

# School of Forestry & Environmental Studies

2019–2020



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# CALENDAR

## FALL 2019

July 31	W	Orientation for international students
Aug. 1-2	TH-F	Orientation for new students and for summer modules
Aug. 5-22	M-TH	Training modules in technical skills and orientation events
Aug. 26	M	Academic orientation – part I for first-year students (mandatory)
Aug. 27	T	Academic orientation – part II
Aug. 28	W	Fall-term classes begin, 8:30 a.m.
Aug. 30	F	Friday classes do not meet; Monday classes meet instead
Sept. 2	M	Labor Day; classes do not meet
Sept. 11	W	Course registration closes
Sept. 18	W	Add/Drop period ends
Oct. 15	T	October recess begins, 11 p.m.
Oct. 21	M	Classes resume, 8:30 a.m.
Oct. 25	F	Midterm
Nov. 22	F	Open house for prospective students November recess begins, 5 p.m.
Dec. 2	M	Classes resume, 8:30 a.m.
Dec. 6	F	Classes end, reading period begins, 5 p.m.
Dec. 7-18	SA-W	Reading period/final examinations
Dec. 18	W	Fall term ends; winter recess begins, 5 p.m.

## SPRING 2020

Jan. 3	F	Fall-term grades due
Jan. 13	M	Spring-term classes begin, 8:30 a.m.
Jan. 20	M	Martin Luther King, Jr. Day; classes do not meet
Jan. 28	T	Course registration closes
Feb. 4	T	Add/Drop period ends
Mar. 6	F	Midterm Spring recess begins, 5 p.m.
Mar. 23	M	Classes resume, 8:30 a.m.
Apr. 24	F	Classes end, reading period begins, 5 p.m.
Apr. 25- May 6	SA-W	Reading period/final examinations
May 6	W	Spring term ends, 5 p.m.
May 11	M	Spring-term grades due for graduating students
May 18	M	University Commencement
May 22	F	Spring-term grades due for continuing students

# THE PRESIDENT AND FELLOWS OF YALE UNIVERSITY

## President

Peter Salovey, A.B., A.M., Ph.D.

## Fellows

His Excellency the Governor of Connecticut, *ex officio*

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

Joshua Bekenstein, B.A., M.B.A., Wayland, Massachusetts

Charles Waterhouse Goodyear IV, B.S., M.B.A., New Orleans, Louisiana

Catharine Bond Hill, B.A., B.A., M.A., Ph.D., New York, New York

Paul Lewis Joskow, B.A., Ph.D., Brookline, Massachusetts

William Earl Kennard, B.A., J.D., Charleston, South Carolina

Reiko Ann Miura-Ko, B.S., Ph.D., Menlo Park, California (*June 2025*)

Gina Marie Raimondo, A.B., D.Phil., J.D., Providence, Rhode Island (*June 2020*)

Emmett John Rice, Jr., B.A., M.B.A., Bethesda, Maryland

Eve Hart Rice, B.A., M.D., Bedford, New York (*June 2021*)

Joshua Linder Steiner, B.A., M.St., New York, New York

David Li Ming Sze, B.A., M.B.A., Hillsborough, California

Annette Thomas, S.B., Ph.D., Cambridge, England (*June 2022*)

Kathleen Elizabeth Walsh, B.A., M.P.H., Wellesley, Massachusetts (*June 2023*)

Douglas Alexander Warner III, B.A., Hobe Sound, Florida

Michael James Warren, B.A., P.P.E., Washington, D.C. (*June 2024*)

Lei Zhang, B.A., M.A., M.B.A., Hong Kong, China



# THE OFFICERS OF YALE UNIVERSITY

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**Provost**

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**Senior Vice President for Institutional Affairs and General Counsel**

Alexander Edward Dreier, A.B., M.A., J.D.

**Vice President for Finance and Chief Financial Officer**

Stephen Charles Murphy, B.A.

**Vice President for Alumni Affairs and Development**

Joan Elizabeth O'Neill, B.A.

**Vice President for West Campus Planning and Program Development**

Scott Allan Strobel, B.A., Ph.D.

**Vice President for Human Resources and Administration**

Janet Elaine Lindner, B.S., M.P.A., Ed.D.

**Vice President for Global Strategy**

Pericles Lewis, B.A., A.M., Ph.D.

**Vice President for Facilities and Campus Development**

John Harold Bollier, B.S., M.B.A.

**Vice President for Communications**

Nathaniel Westgate Nickerson, B.A.

# FACULTY AND ADMINISTRATION

## BOARD OF PERMANENT OFFICERS

Peter Salovey, Ph.D., President of the University

Benjamin Polak, Ph.D., Provost of the University

Ingrid C. Burke, Ph.D., Carl W. Knobloch, Jr. Dean; and Professor of Ecosystem Ecology

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

Michelle L. Bell, M.S.E., Ph.D., Mary E. Pinchot Professor of Environmental Health; and Professor of Environmental Health, School of Public Health (on leave, fall 2019)

Gaboury Benoit, M.S., Ph.D., Grinstein Class of 1954 Professor of Environmental Chemistry; and Director, Hixon Center for Urban Ecology (on leave, fall 2019)

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

Mark A. Bradford, Ph.D., Professor of Soils and Ecosystem Ecology

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

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

Michael R. Dove, M.A., Ph.D., Margaret K. Musser Professor of Social Ecology; Professor of Anthropology; Curator of Anthropology, Peabody Museum of Natural History; and Coordinator, F&ES/Anthropology Degree Program

Daniel C. Esty, M.A., J.D., Hillhouse Professor of Environmental Law and Policy; Clinical Professor, Law School; Professor, School of Management; Professor in the Institution for Social and Policy Studies; and Director, Yale Center for Environmental Law and Policy

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

Matthew J. Kotchen, Ph.D., Professor of Economics; Professor, School of Management (on leave, 2019–2020)

Xuhui Lee, M.Sc., Ph.D., Sara Shallenberger Brown Professor of Meteorology; and Director, Yale Center for Earth Observation (on leave, fall 2019)

Robert O. Mendelsohn, Ph.D., Edwin Weyerhaeuser Davis Professor of Forest Policy; Professor of Economics; and Professor, School of Management (on leave, spring 2020)

Chadwick Dearing Oliver, M.F.S., Ph.D., Pinchot Professor of Forestry and Environmental Studies; and Director, Global Institute of Sustainable Forestry

Peter A. Raymond, Ph.D., Professor of Ecosystem Ecology; and Professor of Geology and Geophysics

James E. Saiers, M.S., Ph.D., Clifton R. Musser Professor of Hydrology; and Professor of Geology and Geophysics

Oswald J. Schmitz, M.Sc., Ph.D., Oastler Professor of Population and Community Ecology; Professor of Ecology and Evolutionary Biology; Senior Associate Dean of Research; and Director of Doctoral Studies

- Karen Seto, Ph.D., Frederick C. Hixon Professor of Geography and Urbanization Science (on leave, spring 2020)
- David K. Skelly, Ph.D., Frank R. Oastler Professor of Ecology; Professor of Ecology and Evolutionary Biology; and Director, Yale Peabody Museum of Natural History
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- Julie B. Zimmerman, Ph.D., Professor of Green Engineering; Professor of Environmental Engineering; Senior Associate Dean of Academic Affairs; and Deputy Director, Center for Green Chemistry and Green Engineering

### FACULTY EMERITI

- William R. Burch, Jr., M.S., Ph.D., Frederick C. Hixon Professor Emeritus of Natural Resource Management; and Senior Research Scientist
- John C. Gordon, Ph.D., Pinchot Professor Emeritus of Forestry and Environmental Studies
- Thomas E. Graedel, M.A., M.S., Ph.D., Clifton R. Musser Professor Emeritus of Industrial Ecology; and Senior Research Scientist
- William H. Smith, M.F., Ph.D., Clifton R. Musser Professor Emeritus of Forest Biology

### LADDER FACULTY

- Craig R. Brodersen, M.S., Ph.D., Associate Professor of Plant Physiological Ecology; and Associate Professor of Ecology and Evolutionary Biology (on leave, 2019–2020)
- Liza S. Comita, M.A., Ph.D., Associate Professor of Tropical Forest Ecology; and Associate Professor of Ecology and Evolutionary Biology
- Justin Farrell, M.Div., Ph.D., Associate Professor of Sociology; and Associate Professor in the Institution for Social and Policy Studies and Department of Sociology (on leave, 2019–2020)
- Eli P. Fenichel, M.S., Ph.D., Associate Professor of Bioeconomics and Ecosystem Management
- Kenneth T. Gillingham, Ph.D., Associate Professor of Economics; and Associate Professor, School of Management and Department of Economics
- Narasimha Rao, M.S., Ph.D., Assistant Professor of Energy Systems

### NON-LADDER TEACHING FACULTY

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- Shimon C. Anisfeld, Ph.D., Senior Lecturer and Research Scientist in Water Resources and Environmental Chemistry
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- Susan G. Clark, M.S., Ph.D., Joseph F. Cullman 3rd Professor Adjunct of Wildlife Ecology and Policy
- Amity Doolittle, M.E.S., Ph.D., Senior Lecturer in Political Ecology
- Marlyse C. Duguid, M.F., Ph.D., Thomas G. Siccama Lecturer in Environmental Field Studies; Associate Research Scientist; and Director of Research, School Forests
- L. Kealoha Freidenburg, Ph.D., Lecturer

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

Bradford S. Gentry, J.D., Frederick K. Weyerhaeuser Professor in the Practice of Forest Resources Management and Policy, School of Forestry & Environmental Studies and School of Management; Senior Associate Dean of Professional Practice; Director, Yale Center for Business and the Environment; and Director, Research Program on Private Investment and the Environment

John Grim, Ph.D., Senior Lecturer and Senior Research Scholar in Religion and Ecology; Senior Research Scholar, Divinity School; Senior Lecturer in Religious Studies; and Coordinator, Forum on Religion and Ecology

William Lauenroth, Ph.D., Professor in the Practice

Simon A. Queenborough, M.Sc., Ph.D., Lecturer and Research Scientist; and Mrs. John Musser Director, Tropical Resources Institute

Jonathan D. Reuning-Scherer, Ph.D., Senior Lecturer in Statistics and Data Science

Mary Evelyn Tucker, Ph.D., Senior Lecturer and Senior Research Scholar in Religion and Ecology; Senior Research Scholar, Divinity School; Senior Lecturer in Religious Studies; and Coordinator, Forum on Religion and Ecology

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Natalie Marie Schultz, Ph.D., Associate Research Scientist

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Rachel Sperling, Librarian  
Rosanne Stoddard, Registrar  
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Donna Rochelle Williams, M.B.A., Financial Assistant IV, Business Office

# A MESSAGE FROM THE DEAN

Since its founding, the Yale School of Forestry & Environmental Studies has been at the forefront of bringing the best science to resource management, tackling environmental challenges through our scholarship and by creating leaders. Today we continue to build on this rich legacy by providing world-leading research, teaching, and public engagement that aim to create a more sustainable world. Graduates of our programs have become leaders all over the world in guiding environmental decisions.

Now in its second century, the School addresses a broad range of issues related to the health of the planet and human-environment interactions. Our academic programs provide a balance of interdisciplinary breadth, focused areas of study, and professional skills development. These programs, along with our strong relationships with schools and programs across Yale and around the world, enable our students to understand the scale of today's challenges, and to become leaders in addressing these and the unforeseen challenges of the future.

Our alumni – 5,100 and counting – are tackling the increasingly complex environmental, social, and economic challenges of the twenty-first century in all corners of the world. They work in NGOs, government, business, academia, law, public health, and communications. They also maintain vital connections to the School; the F&ES alumni network provides valuable mentorship and support to our students as they prepare for their own professional challenges.

In 2017 the School unveiled an ambitious new Strategic Plan that has brought renewed focus on our shared mission and outlined priorities for the next five years. Among the plan's critical goals were the development of new curricula that track our current and evolving strengths; increased programs and hiring to address environmental equity and diversity issues; a new emphasis on research and training in environmental communication; and expanded interdisciplinary research. We've made exciting strides on all these fronts, including a new curriculum for our Master of Environmental Management program, introduced last year, that places more emphasis on subject specialization while maintaining our signature flexibility; the introduction of the Yale Center for Environmental Communication; and the creation of the Yale Environmental Dialogue, an initiative that has engaged environmental leaders from a wide range of disciplines and sectors to inject new ideas and fresh energy into the national conversation on environmental policy. During your time here, we will be working to develop and strengthen our other key strategic initiatives – environmental data, urban science, and environmental health and justice. You will have the opportunity to work with us as we do this.

The challenges we face require ever greater levels of innovative scholarship and leadership. Together we will work to broaden and deepen the School's impact, provide global leadership on the range of issues we address, and promote an inclusive community both at our School and across the greater environmental field.

Our vision statement says it all: we aim to provide knowledge and leadership for a sustainable future. We invite you to be a part of this work.

Ingrid C. Burke

*Carl W. Knobloch, Jr. Dean*

*School of Forestry & Environmental Studies*

# SCHOOL MISSION

The Yale School of Forestry & Environmental Studies aspires to lead the world toward a sustainable future with cutting-edge research, teaching, and public engagement on society's evolving and urgent environmental challenges.

Our mission is grounded in seven fundamental values:

**Excellence** We promote and engage in pathbreaking science, policy, and business models that build on a fundamental commitment to analytic rigor, data, intellectual integrity, and excellence.

**Leadership** We attract outstanding students nationally and internationally and offer a pioneering curriculum that defines the knowledge and skills needed to be a twenty-first-century environmental leader in a range of professions.

**Sustainability** We generate knowledge that will advance thinking and understanding across the various dimensions of sustainability.

**Community** We offer a community that finds strength in its collegiality, diversity, independence, and commitment to excellence and lifelong learning.

**Diversity** We celebrate our differences and identify pathways to a sustainable future that respects diverse values including equity, liberty, and civil discourse.

**Collaboration** We foster collaborative learning, professional skill development, and problem solving—and we strengthen our scholarship, teaching, policy work, and outreach through partnerships across the university and beyond.

**Responsibility** We encourage environmental stewardship and responsible behavior on campus and beyond.

In pursuit of our mission, we:

- Build on more than a century of work bringing science-based strategies, ethical considerations, and conservation practices to natural resource management.
- Approach problems on a systems basis and from interdisciplinary perspectives.
- Integrate theory and practice—and provide innovative solutions to society's most pressing environmental problems.
- Address environmental challenges at multiple scales from local to global and multiple settings from urban to rural and from managed to wild—including working lands and landscapes.
- Draw on the depth of resources at Yale and the network of alumni that extends across the world.
- Create opportunities for research and policy application as well as professional development through a structure of faculty-led centers and programs.
- Provide a neutral forum to convene conversations on difficult issues that are critical to progress on sustainability.
- Bring special focus on the most significant threats to a sustainable future including climate change, the corresponding need for clean energy, and the increasing stresses on our natural resources.

# HISTORY OF THE SCHOOL OF FORESTRY & ENVIRONMENTAL STUDIES

Yale University has played a leading role in the development of the American conservation movement and the practice of natural resource management since the 1880s, when Yale graduates such as William Henry Brewer, Othniel C. Marsh, Clarence King, and George Bird Grinnell became deeply involved in the exploration of the West. In 1900 that tradition was further strengthened when the University established the Yale Forest School. The School was founded by Gifford Pinchot 1889 B.A., 1925 LL.D., and Henry S. Graves 1892 B.A., 1949 LL.D., with a gift from the Pinchot family, with the goal of ensuring a steady supply of American forestry professionals.

Pinchot, who became one of the leading figures in the administration of President Theodore Roosevelt, created the U.S. 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.”

In the School’s first four decades, it would produce the first four Forest Service chiefs. In the decades since, the School has grown from a small, narrowly focused forestry program to an international institution with a diverse array of students from across the world graduating each year. Over the past century, the School’s objectives have broadened, its mission has evolved, and its methods of instruction have changed to address the changing and increasingly complex environmental challenges facing the planet.

In 1972 the School changed its name to the School of Forestry & Environmental Studies in recognition of the fact that it is, in the broadest sense, concerned with the scholarly understanding and long-term management of ecosystems for both conservation of biodiversity and for human benefit. The School’s research and teaching now are conducted across a broad range of 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 law; urban science, environmental planning, design, and values; and coastal watershed systems.

Over the past two decades, the School has also strengthened its connections within the larger Yale community and with external partners. The School has introduced joint programs with Yale Law School, the Yale School of Management, the Yale School of Public Health, and the Yale School of Architecture, as well as with partner universities including Pace Law School, Vermont Law School, and Tsinghua University in China. During the 1990s, the School invested in a range of new centers and programs to deepen its work beyond faculty research and classroom learning into engagement with environmental problems in a wide array of dimensions. These and other emerging initiatives have created dynamic foci for scholarship, research, student learning, and outreach to alumni and the wider professional communities.

The School's faculty and students have also become more diverse and representative of the wider world, coming from a range of professional, cultural, and sociological backgrounds. In 2017, a new strategic plan led by Dean Indy Burke identified as a priority the establishment of programs and hiring to address diversity within the School and the environmental field.

# LEADERSHIP FOR SUSTAINABILITY

Through its scholarship, teaching, practice, and power to convene, the Yale School of Forestry & Environmental Studies is a leader in the development and implementation of sustainable practices on the Yale campus, in the city of New Haven, nationally, and internationally. The School creates new knowledge in the science of sustainability and new methods of applying that knowledge to the challenges of environmental management, the restoration of degraded environments, and the pursuits of sustainable development.

On the Yale campus, the School has stepped up as a model in the sustainable use of resources and materials and has helped develop strategies and programs to achieve sustainability goals campuswide, including the creation of a University stormwater management plan and construction of Kroon Hall, the most energy-efficient building on campus. The Yale Carbon Charge, an initiative born in an F&ES classroom and developed in part by F&ES faculty and students, has grown into a first-of-its-kind campuswide effort to reduce energy use through the use of internal carbon pricing. Since its inception, the School has been working on sustainable management of forests across the world, for biological diversity, for natural resource production, and most recently, for carbon storage. For more than twenty years, the F&ES-based Urban Resources Initiative has promoted community-based land stewardship, urban forestry, and green job training in the city of New Haven. In northeastern Connecticut, F&ES students and faculty every year work with landowners to promote sustainable forestry practices as part of the Quiet Corner Initiative.

For students, classroom learning often extends into local communities, where students have helped officials with climate resilience and adaptation strategies, green infrastructure development, and sustainable land stewardship and resource management plans. Their work has also addressed complex challenges in communities across the United States and the world, from dealing with lead-contaminated water in Flint, Michigan, to endangered species conservation in China. And across the world, our alumni continue this commitment to sustainability in all its forms through their leadership in ongoing academic research, major corporate initiatives, government programs, and the nonprofit sector.

# MASTER'S DEGREE PROGRAMS

## Two-Year Master's Degree Programs

The School of Forestry & Environmental Studies offers four two-year master's degrees: the professionally oriented Master of Environmental Management (M.E.M.) and the Master of Forestry (M.F.), and the research-oriented Master of Environmental Science (M.E.Sc.) and Master of Forestry Science (M.F.S.). The master's degree programs vary in their level of prescription, but all are sufficiently flexible to accommodate the diverse academic backgrounds, professional experiences, and career aspirations of a large and vibrant student body. The program curricula draw from more than 200 courses taught by more than fifty F&ES faculty, as well as from courses taught elsewhere at Yale. Each student's course of study is customized through consultation with a faculty adviser who guides the student's learning experience from the first week at Yale until graduation. The master's degree programs require a minimum of two years in residence, 48 credits of course work at Yale, a summer internship or research experience, and completion of the Training Modules in Technical Skills prior to the student's first term (see below).

### MASTER OF ENVIRONMENTAL MANAGEMENT

The Master of Environmental Management curriculum draws from course work in the natural and social sciences and focuses on the complex relationships among science, management, and policy. The purpose of the program is to provide students with an in-depth understanding of natural and social systems that can be applied to environmental and natural resource problem solving in a policy or management context. In addition to course work, students are expected to hone their capacities as leaders and managers through summer internships, professional skills courses, and other opportunities.

The M.E.M. curriculum requires students to focus on an area of specialization, while still offering the flexibility to tailor their course programming in a way that exposes them to other disciplines and subject areas. This structure assures that students develop both depth and breadth in their course study. Students can choose from more than 100 courses offered by F&ES faculty and have access to an even larger number of courses from across Yale University. All M.E.M. students take the fall Perspectives course (F&ES 601), demonstrate interdisciplinary conversancy through either taking or satisfying waiver requirements for four 1.5-credit Basic Knowledge courses (F&ES 511, F&ES 512, F&ES 521, and F&ES 522), and complete a Capstone course or project. They round out their experience with general electives and a selection of at least four of eight Professional Skills Modules.

Specializations are designed to ensure that students obtain sufficient depth in their chosen area of study. The specializations are:

1. Business and the Environment
2. Climate Change Science and Management
3. Ecosystem and Land Conservation and Management
4. Energy and the Environment
5. Environmental Policy Analysis
6. Industrial Ecology and Green Chemistry



7. Nature and Society
8. Water Resources Science and Management

Specialization requirements account for 18 of the 48 total credits required for the M.E.M. degree, made up of two core courses and four electives, and it is possible to add a second specialization. Students have until the end of their second term of study to choose their specialization, which will be listed on their transcript upon completion. Students may also propose a self-designed specialization path in collaboration with a faculty adviser and the senior associate dean of academic affairs.

## MASTER OF FORESTRY

The Master of Forestry program trains professionals for the protection, management, and restoration of native forests and woodlands and associated human-made forest ecosystems (urban trees, agroforests, plantations); and for mediating and resolving the conflicting values of society that concern forests and associated ecosystems. 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, including Aldo Leopold, M.F. 1909, and nine of the first twelve chiefs of the USDA Forest Service.

Master of Forestry graduates have pursued a variety of professional opportunities in forestry. Most start as general practitioners in management and with experience move through management to become policy makers and organizers. Some graduates use the degree as preparation for advanced study in doctoral programs.

The broad objective of the two-year M.F. program is realized by requiring a multidisciplinary suite of formal course work coupled with a progressive synthesis of knowledge in a significant project. Course work is supplemented through an array of local, regional, national, and international field trips to witness the practice of forestry in diverse settings. Real-world professional experience is provided through the Yale Forest and summer internships at a wide variety of resource management and policy organizations. Opportunities to engage in discussion with forest leaders are provided through workshops, meetings with visiting speakers of national and international repute, and involvement in the School's programs such as the Global Institute of Sustainable Forestry, the Forests Dialogue, the Tropical Resources Institute, and the Urban Resources Initiative.

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

The Master of Forestry degree is accredited by the Society of American Foresters (SAF). A minimum of two full years in residence and sixteen full courses (48 credits) is required for completion of this program.

## MASTER OF ENVIRONMENTAL SCIENCE/MASTER OF FOREST SCIENCE

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

The course of study for both degrees includes formalized School-level training in the philosophy and practice of science. Training is provided through key courses in combination with extended project research and disciplinary and nondisciplinary electives. The scientific research required for this degree will be conducted in close collaboration with an F&ES faculty adviser. *Therefore students must have a commitment from a faculty adviser before being admitted to these degree programs.* The Master of Environmental Science and Master of Forest Science programs require the student to produce a “scholarly product.” This product may take the form of a traditional master’s thesis or a paper(s) submitted to a refereed journal.

## TRAINING MODULES IN TECHNICAL SKILLS (MODS)

All incoming master’s students participate in three weeks of summer modules, which introduce the students to a basic understanding of field data, the basis for all environmental science and policy. MODs have three goals: (1) introduce basic systems analysis techniques, the foundation for all environmental science, management, and policy, using three local ecosystems; (2) build F&ES community spirit; and (3) introduce new students to the landscape they will be living, studying, and working in for the next few years. MODs take place in three settings: the urban environment of New Haven, the Yale Myers Forest in northeast Connecticut, and the Great Mountain Forest in northwestern Connecticut.

These modules are *required* of all first-year master’s students enrolled in two-year programs, the five-year program for Yale College and Yale-NUS College students, and the one-year midcareer degree program. Course work is primarily in the field and covers three technical areas:

**Ecosystem analysis** Understanding the process of data collection, analysis, and interpretation is important for all natural resource professionals, from field researchers to resource managers and policy makers. The objective of this module is to improve the ability to evaluate ecosystem data by introducing/reviewing principles of and techniques for quantifying natural resources.

**Urban** The goal of this module is to acquaint students with field skills for characterizing and understanding urban ecosystems. It is designed to complement the ecosystem

analysis module, which uses an ecosystem framework and examines largely undisturbed systems. In contrast, the urban module explicitly considers how the actions of humans and the existence of the built environment alter ecosystem structure and function.

**Reading the landscape** The goal of this module is to provide a basic understanding of how to interpret landscapes, taking into consideration land use history, land management, ecological conditions, and geological features, and how they have combined to shape the land and ecosystems today. Students are also introduced to the fundamentals of navigation, surveying, and map making, leading to an understanding of how to interpret various representations of spatial information.

## One-Year Midcareer Master's Degree Program

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

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

The curricula for the one-year midcareer Master of Environmental Management and Master of Forestry degree programs are less structured than the curricula for the two-year programs. Attendance at the Training Modules (see Training Modules in Technical Skills, above) is expected, and the successful completion of 24 credits of course work and independent study is required. In addition, all first-year M.E.M. students must enroll in the fall Perspectives course (F&ES 601). One academic year in residence is normally expected, as is initial enrollment at the start of the fall term.

## Five-Year Program for Yale College and Yale-NUS College Students

The School of Forestry & Environmental Studies offers joint-degree, five-year options that culminate in a baccalaureate and master's degree intended for students who want to pursue careers in an environmental field. The joint-degree option is available to all undergraduates in Yale College and to environmental studies majors at Yale-NUS College. The program provides well-prepared students with accelerated graduate training in environmental science, management, and policy. Eligible students may apply for either a Master of Environmental Management (M.E.M.) or Master of Environmental Science (M.E.Sc.) degree. The program is built on careful integration

of a student's undergraduate curriculum with graduate requirements. Graduates have become highly successful leaders within governments, corporations, nonprofit organizations, and academia.

Yale students interested in the five-year joint-degree program should apply to the program at the end of the fall term of their senior year, or in the two years immediately following graduation. Applicants interested in applying to the M.E.Sc. should make an appointment to talk to the F&ES Office of Admissions at [fesinfo@yale.edu](mailto:fesinfo@yale.edu) prior to applying.

## Joint Master's Degree Programs

The School of Forestry & Environmental Studies supports several curricula that work concurrently toward two degrees from different academic units of Yale University. Opportunities for development of joint-degree programs exist with the School of Architecture, Divinity School, Law School, School of Management, School of Public Health, the Graduate School of Arts and Science's Global Affairs program coordinated through the Jackson Institute, the International and Development Economics program of the Graduate School's Department of Economics, and three programs offered by the Graduate School and coordinated through the MacMillan Center (African Studies, East Asian Studies, and European and Russian Studies). Joint-degree programs with Pace Law School and Vermont Law School constitute additional options. Applicants are urged to apply to both units at the same time. All of these programs are subject to the following general guidelines.

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

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

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

8. African Studies (Graduate School of Arts and Sciences): Master of Arts (three terms).
9. East Asian Studies (Graduate School of Arts and Sciences): Master of Arts (three terms).
10. European and Russian Studies (Graduate School of Arts and Sciences): Master of Arts (three terms).

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

### JOINT-DEGREE PROGRAM WITH TSINGHUA UNIVERSITY

F&ES offers a three-year joint-degree program with Tsinghua University School of Environment in China. This program consists of one and one-half years (three terms) at Tsinghua working toward a Master of Environmental Engineering and one and one-half years (three terms) at Yale working toward a Master of Environmental Management, Master of Environmental Science, Master of Forestry, or Master of Forest Science. Students who begin their program at F&ES will spend one year (two terms) at F&ES, followed by one and one-half years (three terms) at Tsinghua, and then conclude their program with one-half year (one term) at F&ES. Students who begin their program at Tsinghua will spend one-half year (one term) at Tsinghua, one and one-half years (three terms) at F&ES, and then conclude their program with one year (two terms) at Tsinghua.

Applicants must apply to, and be accepted by, both F&ES and Tsinghua University under normal admissions procedures. For questions about this joint-degree program, please contact the F&ES Office of Admissions at [fesinfo@yale.edu](mailto:fesinfo@yale.edu) or 800.825.0330.

### JOINT MANAGEMENT PROGRAM WITH UNIVERSIDAD DE LOS ANDES

F&ES offers an additional joint program with the Universidad de los Andes in Bogotá, Colombia. This program consists of two years (48 credits) at F&ES working toward the Master of Environmental Management, followed by fifteen months at the Universidad de los Andes working toward completion of the full-time Master of Business Administration. Upon successful completion of each program, the student will be awarded a Master of Environmental Management degree from Yale and a Master of Business Administration degree from Universidad de los Andes.

Applicants must apply to, and be accepted by, both F&ES and the Universidad de los Andes under normal admissions procedures. For questions about this joint-degree program, please contact the F&ES Office of Admissions at [fesinfo@yale.edu](mailto:fesinfo@yale.edu) or 800.825.0330.

## Part-Time Program

Students who wish to obtain a degree through the part-time option must complete the same curriculum as full-time students. Participants must enroll for at least two courses per term and must complete the degree requirements within four years of matriculation. Part-time tuition will be \$14,142.50 per term for the academic year 2019–2020.

## Special Students

For those who do not wish to pursue a degree program, F&ES offers the option of special-student status. Special students may be registered for a period as short as one term and may enroll in a minimum of one course or elect to take a full program of four courses per term. Please note that international applicants who are not coming through a preestablished Memorandum of Understanding between a partner university and Yale University will likely not be able to participate in the special-student program. Special students may not be eligible to participate in the summer Training Modules in Technical Skills. Under normal circumstances, no one may hold special-student status for more than one academic year. No degree or certificate is granted for special-student course work. Students will receive official transcripts of course work completed. For information on tuition for special students, see the chapter Tuition, Fees, and Other Expenses.

Special students wishing to matriculate in a degree program after completing courses will need to apply and be admitted through the F&ES admission process described in the chapter Admissions: Master's Degree Programs. Course credits earned while in special-student status will not be applied toward any degree credit requirements, and any fees paid while in attendance as a special student will not be applied toward degree tuition requirements.

# DOCTORAL DEGREE PROGRAM

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

## Requirements for the Doctoral Degree

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

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

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

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

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

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

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

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

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

## Combined Doctoral Degree

### Department of Anthropology

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

Prospective combined-degree students must initially apply either to Anthropology or to F&ES but not to both at the same time. However, applicants should indicate their interest in the combined degree by marking the application form appropriately. Once the student is accepted in the initial doctoral program, the application file will be considered in the second program, and a decision on the combined-degree application will be communicated by the Graduate School by the usual deadline for acceptance of admission offers. Such students will be allocated to their initial program as their primary administrative home, but will enter Yale as members of the combined-degree program. Being turned down for entry into the combined-degree program initially does not preclude reapplication after arriving at Yale the following fall term. More detailed guidelines for the combined-degree program can be found on the F&ES website at <http://environment.yale.edu/doctoral/degrees/combined-anthropology>.



## New York Botanical Garden

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

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

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

# 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. The letter “E” following a course number indicates an online course. Courses with bracketed titles will not be offered during the 2019–2020 academic year.

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

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

**Note** For updated course listings, please see the School of Forestry & Environmental Studies website, <https://environment.yale.edu/courses>.

## List of Courses by Topic

### Basic Knowledge

F&ES 511	Ecological Patterns and Processes
F&ES 512	Microeconomics for Environmental Management
F&ES 521	Physical Science Foundations for Environmental Managers
F&ES 522	Topics in Community Engagement

### Professional Skills Courses

F&ES 577	PSC: Environmental Communicator
F&ES 578	PSC: Financial Concepts for Environmental Managers

### Perspectives

F&ES 601	Perspectives: Bristol Bay/Pebble Mine
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### Capstone

F&ES 953	Business and the Environment Consulting Clinic
F&ES 954	Management Plans for Protected Areas
F&ES 955	Seminar in Research Analysis and Communication in Forest Ecology
F&ES 956	Health Care Environmental Sustainability Practicum
F&ES 959	Clinic in Environmental/Climate Justice, Sustainability, and Public Health
F&ES 964	Large-Scale Conservation: Integrating Science, Management, and Policy
F&ES 965	Advanced Readings: Social Science of Conservation and Development
F&ES 970	Environmental Protection Clinic: Policy and Advocacy

F&ES 971	Land Use Clinic
F&ES 972	Advanced Environmental Protection Clinic
F&ES 973	Capstone in Industrial Ecology
F&ES 980	Social Justice in the Global Food System Capstone
F&ES 981	Climate, Animal, Food, and Environmental Law and Policy Lab
F&ES 983	Water Resource Science and Management
F&ES 984	Energy and Climate Change Policy Practicum
F&ES 985	Capstone: Urban, Suburban, and Regional Planning Practice

## Ecology

### COMMUNITY AND ECOSYSTEM ECOLOGY

F&ES 530	Ecosystems and Landscapes
F&ES 629	North American Drylands: Ecology and Land Use
F&ES 681	Ethnobotany
F&ES 717	Tropical Field Ecology
F&ES 723	Wetlands Ecology, Conservation, and Management
F&ES 731	Tropical Field Botany
F&ES 741	Ecosystem Measurements for Conservation and Restoration
F&ES 752	Ecology and Conservation of Tropical Forests

### ENVIRONMENTAL EDUCATION AND COMMUNICATION

F&ES 592	Documentary Film Workshop
F&ES 595	Yale Environment Review
F&ES 603	Environmental Data Visualization and Communication
F&ES 613	Writing as a Public Scholar
F&ES 625	Writing Workshop
F&ES 719	Making Climate Knowledge
F&ES 742	Fundamentals of Working with People
F&ES 743	Strategic Environmental Communication
F&ES 747	Global Communication Skills
F&ES 750	Writing the World
F&ES 822	Strategic Communication: Delivering Effective Presentations
F&ES 862	The Science of Science Communication
F&ES 900	Doctoral Student Seminar and Responsible Conduct of Research
F&ES 910	Survival Skills for Finishing Doctoral Students

## Forestry

### FOREST BIOLOGY

F&ES 652	Wood: Structure and Function
F&ES 654	Structure, Function, and Development of Trees
F&ES 656	Tree Physiology and Ecophysiology

F&ES 671	Temperate Woody Plant Taxonomy and Dendrology
F&ES 674	Seminar in Forest Ecosystem Health and Climate Adaptation
F&ES 679	Plant Ecophysiology
F&ES 679L	Lab: Plant Ecophysiology
F&ES 694	The Ecology, Economics, and Politics of Species Invasion

#### FOREST MANAGEMENT

F&ES 653	Maple: From Tree to Table
F&ES 658	Global Resources and the Environment
F&ES 659	The Practice of Silviculture: Principles in Applied Forest Ecology
F&ES 660	Forest Stand Dynamics
F&ES 668	Field Trips in Forest Resource Management and Silviculture
F&ES 669	Forest Management Operations for Professional Foresters
F&ES 670	Southern Forest and Forestry Field Trip
F&ES 680	Ecosystem Finance
F&ES 683	Seminar in Tropical Forest Restoration in Human-Dominated Landscapes
F&ES 684	Forest Finance
F&ES 688	Forested Management and Landscape Planning
F&ES 692	Science and Practice of Temperate Agroforestry

### Physical Sciences

#### ATMOSPHERIC SCIENCES

F&ES 608	Air Pollution and Public Health
F&ES 630	The Physical Science of Climate Change
F&ES 700	Alpine, Arctic, and Boreal Ecosystems Seminar
F&ES 718	Climate Change Seminar

#### ENVIRONMENTAL CHEMISTRY

F&ES 706	Organic Pollutants in the Environment
F&ES 707	Aquatic Chemistry
F&ES 708	Introduction to Environmental Chemistry
F&ES 773	Air Pollution Control

#### SOIL SCIENCE

F&ES 709	Lectures, Discussions, and Applications of Soil Science
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#### WATER RESOURCES

F&ES 710	Coastal Governance
F&ES 712	Water Management
F&ES 713	Coastal Ecosystems
F&ES 714	Environmental Hydrology
F&ES 724	Watershed Cycles and Processes

F&ES 734	Biological Oceanography
F&ES 777	Water Quality Control

## Quantitative and Research Methods

F&ES 510	Introduction to Statistics and Data Analysis in the Environmental Sciences
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F&ES 510E	Introduction to Statistics and Data Analysis in the Environmental Sciences
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F&ES 550	Natural Science Research Methods
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F&ES 551	Qualitative Social Science Research
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F&ES 552	Master's Student Research Conference
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F&ES 611	Introduction to Environmental Data Science
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F&ES 720	Introduction to R
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F&ES 726	Observing Earth from Space
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F&ES 751	Sampling Methodology and Practice
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F&ES 753	Regression Modeling of Ecological and Environmental Data
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F&ES 754	Geospatial Software Design
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F&ES 755	Modeling Geographic Space
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F&ES 756	Modeling Geographic Objects
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F&ES 757	Data Exploration and Analysis
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F&ES 758	Multivariate Data Analysis in the Environmental Sciences
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F&ES 762	Applied Math for Environmental Studies
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F&ES 781	Applied Spatial Statistics
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F&ES 902	Environmental Anthropology Research Lab
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## Social Sciences

### ECONOMICS

F&ES 624	Economics of Sustainability
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F&ES 701	Climate Change Economics
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F&ES 804	Economics of Natural Resources
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F&ES 805	Seminar on Environmental and Natural Resource Economics
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F&ES 834	Environmental Economics and Policy
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F&ES 905	Doctoral Seminar in Environmental and Energy Economics
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### ENERGY AND THE ENVIRONMENT

F&ES 583	American Energy History
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F&ES 635	Renewable Energy Project Finance
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F&ES 716	Renewable Energy
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F&ES 789	Energy and Development
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F&ES 800	Energy Economics and Policy Analysis
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F&ES 814	Energy Systems Analysis
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F&ES 816	Electric Utilities: An Industry in Transition
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**ENVIRONMENTAL POLICY**

F&ES 573	Urban Ecology for Local and Regional Decision-Making
F&ES 590	The Climate Change Negotiations: A Practical Approach
F&ES 631	Solving Super Wicked Problems of Global Climate Change
F&ES 632	Introduction to Social Entrepreneurship
F&ES 645	Urbanization, Global Change, and Sustainability
F&ES 761	Negotiating International Agreements: The Case of Climate Change
F&ES 769	Public Lands and Policy in the American West
F&ES 799	Sustainable Development Goals and Implementation
F&ES 807	Corporate Environmental Management and Strategy
F&ES 811	Metrics, Tools, and Indicators in Corporate Responsibility
F&ES 817	Urban, Suburban, and Regional Planning Practice
F&ES 819	Strategies for Land Conservation
F&ES 820	Land Use Law and Environmental Planning
F&ES 824	Environmental Law and Policy
F&ES 826	Foundations of Natural Resource Policy and Management
F&ES 827	Animal Law
F&ES 835	Seminar on Land Use Planning
F&ES 835E	Seminar on Land Use Planning
F&ES 840	Climate Change Policy and Perspectives
F&ES 850	International Organizations and Conferences
F&ES 855	Climate Change Mitigation in Urban Areas
F&ES 860	Understanding Environmental Campaigns
F&ES 875E	Urban Resilience: Complexity, Collaborative Structures, and Leadership Challenges

**SOCIAL AND POLITICAL ECOLOGY**

F&ES 520	Society and Environment: Introduction to Theory and Method
F&ES 615	Political Ecology of Conservation and Restoration of Tropical Forest Landscapes
F&ES 619	Ethics and Ecology
F&ES 744	Conservation Science and Landscape Planning
F&ES 760	Conservation in Practice: An International Perspective
F&ES 764	Nature, Rationality, and Moral Politics
F&ES 767	Tools for Conservation Project Design and Management
F&ES 789E	Journey of the Universe
F&ES 793	Climate Change, Societal Collapse, and Resilience
F&ES 796	Human-Animal Relations: New Anthropological Approaches to the Nonhuman
F&ES 831	Society and Natural Resources

F&ES 836	Agrarian Societies: Culture, Society, History, and Development
F&ES 839	Social Science of Conservation and Development
F&ES 846	Perspectives on Environmental Injustices
F&ES 857	Environmental History and Values
F&ES 869	Disaster, Degradation, Dystopia: Social Science Approaches to Environmental Perturbation and Change
F&ES 873	Global Environmental History
F&ES 877	Anthropology of the Global Economy for Conservation and Development
F&ES 878	Climate and Society: Past to Present
F&ES 892	Introduction to Planning and Development

#### HEALTH AND ENVIRONMENT

F&ES 628	Global Aspects of Food and Nutrition
F&ES 639	Urban Sanitation
F&ES 646	Foundations of Agriculture and Environment
F&ES 721	Climate Change Adaptation: Resilience and Resistance in Global Health
F&ES 727	Food: Science, Law, and Policy
F&ES 893	Principles of Risk Assessment
F&ES 896	Public Health Toxicology
F&ES 897	Environmental and Occupational Exposure Science

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

F&ES 609	Advanced Seminar on Industrial Ecology: Waste Management and the Circular Economy
F&ES 771	Fundamentals of Green Engineering and Green Chemistry
F&ES 782	Globalization Space: International Infrastructure and Extrastatecraft
F&ES 884	Industrial Ecology
F&ES 885	Green Engineering and Sustainable Design
F&ES 894	Green Building: Issues and Perspectives

## Online and Flipped Courses

In addition to offering courses in the traditional classroom setting, the School of Forestry & Environmental Studies in recent years has made a growing commitment to providing quality education through online learning. As part of this initiative, the School introduced a series of courses that “flip” the typical classroom model. These courses allow students to watch lectures online while still providing an opportunity for weekly personal interactions with F&ES faculty. The digital format helps the instructors incorporate multimedia resources that are difficult to use in the classroom and enables more time for discussion, questions, and/or group work during student-instructor interactions. During the 2019–2020 academic year, the School will offer several courses that use the flipped model. We are also actively developing flipped

courses and integrating technology into the classrooms. Therefore, classes not listed here may include some flipped features. Courses offered in 2019–2020 include the following:

F&ES 510E	Introduction to Statistics and Data Analysis in the Environmental Sciences
F&ES 530	Ecosystems and Landscapes
F&ES 659	The Practice of Silviculture: Principles in Applied Forest Ecology
F&ES 720	Introduction to R
F&ES 762	Applied Math for Environmental Studies
F&ES 789E	Journey of the Universe
F&ES 835E	Seminar on Land Use Planning
F&ES 875E	Urban Resilience: Complexity, Collaborative Structures, and Leadership Challenges

## Course Descriptions

At F&ES, new courses are often added after this bulletin is printed. Our website at <https://environment.yale.edu/courses> will have an updated list, as well as a list of environmental courses available in other departments at Yale. See also Yale Course Search at <https://courses.yale.edu>.

