, government agencies, community organizations, and private-sector enterprises) staffed by interdisciplinary teams of law and environmental studies students.

The center also supports a wide-ranging program of research and policy development aimed at local, regional, national, and global issues. Projects have included an effort to develop a "next generation" of environmental policy tools and strategies including "Information Age" opportunities and challenges; a series of studies examining the role of foreign investment in supporting sustainable development; work on the linkage between trade liberalization and environmental protection; a study focused on environmental issues in the context of the Free Trade Agreement of the Americas; analyses of the role of nongovernmental organizations in environmental policy making; research on the design of environmental regulatory structures; rethinking of global environmental governance institutions; and an exploration of environmental performance measurement and an Environmental Sustainability Index ranking countries. These efforts involve faculty and student collaboration aimed at shaping both academic thinking and public policy making.

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 which seeks to optimize the total materials cycle from virgin material, to finished material, to component, to product, to obsolete product, and to ultimate disposal. Factors to be optimized include resources, energy, and capital.

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
- · Doctoral and postdoctoral study programs in industrial ecology

Two major research foci are (I) 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, and (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. The center also is engaged in a collaborative project to develop and disseminate research and training in industrial ecology in Asia, supported by the Henry Luce Foundation.

Journal of Industrial Ecology

CIE is home to a highly regarded, international, peer-reviewed journal. Published by MIT Press, the *Journal of Industrial Ecology* is a 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.

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 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: (I) 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 management.

ENVIRONMENT AND HEALTH INITIATIVE

The Environment and Health Initiative is a new research effort being developed to explore important environmental threats to human health. The initiative has a special focus on the risks faced by infants, children, women, and other susceptible populations, and on the common overlap of poverty and environmental health threats. The research is problem-focused and interdisciplinary, and is intended to result in concrete suggestions for improving health and environmental quality through development, education, law, and private investment. Most projects have lives between two and four years, and now include: (1) Food Security, Trade, and Agriculture: GMOs, Beef, Pesticides; (2) Vector-Borne Disease: Malaria and West Nile Encephalitis; (3) Water Availability and Quantity: Israeli Treatment, Urban Supply; (4) Air Quality: Diesel, TRI, and Land Use; (5) Urban Environmental Quality and Health: Asthma in Connecticut Schools; (6) Institutional Capacity for Risk Management: Tanzania and Cameroon; (7) Risk Assessment Methods: Computer Modeling of Exposure and Risk; and (8) Education and Outreach: Curricular Development, Video Production.

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 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 or 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 (http://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.
- Interactive databases on public-private partnerships designed by PPPUE and Yale, and assembled by graduate researchers at Yale. As of September 1999, the databases included over 400 PPP reference cases, over 350 PPP contacts, and over 800 bibliographic entries. The databases are interactive: users can not only search them, but can also upload data on their own cases, contacts, and documents.
- 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 PPP; 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 distance 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. In 1999, the course involved students in South Africa, China, the UK, and the U.S. In 2001, over fifteen universities from Africa, Asia, Latin America, and Central Europe were involved. Faculty at each of the involved 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. The Chinese collaborators are now adapting the course materials for use with non-academic 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, to Lebanon. For the next several years, particular attention will be paid to building the capacity for partnerships in countries such as Mozambique, Namibia, Uganda, Zambia, the Philippines, and Nepal.

As the School continues to confront the challenges of a rapidly urbanizing world, the Yale–UNDP Collaborative Program is poised to be an increasingly important part of 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, environmental education initiatives, 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 2,500 New Haven students in twenty 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.

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 longterm 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.

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 (http://www.yale.edu/tri/).

Publications

TRI publishes *Tropical Resources: The Bulletin of the Tropical Resources Institute*, an annual journal of student research, and a *Working Paper* series.

THE GLOBAL INSTITUTE OF SUSTAINABLE FORESTRY

For over 100 years, the Yale School of Forestry & Environmental Studies has had a rich history in the pursuit of sustainable forestry. From the establishment of the School in 1901, in response to the need to train highly effective and innovative leaders in forestry, to the School's expansion in the 1970s, Yale has played an integral role in the production of leaders who are prepared to confront the environmental challenges of the day.

The new Global Institute of Sustainable Forestry (GISF) at the School continues this rich tradition. Established by the dean and a group of F&ES faculty members in 2000, GISF has launched innovative initiatives while coalescing and coordinating the many activities related to sustainable forest management at the School. The mission of GISF is to foster leadership through innovative programs and activities in research, education, and outreach, to create and test new tools and methods, and to better understand and support sustainable forest management worldwide.

The Institute was created to address the management and conservation of both domestic and international forestlands in a holistic and comprehensive fashion. In pursuit of these ideals, GISF has developed several formal programs, core activities, and initiatives. The programs include the Program on Forest Certification (PFC), The Forests Dialogue (TFD), the Program on Forest Physiology and Biotechnology (PFPB), the Program on Landscape Management Systems (LMS), the Program on Private Forests (PPF), the School Forests, the Program on Tropical Forestry (PTF), and the Yale Forest Forum (YFF). The programs are described in greater detail below.

Current core activities of GISF include the Visiting Fellows Program, a term in residence for senior-level scientists or executives from the forest products industry and con-



servation community that allows fellows the opportunity to teach seminars, develop partnerships and collaboratives, and interact with the Yale F&ES community; the Summer Internship Program, through which GISF provides summer internship opportunities for students interested in sustainable forestry; the Lantern Slide Preservation Project, a database project in which F&ES students catalogued and scanned turn-of-thecentury forestry images onto a CD; the Sustainable Forestry Library, housed in Marsh Hall, which contains working papers, books, and other documents related to forestry and forest management; and the Working Paper Series, which is a new series of working papers, produced by GISF, dedicated to current forest issues.

To carry out these activities, GISF draws on faculty and staff expertise of the School of Forestry & Environmental Studies, partners with other Yale centers, and cooperates with many institutions in the United States and abroad. In the past, students have participated in these programs as research assistants and interns, and as field crewmembers at the School Forests, and have contributed to published documents that have emerged from program activities. While students provide valuable assistance to the operation of the program, they in turn receive the benefits of working and interacting with global leaders in the field of sustainable management.

The institute is governed by the dean of the School and a group of faculty advisers. The main office and bulk of the work of the institute are housed in Marsh Hall.

Program on Forest Certification

The mission of the Yale Program on Forest Certification 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. Forest certification is a unique market-based policy approach that has emerged recently to address global and domestic environmental deterioration. Business associations, landowners, and environmental organizations are attracted to forest certification because it harnesses the power of the marketplace to encourage compliance with environmental and socially responsible standards. Companies and forest owners are audited for compliance and, if successful, are certified as practicing responsible forestry. The promise of forest certification is that it offers an alternative to traditional "stick" approaches that often characterize governmental regulations and boycott campaigns, with "economic based carrot" incentives instead.

The program focuses on three interrelated efforts:

- Research designed to understand the impacts of forest certification in the promotion of sustainable forestry. Our research is organized around four key themes: governance and certification; the consequences of forest certification in developing countries; environmental effects of certification; and market supply dynamics.
- 2. Teaching and training on forest certification. Our teaching includes a comprehensive seimnar on forest certification, as well as 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 on forest certification, as well as attending the key certification and sustainable forest policy conferences globally.

The program is housed on the third floor of Marsh Hall. Students have the opportunity to work as researchers and/or assist in the coordination of program activities and certification assessment training.

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 Systems

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 Program (LMP) 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 LMS program 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 health and sustainable management of private forestlands. Our mission is to advance the state of knowledge about sustainable forestry on private forestlands at multiple scales and within multiple contexts. Program initiatives currently focus on forest fragmentation, forest health, management of eastern hardwoods, and changes in forestland ownership.

In order to advance the understanding and management of hardwood forests in the eastern United States, we are working on collaborative efforts in two areas: southern bottomland hardwoods and eastern upland hardwoods. The goals are to enhance communication and collaboration among hardwood silviculturists to build the scientific knowledge base required to meet the future needs of private landowners focused on forest management in an ever more complex and challenging environment.

Faced with urban and suburban sprawl, forests in many parts of the United States are becoming increasingly fragmented, with implications for wildlife, invasive species, forest management, and local forest-based economies. 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 project is being piloted in the northeastern United States.

Other projects currently under way include: creation of an annotated bibliography and clearinghouse for forest fragmentation literature; organizing forums and workshops to foster informed dialogue about critical forest health risks, such as invasive species and wildfire, and developing strategies for dealing with those risks; and exploring changing ownership patterns on industrial timberlands and the implications of these changes for the conservation of environmental values of forests worldwide. The program also has ongoing projects in New Haven working with a local NGO partner and a charter high school both to manage their twenty-acre urban forest and to develop opportunities for forest ecology and environmental education.

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.

Students working as interns and managers carry out all management of the forests.

Yale Forest Forum

The Yale Forest Forum (YFF) is a program that 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 creation and the management of forests 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.

CORPORATE ENVIRONMENTAL LEADERSHIP SEMINAR

In June of each year, the School runs the Corporate Environmental Leadership Seminar (CELS), an intensive course in environmental management and policy for executives

from industry, government, and NGOs. Begun in 1992, the seminar has attracted international participation by major companies and has established itself as the principal executive program in the United States to focus on environmental issues. The faculty for the seminar is interdisciplinary, drawn from many schools and departments within Yale, as well as invited industry experts.

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 dimension 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 Yale 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 pages 48 and 51.

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 page 12.

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 seven YIBS Research Centers: YIBS Center for Earth Observation; YIBS Center for the Study of Global Change, YIBS Center for the Ecology and Systematics of Animals on the Verge of Extinction (ECOSAVE); YIBS Field Ecology Center; YIBS Center for Stable Isotopic Studies of the Environment; and YIBS Microbial Diversity Center. The School's current interests are most closely aligned with the Center for Earth Observation and the Field Ecology Center. For full information on the Yale Institute for Biospheric Studies and its associated centers, please refer to the YIBS Web site: http://www.yale.edu/yibs/.

YALE PEABODY MUSEUM OF NATURAL HISTORY

The Yale Peabody Museum of Natural History, founded in 1866, contains one of the great scientific collections in North America. Numbering more than eleven million objects and specimens, the collections are used for exhibition and for research by scholars throughout the world. A growing Internet service makes catalogue data for more than one million of these specimens and objects available online at http://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 to share scientific, academic, and technical resources; exchange faculty and students; and cooperate in research, outreach, and conferences.

THE 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 thirty-nine 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 NewDelhi, 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 week of seminars on urban sustainable development trends, challenges, and opportunities; sustainable development in urban ecosystems; and the principles and methods of industrial ecology and cleaner production. The initial week of seminars is followed by a two-week study tour in the United States or Europe.

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

Each applicant must be a graduate of a college or university and must provide a completed application form, a résumé, an essay discussing his/her reasons for applying, GRE scores, TOEFL scores for international students, transcripts from colleges and universities attended, and three letters of reference. (See Application Procedures, page 122, for detailed instructions.)

The Mid-Career Program is a one-year (two-term) M.E.M. or M.F. degree program for professionals who have worked for seven or more years in the natural resource and environmental fields and who wish to advance their current careers through additional training. The Mid-Career Program is not intended for those who are contemplating a major shift in fields of interest; for this purpose, the two-year degree program is more appropriate.

Applicants to the master's degree programs are required to take the Graduate Record Examination (GRE). When taking the GRE, applicants should indicate the School's Institution Code Number 3996; no department code is necessary. Applicants for whom English is not a native or customary language of instruction must take the Test of English as a Foreign Language (TOEFL). Both these tests are administered by the Educational Testing Service, Princeton NJ 08541. For further information applicants should write directly to these organizations, or visit their Web sites at http://www.gre.org/com.html/ or http://www.toefl.org/index.html/. Official test results should be sent directly to the Office of Admissions, Yale School of Forestry & Environmental Studies, 205 Prospect Street, New Haven, CT 06511-2509.

All applicants must have satisfactory undergraduate records, but there are no arbitrary standards or cutoffs for GRE 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 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.

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. Exposure to the biophysical 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. 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. The ideal applicant has had the first two courses listed under each of the following three categories:

| 1. College mathematics — to | wo terms selected from: |
|-----------------------------|-------------------------|
| a. calculus | c. linear algebra |
| b. statistics | d. discrete mathematics |

- 2. Natural science four terms selected from:
 a. general biology
 b. general chemistry
 c. geology/earth science
 d. general physics
- 3. Social science four terms selected from:

| a. introductory economics | c. sociology |
|---------------------------|-----------------|
| (micro and macro) | d. anthropology |
| b. political science | |

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

ENGLISH AS A SECOND LANGUAGE TRAINING REQUIREMENT

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 on June 30, 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, please contact the Yale English Language Institute, PO Box 208355, New Haven, CT 06520-8355, U.S.A., or visit their Web site at http://www.yale.edu/eli/.

APPLICATION PROCEDURES

Application forms for admission to studies leading to the professional degrees of M.E.M., M.E.Sc., M.F.S., or M.F. may be acquired in several ways. The application form explains in detail the supporting documents required by the School. The application fee is \$60.00.

 Online application. We anticipate having an online application in place by fall 2003. Please check our Web site at http://www.yale.edu/environment/ for this option.

- Download application forms. Application forms may be downloaded directly from our Web site http://www.yale.edu/environment/. They 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 application forms and they will be mailed to you.
- 4. Call the Office of Admissions at 1.800.825.0330 to request the forms.
- 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 February 1. Students are admitted only in the fall.

Learning About FES

Our Web site is full of information about the School, and hard copies of information may be requested at fesinfo@yale.edu. But 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; a fourth is held in April for admitted students. Please visit the F&ES Web site www.yale.edu/ environment/ for the schedule. The Open Houses are full-day programs, including breakfast and lunch, where participants will learn from faculty, students, and staff about the mission and goals of the School, opportunities for research and applied projects, career development, and life at Yale.

Each Thursday morning when School is open (please check calendar on page 6), Information Sessions will be held from 9 to 11 A.M. Prospectives 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.

