ENVIRONMENTAL STUDIES

Director of undergraduate studies: Paul Sabin, 2677 HGS, 436-2516, paul.sabin@yale.edu; www.yale.edu/evst

FACULTY ASSOCIATED WITH THE PROGRAM OF ENVIRONMENTAL STUDIES

Professors D. Michelle Addington (School of Architecture, Forestry & Environmental Studies), Paul Anastas (Forestry & Environmental Studies), Gaboury Benoit (Forestry & Environmental Studies), Graeme Berlyn (Forestry & Environmental Studies), Ruth Blake (Geology & Geophysics), Garry Brewer (Emeritus) (School of Management), Derek Briggs (Geology & Geophysics), Gary Brudvig (Chemistry, Molecular Biophysics & Biochemistry), Benjamin Cashore (Forestry & Environmental Studies), Peter Crane (Forestry & Environmental Studies), Michael Donoghue (Ecology & Evolutionary Biology, Forestry & Environmental Studies), Michael Dove (Forestry & Environmental Studies, Anthropology), Menachem Elimelech (Chemical & Environmental Engineering), John Mack Faragher (History, American Studies), Durland Fish (Public Health, Forestry & Environmental Studies), Thomas Graedel (Forestry & Environmental Studies), Daniel Kevles (History, History of Medicine), Benedict Kierman (History), Robert Mendelsohn (Forestry & Environmental Studies, Economics), Alan Mikhail (History), Mark Pagani (Geology & Geophysics), Jeffrey Park (Geology & Geophysics), Peter Perdue (History), Linda Peterson (English), David Post (Ecology & Evolutionary Biology), Jeffrey Powell (Ecology & Evolutionary Biology, Forestry & Environmental Studies), Peter Raymond (Forestry & Environmental Studies), Nicholas Robinson (Adjunct) (Forestry & Environmental Studies), Susan Rose-Ackerman (Law School, Political Science), James Saiers (Forestry & Environmental Studies), Oswald Schmitz (Forestry & Environmental Studies, Ecology & Evolutionary Biology), James Scott (Political Science, Anthropology), Karen Seto (Forestry & Environmental Studies), Kalyanakrishnan Sivaramakrishnan (Anthropology, Forestry & Environmental Studies), David Skelly (Forestry & Environmental Studies, Ecology & Evolutionary Biology), Brian Skinner (Geology & Geophysics), Ronald Smith (Geology & Geophysics, Forestry & Environmental Studies), Stephen Stearns (Ecology & Evolutionary Biology), Charles Tomlin (Forestry & Environmental Studies) (Visiting), John Wargo (Forestry & Environmental Studies, Political Science), Harvey Weiss (Near Eastern Languages & Civilizations, Anthropology), John Wettlaufer (Geology & Geophysics), Robert Wyman (Molecular, Cellular, & Developmental Biology)

Associate Professors Paul Sabin (History), David Vasseur (Ecology & Evolutionary Biology), Julie Zimmerman (Chemical & Environmental Engineering)

Assistant Professors Mark Bradford (Forestry & Environmental Studies), Alex Felson (Forestry & Environmental Studies), Anjelica Gonzalez (Biomedical Engineering), Karen Hébert (Forestry & Environmental Studies, Anthropology), William Rankin (History, History of Science)

Senior Lecturers Shimon Anisfeld, Carol Carpenter, Amy Doolittle, John Grim, Fred Strebeigh

Lecturers Mary Beth Decker, Kealoha Freidenburg, Gordon Geballe, Paul Lussier, Linda Puth, Catherine Skinner, Carl Zimmer

Environmental Studies provides an interdisciplinary approach to understanding and solving environmental problems. From the natural sciences, students learn experimental techniques and methods of analysis needed to make accurate observations, to document change, to distinguish those changes resulting from human activity, and to understand what comprises healthy landscapes and functioning ecosystems. Students look to the humanities and social sciences for explanations of the ways people behave and for analyses of our institutions and their social, political, and economic activities. The Environmental Studies major prepares students for graduate study in a range of disciplines including law, medicine, and public health, and for careers in business, environmental management and conservation, teaching, and writing.

Prerequisites The major requires preparation in chemistry, biology, laboratory or field training, and either mathematics, physics, or statistics. The general chemistry prerequisite is fulfilled by a two-term lecture sequence in chemistry, or CHEM 118. The introductory biology prerequisite includes BIOL 101 and 102, or G&G 125, or MCDB 123. A natural science laboratory or field course focusing on research and analytic methods is chosen from chemistry laboratories, EVST 221, 234L, 244, or G&G 126L. A term course in mathematics, physics, or statistics is selected from MATH 112 or above (excluding MATH 190), PHYS 170 or above, or STAT 101 or above. Students are advised to take chemistry and biology during the freshman year before enrolling in the EVST core courses in natural sciences. It is recommended that students complete the prerequisites by the end of the fall term in their sophomore year, prior to application to the major (see below), although this is not required. Where relevant, students may employ acceleration credit to fulfill the prerequisites.