### Basic Knowledge

#### **F&ES 511a, Ecological Patterns and Processes** L. Kealoha Freidenburg

This course gives students a fundamental mechanistic understanding about the way abiotic (e.g., climate) and biotic (e.g., resources, competitors, predators) factors determine pattern in the distribution and abundance of species. Students learn how individuals within a species cope with changing environmental conditions by altering their behavior, making physiological adjustments, and changing the allocation of resources among survival, growth, and reproduction. Students learn how populations of species coexist within communities and how species interactions within communities can drive ecosystem functioning. Students also learn how ecologists use scientific insight to deal with emerging environmental problems such as protecting biodiversity, understanding the consequences of habitat loss on species diversity, and forecasting the effects of global climate change on species population viability and geographic distribution. 1½ Course cr

#### **F&ES 512a, Microeconomics for Environmental Management** Staff

This six-week course provides an introduction to microeconomic analysis and its application to environmental policy. Students study how markets work to allocate scarce resources. This includes consideration of how individuals and firms make decisions, and how policy analysts seek to quantify the benefits and costs of consumption and production. We consider the conditions under which markets are beneficial to society and when they fail. We see that market failure arises frequently in the context of environmental and natural resource management. The last part of the course focuses on the design of environmental and natural resource policies to address such market failures. The course is designed to cover basic knowledge of economics analysis and prepare students for F&ES 834 and other more advanced offerings. 1½ Course cr



**F&ES 521a, Physical Science Foundations for Environmental Managers**

Shimon Anisfeld

This required foundational course provides students with the physical science basics that they need in order to understand and manage environmental problems. The course draws on the following disciplines: climatology, environmental chemistry, geology, hydrology, meteorology, oceanography, and soil science. Focus is on understanding both the underlying concepts and how they apply to real-world environmental challenges. Useful both as a freestanding course and as a gateway to a wide spectrum of intermediate and advanced courses. 1½ Course cr

**F&ES 522a, Topics in Community Engagement** Amity Doolittle

This basic knowledge course is designed to introduce students to a range of sociocultural and political factors that drive the actions of individuals and communities surrounding natural resource management. In Part 1, Introduction to Social Science and Conservation, we explore basic questions such as: What is knowledge? What is nature? Students are introduced to the many disciplines that intersect environmental problems, and specific attention is placed on the field of political ecology. In Part 2, Justice and Indigenous Peoples, we learn the basic concepts of “justice” and discuss the ways in which climate change can be seen as a justice issue. We also explore the thorny issues of integrating local knowledge with scientific knowledge. In Part 3, Environmental Governance, we explore the role of the state and markets in shaping natural resource use. Concepts like property rights, the commons, and decentralization are introduced. Finally, in Part 4, Pulling It Together: Working with Communities, we discuss basic approaches to community-based, participatory research and how to integrate culture and livelihoods into conservation. 1½ Course cr

**Professional Skills Courses****F&ES 577b, PSC: Environmental Communicator** William Vance

This course prepares students for the communication tasks they will face as environmental professionals, researchers, or employees. In their careers, most professionals spend more than half their work time communicating with others, both inside and outside their organization. To advance in their careers and contribute to the progress of an environmental cause, students need a refined ability to communicate their ideas with clarity and credibility. This course focuses on building a constellation of skills that students can apply to their work. They learn how to use communication to influence others, advocate their ideas, and collaborate with colleagues on project teams. Course topics include strategy in communication, diplomatic language, public speaking, writing styles, listening to people, and framing environmental issues for the public. The course meets for a weekly two-hour lecture and demonstration, and students attend a one-hour small-group practice session that allows them to reinforce new communicative behaviors in simulated job tasks, such as project meetings, budget requests, and public hearings. Meeting dates to be determined. Enrollment limited to forty-five. 1 Course cr

**F&ES 578a, PSC: Financial Concepts for Environmental Managers** Maureen Burke

This course, which meets Oct. 21–Dec. 2, exposes students to the financial concepts used by companies to make and evaluate business decisions. The class covers key financial statements of for-profit businesses; building financial projections for a business, project, or investment; financial markets: what they are and how they

operate; investors: the tools they use to evaluate potential investments; and common valuation techniques: uses and limitations. 1 Course cr

## Perspectives

### **F&ES 601a, Perspectives: Bristol Bay/Pebble Mine** Julie Zimmerman

The course is intended to offer a common experience and exposure to the variety of perspectives represented by F&ES faculty and guest experts on the challenges and opportunities of environmental management. This year's theme is the case of Bristol Bay and the proposed Pebble Mine in Alaska. We spend the term pulling apart the case from a wide variety of lenses to understand the system dynamics at play, as well as possible leverage points. 3 Course cr

## Capstone

### **F&ES 953a or b, Business and the Environment Consulting Clinic** Maureen Burke

Students work as a team on a specific project for an external company. The course provides students with an opportunity to apply their knowledge of business and environmental issues to real-life situations. It also provides a unique opportunity for students to manage a real-life client consulting engagement. Examples of projects include (1) researching and recommending best practices in supply chain sourcing; (2) assessing water risk in a company's operations; and (3) recommending improvements around energy usage, waste disposal, etc. The intent is to provide a "capstone" experience, calling for the application of skills and tools learned from previous courses. Class sessions consist of a mix of in-class lectures, team meetings with the instructor, and guest lecturers. Lectures address topics such as project management and business strategy. Guest speakers discuss various environmental and sustainability topics such as sustainability reporting, and environmental certifications and labeling. Enrollment limited to twenty-four. Prerequisite for F&ES students applying to the clinic is at least one of the following courses (or equivalent experience): F&ES 578, F&ES 616, F&ES 636, F&ES 680, F&ES 807, F&ES 811, F&ES 821, or F&ES 874. 3 Course cr

### **F&ES 954a, Management Plans for Protected Areas** Mark Ashton

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 private smallholders within the Quiet Corner Initiative partnership managed by the Yale School Forests. In the past, plans have been completed for the Nature Conservancy; Massachusetts Trustees of Reservations; town land trusts; city parks and woodlands of New Haven, New York, and Boston; and the Appalachian Mountain Club. Ten days fieldwork. Enrollment limited to twenty. Prerequisite: F&ES 659 or permission of the instructor. 6 Course cr

### **F&ES 955a or b, Seminar in Research Analysis and Communication in Forest Ecology**

Mark Ashton

Students work through the peer-review publication process on data sets and projects in applied forest ecology. Discussions involve rationale and hypothesis testing for a project, data analysis techniques, reporting and interpretation of results. It is expected that manuscripts developed in the course are worthy of publication and that oral presentations are of a caliber for subject area conferences and meetings. Three hours lecture. Enrollment limited to twelve. Prerequisite: F&ES 659 or permission of the instructor. 3 Course cr

**F&ES 956b, Health Care Environmental Sustainability Practicum** Jodi Sherman

If the U.S. health care sector were a nation itself, it would rank thirteenth in the world for greenhouse gas emissions. Health care is an enormous and complex system, in need of environmental health assessment and sustainability science to measure and mitigate pollution and public health damages. Policy and business innovation is also essential to implement pollution preventive efforts while maintaining patient safety and quality care. In this course, interdisciplinary student teams perform applied public health or practice projects related to health care, sustainability science, and public health. Each team works with a clinical (physician or nurse) and/or management mentor from Yale New Haven Hospital or its affiliates, or in collaboration with partners such as the National Health Service Sustainable Development Unit of the United Kingdom. Each group uses the opportunity to apply concepts and competencies learned in the classroom to the field of health care. This course should be of interest to students from the Schools of Public Health, Forestry & Environmental Studies, Management, Medicine, and Nursing. This course is one of the options available to students to fulfill the practice requirement for the M.P.H. degree and the F&ES capstone requirement. 3 Course cr

**F&ES 959a or b, Clinic in Environmental/Climate Justice, Sustainability, and Public Health** Robert Dubrow, Laura Bozzi, and Marianne Lado

In this course, interdisciplinary student teams carry out applied public health research or practice projects in the areas of environmental/climate justice, climate change, sustainability, and public health. Each team works with a sponsoring organization (e.g., unit within Yale, local health department, state agency, community organization, other nongovernmental organization). The course affords the opportunity to apply concepts and competencies learned in the classroom to these important areas. It should be of interest to students across the University, from the Schools of Public Health and Forestry & Environmental Studies to Yale College juniors and seniors. In addition, it is one of the options available to Public Health students to fulfill the practice requirement for the M.P.H. degree. 3 Course cr

**F&ES 964b, Large-Scale Conservation: Integrating Science, Management, and Policy**  
Susan Clark

Environmental sustainability and human dignity are important societal goals, but figuring out how to achieve them on large scales – geographic, temporal, and in terms of complexity – has proven to be extremely challenging. Abundant trend data show that many species, ecosystems, and other environmental and human systems are being overused, stressed, or degraded, thus undercutting the likelihood that we can reach sustainability and human rights for all. In addition, our institutions for science, management, and policy are not designed to address sustainability challenges on these scales. Over the past few decades numerous management and policy initiatives have been put forward to address large-scale resource use, including single and multiple use, parks and protected areas, ecosystem management, bioregional planning, integrated conservation and development, transboundary approaches, and adaptive governance. This course (a mixed seminar and practicum) explicitly uses an integrative (i.e., interdisciplinary) framework to examine the conceptual and contextual basis for these efforts; compares and contrasts their scientific, management, and policy components; explores themes of leadership, problem solving, decision-making, governance, change, and learning; and surveys cases from three arenas (terrestrial, aquatic, and marine). The course takes a problem-oriented, contextual, and multi-method approach that offers students conceptual, practical, and professional benefits. It

includes readings, lectures, discussions, workshops, exercises, oral presentations, guest speakers, individual and small-group assignments, and possibly a field trip and group project. In past years the course has taken field trips to the Connecticut River system to evaluate region-wide conservation efforts, the Greater Yellowstone Ecosystem, and the Grand Canyon Ecosystem. It also organized an international workshop focused on the Yellowstone to Yukon initiative and assisted a major U.S. NGO plan for transboundary projects along the U.S.-Canadian border. Extensive student participation is required throughout. Enrollment limited to eighteen. 3 Course cr

**[ F&ES 965, Advanced Readings: Social Science of Conservation and Development ]**

This course is an advanced seminar on the social science theory of conservation and development, designed as an M.E.M. capstone course and to give M.E.Sc. and doctoral students a wider theoretical context for analyzing and writing up their research. The course traces the conceptual history of the social science theory of conservation and development, focusing on theories of power, governmentality, subject creation, and the economy. It examines relations between these theories, alternative theories, and how this history influences the field. The course covers the works of Michel Foucault most relevant to the field, important social scientists who have used Foucault's ideas (e.g., Timothy Mitchell, Tania Li, Donald Moore, David Mosse, Anand Pandian), alternative theories of power (e.g., James Scott, Bruno Latour, Timothy Mitchell), applications of Foucault's ideas to development (James Ferguson, Arturo Escobar), applications of Foucault's ideas to the environment (especially Arun Agrawal, Bruce Braun, Eric Darier), theories of the economic subject (Peter Miller and Ted O'Leary, Anna Tsing, Katherine Rankin), Foucault on the economy and neoliberalism, the power of the economy in Tania Li, theories of resistance and counter-conduct (Foucault, Carl Death, James Scott), and Foucault and space. Students are expected to use the course to develop, and present in class, their own research and writing. Three hours lecture/ seminar. Enrollment limited to twelve. Prerequisite: F&ES 839, F&ES 877, or F&ES 882. 3 Course cr

**F&ES 970a or b, Environmental Protection Clinic: Policy and Advocacy**

Douglas Kysar and Staff

The clinic's mission is to train students in environmental advocacy through skills-based seminars, interdisciplinary project work, and collaboration with the Natural Resources Defense Council and other significant environmental organizations. Students are assigned to teams of two-to-four members drawn from both the Law School and the School of Forestry & Environmental Studies. Teams work on a project developed in collaboration with client organizations, with most projects having both legal and policy components. In addition to covering substantive areas of environmental law, clinic seminars help students master the tools of effective environmental advocacy, including the abilities to research law and science, write and cite persuasively, navigate environmental organizations, and manage projects cooperatively. Enrollment limited to eighteen. For all questions, please e-mail [conor.reynolds@yale.edu](mailto:conor.reynolds@yale.edu). *Note:* Attendance at the first-class meeting is mandatory for admitted students and for those on the waiting list who wish to remain in consideration for admission if a place becomes available. Admitted students must confirm their participation in advance of the first class by a date designated by the instructors. A no-drop policy applies. Students in the School of Forestry & Environmental Studies (and students from any other school besides Yale Law School) must complete the clinic's Bidding Form by 4:30 p.m. on June 27. 3 Course cr

**F&ES 971b, Land Use Clinic** Jessica Bacher

This clinic explores a variety of specific community land use topics of current concern and relevance to the field, to the curriculum, and to society. Potential project topics include renewable energy, natural resources, rural-based land uses, the intersection of water and land management, agriculture, climate adaptation, and sustainable urban planning. Students work with the instructor to develop papers, research memorandums, presentations, and publications on a selected topic for a client. The average project requires 10–12 hours of work outside of class per week. The instructor and guest speakers lecture on specific skills and topics related to student projects during a weekly class meeting. Students select from a project list or meet with the instructor to design a relevant project at the beginning of the term. Attendance at the first class is mandatory to learn about project options. A part of the course is a one-week field trip during spring break. Enrollment limited to twelve, with priority given to F&ES students. Due to high demand, the course requires a short application. Students are selected during the fall term. 3 Course cr

**F&ES 972a or b, Advanced Environmental Protection Clinic** Douglas Kysar and Staff

Open only to students who have successfully completed the Environmental Protection Clinic (F&ES 970). No statement of interest required. Attendance at clinic seminar is optional. For all questions, please e-mail [conor.reynolds@yale.edu](mailto:conor.reynolds@yale.edu). Permission of the instructor required. 1 Course cr

**F&ES 973b, Capstone in Industrial Ecology** Reid Lifset

The industrial ecology specialization examines the relationships among production, consumption, sustainability, design, and industrial ecology in diverse settings, from products to firms to cities to international trade flows. This capstone course offers opportunities to student teams to work with sponsor organizations to apply industrial ecology-related methods, including life-cycle assessment, to practical problems facing the organization. In addition, students working independently join the class to learn more about project preparation and to share insight with other students interested in industrial ecology applications. 3 Course cr

**F&ES 980a, Social Justice in the Global Food System Capstone** Kristin Reynolds

This course explores social justice dimensions of today's globalized food system, considering justice in terms of sociopolitical and environmental dynamics. We connect theory and practice through work with community-based organizations working at the nexus of food, agriculture, and social justice. The capstone project work is grounded in food and social justice concepts examined through course materials and seminar discussions. We examine how governmental environmental strategies affect social equity in the food system at multiple scales. We discuss how land grabbing or food insecurity is connected to relative power on the global stage. We consider how phenomena such as structural violence and neoliberalization surface within the food system, and what this means for sustainability and justice – in urban and rural settings. We examine and debate concepts and practices including food sovereignty, agroecology, black agrarianism, and the right to food used to advance positive change. Through the capstone project, students have the opportunity to deepen learning and contribute to the work of community groups forging pathways for equity and justice in the food system, particularly among communities historically marginalized from mainstream economies and policy making. Project work includes meetings with organizational leaders to understand context and co-develop appropriate project approaches. Students work in groups to conduct in-depth research and analysis, and engage in additional

professional and educational activities connected to the project. Student groups prepare a final presentation and report to be shared with the partner organizations. The course provides opportunities to develop competencies in analyzing global food system phenomena through social justice frameworks, and working within diverse settings on food and social justice issues, as practice for management, policy making, and other professional roles. 3 Course cr

**F&ES 981b, Climate, Animal, Food, and Environmental Law and Policy Lab**

Douglas Kysar

Students in the CAFE Lab gain firsthand experience working with faculty, outside experts, and nongovernmental organizations to develop innovative law and policy initiatives to bring systemic change to the global food industry, which is one of the top contributors to climate change, animal suffering, human exploitation, and environmental degradation worldwide. The lab's mission is to devise and propagate novel legal and policy strategies to compel industrial food producers to pay the currently uncoupled, externalized costs of industrial agriculture for animals, workers, communities, and the environment. Students work in small teams on initiatives to create a more equitable food system. Potential projects for the CAFE Lab include developing legislative, regulatory, and litigation prototypes to reduce suffering of factory-farmed animals; stop physical abuse, labor violations, wage theft, and other methods of exploiting workers; require reporting and reduction of greenhouse gas emissions from industrial agriculture; hold corporations accountable for self-declared deadlines for climate, labor, and animal welfare reforms; remove legal barriers to sustainable alternatives products; and challenge false "humane," "sustainable," "green," "fair trade," or "environmentally friendly" marketing claims. The Lab is supervised by faculty with expertise in food, animal, climate, and environmental law and policy. Guest lecturers are drawn from the world of practitioners, scholars, journalists, legislators, farmers, corporate innovators, and other stakeholders. The CAFE Lab provides a creative space for students to develop and launch new prototypes each year that will be shared in open-source format with the express purpose of fostering imitation and adoption by a wide-ranging cross-section of nonprofit, government, and corporate leaders. Enrollment limited. Permission of instructors is required. 3 Course cr

**F&ES 983b, Water Resource Science and Management** Gaboury Benoit

This course is designed as the preferred option to fulfill the requirement of a capstone course within the M.E.M. specialization in Water Resource Science and Management. Students work under the instructor's direction, with advice from other water faculty, to develop management plans or other guidance documents supported by new or existing applied research. Students are trained in research methods so that they have useful background knowledge that will be essential in their future management careers. Topics emphasize real-world, interdisciplinary problems with possible immediate application. 3 Course cr

**F&ES 984b, Energy and Climate Change Policy Practicum** Dan Utech

This course provides an opportunity for students to apply knowledge and skills gained at F&ES to energy policy projects conducted for client organizations. At the outset of the course, students pair with client organizations (e.g., nongovernmental advocacy organizations, companies, etc.) to work on current energy policy projects for the remainder of the term. Students are presented with a menu of potential projects; they may also propose organizations and projects, subject to approval by the instructor. Students work in groups or individually, depending on the nature of the project.

They are expected to work ten hours per week on their projects, including weekly discussions with clients and with the instructor. After choosing a project, students work with clients to prepare and submit a work plan. Over the remainder of the term, they work directly with clients to produce project-specific products, such as draft legislation or regulations, policy briefs, analytic studies, or white papers. Students submit a portfolio of these project products for evaluation during the reading period. In addition, student performance is evaluated based on project work plans, as well as summary presentations made during the final weeks of class. Project-related work comprises the bulk of the course, but is supplemented by guest lectures and discussion with the instructor. 3 Course cr

**F&ES 985b, Capstone: Urban, Suburban, and Regional Planning Practice** David Kooris

This capstone course provides an opportunity for students to apply the theory of practice developed in F&ES 817 to a real-world, local project for a public- or civic-sector client as part of an interdisciplinary student team. One or two teams of four or five students each work together, focusing on a critical neighborhood of New Haven or a nearby municipality. The emphasis in each location is on identifying and overcoming the tensions and conflicts between economic, social, and environmental objectives to develop a balanced strategy for the neighborhood that meets stakeholders' goals within the context of overarching regional, national, and even global challenges and opportunities (e.g., climate change and demographic shifts). Toward that end, students are exposed to the detailed process of local government and decision-making as well as techniques used by city planners to collect and assess data and utilize that information coupled with stakeholder engagement to develop tools to help the community achieve its vision. With a focus on interdisciplinary problem solving and the collective project management resulting in a client-driven work product, students learn valuable skills for their future careers. 3 Course cr

## Ecology

### COMMUNITY AND ECOSYSTEM ECOLOGY

**F&ES 530a, Ecosystems and Landscapes** Mark Bradford

This course is an introduction to concepts in ecosystem and landscape ecology. Topics covered include biogeochemical cycling, food web interactions, biodiversity, and the abiotic and biotic controls that act on them. The course emphasizes how to integrate this knowledge to understand and manage natural systems so they continue to serve their own and human needs. 3 Course cr

**F&ES 629b, North American Drylands: Ecology and Land Use** William Lauenroth

The first half of the course consists of lectures about the causes of the geographic distribution of North American drylands and their ecology. The second half consists of reading and discussing scientific papers about past, present, and future land use. Students lead the discussions. While we cover the breadth of drylands, in the second half we emphasize ecosystems in which big sagebrush is the dominant plant species. Enrollment limited to twelve. 3 Course cr

**F&ES 681a, Ethnobotany** Ina Vandebroek

The objective of this course is to introduce students to the interdisciplinary nature of ethnobotany studies from the perspective of a field researcher, aiming to highlight the methods used in ethnobotanical research and to showcase the diversity of contemporary field studies in ethnobotany. Topics discussed encompass changing

traditional knowledge systems, community-based resource management, conservation of biocultural diversity, migration and urbanization, smallholder tropical agriculture and traditional food plants, and community health. Classes combine PowerPoint lectures around key topics and group discussion of selected scientific readings. Guest lectures by invited scientists allow students to learn first-hand about ongoing research projects. This is an interactive course with students expected to actively participate in class and discuss the readings listed each week in group, in moderator-audience style. Each week, two rotating students serve as moderators. Class discussion of readings focuses on the critical reflection of the research questions and/or methods used by the authors, experimental study design (when applicable), the main findings of the papers, as well as the conclusions inferred by the authors. To broaden and deepen class discussion, students are expected to actively peruse papers in ethnobotanical journals such as the *Journal of Ethnobiology and Ethnomedicine*, *Economic Botany*, *Journal of Ethnobiology*, *Human Ecology*, *Ethnobiology and Conservation*, *Journal of Ethnopharmacology*, and related journals to find other papers on the topics discussed. 3 Course cr

**F&ES 717b, Tropical Field Ecology** Liza Comita and Simon Queenborough

This course is designed to give students firsthand knowledge of tropical biology and the issues surrounding conservation of biodiversity in a developing nation, through a combination of seminar-style discussions and a mandatory twelve-day field trip over winter break. The emphasis is on active learning and developing independent research projects carried out during the field trip. Using a case-study approach, topics covered include patterns of biodiversity, tropical forest dynamics, reforestation, species interactions and coevolution, climate change impacts, ecosystem services, and human land use. Students also gain experience with study design, data collection methods, and statistical analysis. This year's field trip is to Panama, a country famous for its high biological, cultural, and economic diversity. We visit a variety of forest ecosystems and hear from local and international scientists about current research in the field. Students undertake two short research projects and also learn basic identification and natural history of tropical plant, bird, and insect species. Students should expect to spend a major part of each day outside in the natural tropical environment under adverse conditions. Enrollment limited to fifteen, with a course application due early in the fall term. Priority is given to students planning to conduct field research in the tropics. Prerequisite: F&ES 752. 3 Course cr

**F&ES 723a, Wetlands Ecology, Conservation, and Management**

L. Kealoha Freidenburg

Wetlands are ubiquitous. Collectively they cover 370,000 square miles in the United States and globally encompass more than five million square miles. Most points on a map are less than one kilometer from the nearest wetland. Yet wetlands are nearly invisible to most people. In this course we explore wetlands in all of their dimensions, including the critical services they provide to other systems, the rich biodiversity they harbor, and the links by which they connect to other systems. Additionally, wetlands are linchpin environments for scientific policy and regulation. The overarching aim of the course is to connect what we know about wetlands from a scientific perspective to the ways in which wetlands matter for people. 3 Course cr

**[ F&ES 731, Tropical Field Botany ]**

This course teaches students how to identify the most important tropical plant families, with an emphasis on woody taxa. Students learn key characteristics for identification.



We concentrate on families that have high economic, ecological, or ethnobotanical importance. We also discuss distribution, habitat, and ecology. The course has a strong practical component, and instructors emphasize vegetative characters to identify families and higher-level taxa. The course includes a two-week field trip to Costa Rica over spring break. Enrollment limited to twelve. 3 Course cr

**[ F&ES 741, Ecosystem Measurements for Conservation and Restoration ]**

This course is intended to expose students to a variety of field and laboratory methods used in conservation science. During the first half of the term, students gain experience in a broad range of field and lab methods and analysis with applied conservation relevance (e.g., carbon stocks, biodiversity). The second half of the term is a practicum where students design, conduct, analyze, and present data as a rapid assessment of a local property of interest to local conservation organization(s). 3 Course cr

**F&ES 752a, Ecology and Conservation of Tropical Forests** Liza Comita

Tropical forests contain extraordinarily high biological diversity and provide critical ecosystem services, yet are being rapidly destroyed and degraded by human activities. This course focuses on the structure, function, and diversity of intact and degraded tropical forests, with an emphasis on the ecological processes that shape these unique and diverse ecosystems. We also discuss the major threats to tropical forests, as well as examples of tropical forest recovery following disturbance. The course involves a mix of lectures and student-led discussions. Students who successfully complete this course are given priority for F&ES 717. 3 Course cr

**ENVIRONMENTAL EDUCATION AND COMMUNICATION**

**F&ES 592a or b, Documentary Film Workshop** Charles Musser

This workshop in audiovisual scholarship explores ways to present research through the moving image. Students work within a Public Humanities framework to make a documentary that draws on their disciplinary fields of study. Designed to fulfill requirements for the M.A. with a concentration in Public Humanities. 3 Course cr

**F&ES 595a, Yale Environment Review** Matthew Kotchen

The *Yale Environment Review* is a student-run publication that aims to increase access to the latest developments in environmental studies. We aim to shed light on cutting-edge environmental research through summaries, analysis, and interviews. Students produce one or two articles on subjects of their choosing for publication on the *YER* website. Please refer to our Canvas page for an overview of the different types of content that *YER* produces. Students receive coaching to improve their writing skills, and their work goes through a rigorous editing process. Participation in *Yale Environment Review* helps students sharpen their writing skills and familiarize themselves with science communication, and it provides a platform to showcase their expertise. Enrollment is limited to sixteen, and the class is selected through an application process. Application instructions can be found on our Canvas page and will be discussed during the information session on Aug. 29. Applications are due by Sept. 3 at 11:59 p.m. Please e-mail [environment.review@yale.edu](mailto:environment.review@yale.edu) with any questions. 1 Course cr

**F&ES 603b, Environmental Data Visualization and Communication**

Simon Queenborough and Jennifer Marlon

Welcome to the Information Age. Data production is growing at 50 percent per year, or more than doubling every two years. We are not only producing more data from existing sources, we are also constantly creating entirely new streams of data, whether statistical, text, audio, video, sensor, or biometric. Yet our ability to access, manage,

understand, and synthesize all this data is extremely limited. Visualization is a powerful means of enhancing our cognitive abilities to learn from data, especially when informed by insights into human behavior and social systems. While developing the quantitative skills necessary for analyzing Big Data is important, understanding how to effectively explore and communicate insights from data—whether big or small—is equally essential for policy makers, researchers, and practitioners alike. 3 Course cr

**F&ES 613b, Writing as a Public Scholar** Stephanie Hanes Wilson

Environmental scholars and practitioners increasingly recognize the need, and often have the desire, to communicate their passions and expertise to a wide lay audience. The seminar starts from the premise that to do this effectively requires a mastery of written storytelling, particularly in today’s saturated and fractured media landscape. Students read popular works by classic and contemporary scholars, such as Rachel Carson and Richard Prum; practitioners in the sciences, such as Atul Gawande and Peter Wohlleben; and journalists such as Elizabeth Kolbert and John McPhee; as well as a growing number of authors, such as Bill McKibben, whose work crosses these categories. Students analyze some pieces multiple times, developing an increasingly nuanced understanding of storytelling technique. 3 Course cr

**F&ES 625b, Writing Workshop** Roger Cohn

This is a practical course aimed at helping students improve their writing. The goal is not to try to shape students into professional writers, but rather to develop their writing skills and make them better able to communicate their work and ideas through writing that is clear, accessible, and free of jargon. Students are required to write short pieces each week and have the option of writing one longer article. The class is organized as a workshop, with students reading and commenting on each other’s work. The instructor is available for weekly meetings with students to discuss their writing. There are regular readings of articles or short book selections, but the focus is on developing the students’ own writing. Students are evaluated on the completion of all assignments on time; the quality of their work; the progress their writing shows over the course of the term; and participation in discussions. 3 Course cr

**F&ES 719a, Making Climate Knowledge** Deborah Coen

This is a course about *how* humans have come to know what we know about our impacts on the earth’s climate and our vulnerability to climate change. This historical question is pivotal to thinking about who bears moral responsibility for the climate crisis. At what point in history did humans become the first species to alter the conditions of life on earth in full consciousness of the consequences of their actions? When did people first *know* that their actions, in the aggregate, could transform the planet? At what point did their knowledge outweigh their uncertainty? Did scientists bear responsibility to warn of these consequences? What evidence did their knowledge rest on? In what ways has the modern science of climate both appropriated and undermined traditional and indigenous forms of climate knowledge? What makes modern climate science “modern”? 3 Course cr

**F&ES 742b, Fundamentals of Working with People** Bradford Gentry and Stuart DeCew

Using environmental science to help inform and change human actions is a key challenge for environmental managers. Doing so requires that professionals be able to work across different scales, including: (1) understanding their own values and ways of working, as well as those of others; (2) forming, working in, and leading teams reflecting a diversity of experiences and skills; (3) influencing the actions of

the organizations within which they are working; and (4) building and managing collaborative networks with others in other organizations affecting the resource systems about which they care. The purpose of this course is to introduce students to the scholarship being done (mostly within management fields) on how best to make these connections, as well as the ways individuals are putting those lessons learned into action. The course also introduces students to the professors, individual courses, workshops, and other offerings across Yale that offer deeper dives into specific approaches to working more effectively with people. 3 Course cr

**F&ES 743b, Strategic Environmental Communication** Anthony Leiserowitz  
Increasing economic prosperity and improving the lives of an estimated ten billion people while maintaining and restoring the life-support systems of the planet is the ultimate challenge of the twenty-first century, often labeled “sustainability.” Organizations of all kinds will play important roles in this historic transition and must operate and succeed in ever-more complex and often contested social, cultural, political, and natural environments. Strategic communication is a powerful means of achieving an organization’s mission, especially when informed by insights into human behavior and social systems. By the end of this course, students are able to develop communication strategies and apply insights from the social and behavioral sciences to improve the effectiveness of their communication campaigns. Enrollment limited to twelve. 3 Course cr

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

**F&ES 750a, Writing the World** Verlyn Klinkenborg  
This is a practical writing course meant to develop the student’s skills as a writer. But its real subject is perception and the writer’s authority – the relationship between what you notice in the world around you and what, culturally speaking, you are allowed to notice. What you write during the term is driven entirely by your own interest and attention. How you write is the question at hand. We explore the overlapping habitats of language – present and past – and the natural environment. And, to a lesser extent, we explore the character of persuasion in environmental themes. Every member of the class writes every week, and we all read what everyone writes every week. It makes no difference whether you are a would-be journalist, scientist, environmental advocate, or policy maker. The goal is to rework your writing and sharpen your perceptions, both sensory and intellectual. Enrollment limited to fifteen. 3 Course cr

**F&ES 822a, Strategic Communication: Delivering Effective Presentations** Taly Reich

The focus of this half-term course is to increase students' competencies in oral communication and presentation. Developing and executing effective communication strategies is essential in a variety of business settings. Business leaders are often expected to present their message with confidence and clarity to employees, clients, partners, investors, and the public. This highly interactive, practical course helps students develop confidence in public speaking through weekly presentations and assignments, lectures and discussions, guest speakers, simulated activities, and filmed feedback. Students are given the opportunity to present both individually and as part of a team. We explore the essentials of communication strategy and persuasion: audience analysis, message construction, communicator credibility, and delivery. Students at all levels of mastery of public speaking will benefit from this course. Limited enrollment. F&ES students must submit a statement of interest to the instructor. Students are required to attend the first class session in order to remain enrolled in or bid for the course. 1½ Course cr

**[ F&ES 862, The Science of Science Communication ]**

The simple dissemination of valid scientific knowledge does not guarantee it will be recognized by non-experts to whom it is of consequence. The science of science communication is an emerging, multidisciplinary field that investigates the processes that enable ordinary citizens to form beliefs consistent with the best available scientific evidence, the conditions that impede the formation of such beliefs, and the strategies that can be employed to avoid or ameliorate such conditions. This seminar surveys and makes a modest attempt to systematize the growing body of work in this area. Special attention is paid to identifying the distinctive communication dynamics of the diverse contexts in which non-experts engage scientific information, including electoral politics, governmental policy making, and personal health decision-making. Paper required. Permission of the instructor required. 3 Course cr

**F&ES 900a, Doctoral Student Seminar and Responsible Conduct of Research**

Oswald Schmitz

This course provides the foundation for doctoral study at the School of Forestry & Environmental Studies. Students learn what it means to do scholarly research as well as become adept with philosophy of science and research methodology and proposal writing, as a basis for exploring diverse approaches to formulating and addressing research questions. Students work with their advisers to put these concepts and principles into practice to develop the basis for their dissertation research (including building bibliography, identifying and crafting research questions, formulating research hypotheses, and drafting a research proposal). Students further learn about funding opportunities and procedures for submitting grants. The course also covers professional ethics and responsible conduct of research, including ethical approaches to inquiry and measurement, data acquisition and management, authorship and publication, peer review, conflicts of interest, mentoring, collaborative research, and animal and human subjects research. Finally, the course explores ethical ways to advocate for the application of scholarly knowledge in the interest of environmental problem solving. Weekly assigned readings support concepts and issues addressed in class. Students present their embryonic research ideas in class and use feedback from the group to further develop their ideas. 3 Course cr

**F&ES 910b, Survival Skills for Finishing Doctoral Students** William Lauenroth and Ingrid Burke

This course is aimed at preparing advanced doctoral students for successful and rewarding careers in ecology and environmental science. Students learn about academic and non-academic careers from readings of and presentations by scientists in those positions. Students identify important steps toward planning and launching their career paths, and skills for being effective in these positions; and they develop their own career plan, curriculum vitae, teaching and research plans, and critiques of professional webpages. Finally, the course exposes students to resources and opportunities for continuing to apply and polish their skills. Pass/Fail. 1 Course cr

## Forestry

### FOREST BIOLOGY

**[ F&ES 652, Wood: Structure and Function ]**

This course focuses on the extraordinary diversity of wood anatomy at the cellular level, and on the practice of dendrochronology that allows students to take advantage of predictable, inter-annual variability in tree growth to reconstruct environmental history. The primary focus of the course is on common northeastern trees and other commercially important timber species. A primary goal is to participate in the development of a master tree-ring chronology for the School Forests. Prerequisites: basic statistics and a background in tree physiology and anatomy are strongly recommended. 3 Course cr

**F&ES 654a, Structure, Function, and Development of Trees** Graeme Berlyn

This course focuses on two aspects of plant life: (1) basic processes that drive plant development, such as seed formation, germination, seedling establishment, maturation, and senescence; and (2) basic structure and function of plants (such as root systems, leaf formation and development, height, and diameter growth). Differences between different groups of seed plants are analyzed from structural, functional, ecological, and evolutionary standpoints. Special attention is given to woody plants and their importance in the biosphere and human life. Coverage includes tropical, temperate, and boreal trees. Plant biology is discussed in the context of physiological and structural adaptations in terms of strength, storage, and water and solute transport. 3 Course cr

**F&ES 656b, Tree Physiology and Ecophysiology** Graeme Berlyn

Mineral nutrition and cycling, mycorrhizas, symbiosis, nitrogen fixation, light processing, photosynthesis, respiration, water relations including transpiration, and ecophysiology are covered. The interaction of photosynthesis with water relations, mineral nutrition, temperature, and environmental stress is discussed. Effects of climate changes on forests, past and present, and other current topics are also considered. Term paper required. 3 Course cr

**F&ES 671a, Temperate Woody Plant Taxonomy and Dendrology** Marlyse Duguid

Dendrology literally translates as “the study of trees” and integrates morphology, phenology, ecology, biogeography, and the natural history of tree species. In this course students learn how to identify more than 120 individual species of woody plants using common morphological and ecological traits used for field identification. Dendrology is by nature context-specific, so this course has a focus on North American forest species, primarily of eastern North America. In addition, we use phylogenetic systematics as the

structure for understanding taxonomy and the evolutionary history and relationships between species. Enrollment limited to thirteen. 3 Course cr

### **F&ES 674b, Seminar in Forest Ecosystem Health and Climate Adaptation**

Mark Ashton

This course is an introduction to the biotic and abiotic agents affecting the health of forest ecosystems and forest sustainability, including insects, pathogens, parasites, climate change, and other large-scale disturbances, and includes the consideration of linkages between forest health and human health. Using a case-study approach, several different forest types are examined in detail, with students interacting with research and management professionals who visit the class in person or via remote conferencing. Students learn concepts and methods of assessing forest health, as well as some of the challenges in describing and defining forest health. The course emphasizes the ecological roles played by disturbance agents (both biotic and abiotic), discusses how they affect the health and sustainability of forest ecosystems, and identifies when and how management can be used to improve forest health and/or forest sustainability to manage or mitigate disturbance agents such as invasive pathogens and insects. The course provides students with the necessary background to determine how different stressors may negatively impact management objectives, to identify the probable stress agents, and to decide what, if any, actions should be initiated to protect forest health and sustainability. The course includes several field trips and workshops on the weekends. 3 Course cr

### **[ F&ES 679, Plant Ecophysiology ]**

This course focuses on the physiological ecology of plants and their interaction with the biotic and abiotic environment, understood through the lens of first principles. We use a quantitative approach to demonstrate the linkages between photosynthesis, growth, and carbon allocation at the tissue and whole plant level, which can then be scaled up to forests and ecosystems. We also focus on specific physiological and anatomical adaptations plants use to survive in the many varied habitats on Earth. The laboratory component of this course (F&ES 679L) involves the theory, programming, and deployment of micrometeorological equipment to monitor environmental conditions in the field; as well as methods for measuring photosynthesis and growth in the greenhouse and field. Enrollment limited to sixteen. 3 Course cr

### **[ F&ES 679L, Lab: Plant Ecophysiology ]**

Lab for F&ES 679. 1 Course cr

### **F&ES 694b, The Ecology, Economics, and Politics of Species Invasion**

Marlyse Duguid

Humans are moving species outside of their native ranges at unprecedented rates, and the resulting biological invasions present challenges for ecologists, conservationists, and policy makers alike. Through course readings, in-class discussions, and debates, students learn to critically assess contemporary conservation and policy decisions regarding the regulation and management of nonnative species using information gained from the ecological study of biological invasions. We explore the major scientific questions in biological invasions—including “What makes a species invasive?” and “What makes a habitat invadable?”—as well as more nuanced questions of how invasive species interact with native and other invasive species and how these interactions alter ecological consequences of biological invasions. Throughout the term we discuss how invasion biology research informs policy decisions, assessing relevant policy questions such as “Should biocontrol agents be used against species invasions?” or “Should

we eat invasive species to control their abundance?” This course is appropriate for graduate students (master’s and Ph.D.) interested in learning how species introductions and anthropogenic change interact on a global scale, and how to use the science of species invasions to inform policy and management decisions. By the end of the course, students have gained a solid background in the ecology and social dimensions of biological invasions. 2 Course cr

#### FOREST MANAGEMENT

##### **F&ES 653b, Maple: From Tree to Table** Joseph Orefice

This course covers the cultural, industrial, and sustainable practices of nontimber forest products through the lens of maple sap and syrup. Maple sugar is a forest product unique to northeastern North America, and it has seen a resurgence in interest as global consumers seek nutritious, natural, and sustainably produced foods. This course covers the booming industry and culture around maple syrup, from backyard operations through modern 100,000-tap investment operations. Maple producers are on the front lines of climate change and forest health threats. The course provides students with the knowledge of how challenges related to forest health and climate change are directly impacting maple producers and how these producers are learning to adapt in ways that are environmentally friendly, ecologically sound, and financially competitive in a global market. 1 Course cr

##### **F&ES 658a, Global Resources and the Environment** Chadwick Oliver

Students first learn the global distribution of resources—the amounts, importance, and causes of distribution, and potential changes to soils, water, biodiversity, human societies, energy sources, climates, agriculture, forests and forest products, minerals, and disturbances. They also learn how to analyze and interpret data on global resource distributions. Second, they gain an understanding of the value of multiple-country trading of resources. Third, they gain an understanding of the many mechanisms that facilitate such exchanges, including policies and treaties; business, markets, trading partners, and economics; “good will”; social “taboos”; force; news media; philanthropy; skillful negotiations; cultural/social affiliation; technologies; shared infrastructures; and others. Four teaching methods are used: lectures on the different resources and policy mechanisms; analytical exercises for understanding how to use and interpret international data—and its limitations; a class negotiation exercise for learning the uses of international trade; and guest lectures by faculty and meetings with practitioners for learning the facilitation mechanisms. Three hours lecture; possible field trips. 3 Course cr

##### **F&ES 659b, The Practice of Silviculture: Principles in Applied Forest Ecology**

Mark Ashton

The scientific principles and techniques of controlling, protecting, and restoring the regeneration, composition, and growth of natural forest vegetation and its plantation and agroforestry analogs worldwide. Analysis of biological and socioeconomic problems affecting specific forest stands and design of silvicultural systems to solve these problems. Applications are discussed for management of wildlife habitat, bioenergy and carbon sequestration, water resources, urban environments, timber and nontimber products, and landscape design. Four to six hours lecture. One hour tutorial. Seven days fieldwork. Recommended: some knowledge of soils, ecology, plant physiology, human behavior, and resource economics. 4 Course cr

**[ F&ES 660, Forest Stand Dynamics ]**

This course introduces the study of forest stand dynamics—how forest structures and compositions change over time with growth and disturbances. Understanding the dynamic nature of forest stands is important for creating and maintaining a variety of critical ecosystem services sustainably and synergistically, including sustainable supplies of wood products, biodiversity and wildlife habitats, water, fire protection, and others. Through readings, lectures, discussions, and field trips we explore forest development processes and pathways, concentrating on the driving mechanisms and emergent properties including natural and human disturbances. We make use of New England forests as living laboratories while discussing how similar forest patterns and processes are played out throughout the temperate, tropical, and boreal worlds. The course also provides context on the history and politics of forest ecology and conservation. It uses a book written by the instructor (*Forest Stand Dynamics*, 1996) and made available electronically. This class is a core component of the M.F. degree but is explicitly designed to be accessible to anyone interested in an in-depth exploration of forest ecosystems. 3 Course cr

**[ F&ES 668, Field Trips in Forest Resource Management and Silviculture ]**

Seven- to twelve-day field trips to study the silviculture and forest management of particular forest regions. In previous years, classes have visited Slovenia, Germany, Austria, the United Kingdom, British Columbia, and, in the United States, the southern Coastal Plain and Piedmont, and the Allegheny, Appalachian, Adirondack, and Green mountains. Enrollment limited to sixteen. 1 Course cr

**F&ES 669b, Forest Management Operations for Professional Foresters**

Michael Ferrucci

The operational aspects of managing forestland are taught, including topics essential to the professional practice of forest management. Operational aspects of regeneration, intermediate tending, and harvesting (planning, layout, implementation, and postoperation evaluation), best management practices, regulatory and wetlands considerations, and socioeconomic dimensions of field operations are included. The ethical and professional responsibilities of forest managers who are responsible for land-altering activities are also considered. The course includes field time to help students utilize their existing knowledge about forests to rapidly assess stands and land parcels with respect to the planning and implementation of on-the-ground treatments. Classes feature local field trips to view forestry operations and to develop and refine field skills. Students who take this class for credit have priority for selection for F&ES 670 for 1 additional credit. This trip is scheduled for the first week of March break and involves an intensive view of southern forest management and culture, including silviculture, harvesting, processing, and other management operations. Prerequisite: any silviculture course. 2 Course cr

**[ F&ES 670, Southern Forest and Forestry Field Trip ]**

This course augments our forestry curriculum by providing a forum for viewing and discussing forestry and forest management with practitioners. The trip provides M.F. candidates and other interested students with an opportunity to experience the diversity of southeastern forested ecosystems and ownership objectives ranging from intensively managed pine plantations to restoration and protection of endangered habitats. Students discuss forest management issues—including forest health, fragmentation, policy, law, and business perspectives—with landowners and managers from large industries, nonindustrial private landowners, TIMOs, federal and state land managers,



NGOs, and forestry consultants. We also tour sawmills, paper mills, and other kinds of forest products processing facilities, active logging operations, and, weather permitting, participate on prescribed fires. Not least, we experience the unique cultures, food, and hospitality of the southeastern United States. The course can be taken for 1 credit by any student at F&ES or combined with the 2-credit Forest Management Operations (F&ES 669) for 3 credits. Applications for the course are done in December.

1 Course cr

**F&ES 680a, Ecosystem Finance** Dominick Grant and Deborah Spalding

Understanding the tools used in financial analysis is an important component of successful investment in the emerging field of ecosystem services. This course provides students with a basic suite of financial tools used in the acquisition and management of ecosystem investments. It includes an overview of traditional financial analysis metrics as well as an exposure to the established and emerging markets and financing schemes in the field of ecosystem investments. Concepts are reinforced through spreadsheet-based exercises, case studies, and guest speakers. Each week, one class session is devoted to concepts; the second session is devoted to applying these concepts by analyzing a real-world deal, case study, or investment strategy, often presented by a guest speaker who is a professional in the field. Prerequisite: F&ES 578 or permission of the instructor. 1½ Course cr

**F&ES 683b, Seminar in Tropical Forest Restoration in Human-Dominated Landscapes** Staff

This seminar is focused on the biological and social science, management, and policy governing reforestation in tropical regions. Topics covered include the ecology and management of native species plantations and second-growth forests; the social drivers and barriers of restoration; and the methodological protocols of gathering and assessing social, economic, and cultural values. A particular emphasis is placed on tropical Asia and Latin America. Part of this course is taught online, part in a series of weekly discussions. Optional 1-credit field trip on dry tropical forest restoration, Azuero, Panama. Enrollment limited to twenty. Prerequisite: F&ES 659. 3 Course cr

**F&ES 684a, Forest Finance** Dominick Grant and Deborah Spalding

Understanding the tools used in financial analysis is an important component of successful forestland investment and forest management decision-making. This course provides students with a basic suite of financial tools used in the acquisition and management of forestland/timber. It includes an overview of traditional financial analysis metrics used in land acquisition, timber management, and risk management, and emerging trends in forestland investing. Concepts are reinforced through spreadsheet-based exercises, case studies, and guest speakers. Each week, one class session is devoted to concepts; the second session is devoted to applying these concepts by analyzing a real-world deal, case study, or investment strategy, often presented by a guest speaker who is a professional in the field. 1½ Course cr

**F&ES 688b, Forested Management and Landscape Planning** Joseph Orefice

The format of the first half of this course is a weekly one-hour lecture reinforced by an experiential three-hour lab. The second half is seminar-style, with guest speakers and additional time for one-on-one assistance with projects. Students are required to work in groups of two or three to complete a final project related to landscape-scale forest planning and management in the broadest sense. Options for the final project geographic location and management objectives are variable to allow students to dovetail their project with their own educational and professional aspirations.