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. Fridays are generally reserved for field trips. You are welcome to sit in on any classes of interest with no advance notice; the class schedule each term is posted on our Web site. Feel free to contact faculty whose work is of interest to you directly; 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

Two doctoral degrees exist at the School of Forestry & Environmental Studies. The first is the Doctor of Philosophy (Ph.D.) degree, which is administered jointly by the School of Forestry & Environmental Studies and the Yale Graduate School of Arts and Sciences. The second is the Doctor of Forestry and Environmental Studies (D.F.E.S.) degree, which is administered solely by the School of Forestry & Environmental Studies. In the 2003–2004 academic year, the D.F.E.S. program has merged with the Ph.D. program. The D.F.E.S. program will continue to exist until all its current students complete the program. No additional students will be admitted into the D.F.E.S. program. New students will be admitted into the Ph.D. program.

Applications for the Ph.D. program can be obtained from the Web site of the Yale Graduate School of Arts and Sciences at http://www.yale.edu/graduateschool/admissions/index.html/, or by contacting the Yale Graduate Admissions Office, 320 York Street, New Haven CT 06520; telephone, 203.432.2771. The application deadline for the Ph.D. program is January 2, 2004.

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, http://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, http://www.toefl.org/.



Tuition, Fees, and Other Expenses

TUITION AND FEES, 2003-2004

Master's Programs

The 2003–2004 tuition for master's degrees (Master of Environmental Management, Master of Forest Science, Master of Environmental Science, and Master of Forestry) is \$22,760. 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.

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 \$865 for a three-week period.

Doctor of Philosophy Program

The tuition for the Ph.D. degree is \$25,600. Most doctoral students receive a University fellowship that covers the costs of the first four years of tuition, health insurance, and a stipend during the academic year. Doctoral students must pay a nominal continuing registration fee for no more than four years thereafter.

Doctoral students must pay full tuition for four years.

For 2003–2004, students should also anticipate expenses of \$1,000 for hospitalization coverage and \$1,025 for books and supplies. A single student can expect living expenses of approximately \$10,115 for a nine-month period.

REGISTRATION

All students in the master's programs must register for courses at the Office of the Registrar of the School of Forestry & Environmental Studies within *two weeks of the first day of classes* in the fall and spring terms (see calendar, page 6). 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 (see pages 152-53) 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 oneyear internship are permitted to do so and are considered enrolled on a full-time basis. This sequence must be followed by a related project course upon return to the School. 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 POLICIES

Students enrolled at F&ES who withdraw during an academic term are subject to the following policies.

- 1. Students must submit a written request for withdrawal to the associate dean of academic affairs.
- 2. *Tuition* will be rebated on the following schedule:
 - a. The summer module fee will be refunded in full if the student withdraws before the modules begin; thereafter no fee will be refunded.
 - b. 100 percent of tuition will be rebated for withdrawals on or before the end of the first 10 percent of the term. In the fall term, that date is September 12, 2003; in the spring, that date is January 22, 2004.
 - c. One-half (50 percent) of tuition will be rebated for withdrawals after the first 10 percent of the term but on or before the last day of the first quarter. The first quarter date is September 27, 2003 in the fall term and February 6, 2004 in the spring term.
 - d. One-quarter (25 percent) of tuition will be rebated for withdrawals after the first quarter of the term but before the midterm. In the fall, the midterm date is October 22, 2003; in the spring the date is March 4, 2004.
 - e. Students who withdraw after the midterm date will not be eligible for a tuition rebate.
 - f. The death of a student shall cancel tuition charges pro rata to the date of death.
- 3. *Financial aid* is refunded pro rata up to 60 percent of the term. The last day for refunds of federal student aid is November 1, 2003; March 30, 2004 is the 60 percent date for spring. Federal regulations require that aid be refunded in the following order: first to the Unsubsidized and Subsidized Federal Stafford Loan; 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.

Loan recipients must complete an exit interviewin compliance with federal regulations. The Student Loan Office will contact recipients.

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.

Yale Charge Account

Students who sign and return a Yale Charge Card Account Authorization form will be able to charge designated optional items and services to their student accounts. Students who want to charge toll calls made through the University's telephone system to their accounts must sign and return this Charge Card Account Authorization. The University may withdraw this privilege from students who do not pay their monthly bills on a timely basis. For more information, contact the Office of Student Financial Services at 246 Church Street, PO Box 208232, New Haven CT 06520-8232; telephone, 203.432.2700; fax, 203.432.7557; e-mail, sfs@yale.edu.

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 Academic Management Services (AMS). To enroll by telephone, call 800.635.0120. The fee to cover administration of theplan is \$50. The deadline for enrollment is June 20. Application forms will be mailed to all students. For additional information, please contact AMS at the number above or visit their Web site at http://www.tuitionpay.com/.

Bills

A student may not register for any term unless all bills due for that and for any prior term are paid in full.

Bills for tuition, room, and board are mailed 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:

If fall-term payment in full is not received

Late charge by August 1 \$110 by September 1 an additional 110 by October 1 an additional 110

| If spring-term payment in full is not rece | eived | Late charge |
|--|--------------|-------------|
| by December 1 | | \$110 |
| by January 2 | an additiona | l 110 |
| by February 1 | an additiona | l 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.

Charge for Returned Checks

A processing charge of \$20 will be assessed for checks returned for any reason by the bank on which they were drawn. In addition, the following penalties may apply if a check is returned:

- 1. If the check was in payment of a term bill, a \$110 late fee will be charged for the period the bill was unpaid.
- 2. If the check was in payment of a term bill to permit registration, the student's registration may be revoked.
- 3. If the check was given in payment of an unpaid balance in order to receive a diploma, the University may refer the account to an attorney for collection.

MASTER'S FINANCIAL AID, 2003-2004

Policy and Procedures

The School offers a combination of scholarships, employment, and loans to students with demonstrated financial need. To be considered for financial aid, students *must* complete the aid applications on time.

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 level of School aid will remain the same 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 2003 for matriculation in fall 2004, for example. New forms are available at the School's Web site, http://www.yale.edu/environment/ or from the Financial Aid Office anytime after November 1. *Financial Aid applications must be postmarked by February* 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 http://www.fafsa. ed.gov/ and a School of Forestry & Environmental Studies Financial Aid Application, available from the School. International students must complete an International Student Financial Aid Application and a School of Forestry & Environmental Studies Financial Aid Application.

SCHOLARSHIPS

Students who demonstrate financial need may receive a scholarship to cover a portion of the tuition. Because funds are limited, scholarships are awarded to the top admissions

candidates only. 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:

The *Rockefeller-Underbill Scholarship for Tropical Conservation* provides full funding to a native of Central or South America who intends to pursue a career in tropical conservation in Latin America. The *Evan Frankel Fellowships* are funded under a grant from the Evan Frankel Foundation, and are geared to providing deep scholarship support to students from developing countries, particularly those countries with high biodiversity. Applicants must submit the International Student Financial Aid Application.

The *GE Fund Environmental Scholars Program* has been established to provide scholarship assistance for students from traditionally underrepresented communities in the United States. Applicants must complete the School's Financial Aid Application and the FAFSA.

A number of additional endowed scholarships are available to second-year students. Grants range from \$2,000 to \$8,000 and are awarded on the basis of need, scholarship, professional promise, and other criteria specified by the donors. The Philip Laurance Buttrick Fund makes awards to selected students, with preference given to students of American Indian descent. The Paul Douglas Camp Scholarship is awarded to a student or students interested in forestry, forest management, or the use of forest products. The recipient of this scholarship must be a resident of Virginia, North Carolina, South Carolina, Florida, or Georgia. The Crown Zellerbach Foundation Fund provides graduate fellowships, with preference given to graduates of institutions in Oregon or Washington. Students entering in 2004 who are planning to pursue conservation careers may apply for approximately ten Doris Duke Conservation Fellowships provided by the Doris Duke Charitable Foundation to assist them with one subsequent year of tuition support. Funds are also available to aid these Fellows in summer internships with nonprofit and public agencies in the conservation field and for loan repayment assistance. The Enid Storm Dwyer Scholarship is awarded to a student with an interest in conservation and the environment. The John S. Griswold Scholarship is awarded to a student demonstrating financial need. The H. Stuart Harrison Fellowships are awarded to students of environmental studies. The Marvin Klemme Fellowship is awarded to a student interested in research on the genetics of oaks or other slow-growing tree species, or to a student interested in research on tropical ecosystems. The Kroon Family Tercentennial Fund provides scholarships to Yale College graduates interested in pursuing an advanced degree in Forestry & Environmental Studies. The Fred Krupp Scholarship in Environmental Studies is awarded to graduate students who intend to pursue a position with an American nongovernmental environmental organization upon gradutation. The John A. MacLean Scholarships are awarded to graduate students interested in forest conservation. The John M. Musser Fellowships in Population and Environment are awarded to candidates who study the relationship between human population and the use and management of the environment, with priority given to women and minority students. The Alan N. Mann Memorial Fellowships are awarded to students demonstrating financial need. The Carl F. Norden Scholarship is

awarded to a student demonstrating financial need. *The Gilman Ordway Family Scholarship Fund for Environmental Studies* makes awards to students who will give serious consideration to a career in environmental studies either with a nongovernmental private organization or in a government job devoted to national resource protection. The *Leonard Carpenter Scholarships* are awarded to students engaged in the study of environmental and natural-resource topics. The *Mrs. James Wiley Scholarship Fund* makes awards to students interested in conservation and conservation biology. The *Charles F. Wilson* and the *Ray L. Wilson Scholarships* are awarded to students interested in forestry.

NATIONAL FELLOWSHIPS AND SCHOLARSHIPS

Students and applicants are strongly urged to compete for outside fellowships and scholarships which can be used at Yale. These fellowships are sponsored by both public and private agencies and are often generous. In addition to financial advantages, the student who wins 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. More information is available on the Web.

EMPLOYMENT OPPORTUNITIES

Student Employment opportunities are listed at the Student Employment Office at 246 Church Street, or on its Web site at http://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.

Teaching Fellowships are also available at the University. Each department makes its own hiring decisions; therefore, interested students must contact them directly. The usual 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 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 http://www.fafsa.ed.gov/.

International Student Financial Aid

In order to apply for financial aid from the School, international students must complete two applications: the School of Forestry & Environmental Studies Financial Aid Application and the International Student Financial Aid Application. Both applications are available on the Web and must be completed and postmarked by February 15.

Three full scholarships will be offered to 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 and will cover all costs for the twoyear program. 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 Latin Americans, and the ATLAS program for African students. 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. It is for this reason that international students are encouraged to seek support from their government, employer, or various international agencies.

International students must certify full funding for their entire course of study before visa documents can be issued. Instructions and forms are mailed with admission decisions. More information is available at the Web site of Yale's Office of International Students and Scholars (http://www.oiss.yale.edu/).



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, as are most of the classrooms. Sage Hall is home to a microcomputer center for students, with over thirty-five IBM and Apple computers, each with GIS capabilities. Sage also houses an 800-square-foot student lounge, appointed with large tables 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 modern, one-story building with seven laboratories for work in 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.

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 153–54.

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 POLTOX and TREE-CD, is provided through the library's Web site at http://www.library.yale.edu/science/subject/forestry.html. These research tools and others, on such subjects as water, soils, fish, and wildlife, are accessible throughout the campus, and are supplemented by an in-house CD-ROM collection, which includes Wildlife and Ecology Studies Worldwide and Water Resources Abstracts.

Library resources outside of Yale are accessed primarily through the Research Libraries Information Network (RLIN), the communications link between Yale and some eighty research libraries belonging to the Research Libraries Group (RLG). These network and membership connections have become increasingly important for arranging interlibrary loans and photocopies of highly specialized research materials.

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 hard-

woods 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 both general interest and scholarly publications. The School's general interest publications include the biannual magazine *Environment: Yale*, the newletter *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 scholarly side, the Yale F&ES Publication Series produces books and working papers based on environmental conferences, courses, and events at Yale of special interest to a wider professional audience. Recent titles include *Global Environmental Governance: Options and Opportunities; Human Population and Freshwater Resources:* U.S. Cases and International Perspectives; Developing Industrial Ecosystems: Approaches, Cases, and Tools; Climate Change and Development; Species and Ecosystem Conservation: An Interdisciplinary Approach; and Transformations of Middle Eastern Natural Environments: Legacies and Lessons. For a complete listing of titles, free downloadable PDFs of individual chapters, 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, the Energy Interest Group, the Environment and Development Interest Group, the Faith Environment Religion Nature Spirituality Network, the Food Student Interest Group, the Forestry Club, the Forest Stewards Guild, the Industrial Environmental Management Interest Group, the Information Technology Interest Group, the Integrated Student Development Coalition, a student chapter of the International Society of Tropical Foresters (ISTF), the Multi-Ethnic Student Association, the New England Student Interest Group, Other Voices - Alternative Perspectives on Environmental Problems, Social and Community Oriented Research on the Environment (SCORE), 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, Special Trees in the Forest (STIF), the Western Resource Group, the Yale Environmental Health Association, and the Yale Environmental Law Association. 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 Alumni Association, Yale School of Forestry & Environmental Studies. This association is part of the Association of Yale Alumni, which serves all alumni/ae of the University. The association holds regular meetings at the School and 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 administers the Distinguished Alumnus Award and advises the director of Alumni/ae Affairs and the officers of the School on the Annual Fund and the Annual Reunion. The School's journal *Environment: Yale*, published twice each year, keeps alumni/ae throughout the world in touch with each other and with the School. All graduates are encouraged to stay in touch with each other and the School through an electronic database maintained by Yale.

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 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 and receives them either in paper form or in a format that is accessible to students and alumni/ae anywhere via the World Wide Web. The office's Web site at http://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 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

Internships 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. Attention is given to students to help them enter programs that meet their individual needs and interests.