Examples are taken from public land management issues in the West, industrial timberland planning in the East, conservation planning and sustainable community development in the tropics, and cityscape planning of parks, woodlands, and street trees. 3 Course cr

**F&ES 692a, Science and Practice of Temperate Agroforestry** Joseph Orefice

This course explores the science and practices of temperate agroforestry, covering current knowledge of agroforestry science and shedding light on the myths and assumptions that have yet to be tested regarding the integration of trees in agricultural systems. The course begins with an overview of modern agriculture to help us better understand why agroforestry systems have potential to improve the sustainability of farming systems. We also cover the social science regarding agroforestry and why it has not been widely adopted. Silvopasture and forest farming systems are the primary focus, but windbreaks, alley cropping, and riparian forest buffers are also covered. The field of agroforestry has struggled with the promotion of hypothetical practices; this course introduces students to real-world production agroforestry systems and helps them better contribute to financially viable and environmentally sound agricultural operations. 3 Course cr

## Physical Sciences

### ATMOSPHERIC SCIENCES

**F&ES 608a, Air Pollution and Public Health** Krystal Pollitt

Exposure to air pollution is a leading contributor to the global disease burden. This course discusses major emission sources, atmospheric transformation and transport, measurement and modeling techniques for human exposure assessment, and the health impacts of air pollutants. Emphasis is placed on students gaining hands-on experience with measurement (e.g., low-cost sensors, passive samplers) and spatial analysis tools (e.g., ArcGIS) for application to research, public health practice, and community engagement. Through a series of laboratory sessions, students quantitatively characterize indoor and outdoor exposure concentrations and learn methods to critically assess data quality. The public health implications of air pollutant exposure are examined through review of recent epidemiological and toxicological research. The course discusses inequitable distribution of air pollutant exposure across the United States in relation to environmental health disparities. The health benefits of air pollutant intervention strategies in developed and developing regions and implications for public action are also covered. 3 Course cr

**F&ES 630b, The Physical Science of Climate Change** Staff

This course covers the science behind Earth's climate system. The first part of the course entails understanding the components of Earth's climate, including the chemical and physical atmosphere and the role of land, ice, and the oceans in regulating global climate. The second half takes a closer look at how Earth's climate system impacts global sustainable boundaries, including its impact on ecosystems, water resources, the built environment, human health, and the global food system. During the first half of the course students are expected to complete weekly homework assignments that reinforce class concepts and perform a guided analysis using a climate model. The second half of the course involves project work on the impact of climate on a system (e.g., ecosystem, water resource, community, health, etc.). 3 Course cr

**F&ES 700b, Alpine, Arctic, and Boreal Ecosystems Seminar** Graeme Berlyn  
Biogeoclimatic analysis of these systems worldwide with special attention to biogeography, biometeorology, physiology, histology, morphology, autecology, and silviculture of high-elevation and high-latitude forests through lectures, guest lectures and discussions, student seminars, and field experience. 3 Course cr

**F&ES 718b, Climate Change Seminar** Peter Raymond  
Critically reading the scientific literature is a key skill set for a scientific career. So is interacting with scientists during seminars and meetings. The goal of this class is to provide opportunities to improve these skills, while gaining competence in climate change science through reading a core set of papers. The class meets Wednesdays at 2:30 to interact with experts and a second TBD time to discuss the papers. During the TBD class we critically discuss a paper by an expert in the field. On Wednesday, we Skype that person in for a short presentation on the paper and then a discussion with the class. The speakers have a broad range of experience and are at different points in their careers; the close of discussion is reserved for questions on the scientific process and career advice. There is a wide range of topics, such as permafrost vulnerability, sea-level rise, ice sheet dynamics, and ocean acidification. 3 Course cr

#### ENVIRONMENTAL CHEMISTRY

##### [ F&ES 706, Organic Pollutants in the Environment ]

An overview of the pollution problems posed by toxic organic chemicals, including petroleum, pesticides, PCBs, dioxins, chlorinated solvents, and emerging contaminants. Processes governing the environmental fate of organic pollutants, e.g., evaporation, bioconcentration, sorption, biodegradation. Technologies for prevention and remediation of organic pollution. Previous experience with organic chemistry is not required. 3 Course cr

##### [ F&ES 707, Aquatic Chemistry ]

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. 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 is also presented. 3 Course cr

##### [ F&ES 708, Introduction to Environmental Chemistry ]

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 sometimes may find it necessary to make decisions based on knowledge of environmental chemistry. 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 sources, behavior, toxicity, and fate. Topics include the fundamental kinds of chemical reactions in the environment, critical analysis of chemical data, sampling techniques, analytical methods, natural biogeochemical controls on environmental chemistry, water treatment, and green infrastructure, as well as detailed examination of such contaminants as acid precipitation, nutrients, urban runoff, and sewage. Three hours lecture. One class project, problem sets, midterm,

final exam. A small number of field trips. Prerequisite: college-level general chemistry.  
3 Course cr

[ **F&ES 773, Air Pollution Control** ]

An overview of air quality problems worldwide with a focus on emissions, chemistry, transport, and other processes that govern dynamic behavior in the atmosphere. Quantitative assessment of the determining factors of air pollution (e.g., transportation and other combustion-related sources, chemical transformations, climate change, photochemical “smog,” pollutant measurement techniques, and air quality management strategies. 3 Course cr

**SOIL SCIENCE**

**F&ES 709b, Lectures, Discussions, and Applications of Soil Science** Mark Bradford  
Topics cover the structure and functioning of soils, and how this relates to soil fertility, carbon accounting, climate feedbacks, and ecosystem health in a changing environment. Prerequisite: F&ES 521 or permission of the instructor. 3 Course cr

**WATER RESOURCES**

**F&ES 710b, Coastal Governance** Richard Burroughs  
Effective governance combines a basic understanding of natural systems with human values to create new coastal institutions. Single-use regulations of the past (energy, wastewater, ports, marsh conservation) are being replaced by more holistic thinking (spatial management and/or ecosystem-based management). To understand the state of this transition, policy analysis frameworks are applied to sector-based and ecosystem-based management initiatives. Term projects allow student teams to consider the merit of various alternatives that they create to address contemporary problems, which have included sea-level rise, hurricane damage, fisheries, and management in developing countries. Three hours seminar; term project. Enrollment limited to eighteen. F&ES 515 and F&ES 525 or equivalent knowledge recommended.  
3 Course cr

**F&ES 712b, Water Management** Shimon Anisfeld

An exploration of water management at scales ranging from local to global. The course looks at multiple dimensions of the water crisis, including both human and ecosystem impacts; quantity and quality issues; and engineering, legal, economic, and behavioral solutions. Theory is illustrated through a variety of case studies. Topics covered include global water resources; flooding; water scarcity; residential, agricultural, and industrial water use; water and health; water justice; impacts of climate change and land use change; storm water management; dams and other technologies for water management; human impacts on aquatic ecosystems; water and energy; water economics; water rights; water conflict and cooperation. 3 Course cr

**F&ES 713a, Coastal Ecosystems** Shimon Anisfeld

An examination of the natural processes controlling coastal ecosystems, the anthropogenic threats to the health of these systems, and the potential for restoration. Coverage of estuaries, rocky shores, seagrass meadows, coral reefs, and mangrove swamps, with a special emphasis on tidal marshes. The course covers a wide range of physical, chemical, and ecological processes. Anthropogenic impacts covered range from local to global and include nutrient enrichment, hypoxia, sea-level rise, invasive species, over-fishing, chemical pollution, marsh drowning, and wetland filling.  
4 Course cr

**F&ES 714b, Environmental Hydrology** James Saiers

Groundwater quenches the thirst of half the planet's population. It also supports 40 percent of the world's irrigated agriculture, while enabling production of numerous commodities that make us comfortable and content. Groundwater is in high demand, and in some places we've taken too much, causing streams to disappear, land to sink, and wells to run dry. Groundwater in other places has been ruined by pollutants that are dangerous side effects of mining, reckless agricultural practices, and unchecked industrial processes. Unless we begin to make better decisions, stresses on groundwater resources will worsen, ultimately to the detriment of human health, food security, and ecosystems. This course introduces principles and approaches of hydrologic science requisite to informing the smart management of groundwater resources. It is designed for M.E.M., M.E.Sc., and Ph.D. students seeking to (1) learn about processes governing the circulation, availability, and quality of groundwater; (2) apply hydrological models used by environmental professionals to evaluate groundwater resource issues; (3) gain familiarity with methods used to interpret data encountered in groundwater-oriented problems; and (4) sharpen analytical skills that have broad application to environmental science and management. Prerequisite: the course is designed for students who typically do not have previous course work in mathematics beyond one semester of college-level calculus. Students who have not completed a college-level calculus course can succeed provided that they are comfortable with arithmetic operations and algebra and are willing to learn a few, very basic principles of introductory calculus. Although students use hydrologic simulation model – and may, depending on the level of interest, learn to develop simple computer models – the course does not involve any computer programming and requires no special computer skills. 3 Course cr

**F&ES 724a, Watershed Cycles and Processes** James Saiers and Peter Raymond

Everyone lives in a watershed, an area of land that funnels rainfall and snowmelt to a stream, river, lake, or section of coastline. This course explores watershed processes that affect, or are affected by, the stocks, flows, and quality of freshwater. It also surveys challenges faced by watershed managers, while emphasizing the science that informs their choices. Drawing from the fields of hydrology, ecology, and chemistry, the course begins by examining the flows of water, nutrients, carbon, and pollutants through watersheds. This basic knowledge underpins watershed management decisions that, for example, are intended to safeguard drinking-water quality, ensure sustainable freshwater consumption, and preserve ecosystem services that depend on healthy riparian corridors. Following treatment of watershed functions, the course shifts focus toward impacts of landscape alteration and other anthropogenic stresses on freshwater cycles, water quality, and the ecology of sensitive watershed ecosystems. The course culminates by covering measurements, models, and other tools used in watershed assessment and with case studies of science-based watershed planning and adaptive management. 3 Course cr

**F&ES 734b, Biological Oceanography** Mary Beth Decker

This course explores a range of oceanic ecosystems and how these environments function as coupled physical/biological systems. Solar energy drives the structuring of the oceans in the vertical dimension, and the formation of both deep and surface currents. These currents are the means by which heat and material are redistributed and are the determinants of where nutrients are available for support of primary production. The currents and other physical processes also determine the distribution and abundance of organisms from phytoplankton to fish and whales.

Anthropogenic impacts on oceans are also explored, such as the effects of fishing and climate change. This natural science course provides a foundation for those interested in the ecology of marine systems and in the management of coastal zones. Enrollment limited to fifteen. Recommended prerequisite: college-level biology or ecology course.

3 Course cr

**F&ES 777a, Water Quality Control** Jaehong Kim

Study of the preparation of water for domestic and other uses and the treatment of wastewater for recycling or discharge to the environment. Topics include processes for removal of organics and inorganics, regulation of dissolved oxygen, and techniques such as ion exchange, electro dialysis, reverse osmosis, activated carbon adsorption, and biological methods. 3 Course cr

## Quantitative and Research Methods

**F&ES 510a, Introduction to Statistics and Data Analysis in the Environmental Sciences** Jonathan Reuning-Scherer

An introduction to statistics and data analysis with emphasis on practical applications in the environmental sciences. Includes graphical analysis, common probability distributions, hypothesis testing, confidence intervals, and linear regression. The second part of the course introduces the topics of multiple regression and ANOVA that are typically not covered in an introductory class such as AP statistics. There are weekly problem sets using MINITAB, SPSS, or R, as well as a final project. This course is a prerequisite for other statistics courses offered through F&ES, and it presents statistical methods used in many Yale courses in both the natural and social sciences. Three hours lecture. 3 Course cr

**F&ES 510Ea, Introduction to Statistics and Data Analysis in the Environmental Sciences** Jonathan Reuning-Scherer

An introduction to statistics and data analysis with emphasis on practical applications in the environmental sciences. Includes graphical analysis, common probability distributions, hypothesis testing, confidence intervals, and linear regression. The second part of the course introduces the topics of multiple regression and ANOVA that are typically not covered in an introductory class such as AP statistics. There are weekly problem sets using MINITAB, SPSS, or R, as well as a final project. This course is a prerequisite for other statistics courses offered through F&ES, and it presents statistical methods used in many Yale courses in both the natural and social sciences. This course is taught in a flipped classroom approach. Enrollment limited to thirty. 3 Course cr

**F&ES 550a, Natural Science Research Methods** William Lauenroth

The course prepares students to design and execute an intensive research project. It covers elementary principles and philosophy of science; research planning, including preparation, criticism, and oral presentation of study plans; communicating research findings; limitations of research techniques; the structure of research organizations; and professional scientific ethics. 3 Course cr

**F&ES 551a, Qualitative Social Science Research** Amity Doolittle

This course is designed to provide a broad introduction to issues of qualitative research methods and design. The course is intended for both doctoral students who are in the beginning stage of their dissertation research, as well as master's students developing research proposals for their thesis projects. The course covers the basic techniques of designing qualitative research and for collecting, interpreting, and analyzing qualitative data. We explore three interrelated dimensions of research: theoretical foundations of

science and research, specific methods available to researchers for data collection and analysis, and the application and practice of research methods. The final product for this course is a research proposal. 3 Course cr

**[ F&ES 552, Master's Student Research Conference ]**

One of the most important aspects of scientific research involves the communication of research findings to the wider scientific community. Therefore, second-year M.E.Sc. and M.F.S. students are required to present the results of their faculty-supervised research as participants in the Master's Student Research Conference, a daylong event held near the end of the spring term. Student contributors participate by delivering a fifteen-minute oral presentation to the F&ES faculty and student body or by presenting a research poster in a session open to the F&ES community. Students receive a score of satisfactory completion for this effort. 0 Course cr

**F&ES 611a, Introduction to Environmental Data Science** Eli Fenichel

This course provides an introduction to the rapidly growing and promising area of data science in environmental and social-environmental research that is accompanying the explosion of data in our digital age. The course helps students develop highly marketable tech skills and incubate and launch new interdisciplinary collaborative projects at Yale that integrate data science techniques to solve important problems. Nearly every aspect of life is now connected (e.g., mobile phones, smart devices, social media) and/or digitized (e.g., book archives, government records, websites, communication), and observation of the natural environment increasingly occurs in digital form. In this course, students are introduced to various techniques and software for wrangling, cleaning, managing, and analyzing data and text at various scales, with an emphasis on integrating these methods into analysis and research. The course has an innovative format that leverages distributed knowledge around Yale. Students meet as a whole class a few times during the term to cover overarching topics. Meanwhile, students also work with the instructors to: (1) design a coherent path of study using the resources of StatLab, YCRC, and other workshops around campus, and (2) create a data project that will be presented to the class at the end of the term. 3 Course cr

**F&ES 720a, Introduction to R** Simon Queenborough

This seminar provides an overview and introduction to the statistical software R for the analysis and graphical presentation of natural and social science data. We follow a flipped style of teaching, with class time primarily used for worked examples and problems. Students also work together in small groups to analyze data from collaborators (or the student's own data) with a view to publication. The course provides the practical training in R for theoretical courses such as F&ES 510 and 753; they can be taken concurrently or sequentially, although some statistics background is preferred. 3 Course cr

**F&ES 726b, Observing Earth from Space** Ronald Smith

A practical introduction to satellite image analysis of Earth's surface. Topics include the spectrum of electromagnetic radiation, satellite-borne radiometers, data transmission and storage, computer image analysis, the merging of satellite imagery with GIS and applications to weather and climate, oceanography, surficial geology, ecology and epidemiology, forestry, agriculture, archaeology, and watershed management.

3 Course cr

**F&ES 751b, Sampling Methodology and Practice** Timothy Gregoire

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

**F&ES 753a, Regression Modeling of Ecological and Environmental Data**

Timothy Gregoire

This course in applied statistics assists scientific researchers in the analysis and interpretation of observational and field data. After considering the notion of a random variable, the statistical properties of linear transformations and linear combinations of random data are established. This serves as a foundation for the major topics of the course, which explore the estimation and fitting of linear and nonlinear regression models to observed data. Three hours lecture. Statistical computing with R, weekly problem exercises. Prerequisite: a course in introductory statistics. 3 Course cr

**F&ES 754a, Geospatial Software Design** Charles Tomlin

This course introduces computer programming tools and techniques for the development and customization of geospatial data-processing capabilities. It relies heavily on use of the Python programming language in conjunction with ESRI's ArcGIS and on JavaScript in conjunction with Google's Earth Engine geographic information systems (GIS). Three hours lecture, problem sets. Prerequisite: previous experience in GIS. 3 Course cr

**F&ES 755b, Modeling Geographic Space** Charles Tomlin

An introduction to the conventions and capabilities of image-based (raster) geographic information systems (GIS) for the analysis and synthesis of spatial patterns and processes. In contrast to F&ES 756, 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. No previous experience is required. 3 Course cr

**F&ES 756a, Modeling Geographic Objects** Charles Tomlin

This course offers a broad and practical introduction to the nature and use of drawing-based (vector) geographic information systems (GIS) for the preparation, interpretation, and presentation of digital cartographic data. In contrast to F&ES 755, 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. No previous experience is required. 3 Course cr

**F&ES 757a or b, Data Exploration and Analysis** Staff

Survey of statistical methods: plots, transformations, regression, contingency tables, analysis of variance, logistic regression, and cluster analysis. Data manipulation, web scraping, and data cleaning techniques are discussed. The R computing language



is taught, and web data sources are used. Prerequisite: F&ES 510 or the equivalent.  
3 Course cr

**F&ES 758b, Multivariate Data Analysis in the Environmental Sciences**

Jonathan Reuning-Scherer

An introduction to the analysis of multivariate data. Topics include multivariate analysis of variance (MANOVA), principal components analysis, cluster analysis (hierarchical clustering, k-means), canonical correlation, multidimensional scaling ordination methods, discriminate analysis, factor analysis, and structural equations modeling. Emphasis is placed on practical application of multivariate techniques to a variety of natural and social examples in the environmental sciences. Students are required to select a dataset early in the term for use throughout the term. There are regular assignments and a final project. Extensive use of computers is required – students may use any combination of R, SAS, SPSS, STATA, and MINITAB. Three hours lecture/discussion. Prerequisites: a prior course in introductory statistics and a good understanding of multiple linear regression. 3 Course cr

**F&ES 762a, Applied Math for Environmental Studies** Eli Fenichel

The language of mathematics is an important leg in the stool of interdisciplinary research and analysis, and many graduate courses at F&ES involve mathematical content. However, many graduate students have not taken a math course in years, and their math skills are rusty. Furthermore, many graduate-level mathematical concepts may be entirely new. Experience suggests that many students either opt out of taking courses they are truly interested in or muddle through, struggle with the math, and miss important concepts. AMES is meant to help students refresh or acquire new math skills and succeed in content and “toolbox” graduate-level courses. AMES provides a structured opportunity to learn a range of mathematical concepts used in environmental studies. The course assumes that, at a minimum, students took college algebra and perhaps a semester of calculus (but might not really remember it). Concepts are presented heuristically in a “how to” and “why” approach with examples from environmental studies. The goal is for students to be conversant and have intuition about (i.e., to demystify) why logs, exponents, derivatives, integrals, linear algebra, probability, optimization, stability analysis, and differential equations show up throughout environmental studies. Students learn (review) how to use these techniques. Also covered is a bit of history of math and an introduction to computer programming. 3 Course cr

**F&ES 781b, Applied Spatial Statistics** Timothy Gregoire

An introduction to spatial statistical techniques with computer applications. Topics include modeling spatially correlated data, quantifying spatial association and autocorrelation, interpolation methods, variograms, kriging, and spatial point patterns. Examples are drawn from ecology, sociology, public health, and subjects proposed by students. Four to five lab/homework assignments and a final project. The class makes extensive use of the R programming language. Prerequisite: introductory course in statistics is mandatory. An intermediate-level course in statistical modeling and handling spatial data is strongly preferred, but not required. 3 Course cr

**F&ES 902a or b, Environmental Anthropology Research Lab** Michael Dove

A biweekly seminar for Dove doctoral advisees and students in the combined F&ES/Anthropology doctoral program. Presentation and discussion of dissertation prospectuses and proposals, dissertation chapters, and related publications; collaborative writing and publishing projects on subjects of common interest; and

discussion of such topics as grantsmanship, data analysis, writing and publishing, and the job search. Two and one-half hour seminar. 1 Course cr

## Social Sciences

### ECONOMICS

#### **F&ES 624b, Economics of Sustainability** Eli Fenichel

Meeting the needs of future generations without compromising the ability of future generations to meet their needs means allocating resources across and through time. Resource allocation is a central theme in economics. For more than 100 years the economics literature has investigated allocating resources within a generation and between generations. The purpose of this course is to provide students with core ideas from economics relevant to the conversation around sustainability and sustainable development. The course addresses normative theory, ideas around sustainability (even before it was called that), and initiatives for measuring sustainability (with some historical context), and it touches on modern techniques for incorporating the environment in measures of social progress. 3 Course cr

#### **F&ES 701a, Climate Change Economics** Robert Mendelsohn

The seminar reviews the economic and scientific framework and the facts that underlie efficient mitigation and adaptation decisions concerning climate change. The course then focuses on the key uncertainties and value judgments that make managing climate change complicated and controversial. Prerequisites: econometrics and relevant courses in economics. 3 Course cr

#### **F&ES 804a, Economics of Natural Resources** Robert Mendelsohn

Linking of abstract economic concepts to concrete policy and management decisions. Application of theoretical tools of economics to global warming, pollution control, fisheries, water management, forestry, recreation, and mining. 3 Course cr

#### **F&ES 805a or b, Seminar on Environmental and Natural Resource Economics**

Kenneth Gillingham and Eli Fenichel

This seminar is based on outside speakers and internal student/faculty presentations oriented toward original research in the field of environmental and natural resource economics and policy. Presentations are aimed at the doctoral level, but interested master's students may enroll with permission of the instructors. 1½ Course cr

#### **F&ES 834b, Environmental Economics and Policy** Staff

This is a course in environmental and natural resource economics and policy. It covers both general methodological principles and specific applications. Rather than serving as a standard course in environmental and natural resource economics, the material is tailored specifically to master's students pursuing professional degrees in environmental management. The course therefore has a focus on environmental problem solving in the real world. Topics covered include, but are not limited to: evaluation of environmental policies (e.g., standards, taxes, cap-and-trade); cost-benefit analysis and its critiques; nonmarket valuation (ecosystem services, revealed and stated preferences); discounting and macroeconomic perspectives on climate change; management of nonrenewable resources (oil, minerals, etc.); management of renewable resources (forests, fisheries, etc.); land and biodiversity conservation; the relationship between development, trade, and the environment; strategic incentives for international environmental agreements; and environmental behavioral economics. Prerequisite: F&ES 512 or equivalent. 3 Course cr

**F&ES 905b, Doctoral Seminar in Environmental and Energy Economics**

Kenneth Gillingham

This course is designed to bring doctoral students up to speed on the latest developments in the literature on environmental and energy economics. Key papers are presented, and associated mathematical and empirical methods are covered. Topics include uncertainty and climate change policy, estimating energy demand, electricity markets, and behavioral economics and the environment. A focus is on identifying areas that deserve future research attention. Open to advanced master's students with permission of the instructor. 3 Course cr

**ENERGY AND THE ENVIRONMENT****F&ES 583a, American Energy History** Paul Sabin

The history of energy in the United States from early hydropower and coal to present-day hydraulic fracturing, deepwater oil, wind, and solar. Topics include energy transitions and technological change; energy and democracy; environmental justice and public health; corporate power and monopoly control; electricity and popular culture; labor struggles; the global quest for oil; changing national energy policies; the climate crisis. 3 Course cr

**F&ES 635b, Renewable Energy Project Finance** Daniel Gross

The course is intended to be a practicum, exposing students to real-world tools of the trade as well as the theory underlying them. In place of a textbook, students are provided with approximately 400 pages of actual project documents used for a U.S. wind energy project constructed relatively recently. Through weekly homework assignments, students develop the skills necessary to construct a detailed financial model, largely comparable to what would be used by an investment firm, project developer, or independent power producer. Modeling skills include sizing debt capacity, sensitivity analysis, stochastic forecasting, taxes, and the creation of financial statements. Lectures also provide an introduction to risk management, energy market dynamics, alternative contractual structures, financial structuring, and the core engineering and risks inherent in the most common renewable energy technologies. 3 Course cr

**F&ES 716b, Renewable Energy** Ronald Smith

Introduction to renewable energy, including physical principles, existing and emerging technologies, and interaction with the environment. Energy demand; transmission and storage; generation by hydroelectric, wind, solar, biofuel, and geothermal sources, as well as waves and tidal generation. Includes field trips to conventional, hydroelectric, and wind-power facilities in Connecticut. Prerequisites: high school physics, chemistry, and mathematics; college-level science, engineering, and mathematics recommended. 3 Course cr

**F&ES 789a, Energy and Development** Narasimha Rao

This course delves into the relationship between energy use and economic development, at a household, national, and global scale. The course provides both a quantitative and qualitative understanding of poverty, energy demand, and the relationship between the two. Students grapple with different income and multidimensional poverty and standard of living indicators, and with GDP and its limitations as a human development measure. They learn about energy poverty in various parts of the world and about energy consumption patterns with rising income. Students study actual household survey and national statistics data on consumption and energy use, and are exposed to cutting-edge research on standard of living

measures and their embodied energy needs. The course covers basic models for household energy transitions and appliance diffusion. This is a seminar course, wherein students are expected to present readings in class. The course involves one term project and presentation, which may be quantitative or qualitative. Prerequisites: basic math, Excel, and microeconomics. Those selecting technical projects should have basic R or other data manipulation skills. 3 Course cr

**F&ES 800a, Energy Economics and Policy Analysis** Kenneth Gillingham

This course examines energy policy issues that pertain to the environment, with a focus on providing tools for analyzing these issues. A primary objective is to apply economics to particular issues of energy markets, environmental impacts, investment in renewables, and other energy issues such as transportation and energy efficiency. We cover the economic and technical considerations behind a particular energy policy issue and then discuss a related article or case study. Prerequisites: F&ES 512 (or equivalent background) and at least one course on energy. 3 Course cr

**F&ES 814b, Energy Systems Analysis** Narasimha Rao

This lecture course offers a systems analysis approach to describe and explain the basics of energy systems, including all forms of energy (fossil and renewable), all sectors/activities of energy production/conversion, and all energy end uses, irrespective of the form of market transaction (commercial or noncommercial) or form of technology (traditional as well as novel advanced concepts) deployed. Students gain a comprehensive theoretical and empirical knowledge base from which to analyze energy-environmental issues as well as to participate effectively in policy debates. Special attention is given to introducing students to formal methods used to analyze energy systems or individual energy projects and also to discussing traditionally less-researched elements of energy systems (energy use in developing countries; energy densities and urban energy use; income, gender, and lifestyle differences in energy end-use patterns) in addition to currently dominant energy issues such as climate change. Active student participation is required, including completion of problem sets. Participation in extra-credit skill development exercises (presentations, fact-finding missions, etc.) is encouraged. Invited outside speakers complement topics covered in class. 3 Course cr

**F&ES 816a, Electric Utilities: An Industry in Transition** Lawrence Reilly

The U.S. electric utility industry is a \$370 billion business with capital expenditures on the order of \$100 billion per year to replace aging infrastructure, implement new technologies, and meet new regulatory requirements. A reliable electricity infrastructure is essential for the U.S. economy and the health and safety of its citizens. The electric industry also has a significant impact on the environment. In the United States, electric power generation is responsible for about 40 percent of human-caused emissions of carbon dioxide, the primary greenhouse gas. Electric utilities in the United States are at a crossroads. Technological innovations, improving economics, and regulatory incentives provide a transformational opportunity to implement demand-side resources and distributed energy technologies that will both lower emissions and improve service to customers. Such significant changes could, however, disrupt existing utility business models and therefore may not be fully supported by incumbent utilities. This course focuses on the issues, challenges, risks, and trade-offs associated with moving the U.S. utility industry toward a cleaner, more sustainable energy future. We explore how utilities are regulated and how economic factors and regulatory policies influence

outcomes and opportunities to align customer, environmental, and utility shareholder interests to craft win-win-win solutions. 3 Course cr

#### ENVIRONMENTAL POLICY

##### **F&ES 573a, Urban Ecology for Local and Regional Decision-Making**

J. Morgan Grove

Urban ecology is the interdisciplinary study of urban and urbanizing systems from local to global scales. While urban ecology shares many features with the biological science of ecology, it emphasizes linkages with social, economic, and physical sciences and the humanities. Geographically, the subject includes central and edge cities, suburbs of various ages and densities, and exurban settlements in which urban lifestyles and economic commitments are dominant. In application, urban ecology can be useful as a social-ecological science for making cities more sustainable, resilient, and equitable. Emerging “grand challenges” in urban ecology include the development of robust approaches and understanding of (1) integrated social-ecological systems in urban and urbanizing environments; (2) the assembly and function of novel ecological communities and ecosystems under novel environmental conditions; (3) drivers of human well-being in diverse urban areas; (4) pathways for developing healthy, sustainable, and disaster-resilient cities; and (5) co-production of actionable science for policy, planning, design, and management. 3 Course cr

##### **F&ES 590a, The Climate Change Negotiations: A Practical Approach** Susan Biniarz

This course introduces students to the history of the international climate change negotiations (from the UNFCCC to the Paris Agreement), discusses the ways in which negotiating differences are typically resolved, identifies the issues to be addressed at this year’s Conference of the Parties, and concludes with a mock negotiation. It meets on four evenings in Oct.–Nov., each session lasting two hours. Dates: October 14 & 28, November 4 & 11 1 Course cr

##### **F&ES 631a, Solving Super Wicked Problems of Global Climate Change**

Benjamin Cashore

3 Course cr

##### **[ F&ES 632, Introduction to Social Entrepreneurship ]**

This is a practice-based course in which students form interdisciplinary teams to characterize and tackle a social challenge of their choice by designing an innovative, impactful, financially viable, and potentially scalable or replicable solution. Solutions can include products, services, methods, or systems that increase access to existing resources or generate new resources targeting or including underserved populations. These solutions can be implemented within existing organizations or by launching new organizations where there is a need. The course draws students from all programs and disciplines across the University. Students go through the stages of characterizing the challenge, co-creating the solution, ideating and iterating using human-centered design thinking, setting success metrics, and building a business model around their solution. At the end of the term, teams pitch to a panel of judges and submit a write-up. Guest social entrepreneurs and funders visit class to share their work, challenges, successes, and failures. 3 Course cr

##### **F&ES 645a, Urbanization, Global Change, and Sustainability** Karen Seto

Urbanization and associated changes in human activities on the land (*land use*) and in the physical attributes of Earth’s surface (*land cover*) have profound environmental consequences. Aggregated globally, these effects constitute some of the most significant

human impacts on the functioning of Earth as a system. This class examines the interactions and relationships between urbanization and global change at local, regional, and global scales with an emphasis on the biophysical aspects of urbanization. Topics include urbanization in the context of global land use change, habitat and biodiversity loss, modification of surface energy balance and the urban heat island, climate change and impacts on urban areas, urban biogeochemistry, and urbanization as a component of sustainability. Emphasis is on management of urban areas *worldwide* or at national scales for planetary sustainability. 3 Course cr

**F&ES 761b, Negotiating International Agreements: The Case of Climate Change**

Susan Biniarz

This seminar is a practical introduction to the negotiation of international agreements, with a focus on climate change. Students learn about the cross-cutting features of international environmental agreements and, through the climate change lens, explore the process of negotiating agreements, the development of national positions, the advocacy of positions internationally, and the many ways in which differences among negotiating countries are resolved. The course also examines the history and substance of the climate change regime, including, *inter alia*, the 1992 UN Framework Convention on Climate Change, the 1997 Kyoto Protocol, the 2009 Copenhagen Accord, and the 2015 Paris Agreement. Climate change issues in other international fora are also discussed, e.g., the International Civil Aviation Organization's market-based mechanism to address CO<sub>2</sub> emissions from international aviation. Grades are based on a series of short non-research papers, as well as class participation and a mock negotiation. Enrollment limited to eighteen to twenty. 2 Course cr

**F&ES 769b, Public Lands and Policy in the American West** Justin Farrell

Nearly 30 percent of land in the United States is owned and managed by the federal government, almost all of which is in the western U.S. (e.g. 85% of Nevada is federally owned, compared to 0.03% of Iowa and Connecticut). Thus the problems, policies, and management issues facing western lands are remarkably different than other contexts, especially in light of the west's unique ecological, social, and political landscapes. This seminar takes up these issues with a focus on the nuts and bolts of public land policy and management, using a variety of historical and contemporary case studies. 1 Course cr

**F&ES 799b, Sustainable Development Goals and Implementation** Gordon Geballe

This course has students (working alone or in a small group) design a specific implementation plan for a specific country for a specific item that is part of the Sustainable Development Goals adopted by the UN in September 2015. Students study the new post-2015 sustainable development goals and their implementation in the real world. The course focuses primarily on understanding and developing the ability to effectively apply a variety of tools and means of implementation, relying primarily on guest lecturers. The aim is for each student or group of students to combine a geographic area/region (for example, a country of key interest), a sustainable development goal, and a tool for implementation to design an effective implementation strategy to present to those at the ministerial and decision-making level. 3 Course cr

**F&ES 807a, Corporate Environmental Management and Strategy** Marian Chertow

This survey course focuses on understanding how adroit environmental management and strategy can enhance business opportunities; reduce risk, including resource dependency; promote cooperation; and decrease environmental impact. The course combines lectures, case studies, and class discussions and debates on management

theory and tools, legal and regulatory frameworks shaping the business-environment interface, and the evolving requirements for business success (including how to deal with diverse stakeholders, manage in a world of transparency, and address rising expectations related to corporate responsibility). 3 Course cr

**F&ES 811b, Metrics, Tools, and Indicators in Corporate Responsibility** Todd Cort

This is an applied course on the standards, guidelines, and tools for designing, implementing, auditing, and communicating a corporate environmental and social responsibility (CR) program. The purpose of the course is to introduce students to the knowledge and tools needed to enter a career in CR and sustainability. The course is designed for students who currently hold or will hold positions in organizations where they are or will be responsible for creating, implementing, measuring, and/or managing internal CR and sustainability programs, or responsible for assisting a corporation in this area. 3 Course cr

**F&ES 817a, Urban, Suburban, and Regional Planning Practice** David Kooris

Our cities, towns, and regions represent the cumulative impact of planning policies implemented at multiple scales over the past century. This course explores the dynamic trends facing the United States and its communities and the evolution in planning practice that is occurring at the local and regional scale to address them. It looks at both suburban and urban approaches. The recent deep recession, climate change, and a lack of social cohesion call for a new triple bottom-line approach to decision-making for our future. Existing policies and governance structures are not always well suited for the new challenges and opportunities that we face. Local, state, and the national government are, to varying degrees, crafting new solutions to the challenges of urban and suburban America. 3 Course cr

**F&ES 819b, Strategies for Land Conservation** Bradford Gentry

This is a professional seminar on private land conservation strategies and techniques, with particular emphasis on the legal, financial, and management tools used in the United States. The seminar is built around presentations by guest speakers from land conservation organizations. Speakers are assigned topics across the land conservation spectrum, from identification of target sites, through the acquisition process, to ongoing stewardship of the land after the deal is done. The tools used to protect land are discussed, including the basics of real estate law, conservation finance, and project/organizational management. Students are required to undertake a clinical project with a local land conservation organization. Enrollment limited to twenty-five; preference to second-year students if limit reached. 3 Course cr

**F&ES 820b, Land Use Law and Environmental Planning** Marjorie Shansky

This course explores the regulation by local governments of land uses in urban, rural, and suburban areas and the effect of development on the natural environment. The course helps students understand how the environment can be protected through effective regulation at the local level. It provides an introduction to federal, state, regional, and local laws and programs that promote 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, as are the cases that provide a foundation in regulatory takings and the legitimate scope of land use regulation. 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 that relate to human settlement patterns, water resources, low-impact development, watershed protection, alternatives to Euclidean

zoning, brownfields redevelopment, and resiliency and adaptation in response to sea-level rise and climate change. Students engage in empirical research to identify, catalog, and evaluate innovative local laws that successfully protect environmental functions and natural resources, and the manner in which towns incorporate climate change into their planning and regulations. Nearby watersheds are used as a context for the students' understanding of the strengths and weaknesses of local planning and regulation. Attention is paid, in detail, to how the development of the land adversely affects natural resources and how these impacts can be mitigated through local planning and subsequent adoption of environmental and other regulations designed to promote sustainable development in a climate-changing world. 3 Course cr

**F&ES 824a, Environmental Law and Policy** Daniel Esty

This course provides an introduction to the major concepts of environmental law with a focus on U.S. statutes, regulations, and treaties for managing waste, air and water pollution, toxic substances, public lands, and global environmental resources. Alternative policy approaches to addressing environmental problems, such as market-based incentives, “nudges,” information disclosure requirements, and voluntary programs, are also considered. Overarching legal and policy concepts, such as federalism, administrative procedure, separation of powers, environmental justice, judicial review, and statutory interpretation, are explored. 3 Course cr

**F&ES 826a, Foundations of Natural Resource Policy and Management** Susan Clark

This course offers an explicit interdisciplinary (integrative) framework that is genuinely effective in practical problem solving. This unique skill set overcomes the routine ways of thinking and solving conservation problems common to many NGOs and government organizations by explicitly developing more rigorous and effective critical-thinking, observation, and management skills. By simultaneously addressing rational, political, and practical aspects of real-world problem solving, the course helps students gain skills, understand, and offer solutions to the policy problems of managing natural resources. The approach we use requires several things of students (or any problem solvers): that they be contextual in terms of social and decision-making processes; that they use multiple methods and epistemologies from any field that helps in understanding problems; that they strive to be both procedurally and substantively rational in their work; and, finally, that they be clear about their own standpoint relative to the problems at hand. The approach used in this course draws on the oldest and most comprehensive part of the modern policy analytic movement—the policy sciences (interdisciplinary method)—which is growing in its applications worldwide today. The course includes a mix of critical thinking, philosophical issues, history, as well as issues that students bring in. Among the topics covered are human rights, scientific management, decision-making, community-based approaches, governance, common interest, sustainability, professionalism, and allied thought and literature. In their course work students apply the basic concepts and tools to a problem of their choice, circulating drafts of their papers to other seminar participants and lecturing on and leading discussions of their topics in class sessions. Papers of sufficient quality may be collected in a volume for publication. Active participation, reading, discussion, lectures, guests, and projects make up the course. Enrollment limited to sixteen; application required. 3 Course cr

**F&ES 827a, Animal Law** Douglas Kysar

This course examines the application of the law to nonhuman animals, the rules and regulations that govern their treatment, and the concepts of “animal welfare” and



“animal rights.” The course explores the historical and philosophical treatment of animals; discusses how such treatment impacts the way judges, politicians, lawyers, legal scholars, and lay people see, speak about, and use animals; surveys current animal protection laws and regulations, including overlap with such policy issues as food and agriculture, climate change, and biodiversity protection; describes recent political and legal campaigns to reform animal protection laws; examines the concept of “standing” and the problems of litigating on behalf of animals; discusses the current classification of animals as “property” and the impacts of that classification; and debates the merits and limitations of alternative classifications, such as the recognition of “legal rights” for animals. Students write a series of short response papers. An option to produce a longer research paper for Substantial or Supervised Analytic Writing credit is available for Law School students. Enrollment limited to forty. 2 Course cr

**F&ES 835a, Seminar on Land Use Planning** Jessica Bacher

Land use control exercised by state and local governments determines where development occurs on the American landscape, the preservation of natural resources, the emission of greenhouse gases, the conservation of energy, and the shape and livability of cities and towns. The exercise of legal authority to plan and regulate the development and conservation of privately owned land plays a key role in meeting the needs of the nation’s growing population for housing and nonresidential development and in ensuring that critical environmental functions are protected from the adverse impacts of land development. This course explores the multifaceted discipline of land use and urban planning and their associated ecological implications. Numerous land use strategies are discussed, such as consensus building, resiliency planning, and proper renewable energy siting, that provide practical tools for professionals to use to create sustainable buildings, neighborhoods, and communities. The focus of this seminar is to expose students to the basics of land use and urban planning in the United States and to serve as an introduction for the F&ES curricular concentration in land use. Guest speakers are professionals involved in sustainable development, land conservation, smart growth, renewable energy, and climate change management. Classes include discussions on the trajectory for professional careers. 1½ Course cr

**F&ES 835Eb, Seminar on Land Use Planning** Jessica Bacher

This is an online course. Land use control exercised by state and local governments determines where development occurs on the American landscape, the preservation of natural resources, the emission of greenhouse gases, the conservation of energy, and the shape and livability of cities and towns. The exercise of legal authority to plan and regulate the development and conservation of privately owned land plays a key role in meeting the needs of the nation’s growing population for housing and nonresidential development and in ensuring that critical environmental functions are protected from the adverse impacts of land development. This course explores the multifaceted discipline of land use and urban planning and their associated ecological implications. Numerous land use strategies are discussed, such as consensus building, resiliency planning, and proper renewable energy siting, that provide practical tools for professionals to use to create sustainable buildings, neighborhoods, and communities. The focus of this seminar is to expose students to the basics of land use and urban planning in the United States and to serve as an introduction for the F&ES curricular concentration in land use. Guest speakers are professionals involved in sustainable development, land conservation, smart growth, and climate change management. Classes include discussions on the trajectory for professional careers. 1 Course cr

**F&ES 840a, Climate Change Policy and Perspectives** Daniel Esty

This course examines the scientific, economic, legal, political, institutional, and historic underpinnings of climate change and the related policy challenge of developing the energy system needed to support a prosperous and sustainable modern society. Particular attention is given to analyzing the existing framework of treaties, law, regulations, and policy—and the incentives they have created—which have done little over the past several decades to change the world’s trajectory with regard to the build-up of greenhouse gas emissions in the atmosphere. What would a twenty-first-century policy framework that is designed to deliver a sustainable energy future and a successful response to climate change look like? How would such a framework address issues of equity? How might incentives be structured to engage the business community and deliver the innovation needed in many domains? While designed as a lecture course, class sessions are highly interactive. Self-scheduled examination or paper option.

3 Course cr

**F&ES 850a, International Organizations and Conferences** Gordon Geballe

IOC focuses on UNFCCC COP 25, taking place in Chile in December 2019. This course and F&ES 590 are coordinated, and both are required in order to apply for F&ES funding and Yale badges. Both courses focus on being prepared to get the most out of the trip. Dates: Sept 4, Oct 21 & 28, Nov 11 & 18 Prerequisite: F&ES 840 is strongly recommended. 1 Course cr

**F&ES 855a, Climate Change Mitigation in Urban Areas** Karen Seto

This class provides an in-depth assessment of the relationships between urbanization and climate change, and the central ways in which urban areas, cities, and other human settlements can mitigate climate change. The course explores two major themes: (1) the ways in which cities and urban areas contribute to greenhouse gas emissions and climate change; and (2) the ways in which urban areas can mitigate greenhouse gas emissions and climate change. Class topics parallel the IPCC 5th Assessment Report, Chapter 12, Human Settlements, Infrastructure, and Spatial Planning, and include spatial form and energy use, land use planning for climate mitigation, urban metabolism, and local climate action plans. The class format is reading-, writing-, and discussion-intensive. Students are taught how to synthesize scientific literature, write policy memos, and develop effective oral presentations on the science of climate change mitigation in urban areas. Enrollment limited to fourteen. This is a two-week intensive short course offered the weeks of Sept. 16–20 and Oct. 7–11. 1 Course cr

**F&ES 860b, Understanding Environmental Campaigns** Michael Northrop

This course is about the strategies and tactics used by successful environmental campaigns, taught from a practitioner’s perspective. It is also a course about environmental policy making. Policy doesn’t just happen the way it’s described in grade school civics textbooks. And it isn’t just policy makers who make it. Corporate and civic interests play an influential role at all levels of policy making. As future participants in the policy process, whether you come from a perch in government or business, as an advocate, or as a private citizen, you can jump-start your ability to participate and respond by understanding how policy campaign advocacy impacts policy making. Though this topic is neither well documented nor regularly taught, there is a toolkit that can be learned. Most environmental campaigners and policy makers learn about policy campaigning on the job. This course attempts to advance understanding of the policy-making process by exposing students to case examples from the environmental policy-making world of the past decade. The course examines selected case examples of

successful policy campaigns and seeks to tease out lessons and best practice. No single environmental campaign is the same, and strategies and tactics are always evolving, but there are key lessons about campaign practices that can be learned. Case studies we examine include campaigns enacting anti-toxic legislation in Washington State; stopping the Keystone XL Pipeline; retiring coal-fired power plants in the United States; protecting the Great Bear Rainforest and the boreal forest in Canada; banning the use of high-sulphur fuels in the Arctic; securing an international ban on Arctic ocean fishing; catalyzing the decarbonization of supply chain emissions at Levi's; pushing Starbucks to adopt a recyclable, compostable coffee cup; and encouraging banks and insurers to commit to Paris-aligned lending and financing. Campaigners who played leadership roles in these efforts join us for class. We examine each case, seek a practical understanding of strategies and tactics used by each campaign, and attempt to synthesize lessons and best practice. 3 Course cr

**F&ES 875Ea, Urban Resilience: Complexity, Collaborative Structures, and Leadership Challenges** Staff

The world continues to urbanize. From 1913 to 2013, the proportion of the world's population that lives in cities grew fivefold from 10 to 50 percent, and estimates suggest that 75 percent will live in cities in 2050. Though history reveals that urbanization has always been an accelerator of growth and development, it also poses profound challenges for corporations, communities, cities, and countries. A recent McKinsey report succinctly notes: "Cities are essential to global economic growth and productivity. They are where most of the world's population live, work, and play, and they are important to everyone else, too. They are the world's economic engine, consuming the majority of global power and resources, while generating 80 percent of GDP and 70 percent of greenhouse-gas emissions. Making cities great is the critical infrastructure challenge of this century." This online course is a collaborative offering to students across the GNAM network schools. It brings together the 100 Resilient Cities (100RC) network, the Rockefeller Foundation, schools across the GNAM (with faculty from Yale, as well as the University of British Columbia, EGADE Business School, University of Ghana Business School, and the Indian Institute of Management Bangalore), and practitioners from business, government, and civil society to engage with the topic of urban resilience. For the purposes of this course, we draw on the view of urban resilience articulated by 100RC as the ability of individuals, communities, businesses, institutions, and systems within a city to survive, adapt, and thrive in response to the acute shocks and chronic stresses they may experience. The purposes of the course are to help students: (1) articulate resilience challenges and opportunities facing global cities; (2) describe the holistic and integrated nature of resiliency and its key drivers; and (3) work in virtual global teams to design collaborative approaches to addressing urban resilience challenges involving business, government, and civil society. The application form is online at <http://event-reg.som.yale.edu/signup/UrbanResilience2019>. 3 Course cr

**SOCIAL AND POLITICAL ECOLOGY**

**F&ES 520a, Society and Environment: Introduction to Theory and Method**

Michael Dove

Introductory course on the scope of social scientific contributions to environmental and natural resource issues. Section I, overview of the field and course. Section II, framing of environmental problems: placing problems in their wider political context, new approaches to uncertainty and failure, and the importance of how the conceptual

boundaries to resource systems are drawn. Section III, methods: the dynamics of working within development projects, and the art of rapid appraisal and short-term consultancies. Section IV, local communities, resources, and (under)development: representing the poor, development discourse, and indigenous peoples and knowledge. Two guest lectures by leading scholars in the field. No prerequisites. This is a core M.E.M. specialization course in F&ES, a core course in the combined F&ES/Anthropology doctoral degree program, and a prerequisite for F&ES 869/ANTH 572.  
3 Course cr

**F&ES 615b, Political Ecology of Conservation and Restoration of Tropical Forest Landscapes** Amity Doolittle

Study of the relationship between society and the environment focusing on tropical forest conservation. Global processes of environmental conservation, development, and conflicts over natural resource use and control; approaches to conserving trees and forest cover using strategies that support biodiversity and rural agricultural livelihoods; specific focus on tropical forest landscapes dominated by agriculture and cattle ranching practices using Panama and Colombia as case studies. The course includes a required field trip during the first week of spring break in Colombia, at the ELTI's focal training site. 4 Course cr

**F&ES 619a, Ethics and Ecology** Stephen Latham

This is a philosophical introduction to environmental ethics. The course introduces students to the basic contours of the field of environmental ethics and to a small number of special topics and special philosophical problems within that field. No philosophical background is required or expected. 3 Course cr

**F&ES 744b, Conservation Science and Landscape Planning** Oswald Schmitz

This advanced course applies ecological principles to understand and manage biodiversity and attendant ecosystem functioning and services in the anthropocene. The course addresses the ethical and functional basis for conservation and fosters thinking about why and how humans ought to share the planet with nonhuman life. It covers scientific principles such as evolution, life-history and the viability of species, species endangerment and extinction risk, the kinds of biodiversity, the spatial distribution of biodiversity, the functional roles of species in ecosystems, vulnerability and risk assessments, and valuing biodiversity and ecosystem services. The course applies these principles to the exploration of such topics as biodiversity's role in the functioning and sustainability of ecological systems, restoration of environmental damages, conserving biodiversity in dynamic landscapes, adapting landscapes to climate change, balancing conservation with urban development and agriculture, and renewable energy siting. It provides students with the quantitative skills to conduct population viability analyses, geospatial analyses of the distribution of biodiversity across landscapes, vulnerability analyses, and decision analysis to balance trade-offs among multiple objectives of human land development and biodiversity conservation. Prerequisites: F&ES 530 or equivalent course in population or community ecology, F&ES 755 or equivalent course in GIS, and F&ES 510 or equivalent course in statistical analysis of biological data. A course in economics or applied math for environmental studies is strongly encouraged.  
4 Course cr

**F&ES 760b, Conservation in Practice: An International Perspective** Amy Vedder and Albert Weber

This seminar focuses on the practice of wildlife and wildlands conservation, examining key topics from the dual perspectives of academic literature and actual field experiences;

bringing together interdisciplinary thinking; and drawing on examples from Africa, Asia, Latin America, and the United States. The thematic outline of the seminar is organized around three fundamental questions in nature conservation: What are we trying to save – and why? How is this being done – and how has it changed over time? What lessons are we learning – and what overarching issues remain problematic? Specific topics include how different players define and value wildness; selection and prioritization of conservation targets; comparisons of various species and landscape conservation approaches; and governance and decision-making in conservation, including ties between conservation and development and community-based conservation. During the course of the term, six to eight guest conservation practitioners join the seminar, bringing tangible examples of current practice into the classroom via presentations and discussions. Student participation and leadership are key, as the seminar is discussion-based, centers on the sharing of ideas and experiences, demands challenging thinking, and is frequently led by students. Limited enrollment. Evaluation is based on participation, comments on assigned readings, and a final paper. 3 Course cr

**F&ES 764b, Nature, Rationality, and Moral Politics** Justin Farrell

This course equips students to think critically and imaginatively about the social aspects of natural landscapes and the communities who inhabit them. It draws on empirical cases from the United States to examine interrelated issues pertaining to culture, morality, religion, politics, power, elites, corporations, and social movements. Because of the deep complexity of these issues, and the fact that this is a reading- and writing-intensive course, it requires a significant time commitment from each student. Students gain fluency with cutting-edge empirical research on these issues; better recognize the social, moral, and political roots of all things; and finally, are able to apply philosophical theory to concrete environmental problems. 3 Course cr

**F&ES 767b, Tools for Conservation Project Design and Management** Amy Vedder and Albert Weber

As wildlife and wildland conservation programs have multiplied and grown in size, conservation organizations have sought methods to improve strategic project planning, assessment of progress, cross-project comparison, learning of lessons, and transparency for donors. To address these challenges, major nonprofit organizations have collaboratively designed a set of decision-support tools for planning field projects and programs and for monitoring their progress, summarized in the “Open Standards for the Practice of Conservation” (<http://cmp-openstandards.org>). Use of these tools has allowed organizations to more clearly articulate strategies, define priority actions, critically assess success, manage adaptively, and derive lessons – all of which help to improve effectiveness and respond to donor interests. Students in this course explore a mutually reinforcing suite of these project tools: their underlying principles are introduced, students practice the techniques, and current case studies from field conservation are examined to explore tool utility. Students synthesize use of these design tools in a final project or program proposal focused on a single case study of their choice. The suite of decision-support tools covered includes conceptual models for project design, situational and stakeholder assessments, threats and opportunities analysis, conservation target identification (particularly landscape species selection), and monitoring frameworks. Students gain experience in design of projects and their monitoring, as well as familiarity with budgeting. Enrollment limited to twelve.

3 Course cr

**F&ES 789Eb, Journey of the Universe** John Grim and Mary Tucker

This six-week hybrid course draws on the resources created in the *Journey of the Universe* project—a film, a book, and a series of twenty interviews with scientists and environmentalists. *Journey of the Universe* weaves together the discoveries of evolutionary science with cosmological understandings found in the religious traditions of the world. The authors explore cosmic evolution as a creative process based on connection, interdependence, and emergence. The *Journey* project also presents an opportunity to investigate the daunting ecological and social challenges of our times. This course examines a range of dynamic interactions and interdependencies in the emergence of galaxies, Earth, life, and human communities. It brings the sciences and humanities into dialogue to explore the ways in which we understand evolutionary processes and the implications for humans and our ecological future. This is an online hybrid course; no shopping period. 2 Course cr

**[ F&ES 793, Climate Change, Societal Collapse, and Resilience ]**

Collapse documented in the archaeological and early historical records of the Old and New Worlds, including Mesopotamia, Mesoamerica, the Andes, and Europe. Analysis of politicoeconomic vulnerabilities, resiliencies, and adaptations in the face of abrupt climate change, anthropogenic environmental degradation, resource depletion, “barbarian” incursions, or class conflict. 3 Course cr

**F&ES 796b, Human-Animal Relations: New Anthropological Approaches to the Nonhuman** Michael Dove

Advanced seminar on the “post-humanist” turn toward multispecies ethnography. Section I, introduction to the course; and “sacred cows.” Section II, theory and practice of multispecies ethnography; the question of human consciousness; and the tradition of natural history studies. Section III, current work on human-animal relations: wildlife conflict; biopower/biopolitics; hunting and mimesis; colonial/postcolonial politics. Section IV, presentations by the students and teaching fellow. One other class is devoted to student selections of influential current literature; and there are two guest lectures by prominent scholars in the field. Enrollment capped. Prerequisite: F&ES 520/ANTH 581, F&ES 838/ANTH 517, or F&ES 839/ANTH 597. 3 Course cr

**F&ES 831a, Society and Natural Resources** Susan Clark

This research seminar explores the relationship between society and natural resources in a genuinely interdisciplinary manner. This session focuses on the foundations (philosophic, methodological, and pragmatic) of social and integrative/interdisciplinary sciences/approaches to understanding and policy. We demonstrate a major case application. 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 environmental psychology and sociology. We focus on leadership (the lead and leader’s relationships), too. Guests and students make presentations and participate in discussions each week. Readings, active participation, and student papers are required. 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. A few years ago, the seminar examined the relationship of human dignity as a universal value goal, professionalism and practice, and sustainability as an applied notion. Other versions of the seminar have looked at conceptual (theoretical) models about society and natural

resources from policy sciences, social ecology, political ecology, and other knowledge areas. Still other seminars focused on “Bridging Local and Professional Knowledge in Environmental Sustainability” and “War and the Environment.” 3 Course cr

**F&ES 836a, Agrarian Societies: Culture, Society, History, and Development**

James Scott, Elisabeth Wood, and Peter Perdue

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 transformations of rural society. Team-taught. 3 Course cr

**F&ES 839b, Social Science of Conservation and Development** Carol Carpenter

This course is designed to provide a fundamental understanding of the social aspects involved in implementing conservation and sustainable development projects. Social science makes two contributions to the practice of conservation and development. First, it provides ways of thinking about, researching, and working with social groupings—including rural households and communities, but also development and conservation institutions, states, and NGOs. This aspect includes relations between groups at all these levels, and especially the role of politics and power in these relations. Second, social science tackles the analysis of the knowledge systems that implicitly shape conservation and development policy and impinge on practice. The emphasis throughout is on how these things shape the practice of sustainable development and conservation. Case studies used in the course have been balanced as much as possible between Southeast Asia, South Asia, Africa, and Latin America; most are rural and Third World. The course includes readings from all noneconomic social sciences. The goal is to stimulate students to apply informed and critical thinking (which means not criticizing others, but questioning our own underlying assumptions) to whatever roles they may come to play in conservation and sustainable development, in order to move toward more environmentally and socially sustainable projects and policies. The course is also designed to help students shape future research by learning to ask questions that build on, but are unanswered by, the social science theory of conservation and development. No prerequisites. This is a requirement for the combined F&ES/Anthropology doctoral degree program and a prerequisite for some advanced F&ES courses. Open to advanced undergraduates. Three hours lecture/seminar. 3 Course cr

**F&ES 846b, Perspectives on Environmental Injustices** Amity Doolittle

In this seminar we explore domestic and global environmental issues from a perspective that foregrounds questions of social justice. This course is based on three fundamental premises: (1) all individuals and communities, regardless of their social or economic conditions, have the right to a clean and healthy environment; (2) there is a connection between environmental exploitation, human exploitation, and social justice; and (3) many environmental and social injustices are rooted in larger structural issues in society that must be understood. With these premises as a starting point, we turn to more difficult questions such as, Why and through what political, social, and economic processes are some people denied this basic right to a clean and safe environment? What is the state of scientific evidence surrounding environmental injustice and what are the current scientific challenges in assessing environmental injustices in relationship to human health? What legal frameworks exist within the United States to address environmental injustice? 3 Course cr

**F&ES 857b, Environmental History and Values** John Grim and Mary Tucker

This course provides an overview of major figures, ideas, and institutions in American environmentalism. The course explores the development of environmental awareness in America as distinct historical strands with diverse ethical concerns. It begins with an examination of Native American perspectives on land and biodiversity and then focuses on writings by Thoreau and Emerson to explore early American voices in the discourse on “nature.” Readings from Pinchot, Muir, and Leopold have been selected to investigate the emergence of conservation and forest management. The beginnings of urban and park planning are considered in relation to these positions on the management of nature. Students survey the environmental movements from the 1960s onward in readings from the social sciences and humanities. The course explores the major debates in environmental ethics and the broader reach for global ethics. Writings celebrating biodiversity are examined along with the emergence of conservation biology as an example of engaged environmental scholarship. New efforts to widen the interdisciplinary approaches toward environmental issues are introduced in investigating world religions and ecology as well as cosmology and ecology. 3 Course cr

**[ F&ES 869, Disaster, Degradation, Dystopia: Social Science Approaches to Environmental Perturbation and Change ]**

Advanced seminar on the tradition of social science scholarship on environmental perception, perturbation, and disaster, in light of the current attention to climate change. Section I, introduction to the course. Section II, central questions and debates in the field: social dimensions of natural disasters; discursive dimensions of environmental degradation; asymmetries between political power and resource wealth; and anthropological approaches to the study of climate and society. Section III, historic and comparative understandings of environmental perturbation: the half-millennium tradition of natural history studies; and the twenty-first-century development of post-humanist, multispecies ethnography. Section IV, presentations by the students and teaching fellow. One other class is devoted to student selections of influential current literature; and there are two guest lectures by prominent scholars in the field. Enrollment capped. Prerequisite: F&ES 520/ANTH 581, F&ES 838/ANTH 517, or F&ES 839/ANTH 597. 3 Course cr

**F&ES 873b, Global Environmental History** Harvey Weiss

The dynamic relationship between environmental and social forces from the Pleistocene glaciations to the Anthropocene present: Pleistocene extinctions; transitions from hunting to gathering to agriculture; Old World origins of cities, states, and civilization; adaptations and collapses of Old and New World civilizations in the face of climate disasters; the destruction and reconstruction of the New World by the Old. In the foreground of each analysis are the issues of adaptation, resilience, and sustainability: what forced long-term societal changes? 3 Course cr

**F&ES 877b, Anthropology of the Global Economy for Conservation and Development**

Carol Carpenter

This seminar explores topics in the anthropology of the global economy that are relevant to conservation and development policy and practice. Anthropologists are often assumed to focus on micro- or local-level research, and thus to have limited usefulness in the contemporary, global world of conservation and development policy. In fact, however, they have been examining global topics since at least the 1980s, and little current anthropological research is limited to the village level. More



importantly, the anthropological perspective on the global economy is unique and important. This course examines the topics that make up this perspective, including using a single commodity to study the global economy, theorizing the transition to capitalism, the moral relation between economy and society, models for thinking about power in the global economy, articulations between rural households and the global economy, rural-urban relations in the global economy; the process of becoming a commodity, the commons debate, credit and debt, contracting and flexible accumulation, globalization and scale, and theorizing REDD. Readings for the course come from the subfields of environmental anthropology, economic anthropology, the anthropology of development, and the anthropology of conservation. This class is a prerequisite for F&ES 965. Though designed for master's and doctoral students, it is open to advanced undergraduates. Three hours lecture/seminar. 3 Course cr

**F&ES 878a, Climate and Society: Past to Present** Michael Dove

Seminar on the major traditions of thought – both historic and contemporary – regarding climate, climate change, and society, drawing on the social sciences and anthropology in particular. Section I, overview of the field and course. Section II, continuities from past to present: use of differences in climate to explain differences among people; differences between Western and non-Western intellectual traditions; and the ethnographic study of folk knowledge. Section III, impact on society of environmental change: environmental determinism in the nineteenth and twentieth centuries; attribution of historic cases of societal “collapse” to extreme climatic events; and the role of extreme events in the development of a society. Section IV, vulnerability and control: how societies cope with extreme climatic events; and how such events reflect, reveal, and reproduce socioeconomic fault lines. Section V, knowledge and its circulation: construction of knowledge of climate and its extremes; and contesting of knowledge between central and local authorities and between the global North and South. The main texts, *The Anthropology of Climate Change* and *Climate Cultures*, were written especially for this course. Two-hour lecture/seminar. 3 Course cr

**F&ES 892a, Introduction to Planning and Development** Alexander Garvin

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. 3 Course cr

**HEALTH AND ENVIRONMENT**

**F&ES 628a, Global Aspects of Food and Nutrition** Debbie Humphries

The course presents a core topic in global health and development that is at the intersection of science, society, and policy. The course familiarizes students with leading approaches to analyzing the causes of malnutrition in countries around the world and to designing and evaluating nutrition interventions. It covers micronutrient and macronutrient deficiencies; approaches to reducing malnutrition; the cultural, economic, environmental, agricultural, and policy context within which malnutrition exists; and the relationships between common infections and nutritional status.

3 Course cr

**F&ES 639b, Urban Sanitation** Shimon Anisfeld

This interdisciplinary course examines the challenges posed by the growing volumes of human excreta that are generated daily in cities around the world. Topics to be covered include: environmental, engineering, and public health aspects of sanitation; the history of sanitation; innovation in sanitation; sewage reuse; cultural and social considerations; and case studies of different centralized and decentralized solutions. The course is organized around two alternative final projects: (1) a spring-break trip to Lima, Peru, where students observe firsthand some of the components of this complex sanitation system and meet with stakeholders ranging from government officials to slum-dwellers to nonprofits pursuing innovative sanitation solutions; and (2) a U.S.-based analysis of a comparable sanitation system. Enrollment is limited to twelve students each from the School of Forestry & Environmental Studies, the School of Public Health, and the Department of Chemical & Environmental Engineering, while participation in the Peru field trip/project is limited to five students from each school. Applications for enrollment and participation in the Peru field trip are due in December 2019. 3 Course cr

**F&ES 646a, Foundations of Agriculture and Environment** Stephen Wood

Agricultural systems have a profound impact on the environment, but also depend on environmental processes—such as climate and nutrient cycling—for continued productivity. Because of this two-way relationship, there has been a growing integration of environmental and agricultural sciences over the past several decades with growing recognition that designing and implementing agricultural systems that minimize environmental harm and benefit people is necessary to sustainable development. This course provides foundational knowledge of how agricultural and environmental systems are linked. The goal is to provide theoretical understanding of the important environmental and human processes, as well as practical experience interpreting these processes and applying them to real-world scenarios. 3 Course cr

**F&ES 721a, Climate Change Adaptation: Resilience and Resistance in Global Health**

Steve Whittaker

Climate change has the observable potential to increase the frequency and intensity of extreme weather events such as hurricanes, heat waves, droughts, frosts, and floods. In response, many concerned citizens, communities, scientific consortia, industries, and governments around the world have sought to address climate change for the sake of global well-being even while others resist the realities of the threat. This course examines climate change effect management strategies: specifically, building resilience in places of acknowledged vulnerability against the grain of philosophical and practical challenges. Environment and health-centered activities resulting from thoughtful, interdisciplinary approaches and audits are held as the ideal among various adaptive responses. Scope includes but is not limited to food, energy, and water security as well as the readiness of health systems in the United States, Latin America, Asia, and the Caribbean. Throughout the term, students engage in readings of journal articles, lectures, discussions, and interactive exercises per themes and critical questions outlined in the syllabus. There are no prerequisites. Enrollment (capped at twenty-five) is open to Yale College juniors and seniors, graduate students, and other scholars. Permission of the instructors required. 3 Course cr

**[ F&ES 727, Food: Science, Law, and Policy ]**

This seminar explores significant challenges posed by the global food supply to environmental quality and human health. The primary obligation is a research paper,

dissertation chapter, master's project, or senior essay draft. We read critically 150–200 pages per week, and students should be prepared to discuss or present analyses. Challenges examined include fresh vs. processed foods, nutritional sufficiency and excess, radionuclides, pesticides, pharmaceuticals, fertilizers, animal feeds, plastics, flame retardants, flavors, fragrances, ingredient fraud, genetic modification, waste, energy input and yield, locality, processing technologies, packaging, and carbon emissions. Corporate case histories are considered in a number of sessions. Private innovations in the production and management of food are analyzed, including trends in certification and labeling initiatives. Most sessions examine one or several foods. Examples include cow's milk, human milk, infant formula, grapes, wine, corn, bananas, tomatoes, salmon, cod, tuna, sodas, fruit juice, water, coffee, and olive oil. Enrollment limited to sixteen. 3 Course cr

#### [ F&ES 893, Principles of Risk Assessment ]

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 and perform QRA. Emphasis is on the intellectual and conceptual basis of risk assessment, particularly its dependence on toxicology, epidemiology, and exposure assessment. Quantitation of exposure and dose response provides practical skills and theoretical background, although not detailed in mathematical and model derivations. 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, drinking water, consumer products, and the built environment 3 Course cr

#### [ F&ES 896, Public Health Toxicology ]

This course is designed to serve as a foundation for understanding public health toxicology in the twenty-first century. Although it includes the basic principles of toxicology such as dose response and mechanisms of toxicity and cellular defense, this course introduces new concepts of toxicology such as lifetime exposures, low-level exposure to mixtures, high-throughput screening and computational toxicology, and green chemistry in order to understand fundamental interactions between chemicals and biological systems and possible health outcomes. Through the use of case studies and up-to-date published research, the course provides insights into prevention of mortality and morbidity resulting from environmental exposure to toxic substances, the next-generation risk assessment and regulatory toxicology, and the causes underlying the variability in susceptibility of people to chemicals. 3 Course cr

#### **F&ES 897b, Environmental and Occupational Exposure Science** Nicole Deziel

This course examines the fundamental and practical aspects of assessing exposures to environmental agents, broadly defined, in the residential, ambient, and workplace environments. The course provides the knowledge and skills to design and conduct exposure assessments, and has a particular focus on applications to environmental epidemiology and risk assessment. Indirect and direct methods of assessing exposures, such as questionnaires, environmental sampling, biological monitoring, and spatial modeling, are reviewed; and case studies and hands-on projects are presented.

3 Course cr

## INDUSTRIAL ECOLOGY, ENVIRONMENTAL PLANNING, AND TECHNOLOGY

### **F&ES 609a, Advanced Seminar on Industrial Ecology: Waste Management and the Circular Economy** Reid Lifset

Diversion of waste from disposal has been a long-standing issue in environmental policy and management. It has gained renewed salience as the notion of the circular economy (CE) has captured the imagination of policy makers, business leaders, and environmental advocates around the world. The CE has also been challenged as to its environmental goals, scientific foundations, and economic feasibility. In a circular economy, resources are kept in circulation for as long as possible, the maximum value is extracted from them while in use, and products and materials are recovered at end of life for continued productive usage. The core conception of closing material cycles and key strategies in the circular economy—reduction, reuse, recycling, extension of product lifespans, product-service systems, systems analysis—have been proposed and examined for more than two decades in industrial ecology. 2 Course cr

### **F&ES 771b, Fundamentals of Green Engineering and Green Chemistry** Paul Anastas

There is a broad desire to ensure that consumer products, manufacturing processes, and material and energy systems are compatible with public health and environmental sustainability. This course provides fundamental knowledge of the frameworks, methods, tools, and techniques of designing for sustainability. Through an understanding of conceptual contracts and application to real-world case studies, students learn the impacts of design on health (including toxic and ecotoxic effects) and the ways to ensure that new products, processes, and systems can be constructed through the principles of green engineering and green chemistry. This course provides the foundation for more advanced investigations in sustainable design; there are no prerequisites. 3 Course cr

### **F&ES 782b, Globalization Space: International Infrastructure and Extrastatecraft** Keller Easterling

The course researches global infrastructure space as a medium of polity. It considers networks of trade, energy, communication, transportation, spatial products, finance, management, and labor as well as new strains of political opportunity that reside within their spatial disposition. Case studies include free zones and automated ports around the world, satellite urbanism in South Asia, high-speed rail in Japan and the Middle East, agripoles in southern Spain, fiber-optic submarine cable and mobile telephony in East Africa, spatial products of tourism in the DPRK, and the standards and management platforms of ISO. 3 Course cr

### **F&ES 884a, Industrial Ecology** Marian Chertow

Industrial ecology studies (1) the flows of materials and energy in industrial and consumer activities, (2) the effects of these flows on the environment, and (3) the influences of economic, political, regulatory, and social factors on the flow, use, and transformation of resources (White 1994). The goals of the course are to define and describe industrial ecology; to demonstrate the relationships among production, consumption, sustainability, and industrial ecology in diverse settings and at multiple scales; to show how industrial ecology serves as a framework for the consideration of environmental and sustainability-related aspects of science, technology, and policy; and to define and describe tools, applications, and implications of industrial ecology. 3 Course cr

**F&ES 885b, Green Engineering and Sustainable Design** Julie Zimmerman

This course provides a hands-on foundation in green engineering and the design and assessment of green products. Approaching sustainability from a design perspective requires a fundamental conceptual shift from the current paradigms of product toward a more sustainable system, based on efficient and effective use of benign materials and energy. Through course assignments, class exercises, and a term-long team project, students are challenged with the same issues facing production and consumption systems today. The course is organized around the “engineering design process” from opportunity definition; criteria definition; ideation; alternatives assessment; and solution selection, implementation, and monitoring. To begin, the mega-trends driving sustainability discussions are presented and the case for new greener product systems is made. The course emphasizes quantitative and rigorous analysis of green design in addition to the tools needed to develop these designs. The foundational principles of the course can be summarized in the five I’s: (1) *Innovation* – we can’t solve problems at the same level of thinking used to create them, (2) *Inherency* – we can’t solve problems without looking at the nature of the system that created them, (3) *Interdisciplinary* – we can’t solve problems without looking at other aspects of the problem, (4) *Integration* – we can’t solve problems without connecting segments at a system level, and (5) *International* – we can’t solve problems without considering their context. The current approach to design, manufacturing, and end of life is discussed in the context of examples and case studies from various sectors, providing a basis for what and how to consider designing green products, processes, and systems. Fundamental engineering design topics include pollution prevention and source reduction, separations and disassembly, virtual and rapid prototyping, life-cycle design, management, and assessment. Enrollment limited to thirty-two. Preference given to second-year M.E.M. students. 3 Course cr

**F&ES 894a, Green Building: Issues and Perspectives** Peter Yost

Our built environment shapes the planet, our communities, and each of us. Green buildings seek to minimize environmental impacts, strengthen the fabric of our cities and towns, and make our work and our homes more productive and fulfilling. This course is an applied course, exploring both the technical and the social-business-political aspects of buildings. Topics range from building science (hygrothermal performance of building enclosures) to indoor environmental quality; from product certifications to resilience (robust buildings and communities in the face of disasters and extended service outages). The purpose of the course is to build a solid background in the processes and issues related to green buildings, equipping students with practical knowledge about the built environment. Extensive use is made of resources from BuildingGreen, Inc., one of the leading information companies supporting green building and green building professionals. The course takes a “joint-discovery” approach with substantial emphasis on research and group project work, some fieldwork, and online individual testing. There are too many topics within green building to cover in one term, so the course is broken down into two sections. The first six weeks focus on the following topics, led by the instructor and/or an expert guest lecturer: building science, materials, indoor environmental quality, rating programs and systems, resilience, systems integration. The second half of the course focuses on selected topics driven by students and their particular interest/academic focus. The class meets once a week, with the instructor available to students that same day. Enrollment limited to twenty-four. 3 Course cr

## Undergraduate Courses

Seminars are identified by an asterisk; enrollment is limited. The abbreviations SC and SO identify courses that fulfill Yale College distributional requirements in the sciences and social sciences, respectively.

### Ecology

#### [ F&ES 221, Field Ecology ]

A field-based introduction to ecological research, using experimental and descriptive approaches, comparative analysis, and modeling for field and small-group projects. Weekly field trips explore local lake, salt marsh, rocky intertidal, traprock ridge, and upland forest ecosystems. Includes one Saturday field trip and a three-day trip during the October recess. Concurrently with or after E&EB 220 or with permission of instructor. 1 Course cr

#### F&ES 315a / E&EB 115a, Conservation Biology Linda Puth

An introduction to ecological and evolutionary principles underpinning efforts to conserve Earth's biodiversity. Efforts to halt the rapid increase in disappearance of both plants and animals. Discussion of sociological and economic issues. SC 1 Course cr

#### [ F&ES 365, Landscape Ecology ]

An introduction to the study of large-scale ecological patterns and processes. Topics include species viability, ecosystem management, and the design of nature reserves. Focus on when and how to integrate a spatial perspective into consideration of major ecological questions. *After* E&EB 220a. 1 Course cr

#### [ F&ES 370, Aquatic Ecology ]

An intensive introduction to the ecology of populations and communities in freshwater systems. Concepts, patterns, and organisms important in lakes and streams; techniques of information collection and analysis. Weekly field trips to gather data. Familiarity with ecological concepts and terminology is presumed. *After* E&EB 220. 1 Course cr

### Physical Sciences

\* F&ES 261a / EVST 261a / G&G 261a, Minerals and Human Health Ruth Blake  
Study of the interrelationships between Earth materials and processes and personal and public health. The transposition from the environment of the chemical elements essential for life. After one year of college-level chemistry or with permission of instructor; G&G 110 recommended. SC 1 Course cr

#### [ F&ES 307, Organic Pollutants in the Environment ]

An overview of the pollution problems posed by toxic organic chemicals, including petroleum, pesticides, PCBs, dioxins, chlorinated solvents, and emerging contaminants. Processes governing the environmental fate of organic pollutants, e.g., evaporation, bioconcentration, sorption, and biodegradation. Technologies for prevention and remediation of organic pollution. No background in organic chemistry required. 1 Course cr

#### \* F&ES 344b / EVST 344b, Aquatic Chemistry Gaboury Benoit

A detailed examination of the principles governing chemical reactions in water. Emphasis on developing the ability to predict the aqueous chemistry of natural, engineered, and perturbed systems based on a knowledge of their biogeochemical setting. Calculation of quantitative solutions to chemical equilibria. Focus on inorganic

chemistry. Topics include elementary thermodynamics, acid-base equilibria, alkalinity, speciation, solubility, mineral stability, redox chemistry, and surface complexation reactions. SC 1 Course cr

**[ F&ES 367, Water Resources and Environmental Change ]**

The effects of variations in the hydrologic cycle on the global distribution of freshwater. The role of environmental change in regulating freshwater supply and quality. The influences of agriculture, industry, mining, urbanization, climate change, and energy-production alternatives on freshwater resources in the United States and abroad. 1 Course cr

**[ F&ES 440, Environmental Hydrology ]**

An overview of the principles that govern the distribution and flows of water and waterborne constituents between the land, atmosphere, and oceans. 1 Course cr

## Quantitative and Research Methods

**\* F&ES 290b / EVST 290b, Geographic Information Systems** Charles Tomlin

A practical introduction to the nature and use of geographic information systems (GIS) in environmental science and management. Applied techniques for the acquisition, creation, storage, management, visualization, animation, transformation, analysis, and synthesis of cartographic data in digital form. 1 Course cr

**[ F&ES 441, Methods in Geomicrobiology ]**

A laboratory-based course providing interdisciplinary practical training in geomicrobiological methods including microbial enrichment and cultivation techniques; light, epifluorescence, and electron microscopy; and molecular methods (DNA extraction, PCR, T-RFLP, FISH). Prerequisite: college-level chemistry. 1 Course cr

## Social Sciences

**[ F&ES 245, Global Environmental Governance ]**

The development of international environmental policy and the functioning of global environmental governance. Critical evaluation of theoretical claims in the literature and the reasoning of policy makers. Introduction of analytical and theoretical tools used to assess environmental problems. Case studies emphasize climate, forestry, and fisheries. 1 Course cr

**F&ES 255b / EVST 255b / GBLB 282b / PLSC 215b, Global Food Challenges:**

**Environmental Politics and Law** John Wargo

We explore relations among food, environment, health, and law. We consider global-scale *avoidable* challenges such as: starvation and malnutrition, obesity, other food related human diseases, climate instability, soil loss, water depletion and contamination, microbial hazards, chemical contamination, food waste, dietary convergence, air pollution, energy, packaging, culinary globalization, and biodiversity loss. We focus on laws that influence the world's food system, including those intended to reduce or prevent environmental and health damages. Other laws protect rights of secrecy, property, speech, confidential business information, free trade, worker protection, equal opportunity, and freedom from discrimination. Ethical concerns of justice, equity, and transparency are prominent themes. Examples of effective law, consumer movements and corporate innovations provide optimism for the future of responsible food. SO 1 Course cr

**[ F&ES 277, Environmental Science and Policy ]**

The synthesis of science, both for scientists and for policy makers. Usefulness of the two types of synthesis for developing scientific research and policy. Advancement of complementary practices between science and policy arenas. Concepts and data from ecological and biogeochemical disciplines are used to predict and manage the effects of environmental change on ecosystem services that underlie the provisioning of resources such as food and clean water. 1 Course cr

**\* F&ES 285b / EVST 285b, Political Ecology of Tropical Forest Conservation**

Amity Doolittle

Study of the relationship between society and the environment focusing on tropical forest conservation. Global processes of environmental conservation, development, and conflicts over natural resource use and control; approaches to conserving trees and forest cover using strategies that support biodiversity and rural agricultural livelihoods; specific focus on tropical forest landscapes dominated by agriculture and cattle ranching practices using Panama and Colombia as a case studies. The course includes an optional field trip during Spring Break: March 17-March 23 in Panama at the ELTI's focal training site. SO 1 Course cr

**[ F&ES 384, Environmental Anthropology ]**

The history and contemporary study of anthropology and the environment, with special attention to current debates regarding human environmental relations. Topics include: nature-culture dichotomy; ecology and social organization; methodological debates; politics of the environment; and knowing the environment. 1 Course cr

**\* F&ES 422a / ANTH 409a / ER&M 394a / EVST 422a, Climate and Society from Past to Present** Michael Dove

Discussion of the major currents of thought – both historic and contemporary – regarding climate, climate change, and society; focusing on the politics of knowledge and belief vs disbelief; and drawing on the social sciences and anthropology in particular. SO 1 Course cr



# 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 that have been initiated by faculty over 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 through funded student internships and projects, coordination of faculty research in areas of common interest, and creation of 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 Green Chemistry and Green Engineering at Yale

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

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

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

The center concentrates on five focus areas:

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

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

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

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

**Industrial collaborations** GC&GE can only provide meaningful impact on the challenges of global sustainability when implemented on a large scale. For this reason, collaboration with industry is a key part of the center's work. Direct engagement creates a dialogue that informs industry of the latest research breakthroughs in the field of sustainable science and technology. Likewise, such engagement informs academic researchers on industry's most important concerns. This dialogue facilitates a direct line for implementation of these innovations.

## Center for Industrial Ecology

The Center for Industrial Ecology (CIE) is dedicated to the development and promotion of research, teaching, and outreach in industrial ecology. Through the study of consumption and production systems, industrial ecology helps companies and policy makers to understand how resources are converted to products and how pollution comes about as a byproduct of that process, and to identify options to reduce resource use and pollution. Industrial ecology addresses the environmental footprints of products and technologies through mass and energy balances, thus also helping consumers make environmentally conscious decisions. Among the programs and goals of the center are the following:

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

Major foci include (1) the Clean Energy Choices project, which assesses different options to mitigate greenhouse gas emissions from our energy system in terms of their feasibility, resource requirements, and environmental impacts; (2) development of a generalizable system dynamics modeling framework to assess the profitability and net energy, CO<sub>2</sub> emissions, and resource-saving benefits of U.S. fiber-recycling systems under different economic, technological, and scrap market assumptions; and leadership of the systems node of REMADE Institute, which seeks to reduce energy use and greenhouse gas emissions of materials production through recycling and remanufacturing; CIE's role addresses understanding the stocks and flows of materials, developing scenarios, and analyzing benefits; (3) the Industrial Symbiosis Project, in which multiyear research has been conducted, including examination of the environmental and economic rationale for intra-industry exchange of materials,

water, and energy; (4) a project for the U.S. Critical Materials Institute providing material flow and scenario analyses for several critical materials, as well as forward-looking criticality assessments and underlying economic analyses; (5) the Program on Industrial Ecology in Developing Countries, which adapts industrial ecology theory and practice to issues related to energy access, water quality and quantity, waste and material management, and global warming in industrializing countries with a current focus on a study of low-carbon and sustainable cities in China, India, and the United States; and (6) Extended Producer Responsibility (EPR) research, which analyzes the conceptual, policy, and legal foundations of EPR, including the investigation of the governance of EPR and the conditions necessary for the implementation of individual producer responsibility as well as development of a reference database of studies and documents.

## JOURNAL OF INDUSTRIAL ECOLOGY

CIE is home to a highly regarded international journal. Published by Wiley and owned by Yale University, the *Journal of Industrial Ecology* is a peer-reviewed, online, multidisciplinary bimonthly on industry and the environment that is aimed at both researchers and practitioners in academe, industry, government, and advocacy organizations. It is edited in partnership with Tsinghua University in Beijing, China, and the Norwegian University of Science and Technology in Trondheim, Norway. The *Journal of Industrial Ecology* is indexed in Science Citation Index Expanded (ISI), and it is the official journal of the International Society for Industrial Ecology. See [www.wileyonlinelibrary.com/journal/jie](http://www.wileyonlinelibrary.com/journal/jie).

## INDUSTRIAL ENVIRONMENTAL MANAGEMENT PROGRAM

The Industrial Environmental Management (IEM) program at Yale aims to equip students with an integrated set of skills with which to tackle the complex, multifaceted environmental problems facing industrial and corporate managers. The core intellectual framework for IEM is the systems science of industrial ecology, which examines materials, water, and energy in a common framework. Students can pursue specialization and certification through the M.E.M. program in Industrial Ecology and Green Chemistry.

An active Industrial Environmental Management and Energy Student Interest Group sponsors field trips to industrial sites, on-campus talks by visiting managers, and symposia on current topics of interest.

## PROGRAM ON SOLID WASTE POLICY

The program has two principal goals: (1) to inform contemporary policy discussions about solid waste and materials management and the circular economy by applying the methods and findings of social and environmental science and industrial ecology; and (2) to develop workable policy solutions that address the impediments to safe, cost-effective solid waste management and the complexities of comprehensive materials and life-cycle management. Current research focuses on high-resolution mapping of nonhazardous industrial waste to improve the potential for reuse.

## The Environmental Leadership and Training Initiative

In April 2006 the Environmental Leadership and Training Initiative (ELTI) – <http://elti.yale.edu> – was launched, thanks to a generous grant from the Arcadia Fund, a charitable fund of Lisbet Rausing and Peter Baldwin. For the execution of the project, F&ES has partnered with more than twenty organizations, including universities, research institutes, government ministries, NGOs, and community organizations, in tropical countries around the globe. ELTI's mission is to train and support people from all sectors and backgrounds to restore and conserve tropical forest landscapes using strategies that support biodiversity and livelihoods. Through complementary, applied, and action-oriented training and leadership support, ELTI strives to accelerate on-the-ground conservation and restoration results with the people who manage and influence tropical forest landscapes.

ELTI was created to strengthen the conservation and restoration of tropical forest landscapes by offering field-based, online, and blended courses to policy makers, natural resource practitioners, community members, and other key actors who manage and influence these regions. ELTI's primary field programs that include training landscapes established with local partners are located in Brazil, Colombia, Panama, Indonesia, and the Philippines. The online program is global in reach, with several courses occurring in African countries. The program's goal is to provide participants with the knowledge, tools, skills, and networking opportunities to advance the conservation and restoration of forests and biodiversity. Alumni of ELTI's training events can participate in ELTI's Leadership Program, which supports their efforts to share and apply what they learn during an ELTI course. ELTI involves faculty, staff, and students from F&ES in various aspects of the program, as well as scientists, practitioners, and land managers in the countries where ELTI works.

## Forum on Religion and Ecology at Yale

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

The forum arose from a series of ten conferences on the world's religions and ecology held at Harvard from 1996 to 1998, which resulted in ten volumes distributed by Harvard University Press. Several of these volumes have been translated into other languages, including Chinese.

One of the principal objectives of the Forum on Religion and Ecology was to help create a new field of study that will assist environmental policy. Since its creation, the forum has played an active role in promoting the study of religion and ecology as an emerging field of study and a force for transformation. Courses are now taught at colleges

and high schools across North America and in some universities in Europe. Canada, Australia, and Europe now have their own forums on religion and ecology. Moreover, a new force of religious environmentalism is growing in churches, synagogues, temples, and mosques around the world. Now every major religion has statements on the importance of ecological protection, and hundreds of grassroots projects have emerged. The Forum on Religion and Ecology has played an active role in these developments. The work of the forum includes:

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

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

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

- The forum, with its scholarly network, published the ten-volume *World Religions and Ecology* series from Harvard.
- In 2014 the forum published the book *Ecology and Religion*, by John Grim and Mary Evelyn Tucker, in an F&ES series from Island Press.
- The forum has supported the first journal in the field, *Worldviews: Global Religions, Culture, and Ecology*.
- It produced a *Daedalus* volume, *Religion and Ecology: Can the Climate Change?*, which was the first discussion of world religions and the ethics of climate change.
- The forum's founders have also served as editors for the twenty-volume *Ecology and Justice* series from Orbis Books.
- The encyclopedia *The Spirit of Sustainability* (Berkshire Publishers, 2009), edited by Willis Jenkins of the University of Virginia and Whitney Bauman of Florida International University, was also a project of the forum.
- Tucker and Grim have also edited a number of volumes by the late cultural historian Thomas Berry: *The Sacred Universe* (Columbia University Press, 2009), *The Christian Future and the Fate of Earth* (Orbis Books, 2009), *Evening Thoughts* (Sierra Club Books, 2006), and *The Great Work* (Random House, 1999).

**Conferences** The forum has organized many conferences, including “Renewing Hope: Pathways of Grassroots Religious Environmentalism” (F&ES and YDS, 2007), the Forum on Religion and Ecology's 10th Anniversary Symposium (Yale Club of New York, 2008), and the Thomas Berry Memorial (Cathedral of St. John the Divine, New York, 2009). The forum cosponsored the conference “Environmental Dis/locations: Environmental Justice and Climate Change” (F&ES & YDS, 2010) and organized

an interdisciplinary conference for the premiere of the film *Journey of the Universe* at F&ES (2011). It has also assisted in organizing the Thomas Berry Award and Lecture since 1998. The forum organized with TERI University an interdisciplinary workshop focused on the Yamuna River and held in Delhi and Vrindavan in north India (2011). In 2012 the forum organized a conference between F&ES and YDS titled “Religion and Environmental Stewardship.”