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

Summer 2002 Internships

NGOS AND OTHER NOT-FOR-PROFIT GROUPS

Alaska Conservation Foundation, Intern/Technician – Wolf Management in Denali National Park and Preserve, AK Alnwick Garden, Consultant, England

- Brazilian Climate Change Forum, Intern, Brazil
- Brazilian Institute for Education in Sustainable Business, Intern, Brazil
- Center for Environmental Law and Policy, Intern Watershed Analysis and Planning, WA
- CERES, Intern Accountability Programs, MA
- Conservation International, Research Assistant Resource Economics Department, DC
- CORALINA, Environmental Education Intern Marine Education, Colombia
- Council on the Environment of New York City, Street Tree Surveyor Open Space Greening Program, NY
- Defenders of Wildlife, Habitat Intern Habitat Department, DC
- Fund for Animals, Researcher International Affairs, MD
- Health Effects Institute, Summer Intern, MA
- Institute for Bird Populations, Volunteer Intern Sierra Nevada Breeding Bird Survey Habitat Classification, CA
- Institute for Global Environmental Strategies, Intern Program on Climate Change, Japan
- Institute of Ecosystem Studies (IES), Education Intern Programs for Children and Teachers, NY
- International Centre for Research in Agroforestry (ICRAF), Research Fellow Agroforestry in Conservation, Uganda
- Munasinghe Institute for Development (MIND), Research Fellow Climate Change Impacts Study on Sri Lanka
- Natural Resources Defense Council (NRDC) DC Regional Office, Intern BioGems Program for Latin America, DC
- Nez Perce Tribe, Wolf Conservationist Nez Perce Wolf Recovery Project of Idaho, ID
- Northern Rockies Conservation Cooperative, Intern, WY
- Political Economy Research Center, Research Associate, MT
- QLF/Atlantic Center for the Environment, Conservation Associate Communitybased Environmental Conservation, Canada
- Sudbury Valley Trustees, Management Planning Intern Stewardship, MA
- Tata Energy Research Institute (TERI), Intern Commercialization of Renewable Energy, England
- The Council of Governments of the Central Naugatuck Valley, Researcher Wetland Evaluation, CT
- The Institute for Public-Private Partnerships (IP3), Intern Water and Sanitation, DC
- The Nature Conservancy Coastal/Marine Program, Outreach Coordinator The Oyster River Coalition Project, CT
- The Nature Conservancy of Alaska, Conservation Planning Intern Alaska Conservation Foundation's Intern Program, AK
- The Nature Conservancy of Maine, Intern, ME
- The Nature Conservancy of Montana, Intern Rocky Mountain Front Preservation Program, MT

| The South Central Connecticut Regional Water Authority, Land Management Intern, CT |
|---|
| Toxics Action Center, Intern, MA |
| United Nations Development Program (UNDP), Researcher/Analyst – |
| Agrobiodiversity Conservation in the Near East, Lebanon |
| United Nations Economic & Social Commission for Asia & Pacific (UNESCAP). |
| Researcher – Human Settlements Section, Thailand |
| United Nations Economic & Social Commission for Asia & Pacific (UNESCAP), |
| Project Assistant – Arsenic Contamination of Groundwater, Thailand |
| Vermont Natural Resources Council, Mollie Beatty Intern, VT |
| WaterKeepers of Northern California, Policy Fellow – Water Quality Advocacy, CA/CT |
| Western Watersheds Project, Inc., Independent Research – The Effects of Livestock |
| Grazing on Forest Stand Dynamics in a Watershed, ID |
| Wild Fund, Intern, AK |
| Wilderness Society, Policy Intern – National Parks Program, DC |
| Woods Hole Research Center, Independent Researcher – The Effects of Accidental |
| Fires, MA |
| World Agroforestry Centre, Fellow – Agroforestry Extension Near the Boundary of |
| Mount Elgon National Park, Uganda |
| World Bank – Jakarta Office, Assistance Officer, Indonesia |
| World Bank, Short Term Consultant – Environmentally and Socially Sustainable |
| Development in East Europe and Central Asia, DC |
| WWF – Cameroon Programme Office, Independent Researcher – Central African |
| Program, DC/Cameroon |
| World Wildlife Fund – U.S., Researcher – Global Toxics, DC |
| , , , , |
| BUSINESS AND INDUSTRY |
| A2R, Associate Intern, Brazil |
| AMEC Earth and Environmental, Environmental Scientist I, CO |
| BP, Intern – Alternative Business Fuels Strategy, England |
| C&S Wholesale Grocers, Environmental Design Intern, VT |
| Consejo de Defensa del Estado, Ecologist – Environmental Unit, Chile |
| Cross Current Productions, Research Assistant – Livable Landscapes Project, NH |
| Fisher International, Inc., Eastern Block Research Manager, CT |
| GE Corporate – Environmental Programs, Intern – Corporate |
| Health and Safety Group & Hazardous/Solid Waste Group, CT |
| GE Wind Energy, Summer Associate, CA |
| JJ Degussa Chemicals, ISO OHSAS Intern, Philippines |
| Karlson Far East Corporation, Intern, Korea |
| Nikken Sekkei, Planning Assistant – Urban Planning Department, Japan |
| Proton Energy Systems, Inc., Business Development Assistant – Renewables and |
| Transportation Fueling, CT |
Sikorsky Aircraft Corporation, Intern, CT

Tetra Tech, Inc., Intern – Environmental Sciences Division, VA (2)

UFJ Institute Ltd., Intern – Forest Management Policy Area, Japan

Winslow Management, Environmental Analyst, MA

GOVERNMENTAL AND PUBLIC SECTOR GROUPS

- Alaska Department of Natural Resources, GIS Model Developer Alaska Land Disposal Program, AK
- City of Cambridge Community Development Department, Urban Forest Intern Urban Forestry Canopy Assessment Project, MA
- Ministry of Agriculture, Intern Nature Conservation Division, Bhutan
- National Park Service Glacier National Park, Wildlife Technician, MT
- National Park Service, Archaeological Technician Longfellow Historic Site, MA
- New York State Office of the Attorney General, Water Quality Specialist Environmental Protection Bureau, NY

Office of Management and Budget (OMB), Intern – Environmental Branch, DC

- Overseas Private Investment Corporation (OPIC), Intern Environmental Department, DC
- The South Central Connecticut Regional Water Authority, Forestry Technician Intern – Forestry Department, CT
- USDA Forest Service, Intern Chesapeake Bay Program, MD
- U.S. Environmental Protection Agency (U.S. EPA), ECO Associate Clean Air Markets Office, DC
- U.S. Environmental Protection Agency (U.S. EPA) Office of Policy, Economics, & Innovation, Intern Innovation and Emerging Challenges Division, DC
- U.S. Environmental Protection Agency (U.S. EPA) Office of Policy, Economics, & Innovation, Intern Sector Strategies Division, DC
- U.S. Environmental Protection Agency (U.S. EPA) Region 10, NNEMS Fellow, WA

EDUCATION

- Queensland University School of Life Sciences, Research Intern, Australia
- Tsinghua University Department of Environmental Science and Engineering, Assistant to Director/PI – Environment & Sustainable Development Leadership Program, China
- University San Carlos de Guatemala, Intern Species Choices for Forest Incentives in Guatemala
- Yale Institute for Biospheric Studies, Research Assistant Conservation Genetics Lab – Population Genetics/Phylogenetics, CT
- Yale Myers Forest, Forest Apprentice, CT (3)
- Yale University School of Forestry & Environmental Studies, Intern/Researcher Effects of Land Use on Amphibian Distribution and Abundance at Yale Myers Forest, CT

Yale University – School of Forestry & Environmental Studies, Research Assistant – Industrial Ecology/IEM Program, CT (3)

Yale University – School of Forestry & Environmental Studies, Research Assistant, CT

Yale University – School of Management, Intern – Entrepreneurship Program, CT

Yale Urban Resources Initiative, Community Forester – Community Greenspace Program, CT (2)

U.S. RESEARCH

- Independent Research A Study on the Ability of Herbaceous Plants to Re-colonize Areas After Disturbance, CT/MA
- Independent Research Corn and Consequences: Subsistence in Late Woodland and Contact Period Southern New England, MA
- Independent Research Principal Investigator, Newhall Landfill Community Health Study, CT
- Independent Research Revitalization of Farnham Park through Youth Participation, NJ
- Yale University School of Forestry & Environmental Studies, Independent Researcher — Stocks and Flows of Copper in the Middle East, CT

NON-U.S. RESEARCH

- Bhutan Trust Fund For Environmental Conservation, Independent Researcher Deities of the Land: Sacred Landscapes of Bhutan
- Independent Research A Comparative Analysis of Water Pollution Control Federal Funding Mechanisms in the U.S., Mexico, and Canada, DC/Mexico/Canada
- Independent Research Adviasi Gender Relations and Resistance Strategies, India
- Independent Research Alleviating the Human-Elephant Conflict in Simao, China via a Joint Community Development and Habitat Conservation Approach, China
- Independent Research Annual Growth Rings in Tropical Trees: Physiological Predictors of Formation, Panama
- Independent Research Assessment of Native Species Use and Preferences in Dry Agropastoral Systems of the Azuero Peninsula, Panama
- Independent Research Economic Impact of Sea Level Rise on Non-Developed Coastal Regions in Singapore
- Independent Research Finders Keepers, Losers Weepers: An Examination of the Shifting Ecological and Botanical Knowledge of the Rungus in Sabah, Malaysia
- Independent Research Harvesting Patterns and Intensity: Effects on Production and Distribution of Bamboo in Jhapa, Nepal
- Independent Research Highland Development Programs in Northern Thailand
- Independent Research Impact of Sea Turtle Conservation Projects on Nearby Communities in Southern Sri Lanka
- Independent Research Implications of Feedback Between Enso and Anthropogenic Disturbance on Ecosystem Function and Resiliency in West Kalimantan, Indonesia

- Independent Research Modeling Soil Erosion Risk in the Volcanic Chain Los Maribios, Nicaragua
- Independent Research Plantation Tree Modeling for Basis of Recommendations for Reforestation Species, Costa Rica
- Independent Research Research in Bhadra National Park on People in Protected Areas: Impacts of Village Size on Avian Biodiversity in India
- Independent Research Shifting Space: Land Allocation and Resource Use Change in Laos
- Independent Research The Impact of Forest Certification to the Management Practices of Forest Companies, Indonesia
- Independent Research Tropical Oil Palm Plantations: Carbon Storage and Uptake in a Poorly Understood Ecosystem, Indonesia
- Independent Research Understory Regeneration on Plantations in Costa Rica
- Independent Research Water Pricing and Willingness to Pay for Potable Water by Low-Income Users in Metropolitan Bangkok, Thailand
- Independent Research Who Cares About the Sao Francisco? Mapping the Social Context of the Sao Francisco River Basin, Brazil

Compiled by the Career Development Office, Yale School of Forestry & Environmental Studies. For more information, please contact Peter Otis, Director. Tel: 203.432.8920 or e-mail: peter.otis@yale.edu

The School and its students would like to thank donors and host organizations and supervisors for making these valuable professional experiences possible.

Immediately Following Graduation

Each year our graduates enjoy employment success in environmental science, policy, and management within the United States and around the world, or they pursue admission for further academic study. Details including salary information can be found on the most recent as well as previous classes at http://www.yale.edu/cdostud_info.htm.

Following each graduation about 15 percent of the master's students go on for further study, primarily in Ph.D. programs. The remaining graduates' employment is split, with about a quarter of the class in NGOs and other not-for-profit groups and a quarter in business and industry (including consulting). The remainder is divided between governmental/public-sector groups and education employers.



University Services and Privileges

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 apartments consisting of efficiencies and one-, two-, and three-bedroom apartments for singles and families. Both offices are located in Helen Hadley Hall, a graduate dormitory at 420 Temple Street, and have office hours from 9 A.M. to 4 P.M., Monday through Friday.

Applications for 2003–2004 are available online and must be downloaded from the Web site (http://www.yale.edu/graduatehousing/) and then mailed or faxed—along with your letter of acceptance from Yale—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 beverly. whitney@yale.edu, tel. 203.432.2167, fax 203.432.4578. For more apartment information, contactbetsy.rosenthal@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 through the intranet at http://www.yale.edu/offcampushousing/. Call 203.432.9756 to obtain the necessary passwords to access the system from other areas.

DINING AT YALE

Yale University Dining Services has tailored its services to meet the particular concerns of graduate and professional school students by offering meal plan options. "Eli Bucks," a favorite choice based on declining points, are accepted in all campus locations in lieu of cash. Whether residents or nonresidents of University housing, students are invited to take advantage of Yale University Dining Services.

The following dining areas and snack bars are available to students: A&A Penthouse at the School of Architecture; the Divinity School Cafe on Prospect Street; the dining room of the Kline Biology Tower; Donaldson Commons at the School of Management; and Durfee's, a traditional convenience store offering coffee, snacks, sandwiches, soft yogurt, and a variety of convenience items. Students are also encouraged to dine in any of Yale's residential college dining rooms, where students without meal contracts may purchase "all-you-care-to-eat" meals at fixed prices 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 1.888.678.9837 (toll free), or 203.432.0420. Dining Services can also be found on the Web at http://www.yale.edu/dining/.

SECURITY

As with most universities in urban settings, the security of persons and property is a primary concern of the School of Forestry & Environmental Studies. The University police and the fire marshal, in cooperation with the police and fire services of the city of New Haven, strive constantly to maintain a safe environment for the Yale community. At an orientation session during the summer modules, incoming students receive detailed information on emergency communications, personal safety tips, and other ways to protect themselves, equipment, and buildings.

HEALTH SERVICES FOR F&ES STUDENTS

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, internal 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.

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 enroll 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-forservice basis. Students who wish to be seen fee-for-service must enroll 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 Care 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

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.

For a detailed explanation of this plan, see the YHP Student Handbook.

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-sex 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 coverage for YHP Basic Coverage and for coverage under 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 (http://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 coverage for YHP Basic and for the benefits offered under 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 (http://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. 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. Coverage is not automatic and enrollment forms are available at the YHP Member Services Department or can be downloaded from the YUHS Web site (http://www.yale.edu/uhs/).

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 coverage for YHP Basic and for the benefits offered under 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 (http://www.yale.edu/uhs/). Students must complete an enrollment application for the plan prior to the start of the term.

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 for F&ES Students

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, 2003. Please note that the State of Connecticut does not require this vaccine for students who intend to reside off campus.