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

**Website** The forum’s website is a world-class international site for research, education, engagement, and outreach in the field of religion and ecology. It contains detailed information on the world’s religions and their ecological contributions; resources that address environmental issues related to ethics, economics, policy, and ecological sciences; syllabi and lists of educational videos and CD-ROMs; links to programs and institutions related to environmental education; and a variety of other resources for educators. The site provides current information on news, publications, and events related to world religions and ecology. This is available in a monthly online newsletter that is distributed to some 12,000 people. See <http://fore.yale.edu>.

**Films** The forum was a principal adviser for the film *Renewal: Inspiring Stories from America’s Religious Environmental Movement* (2007), and it collaborated with evolutionary philosopher Brian Swimme on the Emmy Award-winning film *Journey of the Universe* (2011), which was broadcast on PBS. The latter project includes a book published by Yale University Press, a twenty-part DVD series of interviews, curricular materials, and a website, <http://www.journeyoftheuniverse.org>.

## The Global Institute of Sustainable Forestry

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

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

Forestry at Yale is broadly defined to include all aspects of forest management and conservation. The Global Institute works primarily through faculty-led programs and partnerships with other Yale centers and forestry institutions in the United States and abroad. Students participate as research assistants, interns, and School Forests field crew; are encouraged to take on high levels of leadership in planning activities and events; and regularly contribute to published documents that emerge from program activities.

The Global Institute coordinates the School's participation in regional, national, and international forestry events such as the Society of American Foresters and IUFRO (International Union of Forest Research Organizations) Conferences and the World Forestry Congresses, and coordinates activities with other institutions throughout the world.

### **YALE FOREST FORUM (YFF)**

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

YFF's activities are centered on bringing individuals together for open public dialogues to share experiences, explore emerging issues, and debate varying opinions constructively. In that light YFF sponsors issues forums and leadership seminars throughout the academic year. YFF forums and seminars not only focus on emerging issues in forest management, they also give students exposure to leaders in the NGO, industry, landowner, and government sectors in forest conservation and sustainable forestry. They provide an opportunity for diverse parties to meet and exchange ideas and have led to ongoing dialogue concerning forestry problems and solutions. YFF publishes the *YFF Review* to disseminate to a wide audience the outcomes and lessons learned from its work.

### **UCROSS HIGH PLAINS STEWARDSHIP INITIATIVE**

The Ucross High Plains Stewardship Initiative (UHPSI) fosters land stewardship and conservation in the American West through teaching, research, and outreach. This is primarily achieved through mentoring students on applied research and management projects in collaboration with Western partners. Research and management projects are diverse and interdisciplinary, and address Western conservation challenges. Our broad network of more than fifty partners comprises ranchers, nonprofits, federal and state agencies, and academics. Students engaged with UHPSI develop knowledge and skills in Western issues and natural resource management on private and public lands through our collaborative, experiential-learning framework.

For more information about UHPSI, visit <http://highplainsstewardship.org>.

### **PROGRAM ON LANDSCAPE MANAGEMENT**

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. Ecosystems contain forests and other resources that interact both competitively and synergistically. Managing ecosystems requires an understanding and appreciation of the biological, social, and economic dynamics of ecosystems.

Experience in forest management has shown that managing at small scales is difficult, because many different values need to be provided. Consequently, diverse conditions

need to be coordinated across the landscape. This is the basis of the landscape approach to forest and other resource management.

The Program on Landscape Management works cooperatively with other organizations throughout the world. It develops the scientific basis, concepts, and tools needed to help people provide a wide range of resource values, including commodities, wildlife habitat, fire safety, employment, and carbon sequestration.

The program applies local knowledge, science, and technical tools to achieve practical results (see D.E. Stokes, *Pasteur's Quadrant*, Brookings Institution Press, 1997). Ongoing projects include developing open-source, online access software that allows landowners throughout the world to manage forests sustainably and to demonstrate that their forests are sustainable with regard to sustainable development goals (SDGs); this project builds on the Landscape Management System (see <http://landscapemanagementsystem.org>) and is cooperative among the General Directorate of Forestry of Turkey, the United Nations Development Programme, Yale Global Institute of Sustainable Forestry, and the University of Washington College of the Environment. Another ongoing project is examining the potential of expanded wood use to substitute for steel and brick construction, and thus reduce greenhouse gas emissions and fossil fuel consumption. Recently completed projects include developing a sustained harvest level for Connecticut state forests; mitigating the wildfire danger in the irradiated forests around the Chernobyl nuclear reactor, Ukraine; developing ways to increase habitats for the Amur (Siberian) tiger in northeastern China; and developing a decision tool for conversion between agriculture and forest land in Mississippi.

## SUSTAINING FAMILY FORESTS INITIATIVE

The Sustaining Family Forests Initiative (SFFI) is a collaboration among the School of Forestry & Environmental Studies, the U.S. Forest Service, and the Center for Nonprofit Strategies, aimed at gaining and disseminating comprehensive knowledge about family forest owners throughout the United States. SFFI conducts research on U.S. family forest owners and has developed a practical set of tools to help conservation and forestry professionals reach these landowners with effective stewardship messages and to develop programs that serve the needs and values of the landowners. The basis of SFFI's work is to apply a social marketing approach—the use of commercial marketing techniques to affect positive social change—as a promising means by which to influence family forest owners to take steps to conserve and sustainably manage their land. Since 2010 SFFI has trained more than twelve hundred natural resource professionals in landowner outreach. These professionals work in thirty-five states and represent more than 350 organizations, primarily state forestry agencies and their conservation and stewardship partners. More information about SFFI is available at <http://sffi.yale.edu>.

## Governance, Environment, and Markets Initiative

The Governance, Environment, and Markets (GEM) Initiative is an action-oriented network of scholars and practitioners who collaborate on the study, development, and implementation of effective, durable, and equitable solutions to complex problems in environmental policy and governance. The GEM Initiative provides Yale students an opportunity to work as researchers and assist in the coordination and delivery



of worldwide activities that address three cross-cutting themes: the management of complex governance arrangements; the fostering of learning among multiple stakeholders; and the determinants of effective, durable policy pathways.

Embracing a future of multiparty collaboration, GEM's research, teaching, and outreach activities bridge scholarship and practice and encourage long-term and collaborative approaches to some of the most important questions facing the planet, including forest policy and governance, climate policy, and the role of private governance. GEM identifies and promotes viable pathways for government officials, the private sector, environmental groups, and other stakeholders to effect positive change in environmental governance.

The GEM Initiative accomplishes this objective through a "governing for global environmental problems" approach in which innovative governance/policy proposals are assessed by their ability to develop enduring solutions to global environmental challenges. In order to uncover new opportunities, we focus on understanding and disseminating knowledge about:

- Multi-stakeholder policy learning for ameliorating environmental problems;
- Pathways for durable results

These efforts divert attention from purely interest-based compromises that, in many cases, are incapable of addressing environmental problems, in order to focus stakeholders from government, business, and NGOs on better understanding the complex causal processes through which policy instruments might be nurtured over time. Key thematic areas on which we focus our efforts include:

**Private Authority and Environmental Governance** This program focuses on the emergence and evolution of "non-state, market-driven" global governance, particularly certification systems. The use of these systems to address environmental problems has the potential to shift the prevailing regulatory paradigm. Our work explores under what circumstances market mechanisms, such as certification systems, effectively address problems where governments have failed. We focus on several sectors, including timber legality verification and forest certification, fisheries and the ornamental fish trade, organic agriculture, climate mitigation, and electronic waste recycling.

**Climate Policy and Governance** GEM's substantive focus on climate departs from existing international relations research, which focuses primarily on why states do or do not cooperate in exploring policy interventions outside of this model. GEM applies key mechanisms to assess climate in three ways: (1) How climate, as the leading case of a "super wicked problem," might benefit from attention to "path-dependency" policy analysis; (2) How symbiotic interaction among intergovernmental approaches, such as the CDM mechanisms, might interact with non-state, market-driven global governance, such as the CDM gold standard certification, to produce authoritative approaches in ways that neither intervention by itself could; and (3) How the intersection of climate and forests might shape the definition of problems and solutions unimaginable a generation earlier. Significant attention is devoted to the intersection of technology, path dependency, and policy innovation.

**Environment, Resource, Land Use, and Forest Policy and Governance** This effort houses three interrelated efforts: (1) research designed to understand the development of state and non-state resources policies and their impacts on land use change and sustainable resource and forest management; (2) teaching and training; and (3)

outreach activities to the broader applied community. The program hosts visiting speakers at Yale and participates in key conferences.

**Law, Rights, and Environmental Governance** Numerous jurisdictions have developed new procedural and substantive environmental rights and have sought to provide enhanced access to decision-making, information, and justice in environmental matters. Private rights also continue to play an important role in how environmental issues and problems are addressed in different jurisdictions. These rights raise critical issues about the role of legal norms in different systems, modes, and levels of environmental governance. GEM's Program on Law, Rights, and Environmental Governance seeks to understand and explain the implications of law and rights for efforts to improve environmental governance at the local, national, and international levels. The program aims to generate innovative interdisciplinary knowledge that assesses the emergence, spread, and effectiveness of rights norms across political, institutional, and social contexts, processes, and actors. It also seeks to share this analytical research with practitioners and policy makers working at the intersection of law, rights, and environmental governance.

## Hixon Center for Urban Ecology

The Hixon Center for Urban Ecology provides an interdisciplinary forum for scholars, students, and practitioners to work collaboratively on integrated research, teaching, and outreach to improve our understanding and management of urban environmental systems 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 and the people who live there. This need has never been greater than today, when a majority of the world's population either resides in or is rapidly migrating to urban areas.

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

The Hixon Center has a strong focus on collaboration within the School, across the University, and beyond. The center sponsors lectures and symposia as a means to disseminate ideas about and understanding of the critical issues confronting urban ecosystems.

The Hixon Center also supports Yale faculty initiatives to optimize sustainability and resilience through observational and experimental research on the urban water cycle, green infrastructure, vegetation, urban green spaces, and people. In addition, the center supports students' basic and applied research through fellowships connected to current Hixon Center priorities in the realm 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 challenges.

## 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, must emphasize social revitalization alongside environmental restoration.

Yale's URI program draws on these essential elements to facilitate community participation in urban ecosystem management. "Community" is defined quite broadly. It includes the group of neighborhood leaders with whom interns work to restore abandoned lands near their homes. Community is a group of teens who are learning how to assess the tree canopy of their city. Community is the staff and leadership of city agencies who have the responsibility and resources to become the environmental stewards of their city. URI's approach responds to and engages all of these communities.

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

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

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

**Environmental education/green job training** Since 1991 URI education interns have taught hands-on environmental education programs to New Haven public school students. For many years, URI staff and interns worked directly within the New Haven school system, teaching thousands of elementary school students about environmental stewardship through the exploration of the city's open spaces. During the 2009–2010 academic year, the City of New Haven officially incorporated the pond and rivers

units from URI's Open Spaces as Learning Places curriculum into the district's science curriculum. Now, students in every sixth-grade classroom have the opportunity to learn about watersheds as they canoe New Haven's rivers and explore local ponds.

URI's GreenSkills program creates opportunities for teens and adults to learn about and improve New Haven's tree canopy and to gain practical job skills. Launched in 2007, the GreenSkills program creates an opportunity to address a critical predicament—a growing deficit in New Haven's street tree canopy that can be countered by a career development program bringing together Yale and high school interns. In 2010 the GreenSkills program was expanded to include adults with barriers to employment, particularly those recently released from incarceration. Its goals are to improve New Haven's street tree canopy by engaging vulnerable adults and local high school students in the planting effort, thereby providing them with job skills and mentoring opportunities in environmental careers, and to foster a sense of environmental stewardship.

**Research** URI activities provide valuable research opportunities in community organizing and development, urban forestry management, environmental education, and monitoring and evaluation of community-managed ecosystems. Some examples of past student research activities include a community survey to determine human health impacts of vacant lands; measurement of biological communities found in Greenspace sites and abandoned lots; how community group dynamics affect urban street-tree survival; and measurement of how children's behavior at play is affected by the design of schoolyards.

## URBAN WATERSHED PROGRAM

The Urban Watershed Program promotes faculty and student research on the unique relationships, impacts, and demands of watersheds in urban areas. Watersheds in urban areas encounter unique stresses, while sharing common characteristics and following natural laws of all water systems. Urban watersheds are often polluted, heavily engineered, and little understood by nearby residents. Stream courses are often transferred to pipes running underground. Population density exacerbates stresses on waterways. As cities emerge from a period when they ignored their rivers and harbors, new relationships are being developed with adjacent waterways. Past practices that marginalized waterscapes from the urban environment are being reevaluated. Now, with more attention to urban environmental quality, there is a greater understanding of the vital role waterways play as sources of open space, transportation, recreation, and habitat.

The Urban Watershed initiative currently has two major activities. One is a study of an urban ecosystem restoration project situated in an urban park. For nearly a century, flow in the West River, on the New Haven–West Haven border, has been regulated by tide gates that allow the outward flow of freshwater, but restrict flushing by seawater. These restrictions are being replaced by self-regulating tide gates, which close only in the rare event of potentially hazardous storm surges. As a result, the current degraded tidal freshwater marsh will evolve into a healthier salt marsh, the ecosystem type that existed there in the past. This restoration is being monitored, using a nearby, gated marsh that will not be restored. Monitored parameters are water quality, hydrology, vegetation, fish populations, bird communities, and the attitudes, values,

and recreational and stewardship behaviors of people who use the park. This before-after-control-impact (BACI) experiment is almost unprecedented at this scale.

The second major activity of the Hixon Center's Urban Watershed Program is to monitor, evaluate, and optimize green infrastructure solutions to manage stormwater and improve water quality in partnership with the City of New Haven. In New Haven, three rivers flow through densely settled urban areas before draining into New Haven Harbor and Long Island Sound. Large areas of impervious surface and compacted soils lead to significant overland flow of contaminated stormwater. The contamination in the waterways is the direct result of stormwater runoff from the city's impervious surfaces, overloading the city's combined and separate storm sewer systems, and eventually discharging into Long Island Sound. Green infrastructure such as infiltration bioswales significantly reduces storm flows and improves water quality. URI, in partnership with the City of New Haven and EMERGE, a local NGO, is installing one hundred bioswales to improve stormwater quality and reduce storm flows to separated and combined sewers.

### **YALE EXPERIMENTAL WATERSHED**

The Yale Experimental Watershed (YEW) is a living laboratory of urban ecology located adjacent to the School. The YEW, a 5.5-acre site between Prospect and Mansfield streets, is being transformed from an underutilized and overgrown site to one that is of great value to the University and the community – where academic research and teaching are conducted, and community members can learn and explore.

Fieldwork and research projects have included tree identification and mapping, coarse woody material assessment, soil sampling and analysis, land cover mapping, bird habitat investigation, and site hydrology and groundwater monitoring. The site has also been used as an educational resource for graduate courses in the School of Forestry & Environmental Studies, for high school students in the Common Ground Green Jobs Corps and the Yale SCHOLAR program, and for interns from high schools such as Achievement First Amistad and Hopkins School.

## **The SEARCH Center: Solutions for Energy, AiR, Climate, and Health**

The SEARCH Center (Solutions for Energy, AiR, Climate, and Health), funded by a five-year Air, Climate and Energy (ACE) Center grant from the U.S. Environmental Protection Agency, aligns cutting-edge scientific research and technology to support the EPA's strategic goals of protecting human health and the environment. Based at Yale University, with major participation by Johns Hopkins University, the SEARCH Center involves more than two-dozen researchers across a number of institutions including North Carolina State University, Stanford University, Northeastern University, University of Chicago, University of Michigan, and the Pacific Northwest National Laboratory.

The center's main objectives are to: (1) investigate energy-related transitions under way across the United States by combining state-of-the-science modeling of energy systems, air quality, climate, and health; (2) characterize factors contributing to emissions, air quality, and health associated with key energy-related transitions in order to understand how these factors affect regional and local differences in air pollution and public health effects today and in the future; and (3) identify key modifiable factors

(e.g., transportation, land use, power generation) and how those factors and their air pollution impacts are likely to change over time. The center has four research projects, two support units, and an administrative core.

- Project 1 (*Modeling Emissions from Energy Transitions*) encompasses economic modeling of national emissions and air quality under different energy policy scenarios.
- Project 2 (*Assessment of Energy-Related Sources, Factors, and Transitions Using Novel High-Resolution Ambient Air Monitoring Networks and Personal Monitors*) measures and examines real-world exposure to air pollution using stationary and personal monitors.
- Project 3 (*Air Quality and Climate Change Modeling*) draws upon projects 1 and 2 to model relationships between air quality, policy, and health under various climate change scenarios using air quality and climate change modeling.
- Project 4 (*Human Health Impacts of Energy Transitions*) estimates the health impacts of various air quality scenarios from the other SEARCH projects and identifies populations most vulnerable to air pollution.
- The Policy and Decision-Making Unit bridges the divide that often separates science and policy through iterative processes bringing SEARCH scientists and real-world policy makers together.
- The Environmental Data Science Unit provides statistical support for all four projects. This unit is developing statistical methods to address the scientific questions of interest and will facilitate integration across different projects. This unit will also encourage reproducible research through dissemination of data and statistical code, where feasible.

## The Forests Dialogue

The Forests Dialogue (TFD) was established in 2000 to provide international leaders in the forest sector with an ongoing, multi-stakeholder dialogue platform and process focused on developing mutual trust, a shared understanding, and collaborative solutions to challenges in achieving sustainable forest management and forest conservation around the world. In recent years, TFD has expanded its remit to include all actors across the landscape, not just the forest sector. TFD is an autonomous, unincorporated organization hosted by Yale University and with a Secretariat based at F&ES.

The goal of TFD is to reduce conflict among stakeholders over the use and protection of vital forest resources. Since its founding, TFD has brought together more than 3,000 diverse leaders to work through nineteen key compelling forest and landscape sustainability challenges. Current TFD initiatives include: Land Tenure Reform (LTR), The Land Use Dialogues (LUD), Tree Plantations in the Landscape (TPL), and Understanding Deforestation-Free (UDF). TFD uses the multi-stakeholder dialogue model to progress from building trust among participants to achieving substantive, tangible outcomes in such a way that participants are committed to advocate for and work to implement those consensus-based outcomes.

TFD is governed by a steering committee composed of leading individuals representing key stakeholder groups from around the world. TFD hires F&ES students as program associates each term to work with the Secretariat and steering committee members on

all facets of TFD's operations. Duties include background research, communications, Secretariat support, dialogue planning, and implementation. Students who are interested in forest and landscape-related issues as well as those who are interested in stakeholder engagement are encouraged to apply to work with TFD.

## Tropical Resources Institute

The mission of the Tropical Resources Institute (TRI) is to support interdisciplinary student research on the most complex challenges confronting the conservation and management of tropical environments worldwide. TRI was created in 1983 to strengthen the School's involvement in the study and management of tropical resources. The institute recognizes that the problems surrounding the conservation and management of tropical resources are rapidly increasing in complexity, while demands on those resources continue to grow. Emerging structures of global environmental governance and local conflicts over land use require new strategies and leaders able to function across diverse disciplines and sectors, and at multiple scales. TRI seeks to train students to be leaders in this new era, equipping them with the resources and tools this new generation will require to equitably address the challenges ahead.

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

TRI is run by a director, student program assistants, and a faculty steering committee. Its directorship and its student grant program are supported by its own endowments.

**Research** TRI administers the TRI Fellowship, an endowed fellowship program that supports several dozen master's and doctoral students conducting natural and social science research in the tropics each year. Following the mission of TRI, these research projects are typically interdisciplinary and problem-oriented and cover a wide range of issues concerning the management and conservation of tropical resources. TRI also administers a small grants program focused on Sri Lanka. More information on both programs can be found at <http://tri.yale.edu>.

**Education** Throughout the academic year, TRI sponsors workshops, discussions, and speakers that focus on timely conservation and development issues in the global tropics.

TRI provides mentoring and training to graduate students in research design, proposal writing, and field methods; after research, it helps them develop articles for *Tropical Resources*, TRI's annual journal of student research.

**Outreach** TRI supports partnerships with international organizations in many tropical regions in order to create innovative research opportunities for F&ES students. TRI works to build networks among scholars and international institutions to facilitate research and the dissemination of knowledge on tropical resource issues. TRI distributes its annual *Bulletin* to an international list of practitioners and academics, and it hosts a website, <http://tri.yale.edu>.

**Publications** TRI publishes *Tropical Resources: The Bulletin of the Yale Tropical Resources Institute*, an annual journal of student research funded by grants from TRI. This publication is disseminated both internationally and domestically to a list that includes practitioners, academics, and institutions that focus on tropical issues; it can also be

read online at <http://tri.yale.edu/tropical-resources-bulletin>. *Tropical Resources* typically contains articles by a dozen or more students based on a wide range of field research experiences.

## Yale Center for Business and the Environment

The Yale Center for Business and the Environment (CBEY) educates and inspires interdisciplinary leaders through business solutions to systemic environmental problems.

CBEY joins the strengths of two world-renowned graduate schools—the Yale School of Forestry & Environmental Studies (F&ES) and the Yale School of Management (SOM)—together with a global network of thought leaders and practitioners working at the interface of business and the environment. Home to the oldest and nationally preeminent joint-degree program in business and the environment, we address the need for both environmentally minded business leaders and skilled managers in environmental organizations.

Our approach is characterized by pragmatic optimism: we hold simultaneous ambitions for incremental and systemic change. While we recognize that this takes time, we also recognize a profound urgency in the work that we do. We are building world-class resources for our community of alumni, students, academics, corporate executives, governments, and NGOs in three key areas: (1) new models for markets and finance; (2) innovation and entrepreneurship; (3) “intrapreneurship” and systems change.

CBEY’s vision is to build a purpose-driven community that collaborates in diverse networks to:

- CBEYond boundaries, disciplines, and challenges and move toward sustainable solutions
- CBEYond current business models by catalyzing innovation and entrepreneurship
- CBEYond traditional financial markets by growing sustainable investment
- CBEYond the degree into active-learning communities and vibrant alumni networks

To learn more, visit <http://cbey.yale.edu>.

## Yale Center for Environmental Communication

The Yale Center for Environmental Communication (YCEC) conducts research on the psychological, cultural, and political factors that influence environmental attitudes and behavior; teaches students and trains working professionals; informs and engages the public through environmental journalism; and supports a global network of organizations seeking to build public and political will for environmental solutions.

**Research** The YCEC conducts world-class research on climate change and environmental communication. Research results are published in public reports, interactive maps, and scientific articles and are shared via public presentations and private briefings. The findings are used by hundreds of news organizations, including CBS, ABC, NBC, CNN, the *New York Times*, *Washington Post*, Associated Press, the *Guardian*, Xinhua, and many others.



**Teaching and training** The YCEC provides courses in environmental communication for Yale graduate and undergraduate students and training programs for working environmental professionals.

**Environmental journalism** The YCEC informs and engages the public in environmental science and solutions through several environmental journalism initiatives, including *Yale Environment 360*, Yale Climate Connections, the Environmental Film Festival at Yale, *Sage Magazine*, and the *Yale Environmental Review*.

**Supporting a global network of environmental communicators** The YCEC organizes national and international meetings, conferences, and events to convene climate change and environmental leaders and supports a global network of environmental communication scholars and practitioners.

## Yale Center for Environmental Law & Policy

The Yale Center for Environmental Law & Policy, a joint undertaking between Yale Law School and the Yale School of Forestry & Environmental Studies, advances fresh thinking and analytically rigorous approaches to environmental decision-making across disciplines, sectors, and scales. In addition to its research activities, the center also aims to foster discussion and collaboration across the Yale campus on environmental law and policy issues at the local, regional, national, and global levels. Its recent projects include the biennial Environmental Performance Index (<http://epi.yale.edu>), which ranks countries on performance indicators tracked across policy categories covering both environmental public health and ecosystem vitality, as well as initiatives on sustainable finance, trade and climate change, rethinking environmental protection for the twenty-first century, corporate sustainability, and global climate governance. For additional information, visit <http://envirocenter.yale.edu>.

## Yale Program on Climate Change Communication

The Yale Program on Climate Change Communication conducts scientific research on public climate change knowledge, attitudes, policy preferences, and behavior, and on the underlying psychological, cultural, and political factors that influence them. We also engage the public in climate change science and solutions, in partnership with governments, media organizations, companies, and civil society, and with a daily national radio program, Yale Climate Connections.

# PARTNERSHIPS

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

## Within Yale

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

The School has joint-degree agreements with the School of Architecture, Divinity School, Law School, School of Management, School of Public Health, and Graduate School of Arts and Sciences. For further information on joint degrees, please refer to Joint Master's Degree Programs in the chapter Master's Degree Programs, and to Combined Doctoral Degree in the chapter Doctoral Degree Program.

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

## YALE INSTITUTE FOR BIOSPHERIC STUDIES

Established in May 1990, the Yale Institute for Biospheric Studies (YIBS) serves as a key convener 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 and programs 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 three YIBS centers: the Center for Earth Observation, the Earth System Center for Stable Isotopic Studies, and the Center for Genetic Analysis of Biodiversity. YIBS also provides master's and doctoral student research support through various small-grant initiatives and a doctoral dissertation-enhancement grant program. For full information on YIBS and its associated programs and centers, see <http://yibs.yale.edu>.

## 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 thirteen million objects and specimens, the collections are used for exhibition and for research by scholars throughout the world. Each year, an increasing number of specimens from the collection are available online at <http://peabody.yale.edu>.

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

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

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

In 1995, a formal collaboration was established among the Peabody Museum, the Yale Institute for Biospheric Studies, and the School of Forestry & Environmental Studies. This environmental partnership recognizes the Peabody Museum as a resource and catalyst for interdisciplinary research on Earth's history and environment, and seeks to strengthen the intellectual ties between the museum and other groups with a shared interest in environmental research at Yale. The School of Forestry & Environmental Studies maintains a close association with the Peabody.

**Coastal field station** The Peabody Museum Field Station on Long Island Sound in Guilford, Connecticut, is used collaboratively by F&ES faculty, staff, and students for research on coastal and estuarine systems. The station is a thirteen-mile drive east of Yale and provides centrally located access to one of the country's most important estuaries. The station includes a boat ramp, deep-water moorings, and a small boat. There is also simple laboratory space within the field station building, Beattie House. Nearby research lands available to F&ES students include an island (Horse Island), coastal pond (Guilford Pond), and salt marsh complex (the Richards Property).

## 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.

### NATIONAL UNIVERSITY OF SINGAPORE

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

In 2001 the Yale School of Forestry & Environmental Studies entered into an official agreement with the National University of Singapore School of Design and

Environment to share scientific, academic, and technical resources; exchange faculty and students; and cooperate in research, outreach, and conferences. There is an active faculty exchange and a joint research program examining industrial ecology and urban metabolism in Singapore.

### **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 about a dozen students who are carrying out studies in systematic and economic botany and applied plant ecology 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, an herbarium 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 School of Forestry & Environmental Studies offers a combined doctoral degree with the New York Botanical Garden, which is funded by the Lewis B. Cullman Fellowship. NYBG faculty teach courses at F&ES in tropical plant taxonomy, applied plant ecology, and ethnobotany.

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

The Yale School of Forestry & Environmental Studies also has joint-degree agreements with the Pace University School of Law, the Vermont Law School, Tsinghua University School of Environment, and Universidad de los Andes. Further information on these programs is available through the Office of Admissions.

# ADMISSIONS: MASTER'S DEGREE PROGRAMS

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

## Learning about F&ES

The best way to learn about the School is to visit New Haven before submitting an application. An on-campus open house for prospective students will be held in the fall (November 22, 2019). Participants will meet faculty, students, and staff to become familiar with the mission and goals, degree requirements and courses, opportunities for research and applied projects, career development, and life at Yale. F&ES faculty and staff also conduct outreach events around the United States and abroad, including attending graduate school fairs, hosting off-campus information sessions, and visiting schools and universities. To learn whether a representative will be coming to your area, please visit the admissions event schedule at <http://environment.yale.edu/admissions>.

The Office of Admissions offers a formal campus visit program throughout the year, and we encourage prospective students to visit during one of these events for the most comprehensive view of F&ES. Individual appointments are also available based on staff availability. Please note that it is best to visit Monday through Thursday, as few classes are held on Fridays, which are generally reserved for field trips and research. Weekend visits are not available. Visitors are welcome to sit in on classes of interest with no advance notice; the class schedule each term is posted at <http://environment.yale.edu/courses>. Feel free to contact directly any faculty member whose work is of interest to you; e-mail is best. We do not conduct formal interviews. To schedule a visit, please contact us at [fesinfo@yale.edu](mailto:fesinfo@yale.edu).

The Admissions website, <http://environment.yale.edu/admissions>, has extensive information about the School. Should you have additional questions, we are pleased to correspond with you by e-mail, or you may schedule a telephone conversation with our Admissions staff. The Admissions office can be reached by e-mail at [fesinfo@yale.edu](mailto:fesinfo@yale.edu) or telephone at 800.825.0330.

## Application Procedures

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

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

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

Previous applicants planning to reapply to F&ES must submit a new application form and current application fee, an updated résumé/curriculum vitae, and transcripts depicting all academic work not included in the previous application. We also recommend that applicants consider submitting an updated personal statement. Admissions records including application forms and supplemental materials are held for two years by the Office of Admissions. Provided reapplication occurs within two admissions cycles, all required materials previously submitted to the Office of Admissions will be incorporated into the new application as requested. Documents submitted prior to the admissions cycle for a fall 2018 entry are no longer available.

## Preparation for Admission

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

Experience has demonstrated the special value of a short list of selected courses that provide a good foundation for all master's programs in the School. Therefore the Admissions Committee favors applicants who have successfully completed a combination of the courses listed below prior to beginning a degree program at the School. For this reason, it is highly recommended that applicants have at least (a) two college courses in mathematics, (b) two college courses in the biological sciences, (c) two college courses in the physical sciences, and (d) two college courses in the social sciences.

The specific courses listed under each distribution area are judged to be most suitable for helping students gain the maximum benefit from Yale course offerings. Students wishing to fulfill these recommendations can take courses at any accredited institution and must have been awarded a final grade of C or better (courses taken pass/fail do not count in this review). Advanced Placement (AP) and International Baccalaureate (IB) courses are not considered during our transcript review process. Courses listed below can serve as a guide; however, this list is not comprehensive.

1. College mathematics – two courses selected from:
  - a. calculus
  - b. statistics
  - c. linear algebra
  - d. discrete mathematics

2. Biological science – two courses selected from:
  - a. evolutionary biology
  - b. ecology
  - c. botany
  - d. zoology
3. Physical science – two courses selected from:
  - a. general chemistry
  - b. general physics
  - c. geology/earth science
  - d. hydrology/soil science
4. Social science – two courses selected from:
  - a. anthropology
  - b. economics (micro and macro)
  - c. political science
  - d. sociology

## Application Requirements

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

1. A completed online application form.
2. A résumé/curriculum vitae. Indicate full- or part-time for each job/internship/volunteer position.
3. A combination of short essays and longer statements that illustrate fit, skills, and overall experience.
4. One transcript or mark sheet from each college and/or university attended. Official transcripts are not required; however, all transcripts submitted must include the applicant's name and institution (not to be added by the applicant).
  - Applicants who have completed a degree outside of the United States or Canada are strongly encouraged to submit a transcript evaluation. If submitting a transcript evaluation, applicants should use EducationUSA advisers (<https://educationusa.state.gov/find-advising-center>), World Education Services ([www.wes.org](http://www.wes.org)), or Educational Credential Evaluators (<http://ece.org>) for course-by-course or ICAP evaluation of all transcripts (undergraduate and graduate). Those who secure WES or ECE evaluations should submit their official transcripts directly to WES or ECE, not to the Office of Admissions. An additional copy of the transcript beyond the official evaluation is not required. Evaluations must be received in the Office of Admissions by the December 15 deadline for an application to be considered complete. The applicant is strongly encouraged to begin this process early, as evaluations can take more than a month to complete.
  - Admitted students submitting transcripts and degree certificates from Chinese universities must arrange for a verification report of their university transcript with the China Academic Degrees and Graduate Education Development Center (CDGDC; [www.chinadegrees.cn/cn](http://www.chinadegrees.cn/cn)). Do not request your verification report from the CDGDC until your degree has been awarded. Verification reports should only be sent after accepting an offer of admission. The report must be

mailed directly to the Office of Admissions by the CDGDC, rather than by the admitted student or any third party. Any transcript not mailed by the CDGDC will not be considered as a final official transcript.

5. Three letters of reference (academic and/or professional). Submission of the recommendation form and a one- to two-page letter is expected. Please note that we are unable to accept any additional recommendations beyond the required three. It is strongly recommended that the applicant submit at least one academic letter of reference.
6. Standardized test score reports:
  - The submission of GRE, GMAT, or LSAT scores is optional at this time.
  - An official TOEFL or IELTS score report if English is not a native or customary language of instruction (copies will not be accepted). Applicants must achieve at least a 100 on the iBT version of the TOEFL or a 7.0 on the IELTS examination (minimum of 6.5 in each section) to be given full consideration for admission. See additional information on requirements related to English as a second language below.
7. The \$80 application fee (a need-based fee waiver is available online).
8. If applying to the M.E.Sc. or M.F.S. program, please be sure to include a list of three potential advisers on the application form. Please also attach as an addendum to the personal statement a short paragraph for each of the listed advisers describing why you would like them to serve as your adviser on your intended research. Please be sure to link your research interests with theirs to help connect how they may be able to best advise you on your project.
9. An optional supplemental statement on your “Contribution to the F&ES Community” (no more than 300 words). In its mission, the Yale School of Forestry & Environmental Studies aspires to be a global leader in addressing “society’s evolving and urgent environmental challenges” and to “identify pathways to a sustainable future that respects diverse values.” How do your life experiences/background enhance F&ES’s commitment to a diverse set of perspectives and to training individuals in an increasingly varied society?

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

All application materials should be uploaded to the electronic application form. Materials cannot be returned, copied, or forwarded to third parties.

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



## English as a Second Language Training Requirement

Applicants for whom English is not a native or customary language of university instruction must take the Test of English as a Foreign Language (TOEFL) or the International English Language Testing System (IELTS). We require a minimum TOEFL score of 100 on the Internet test. A minimum overall score of band 7.0 is required on the IELTS, with a minimum of 6.5 in each section. Please note that we will only accept the iBT version of the TOEFL examination. When taking either test, applicants should indicate the School's Institution Code Number 3996; no department code is necessary. Additional information about TOEFL can be found at [www.ets.org/toefl](http://www.ets.org/toefl). Information about IELTS can be found at [www.ielts.org](http://www.ielts.org). Official test results will be sent directly to the School by the testing service and generally take two to three weeks to arrive.

Applicants who are required to submit the TOEFL or IELTS must also submit a supplemental essay (300 words maximum) detailing all educational, research, and/or work and internship experience related to the English language. The Admissions Committee may follow up with a phone interview to assist in determining English proficiency. As a condition of acceptance, it may be required that applicants for whom English is a second language, whose undergraduate degree work has not been conducted in English, or whose application suggests such a need, complete a six-week instructional program in written and spoken English conducted by Yale Summer Session. More information will be provided to those students who may qualify for this requirement.

# ADMISSIONS: DOCTORAL DEGREE PROGRAM

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

## Application Procedures

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

Applications for the Ph.D. program can be obtained from the website of the Yale Graduate School of Arts and Sciences at <http://gsas.yale.edu/admission-graduate-school>. The application deadline for the Ph.D. program is January 2, 2020. Doctoral education involves a close pairing between the student and a faculty adviser. Before applying to the doctoral program, applicants must identify and contact one or two faculty members who would serve as their major adviser if accepted to the program.

The Graduate Record Examination (GRE) General Test is required of all applicants. For more information on the GRE, visit [www.ets.org/gre](http://www.ets.org/gre). The Test of English as a Foreign Language (TOEFL) is required of all applicants whose native language is not English. This requirement is waived only for applicants who, prior to matriculation at Yale, will have received a baccalaureate degree or its international equivalent from a college or university where English is the primary language of instruction. The applicant must have studied in residence at the baccalaureate institution for at least three years to receive a waiver. If you do not qualify for a waiver but have taken the TOEFL within the past two years, you will need to have your TOEFL scores released to the Yale Graduate School of Arts and Sciences (code 3987). The International English Language Testing System (IELTS) may be substituted for the TOEFL. For more information and the latest updates on the TOEFL and IELTS, visit [www.ets.org/toefl](http://www.ets.org/toefl) and [www.ielts.org](http://www.ielts.org).

# TUITION, FEES, AND OTHER EXPENSES

## Master's Program Tuition and Fees

The 2019–2020 tuition for master's degrees (M.E.M., M.F.S., M.E.Sc., and M.F.) is \$43,570. 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 hospitalization/specialty insurance as required by the University, or materials fees charged by other schools and departments in the University.

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

For 2019–2020, a single student should also anticipate estimated expenses of \$500 for books and supplies; \$1,500 for transportation, \$2,450 for hospitalization/specialty insurance; living expenses of \$16,200 for room, board, and personal expenses for the nine-month academic year; \$375 for the mandatory Student Activity Fee; and \$125 for the mandatory Student IT Fee.

## Ph.D. Program Tuition and Fees

The 2019–2020 tuition for the Ph.D. program is \$43,300. Most doctoral students receive a School fellowship that covers the cost of their tuition and provides a twelve-month stipend for the first five years of their program. In 2019–2020 the stipend is \$31,800. Doctoral students must pay a nominal continuous registration fee (CRF) for no more than three years thereafter. The continuous registration fee is \$675 per term.

## Registration

All students in the master's programs must register for courses using the online registration system (available at [www.yale.edu/sis](http://www.yale.edu/sis)) within the normal shopping period. The shopping period is the first two weeks of classes for the fall and spring terms (see academic calendar). A penalty of \$35 will be charged for any changes made to a student's course registration after the Add/Drop period. No changes are allowed after the midterm point in each term.

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

## Tuition Fees for Special Students

The tuition charge for special 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 for each term of attendance.

## Continuous Registration

Master's degree students who wish to pursue their research through a six-month or one-year internship are permitted to do so and are considered enrolled on a full-time

basis (student is entitled to continue membership in Yale Health and defer student loans). Upon return, the student will register as a full-time student and pay tuition for the period needed to complete the degree requirements. Students may not register for regular course work, or work as a teaching assistant, while on continuous registration status. The fee for continuous registration is \$3,250 per term. Students are permitted to be on continuous registration for a maximum of two terms.

## Tuition Deposit

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

## Tuition Rebate and Financial Aid Refund Policy

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

1. For purposes of determining the refund of Title IV funds, any student who withdraws from the School of Forestry & Environmental Studies for any reason during the first 60 percent of the term will be subject to a pro rata schedule that will be used to determine the amount of Title IV funds a student has earned at the time of withdrawal. A student who withdraws after the 60 percent point has earned 100 percent of the Title IV funds. In 2019–2020, the last days for refunding Title IV funds will be October 30, 2019, in the fall term and March 27, 2020, in the spring term.
2. For purposes of determining the refund of institutional aid funds and for students who have not received financial aid:
  - a. 100 percent of tuition will be rebated for withdrawals that occur on or before the end of the first 10 percent of the term: September 6, 2019, in the fall term and January 22, 2020, in the spring term.
  - b. A rebate of one-half (50 percent) of tuition will be granted for withdrawals that occur after the first 10 percent but on or before the last day of the first quarter of the term: September 21, 2019, in the fall term and February 6, 2020, in the spring term.
  - c. A rebate of one-quarter (25 percent) of tuition will be granted for withdrawals that occur after the first quarter of a term but on or before the day of midterm: October 21, 2019, in the fall term and March 2, 2020, in the spring term.
  - d. Students who withdraw for any reason after midterm will not receive a rebate of any portion of tuition.
3. The death of a student shall cancel charges for tuition as of the date of death, and the bursar will adjust the tuition on a pro rata basis.
4. If the student has received student loans or other forms of financial aid, funds will be returned in the order prescribed by federal regulations; namely, first to Federal Direct Unsubsidized Loans, if any; then to Federal Direct Graduate PLUS Loans; next to any other federal, state, private, or institutional scholarships and loans; and, finally, any remaining balance to the student.

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

## 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 office's website is <http://student-accounts.yale.edu>.

### BILLS

Yale University's official means of communicating monthly financial account statements is through the University's Internet-based system for electronic billing and payment, Yale University eBill-ePay. Yale does not mail paper bills.

Student account statements are prepared and made available twelve times a year at the beginning of each month. Payment is due in full by 4 p.m. Eastern Time on the first business day of the following month. E-mail notifications that the account statement is available on the University eBill-ePay website (<http://student-accounts.yale.edu/ebep>) are sent to all students at their official Yale e-mail addresses and to all student-designated proxies. Students can grant others proxy access to the eBill-ePay system to view the monthly student account statements and make online payments. For more information, see <http://sfas.yale.edu/proxy-access-and-authorization>.

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

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

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

### PAYMENTS

There are a variety of options offered for making payments. Yale University eBill-ePay (<http://student-accounts.yale.edu/ebep>) is the *preferred* means for payment of your monthly student account bill. The ePayments are immediately posted to the student account. There is no charge to use this service. Bank information is password-protected and secure, and a printable confirmation receipt is available. On bill due dates, payments using the eBill-ePay system can be made up to 4 p.m. Eastern Time in order to avoid late fees.

For those who choose to pay the student account bill by check, a remittance advice and mailing instructions are included with the online bill available on the eBill-ePay website. All bills must be paid in U.S. currency. Checks must be payable in U.S. dollars drawn on a U.S. bank. Payments can also be made via wire transfer. Instructions for wire transfer are available on the eBill-ePay website.

Yale does *not* accept credit card payments.

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

1. If the payment was for a term bill, late fees of \$125 per month will be charged for the period the bill was unpaid, as noted above.
2. If the payment was for a term bill to permit registration, the student's registration may be revoked.
3. If the payment was given to settle an unpaid balance in order to receive a diploma, the University may refer the account to an attorney for collection.

## YALE PAYMENT PLAN

The Yale Payment Plan (YPP) is a payment service that allows students and their families to pay tuition, room, and board in ten equal monthly installments throughout the year based on individual family budget requirements. It is administered by the University's Office of Student Financial Services. The cost to enroll in the YPP is \$100 per contract. For enrollment deadlines and additional details concerning the Yale Payment Plan, see <http://student-accounts.yale.edu/ypp>.

# Master's Financial Aid

## POLICIES AND PROCEDURES

In general, students must apply for financial aid in order to be considered for an F&ES scholarship. Since financial aid awards are based primarily on financial need, information about student finances that is not available in the application for admission is required. F&ES is need-blind. Therefore, applying for financial aid and having financial need in no way affect the decision to offer admission.

The deadline for prospective students to apply for need-based financial aid is February 15. If that deadline is missed, the student will not be considered for need-based financial aid. This can be a costly oversight, as what is received in the second year is generally the same as what is received in the first year. The deadline for current students to apply for financial aid is April 15.

If a student is a U.S. citizen or permanent resident, two forms must be submitted, the F&ES Financial Aid Application and the Free Application for Federal Student Aid (FAFSA). If a student is an international student, only one form must be submitted, the F&ES Financial Aid Application. Students must reapply for financial aid for the second year, although the amount of F&ES scholarship will most likely remain the same as in the first year.

A limited number of merit-based scholarships are available, for which no separate financial aid application is required. Examples include merit awards to the top applicants to the Master of Environmental Science and Master of Forest Science

programs and the Paul D. Coverdell Fellowships for qualifying Returned Peace Corps Volunteers.

F&ES scholarships, work study, and federal loans (Direct Stafford and Grad PLUS) are available to U.S. citizens and permanent residents. F&ES scholarships, work study, and Yale International Loans are available to international students.

The primary factor in determining the amount of a need-based F&ES scholarship is financial need as determined by the review of the student's (and spouse's, if applicable) income and assets and any third-party funding that the student expects to receive. Merit is a secondary factor.

Students are considered to be financially independent of their parents. Therefore, information about parent income and assets is not required. Students have the option of providing that information, however, which may yield a higher need-based scholarship award. Under no circumstances will it yield a lower scholarship award. On the other hand, students must report any direct financial support that they expect to receive from their parents, such as money for tuition or rent.

Approximately three-quarters of F&ES students receive scholarships in any given year from an annual scholarship budget in excess of \$5 million.

## Satisfactory Academic Progress

To be eligible for financial aid, a student must be making Satisfactory Academic Progress (SAP) in the degree program. Financial aid includes all federal student aid funds (Federal Direct Stafford Loan, Federal Direct Grad PLUS Loan, and/or Federal Work Study) as well as institutional funds. For a complete explanation of the F&ES SAP policy, please see the F&ES Student Handbook, chapter Rules & Regulations, section Academic Regulations and Policies.

## Less Than Half-Time Enrollment, Including Continuous Registration

Students enrolled less than half-time (i.e., for less than 6 credits in a term) and students who are not actively working toward a degree, such as those in continuous registration status, are not eligible for federal or institutional financial aid. Furthermore, financial aid awards are based on an assumption of full-time enrollment and will be revised proportionately should a student choose to enroll less than full-time. Students considering enrolling less than full-time should first consult with the assistant dean of student services and director of financial aid to understand the academic and financial consequences, respectively, of that decision.

## Joint-Degree Students

In most joint-degree programs, students split their time between the two joint schools, spending one and one-half years at each school for a total program length of three years.

Each school at Yale is financially independent, which means that the financial aid award a student receives at one school is not transferrable to the joint school. The joint-degree student should follow the financial aid application procedures of the school to which the student will be paying tuition. If the student is paying tuition at F&ES, the student

should apply for financial aid through F&ES. If the student is paying tuition at the joint school, the student should apply for financial aid through that school.

If the joint-degree student is applying for admission to two schools simultaneously, the student should apply for financial aid at both schools, also simultaneously.

## Fifth-Year Students

During their senior year at Yale College, students may apply for admission to the F&ES Five-Year Program. These students sometimes defer their enrollment in the F&ES master's program for a year of outside volunteer work or employment. To be considered for financial aid for their enrollment at F&ES, these students must submit their financial aid application materials by the February 15 deadline prior to their matriculation into the program. This could mean that the student submits the financial aid application materials during the student's deferral or "gap" year. It is the student's responsibility to submit all documents by the February 15 deadline.

## Scholarships

Most of the School's scholarship budget is funded by private donors. Scholarship recipients are automatically considered for all named scholarships. The named scholarships listed below are *not* in addition to any generic scholarship a student receives in the financial aid award notification but may be matched to a scholarship recipient once the student matriculates.

The School is delighted to recognize the generosity of the donors who have helped make the following scholarships possible:

Jonah Meadows Adels Memorial Scholarship  
Anne Armstrong-Colaccino Scholarship  
Bataua Scholarship  
Beinecke/FES Scholarship  
Flora and John Berbee Scholarship Fund  
Berkley Scholarship  
Jabe Blumenthal Scholarship  
George Brett Memorial Fund  
Broad Arrow Scholarship  
Nelson C. Brown (B.A. 1906, M.F. 1908) Scholarship  
Sara Shallenberger Brown Scholarship  
Coleman P. Burke Scholarship  
Leland H. Burt ('30 B.S.) Endowed Scholarship  
Burt-Pfeiffer Fund  
Philip Laurance Buttrick (M.F. 1911) Scholarship  
Paul Douglas Camp Memorial Scholarship  
Leonard G. Carpenter (B.A. 1924) Scholarship  
Class of 1980 Scholarship  
Class of 2017 Scholarship  
Crane Family Scholarship  
Trammell S. Crow (1974) Scholarship  
Crown Zellerbach Foundation Fund  
Strachan and Vivian Donnelley Scholarship  
Michael P. Dowling Scholarship



Enid Storm Dwyer Scholarship  
 Environmental Scholars Fund  
 Frederick V. Ernst (1960) Gift Fund  
 Boyd Evison Scholarship Fund  
 F&ES Alumni Association Board Scholarship  
 Forestry YAF Scholarship Fund  
 Edith and Johannes Frondt Scholarship  
 Gonzalez Family Scholarship  
 James Lippincott Goodwin (B.A. 1905, M.F. 1910)  
 Charles W. Goodyear Memorial Fund  
 John S. Griswold (B.A. 1937) Scholarship  
 Leah Hair Scholarship  
 H. Stuart Harrison (B.A. 1932) Fellowship  
 Vira I. Heinz Endowment Scholarship  
 John and Catha Hesse Fund  
 Adelaide Hixon Scholarship  
 Joseph Hixon FES Scholarship  
 Jacqueline C. and John P. Hullar Scholarship  
 Jesse D. Johnson Scholarship  
 Stephen and Betty Kahn Scholarship  
 Peggy King Memorial Scholarship  
 Marvin Klemme (M.F. 1935) Fellowship  
 Carl W. Knobloch, Jr. Fellowship  
 Kroon Environmental Studies Scholarship  
 Fred Krupp Scholarship in Environmental Studies  
 Charles Chacey Kuehn (M.F. 1934) Fund  
 Robert H. Kuehn, Jr. '64 B.A., '68 M.U.S., '68 M.Arch. Scholarship  
 Leadership Scholars Fund  
 Urey Lisiansky Scholarship Fund  
 John A. MacLean '27S Scholarship  
 Alan N. Mann (1908) Memorial Fellowship  
 Margaret K. McCarthy and Robert Worth Scholarship  
 Dorothy S. McCluskey Scholarship  
 Thomas McHenry Scholarship  
 Preston R. Miller, Jr. '71 F&ES Scholarship  
 Arthur N. Milliken Scholarship  
 Mary P. Moran Scholarship  
 John M. Musser Fellowship  
 Carl F. Norden Family Scholarship  
 Obernauer Family Scholarship  
 Gilman Ordway (B.A. 1947) Family Scholarship  
 Parklands Scholarship  
 PETAL Foundation Scholarship  
 Joanne Polayes Scholarship  
 Kushok Bakula Rimpoche Scholarship  
 Rockefeller-Underhill Scholarship for Tropical Conservation  
 Heather L. Ross and Edward L. Strohbehn, Jr. Scholarship  
 Andrew Sabin International Environmental Fellowship  
 William Henry Sage Memorial Fund

Ralph C. Schmidt and Susan M. Babcock Scholarship  
 Drs. Poh Shien and Judy Young International Scholarship  
 Simeone Entomology Scholarship  
 David M. Smith, Morris K. Jesup Professor of Silviculture Scholarship  
 David and Karen Sobotka Scholarship  
 Sobotka Joint F&ES-Jackson Institute Fellowship  
 Cameron and Gus Speth Scholarship  
 Gillian and Stuart W. Staley '95 M.P.P.M., '95 M.E.S. Scholarship  
 Stapleton Scholarship  
 Student Conservation Association Fellowship in honor of John R. Twiss '60  
 VIEW Scholarship  
 Rodney B. Wagner Class of 1954 International Scholarship  
 William D. Waxter III Fellowship  
 Marianne Welch Scholarship  
 William Egbert Wheeler Fund  
 Mr. and Mrs. James Wiley Endowed Scholarship for Conservation Biology  
 Hubert Coffing Williams (Ph.D. 1906, M.F. 1908)  
 Joseph H. Williams Scholarship  
 Charles F. Wilson (B.A. 1939) Memorial Fund  
 Ray L. Wilson Scholarship  
 Frank & Lynne Wisneski F&ES Scholarship  
 Charles Boughton Wood Fund  
 Wyss Foundation Scholarship for Conservation of the American West  
 Yale Club of New Haven

## Employment Opportunities

**F&ES work study** These positions vary from clerical to research to editorial work. Eligible students must have financial need, as confirmed by the F&ES Office of Admissions and Financial Aid. Applications are available on the Yale Student Employment Office website ([www.yalestudentjobs.org](http://www.yalestudentjobs.org)) beginning in August. The pay rate is fixed at \$14.50 per hour. At least eighty positions are available annually and only to students with an F&ES affiliation.

**Regular student jobs and teaching fellowships** Financial need is not required. Interested students should contact centers, departments, professors, and programs directly beginning in late spring or summer. Pay rates begin at \$12.50 per hour for regular student jobs. Pay rates for teaching fellowships are either \$4,000 or \$8,000 per term depending on the effort level. At least seventy positions are available annually.

**Community service jobs** Eligible students must be U.S. citizens or permanent residents and have financial need, as confirmed by the F&ES Office of Admissions and Financial Aid. Applications are available on the Yale Student Employment Office website beginning in August. Pay rates begin at \$12.50 per hour. At least 100 positions are available annually to students across the University.

**Other on-campus jobs** Financial need is not required. Applications are available on the Yale Student Employment Office website beginning in August. Pay rates begin at \$12.50 per hour. At least 400 positions are available annually to students across the University.

## Loans

**Federal Direct Stafford Loan (U.S. citizens and permanent residents only)** In general, the maximum annual loan amount is \$20,500. The interest rate is fixed at 6% with an origination fee of 1.066%. There is no credit check required. The standard repayment term is ten years. A six-month grace period immediately follows separation from school or otherwise dropping below half-time enrollment status, at which time repayment is required. The loan is requested by completing and returning a loan request form available on the School's financial aid forms webpage: <http://environment.yale.edu/aid/forms>. After initial processing, the loan will be assigned to a servicer contracted with the U.S. Department of Education, such as FedLoan, Great Lakes, Navient, or Nelnet.

**Federal Direct Grad PLUS Loan (U.S. citizens and permanent residents only)** In general, the maximum annual loan amount is the cost of attendance less all other resources. The interest rate is fixed at 7.0% with an origination fee of 4.624%. A credit check is required. Repayment terms are similar to Federal Direct Stafford Loans. The loan is requested by completing and returning a loan request form available on the School's financial aid forms webpage. After initial processing, the loan will be assigned to a servicer contracted with the U.S. Department of Education, such as FedLoan, Great Lakes, Navient, or Nelnet.

**Yale International Loan (international students only)** In general, the maximum annual loan amount is \$30,000 or the cost of attendance less all other resources, whichever is less. The interest rate is fixed at 7.75% with an origination fee of 5%. There is no credit check required. Repayment terms are similar to Federal Direct Stafford Loans. The loan is requested by completing and returning loan request and self-certification forms available on the School's financial aid forms webpage. The Yale Student Loan Billing and Payment Office is responsible for the management and collection of the loan.

**Private education loan (U.S. citizens and permanent residents as primary borrowers or co-borrowers only)** In general, the maximum annual loan amount is the cost of attendance less all other resources. The interest rate is fixed or variable and dependent on the credit rating of the primary borrower and co-borrower, if applicable. Origination fees from zero to 3%, repayment terms, and servicing are dependent on the lender. A credit check is required. The loan is requested by applying directly to a lender. A list of lenders from whom students have borrowed recently is available at [www.elmselect.com/?schoolid=156#/results](http://www.elmselect.com/?schoolid=156#/results).

## International Students—Certification of Finances for Visa

International students must certify full funding for their entire two-year course of study before visa documents can be issued. Instructions and forms are mailed after an admitted student accepts the offer of admission (deadline April 15). More information is available from Yale's Office of International Students and Scholars: <https://oiss.yale.edu>.

## Veterans

Eligible students are strongly encouraged to seek specific information about Veterans Administration benefits from their local Veterans Administration office by calling 800.827.1000 or visiting <http://benefits.va.gov/gibill>. The School also participates

in the Yellow Ribbon Program, with a maximum contribution amount of \$7,500 per student per year. The assistant dean of student services and the director of financial aid coordinate the administration of Veterans Administration benefits at F&ES.

# LIFE AT THE SCHOOL OF FORESTRY & ENVIRONMENTAL STUDIES

## Educational Facilities

Kroon Hall, the ultra-green home of F&ES, expresses in physical form the School's best traditions, values, and aspirations. The building, which opened in January 2009, achieves its remarkable energy savings from a host of design elements and technical strategies molded to fit the weather and climate of its New England location. Situated in the area of the University known as Science Hill, Kroon Hall is named for the family of benefactor and Yale College alumnus Richard Kroon, B.A. 1964. With its high barrel-vaulted gable ends, simple lines, and curved rooftop, Kroon Hall is a modernist blend of cathedral nave and Connecticut barn.

Kroon Hall provides office space for fifty faculty and staff members and has three classrooms. The 175-seat Burke Auditorium is used for lectures and classes, and commands beautiful views of West Rock and the David S. Ingalls Rink across the street. The Knobloch Environment Center is meant for socializing, but students have also embraced it as a study space. The Ordway Learning Center on the ground floor also has ample space for quiet study. The \$43.5-million building was designed by Hopkins Architects of Great Britain in partnership with Connecticut-based Centerbrook Architects and Planners and holds the highest rating – platinum – in the green-building certification program, Leadership in Energy and Environmental Design (LEED). Kroon Hall provides 56,467 square feet and is designed to use 67 percent less energy than a typical building of its size. Its tall, thin shape and east-west orientation play a big role in heating and cooling. The lowest floor is set into a hillside, with only its south side exposed, providing thermal insulation, minimizing northern exposure, and increasing the amount of natural light that enters the building from adjacent courtyards. The long south facade maximizes solar gain during the winter, and Douglas fir louvers covering glass facades on the east and west ends keep out unwanted heat and glare. The building's shape, combined with the glass facades, enables daylight to provide much of the interior's illumination. Light and occupancy sensors dim artificial lighting when it is not needed.

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

In mild weather, Kroon's occupants assist in the energy savings by opening windows in response to an electronic, color-coded prompt system. A pair of green and amber lights in each hallway indicate whether it's a "Green Day": i.e., when the green indicator light is on, the ventilation and cooling/heating systems shut down, and the windows should be opened for natural ventilation.

A rainwater-harvesting system channels water from the roof and grounds to a garden in the south courtyard, where aquatic plants filter out sediment and contaminants. The gray water, held in underground storage tanks, is used for irrigation and pumped back into Kroon for flushing toilets. The system is designed to save 300,000 gallons of potable city water annually and to reduce the burden on city sewers by lessening the amount of storm runoff. Half of Kroon Hall's red oak paneling—15,000 board feet—came from the 7,840-acre Yale-Myers Forest in northern Connecticut, which is managed by the School. The building's pale yellow exterior, composed of sandstone from Ohio, echoes other Yale buildings. The north and south courtyards were constructed to create a community among disparate buildings on Science Hill. The south courtyard, landscaped by Olin Studio of Philadelphia, is a raised platform, with a green roof of soil one-foot deep and surrounded by twenty-five varieties of native plantings. Underneath the courtyard is a service node, centralizing all trash and recycling pickups as well as deliveries for the southwest corner of Science Hill and accessible by a single driveway off Sachus Street.

Sage Hall, a four-story building located at 205 Prospect Street and a gift of William H. Sage, B.A. 1865, in memory of his son, DeWitt Linn Sage, B.A. 1897, was completed in 1923. Administrative, development, alumni, and program offices of the School are housed in Sage Hall, along with four classrooms. Sage Hall is home to a computer cluster with twenty-four computers for student use. Sage also houses a 490-square-foot student lounge, appointed with a large table and comfortable couches, which students use for studying, special events, and weekly social events. Bowers Auditorium is designed to handle large lectures and seminars as well as small group projects. Bowers, which has a seating capacity of one hundred with tables and chairs, was built onto Sage Hall in 1931 with funds provided by the bequest of Edward A. Bowers, B.A. 1879. In 2011 the original Bowers floor was replaced using beautiful red oak flooring harvested from Yale-Myers Forest, and in 2016 energy-efficient LED lights were installed.

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. A classroom, meeting space, kitchen, and accessible bathroom are available on the first floor. 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, houses a recently renovated social space in the main lobby; laboratories for research into the ecology and management of landscapes and ecosystems, urban sustainability, the biology of trees, and environmental chemistry; and doctoral program spaces. The wood shop is available for students—after receiving tool and safety training—to work on projects that require the use of power

tools. The building was designed by renowned architect Paul Rudolph and is a classic example of “Brutalist” architecture. 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 301 Prospect Street and 380 Edwards Street house the offices of many of the School’s programs, as well as doctoral student offices; each building has a classroom.

Starting in fall 2019, the mansion at 300 Prospect Street will house the School’s Admissions, Financial Aid, Communications, and Research offices.

## **LIBRARY COLLECTION**

F&ES students have access to the enormous holdings of the Yale University Library (YUL), which comprises fifteen million print and electronic volumes in more than a dozen different libraries and locations. The YUL is committed to acquiring whatever books and journals are needed to support Yale’s teaching and research activities. The bulk of F&ES materials are located online and in the Center for Science and Social Science Information (CSSSI), while smaller, more specialized collections such as the Henry Solon Graves Papers and the Rachel Carson Papers are housed in Manuscripts and Archives (in Sterling Memorial Library) and the Beinecke Rare Book and Manuscript Library. The librarian for environmental studies has an office in the CSSSI (Rm. C44) and is available most weekday hours to provide assistance to students. Reference and information services are provided by experienced staff in the CSSSI. For electronic retrieval, the library has a network of databases accessible via its website, covering general environmental topics as well as the specific subject areas of forestry, soils, fish and wildlife, and water resources. Overall, Yale University Library subscribes to more than 1,000 databases. Library resources outside of Yale are accessed through the Borrow Direct service as well as Interlibrary Loan. The YUL supports both EndNote and RefWorks bibliographic data management tools, and the librarian for environmental studies provides instruction in both.

The F&ES Library Research Guide is located at <http://guides.library.yale.edu/fes>. Here are found links to Orbis, Yale’s main online catalog; direct links to several of the most frequently used bibliographic databases, such as BIOSIS, Web of Science, ProQuest Agricultural & Environmental Science Database, Environment Complete, and CAB Direct; and information ranging from instruction opportunities to links to online full-text journals. In-house bibliographic instruction begins during MODs and continues throughout the term. Notification of tours and group instruction sessions is posted

via e-mail; students may also contact the librarian directly (203.432.5912) to set up an individual session.

For additional information, please visit <http://web.library.yale.edu>.

## COMPUTER RESOURCES

The mission of the F&ES Information Technology Department (FES-IT) is to support all aspects of computing for every member of the Yale School of Forestry & Environmental Studies community. We use and support multiple platforms, including Windows and Macintosh operating systems. Students are strongly encouraged, but not required, to bring their own computers. Admitted students may contact the FES-IT Helpdesk by e-mailing [feshelpdesk@yale.edu](mailto:feshelpdesk@yale.edu) for advice on the selection of appropriate hardware and software. We strongly encourage the purchase of Apple Macintosh or Lenovo ThinkPad (T or X series) laptop computers. A robust campus network provides wireless access within all F&ES buildings and throughout the Yale campus.

FES-IT and trained student technicians from Yale's Student Technology Collaborative provide drop-in technical support for students to assist with any academic or research computer needs they may have while on campus. Weekend and after-hours student support is also available at Bass Library, within easy walking distance of the School. FES-IT provides secure, centralized backup services for all F&ES faculty, staff, and students, as well as an FES-provisioned Dropbox account.

FES-IT maintains a computer lab in Sage Hall, Rm. 39, with sixteen computer workstations that feature dual 24-inch displays, 3 GHz Intel i5 (quad-core) and 2.2 Xeon (10-core) processors, and at least 16 GB of RAM that were updated in the summer of 2018. The lab also features four 27-inch high-definition monitors for students who would like to utilize their own laptops.

The computer lab houses a multifunction copy/scan/fax/print device. Additional wireless student printing is available in each F&ES building and throughout the Yale campus via the BluePrint Printing System. Three-dimensional and wide-format printing is also available at the Yale Center for Engineering Innovation & Design (CEID) and the Yale School of Architecture.

FES-IT maintains an inventory of equipment that students may borrow for short periods of time through an online equipment checkout system (<http://environment.yale.edu/myfes/computing/equipment>). Equipment may be borrowed at no charge (late and replacement fees apply if equipment is returned late, lost, or damaged). Included are iPads, GPS units, digital cameras, walkie-talkies, compact audio recorders, and other equipment.

The Yale University Library is also very active in the integration of information resources in digital format. Students and faculty have online access to an extensive variety of journals and databases as well as innovative research resources such as the Digital Humanities Lab (<http://dhlabs.yale.edu>).

The Center for Science and Social Science Information (<http://csssi.yale.edu>) offers an array of digital media technologies and operates several important digital resources, including the Statistical Classroom ("StatLab"), featuring thirty machines with dual monitors, and a variety of software and databases, such as a Bloomberg Terminal. The CSSSI is also home to a full-time GIS librarian who assists students in obtaining and working with GIS datasets to support their work in any part of the globe, and to a



data librarian who is available for questions or consultation about finding, using, and managing research data in the sciences and social sciences.

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

## YALE SCHOOL FORESTS AND THE QUIET CORNER INITIATIVE

The Yale School of Forestry & Environmental Studies owns 10,852 acres of forestland in Connecticut, New Hampshire, and Vermont that are managed by the Yale School Forests Program. The program manages seven discrete forests that were donated to the School between 1913 and 1986 that range in size and geography from the 75-acre Crowell Ravine in Vermont to the 7,860-acre Yale-Myers Forest in Connecticut. The composition of the Yale Forests reflects a latitudinal gradient ranging from a central hardwood cover type in Connecticut to a northern hardwood cover type in New Hampshire and Vermont, with extensive mixed-wood stands of pine and hemlock in both regions. The area encompassed by the forests includes almost all of the topographical and soil conditions, site classifications, and cover types found in New England.

The goals of this ownership are to provide educational, research, and professional opportunities to the Yale community and beyond through a sustainably managed and ecologically sound working forest. Faculty and students use the Yale Forests as a laboratory for teaching, management, demonstration, and research. Three faculty and staff oversee management of the forests in partnership with three postgraduate fellows. Graduate professional students working as apprentices or coordinators carry out the bulk of the on-the-ground management. The forests are maintained as working forests, and outputs of management include commercial timber and nontimber forest products. The Yale-Myers Forest is the largest and most actively utilized parcel managed by the Yale School Forests Program and is certified by the Forest Stewardship Council.

Students working at the Yale Forests receive training that covers aspects of hydrology and soils, taxonomy, forest and community ecology, silviculture, forest operations, forest finance and policy, and sociology in order to prepare them for careers as foresters and natural resource managers. Every summer ten to twelve students are chosen for the apprentice forester program at the Yale Forests, which includes hands-on training in maintenance of infrastructure, property boundary research and delineation, geographic information systems (GIS), mapping and classification, sampling and inventory, managing forest operations, and the design and implementation of silvicultural prescriptions. Several students from the apprentice program are selected to work for the School Forests Program the following academic year as assistant forest managers, where they receive additional training in forest administration and management.

Research performed at the Yale Forests is conducted under the supervision of any faculty member of the School and encompasses forest ecology, silviculture, aquatic and wildlife community ecology, hydrology, and economic, legal, and social studies. The forest is used for both doctoral and master's student research, the latter performed either as an independent project or in conjunction with student involvement with existing forest management. The forests also serve as a platform for collaborative research from other universities as well. Many breakthroughs in human understanding of ecological function began with research conducted at the Yale Forests.

The Yale Forests are used for both academic field trips and workshops held for professional or community organizations. Field trip and workshop topics are wide-ranging and include topics such as ecosystem function, hydrology, wildlife habitat, global carbon dynamics, and forest management.

Lastly, the Quiet Corner Initiative (QCI) engages with the communities and working landscape that surround Yale-Myers Forest. QCI works by developing programs that connect master's-level courses and University research to real environmental assessment and management challenges on private lands surrounding the forest. Current programs focus on forest and open space conservation and management; watersheds and rivers; renewable energy; and sustainable agriculture. The initiative seeks to advance three separate but related sets of goals: (1) to enrich the applied curriculum for professional students at the School of Forestry & Environmental Studies, providing reliable and consistent opportunities to bring learned skills to tangible problems that are in easy reach of the classroom and that contribute to a vibrant rural economy based on sustainable natural resource management; (2) to provide and cultivate a high-quality natural and social science research environment for students and faculty to investigate and analyze the drivers of environmental change and adaptive management at a landscape scale; and (3) to leverage the traditional strengths of Yale University in research, education, and leadership in working toward landscape-scale sustainability goals in our own backyard.

In addition to the forestland owned and managed by the School, close working relationships exist with non-Yale forests that faculty and students use for education and research. Yale has a long history of collaboration with the 6,800-acre Great Mountain Forest in northwestern Connecticut, which began through the courtesy of Edward C. Childs, 1928 B.A., 1932 M.F., and his family. Additionally, the 20,000-acre forestland owned and managed by the South Central Connecticut Regional Water Authority in New Haven County is one of the oldest managed forests in the western hemisphere and easily accessible from Yale's campus. Connecticut state forests and Yale's long history with the Connecticut Forest & Park Association serve as resources for student and faculty engagement as well.

## Communications

The goal for the School's strategic communications is, in part, to contribute to public understanding and discourse on environmental issues and to encourage the integration of those issues into strategies for business, international development, government, and nongovernmental organizations.

The communications team publicizes faculty and student research and School-sponsored events through traditional and digital media. School news, alumni profiles, and other community updates are regularly published on the School's website (<http://environment.yale.edu>) and can be received through e-mail newsletters and on our social media platforms, including Facebook (<https://facebook.com/YaleFES>), Twitter (<https://twitter.com/YaleFES>), Instagram (<https://instagram.com/YaleFES>), and LinkedIn (<https://www.linkedin.com/school/5527901>). The communications team also publishes *Canopy* magazine, a biannual publication that showcases how the F&ES community – including its vast alumni network – is providing innovative leadership in addressing environmental challenges across the planet.

Other communications vehicles at F&ES include:

- *Yale Environment 360* (<http://e360.yale.edu>) features reporting, analysis, and opinion on global environmental issues from leading writers, scientists, policy makers, and journalists in the field. Launched in 2008, this online magazine has established a broad global audience and received numerous awards and honors.
- *Sage Magazine* (<http://sagemagazine.org>) is a student-run environmental arts and journalism publication. Through creative and informative journalism, *Sage* seeks to expand popular notions of environmentalism and widen the debate around pressing and important environmental issues.
- *Yale Environment Review* (<http://environment-review.yale.edu>) is a student-run online publication that provides concise summaries of peer-reviewed research from around the world, with a focus on topics of general interest to those engaged in environmental and natural resource management.
- The annual Environmental Film Festival at Yale (<http://effy.yale.edu>), held each spring in New Haven, is one of America's premier student-run environmental film festivals.
- Reports and newsletters from the School's centers and programs; refer to their individual websites, listed online at <http://environment.yale.edu/centers>.

To contact the F&ES communications office, e-mail [communications.fes@yale.edu](mailto:communications.fes@yale.edu) or call 203.436.4805.

## RECORDING POLICY ACKNOWLEDGMENT

In order to capture the breadth of activities that occur at F&ES – and integrate the expertise of our faculty, students, and visitors into the broader environmental dialogue – Yale University frequently photographs, videotapes, and/or records events, lectures, and activities (including during alumni events) at F&ES. By attending and/or participating in classes and in other F&ES and University activities, those in attendance agree to the University's use and distribution of their image and/or voice in photographs, audio, and video capture, or in electronic reproductions of such classes and activities. These images, recordings, or excerpts may be included, for example, in Yale University websites, publications, and online courses, and otherwise used to support the University's mission.

## Student Organizations

The School has many student-run interest groups. Current student groups include the Africa SIG; Asia (ASIA) SIG; Built Environment and the Environment (BE2); Business and Environment Club SIG (joint with the School of Management); the Climate Change SIG; the Coalition for Agriculture, Food, and Environment (CAFÉ); Conservation Finance SIG; Economic Consideration of Nature (ECON); Energy SIG; Environmental Data Science at Yale (EDSY); Environmental Justice at Yale (EJAY); Environmental Media & Arts; Ethnobotany and Economic Botany Student Interest Group (STIGMA); the FES Politics SIG; Fire Ecology & Management; the Forestry Club (FC); Fresh & Salty SIG; Grounded; Health and Environment at Yale (HEY); the Industrial Environmental Management and Energy Group (IEME); a student chapter of the International Society of Tropical Foresters (ISTF); Land Use and Urban Coalition at Yale (LUUCY); the Latin American SIG (LA SIG); LoggeRhythms; Natural Resources Extraction (NRX); Out in the Woods (OIW);

Outdoor Rec Industry; PhD SIG; ROOTS SIG; SCOPE—the Research SIG; the Yale chapter of the Society for Conservation Biology (CONBIO); a student chapter of the Society of American Foresters (SAF); Southern SIG; the Spatial Collective; Sustainable Innovation, Finance and Entrepreneurship (SIFE); Toxics SIG; WESTIES; Yale Environment Women (YEW); and the Student Affairs Committee (SAC). The activities of these groups include sponsoring guest and student lectures, organizing field trips, sponsoring workshops, organizing social events, holding conferences, and interacting with regional divisions of their respective societies.

## Funding for Master's Student Projects and Activities

Master's students often seek funding for research, professional activities, and social events. Sometimes the request is for individual activity, sometimes on behalf of a group. Our School and Yale University have many funds to which students can apply. Among the most useful are the Master's Student Travel fund to support attendance at a conference or symposium at which a student is giving a talk; the Carpenter-Sperry Fund for travel and research; the MacMillan Center for International and Area Studies, which can help bring international visitors to Yale for a lecture or a conference; grants and contracts to faculty and centers for research; the School's Student Affairs Committee (SAC), which supports activities by our many student interest groups (SIGs); the F&ES Community Events Fund, administered by the Dean's Office, which supports student events and conferences; and the Class of '80 Student Project Fund, administered by the School's Office of Development and Alumni Services, to enrich the quality of life of the student body.

## Alumni Association

The F&ES Alumni Association is led by an elected Alumni Association Board (AAB) of 20–25 alumni who represent the School's more than 5,000 alumni around the world. The AAB meets in person two times per year and by phone monthly throughout the rest of the academic year, and holds various committee meetings as needed. The AAB is supported by staff in the F&ES Office of Development and Alumni Services.

AAB members lead a number of initiatives focused on alumni-to-alumni, alumni-to-student, and alumni-to-University engagement. The AAB organizes regional alumni gatherings in the United States and internationally, as well as field-based learning programs, educational opportunities, and volunteer opportunities for alumni.

The Alumni Association Board also oversees the annual AAB nominations/elections process as well as the selection of the Distinguished Alumni and Prospect Street award recipients named at Reunion weekend each year. The F&ES Alumni Association Board Scholarship is awarded annually to two current students who demonstrate outstanding community engagement and volunteer leadership. Alumni e-newsletters and e-blasts, along with the F&ES magazine *Canopy*, keep alumni throughout the world in touch with each other and the School.

The F&ES Alumni Association is also affiliated with the Yale Alumni Association (YAA), which serves all alumni of Yale University.

Alumni may contact the Office of Development and Alumni Services at [alumni.fes@yale.edu](mailto:alumni.fes@yale.edu).

## Career Development Office

<http://environment.yale.edu/careers>

The Career Development Office (CDO) seeks to inspire and prepare all students to pursue high-impact environmental careers aligned with their individual abilities, experience, and interests. Its mission is to proactively educate students to maximize their entire F&ES experience for impactful careers and lives; cultivate strong relationships with leading domestic and international environmental employers; and support career-related initiatives across F&ES.

The CDO's diverse resources, programs, and services enable users to develop key skills needed to present themselves professionally on the job market, develop and refine meaningful career goals, and chart a strategy for conducting effective job and internship searches. We work with students on an ongoing basis through individual advising appointments as well as through workshops conducted by staff and other career development professionals.

### CAREER PLANNING RESOURCES

#### Career Counseling and Peer Advising

Through individual career advising appointments with our professional team, and drop-in hours with trained peer reviewers and interviewers, students work with CDO on:

- General career advising (strategy, focus, vision)
- LinkedIn profile development and reviews
- Résumé reviews
- Cover letter reviews
- CV reviews
- Converting a CV to a résumé; converting a résumé to a CV
- Personal statement reviews for Ph.D. program and fellowship applications
- Networking advice at Yale and beyond
- Online tools orientation (F&ESNext, LinkedIn, Yale Career Network)
- Interview skills and preparation coaching
- Mock interviews
- Internship planning guidance
- Internship funding advice
- Salary negotiation strategies

#### ELM: Environmental Leadership Mentoring Program

All returning second-year F&ES students have the opportunity to be matched with an alumni mentor in their chosen career sector.

#### F&ESNext Online Career Development System

- Research more than 150 F&ES-focused jobs and internships added each month
- Publish your résumé for review by alumni and employers
- Create job and internship alerts

Apply directly online for jobs/internships of interest  
 Schedule career counseling appointments  
 RSVP for upcoming events  
 Access exclusive career development resources

## F&ES Résumé

We work with students individually and through workshops to write and design a targeted professional résumé. We provide an official *F&ES Résumé Template* and *Résumé Content, Style, and Format Guidelines*.

## Workshops and Information Sessions

Jumpstarting the Job Search: Parts 1 and 2. These daylong programs are designed to guide students through phases of career readiness in line with internship, job, and further study timelines. Sample program agendas:

### *Fall*

Building Your LinkedIn Profile  
 Résumé Workshop with Peer Review  
 Hive Mind: Networking  
 Getting Your Strategy in Place: Checklist Review  
 LinkedIn Photobooth

### *Spring*

Interview Skills Workshop: Behavioral and Traditional Interview Questions  
 Cover Letter Writing and Peer Review  
 Yale Library Resources for the Job Search

### *Throughout the academic year*

Internship Showcase and Networking Mixer  
 U.S. Presidential Management Fellowship Information Session  
 Applying for the Ph.D.  
 How to Work a Career Fair  
 Salary Negotiations

## Career Fairs and Regional Events

FESinDC: Approximately one hundred students attend this annual two-day program in Washington, D.C., home to the largest F&ES alumni population. The event includes employer site visits, preselected job and internship interviews, small-group information sessions, alumni networking dinners, and an alumni/student networking reception.

All Ivy Environmental and Sustainable Development Career Fair: Up to eighty employers in a range of fields and more than 1,000 students participate in this annual fair jointly sponsored by the eight Ivy League institutions. Open to all graduate students, undergraduate students, and alumni from partner schools. The fair is held at Columbia University in New York.

Networking nights and career fairs hosted by partner career offices at Yale: Sample programs include STEM career fair, social impact career events, energy employer information sessions, and international development career panels.

## On-Campus Recruiting

Connect with employers during on-campus information sessions, informational interviews, and interview opportunities.

## Alumni Connections

F&ES LinkedIn Group: The Office of Development and Alumni Services and the CDO maintain the Yale School of Forestry & Environmental Studies LinkedIn group.

AlumniFire: A platform that blends professional networking provided by services like LinkedIn with event-sharing and discussion opportunities on platforms like Facebook, and the functions of a job search site.

Yale Career Network (YCN): Students have access to 13,000 alumni who are available to give tips and advice on their industry, employer, or job.

## INTERNSHIPS AND SUMMER RESEARCH

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

Students are assisted by the CDO, faculty, alumni, and other students in their search for internships and summer research experiences. Attention is given to students to help them locate opportunities that meet their individual needs and interests.

Given the School's strong ties with natural-resource, environmental, and conservation organizations worldwide, internship and research possibilities are virtually unlimited. Typical internships and research projects occur between the first and second years of the program; occasionally, however, they last for longer periods.

**F&ES 006, Summer Internship/Research** 0 credits. The summer internship or research project is an important opportunity for students to apply knowledge and skills gained during their first year of study, to gain professional experience and build networks, and to investigate potential career paths. Consists of a research project or internship experience between ten and twelve weeks, typically in the summer between the first and second years of the program. Students have latitude in designing a summer practicum closely aligned with individual academic and career goals. Students are responsible for securing their own internship or developing a relevant research project with appropriate faculty supervision, applying for and securing their own summer funding, and completing appropriate online forms before and after the internship or research experience in order to receive course credit. Required of all master's candidates.

## SUMMER 2018 INTERNSHIPS AND RESEARCH PROJECTS

The following list, compiled by the CDO, shows the rich and diverse experiences that F&ES students had during a recent summer. Data for other years is available online at <http://environment.yale.edu/careers/data>. For more information, please contact Kathryn Douglas, Associate Director, at 203.436.4830 or [kathryn.douglas@yale.edu](mailto:kathryn.douglas@yale.edu). The School and its students thank donors, host organizations, and supervisors for making these valuable professional experiences possible.

## Business and Consulting

AECOM, Intern, Los Angeles, Calif.

Alter Eco Foods, Intern, San Francisco, Calif.  
 Avangrid, Intern, Orange, Conn.  
 Bigelow Tea, Intern, New Haven, Conn.  
 Calvert Research & Management, Intern, Washington, D.C.  
 CDM Smith, Intern, East Hartford, Conn.  
 Centerbridge Partners, New York, N.Y.  
 ConsenSys, Intern, New York, N.Y.  
 EcoLogic Solutions, Intern, New York, N.Y.  
 First Solar, Inc., Intern, San Francisco, Calif.  
 The Forestlands Group, Intern, Pittsburg, N.H.  
 Google, Data Center Operations, Contractor, Sunnyvale, Calif.  
 Grid+, Intern, Austin, Tex.  
 Guggenheim Securities, LLC, New York, N.Y.  
 Happy Family Brands, Intern, Boise, Idaho  
 ICF International, Intern, Fairfax, Va.  
 Kennedy & Violich, Architecture, Ltd., Intern, Boston, Mass.  
 KKR, Intern, New York, N.Y.  
 Metabolic, Intern, Amsterdam, The Netherlands  
 Native Energy, Intern, Burlington, Vt.  
 Outdoor Industry Association, Intern, Boulder, Colo.  
 Ranger Power, Intern, Brooklyn, N.Y.  
 Renewable Resources Group, Intern, Los Angeles, Calif.  
 Roux Inc., Intern, Somerset, N.J.  
 Shorenstein Realty Services, Intern, Philadelphia, Pa.  
 Sir Kensington's, Intern, New York, N.Y.  
 SLAM, Public Education Studio, Intern, Hartford, Conn.  
 Social Finance, Inc., Boston, Mass.  
 Wildwood Consulting, LLC, Intern, Asheville, N.C.  
 Williams-Sonoma, Intern, San Francisco, Calif.

## Education

Pace University School of Law, Land Use Law Center, Grant Writer, White Plains, N.Y.  
 Yale Forum on Religion and Ecology, Intern, New Haven, Conn.

## Government, Intergovernmental, and Public Sector

Auckland Council, Intern, Auckland, New Zealand  
 California Energy Commission, Intern, Sacramento, Calif.  
 City of New Haven, Engineering Department, Climate Change Adaptation Research  
 Intern, New Haven, Conn.  
 Colorado State Forest Service, Intern, Gould, Colo.  
 German Development Cooperation (GIZ), Intern, Suva Suva, Fiji  
 Miami-Dade County Regulatory and Economic Resources Department, Intern, Miami,  
 Fla.  
 National Park Service, Intern, Boston, Mass.  
 National Park Service, Intern, Wellfleet, Mass.  
 New York Power Authority, Intern, White Plains, N.Y.  
 New York State Attorney General's Office, Intern, New York, N.Y.  
 NYSERDA, NY-Sun, Intern, New York, N.Y.  
 NYSERDA, Office of the President and CEO, Intern, New York, N.Y.



Sustainable CT, Intern, Hartford, Conn.  
U.S. Environmental Protection Agency, Intern, Washington, D.C.  
U.S. Environmental Protection Agency, Region 2, Intern, New York, N.Y.  
U.S. Fish and Wildlife Service, Intern, Portland, Ore.  
UNDP, Intern, Panama City, Panama

## Legal

Pennsylvania Department of Environmental Protection, Intern, Norristown, Pa.

## NGO/Not-for-Profit

Breakthrough Institute, Oakland, Calif.  
Ceres, Intern, Boston, Mass.  
COMACO, Intern, Chipata/Lusaka, East Zambia, Zambia  
The Conservation Fund, Intern, Arlington, Va.  
Conservation International, Intern, Arlington, Va.  
Defenders of Wildlife, Intern, Washington, D.C.  
Earthjustice, New York, N.Y.  
Eastern Environmental Law Center, Intern, Newark, N.J.  
Environmental Defense Fund, Intern, San Francisco, Calif.  
Environmental Defense Fund, Intern, Washington, D.C.  
FAO, Intern, Rome, Italy  
The Forests Dialogue, Researcher, Kinshasa, Democratic Republic of Congo  
Gisakura, Intern, Western Province, Rwanda  
Green Building Council of South Africa, Intern, Johannesburg, Gauteng, South Africa  
Hakhu Amazon Design, Intern, Puyo, Ecuador  
National Parks Conservation Association, Intern, Washington, D.C.  
The Natural Resources Defense Council (NRDC), Intern, Washington, D.C.  
The Nature Conservancy, Intern, Arlington, Va.  
The Nature Conservancy, Intern, Washington, D.C.  
The New Haven Land Trust, Intern, New Haven, Conn.  
Rare, Intern, Arlington, Va.  
Redress, Intern, Hong Kong, China  
Responsible Business Alliance, Intern, Alexandria, Va.  
Rio Grande Headwaters Land Trust, Del Norte, Colo.  
Rocky Mountain Institute, Interns (2), Basalt, Colo.  
RSPN, Researcher, Thimphu, Bhutan  
Runa Foundation, Intern, Tena, Ecuador  
Runa Foundation, Social Entrepreneurship Intern, Tena, Ecuador  
Spokane Riverkeeper, Intern, Spokane, Wash.  
Student Conservation Association, Intern, Chicago, Ill.  
Ucross High Plains Stewardship Initiative, Project Manager, New Haven, Conn.  
UNDP, Intern, Bridgetown, Barbados  
UNDP, Intern, Panama City, Panama  
UNDP, Research Assistant, Panama City, Panama  
UNFCCC Regional Collaboration Centre Bangkok, Intern, Bangkok, Thailand  
Wildlife Conservation Society, Intern, New York, N.Y.  
Wildlife Conservation Society, Intern, Saranac Lake, N.Y.  
World Bank, Intern, Washington, D.C.  
World Resources Institute Beijing Office, Intern, Beijing and Hangzhou, China

World Resources Institute, Interns (3), Washington D.C.  
 WWF China, Beijing Office, Intern, Beijing, China  
 WWF, Interns (2), Washington, D.C.  
 Yale Peabody Museum of Natural History, Intern, New Haven, Conn.  
 Yale School of Forestry & Environmental Studies, Forest Apprentice, Eastford, Conn.  
 Yale School of Forestry & Environmental Studies, Forest Research Intern, New Haven, Conn.  
 Yellowstone to Yukon, Intern, Canmore, Alberta, Canada

## Non-U.S. Independent Research

Analyzed Cuba and Puerto Rico agriculture resilience and recovery after Hurricanes Irma and Maria. Havana, Cuba, and San Juan, Puerto Rico  
 Analyzed the constitutive policy process for sustainable bioenergy forest derived from degraded lands in Central Kalimantan. Indonesia  
 Assessed the growth and regeneration of mahogany trees that have regenerated after twenty years. Hill Bank, Belize  
 Carried out interviews, participant observation, and document analysis for research on the political ecology of protected areas in Myanmar. Dawei Tanintharyi, Myanmar  
 Conducted interviews on perceptions of the compensation scheme for human-wildlife conflict resolutions. Kenya  
 Conducted surveys in the Almora region to gain a better understanding of the key drivers of household vulnerability to floods. Almora Uttarakhand, India  
 Created database and mapping of past hazards (fire, flood, landslide, and earthquake) in the Himalayan region. Chitwan, Nepal  
 Discovered perspectives on the status and future potential of ecotourism in post-crisis Cuba and Puerto Rico. Havana, Cuba, and San Juan, Puerto Rico  
 Examined fragile symbiotic relationships between ants and trees in the Amazon rainforest. Coca Yasuni National Park, Ecuador  
 Examined the ecology of the manukahoney bee-human assemblage along with the perspectives of various actors. Christchurch, New Zealand  
 Gathered data for a study on coal mine reclamation. Balikpapan, East Kalimantan, Indonesia  
 Gathered data in order to quantify water demand in the Upper Ewaso Ngiro River basin in Kenya. Nanyuki, Kenya  
 Identified tree species and measuring DBH and height along three transects. Bitung, North Sulawesi, Indonesia  
 Interviewed representatives of CIFOR and various other organizations involved in monitoring and evaluating REDD+. Rio de Janeiro, Brazil, and Bogor, Indonesia  
 Investigated the climate effects of irrigation agriculture in Zhangye Oasis in Northwest China. Zhangye, Gansu, China  
 Performed multi-stakeholder analysis in preparation for the Forests Dialogue spring 2019 Land Use Dialogue. Asankrangwa, Wassa Amenfi, Ghana  
 Researched large carnivore reintroductions in protected reserves in South Africa in order to understand the social and decision process. Pretoria Gauteng, South Africa  
 Researched seedling nursery capacity and potential to upgrade to native species for natural forest regeneration. Musanze, Northern District, Rwanda  
 Studied the extraction and sale of nontimber forest production by indigenous Shipibo communities in the Peruvian Amazon. Pucallpa, Ucayali, Peru

Supported data review and collection, Land Use Dialogue stakeholder mapping, and development of goals for the upcoming dialogue. Ifakara, Kilombero Region, Tanzania

## U.S. Independent Research

- Assessed the financial viability of agroforestry enterprises at Caney Fork Farms, Carthage, Tenn.
- Collected groundwater samples near hydraulic fracturing operations in Susquehanna County, Pa.
- Conducted occupancy modeling using camera trap fieldwork, vegetation surveys, and GIS analysis, Yale-Myers Forest, Eastford, Conn.
- Conducted research on animal law and animal studies, New Haven, Conn.
- Finished allometric modeling for bunchgrasses and forbs, and sagebrush growth ring analysis, New Haven, Conn.
- Interviewed climbers and locals on the moral and spiritual underpinnings of the natural environment and proper land use, Ten Sleep, Wyo.
- Quantified the flood risk that New Haven faces along the coast, New Haven, Conn.
- Researched agriculture and food policy for Office of Congresswoman Pingree, Washington, D.C.
- Sampled onsite wastewater treatment/septic systems and performed laboratory experiments, Charlestown, R.I.
- Studied animal personality and plasticity using old-field arthropods, Yale-Myers Forest, Eastford, Conn.
- Studied morphological plasticity of red maple regeneration in a chronosequence of irregular shelterwoods, Yale-Myers Forest, Eastford, Conn.
- Studied urban material flows in New York City, New York, N.Y.
- Worked on nano-enabled lithium-air batteries, New Haven, Conn.