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 1. 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 College Street 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 (http://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 can 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. OISS issues the visa documents needed to request entry into the United States under Yale's immigration sponsorship and processes requests for extensions of authorized periods of stay in the United States, 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, English conversation programs, and orientation receptions for newly arrived graduate students and postdocs, 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 (http://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 graduate students, postdocs, and visiting scholars can get connected with OISS by subscribing to one or both of the OISS e-mail lists. OISS-L is the electronic newsletter with important information for Yale's international community. YaleInternational E-Group is an interactive list through which over 1,000 international students and scholars keep each other informed about events in the area. Check the Web site for more information. To subscribe to either list, send a message to oiss@yale.edu.

Spouses and partners of international students and scholars will want to know about ISPY – International Spouses and Partners at Yale. Information about ISPY and other OISS programs can be found on the OISS Web site.

The Office of International Students and Scholars, located at 246 Church Street, Suite 201, is open Monday through Friday from 8.30 A.M. to 5 P.M.

THE INTERNATIONAL CENTER

Established in 1949, the International Center of New Haven is a nonprofit communitybased organization. The Center's programs are based on the idea that both the international community in Greater New Haven and the local community can benefit from each other. The Center is located at 442 Temple Street, and the office is open from 9 A.M. to 4.30 P.M., Monday through Friday. The work of the International Center is carried out by a small professional staff and by many volunteers in the community. The Center organizes lectures, trips, picnics, and special events, as well as English as a Second Language (ESL) classes, in addition to a number of programs including the International Host Friendship Program, 'Round The World Women, and the International Classroom Project. The International House, a large Tudor mansion located at 406 Prospect Street in New Haven, is the venue of most of the International Center's activities and the home of sixteen students and scholars. Rooms are available for the academic year and summer. For more information on any of these programs, or on International House, telephone 203.432.6460, fax 203.432.6462, e-mail international.centernh@yale.edu, or visit the Web site at http://www.internationalcenternewhaven.org/.

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 member congregation of the United Church of Christ; and Yale Religious Ministry, the oncampus 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; several Protestant denominational ministries and nondenominational groups; and religious groups such as the Baha'i Association, the New Haven Zen Center, and the Muslim Student Association. Additional information is available at http://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 136). Second largest among the university libraries in the United States, the Yale Library contains more than 10.5 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 and one Apple Macintosh personal computers and a high-speed printer capable of producing double-sided output. The GIS Lab, located next door in Sage 31, contains fifteen IBM computers and several printers, including a color printer capable of printing maps and graphics. 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 four 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

A calendar listing the broad range of events at the University is issued weekly during the academic year in the *Yale Bulletin & Calendar*. The hours when special exhibitions and the University's permanent collections are open to the public are also recorded in this publication. Free copies of the *Yale Bulletin & Calendar* are available at many locations throughout the campus, and the paper is sent via U.S. Mail to subscribers; for more information, call 203.432.1316. The paper is also available online at http://www.yale.edu/opa/yb&c/index.html.

The Yale University Art Gallery contains representative collections of ancient, medieval, and Renaissance art, Near and Far Eastern art, archaeological material from the University's excavations, Pre-Columbian and African art, works of European and American masters from virtually every period, and a rich collection of modern art. The landmark Louis I. Kahn building will be closed for renovation for two years beginning in the summer of 2003. The hub of the museum's activities will be the adjacent Swartwout building, housing Yale's world-renowned collections of American paintings, sculpture, and decorative arts, as well as a selection of masterworks from all other departments.

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, Great Organ Music at Yale, New Music New Haven, Yale Opera performances and public master classes, and the Faculty Artist Series. Among New Haven's numerous performing organizations are Orchestra New England, the New Haven Chorale, and the New Haven Symphony Orchestra.

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, martial arts, aerobic exercise, and sport skills are offered throughout the year. Graduate and professional school students may use the gym at no charge during the academic year and for a nominal fee during the summer term. Academic and summer memberships at reasonable fees are available for faculty, employees, postdoctoral and visiting fellows, and student spouses.

The David S. Ingalls Rink, the Sailing Center in Branford, the Outdoor Education Center (OEC), the tennis courts, and the golf course are open to faculty, students, and employees of the University at established fees. Ingalls Rink has public skating Monday through Thursday from 11.30 A.M. to 12.45 P.M. and on weekends as the training schedule permits. Up-to-date information on hours is available at 203.432.0875. Skate sharpening is available daily; however, skate rentals are not available.

Approximately thirty-five club sports and outdoor activities come under the jurisdiction of the Office of Outdoor Education and Club Sports. Many of the activities, both purely recreational and instructional, are open to graduate and professional school students. Faculty, staff, and alumni, as well as groups, may use the Outdoor Education Center (OEC). The center consists of two thousand acres in East Lyme, Connecticut, and includes cabins, campsites, pavilion, dining hall, swimming, boating, canoeing, and picnic groves beside a mile-long lake. 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://yale.edu/athletics/ (click on Sport and 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 at http://www.yale. edu/athletics/.

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, 2003

Elizabeth Allison (B.A. Williams Coll.), California. Rebecca Ashley (B.A. Colgate Univ.), Vermont. Weslynne Ashton (B.S. Massachusetts Inst. of Technology), Trinidad. Ruth E. Baker (B.A. Macalester Coll.), Minnesota. Ryan Bennett (B.A. Colorado Coll.), Minnesota. Ian Branson (B.S. Univ. New Hampshire), Connecticut. Nicole Leah Breznock (B.A. Univ. California), California. Rebecca Brown (B.A. Tufts Univ.), Pennsylvania. Charles A. Brunton (B.A. James Madison Univ.), Virginia. Olivia Carpenter (B.A. Dartmouth Coll.), New Jersey. Nathaniel Carroll (B.A. Tufts Univ.), Washington, D.C. Melisa Chan (B.A. Barnard Coll., Columbia Univ.), Texas. Richard Chavez (Forestry Engineering Univ. Nacional Ayraria of Nicaragua), Nicaragua. Ian Cheney (B.A. Yale Univ.), Maine. Andrew Clack (B.A. Univ. Pittsburgh), Pennsylvania. Heather Coady (B.S. Muhlenberg Coll.), New Jersey. Kevin Coffey (B.s. Univ. Buffalo), New York. April Connelly (B.A. Univ. Delaware), Delaware. Nancy Cothran (B.A. Michigan State Univ. and James Madison Coll.), Michigan. Daniela Cusack (B.A. Wesleyan Univ.), Colorado. Melanie Cutler (B.S. Bates Coll.), Massachusetts. Maria Ana de Rijk (B.A. Eckerd Coll.), The Netherlands. Naamal Kaushalya De Silva (B.A. Swarthmore Coll.), Washington, D.C. Stephen Dettman (B.A. Univ. Virginia; M.A. Univ. Washington), Washington. Aspasia Alexandra Dimizas (B.A. American Coll. of Greece), Greece. Hoang Dinh (B.A. Hue Agricultural and Forestry Coll.), Vietnam. Lydia Dixon (B.A. Dartmouth Coll.), Pennsylvania. Katherine Dolan (B.A. Middlebury Coll.; M.B.A. Amos Tuck School at Dartmouth Coll.), New York. Jason Drebitko (B.S. Univ. New Hampshire; M.ED. Harvard Univ.), New York. Vic Edgerton (B.A. Univ. California), California. William Finnegan (B.A. Dartmouth Coll.), Arkansas. Jeffrey Firman (B.s. Yale Univ.), New York. Alison Forrestel (B.A. Columbia Univ.), New York. Margaret Francis (B.S. Miami Univ.), Ohio. Roberto Frau (B.A. Boston Univ.), Puerto Rico. Sarah Garman (B.A. Dartmouth Coll.), New Jersey.

Evgeniy A. Gladyshev (B.S. Washington State Univ.), Russia. Brian Goldberg (B.A. Union Coll.), Connecticut. Elizabeth Gordon (B.A. Stanford Univ.), California. Oliver Grantham (B.A. Brown Univ.), Massachusetts. Larisa Renee Grawe (B.S. Univ. California [Berkeley]), California. J. Bishop Grewell (B.A. Stanford Univ.), Montana. Alexander Gritsinin (B.S. Tashkent State Univ.), Uzbekistan. Kathleen Hall (B.S. Cornell Univ.), Arkansas, New York. Kate Hammond (B.A. Yale Univ.), Colorado. Benjamin Hogdon (B.A. Grinnell Coll.), Maine. Yudi Iskandarsyah (B.sc. Bogor Agricultural Univ.), Indonesia. Rebecca Jensen (B.A. Carleton Coll.), Missouri. Krithi K. Karanth (B.S. Univ. Florida), India. Ruiko Kato (в.s., м.s. Sophia Univ.), Japan. Tomomi Kemmochi (B.S. Sophia Univ.), Japan. Sumanda Kishore (B.A. Lady Shriram Coll., Delhi Univ.; M.Sc. Asian Inst. of Technology), India. Takatsugu Kobayashi (в.г. Kanazawa Univ.; гг.м. Univ. Tokyo), Japan. Peter C. Land (B.A. Dartmouth Coll.), Vermont. Theodore Lazano (B.A. Univ. Colorado), Colorado. Cherie Lynn LeBlanc (B.A. Mount Holyoke Coll.), Connecticut. Christine Lee (B.S. Univ. California), California. Kelly Levin (B.A. Yale Univ.), New York. Cherie Laverne Sehleng Ong Lim (B.s. Ateneo de Manila Univ.), Philippines. Po-chuan Lin (B.S., M.S. National Taiwan Univ.), Taiwan. Carlos Linares (B.S. Univ. Notre Dame), El Salvador. Amanda Locke (B.A. Hamilton Coll.), Connecticut. James Lucas (B.A. Univ. Calgary; B.Sc. Univ. Alberta), Canada. Andres Luque (B.s. Univ. de los Andes), Colombia. Ellen Mattfeldt (B.A. Colgate Univ.), New York. Nicole Maywah (B.A. Harvard Coll.), Florida. Brenden McEneaney (B.s. Yale Univ.), New Hampshire. Laiq Ahmad Memon (м.в.в.s. Liaquat Medical Coll. and Civil Services Academy), Pakistan. Boris Mendez Paiz (B.S. Univ. San Carlos de Guatemala), Guatemala. Christopher Menone (B.A. Princeton Univ.), New Jersey. Florence G.B. Miller (B.A. Oxford Univ.), Illinois. Terry Miles Miller (B.A. Univ. Oregon), Oregon. Soni Mulmi (м.sc. Bangalore Univ.), Nepal. Carolyn Munno (B.A. Oberlin Coll.), New York. Karen Murray (B.A. Vassar Coll.), Oregon. Derek K. Murrow (B.A. Carleton Coll.), Vermont. Fuyumi Naito (LL.B. Keio Univ.), Japan.

Naoko Nakagawa (B.LAWS Keio Univ.), Japan. Rajyashree Narayanareddy (B.A. Mount Carmel Coll., Bangalore Univ.; м.A. Hyderabad Central Univ.), India. Wei-Shiuen Ng (B.sc. Univ. New York), Singapore. Andrew Marino Niccolai (B.S. Georgetown Univ.), Alabama. Emily Noah (A.B. Brown Univ.), Texas. Timothy Northrop (B.A. Stanford Univ.), Connecticut. Sungsoo Ok (B.A. Seoul National Univ.), Korea. Takeshi Okumura (B.A. International Christian Univ.), Japan. Alicia Pascasio (B.A. East Carolina Univ.), North Carolina. Kabir Peay (B.A. Univ. California), Maryland. Bryan R. Petit (B.S. Univ. California), California. Nataliya Plesha (B.S. Lviv Inst. of Forestry and Wood Technology), Ukraine. Laura Pyle (B.A. Wesleyan Univ.), New Jersey. Dima Reda (B.A. Brown Univ.), Massachusetts. Elizabeth Roberts (M.A. Univ. Edinburgh), England. Curtis Robinhold (B.A. Univ. California), Oregon. Megan Roessing (B.A. American Univ.; M.A. Johns Hopkins Univ.; M.PHIL. Cambridge Univ.), North Carolina. Samantha G. Rothman (B.A. Smith Coll.), New Jersey. Laura Ruiz (B.A. Univ. California [Santa Cruz]), California. Holly Sage (B.A. Binghamton Univ.), New York. Trey Schillie (B.A. Univ. Missouri), Missouri. Marie-Claire Segger (B.A. Carelton Univ.; LL.B., B.C.L. McGill Univ.), Canada. Teak Seng (M.s. Kirovograd Inst. of Agricultural Machinery Construction), Cambodia. Sung-No Niggol Seo (B.A. Seoul National Univ.), Korea. Abdalla Said Shah (B.sc. Univ. Aberdeen), Zanzibar. Elizabeth Shapiro (B.A. Oberlin Coll.), California. Jay Shepherd (B.A. Univ. Wisconsin), Wisconsin. Carla Short (B.A. Vassar Coll.), Missouri. Theresa Silla (B.A., B.S. Yale Univ.), Ethiopia. Kirsten Spainhower (B.S. Evergreen State Coll.), Washington. Emily Diane Sprowls (B.A. Kenyon Coll.), Massachusetts. Ninian Stein (B.A. Brown Univ.; M.A. Harvard Univ.), Massachusetts. Laura Tam (B.A. Dartmouth Coll.), Hawaii. Michael Threadgill (B.S.F.E.R. Univ. Georgia), Georgia. Veda Simone Truesdale (B.A. Vassar Coll.), New Jersey, New York. Toru Uemachi (LL.B. Kyoto Univ.), Japan. Masamitsu Umezawa (B.A. Aoyama Gakuin Univ.), Japan. George M. Van Duzer (A.S. Napa Valley Coll.; B.S. Univ. San Francisco), California. Glen E. Van Zandt (B.B.A., M.S. Texas A&M Univ.), Texas. Nicole Vickey (B.A. Duke Univ.), Delaware. Sarah Vogel (B.A. Univ. Virginia), Virginia.

Orawan Vorakanonta (B.A., M.S. Chulalongkurn Univ.), Thailand. Sarah Wakefield (B.A., B.S. Univ. Vermont), Vermont. Guoqian Wang (B.A., B.S. Shanghai Jiao Ton Univ.), China. Yvette M. Williams (B.S. Univ. Connecticut), Connecticut. Jason Lamar Wilmot (B.A. Univ. Montana), Montana. Andrew Winston (B.A. Princeton Univ.; M.B.A. Columbia Univ.), New York. Marissa Yao (B.A. Univ. California [Berkeley]), California.