## IMMEDIATELY FOLLOWING GRADUATION

Each year Yale F&ES 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 on the most recent as well as previous classes can be found at <http://environment.yale.edu/careers/data>.

Summary data from the class of 2018 master’s graduates six months after graduation (86 responses):

Private (Business/Consulting/Law)	42%
Nonprofit/Nongovernmental	24%
Government/Public Sector	16%
Academic (K–Higher Education)	8%
Further Study	6%
Entrepreneurial	4%

## Leave of Absence

Students are expected to follow a continuous course of study at the School of Forestry & Environmental Studies. However, a student who wishes or needs to interrupt study temporarily may request a leave of absence. There are three types of leave—personal,

medical, and parental—all of which are described below. The general policies that apply to a leave of absence are:

1. Any student who is contemplating a leave of absence should see the assistant dean of student services to discuss the necessary application procedures.
2. All leaves of absence must be approved by the assistant dean of student services and the associate dean of academic affairs. Medical leaves also require the written recommendation of a physician on the staff of Yale Health, as described below.
3. A student may be granted a leave of absence of one to two years. Any leave approved by the assistant dean of student services and the associate dean of academic affairs will be for a specified period.
4. International students who apply for a leave of absence must consult with OISS regarding their visa status.
5. A student on a leave of absence may complete outstanding work in courses for which extensions have been granted. The student may not, however, fulfill any other degree requirements during the time on leave.
6. A student on a leave of absence is not eligible for financial aid, including loans; and in most cases, student loans are not deferred during periods of nonenrollment.
7. A student on a leave of absence is not eligible for the use of any University facilities normally available to enrolled students.
8. A student on leave of absence may continue to be enrolled in Yale Health by purchasing coverage through the Student Affiliate Coverage plan. In order to secure continuous coverage from Yale Health, enrollment in this plan must be requested prior to the beginning of the term in which the student will be on leave. If a leave of absence is granted during the term, the student must request Yale Health Affiliate Coverage enrollment within thirty days of the date the registrar was notified of the leave. Coverage is not automatic; enrollment forms are available from the Member Services Department of Yale Health, 203.432.0246, or can be downloaded from the Yale Health website (<http://yalehealth.yale.edu>).
9. A student on a leave of absence does not have to file a formal application for readmission. However, the student must notify the assistant dean of student services in writing of the intention to return at least eight weeks prior to the end of the approved leave. In addition, a returning student who wishes to be considered for financial aid must submit appropriate financial aid applications to the School's financial aid office to determine eligibility.
10. A student on a leave of absence who does not return at the end of an approved leave, and does not request and receive an extension from the dean, is automatically dismissed from the School.

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

To request a personal leave of absence, the student must apply in writing before the beginning of the term for which the leave is requested, explaining the reasons for the proposed leave and stating both the proposed start and end dates of the leave,

and the address at which the student can be reached during the period of the leave. If the assistant dean of student services and the associate dean of academic affairs find the student to be eligible, the leave will be approved. In any case, the student will be informed in writing of the action taken. A student who does not apply for a personal leave of absence, or whose application for a leave is denied, and who does not register for any term, will be considered to have withdrawn from the School.

**Medical leave of absence** A student who must interrupt study temporarily because of illness or injury may be granted a medical leave of absence with the approval of the director of student services and the associate dean of academic affairs, on the written recommendation of a physician on the staff of Yale Health. The general policies governing all leaves of absence are described above. A student who is making satisfactory progress toward degree requirements is eligible for a medical leave any time after matriculation. The final decision concerning a request for a medical leave of absence will be communicated in writing by the assistant dean of student services.

The School of Forestry & Environmental Studies reserves the right to place a student on a mandatory medical leave of absence when, on recommendation of the director of Yale Health or the chief of the Mental Health and Counseling department, the dean of the School determines that, because of a medical condition, the student is a danger to self or others, the student has seriously disrupted others in the student's residential or academic communities, or the student has refused to cooperate with efforts deemed necessary by Yale Health and the dean to make such determinations. Each case will be assessed individually based on all relevant factors, including, but not limited to, the level of risk presented and the availability of reasonable modifications. Reasonable modifications do not include fundamental alterations to the student's academic, residential, or other relevant communities or programs; in addition, reasonable modifications do not include those that unduly burden University resources.

An appeal of such a leave must be made in writing to the dean of the School no later than seven days from the effective date of the leave.

An incident that gives rise to voluntary or mandatory leave of absence may also result in subsequent disciplinary action.

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

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

Any student planning to have or care for a child is encouraged to meet with the assistant dean of student services to discuss leaves and other short-term arrangements. For many students, short-term arrangements rather than a leave of absence are possible. Students living in University housing units are encouraged to review their housing contract and the related policies of the Yale Housing before applying for a parental leave of absence.

Students granted a parental leave may continue to reside in University housing to the end of the academic term for which the leave was first granted, but no longer.

## U.S. Military Leave Readmissions Policy

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

1. The student must have served in the U.S. Armed Forces for a period of more than thirty consecutive days;
2. The student must give advance written or oral notice of such service to the assistant dean of student services and the associate dean of academic affairs. In providing the advance notice the student does not need to indicate an intention to return. This advance notice need not come directly from the student, but rather, can be made by an appropriate officer of the U.S. Armed Forces or official of the U.S. Department of Defense. Notice is not required if precluded by military necessity. In all cases, this notice requirement can be fulfilled at the time the student seeks readmission, by submitting an attestation that the student performed the service.
3. The student must not be away from the School to perform U.S. military service for a period exceeding five years (this includes all previous absences to perform U.S. military service but does not include any initial period of obligated service). If a student's time away from the School to perform U.S. military service exceeds five years because the student is unable to obtain release orders through no fault of the student or the student was ordered to or retained on active duty, the student should contact the assistant dean of student services to determine if the student remains eligible for guaranteed readmission.
4. The student must notify the School within three years of the end of the U.S. military service of the intention to return. However, a student who is hospitalized or recovering from an illness or injury incurred in or aggravated during the U.S. military service has up until two years after recovering from the illness or injury to notify the School of the intent to return.
5. The student cannot have received a dishonorable or bad conduct discharge or have been sentenced in a court-martial.

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

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

between the amounts currently charged other students and the amount charged for the academic year in which the student left.

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

## Freedom of Expression

The Yale School of Forestry & Environmental Studies is committed to the protection of free inquiry and expression in the classroom and throughout the school community. In this, the School reflects the University's commitment to and policy on freedom of expression as eloquently stated in the Woodward Report (Report of the Committee on Freedom of Expression at Yale, 1974). See <https://studentlife.yale.edu/guidance-regarding-free-expression-and-peaceable-assembly-students-yale>.

# YALE UNIVERSITY RESOURCES AND SERVICES

## A Global University

Yale continues to evolve as a global university, educating leaders and advancing the frontiers of knowledge across the entire world. The University's engagement beyond the United States dates from its earliest years. Yale has drawn students from abroad for nearly two centuries, and international topics have been represented in its curriculum for the past hundred years and more. Yale aspires to:

- Be the university that best prepares students for global citizenship and leadership
- Be a worldwide research leader on matters of global import
- Be the university with the most effective global networks

This year, Yale welcomed the largest number of international students and scholars in its history. The current enrollment of more than 2,800 international students from 121 countries comprises 22 percent of the student body. Yale is committed to attracting the best and brightest from around the world by offering generous international financial aid packages, conducting programs that introduce and acclimate international students to Yale, and fostering a vibrant campus community. The number of international scholars (visiting faculty, researchers, and postdoctoral fellows) has also grown to nearly 2,700 each year.

Yale's globalization is guided by the vice president for global strategy, who is responsible for ensuring that Yale's broader global initiatives serve its academic goals and priorities, and for enhancing Yale's international presence as a leader in liberal arts education and as a world-class research institution. The vice president works closely with academic colleagues in all of the University's schools and provides support and strategic guidance to the many international programs and activities undertaken by Yale faculty, students, and staff.

The Whitney and Betty MacMillan Center for International and Area Studies (<https://macmillan.yale.edu>) is the University's focal point for teaching and research on international affairs, societies, and cultures.

The Jackson Institute for Global Affairs (<http://jackson.yale.edu>) seeks to institutionalize the teaching of global affairs throughout the University and to inspire and prepare Yale students for global citizenship and leadership.

The Office of International Affairs (<https://world.yale.edu/oia>) provides administrative support for the international activities of all schools, departments, centers, and organizations at Yale; promotes Yale and its faculty to international audiences; and works to increase the visibility of Yale's international activities around the globe.

The Office of International Students and Scholars (<https://oiss.yale.edu>) hosts orientation programs and social activities for the University's international community and is a resource for international students and scholars on immigration matters and other aspects of acclimating to life at Yale.



The Yale World Fellows Program (<https://worldfellows.yale.edu>) hosts fifteen emerging leaders from outside the United States each year for an intensive semester of individualized research, weekly seminars, leadership training, and regular interactions with the Yale community.

The Yale Alumni Association (<https://alumni.yale.edu>) provides a channel for communication between the alumni and the University and supports alumni organizations and programs around the world.

Additional information may be found on the “Yale and the World” website (<https://world.yale.edu>), including resources for those conducting international activities abroad and links to international initiatives across the University.

## Housing

The Yale Housing Office has dormitory and apartment units available for graduate and professional students. Dormitories are single-occupancy and two-bedroom units of varying sizes and prices. They are located across the campus, from Edward S. Harkness Memorial Hall, serving the medical campus, to Helen Hadley Hall and the newly built 272 Elm Street, serving the central/science campus. Unfurnished apartments consisting of efficiencies and one-, two-, and three-bedroom apartments for singles and families are also available. Family housing is available in Whitehall and Esplanade Apartments. The Housing website (<https://housing.yale.edu>) is the venue for graduate housing information and includes dates, procedures, facility descriptions, floor plans, and rates. Applications for the new academic year are available beginning April 22 and can be submitted directly from the website with a Yale NetID.

The Yale Housing Office also manages the Off Campus Living listing service (<http://offcampusliving.yale.edu>; 203.436.9756), which is the exclusive Yale service for providing off-campus rental and sales listings. This secure system allows members of the Yale community to search rental listings, review landlord/property ratings, and search for a roommate in the New Haven area. On-campus housing is limited, and members of the community should consider off-campus options. Yale University discourages the use of Craigslist and other third-party nonsecure websites for off-campus housing searches.

The Yale Housing Office is located in Helen Hadley Hall (HHH) at 420 Temple Street and is open from 9 a.m. to 4 p.m., Monday through Friday; 203.432.2167.

## Dining

Yale Hospitality has tailored its services to meet the particular needs of graduate and professional school students by offering meal plan options that allow flexibility and value. For up-to-date information on all options, costs, and residential and retail dining locations, visit <https://hospitality.yale.edu>. Inquiries concerning food services should be addressed to Yale Hospitality, 246 Church Street, PO Box 208261, New Haven CT 06520-8261; e-mail, [yale.dining@yale.edu](mailto:yale.dining@yale.edu); tel., 203.432.0420.

## 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

The Yale Health Center is located on campus at 55 Lock Street. The center is home to Yale Health, a not-for-profit, physician-led health coverage option that offers a wide variety of health care services for students and other members of the Yale community. Services include student health, gynecology, mental health, pediatrics, pharmacy, laboratory, radiology, a seventeen-bed inpatient care unit, a round-the-clock acute care clinic, and specialty services such as allergy, dermatology, orthopedics, and a travel clinic. Yale Health coordinates and provides payment for the services provided at the Yale Health Center, as well as for emergency treatment, off-site specialty services, inpatient hospital care, and other ancillary services. Yale Health's services are detailed in the *Yale Health Student Handbook*, available through the Yale Health Member Services Department, 203.432.0246, or online at <https://yalehealth.yale.edu/coverage/student-coverage>.

### Eligibility for Services

All full-time Yale degree-candidate students who are paying at least half tuition are enrolled automatically for Yale Health Basic Coverage. Yale Health Basic Coverage is offered at no charge and includes preventive health and medical services in the departments of Student Health, Gynecology, Student Wellness, and Mental Health & Counseling. In addition, treatment for urgent medical problems can be obtained twenty-four hours a day through Acute Care.

Students on leave of absence or on extended study and paying less than half tuition are not eligible for Yale Health Basic Coverage but may enroll in Yale Health Student Affiliate Coverage. Students enrolled in the Division of Special Registration as nondegree special students or visiting scholars are not eligible for Yale Health Basic Coverage but may enroll in the Yale Health Billed Associates Plan and pay a monthly fee. Associates must register for a minimum of one term within the first thirty days of affiliation with the University.

Students not eligible for Yale Health Basic Coverage may also use the services on a fee-for-service basis. Students who wish to be seen fee-for-service must register with the Member Services Department. Enrollment applications for the Yale Health Student Affiliate Coverage, Billed Associates Plan, or Fee-for-Service Program are available from the Member Services Department.

All students who purchase Yale Health Hospitalization/Specialty Coverage (see below) are welcome to use specialty and ancillary services at Yale Health Center. Upon referral, Yale Health will cover the cost of specialty and ancillary services for these students. Students with an alternate insurance plan should seek specialty services from a provider who accepts their alternate insurance.

### Health Coverage Enrollment

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

Hospitalization/Specialty Coverage or elect to waive the plan if they have other hospitalization coverage, such as coverage through a spouse or parent. The waiver must be renewed annually, and it is the student's responsibility to confirm receipt of the waiver by the University's deadlines noted below.

#### YALE HEALTH HOSPITALIZATION/SPECIALTY COVERAGE

For a detailed explanation of this plan, which includes coverage for prescriptions, see the *Yale Health Student Handbook*, available online at <https://yalehealth.yale.edu/coverage/student-coverage>.

Students are automatically enrolled and charged a fee each term on their Student Financial Services bill for Yale Health Hospitalization/Specialty Coverage. Students with no break in coverage who are enrolled during both the fall and spring terms are billed each term and are covered from August 1 through July 31. For students entering Yale for the first time, readmitted students, and students returning from a leave of absence who have not been covered during their leave, Yale Health Hospitalization/Specialty Coverage begins on the day the dormitories officially open. A student who is enrolled for the fall term only is covered for services through January 31; a student enrolled for the spring term only is covered for services through July 31.

**Waiving Yale Health Hospitalization/Specialty Coverage** Students are permitted to waive Yale Health Hospitalization/Specialty Coverage by completing an online waiver form at <https://yhpstudentwaiver.yale.edu> that demonstrates proof of alternate coverage. It is the student's responsibility to report any changes in alternate insurance coverage to the Member Services Department. Students are encouraged to review their present coverage and compare its benefits to those available under Yale Health. The waiver form must be filed annually and must be received by September 15 for the full year or fall term or by January 31 for the spring term only.

**Revoking the waiver** Students who waive Yale Health Hospitalization/Specialty Coverage but later wish to be covered must complete and send a form voiding their waiver to the Member Services Department by September 15 for the full year or fall term, or by January 31 for the spring term only. Students who wish to revoke their waiver during the term may do so, provided they show proof of loss of the alternate insurance plan and enroll within thirty days of the loss of this coverage. Yale Health fees will not be prorated.

#### YALE HEALTH STUDENT DEPENDENT PLANS

A student may enroll the student's lawfully married spouse or civil union partner and/or legally dependent child(ren) under the age of twenty-six in one of three student dependent plans: Student + Spouse, Student + Child/Children, or Student Family Plan. These plans include services described in both Yale Health Basic Coverage and Yale Health Hospitalization/Specialty Coverage. Coverage is not automatic, and enrollment is by application. Applications are available from the Member Services Department or can be downloaded from the website (<https://yalehealth.yale.edu/resources/forms>) and must be renewed annually. Applications must be received by September 15 for full-year or fall-term coverage, or by January 31 for spring-term coverage only.

#### YALE HEALTH STUDENT AFFILIATE COVERAGE

Students on leave of absence or extended study, students paying less than half tuition, students enrolled in the EMBA program, students enrolled in the PA Online program, or students enrolled in the Eli Whitney Program prior to September 2007 may enroll

in Yale Health Student Affiliate Coverage, which includes services described in both Yale Health Basic and Yale Health Hospitalization/Specialty Coverage. Applications are available from the Member Services Department or can be downloaded from the website (<https://yalehealth.yale.edu/resources/forms>) and must be received by September 15 for full-year or fall-term coverage, or by January 31 for spring-term coverage only.

## Eligibility Changes

**Withdrawal** A student who withdraws from the University during the first fifteen days of the term will be refunded the fee paid for Yale Health Hospitalization/Specialty Coverage. The student will not be eligible for any Yale Health benefits, and the student's Yale Health membership will be terminated retroactive to the beginning of the term. The medical record will be reviewed, and any services rendered and/or claims paid will be billed to the student on a fee-for-service basis. Assistance with identifying and locating alternative sources of medical care may be available from the Care Management Department at Yale Health. At all other times, a student who withdraws from the University will be covered by Yale Health for thirty days following the date of withdrawal. Fees will not be prorated or refunded. Students who withdraw are not eligible to enroll in Yale Health Student Affiliate Coverage. Regardless of enrollment in Yale Health Hospitalization/Specialty Coverage, students who withdraw will have access to services available under Yale Health Basic Coverage (including Student Health, Athletic Medicine, Mental Health & Counseling, and Care Management) during these thirty days to the extent necessary for a coordinated transition of care.

**Leaves of absence** Students who are granted a leave of absence are eligible to purchase Yale Health Student Affiliate Coverage for the term(s) of the leave. If the leave occurs on or *before* the first day of classes, Yale Health Hospitalization/Specialty Coverage will end retroactive to the start of the coverage period for the term. If the leave occurs anytime after the first day of classes, Yale Health Hospitalization/Specialty Coverage will end on the day the registrar is notified of the leave. In either case, students may enroll in Yale Health Student Affiliate Coverage. Students must enroll in Affiliate Coverage prior to the beginning of the term unless the registrar is notified after the first day of classes, in which case, the coverage must be purchased within thirty days of the date the registrar was notified. Fees paid for Yale Health Hospitalization/Specialty Coverage will be applied toward the cost of Affiliate Coverage. Coverage is not automatic, and enrollment forms are available at the Member Services Department or can be downloaded from the website (<https://yalehealth.yale.edu/resources/forms>). Fees will not be prorated or refunded.

**Extended study or reduced tuition** Students who are granted extended study status or pay less than half tuition are not eligible for Yale Health Hospitalization/Specialty Coverage. They may purchase Yale Health Student Affiliate Coverage during the term(s) of extended study. This plan includes services described in both Yale Health Basic and Yale Health Hospitalization/Specialty Coverage. Coverage is not automatic, and enrollment forms are available at the Member Services Department or can be downloaded from the website (<https://yalehealth.yale.edu/resources/forms>). Students must complete an enrollment application for the plan prior to September 15 for the full year or fall term, or by January 31 for the spring term only.

For a full description of the services and benefits provided by Yale Health, please refer to the *Yale Health Student Handbook*, available from the Member Services Department, 203-432.0246, 55 Lock Street, PO Box 208237, New Haven CT 06520-8237.

## Required Immunizations

Proof of vaccination is a pre-entrance requirement determined by the Connecticut State Department of Public Health. Students who are not compliant with this state regulation will not be permitted to register for classes or move into the dormitories for the fall term, 2019. Please access the Incoming Student Vaccination Record form for graduate and professional students at <https://yalehealth.yale.edu/new-graduate-and-professional-student-forms>. Connecticut state regulation requires that this form be completed and signed, for each student, by a physician, nurse practitioner, or physician's assistant. The form must be completed, independent of any and all health insurance elections or coverage chosen. Once the form has been completed, the information must be entered into the Yale Medicat online system (available mid-June), and all supporting documents must be uploaded to <http://yale.medicatconnect.com>. The final deadline is August 1.

**Measles, mumps, rubella, and varicella** All students who were born after January 1, 1957, are required to provide proof of immunization against measles (rubeola), mumps, German measles (rubella), and varicella. Connecticut state regulation requires two doses of measles vaccine, two doses of mumps vaccine, two doses of rubella vaccine, and two doses of varicella vaccine. The first dose must have been given on or after January 1, 1980, *and* after the student's first birthday; the second dose must have been given at least thirty (30) days after the first dose. If dates of vaccination are not available, titer results (blood test) demonstrating immunity may be substituted for proof of vaccination. The cost for all vaccinations and/or titers rests with the student, as these vaccinations are considered to be a pre-entrance requirement by the Connecticut State Department of Public Health. Students who are not compliant with this state regulation will not be permitted to register for classes or move into the dormitories for the fall term, 2019.

**Quadrivalent meningitis** All students living in on-campus dormitory facilities must be vaccinated against meningitis. The only vaccines that will be accepted in satisfaction of the meningitis vaccination requirement are ACWY Vax, Menveo, Nimenrix, Menactra, Mencevax, and Menomune. The vaccine must have been given within five years of the first day of classes at Yale. Students who are not compliant with this state regulation will not be permitted to register for classes or move into the dormitories for the fall term, 2019. The cost for all vaccinations and/or titers rests with the student, as these vaccinations are considered to be a pre-entrance requirement by the Connecticut State Department of Public Health. Please note that the State of Connecticut does not require this vaccine for students who intend to reside off campus.

**TB screening** The University requires tuberculosis screening for all incoming students who have lived or traveled outside of the United States within the past year.

**Hepatitis B series** The University recommends that incoming students receive a series of three Hepatitis B vaccinations. Students may consult their health care provider for further information.

## Resource Office on Disabilities

The Resource Office on Disabilities (ROD) facilitates accommodations for all Yale students with disabilities who register with and have appropriate medical documentation on file in the ROD. Documentation may be submitted to the ROD even though a specific accommodation request is not anticipated at the time of registration. Early planning is critical. Requests for housing accommodations must be made in the housing application. The required first step for a student with a disability is to contact the Resource Office on Disabilities to initiate the process of obtaining disability-related accommodations; see [https://yale-accommodate.symplicity.com/public\\_accommodation](https://yale-accommodate.symplicity.com/public_accommodation). Registration with the ROD is confidential.

Generally, a student requiring academic accommodations needs to let the ROD know at the start of each term. We ask students to complete this step as soon as their schedule is known. At any time during a term, students with a newly diagnosed disability or recently sustained injury requiring accommodations should contact the ROD. More information can be found on our website, <https://rod.yale.edu>, including instructions for requesting or renewing accommodations. You can also reach us by phone at 203.432.2324.

## Resources on Sexual Misconduct

Yale University is committed to maintaining and strengthening an educational, working, and living environment founded on civility and mutual respect. Sexual misconduct is antithetical to the standards and ideals of our community, and it is a violation of Yale policy and the disciplinary regulations of Yale College and the graduate and professional schools.

Sexual misconduct incorporates a range of behaviors including sexual assault, sexual harassment, intimate partner violence, stalking, voyeurism, and any other conduct of a sexual nature that is nonconsensual, or has the purpose or effect of threatening, intimidating, or coercing a person. Violations of Yale's Policy on Teacher-Student Consensual Relations also constitute sexual misconduct. Sexual activity requires consent, which is defined as positive, unambiguous, and voluntary agreement to engage in specific sexual activity throughout a sexual encounter.

Yale aims to eradicate sexual misconduct through education, training, clear policies, and serious consequences for violations of these policies. In addition to being subject to University disciplinary action, many forms of sexual misconduct are prohibited by Connecticut and federal law and may lead to civil liability or criminal prosecution. Yale provides a range of services, resources, and mechanisms for victims of sexual misconduct. The options for undergraduate, graduate, and professional school students are described at <https://smr.yale.edu>.

## SHARE: Information, Advocacy, and Support

55 Lock Street, Lower Level  
Office hours: 9 a.m.–5 p.m., M–F  
24/7 hotline: 203.432.2000  
<https://sharecenter.yale.edu>

SHARE, the Sexual Harassment and Assault Response and Education Center, has trained counselors available 24/7, including holidays. SHARE is available to members

of the Yale community who wish to discuss any past or current experience of sexual misconduct involving themselves or someone they care about. SHARE services are confidential and can be anonymous if desired. SHARE can provide professional help with medical and health issues (including accompanying individuals to the hospital or the police), as well as ongoing counseling and support. SHARE works closely with the University-Wide Committee on Sexual Misconduct, the Title IX coordinators, the Yale Police Department, and other campus resources and can provide assistance with initiating a formal or informal complaint.

If you wish to make use of SHARE's services, you can call the SHARE number (203.432.2000) at any time for a phone consultation or to set up an in-person appointment. You may also drop in on weekdays during regular business hours. Some legal and medical options are time-sensitive, so if you have experienced an assault, we encourage you to call SHARE and/or the Yale Police as soon as possible. Counselors can talk with you over the telephone or meet you in person at Acute Care in the Yale Health Center or at the Yale New Haven Emergency Room. If it is not an acute situation and you would like to contact the SHARE staff during regular business hours, you can contact Jennifer Czincz, the director of SHARE (203.432.0310, [jennifer.czincz@yale.edu](mailto:jennifer.czincz@yale.edu)), Anna Seidner (203.436.8217, [anna.seidner@yale.edu](mailto:anna.seidner@yale.edu)), Cristy Cantu (203.432.2610, [cristina.cantu@yale.edu](mailto:cristina.cantu@yale.edu)), Freda Grant (203.436.0409, [freda.grant@yale.edu](mailto:freda.grant@yale.edu)), or John Criscuolo (203.645.3349, [john.criscuolo@yale.edu](mailto:john.criscuolo@yale.edu)).

## Title IX Coordinators

203.432.6854

Office hours: 9 a.m.–5 p.m., M–F

<https://provost.yale.edu/title-ix>

Title IX of the Education Amendments of 1972 protects people from sex discrimination in educational programs and activities at institutions that receive federal financial assistance. Sex discrimination includes sexual harassment, sexual assault, and other forms of sexual misconduct. The University is committed to providing an environment free from discrimination on the basis of sex.

Yale College, the Graduate School of Arts and Sciences, and the professional schools have each designated a deputy Title IX coordinator, reporting to Stephanie Spangler, Deputy Provost for Health Affairs and Academic Integrity and the University Title IX Coordinator. Coordinators respond to and address specific complaints, provide information on and coordinate with the available resources, track and monitor incidents to identify patterns or systemic issues, deliver prevention and educational programming, and address issues relating to gender-based discrimination and sexual misconduct within their respective schools. Coordinators are knowledgeable about, and will provide information on, all options for complaint resolution, and can initiate institutional action when necessary. Discussions with a Title IX coordinator are confidential. In the case of imminent threat to an individual or the community, the coordinator may need to consult with other administrators or take action in the interest of safety. The coordinators also work closely with the SHARE Center, the University-Wide Committee on Sexual Misconduct, and the Yale Police Department.

## University-Wide Committee on Sexual Misconduct

203.432.4449

Office hours: 9 a.m.–5 p.m., M–F

<https://uwc.yale.edu>

The University-Wide Committee on Sexual Misconduct (UWC) is an internal disciplinary board for complaints of sexual misconduct available to students, faculty, and staff across the University, as described in the committee's procedures. The UWC provides an accessible, representative, and trained body to fairly and expeditiously address formal complaints of sexual misconduct. UWC members can answer inquiries about procedures and the University definition of sexual misconduct. The UWC is comprised of faculty, administrative, and student representatives from across the University. In UWC cases, investigations are conducted by professional, independent fact finders.

## Yale Police Department

101 Ashmun Street

24/7 hotline: 203.432.4400

<https://your.yale.edu/community/public-safety/police/sensitive-crimes-support>

The Yale Police Department (YPD) operates 24/7 and is comprised of highly trained, professional officers. The YPD can provide information on available victims' assistance services and also has the capacity to perform full criminal investigations. If you wish to speak with Sergeant Kristina Reech, the Sensitive Crimes & Support coordinator, she can be reached at 203.432.9547 during business hours or via e-mail at [kristina.reech@yale.edu](mailto:kristina.reech@yale.edu). Informational sessions are available with the Sensitive Crimes & Support coordinator to discuss safety planning, available options, etc. The YPD works closely with the New Haven State's Attorney, the SHARE Center, the University's Title IX coordinators, and various other departments within the University. Talking to the YPD does not commit you to submitting evidence or pressing charges; with few exceptions, all decisions about how to proceed are up to you.

## Office of International Students and Scholars

The Office of International Students and Scholars (OISS) coordinates services and support for Yale's nearly 6,000 international students, faculty, staff, and their dependents. OISS staff assist with issues related to employment, immigration, and personal and cultural adjustment, as well as serve as a source of general information about living at Yale and in New Haven. As Yale University's representative for immigration concerns, OISS helps students, faculty, and staff obtain and maintain legal nonimmigrant status in the United States. All international students and scholars must register with OISS as soon as they arrive at Yale; see <http://oiss.yale.edu/coming-to-yale>.

OISS programs, like the Community Friends hosting program, daily English conversation groups, U.S. culture workshops and discussions, bus trips, and social events, provide an opportunity to meet members of Yale's international community and become acquainted with the many resources of Yale University and New Haven. Spouses and partners of Yale students and scholars will want to get involved with the International Spouses and Partners at Yale (ISPY), which organizes a variety of programs.



The OISS website (<http://oiss.yale.edu>) provides useful information to students and scholars prior to and upon arrival in New Haven, as well as throughout their stay at Yale. International students, scholars, and their families and partners can connect with OISS and the Yale international community virtually through Facebook.

OISS is housed in the International Center for Yale Students and Scholars, which serves as a welcoming venue for students and scholars who want to peruse resource materials, check their e-mail, and meet up with a friend or colleague. Open until 9 p.m. on weekdays during the academic year, the center—located at 421 Temple Street, across the street from Helen Hadley Hall—also provides meeting space for student groups and a venue for events organized by both student groups and University departments. For more information about reserving space at the center, go to <http://oiss.yale.edu/about/the-international-center/international-center-room-reservations>. For information about the center, visit <http://oiss.yale.edu/about/international-center>.

## Religious Resources

The religious and spiritual resources of the University serve all students, faculty, and staff of all faiths. These resources are coordinated and/or supported through the Chaplaincy (located on the lower level of Bingham Hall on Old Campus); the University Church in Yale in Battell Chapel, an open and affirming ecumenical Christian congregation; and Yale Religious Ministries, the on-campus association of professionals representing numerous faith traditions. This association includes the Saint Thomas More Catholic Chapel and Center at Yale and the Joseph Slifka Center for Jewish Life at Yale, and it supports Buddhist, Hindu, and Muslim life professionals; several Protestant denominational and nondenominational ministries; and student religious groups such as the Baha’i Association, the Yale Hindu Student Council, the Muslim Student Association, the Sikh Student Association, and many others. Hours for the Chaplain’s Office during the academic term are Monday through Thursday from 8:30 a.m. to 11 p.m., Friday from 8:30 a.m. to 5 p.m., and Sunday evenings from 5 to 11. Additional information is available at <http://chaplain.yale.edu>.

## Libraries

The Yale University Library comprises fifteen million print and electronic volumes in more than a dozen different libraries and locations, including Sterling Memorial Library, the Beinecke Rare Book and Manuscript Library, and the Anne T. and Robert M. Bass Library. The library also encompasses an innovative Preservation and Conservation Department that develops and applies leading-edge technology to maintain the library’s diverse collections, which range from ancient papyri to early printed books, rare film and recorded music collections, and a growing body of born-digital works and resources. A student-curated exhibit program and the University’s emphasis on teaching with original source materials augment students’ access to the physical collections and study spaces of all the libraries at Yale, as well as to a full array of online and digital resources. For additional information, please visit <http://web.library.yale.edu>.

## Graduate-Professional Student Senate (GPSS)

The Graduate and Professional Student Senate (GPSS or “Yale G&P Senate”) is composed of student-elected representatives from each of the thirteen graduate and

professional schools at Yale. Any student enrolled in these schools is eligible to run for a senate seat during fall elections. As a governing body, the GPSS advocates for student concerns and advancement within Yale, represents all graduate and professional students to the outside world, and facilitates interaction and collaboration among the schools through social gatherings, academic and professional events, and community service. GPSS meetings occur on alternating Thursdays and are open to the entire graduate and professional school community, as well as representatives from the Yale administration. GPSS also oversees the management of the Graduate and Professional Student Center, located at 204 York Street. The center provides office and event space for GPSS and other student organizations and houses Gryphon's Pub. For more information, please visit <https://gpsenate.yale.edu>.

## Cultural and Recreational Opportunities

### Cultural Opportunities

There are many ways to keep up-to-date about campus news and events. These include the YaleNews website, which features stories, videos, and slide-shows about Yale people and programs (<http://news.yale.edu>); the interactive Yale Calendar of Events (<http://calendar.yale.edu>); and the University's social media channels on Facebook, Twitter, Instagram, Tumblr, LinkedIn, and YouTube.

The Yale Peabody Museum of Natural History, founded in 1866, houses more than thirteen million specimens and objects in ten curatorial divisions: anthropology, botany, entomology, historical scientific instruments, invertebrate paleontology, invertebrate zoology, mineralogy and meteoritics, paleobotany, vertebrate paleontology, and vertebrate zoology. The renowned collections provide crucial keys to the history of Earth and its life-forms, and in some cases are the only remaining traces of animals, plants, and cultures that have disappeared. About 5,000 objects are on public display, including the original "type" specimens—first of its kind—of *Brontosaurus*, *Stegosaurus*, and *Triceratops*.

The Yale University Art Gallery was founded in 1832 as an art museum for Yale and the community. Today it is one of the largest museums in the country, holding more than 250,000 objects and welcoming visitors from around the world. The museum's encyclopedic collection can engage every interest. Galleries showcase artworks from ancient times to the present, including vessels from Tang-dynasty China, early Italian paintings, textiles from Borneo, treasures of American art, masks from Western Africa, modern and contemporary art, ancient sculptures, masterworks by Degas, van Gogh, and Picasso, and more. Spanning one and a half city blocks, the museum features more than 4,000 works on display, multiple classrooms, a rooftop terrace, a sculpture garden, and dramatic views of New Haven and the Yale campus. The gallery's mission is to encourage an understanding of art and its role in society through direct engagement with original works of art. Programs include exhibition tours, lectures, and performances, all free and open to the public. For more information, please visit <https://artgallery.yale.edu>.

The Yale Center for British Art is a public art museum and research institute that houses the largest collection of British art outside the United Kingdom. Presented to the University by Paul Mellon (Yale College, Class of 1929), the collection reflects the development of British art and culture from the Elizabethan period to the present

day. Free and open to the public. Offers exhibitions and programs, including lectures, concerts, films, symposia, tours, and family events. For more information, please visit <https://britishart.yale.edu>.

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 five hundred musical events take place at the University during the academic year. In addition to recitals by graduate students and faculty artists, the School of Music presents the Yale Philharmonia, the Oneppo Chamber Music Series, the Ellington Jazz Series, the Horowitz Piano Series, New Music New Haven, Yale Opera, Yale Choral Artists, and concerts at the Yale Collection of Musical Instruments. The Yale Summer School of Music/Norfolk Chamber Music Festival presents the New Music Workshop and the Chamber Choir and Choral Conducting Workshop, in addition to the six-week Chamber Music Session. Many of these concerts stream live on the School's website (<https://music.yale.edu>), the Norfolk website (<https://norfolk.yale.edu>), and the Collection of Musical Instruments website (<https://collection.yale.edu>). Additionally, the School presents the Iseman Broadcasts of the Metropolitan Opera Live in HD free to members of the Yale community. Undergraduate organizations include the Yale Bands, the Yale Glee Club, the Yale Symphony Orchestra, and numerous other singing and instrumental groups. The Department of Music sponsors the Yale Collegium, Yale Baroque Opera Project, productions of new music and opera, and undergraduate recitals. The Institute of Sacred Music presents Great Organ Music at Yale, the Yale Camerata, the Yale Schola Cantorum, and many other special events.

For theatergoers, Yale and New Haven offer a wide range of dramatic productions at such venues as the University Theatre, Yale Repertory Theatre, Yale Cabaret, Yale Residential College Theaters, Off Broadway Theater, Iseman Theater, Whitney Humanities Center, Collective Consciousness Theatre, A Broken Umbrella Theatre, Elm Shakespeare Company, International Festival of Arts and Ideas, Long Wharf Theatre, and Shubert Performing Arts Center.

## Recreational Opportunities

The Payne Whitney Gymnasium is one of the most elaborate and extensive indoor athletic facilities in the world. This complex includes the 3,100-seat John J. Lee Amphitheater, the site for many indoor varsity sports contests; the Robert J. H. Kiphuth Exhibition Pool; the Brady Squash Center, a world-class facility with fifteen international-style courts; the Adrian C. Israel Fitness Center, a state-of-the-art exercise and weight-training complex; the Brooks-Dwyer Varsity Strength and Conditioning Center; the Colonel William K. Lanman, Jr. Center, a 30,000-square-foot space for recreational/intramural play and varsity team practice; the Greenberg Brothers Track, an eighth-mile indoor jogging track; the David Paterson Golf Technology Center; and other rooms devoted to fencing, gymnastics, rowing, wrestling, martial arts, general exercise, and dance. Numerous physical education classes in dance (ballet, modern, and ballroom, among others), martial arts, zumba, yoga, pilates, aerobic exercise, and sport skills are offered throughout the year. Yale undergraduates and graduate and professional school students may use the gym at no charge throughout the year. Academic term and summer memberships at reasonable fees are available for faculty, employees, postdoctoral and visiting fellows, alumni, and student spouses. Additional information is available online at <https://sportsandrecreation.yale.edu>.

During the year various recreational opportunities are available at the David S. Ingalls Rink, the McNay Family Sailing Center in Branford, the Yale Outdoor Education Center in East Lyme, the Yale Tennis Complex, and the Golf Course at Yale. Students, faculty, employees, students' spouses, and guests of the University may participate at each of these venues for a modest fee. Up-to-date information on programs, hours, and specific costs is available online at <https://sportsandrecreation.yale.edu>.

Approximately fifty club sports come under the jurisdiction of the Office of Outdoor Education and Club Sports. Most of the teams are for undergraduates, but a few are available to graduate and professional school students. Yale undergraduates, graduate and professional school students, faculty, staff, and alumni/ae may use the Yale Outdoor Education Center (OEC), which consists of 1,500 acres surrounding a mile-long lake in East Lyme, Connecticut. The facility includes overnight cabins and campsites, a pavilion and dining hall available for group rental, and a waterfront area with supervised swimming, rowboats, canoes, stand-up paddleboards, and kayaks. Adjacent to the lake, a shaded picnic grove and gazebo are available to visitors. In a more remote area of the facility, hiking trails loop the north end of the property; trail maps and directions are available on-site at the field office. The OEC runs seven days a week from the third week of June through Labor Day. For more information, including mid-September weekend availability, call 203.432.2492 or visit <https://sportsandrecreation.yale.edu>.

Throughout the year, Yale graduate and professional school students have the opportunity to participate in numerous intramural sports activities. These seasonal, team-oriented activities include volleyball, soccer, and softball in the fall; basketball and volleyball in the winter; softball, soccer, ultimate, and volleyball in the spring; and soft ball in the summer. With few exceptions, all academic-year graduate-professional student sports activities are scheduled on weekends, and most sports activities are open to competitive, recreational, and coeducational teams. More information is available from the Intramurals Office in Payne Whitney Gymnasium, 203.432.2487, or online at <https://sportsandrecreation.yale.edu>.

## 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 students seeking to spend a few hours away from their studies.

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, Jr. 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, 2019

Indra Acharja (B.S. Sherubtse Coll.), Bhutan  
Elvis Acheampong (B.S. Kwame Nkrumah Univ. Science & Technology), Ghana  
Sushant Banjara (B.E. Tribhuvan Univ.), Nepal  
Kalyani Basu (B.S. Univ. Warwick), Oman  
Anna Maria Bezerra de Mello Carcamo (LL.B. Pontificia Univ. Católica [Rio de Janeiro], Brazil  
Prerna Bhat (A.B. Harvard Univ.), Mass.  
Tim Bialecki (B.A. Georgetown Univ.), Mass.  
Coral R. Bielecki (B.S. Univ. Hawaii [Manoa]), Hawaii  
Brendan Boepple (B.A. Colorado Coll.), Tex.  
Aleca Borsuk (B.S. Univ. Hawaii [Manoa]), Calif.  
John Brandt (B.A. Vassar Coll.), Wash.  
Elle Brunsdale (B.A. Yale Univ.), Washington, D.C.  
Laura Brush (B.A. Univ. North Carolina [Chapel Hill]), Pa.  
Jesse Bryant (B.A. Boston Univ.), N.Y.  
Austin Bryniarski (B.A. Yale Univ.), Ill.  
Corey Cantor (B.A. Washington Univ.), N.J.  
Frank Cervo (B.S. Univ. Connecticut), N.Y.  
Paula Chamas Piedrabuena (B.S. Univ. Autònoma Barcelona; M.S. Univ. Pompeu Fabra), Spain  
Kylee Rei Mahina Chang (B.S. Loyola Marymount Univ.; M.S. Univ. California [San Diego]), Hawaii  
Jane Chu (B.A. Univ. California [San Diego]; M.A.Oth. Massachusetts Inst. Technology), China  
Dylan F. Cicero (B.S. Cornell Univ.), N.Y.  
Martín Cillóniz Milberg (B.S. Univ. Nacional Agraria La Molina), Peru  
Rebecca Clarke (B.A. California State Univ. [Chico]; M.S. Univ. San Francisco), Calif.  
Josefina Cobián (B.E. Inst. Tecnológico y de Estudios Superiores Occidente), Mexico  
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Blair Crossman (B.A. Pomona Coll.), Calif.  
Jane Culkin (B.A. Univ. Colorado [Boulder]), Colo.  
Paige Curtis (B.A. Yale Univ.), N.Y.  
Christopher Quinn Denny (B.A. Villanova Univ.; J.D. Vermont Law School), Pa.  
Alexandra Deprez (A.B. Princeton Univ.), Tex.  
Shannon Dulaney (B.A. Univ. California [San Diego]), Calif.  
Courtney Durham (B.A. Ohio Wesleyan Univ.), Washington, D.C.  
Melaina Dyck (B.S. Univ. South Carolina [Columbia]), Canada  
El Mehdi El Hailouch (B.E. Vanderbilt Univ.), Morocco  
Luke Elder (B.A. Middlebury Coll.), Mass.  
Nathan Empsall (A.B. Dartmouth Coll.), Tex.  
Erica Engstrom (B.A. Univ. California [Los Angeles]), Calif.  
Charles Faires (B.S. Warren Wilson Coll.), N.C.  
Bowen Fang (B.S. Peking Univ.), China  
Sam Faries (B.S. Univ. Texas [Austin]), Tex.  
Harris Feldman (B.S. Syracuse Univ.), Mass.