DOCTORAL DEGREES CONFERRED, 2003

Doctor of Forestry and Environmental Studies

Matthew Alan Morrison (B.A. Grinnell Coll.; M.S. Univ. New Hampshire), Pennsylvania.

Doctor of Philosophy

Jeffrey Anthony Albert (B.A. Brown Univ.; M.E.S. Yale Univ.), Connecticut.
Dominika Anna Dziegielewska (B.A., M.A. Warsaw Univ. [Poland]; M.A. Univ. Maryland), Poland.
Brooke Anne Parry Hecht (B.A. Dartmouth Coll.; M.S. Univ. Melbourne [Australia]), Colorado.
Montira Judy Pongsiri (B.A. Oberlin Coll.; M.E.S., M.P.H. Yale Univ.), Maryland.
Andrew David Richardson (B.A. Princeton Univ.; M.F. Yale Univ.), Canada.
Murray B. Rutherford (B.Sc., LL.B. Univ. British Columbia [Canada]; M.R.M. Simon Fraser Univ. [Canada]), Canada.

STUDENTS WORKING TOWARD MASTER'S DEGREES, 2003

Melissa Leigh Aikens (B.A. Bowdoin Coll.), Massachusetts. Nikhil Surinder Anand (B.A. Reed Coll.), India. Misalalatiana Andriamihaja (м.s. Univ. Antananarivo), Madagascar. Irene Anna-maria Angeletti (B.S. Univ. Florence), Ecuador. Eric Daniel Annes (B.A. Connecticut Coll.), New York. Leigh Ann Baker (B.S. Univ. Massachusetts [Amherst]/Univ. Oregon), Wyoming. Jessica Emily Barnes (B.A. Oxford Univ.), United Kingdom. Robin Elise Barr (B.s. Washington State Univ.), Washington. Sarah Elizabeth Bendit (B.s. Univ. Michigan), Maryland. Keith Roland Bisson (B.A. McGill Univ.), Maine. Cecilia Marta Blasco Hernandez (B.A. Dartmouth Coll.), Argentina. Cherelle Antoinette Blazer (B.S. Southern A&M Univ.), Oregon. Elizabeth Borden (B.A. Radcliff Coll.), Connecticut. Marni Burns (B.S. Univ. California [Berkeley]), New York. Marco Buttazzoni (M.sc. London School of Economics and Social Sciences; B.A. Bocconi Univ.), Italy. Kathleen Elizabeth Campbell (B.A. Harvard Univ.), New Jersey.



Javier Gonzalez Campana (Univ. Nacional de La Plata), Argentina. Brandon Enrique Carter (B.S. Western Washington Univ.), Washington. Suzette Anne Carty (B.s. Univ. Wisconsin), Jamaica. Philip Schaeffer Caspar (M.S. Univ. Vermont; B.S. Univ. Notre Dame), Connecticut. Melisa Chan (B.A. Barnard Coll.), Texas. Adrien Arin Chase (B.A. Vassar Coll.), New York. Chih-Kuo George Chiang (B.S. Tufts Univ.), Taiwan. Hahn-Ning Chou (B.S. Sirindhorn International Inst. of Technology-Thammasat Univ.), Thailand. Avery Simon Cohn (B.S. Univ. California [Davis]), California. Jonathan Asa Cook (B.A. Harvard Univ.), Connecticut. Valerie Anne Craig (B.A. Univ. California [Davis/Irvine]), California. Sarah Elizabeth Davidson (B.A. Smith Coll.), Texas. Michela De Palo (B.sc. Univ. Rome), Italy. Lisa Elaine DeBock (B.B.A. Hofstra Univ.), Florida. Curt Tavis DellaValle (B.S. Univ. Connecticut), Connecticut. Heather Katherine Dempsey (B.S. Willamette Univ.), California. Raji Dhital (M.Sc. School of Environmental Management and Sustainable Development; B.SC. St. Xavier's Coll.), Nepal. Manmita Dutta (M.S. Calcutta Univ.; B.S. Loreto Coll.), India.

Elizabeth Browning Egan (B.A. Bowdoin Coll.), New Hampshire. Tasha Kristin Eichenseher (B.A. Univ. Oregon), Wisconsin. Juan Carlos Espinosa (B.S. Univ. Los Andes), Colombia. Trisha Renee Eyler (B.S. Wake Forest Univ.), Maryland. Amanda Maria Farris (B.A. Yale Univ.), New Jersey. Ona Ferguson (B.A. Smith Coll.), Massachusetts. James Fergusson (B.A. Univ. Cambridge), United Kingdom. Margarita Fernandez (B.S. Tufts Univ.), New Jersey. Alphonse Fletcher Jr. (B.A. Harvard Univ.), Connecticut. Jie Gao (B.A. Wuhan Univ.), China. Loni Stewart Gardner (B.S. Univ. South Carolina Honors Coll.), Tennessee. Lisa Gomes-Casseres (B.A. Princeton Univ.), Netherlands Antilles. Ilmi Muhaiyaddeen Elijah Granoff (в.А. Swarthmore Coll.), Pennsylvania. David Andrew Hobson (B.A. Princeton Univ.), California. Morgan Elizabeth Holen (B.S. Univ. Washington), Washington. Beatrice Chen-Yin Huang (B.s. National Taiwan Univ.), Taiwan. Michelle Ann Huang (B.A. Harvard Univ.), Pennsylvania. Chavanond Intarakomalyasut (M.A. Yale Univ.; M.Sc. Chulalongkorn Univ.; B.A. Mahidol Univ.), Thailand. Betony Lee Jones (B.S. Univ. Michigan), Michigan. Elizabeth (Liz) Leigh Kalies (B.S. Cornell Univ.), New York. Geri Elissa Kantor (B.S. Univ. Minnesota), Minnesota. Heather Sue Kaplan (B.A. Univ. Vermont), Massachusetts. Diana Louise Karwan (B.S. Univ. Michigan), Michigan. Kristen Kimball (B.A., B.S., M.S. Univ. Connecticut), Connecticut. Michael William Kisgen (B.A. Univ. California [Santa Barbara]), California. Arcady Petrovich Kropov (St. Petersburg Forest Acad.), Russia. Yuko Kurauchi (B.A. International Christian Univ.), Japan. Cindy Anne Kushner (B.A. Univ. Michigan), Massachusetts. Erin Largay (B.A. Connecticut Coll.), Massachusetts. Joshua Hillary Levine (B.A. Connecticut Coll.), Rhode Island. John Pullman Longstreth (M.S. Columbia Univ.; B.A. Stanford Univ.), Connecticut. Rosemarie Mannik (B.S.E., B.A. Univ. Pennsylvania), New York. Brian Thomas Marcaurelle (B.A. Bowdoin Coll.), Massachusetts. Elizabeth Christine Martin (м.р.н. Hunter Coll. at the City Univ. New York; в.А. Dickinson Coll.), Maryland. Susan Tambi Matambo (B.sc. Univ. Zambia), Zambia. Megan Lisa Mattox (B.S. Univ. Washington), California. Christopher McCune (B.S., M.S. Northwestern Univ.), Maine. Vincent De Paul Medjibe (M.sc. Univ. Bangui), Central African Republic. Neha Ajit Menon (м.м.s. Univ. Mumbai; в.A. St. Xavier's Coll.), India. Jennifer Lynne Molnar (B.S. Harvard Univ.), New Jersey. Kimberlee Anne Mortimer (B.A. Eckerd Coll.), Florida.

Kara Elizabeth Murphy (B.A. Binghamton Univ.), New York. Wei-Shiuen Ng (B.sc. Univ. York), Singapore. Ken Odaka (B.A. Waseda Univ. Japan), Japan. Sarah Elizabeth Owen (B.A. Brown Univ.), Vermont. Christian Tobler Palmer (B.S. Brigham Young Univ.), Hawaii. Elizabeth Anne Petruska (B.A. Univ. Notre Dame), New Jersey. Alison Rae Pierce (B.A., B.S. Virginia Tech), Virginia. Justin Benjamin Pollard (B.A. Stanford Univ.), Maine. Jeffrey Collier Possick (B.A. Yale Univ.), Connecticut. William Jethro Pott (B.A. Princeton Univ.), Virginia. Laura Pyle (B.A. Wesleyan Univ.), New Jersey. Halla Qaddumi (B.A. Univ. Texas; M.Sc. London School of Economics), Texas. Ying Qiu (B.s. Tsinghua Univ.), China. Shona Barton Quinn (B.s. Fashion Inst. of Technology), Connecticut. Marni Rapoport (B.A. Univ. California [Santa Cruz]), California. Jeffrey Diver Reamer (B.S. United States Military Acad. at West Point), Connecticut. Fulton Ewing Rockwell (B.A. Yale Univ.), New York. Shane Rosenthal (M.PHIL. Cambridge Univ.; M.A. Johns Hopkins Univ.-SAIS; B.A. American Univ.), North Carolina. Nalin Sahni (B.ENG. Queen's Univ.), Canada. Daisuke Sasatani (B.S. Osaka Prefecture Univ.), Japan. Emily Danielle Shelton (B.A., B.S. San Jose State Univ.), California. Kenichi Shono (B.s. Univ. Tsukuba), Japan. Dani Lynn Simons (B.S. Brown Univ.), Virginia. Walter Smith (B.S. Univ. Connecticut), Connecticut. Ho Seok Song (B.A. Seoul National Univ.), Korea. Corrina Dawn Steward (B.A. Oberlin Coll.), Massachusetts. Yusuke Taishi (B.A. Chuo Univ.), Japan. Brynn Taylor (B.S. Univ. Redlands), Connecticut. Nao Anna Teshima (B.S. Univ. Michigan), Florida. Mark Shepherd Thomas (B.S., M.D. Univ. Wisconsin), Pennsylvania. Carlisle Jane Tuggey (B.s. Bates Coll.), Pennsylvania. Alison Claire Van Gorp (B.A. Univ. Colorado-Boulder), Minnesota. Daniela Vizcaino (B.S. Universidad Simón Bolívar), Venezuela. Jennifer Elizabeth Vogel (B.A. Tufts Univ.), Vermont. Xue Wang (B.ECON. Jiangxi Univ. Finance and Economics), China. Abigail Weinberg (B.A. St. John's Coll.), New Jersey. Ellen Wells (B.A. Oberlin Coll.), Ohio. Jeremy James West (B.S. North Carolina State Univ.), Ohio. Ethan Hamill Winter (B.A. Bowdoin Coll.), Illinois. Nicolette Ruth Witcher (B.A. SUNY New Paltz), New York. Kevin Michael Woods (B.S. Univ. Dayton), Wisconsin. Laura Elizabeth Wooley (B.A. Grinnell Coll.), Ohio.

Heather Eileen Wright (B.S. Univ. California [Los Angeles]), California. Elizabeth Wyman (B.S. Univ. Miami), New Hampshire. Daniel Yohannes (B.A. SUNY Stonybrook), New York. Hillary Suzanne Young (B.A. Princeton Univ.), California. Austin Gabriel Zeiderman (B.A. Colgate Univ.), California. Baohui Zhang (B.S.,B.A. Peking Univ.), China. Zhizhou Zhang (B.S. Shanghai Jiao Tong Univ.), China. Kathryn Ann Zyla (B.S. Swarthmore Coll.), Michigan.

STUDENTS WORKING TOWARD DOCTORAL DEGREES

Doctor of Forestry and Environmental Studies

Harry Robert Bader (B.A. Washington State Univ.; J.D. Harvard Univ.), Nebraska. Cesar Francisco Flores (B.Sc. La Molina National Agrarian Univ. [Peru]; M.F.S. Yale

Univ.), Peru.

Doctor of Philosophy

David Lionel Roy Affleck (B.S.F., M.S. Univ. British Colombia [Canada]), Canada.

Mónica Araya (в.а., м.а. Univ. Nacional; м.е.м. Yale Univ.), Costa Rica.

- Nicole Michele Ardoin (в.в.а. James Madison Univ.; м.s. Univ. Madison [Stevens Point]), Virginia.
- Cristina Marie Balboa (в.а. Univ. Michigan [Ann Arbor]; м.s. Johns Hopkins Univ.), Washington, D.C.
- Jennifer Kakareka Balch (A.B. Princeton Univ.), Pennsylvania.
- Sanjay Subramanja Baliga (в.s., в.A. Stanford Univ.; м.р.н. Univ. Michigan [Ann Arbor]), Colorado.
- Michael Gabriel Booth (B.S. Principia Coll.), Illinois.
- Marina Campos (B.S., M.S. Univ. São Paulo [Brazil]), Brazil.
- Seth Nathan Cook (B.A. Amherst Coll.; M.E.S., M.A. Yale Univ.), California.

Kevin James Eddings (B.A. Univ. New Hampshire; M.S. Colorado State Univ.), New York.

- Christiane Ehringhaus (Diploma Univ. Bayreuth [Germany]; м.sc. Florida International Univ.), Germany.
- David Scot Ellum (B.S. North Carolina State Univ.; M.F. Yale Univ.), Connecticut.
- Alexander Myrick Evans (B.A. Univ. Pennsylvania; M.F. Yale Univ.), Rhode Island.

Anna Fanzeres (в.s. Univ. Federal Rural do Rio de Janeiro [Brazil]; м.е.s. Yale Univ.), Brazil.

- Alex Jay Finkral (B.S. Colorado State Univ.; M.F.S. Yale Univ.), New Jersey.
- Eva Jennine Garen (B.A. Union Coll.; M.E.S. Yale Univ.), Connecticut.
- Carlos Alejandro Gonzalez (B.S. Cornell Univ.; M.E.S. Yale Univ.), West Virginia.
- Edgardo Gonzalez (B.S. Univ. Puerto Rico; M.F. Yale Univ.), Puerto Rico.
- Uromi Manage Goodale (в.sc. Univ. Colombo; м.f.s. Yale Univ.), Sri Lanka.
- Jason Simpson Grear (B.A. Connecticut Coll.; M.S. Univ. Florida [Gainesville]), Connecticut.