Liz Felker (B.S. Univ. California [Berkeley]), Tenn.  
 Mingmin Feng (B.S. Peking Univ.), China  
 Nicholas Fields (B.A. Univ. West Indies-Mona), Barbados  
 Mark Foster (B.A. Williams Coll.; J.D. Vermont Law School), Mass.  
 Jackie Fouse (B.A., M.D., Ph.D. Univ. Texas [Arlington]), Tex.  
 Zach Garcia (B.A. Univ. Wisconsin [Madison]), Ind.  
 Elise Gilchrist (B.A. Franklin Marshall Coll.), Conn.  
 Emma Gildesgame (B.A. Colby Coll.), Mass.  
 Evan Glessner (B.A. Univ. California [Santa Barbara]), Calif.  
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 Rosa Goldman (B.A. Smith Coll.), Mass.  
 Javier Gonzalez Rivero (B.S. Univ. Iberoamericana-Santa Fe), Venezuela  
 Sally Goodman (B.E. Princeton Univ.), N.Y.  
 Nate Grady (B.A. Lawrence Univ.), Mass.  
 Cori Grainger (B.S. Santa Clara Univ.), Calif.  
 Mickhale Green (B.A. Amherst Coll.), Jamaica  
 Jad Habouch (B.S. Univ. Minnesota [Minneapolis]), Syria  
 Chloe Hanna (B.A. Barnard Coll.), N.Y.  
 Sara Harari (B.S. Tufts Univ.), N.J.  
 Nina Hatch (B.A. Colby Coll.), Washington, D.C.  
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 Yume Hoshijima (B.A. Yale Univ.), Japan  
 Jillian Howell (B.A. Colby Coll.), Mass.  
 Stephanie Hsiung (B.A. Williams Coll.), N.J.  
 Tina Huang (B.S. Univ. California [Berkeley]), China  
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 Fla.  
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 Jaclyn Kachelmeyer (B.A. Univ. Texas [Austin]), Tex.  
 Jenny Katz (B.S. Rutgers Univ. [Cook Coll.]), Israel  
 Hallie Kennan (B.A. Bucknell Univ.), Calif.  
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 Renata Lozano Giral (B.A. Inst. Tecnológico Monterrey [Mexico City]), Mexico  
 Peter Ludwig (B.A. Wesleyan Univ.), N.Y.  
 Erik Lyon (B.A. Whitman Coll.), Calif.  
 Whitney Mann (B.A. Washington Univ.), Ill.  
 Alizeh Maqbool (B.S. Yale Univ.), Pakistan  
 Sam Mardell (B.A. Univ. Massachusetts [Amherst]), Mass.  
 Abby Martin (B.A. Williams Coll.), N.Y.  
 Maria Martinez (B.A. Univ. Florida), Colombia  
 Bruce Mecca (B.E. Inst. Teknologi Bandung), Indonesia  
 Daniel Moccia-Field (B.A. Williams Coll.), N.H.

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Satwik Mudgal (B.A.Eq. School of Planning & Architecture), India  
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Jared Naimark (B.S. Stanford Univ.), Ariz.  
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Lindsay Olsen (B.A. Williams Coll.), Alaska  
Sarah Omusula (B.S. Univ. Eldoret), Kenya  
Naoya Orita (BACH. Univ. Tokyo), Japan  
Laura Ostrowsky (B.A. Bowdoin Coll.), Minn.  
Cora Ottaviani (B.A. Univ. Hartford), Conn.  
Sneha Pandey (B.S. Himalayan WhiteHouse International Coll.), Nepal  
Ollia Pappas (B.A. Boston Univ.), N.Y.  
Silvia Peng (B.A. Mount Holyoke Coll.), China  
Brunilda Pizarro (B.S. Vanderbilt Univ.), N.Y.  
Max Potthoff (B.A. Knox Coll.), Calif.  
Andry Rajaoberison (B.S. Univ. Antananarivo), Madagascar  
Evelyn Rhodes (B.A. Colgate Univ.), Wash.  
Paul Rink (B.S. Univ. Michigan [Ann Arbor]; J.D. Yale Univ.), Mich.  
Rida-e-Zahra Rizvi (B.S. National Univ. Sciences & Technology [Pakistan]), Pakistan  
Alina Rodriguez (B.S. Univ. South Florida), Russia  
Camila Rodriguez Taylor (B.E. Pontificia Univ. Católica [Buenos Aires]), Argentina  
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Ki'ila Salas (A.S. St John's Coll. Sixth Form; B.S. Loyola Univ. [New Orleans]), Belize  
Alexandra Savino (B.A., M.A. Rutgers Univ.), N.J.  
Kabir Sharma (B.S. St. Stephen's Coll.; M.A.OTH. Univ. Delhi; M.S. Univ. Paris-Sud [Orsay]), India  
Viktoriiia Shvydchenko (B.A. Taras Shevchenko National Univ. Kyiv), Ukraine  
Helen Siegel (B.A., B.S. Coll. Wooster), N.Y.  
Katie Siegner (B.A. Middlebury Coll.), Washington, D.C.  
Evan Singer (B.A. Gettysburg Coll.), Pa.  
Jack Singer (B.A. Wesleyan Univ.), N.Y.  
Lexi Smith (B.S. Calif. State Univ. [Chico]), Calif.  
Ben Soltoff (B.S. Duke Univ.), Mass.  
Nathalie Sommer (B.S. Coll. William & Mary), Va.  
Charlotte Stanley (B.S. Univ. California [Los Angeles]), Calif.  
Lauren Stoneburner (B.A., B.S. Univ. Southern California), Calif.  
Laura Tamjarv (B.S. Univ. Coll. London), Estonia  
Perk Han Eugene Tan (B.A. Colorado Coll.), Hong Kong S.A.R.  
Caroline Tasirin (B.A.LEV. Univ. Sam Ratulangi), Indonesia  
Maki Tazawa (B.A. George Washington Univ.), Ecuador  
Vince Tenorio (B.A. Pomona Coll.), Tex.  
Anna Thurston (B.A. Brigham Young Univ.; M.A.R. Yale Univ.), Utah  
Elizabeth Tokarz (B.S. Yale Univ.), Ill.  
Emily Claire Lowe Toland (A.B. Harvard Univ.), Calif.  
Alberto Tordesillas Torres (B.S., M.S. Univ. Politécnica Madrid), Spain  
Dennis Tung (B.A. Hamilton Coll.), N.Y.  
Robert Turnbull (B.S. Univ. Connecticut), Va.  
Maria Urrutia Gonzalez (B.A. Colby Coll.), Nicaragua



Sydney Katherine Usatine (B.S. Harvey Mudd Coll.), Mich.  
 Christine Ventura (A.A. Quinebaug Valley Community Coll.; B.S. Univ. Rhode Island), Conn.  
 Leandro Vigna (BACH. Univ. Nacional Córdoba), Argentina  
 Scott Wentzell (B.A. Colby Coll.), R.I.  
 Brittany Williams (B.A., B.S. Univ. California [Berkeley]), Calif.  
 Ben Williamson (B.S. Univ. Montana), Colo.  
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 Katherine Rose Wolf (B.A. Vassar Coll.), Ill.  
 Martine Wong (B.S. Univ. Vermont), China  
 David J. Woodbury (B.S. Univ. Washington), Colo.  
 Patrick Woolsey (B.A. Columbia Univ.), Mass.  
 Ziyang Wu (B.S. Tsinghua Univ.), China  
 Yihao Xie (B.A. Yale-NUS Coll.), China  
 Chi Xu (B.A. Franklin Marshall Coll.), China  
 Leah Debra Yablonka (B.S. Univ. Maryland [College Park]), Ill.  
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 Xinyi Zheng (B.A. Colby Coll.), China  
 Santiago Zindel Mundet Cruz (B.A. Middlebury Coll.), Mexico  
 Benjamin Allen Zukowski (B.A. Univ. Michigan [Ann Arbor]), Mich.

### DOCTORAL DEGREES CONFERRED, DECEMBER 2018

Luisa Cortesi (B.A. Univ. Torino [Italy]; M.A. Univ. London), Italy  
 Jennifer Burlingame Hoyle-Fair (B.S., M.E.M. Yale Univ.), Mass.  
 Lan Jin (B.S. Nankai Univ.; M.S. New York Univ.), China  
 Meghna Krishnadas (B.S. Bangalore Medical Coll.; M.S. Tata Inst. Fundamental Research), India  
 Alexandria Moore (B.S., M.S. Univ. Michigan [Ann Arbor]), Mich.  
 Christopher Shughrue (B.S. Univ. California [San Diego], M.E.Sc. Yale Univ.), Calif.  
 Noah Sokol (B.S. Univ. Guelph), Canada  
 Eleanor Catherine Stokes (A.B. Dartmouth Coll.; M.S. Massachusetts Inst. Technology), Ala.  
 Lily Zeng (B.S. Queen's Univ. [Canada]; M.E.Sc. Yale Univ.), Canada

### DOCTORAL DEGREES CONFERRED, MAY 2019

Jill Roberta Kelly (B.S. Yale Univ.; M.A. Univ. Connecticut [Storrs]), Conn.  
 Paige Elizabeth Weber (B.A. Univ. California [Berkeley]; M.E.Sc. Yale Univ.), Calif.  
 Byungman Yoon (B.A. Univ. Washington; M.E.Sc. Yale Univ.), Republic of Korea

### STUDENTS WORKING TOWARD MASTER'S DEGREES

Allison Adams (B.S. Syracuse Univ.), Iowa  
 Amma Asantewaa Agyei Boakye (B.S. Kwame Nkrumah Univ. Science & Technology), Ghana  
 Cortney Ahern (B.A. Colgate Univ.), Conn.  
 Eva Albalghiti (B.S. Yale Univ.), Md.  
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Sandeep Aysola (BACH.LR. Jawaharlal Nehru Technological Univ.; M.A.OTH. Univ. Virginia), Conn.  
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Hamid Can Bas (B.S. Bogazici Univ.), Turkey  
Blanca Begert (B.A. Brown Univ.; Cert. Harvard Univ. Graduate School Design), N.Y.  
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Sundara Bhandaram (B.S. Univ. California [Irvine]), Washington, D.C.  
Umang Bhattarai (B.E. Tribhuvan Univ.), Nepal  
Hope Emily Bigda-Peyton (B.A. McGill Univ.), Mass.  
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Abigail Wing Heng Chan (B.S. Univ. Virginia), Va.  
Zhinan Chen (B.A. Peking Univ.), China  
Sandra Chiri Vargas (B.S. Univ. Nacional Agraria La Molina), Peru  
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Austin Michael Dziki (B.S. Univ. Vermont), Conn.  
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 Madeline Sadie Frieze (B.S. Union Coll.), Mass.  
 Matt Gallagher (B.S. Univ. New Haven), Conn.  
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 Carey Catherine Glenn (B.A. Univ. Chicago), N.J.  
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 Regina Harlig (B.A. Syracuse Univ.), Conn.  
 Jessica Harpole (B.S. Massachusetts Inst. Technology), Ore.  
 Kelsey Hartman (B.A. Smith Coll.), Calif.  
 Paul Hatanga (B.S. Makerere Univ.), Uganda  
 Anna-Sophia Haub (B.A. Georgetown Univ.), Conn.  
 Alejandra Magaly Hernandez (B.A. Univ. Dallas), Kans.  
 Meghan Elizabeth Hills (B.S. Univ. Texas [Austin]), Tex.  
 Julia Hofmann (B.A. Reed Coll.), Calif.  
 Daniela Hoyos Gaviria (B.E. Univ. de los Andes), Colombia  
 Chelsea Huang (B.E. Tsinghua Univ.), Conn.  
 Carlos Ibarra Lopez (B.S. Tecnológico de Monterrey), Mexico  
 Mai Ichihara (B.A. George Washington Univ.), Conn.  
 Seth Inman (B.A. Cornell Univ.), Ga.  
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 Lucas Isakowitz (B.A. Univ. Pennsylvania), Conn.  
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 Lynn Jiang (B.E. Tsinghua Univ.), China  
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 Alix Gillian Kashdan (B.A. Coll. William & Mary), Va.  
 Maya Kassoff (B.S. Univ. Delaware), N.Y.  
 Kate Klaus (B.S. Univ. Illinois [Urbana]), Ill.  
 Colin Korst (B.S. Univ. Illinois [Urbana]), Ill.  
 Claire Huntley Lafave (B.A. Williams Coll.), Conn.  
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 N. Mark Lam (B.A. Hamilton Coll.; M.B.A. Univ. California [Los Angeles]), Calif.  
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 Thomas Leonard Launer (B.A. Whitman Coll.), Minn.  
 Noah Greyeagle Lee (B.A. Univ. Chicago), Wis.  
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 Reid Lewis (B.S. Westminster Coll. [Salt Lake City]), Conn.  
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 Zhi Li (B.A. Brandeis Univ.), China  
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 Robert James Little (B.A. Pitzer Coll.), Calif.

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Brazil  
Mike Maier (B.A. Univ. Hartford), Conn.  
Nour Mardini (B.S. Univ. California [Berkeley]), Calif.  
Tony Mazza (B.A. Warren Wilson Coll.), Conn.  
Melissa Mazzeo (B.A. Boston Coll.), Mass.  
Angus McLean (B.A. Wesleyan Univ.), N.Y.  
Rebecca Lynn McLean (B.S. Univ. Central Florida), Conn.  
Alex McRae (B.S. United States Military Acad.), Conn.  
Elisheva Tova Mittelman (B.S. Univ. Maryland [College Park]), Conn.  
Gabriela Michelle Morales-Nieves (B.S. Univ. Puerto Rico [Rio Piedras]), Puerto Rico  
Nomawethu Moyo (B.A. Colby Coll.), Zimbabwe  
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James Ndung'u (B.S. Kenya Polytechnic), Kenya  
Talia Emma Niederman (B.A. Brandeis Univ.), N.J.  
Jorge Nieto Jiménez (B.A. El Colegio de México), Conn.  
Madeleine O'Brien (B.A. Wesleyan Univ.), Ohio  
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Zander Pellegrino (B.S. Coll. William & Mary), Va.  
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Emily Patricia Persico (B.S. Univ. Florida), Fla.  
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Khin Htet Htet Pyone (B.S. Univ. Forestry [Yezin]), Myanmar  
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Zach Ratner (B.A. Northwestern Univ.), Calif.  
Marisa Chieko Repka (B.A. Williams Coll.), Md.  
Frenzi Ritter (B.S. Albert-Ludwigs Univ.), Conn.  
Christopher Robert Rooks (B.A. Duke Univ.), Ore.  
Jack Rusk (B.S. Univ. California [Santa Cruz]), Conn.  
Sara Santiago (B.A. Ohio State Univ. Columbus), Ohio  
Austin Scheetz (B.S. Purdue Univ. [West Lafayette]), Tex.  
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Lucy Shim (B.S. Univ. California [Berkeley]), Republic of Korea  
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Kathryn Segall Sierks (B.S. Harvard Univ.), Minn.  
Emily Sigman (B.A. Yale Univ.), Colo.  
Jonathan Silverthorne (B.A. Dartmouth Coll.), Washington, D.C.  
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Vivian Sorab (B.S. St. Xavier's Coll.; M.S. Indian Inst. Technology [Bombay]), India  
M.K. Speth (B.S. Ursinus Coll.), Ill.  
Gus Steyer (B.S. Yale Univ.), Conn.  
Michael Storace (B.S. Univ. Vermont), N.H.  
Max Storto (A.B. Harvard Univ.), Conn.

Sagarika Subramanian (B.S. Univ. California [Los Angeles]), United Arab Emirates  
 Julia Sullivan (B.A. American Univ. [D.C.]), Mass.  
 Lucien Swetschinski (B.A. Oberlin Coll.), Maine  
 Arianna Tabibzadeh Nuri (B.S. Univ. California [Berkeley]), Calif.  
 Maggie Tallmadge (B.A. Wellesley Coll.), Conn.  
 Shrabya Timsina (B.A. Univ. Chicago), Nepal  
 Evelin Toth (B.A. Middlebury Coll.), Hungary  
 Amy Tourgee (A.B. Princeton Univ.), Conn.  
 Emily Tucker (B.A. Bowdoin Coll.), Conn.  
 Oliver Tully (B.A. Univ. California [Berkeley]), Conn.  
 Burr Tweedy (B.A. Colorado Coll.), Conn.  
 Sophie Tyack (A.B. Princeton Univ.), Mass.  
 Molly Tyson (B.A. Colorado Coll.), Idaho  
 Lysa Uwizeyimana (B.S. Syracuse Univ.), Conn.  
 Zhijun Wang (B.E. Tsinghua Univ.), China  
 Noah Weingart (B.S. Cornell Univ.), Conn.  
 Brittany Wienke (B.A., B.S. Univ. Florida), Conn.  
 Allegra Wiprud (A.B. Princeton Univ.), N.Y.  
 Jeffrey Wong (B.S. Univ. California [Berkeley]), Conn.  
 Yichen Yang (B.S. Chengdu Univ. Technology; M.Eng. Nanjing Inst. Meteorology),  
 China  
 Emily Zhang (B.A. Swarthmore Coll.), Pa.  
 Weihan Zhang (B.S. Univ. California [Berkeley]), Calif.  
 Yuhan Zhang (B.E. Tsinghua Univ.; B.S. Peking Univ.), China  
 Amy Zuckerwise (B.S. Stanford Univ.), Calif.

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Ethan Teichman Addicott (A.B. Harvard Univ.; M.E.Sc. Yale Univ.), Fla.  
 Kelly Aho (A.B. Dartmouth Coll.; M.E.Sc. Yale Univ.), Alaska  
 Adam Andis (B.S. Northland Coll.; M.S. Univ. Montana), Ind.  
 Kristy Marie Barnes (B.S. Boston Coll.; M.S. Vanderbilt Univ.), N.H.  
 Erica Bergen Barth-Naftilin (B.A. Johns Hopkins Univ.; M.E.M. Yale Univ.), N.Y.  
 Christopher Beltz (B.A. Trinity Coll.; M.S. Antioch Univ.), Conn.  
 Alexandra Mochary Bergstein (B.A. Wesleyan Univ.; J.D. Univ. Chicago Law School),  
 Conn.  
 Peter Berrill (B.E. National Univ. Ireland [Galway]; M.S. Univ. Karl-Franz), Ireland  
 Emily Sarah Briggs (B.S., M.S. Univ. Minnesota), Conn.  
 Samara Meade Brock (B.A. Univ. Victoria; M.A. Univ. British Columbia; M.E.M. Yale  
 Univ.), Canada  
 Robert Walter Buchkowski (B.S. Lakehead Univ.; M.E.Sc. Yale Univ.), Canada  
 Mary Burak (B.A. Providence Coll.), Mass.  
 Paul Burow (B.A. Univ. California [Davis]; M.E.Sc. Yale Univ.), Calif.  
 Katherine Burrows (B.A., M.P.H. Columbia Univ.), N.Y.  
 Yutian (Ivy) Cao (B.S. Chinese Univ. Hong Kong; M.P.P. Univ. Chicago), China  
 Tirthankar Chakraborty (B.E. West Bengal Univ. Technology; M.E. Indian Inst.  
 Technology), India  
 Deepti Chatti (B.E. Osmania Univ.; M.S. Stanford Univ.), India  
 Chen Chen (B.S. Fudan Univ.; M.P.H. Johns Hopkins Univ.), China

- Wade Davis (B.A. Williams Coll.), Maine  
Hao Deng (B.E., M.E. Tsinghua Univ.; M.S. Pennsylvania State Univ.), China  
Danica Anne Doroski (B.A. Bates Coll.; M.F.S. Yale Univ.), Conn.  
Alicia Renee Entem (B.S., M.Sc. Univ. Alberta), Canada  
Ana Clara Fanton Borges (B.E. Univ. São Paulo), Brazil  
Michaela Olivia Foster (B.A. Duke Univ.; M.S. North Carolina State Univ.), Ala.  
Yufang Gao (B.S. Peking Univ.; M.E.Sc. Yale Univ.), China  
Henry Glick (B.A. Hampshire Coll.; M.E.Sc. Yale Univ.), N.H.  
Edgardo Gonzalez (B.S. Univ. Puerto Rico; M.F. Yale Univ.), Puerto Rico  
Matthew David Gordon (B.A. Hamilton Coll.; M.S. London School Economics), Conn.  
Chris Hebdon (B.A. Univ. California [Berkeley]), Calif.  
Kangning Huang (B.S., M.S. Zhongshan Univ.), China  
Amy Leigh Johnson (B.A. Barnard Coll.), Ga.  
Sean Demars Johnson (B.S. Iowa State Univ.), Ill.  
Chelsea Elizabeth Judy (B.A. Chapman Univ.; M.P.P. Univ. Melbourne), Calif.  
Daniel Kane (B.A. Middlebury Coll.; M.S. Michigan State Univ.), Fla.  
Lav Kanoi (B.A., M.A. Jadavpur Univ.), India  
Meredith Jeanne Keller (B.A. Univ. Wisconsin [Madison]; M.Phil. Univ. Cambridge), Minn.  
Manon Lefèvre (B.A. Wesleyan Univ.; M.A. Univ. Kentucky), France  
Myles Benjamin Lennon (B.A. Brown Univ.), N.Y.  
Laura Logozzo (B.S., M.S. CUNY City Coll.), N.Y.  
Tamar Israeli Makov (B.S. Hebrew Univ. Jerusalem; M.P.A. Interdisciplinary Center Israel), Israel  
Meredith Pearl Martin (B.A. Columbia Univ.; M.F.S. Yale Univ.), N.Y.  
Kathryn Ann McConnell (B.A. Wesleyan Univ.; M.E.Sc. Yale Univ.), Conn.  
Katherine Adelle Meier (B.A. Macalester Coll.), Conn.  
Fjodor Melnikov (B.S. Brandeis Univ.; M.E.Sc. Cyprus Univ. Technology), Russia  
Julia Monk (B.A. Columbia Univ.), N.Y.  
Andrew John Muehleisen (B.S. Ohio State Univ. [Columbus]), Ohio  
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Bhartendu Pandey (B.S. Univ. Delhi; M.S. TERI Univ.), India  
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Lauren Nicole Pincus (B.A. Middlebury Coll.), N.J.  
Kyra Prats (B.S. Boston Coll.; M.F.S. Yale Univ.), Conn.  
Clara Christina Pregitzer (B.S. Northern Arizona Univ.; M.S. Univ. Tennessee), Mich.  
Rohan Daniel Simkin (B.S. Monash Univ.; M.F.S. Melbourne Univ.), Australia  
Mario Soriano (B.S. Univ. Philippines; M.S. United Nations Univ. [Japan]), Philippines  
Megan Sullivan (B.S. Ohio State Univ.; B.A. Cleveland Inst. Art), Ohio  
Peter Mbanda Umunay (B.S. Univ. Kisangani; M.F.S. Yale Univ.), Democratic Republic of the Congo  
Harikrishnan Venugopalan Nair Radhamoni (B.S. Kerala Agricultural Univ.; M.E.Sc. Yale Univ.), India  
Elisabeth Ballard (Eli) Ward (B.S. Brown Univ.; M.F.S. Yale Univ.), Conn.

Lisa Christina Weber (B.A. Columbia Univ.; M.E.Sc. Yale Univ.), Va.

Stephanie Margalit Weber (B.S. Stanford Univ.), Ill.

Paul Wolfram (B.S. Technische Univ. Dresden; M.S. Technische Univ. Berlin),  
Germany

Zhemín Xuan (B.S. Tongji Univ.; M.S. Univ. Central Florida), China

Jonghyun Yoo (B.A. Seoul National Univ.; M.E.Sc. Yale Univ.), Republic of Korea

Yong Zhao (B.S. Peking Univ.; M.E.Sc. Yale Univ.), China

Wen Zhou (B.A. Columbia Univ.; M.E.M. Univ. Oxford), N.Y.

Zihan Daniel Zhuo (B.A., M.A. Tsinghua Univ.), China

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

**Yale College** Est. 1701. 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 visit <https://admissions.yale.edu>, e-mail [student.questions@yale.edu](mailto:student.questions@yale.edu), or call 203.432.9300. Postal correspondence should be directed to Office of Undergraduate Admissions, Yale University, PO Box 208234, New Haven CT 06520-8234.

**Graduate School of Arts and Sciences** Est. 1847. Courses for college graduates. Master of Advanced Study (M.A.S.), Master of Arts (M.A.), Master of Science (M.S.), Master of Philosophy (M.Phil.), Doctor of Philosophy (Ph.D.).

For additional information, please visit <https://gsas.yale.edu>, e-mail [graduate.admissions@yale.edu](mailto:graduate.admissions@yale.edu), or call the Office of Graduate Admissions at 203.432.2771. Postal correspondence should be directed to Office of Graduate Admissions, Yale Graduate School of Arts and Sciences, PO Box 208236, New Haven CT 06520-8236.

**School of Medicine** Est. 1810. 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. Five-year combined program leading to Doctor of Medicine and Master of Health Science (M.D./M.H.S.). Combined program with the Graduate School of Arts and Sciences leading to Doctor of Medicine and Doctor of Philosophy (M.D./Ph.D.). Master of Medical Science (M.M.Sc.) from the Physician Associate Program and the Physician Assistant Online Program.

For additional information, please visit <https://medicine.yale.edu/education/admissions>, e-mail [medical.admissions@yale.edu](mailto:medical.admissions@yale.edu), or call the Office of Admissions at 203.785.2643. Postal correspondence should be directed to Office of Admissions, Yale School of Medicine, 367 Cedar Street, New Haven CT 06510.

**Divinity School** Est. 1822. 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 visit <https://divinity.yale.edu>, e-mail [div.admissions@yale.edu](mailto:div.admissions@yale.edu), or call the Admissions Office at 203.432.5360. Postal correspondence should be directed to Admissions Office, Yale Divinity School, 409 Prospect Street, New Haven CT 06511.

**Law School** Est. 1824. Courses for college graduates. Juris Doctor (J.D.). For additional information, please visit <https://law.yale.edu>, e-mail [admissions.law@yale.edu](mailto:admissions.law@yale.edu), or call the Admissions Office at 203.432.4995. Postal correspondence should be directed to Admissions Office, Yale Law School, PO Box 208215, New Haven CT 06520-8215.

Graduate Programs: Master of Laws (LL.M.), Doctor of the Science of Law (J.S.D.), Master of Studies in Law (M.S.L.). Doctor of Philosophy (Ph.D.) awarded by the



Graduate School of Arts and Sciences. For additional information, please visit <https://law.yale.edu>, e-mail [gradpro.law@yale.edu](mailto:gradpro.law@yale.edu), or call the Graduate Programs Office at 203.432.1696. Postal correspondence should be directed to Graduate Programs, Yale Law School, PO Box 208215, New Haven CT 06520-8215.

**School of Engineering & Applied Science** Est. 1852. Courses for college graduates. Master of Science (M.S.) and Doctor of Philosophy (Ph.D.) awarded by the Graduate School of Arts and Sciences.

For additional information, please visit <https://seas.yale.edu>, e-mail [grad.engineering@yale.edu](mailto:grad.engineering@yale.edu), or call 203.432.4252. Postal correspondence should be directed to Office of Graduate Studies, Yale School of Engineering & Applied Science, PO Box 208267, New Haven CT 06520-8267.

**School of Art** Est. 1869. Professional courses for college and art school graduates. Master of Fine Arts (M.F.A.).

For additional information, please visit <http://art.yale.edu>, e-mail [artschool.info@yale.edu](mailto:artschool.info@yale.edu), or call the Office of Academic Administration at 203.432.2600. Postal correspondence should be directed to Office of Academic Administration, Yale School of Art, PO Box 208339, New Haven CT 06520-8339.

**School of Music** Est. 1894. 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 (A.D.), Doctor of Musical Arts (D.M.A.).

For additional information, please visit <https://music.yale.edu>, e-mail [gradmusic.admissions@yale.edu](mailto:gradmusic.admissions@yale.edu), or call the Office of Admissions at 203.432.4155. Postal correspondence should be directed to Yale School of Music, PO Box 208246, New Haven CT 06520-8246.

**School of Forestry & Environmental Studies** Est. 1900. 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 Philosophy (Ph.D.) awarded by the Graduate School of Arts and Sciences.

For additional information, please visit <https://environment.yale.edu>, e-mail [fesinfo@yale.edu](mailto:fesinfo@yale.edu), or call the Office of Admissions at 800.825.0330. Postal correspondence should be directed to Office of Admissions, Yale School of Forestry & Environmental Studies, 195 Prospect Street, New Haven CT 06511.

**School of Public Health** Est. 1915. Courses for college graduates. Master of Public Health (M.P.H.). Master of Science (M.S.) and Doctor of Philosophy (Ph.D.) awarded by the Graduate School of Arts and Sciences.

For additional information, please visit <https://publichealth.yale.edu>, e-mail [ysph.admissions@yale.edu](mailto:ysph.admissions@yale.edu), or call the Admissions Office at 203.785.2844.

**School of Architecture** Est. 1916. Courses for college graduates. Professional and post-professional degree: Master of Architecture (M.Arch.); nonprofessional degree: Master of Environmental Design (M.E.D.). Doctor of Philosophy (Ph.D.) awarded by the Graduate School of Arts and Sciences.

For additional information, please visit <https://architecture.yale.edu>, e-mail [gradarch.admissions@yale.edu](mailto:gradarch.admissions@yale.edu), or call 203.432.2296. Postal correspondence should

be directed to the Yale School of Architecture, PO Box 208242, New Haven CT 06520-8242.

**School of Nursing** Est. 1923. Courses for college graduates. Master of Science in Nursing (M.S.N.), Post Master's Certificate, Doctor of Nursing Practice (D.N.P.). Doctor of Philosophy (Ph.D.) awarded by the Graduate School of Arts and Sciences.

For additional information, please visit <https://nursing.yale.edu> or call 203.785.2389. Postal correspondence should be directed to Yale School of Nursing, Yale University West Campus, PO Box 27399, West Haven CT 06516-0974.

**School of Drama** Est. 1925. Courses for college graduates and certificate students. Master of Fine Arts (M.F.A.), Certificate in Drama, Doctor of Fine Arts (D.F.A.).

For additional information, please visit <https://drama.yale.edu>, e-mail [ysd.admissions@yale.edu](mailto:ysd.admissions@yale.edu), or call the Registrar/Admissions Office at 203.432.1507. Postal correspondence should be directed to Yale School of Drama, PO Box 208325, New Haven CT 06520-8325.

**School of Management** Est. 1976. Courses for college graduates. Master of Business Administration (M.B.A.), Master of Advanced Management (M.A.M.), Master of Management Studies (M.M.S.). Doctor of Philosophy (Ph.D.) awarded by the Graduate School of Arts and Sciences.

For additional information, please visit <https://som.yale.edu>. Postal correspondence should be directed to Yale School of Management, PO Box 208200, New Haven CT 06520-8200.

# F&ES MASTER'S CAPSTONE PROJECT NUMBERS

<b>Faculty</b>	<b>F&amp;ES Capstone Project Number</b>
Anastas, Paul	2008
Anisfeld, Shimon	2010
Ashton, Mark	2020
Bacher, Jessica	2030
Bell, Michelle	2035
Benoit, Gaboury	2040
Berlyn, Graeme	2050
Bradford, Mark	2054
Brodersen, Craig	2072
Burke, Maureen	2075
Burroughs, Richard	2080
Carpenter, Carol	2110
Cashore, Benjamin	2120
Chertow, Marian	2130
Clark, Susan	2140
Comita, Liza	2143
DeCew, Stuart	2153
Doolittle, Amity	2158
Dove, Michael	2160
Duguid, Marlyse	2175
Esty, Daniel	2180
Farrell, Justin	2185
Fenichel, Eli	2195
Geballe, Gordon	2200
Gentry, Bradford	2210
Gillingham, Kenneth	2215
Graedel, Thomas	2230
Gregoire, Timothy	2240
Grim, John	2242
Kotchen, Matthew	2257
Kysar, Douglas	2259
Lauenroth, William	2261
Lee, Xuhui	2260
Leiserowitz, Anthony	2263
Lifset, Reid	2270
Mendelsohn, Robert	2320
Mendez, Michael	2321

Oliver, Chadwick	2340
Queenborough, Simon	2350
Raymond, Peter	2364
Reuning-Scherer, Jonathan	2380
Saiers, James	2390
Schmitz, Oswald	2400
Seto, Karen	2408
Skelly, David	2420
Smith, Ronald	2430
Toensmeier, Eric	2457
Tomlin, Dana	2460
Vedder, Amy	2469
Wargo, John	2470
Weber, Albert William	2473
Zimmerman, Julie	2500

# F&ES M.E.SC./M.F.S. THESIS RESEARCH NUMBERS

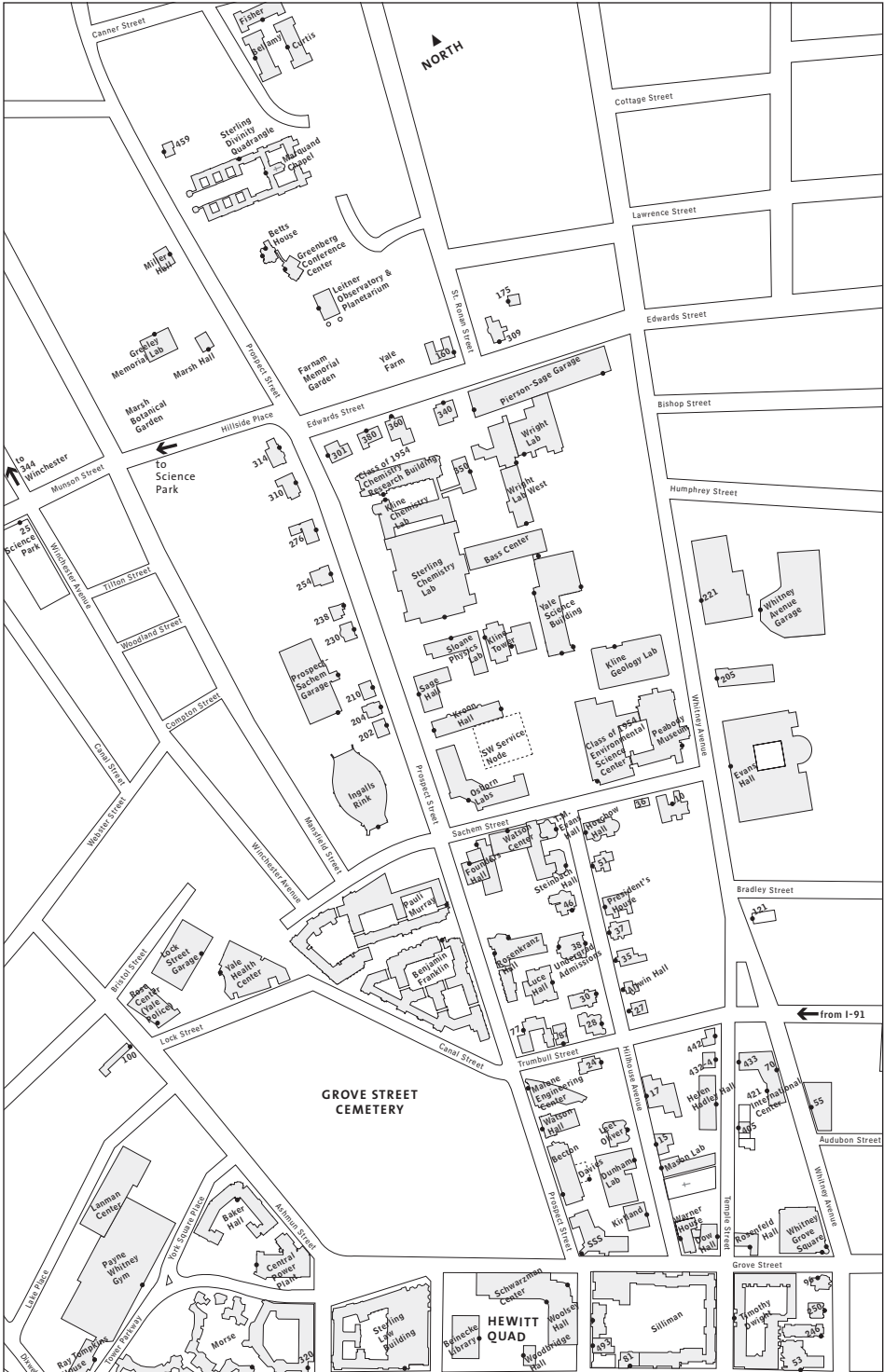
<b>Faculty</b>	<b>F&amp;ES Thesis Research Number</b>
Anisfeld, Shimon	3010
Ashton, Mark	3020
Bell, Michelle	3035
Benoit, Gaboury	3040
Berlyn, Graeme	3050
Bradford, Mark	3054
Brodersen, Craig	3072
Burke, Ingrid	3073
Carpenter, Carol	3110
Cashore, Benjamin	3120
Chertow, Marian	3130
Clark, Susan	3140
Comita, Liza	3143
Doolittle, Amity	3158
Dove, Michael	3160
Duguid, Marlyse	3175
Esty, Daniel	3180
Farrell, Justin	3185
Fenichel, Eli	3195
Gillingham, Kenneth	3215
Gregoire, Timothy	3240
Kotchen, Matthew	3257
Lauenroth, William	3261
Lee, Xuhui	3260
Mendelsohn, Robert	3320
Queenborough, Simon	3350
Raymond, Peter	3364
Saiers, James	3390
Schmitz, Oswald	3400
Seto, Karen	3408
Skelly, David	3420
Wargo, John	3470
Zimmerman, Julie	3500

# F&ES INDEPENDENT STUDY COURSES

<b>Faculty</b>	<b>F&amp;ES Independent Study Course Number</b>
Anastas, Paul	1008
Anisfeld, Shimon	1010
Ashton, Mark	1020
Bacher, Jessica	1030
Bell, Michelle	1035
Benoit, Gaboury	1040
Berlyn, Graeme	1050
Bradford, Mark	1054
Brodersen, Craig	1072
Burke, Maureen	1075
Burroughs, Richard	1080
Carpenter, Carol	1110
Cashore, Benjamin	1120
Chertow, Marian	1130
Clark, Susan	1140
Comita, Liza	1143
Cort, Todd	1147
DeCew, Stuart	1153
Decker, Mary Beth	1155
Doolittle, Amity	1158
Dove, Michael	1160
Duguid, Marlyse	1175
Engelman-Lado, Marianne	1178
Esty, Daniel	1180
Farrell, Justin	1185
Fenichel, Eli	1195
Ferrucci, Michael	1193
Geballe, Gordon	1200
Gentry, Bradford	1210
Gillingham, Kenneth	1215
Graedel, Thomas	1230
Gregoire, Timothy	1240
Grim, John	1242
Gross, Daniel	1243
Klinkenborg, Verlyn	1256
Kotchen, Matthew	1257
Kysar, Douglas	1259

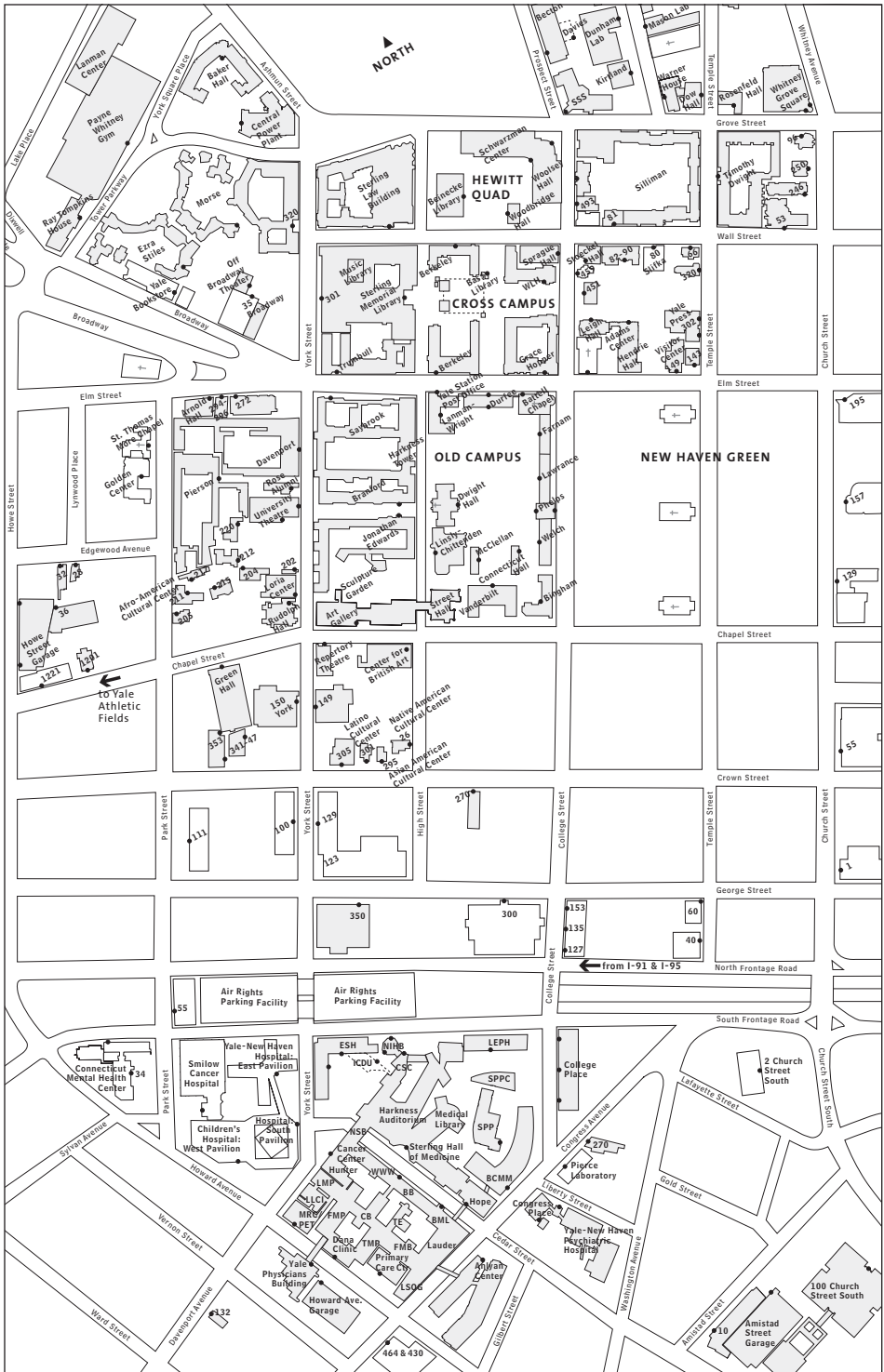
Lauenroth, William	1261
Lee, Xuhui	1260
Leiserowitz, Anthony	1263
Lifset, Reid	1270
Mendelsohn, Robert	1320
Mendez, Michael	1321
Michelangeli, Fabian	1325
Montagnini, Florencia	1330
Oliver, Chadwick	1340
Queenborough, Simon	1350
Raymond, Peter	1364
Reuning-Scherer, Jonathan	1380
Reynolds, Kristin	1368
Saiers, James	1390
Schmitz, Oswald	1400
Seto, Karen	1408
Skelly, David	1420
Smith, Ronald	1430
Toensmeier, Eric	1457
Tomlin, Dana	1460
Tucker, Mary Evelyn	1463
Vandebroek, Ina	1467
Vedder, Amy	1469
Wargo, John	1470
Weber, Albert William	1473
Yost, Peter	1490
Zimmerman, Julie	1500

# YALE UNIVERSITY CAMPUS NORTH





# YALE UNIVERSITY CAMPUS SOUTH & YALE MEDICAL CENTER



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 protected veteran, or national or ethnic origin; nor does Yale discriminate on the basis of sexual orientation or gender identity or expression.

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Title IX of the Education Amendments of 1972 protects people from sex discrimination in educational programs and activities at institutions that receive federal financial assistance. Questions regarding Title IX may be referred to the University's Title IX Coordinator, Stephanie Spangler, at 203.432.4446 or at [titleix@yale.edu](mailto:titleix@yale.edu), or to the U.S. Department of Education, Office for Civil Rights, 8th Floor, 5 Post Office Square, Boston MA 02109-3921; tel. 617.289.0111, fax 617.289.0150, TDD 800.877.8339, or [ocr.boston@ed.gov](mailto:ocr.boston@ed.gov).

In accordance with federal and state law, the University maintains information on security policies and procedures and prepares an annual campus security and fire safety report containing three years' worth of campus crime statistics and security policy statements, fire safety information, and a description of where students, faculty, and staff should go to report crimes. The fire safety section of the annual report contains information on current fire safety practices and any fires that occurred within on-campus student housing facilities. Upon request to the Office of the Vice President for Human Resources and Administration, PO Box 208322, 2 Whitney Avenue, Suite 810, New Haven CT 06520-8322, 203.432.8049, the University will provide this information to any applicant for admission, or prospective students and employees may visit <http://publicsafety.yale.edu>.

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. The Equity in Athletics Disclosure Act (EADA) report is also available online at <http://ope.ed.gov/athletics>.

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

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