Bronson Winthrop Griscom (B.A. Brown Univ.), Washington, D.C. Jefferson Scott Hall (B.A. Miami Univ.; M.F.S. Yale Univ.), Ohio. Achim Halpaap (B.sc. Univ. Bonn [Germany]; M.A. Univ. Oregon), Germany. M. Anders Halverson (B.A. Dartmouth Coll.; M.F.S. Yale Univ.), Colorado. Alissa Anne Hamilton (B.A. Yale Univ.; IL.B. Univ. Toronto; M.E.S. Yale Univ.), Canada. Haiying Hu (B.S., M.S. Peking Univ. [China]), China. Shafqat Hussain (B.A. Indiana Univ. [Pennsylvania]; M.SC. Univ. Hull [United Kingdom]; м.е.м. Yale Univ.), Pakistan. Maria Hristova Ivanova (B.A. Mount Holyoke Coll.; M.A., M.E.S. Yale Univ.), Bulgaria. Eunhae Jeong (B.A., M.S. Seoul National Univ.), Korea. Elizabeth Ralston Jones (B.A. Dartmouth Coll.; M.E.Sc. Yale Univ.), California. Amit Kapur (B.E. Delhi Coll. Engineering [India]; M.S.C.E. Purdue Univ.), India. Richard J. Karty (B.A. Brown Univ.), Missouri. Robert Jason Klee (B.A. Princeton Univ.; M.E.S. Yale Univ.), Connecticut. Olaf Kuegler (Diploma Albert-Ludwigs Univ. [Germany]), Germany. Pradeep Kurukulasuriya (M.S. Univ. Aberdeen; M.PHIL. Univ. Cambridge; M.E.S. Yale Univ.), Sri Lanka. Laly Laing Lichtenfeld (B.S. Univ. Richmond; M.F.S. Yale Univ.), New Jersey. David J. Liptak (B.S. Univ. Connecticut; M.S. Univ. New Haven; M.F.S. Yale Univ.), Connecticut. Cheryl Margoluis (в.а. Univ. California [San Diego]; м.s. George Mason Univ.), California. Philip Marshall (B.S. Cornell Univ.; M.E.SC. Yale Univ.), New York. Andrew Salvador Mathews (B.sc. Leeds Univ. [United Kingdom]; M.sc. Oxford Univ. [United Kingdom]), United Kingdom. Keely Beth Maxwell (B.A. Williams Coll.; M.F.S. Yale Univ.), New York. Pamela Dawn McElwee (B.A. Univ. Kansas; M.Sc. Oxford Univ. [United Kingdom]), Kansas. Laura Suzanne Meitzner (B.A. Messiah Coll.; M.P.S. Cornell Univ.), Pennsylvania. Garrett Fristoe Miller (B.A. Pomona Coll.), Washington. Helen Rose Mills (B.S., B.A. Pepperdine Univ.; M.S. Pennsylvania State Univ.), California. Nicholas Zander Muller (B.S. Univ. Oregon; M.P.A. Indiana Univ.), Pennsylvania. John David Neidel (B.A. Northwestern Univ.; M.S. Univ. Wisconsin [Madison]), Pennsylvania. David William Newcomer (B.A. Univ. Missouri; M.E.M. Yale Univ.), South Carolina. Anastasia Rose O'Rouke (B.A. Univ. Sydney [Australia]; M.Sc. Univ. Lund [Sweden]), Australia. Jonathan Padwe (B.A. Univ. Virginia; M.E.M. Yale Univ.), Virginia. Heather Corey Peckham (B.A. Smith Coll.; M.F.S. Yale Univ.), Nebraska. David Allen Keeney Pinney (B.s. Univ. Massachusetts; M.E.s. Yale Univ.), Connecticut. Alexandra Gisele Ponette (B.A. United States International Univ.; M.A. Univ. Texas), Mexico. 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. Anne Marie Rademacher (B.A. Carleton Coll.; M.E.S. Yale Univ.), Pennsylvania. Suk Steve Rhee (B.A. Washington Univ.; M.E.S. Yale Univ.), Georgia. Wendy Gordon Rockefeller (B.A. Princeton Univ.; M.S. Harvard Univ.), New York. Shane Jeffrey Rosenthal (Diploma London School of Economics; B.A. American Univ.;

M.A. Johns Hopkins Univ.; M.PHIL. Univ. Cambridge), North Carolina. Roy Kenneth Schiff (B.S. Univ. Rochester; M.S. Univ. Washington), Virginia. Leigh Winters Shemitz (B.A. Harvard Univ.; M.F.S. Yale Univ.), Connecticut.

Jeffrey MacAdam Sigler (в.а., м.s. Univ. Virginia), Virginia.

Daniel Somers Smith (B.A. Univ. Pennsylvania; M.F.S. Yale Univ.), New Hampshire.

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

Terry Louise Terhaar (B.A. Univ. California [Santa Cruz]; M.F.S. Yale Univ.), California.

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

Mark Christopher Urban (B.S. Muhlenberg Coll.; M.E.SC. Yale Univ.), Pennsylvania.

Julie Lynn Velasquez Runk (в.а. Grinnell Coll.; м.е.м. Duke Univ.), Michigan.

Tao Wang (в.с.н.е., м.s. Tsinghua Univ. [China]), China

Heinrich zu Dohna (DiplomaSwiss Fed. Inst. Tech. [Switzerland]; M.F.S. Yale Univ.), Germany.

The Work of Yale University

The work of Yale University is carried on in the following schools:

Yale College: Courses in humanities, social sciences, natural sciences, mathematical and computer sciences, and engineering. Bachelor of Arts (B.A.), Bachelor of Science (B.S.).

For additional information, please write to the Office of Undergraduate Admissions, YaleUniversity, PO Box208234, NewHaven CT 06520-8234; telephone, 203.432.9300; e-mail, undergraduate. admissions@yale.edu; Web site, www.yale.edu/admit/

Graduate School of Arts and Sciences: Courses for college graduates. Master of Arts (M.A.), Master of Engineering (M.Eng.), Master of Science (M.S.), Master of Philosophy (M.Phil.), Doctor of Philosophy (Ph.D.).

For additional information, please write to the Yale Graduate School of Arts and Sciences, PO Box 208323, New Haven CT 06520-8323; telephone, 203.432.2771; e-mail, graduate.admissions@ yale.edu; Web site, www.yale.edu/graduateschool/

School of Medicine: Courses for college graduates and students who have completed requisite training in approved institutions. Doctor of Medicine (M.D.). Postgraduate study in the basic sciences and clinical subjects. Combined program with the Graduate School of Arts and Sciences leading to Doctor of Medicine and Doctor of Philosophy (M.D./Ph.D.). Courses in public health for qualified students. Master of Public Health (M.P.H.), Master of Medical Science (M.M.Sc.) from the Physician Associate Program.

For additional information, please write to the Director of Admissions, Office of Admissions, Yale University School of Medicine, 367 Cedar Street, New Haven CT 06510; telephone, 203.785.2643; fax, 203.785.3234; e-mail, medical.admissions@yale.edu; Web site, http://info.med. yale.edu/education/admissions/

For additional information about the Department of Epidemiology and Public Health, an accredited School of Public Health, please write to the Director of Admissions, Yale School of Public Health, PO Box 208034, New Haven CT 06520-8034; e-mail, eph.admissions@yale.edu; Web site, http://publichealth.yale.edu/

Divinity School: Courses for college graduates. Master of Divinity (M.Div.), Master of Arts in Religion (M.A.R.). Individuals with an M.Div. degree may apply for the program leading to the degree of Master of Sacred Theology (S.T.M.).

For additional information, please write to the Admissions Office, Yale University Divinity School, 409 Prospect Street, New Haven CT 06511; telephone, 203.432.5360; fax, 203.432.7475; e-mail, ydsadmsn@yale.edu; Web site, www.yale.edu/divinity/

Law School: Courses for college graduates. Juris Doctor (J.D.). For additional information, please write to the Admissions Office, Yale Law School, PO Box 208329, New Haven CT 06520-8329; telephone, 203.432.4995; e-mail, admissions.law@yale.edu; Web site, www.law.yale.edu/

Graduate Programs: Master of Laws (LL.M.), Doctor of the Science of Law (J.S.D.), Master of Studies in Law (M.S.L.). For additional information, please write to Graduate Programs, Yale Law School, PO Box 208215, New Haven CT 06520-8215; telephone, 203.432.1696; e-mail, gradpro.law@yale.edu; Web site, www.law.yale.edu/

School of Art: Professional courses for college and art school graduates. Master of Fine Arts (M.F.A).

For additional information, please write to the Office of Academic Affairs, Yale University School of Art, PO Box 208339, New Haven CT 06520-8339; telephone, 203.432.2600; e-mail, artschool.info@yale.edu; Web site, www.yale.edu/art/

School of Music: Graduate professional studies in performance, composition, and conducting. Certificate in Performance, Master of Music (M.M.), Master of Musical Arts (M.M.A.), Artist Diploma, Doctor of Musical Arts (D.M.A.).

For additional information, please write to the Yale School of Music, PO Box 208246, New Haven CT 06520-8246; telephone, 203.432.4155; fax, 203.432.7448; e-mail, gradmusic.admissions@yale.edu; Web site, www.yale.edu/schmus/

School of Forestry & Environmental Studies: Courses for college graduates. Master of Forestry (M.F.), Master of Forest Science (M.F.S.), Master of Environmental Science (M.E.Sc.), Master of Environmental Management (M.E.M.), Doctor of Forestry and Environmental Studies (D.F.E.S).

For additional information, please write to the Office of Academic Services, Yale School of Forestry & Environmental Studies, 205 Prospect Street, New Haven CT 06511; telephone, 800.825.0330 or 203.432.5100; e-mail, fesinfo@yale.edu; Web site, www.yale.edu/environment/

School of Architecture: Courses for college graduates. Professional degree: Master of Architecture (M.Arch.); nonprofessional degree: Master of Environmental Design (M.E.D.).

For additional information, please write to the Yale School of Architecture, PO Box 208242, New Haven CT 06520-8242; telephone, 203.432.2296; e-mail, gradarch.admissions@yale.edu; Web site, www.architecture.yale.edu/

School of Nursing: Courses for college graduates. Master of Science in Nursing (M.S.N.), Post Master's Certificate, Doctor of Nursing Science (D.N.Sc.).

For additional information, please write to the Yale School of Nursing, PO Box 9740, New Haven CT 06536-0740; telephone, 203:785.2389; Web site, www.nursing.yale.edu/

School of Drama: Courses for college graduates and certificate students. Master of Fine Arts (M.F.A.), Certificate in Drama, One-year Technical Internship (Certificate), Doctor of Fine Arts (D.F.A.).

For additional information, please write to the Registrar's Office, Yale School of Drama, PO Box 208325, New Haven CT 06520-8325; telephone, 203.432.1507; Web site, www.yale.edu/drama/

School of Management: Courses for college graduates. Professional degree: Master of Business Administration (M.B.A.).

For additional information, please write to the Admissions Office, Yale School of Management, PO Box 208200, 135 Prospect Street, New Haven CT 06520-8200; telephone, 203.432.5932; fax, 203.432.7004; e-mail, mba.admissions@yale.edu; Web site, www.mba.yale.edu/

Index by Course Number

| F&ES 500a | Greening the Industrial Facility | 91 |
|---------------|--|----|
| F&ES 501b | Industrial Ecology | 91 |
| [F&ES 502a,b] | Critical Analysis of Scientific Literature: Applied | |
| | Environmental Chemistry | 74 |
| F&ES 503a | Seminar in Environmental and Natural Resource Leadership | 82 |
| F&ES 504a | Seminar in Industrial Ecology | 91 |
| F&ES 505b | Local Flora | 69 |
| F&ES 506b | Observing the Earth from Space | 78 |
| F&ES 507b | Organic Pollutants in the Environment | 75 |
| [F&ES 509a] | Aquatic Ecology | 66 |
| F&ES 510a | Research Methods | 78 |
| F&ES 513b | Social Science Research Methods | 79 |
| F&ES 515b | Coastal Ecosystem Governance | 76 |
| F&ES 519b | Methods of Ecosystem Analysis | 63 |
| F&ES 520a | Species and Ecosystem Conservation: An Interdisciplinary | |
| | Approach | 66 |
| F&ES 521b | Seminar on Forest Certification | 82 |
| F&ES 524b | Fire: Science and Policy | 69 |
| F&ES 528b | Tropical Ecosystem Dynamics and Anthropogenic Change | 63 |
| F&ES 529a,b | Preparation for Research | 79 |
| F&ES 530a | Introduction to Soil Science | 76 |
| F&ES 533b | Water Resource Management | 76 |
| F&ES 536a | Estuarine Ecology and Anthropogenic Impacts | 77 |
| F&ES 540a | Environmental Hydrology | 77 |
| [F&ES 541b] | Hydrologic Modeling | 77 |
| F&ES 542b | Hydrology Seminar | 77 |
| F&ES 544a | Aquatic Chemistry | 75 |
| [F&ES 545a] | Biogeochemistry and Pollution | 75 |
| F&ES 550a | The Science and Policy of Eutrophication | 77 |
| F&ES 551b | Forest Health | 69 |
| F&ES 556b | Seminar in the Conservation and Development of Amazonia | 64 |
| [F&ES 557b] | Reconciling Development and Conservation on the Amazon | |
| | Frontier: A Tropical Conservation Field Course | 64 |
| F&ES 558b | Applied Hydrology | 78 |
| F&ES 560b | Wildlife Conservation Ecology | 66 |
| F&ES 565a | Human Dimensions in the Conservation of Biological Diversity | 66 |
| F&ES 574a | Tropical Forest Ecology and Management | 65 |
| F&ES 575a | Ecosystem Pattern and Process | 65 |
| [F&ES 576b] | Botanical Resources of the Tropics | 71 |

| [F&ES 578a] | Seminar in Molecular Approaches to Systematics, | |
|-------------|---|-----|
| | Conservation Genetics, and Behavioral Ecology | 67 |
| F&ES 582b | Issues and Approaches in Environmental Education | 68 |
| F&ES 583a | Environmental Writing | 68 |
| F&ES 587a | Laboratory in Molecular Systematics | 67 |
| F&ES 588a | Seminar in Conservation Genetics | 67 |
| F&ES 592b | Agroforestry in the Tropics: Sustainability and Services | 70 |
| F&ES 594a | Comparing Environmental Governance Across Countries: | 0 |
| Do DO | I neory and Evidence | 82 |
| F&ES 596a | Air Pollution | 76 |
| F&ES 598b | Water Quality Control | 76 |
| F&ES 600a | Structure, Function, and Development of Higher Plants: | - 0 |
| | Promised to Towering Tree | 70 |
| F&ES GOID | Exerct Londown Monorana t | 70 |
| F&ES 602D | Forest Landscape Management | 71 |
| F&ES 603a | Marine and Surficial Geochemistry | 74 |
| F&ES 604D | lopics in the 1 ropics | 65 |
| F&ES 605a | Sustainable Forestry: Biology and Management | 71 |
| F&ES 610b | Physiology of Trees and Forests: The Pathway to | |
| 11 | Understanding the World's Forests | 71 |
| [F&ES 612b] | Seminar in Alpine, Arctic, and Boreal Ecosystems | 74 |
| [F&ES 621a] | Biogeography, Biodiversity, and Conservation | 65 |
| F&ES 622a | Seminar in Forest Inventory | 79 |
| F&ES 623b | Tropical Field Botany | 66 |
| F&ES 700b | Principles in Applied Ecology: The Practice of Silviculture | 72 |
| F&ES 701a | Management Plans for Protected Areas | 72 |
| [F&ES 702b] | Rapid Assessments in Forest Conservation | 72 |
| F&ES 703a | Growth and Development of Forest Stands | 72 |
| [F&ES 704a] | Analysis of Silvicultural Problems | 72 |
| F&ES 705a | Seminar in Advanced Silviculture | 73 |
| F&ES 708a,b | Field Trips in Forest Resource Management and Silviculture | 73 |
| F&ES 710a | Seminar on Invasive Species Biology and Ecology | 73 |
| F&ES 711a | Sampling Methodology and Practice | 79 |
| F&ES 713b | Statistics for Environmental Sciences | 79 |
| F&ES 714a | Introduction to Statistics in the Environmental Sciences | 80 |
| F&ES 715a | Modeling Geographic Space | 80 |
| F&ES 716b | Modeling Geographic Objects | 80 |
| F&ES 719b | Statistical Design of Experiments | 80 |
| [F&ES 721b] | Environmental Health Policy | 90 |
| F&ES 722a | Assessing Exposures to Environmental Stressors | 91 |
| [F&ES 724a] | Information Management for Environmental Professionals | 68 |
| [F&ES 725b] | Science and Politics of Environmental Regulation | 83 |
| F&ES 726a | Applied Risk Assessment | 91 |

| F&ES 727a | Forest Financial Analysis | 73 |
|-------------|---|----|
| [F&ES 729b] | Environmental Ethics | 92 |
| F&ES 731a | Foundations of Environmental Policy and Politics | 83 |
| F&ES 733b | Economics of Pollution | 81 |
| F&ES 734a | Economics of Natural Resource Management | 81 |
| [F&ES 737b] | Valuing the Environment | 81 |
| F&ES 739b | Natural Resource Policy Practicum | 84 |
| [F&ES 743b] | Environment and Development: Dilemmas of Power and Place | 93 |
| F&ES 744a | Introduction to Planning and Development | 93 |
| F&ES 745b | Archetypes and the Environment | 69 |
| F&ES 746b | Society and Natural Resources | 93 |
| F&ES 747a | Society and Environment: Introduction to Theory and Method | 93 |
| [F&ES 748b] | Environmental Values | 94 |
| F&ES 752b | Society and Environment: Advanced Readings | 94 |
| F&ES 753a | Agrarian Societies: Culture, Society, History, and Development | 94 |
| F&ES 757a | Sustainable Development and Conservation: Introduction to | |
| | Social Aspects | 94 |
| [F&ES 759b] | Sustainable Development and Conservation: Advanced Readings | 94 |
| F&ES 760a | Landscape Ecology | 67 |
| [F&ES 761a] | Issues in Environment and Design | 95 |
| [F&ES 762b] | Ecology Seminar | 68 |
| F&ES 766b | Public-Private Partnerships: Lessons from the Water Sector | 84 |
| F&ES 767b | Monitoring and Evaluation Techniques, Theory, and | |
| | Methods Applied to Ecosystem Rehabilitation/Community | |
| | Revitalization Interventions | 95 |
| [F&ES 768b] | Business and Environment Leadership | 84 |
| F&ES 769a | Ecological Knowledge and Environmental Problem Solving | 84 |
| [F&ES 770b] | Scope of the Policy Sciences | 85 |
| F&ES 795a | Cities and Sustainability in the Developing World | 96 |
| F&ES 801a | Energy Systems Analysis | 85 |
| F&ES 802a | Technological Change and the Environment | 85 |
| F&ES 803a | Forestry Operations for Resource Professionals | 73 |
| F&ES 810a | Business Concepts for Environmental Managers | 91 |
| F&ES 812b | Environmental Management and Strategy | 92 |
| F&ES 819a | Social and Environmental Dimensions of Biotechnology | 85 |
| F&ES 824a | Doctoral Student Seminar | 69 |
| F&ES 829a | River Processes and Restoration | 78 |
| F&ES 834b | Seminar on Climate Change Science and Policy | 74 |
| F&ES 839b | Development and Globalization | 96 |
| F&ES 842a | The Economics of Sustainable Development | 86 |
| F&ES 843a | The Economics of Climate Change | 86 |
| F&ES 844b | Multivariate Statistical Analysis in the Environmental Sciences | 80 |
| F&ES 846b | Strategies for Land Conservation | 87 |

| F&ES 847b | Understanding Environmental Campaigns: Strategies and | |
|-------------|---|----|
| | Tactics | 87 |
| F&ES 848b | Comparative Environmental Law in Global Legal Systems | 87 |
| F&ES 851b | Local Environmental Law and Land-Use Practices | 88 |
| F&ES 852b | Economics of Energy and the Environment | 81 |
| F&ES 853a | Private Investment and the Environment | 88 |
| F&ES 858a | History of the Environment and Ecological Science | 88 |
| F&ES 861a | Environmental Law and Policy | 89 |
| F&ES 863b | Economics of Water Quality and Water Scarcity | 82 |
| F&ES 864a,b | Environmental Protection Clinic | 89 |
| [F&ES 866b] | Caribbean Coastal Watershed Development: Science and Policy | 78 |
| F&ES 868b | Climate and Life | 74 |
| [F&ES 869a] | A Biological Perspective of Global Change | 74 |
| F&ES 870b | International Environmental Law and Policy | 89 |
| F&ES 884a | Ecological Imagination and Environmental Design | 96 |
| F&ES 886b | The Law of Biodiversity and Nature Conservation | 89 |
| F&ES 891b | Foundations of Natural Resource Policy and Management | 90 |
| F&ES 905a | Public and Private Management of the Environment | 92 |
| F&ES 908a | Global to Local Approaches for Developing Urban Ecosystem | |
| | Theory, Methods, and Applications | 97 |
| F&ES 912a | Seminar: Nature, Economy, and Society | 97 |
| | | |

Index of Courses by Faculty Name

| Agrawal, Arun | Environment and Development: Dilemmas | |
|------------------|--|---------------|
| 0 | of Power and Place | [F&ES 743b] |
| Anisfeld, Shimon | Organic Pollutants in the Environment | F&ES 507b |
| | Water Resource Management | F&ES 533b |
| | Estuarine Ecology and Anthropogenic | 000 |
| | Impacts | F&ES 536a |
| | The Science and Policy of Eutrophication | F&ES 550a |
| Ashton, Mark | Observing the Earth from Space | F&ES 506b |
| | Seminar in Alpine, Artic and Boreal | 5 |
| | Ecosystems | [F&ES 612b] |
| | Principles in Applied Ecology: The Practice | |
| | of Silviculture | F&ES 700b |
| | Management Plans for Protected Areas | F&ES 701a |
| | Rapid Assessments in Forest Conservation | [F&ES 702b] |
| | Analysis of Silvicultural Problems | [F&ES 704a] |
| | Seminar in Advanced Silviculture | [F&ES 705a] |
| | Field Trips in Forest Resource Management | |
| | and Silviculture | F&ES 708a,b |
| Axley, James | Issues in Environment and Design | [F&ES 761a] |
| Benoit, Gaboury | Critical Analysis of Scientific Literature: | |
| | Applied Environmental Chemistry | [F&ES 502a,b] |
| | Aquatic Chemistry | F&ES 544a |
| | Biogeochemistry and Pollution | [F&ES 545a] |
| | Caribbean Coastal Watershed Development: | |
| | Science and Policy | [F&ES 866b] |
| Berlyn, Graeme | Structure, Function, and Development of | |
| | Higher Plants: From Seed to | |
| | Towering Tree | F&ES 600a |
| | Research Methods in Anatomy and | |
| | Physiology of Trees | F&ES 601b |
| | Physiology of Trees and Forests: The Pathway | |
| | to Understanding the World's Forests | F&ES 610b |
| | Seminar in Alpine, Artic, and Boreal | |
| | Ecosystems | [F&ES 612b] |
| | Laboratory for Structure, Function, and | |
| | Development of Vascular Plants | F&ES 261Lb |
| Borak, Jonathan | Applied Risk Assessment | F&ES 726a |
| Brennan-Galvin | Cities and Sustainability in the Developing | |
| | World | F&ES 795a |

| Brewer, Garry | Business and Environment Leadership Ecological Knowledge and Environmental | [F&ES 768b] |
|--------------------|---|---------------|
| | Problem Solving | F&ES 769a |
| | Scope of the Policy Sciences | [F&ES 770b] |
| Brvk. Dale | Environmental Protection Clinic | F&ES 864a.b |
| Burch, William | Society and Natural Resources | F&ES 746b |
| | Monitoring and Evaluation Techniques. | 10000 / 400 |
| | Theory and Methods Applied to Ecosystem | |
| | Rehabilitation /Community Revitalization | |
| | Interventions | F&F\$ 767h |
| | Clobal to Local Approaches for Developing | 1425 /0/5 |
| | Urban Ecosystem Theory Methods and | |
| | Applications | F&F\$ 0082 |
| Burroughs Richard | Coastal Ecosystem Governance | F&FS such |
| Durrougns, Kienaru | The Science and Policy of Futrophication | F&ES 5502 |
| Caccone Adalatica | Seminar in Molecular Approaches to | FGE5 550a |
| Caccone, Maigisa | Systematics Conservation Canatics | |
| | and Behavioral Ecology | [E8-ES == 80] |
| | L aboratory in Molecular Systematics | [F&ES 570a] |
| | Saminar in Concernation Consting | F&ES 50/a |
| Comp Ann | Mathada of Econstation Analysis | FRES 500a |
| Camp, Ann | Fine: Science and Deligy | F&ES 5190 |
| | Fire: Science and Policy | F&ES 5240 |
| | Forest Health | F&ES 5510 |
| | Growth and Development of Forest Stands | F&ES 703a |
| | Seminar in Advanced Silviculture | F&ES 705a |
| | Field Trips in Forest Resource Management | |
| | and Silviculture | F&ES 708a,D |
| | Seminar on Invasive Species Biology and | Do DO |
| | Ecology | F&ES 710a |
| Carpenter, Carol | Society and Environment: Advanced Readings | F&ES 752b |
| | Sustainable Development and Conservation: | |
| | Introduction to Social Aspects | F&ES 757a |
| | Sustainable Development and Conservation: | |
| ~ | Advanced Readings | [F&ES 759b] |
| Cashore, Benjamin | International Environmental Policy and | |
| | Governance | F&ES 245b |
| | Seminar on Forest Certification | F&ES 521b |
| | Comparing Environmental Governance | |
| | Across Countries: Theory and Evidence | F&ES 594a |
| Chertow, Marian | Industrial Ecology | F&ES 501b |
| | Seminar in Industrial Ecology | F&ES 504a |
| | Business Concepts for Environmental | |
| | Managers | F&ES 810a |
| | Environmental Management and Strategy | F&ES 812b |

| Clark, Timothy | Species and Ecosystem Conservation: | |
|-------------------|--|----------------------------------|
| | An Interdisciplinary Approach | F&ES 520a |
| | Management Plans for Protected Areas | F&ES 701a |
| | Rapid Assessments in Forest Conservation | [F&ES 702b] |
| | Society and Natural Resources | F&ES 746b |
| | Foundations of Natural Resource Policy and | |
| | Management | F&ES 891b |
| Curran, Lisa | Tropical Ecosystem Dynamics and | |
| | Anthropogenic Change | F&ES 528b |
| | Seminar in the Conservation and | |
| | Development of Amazonia | F&ES 556b |
| | Reconciling Development and Conservation | |
| | on the Amazon Frontier: A Tropical | |
| | Conservation Field Course | [F&ES 557b] |
| | Topics in the Tropics | F&ES 604b |
| Decker, Mary Beth | The Science and Policy of Eutrophication | F&ES 550a |
| Dove, Michael | Society and Environment: Introduction to | |
| | Theory and Method | F&ES 747a |
| | Society and Environment: Advanced Readings | F&ES 752b |
| | Agrarian Societies: Culture, Society, History, | Do DO |
| | and Development | F&ES 753a |
| | Sustainable Development and Conservation: | [Do DG 1] |
| | Advanced Readings | [F&ES 759b] |
| Draghi, Paul | Information Management for Environmental | |
| | Protessionals | [F&ES 724a] |
| T11: TT7:11: | Archetypes and the Environment | [F&ES 745b] |
| Ellis, William | Business Concepts for Environmental | D 2 D 2 D 2 |
| | Managers | F&ES 810a |
| Esty, Daniel | Environmental Law and Policy | F&ES 861a |
| Faculty | Wildlife Conservation Ecology | F&ES 560b |
| | Air Pollution | F&ES 596a |
| | Modeling Geographic Space | F&ES 715a |
| | Modeling Geographic Objects | F&ES 716b |
| Farley, Margaret | Environmental Ethics | [F&ES 729b] |
| Ferrucci, Michael | Forestry Operations for Resource | |
| | Protessionals | F&ES 803a |
| Forgach, John | Private Investment and the Environment | F&ES 853a |
| Garvin, Alexander | Introduction to Planning and Development | F&ES 744a |
| Gentry, Bradford | Public-Private Partnerships: Lessons from | |
| | the Water Sector | F&ES 766b |
| | Strategies for Land Conservation | F&ES 846b |
| | Private Investment and the Environment | F&ES 853a |

| Graedel, Thomas | Technology and Environment | F&ES 300b |
|--------------------|--|-------------|
| | Greening the Industrial Facility | F&ES 500a |
| | Industrial Ecology | F&ES 501b |
| | Seminar in Industrial Ecology | F&ES 504a |
| Gregoire, Timothy | Seminar in Forest Inventory | F&ES 622a |
| | Sampling Methodology and Practice | F&ES 711a |
| | Statistics for Environmental Sciences | F&ES 713b |
| | Statistical Design of Experiments | F&ES 719b |
| Grübler, Arnulf | Energy Systems Analysis | F&ES 801a |
| | Technological Change and the Environment | F&ES 802a |
| Hardin, Rebecca | Environment and Development: Dilemmas | |
| | of Power and Place | [F&ES 743b] |
| Harms, Robert | Agrarian Societies: Culture, Society, History, | |
| | and Development | F&ES 753a |
| Heng, Lye Lin | Comparative Environmental Law in Global | |
| | Legal Systems | F&ES 848b |
| Irland, Lloyd | Forest Financial Analysis | F&ES 727a |
| Kellert, Stephen | Values and Perception of the Natural | |
| | Environment | [F&ES 250b] |
| | Human Dimensions in the Conservation of | |
| | Biological Diversity | F&ES 565a |
| | Issues and Approaches in Environmental | |
| | Education | F&ES 582b |
| | Environmental Ethics | [F&ES 729b] |
| | Environmental Values | [F&ES 748b] |
| | Issues in Environment and Design | [F&ES 761a] |
| | Ecological Imagination and Environmental | |
| | Design | F&ES 884a |
| Keohane, Nathaniel | Public and Private Management of the | |
| | Environment | F&ES 905a |
| Leaderer, Brian | Assessing Exposures to Environmental | |
| | Stressors | F&ES 722a |
| Lee, Xuhui | Observing the Earth from Space | F&ES 506b |
| | Seminar in Alpine, Artic, and Boreal | |
| | Ecosystems | [F&ES 612b] |
| | Seminar on Climate Change Science and | |
| | Policy | F&ES 834b |
| | Climate and Life | F&ES 868b |
| | A Biological Perspective of Global Change | [F&ES 869a] |
| Lyons, James | Natural Resource Policy Practicum | F&ES 739b |
| MacBroom, James G. | Applied Hydrology | F&ES 558b |
| | River Processes and Restoration | F&ES 829a |
| Mansur, Erin | Economics of Energy and the Environment | F&ES 852b |
| McAfee, Kathleen | Social and Environmental Dimensions of | |
|-----------------------|---|-------------|
| | Biotechnology | F&ES 819a |
| | Development and Globalization | F&ES 839b |
| | Seminar: Nature, Economy, and Society | F&ES 912a |
| McElwee, Pamela | Social Science Research Methods | F&ES 513b |
| McGrath, David | Seminar in the Conservation and Developmen | t |
| , | of Amazonia | F&ES 556b |
| Mendelsohn, Robert | Environmental Economics & Policy | F&ES 230b |
| , | Economics of Pollution | F&ES 733b |
| | Valuing the Environment | [F&ES 737b] |
| Montagnini, Florencia | Introduction to Soil Science | F&ES 530a |
| 0 , | Tropical Forest Ecology and Management | F&ES 574a |
| | Agroforestry in the Tropics: Sustainability | 571 |
| | and Services | F&ES 592b |
| Murphy-Dunning, | Monitoring and Evaluation Techniques, | 57 |
| Colleen | Theory, and Methods Applied to Ecosystem | |
| | Rehabilitation/Community Revitalization | |
| | Interventions | F&ES 767b |
| | Global to Local Approaches for Developing | - / - / - |
| | Urban Ecosystem Theory, Methods, and | |
| | Applications | F&ES 008a |
| Nelson, Arvid | History of the Environment and Ecological | receb your |
| 1 (010011) 11 (10 | Science | F&ES 858a |
| Nepstad, Daniel | Seminar in the Conservation and Developmen | t |
| r (epstud, 2 diller | of Amazonia | F&ES 556b |
| | Reconciling Development and Conservation | 1020 5500 |
| | on the Amazon Frontier: A Tropical | |
| | Conservation Field Course | [F&FS 557b] |
| Nolon John | Local Environmental Law and Land-Use | [1420]]/0] |
| r toron, joini | Practices | F&FS 85th |
| Northron Michael | Understanding Environmental Campaigns: | rals oyld |
| r tor throp, whenaer | Strategies and Tactics | F&FS 847h |
| NVRG Faculty | Botanical Resources of the Tropics | [F&FS 576b] |
| TVIDG Faculty | Tropical Field Botany | F&FS 622b |
| Oliver Chadwick | Seminar in Environmental and Natural | 1425 0250 |
| Oliver, Oliadwick | Resource Leadership | F&F\$ 5023 |
| | Forest Landscape Management | F&FS 602h |
| | Sustainable Forestry: Biology and | 1025 |
| | Management | F&F\$ 6052 |
| | Forestry Operations for Resource | FGE5 005a |
| | Professionals | E&ES 8022 |
| Olmstead Sheila | F conomics of Natural Resource Management | F&F\$ 72.40 |
| Olmstead, Snella | Economics of Water Quality and Water | 1 XL5 /34a |
| | Scarcity | F& F\$ 86.1 |
| | Startity | FAES 0030 |

| Oradia Ofer | Pasaarah Mathada | E8-ES rice |
|----------------------|--|-------------------------------------|
| Dowell Leffrey | Concernation Biology | F&ES 2152 |
| Raymond Peter | The Science and Policy of Futrophication | F&ES 550 |
| Raymond, I etci | F cosystem Pattern and Process | F&ES 550a |
| Papatto Pohart | The Economics of Sustainable Development | F&ES 8 420 |
| Repetito, Robert | The Economics of Sustainable Development | F&ES 8 422 |
| Downing Schoror | Introduction to Statistics in the Environmente | галз 043a 1 |
| Lonothon | Sciences | |
| Jonathan | Multimente Statistical Analasia in the | F&ES 714a |
| | Funing and a statistical Analysis in the | F ⁰ FC 0 1 |
| Saiona Jamaa | Environmental Ludrology | F&ES 6440 |
| Salers, James | Environmental Hydrology | F&ES 540a |
| | Hydrologic Modeling | [F&ES 541D] |
| | Hydrology Seminar | F&ES 5420 |
| 0.1 1 | Applied Hydrology | F&ES 558b |
| Salzman, James | International Environmental Law and Policy | F&ES 870b |
| | The Law of Biodiversity and Nature | |
| | Conservation | F&ES 886b |
| Schmitz, Oswald | Ecology and Environmental Problem Solving | F&ES 262a |
| | Lab: Ecology and Environmental Problem | |
| | Solving | F&ES 263a |
| | Doctoral Student Seminar | F&ES 824a |
| Siccama, Thomas | Local Flora | F&ES 505b |
| | Methods of Ecosystem Analysis | F&ES 519b |
| | Introduction to Soil Science | F&ES 530a |
| | Ecosystem Pattern and Process | F&ES 575a |
| | Management Plans for Protected Areas | F&ES 701a |
| Skelly, David | Conservation Biology | [F&ES 315a] |
| | Aquatic Ecology | [F&ES 509a] |
| | Landscape Ecology | F&ES 760a |
| | Ecology Seminar | [F&ES 762b] |
| Smith, Ronald | Observing the Earth from Space | F&ES 506b |
| Speth, Gustave | International Environmental Law and Policy | F&ES 870b |
| Stearns, Stephen C. | Conservation Biology | [F&ES 315a] |
| Stevenson, Dennis W. | Biogeography, Biodiversity, and Conservation | [F&ES 621a] |
| Strebeigh, Frederick | Environmental Writing | F&ES 583a |
| Stuart, Sheryl | Water Quality Control | F&ES 598b |
| Turekian, Karl | Marine and Surficial Geochemistry | F&ES 603a |
| Wargo, John | Environmental Politics, Policy, and Law | F&ES 255b |
| 0 | Environmental Health Policy | [F&ES 721b] |
| | Science and Politics of Environmental | , , |
| | Regulations | [F&ES 725b] |
| | Foundations of Environmental Policy and | . ,,,,, |
| | Politics | F&ES 731a |
| | | 15 |

| Wildman, Laura | River Processes and Restoration | F&ES 829a |
|--------------------|--|-------------|
| Willard, Andrew | Foundations of Natural Resource Policy and | |
| | Management | F&ES 891b |
| Worby, Eric | Environment and Development: Dilemmas | |
| & Rodary, Estienne | of Power and Place | [F&ES 743b] |

F&ES Master's Project Courses

| Faculty | Master's Project F&ES Course Number |
|-----------------------|-------------------------------------|
| Anisfeld, Shimon | 2010 |
| Ashton, Mark | 2020 |
| Benoit, Gabriel | 2040 |
| Berlyn, Graeme | 2050 |
| Brewer, Garry | 2060 |
| Burch, William | 2070 |
| Camp, Ann | 2100 |
| Carpenter, Carol | 2110 |
| Cashore, Benjamin | 2120 |
| Chertow, Marian | 2130 |
| Clark, Timothy | 2140 |
| Curran, Lisa | 2150 |
| Dove, Michael | 2160 |
| Esty, Daniel | 2180 |
| Evenson, Robert | 2190 |
| Geballe, Gordon | 2200 |
| Gentry, Bradford | 2210 |
| Graedel, Thomas | 2230 |
| Gregoire, Timothy | 2240 |
| Kellert, Stephen | 2250 |
| Keohane, Nathaniel | 2255 |
| Lee, Xuhui | 2260 |
| Mansur, Erin | 2300 |
| McAfee, Kathleen | 2310 |
| Mendelsohn, Robert | 2320 |
| Montagnini, Florencia | 2330 |
| Oliver, Chad | 2340 |
| Olmstead, Sheila | 2350 |
| Raymond, Peter | 2354 |
| Saiers, James | 2390 |
| Schmitz, Oswald | 2400 |
| Siccama, Thomas | 2410 |
| Skelly, David | 2420 |
| Smith, Ronald | 2430 |
| Speth, Gustave | 2440 |
| Wargo, John | 2470 |

F&ES Independent Study Courses

Faculty Name

Independent Study F&ES Course Number

| Anisfeld, Shimon | 1010 |
|-----------------------|------|
| Ashton, Mark | 1020 |
| Bai, Xuemei | 1030 |
| Benoit, Gabriel | 1040 |
| Berlyn, Graeme | 1050 |
| Brewer, Garry | 1060 |
| Burch, William | 1070 |
| Burroughs, Richard | 1080 |
| Caccone, Adalgisa | 1090 |
| Camp, Ann | 1100 |
| Carpenter, Carol | 1110 |
| Cashore, Benjamin | 1120 |
| Chertow, Marian | 1130 |
| Clark, Timothy | 1140 |
| Curran, Lisa | 1150 |
| 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 |
| Kellert, Stephen | 1250 |
| Keohane, Nathaniel | 1255 |
| Lee, Xuhui | 1260 |
| Lifset, Reid | 1270 |
| MacBroom, James | 1290 |
| Mansur, Erin | 1300 |
| McAfee, Kathleen | 1310 |
| Mendelsohn, Robert | 1320 |
| Montagnini, Florencia | 1330 |
| Nelson, Arvid | 1332 |
| Nepstad, Daniel | 1334 |
| Nolon, John | 1336 |
| Oliver, Chad | 1340 |
| Olmstead, Sheila | 1350 |

| Peters, Charles | 1360 |
|---------------------------|------|
| Raymond, Peter | 1364 |
| Repetto, Robert | 1370 |
| Reuning-Scherer, Jonathan | 1380 |
| Saiers, James | 1390 |
| Schmitz, Oswald | 1400 |
| Siccama, Thomas | 1410 |
| Skelly, David | 1420 |
| Smith, Ronald | 1430 |
| Speth, Gustave | 1440 |
| Strebeigh, Frederick | 1450 |
| Tomlin, Dana | 1460 |
| Wargo, John | 1470 |
| | |

The University is committed to basing judgments concerning the admission, education, and employment of individuals upon their qualifications and abilities and affirmatively seeks to attract to its faculty, staff, and student body qualified persons of diverse backgrounds. In accordance with this policy and as delineated by federal and Connecticut law, Yale does not discriminate in admissions, educational programs, or employment against any individual on account of that individual's sex, race, color, religion, age, disability, status as a special disabled veteran, veteran of the Vietnam era, or other covered veteran, or national or ethnic origin; nor does Yale discriminate on the basis of sexual orientation.

University policy is committed to affirmative action under law in employment of women, minority group members, individuals with disabilities, special disabled veterans, veterans of the Vietnam era, and other covered veterans.

Inquiries concerning these policies may be referred to the Director of the Office for Equal Opportunity Programs, 104 W. L. Harkness Hall, 203.432.0849.

In accordance with both federal and state law, the University maintains information concerning current security policies and procedures and prepares an annual crime report concerning crimes committed within the geographical limits of the University. Upon request to the Office of the Secretary of the University, PO Box 208230, New Haven CT 06520-8230, 203.432.2310, the University will provide such information to any applicant for admission.

In accordance with federal law, the University prepares an annual report on participation rates, financial support, and other information regarding men's and women's intercollegiate athletic programs. Upon request to the Director of Athletics, PO Box 208216, New Haven CT 06520-8216, 203.432.1414, the University will provide its annual report to any student or prospective student.

For all other matters related to admission to the School of Forestry & Environmental Studies, please telephone the Admissions Office, 800.825.0330 or 203.432.5100, or e-mail fesinfo@yale.edu

BULLETIN OF YALE UNIVERSITY New Haven CT 06520-8227

Periodicals postage paid New Haven, Connecticut