Requirements of the major In addition to the prerequisites, twelve and one-half or thirteen and one-half course credits are required for the major, including four core courses, one core laboratory, a departmental seminar, a concentration of six courses, and a one- or two-term senior project and colloquium (EVST 496).

Credit/D/Fail courses Courses taken Credit/D/Fail may not be counted toward the requirements of the major.

Core courses Students are required to take at least two core courses in the humanities and social sciences selected from EVST 120, 226, 255, 340, or 345. They must also take the environmental science core courses EVST 201, 202L, and 223. Completing one course in each area is recommended before the end of the sophomore year.

Departmental seminar All majors must complete a departmental seminar approved by the director of undergraduate studies. This requirement may be completed in any year of study. Seminars already approved include EVST 215, 285, and 290.
**Area of concentration**  Students plan their concentration in consultation with the director of undergraduate studies and the student’s adviser. A concentration is defined as six courses that provide depth in a problem or issue, as well as disciplinary expertise. Past concentrations have included biodiversity, climate change, energy, environmental history, food and agriculture, human health, resource use and sustainability, and urban planning. Students also have the opportunity to work with the director of undergraduate studies to design a unique concentration within the major.

**Senior requirement**  Seniors must complete one or two terms of an independent research project and colloquium, taken as EVST 496. One-term senior essays require the permission of the director of undergraduate studies.

**Application to the Environmental Studies major**  Students typically apply to enter the major during their sophomore year. Applications are accepted on a rolling basis throughout the year, and must be made in writing to the director of undergraduate studies; application details can be found on the program’s Web site (http://www.yale.edu/evst). Juniors who have already completed considerable course work toward the major may also apply. Students considering a major in Environmental Studies should consult the director of undergraduate studies as early as possible in the freshman year.

**Summer environmental internship**  During the summer between the junior and senior years, many students gain experience in the field through research or internships in an area pertinent to their senior research project. Internships may be arranged with nonprofit organizations, government agencies, or corporations. Financial support may be available for students who wish to participate in the summer program.

**REQUIREMENTS OF THE MAJOR**

**Prerequisites**  A 2-term lecture sequence in chem, or CHEM 118; BIOL 101 and 102, or G&G 125, or MCDB 123; a chem lab or EVST 221, 224L, 244, or G&G 126L; MATH 112 or above (excluding MATH 190); PHYS 170 or above, or STAT 101 or above

**Number of courses**  12½ or 13½ course credits beyond prereqs, incl one- or two-term senior project

**Specific courses required**  EVST 201, 202L, 223; 2 from EVST 120, 226, 255, 340, 345

**Distribution of courses**  1 departmental sem, 6 courses in area of concentration

**Senior requirement**  One- or two-term research project and colloq (EVST 496)

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* EVST 377a or b / ANTH 376b, *Observing and Measuring Behavior*  
Eduardo Fernandez-Duque  
Survey of theoretical issues and practical methods relevant to the study of animal and human behavior, primarily in the wild. Topics include research design, behavioral and ecological sampling protocols, basic methods for data analysis, including simple descriptive and analytical statistics, and widely-used technologies that facilitate the study of behavior, such as radiotelemetry. Working around a specific research question, students design their own behavioral study. Prerequisite: a course in evolutionary biology or in the study of animal behavior. SO

**Introductory Courses**

* EVST 020a / FRES 020a, *Sustainable Development in Haiti*  
Gordon Geballe  
The principles and practice of sustainable development explored in the context of Haiti’s rich history and culture, as well as its current environmental and economic impoverishment. Enrollment limited to freshmen. Preregistration required; see under Freshman Seminar Program. WR

* EVST 030a / ARCG 031a / CLCV 059a / HIST 020a / NELC 026a, *Rivers and Civilization*  
Staff  
The appearance of the earliest cities along the Nile and Euphrates in the fourth millennium B.C. Settlements along the rivers, the origins of agriculture, the production and extraction of agricultural surpluses, and the generation of class structures and political hierarchies. How and why these processes occurred along the banks of these rivers; consequent societal collapses and their relation to abrupt climate changes. Enrollment limited to freshmen. Preregistration required; see under Freshman Seminar Program. HU, SO

* EVST 100a / APHY 100a / ENAS 100a / G&G 105a / PHYS 100a, *Energy Technology and Society*  
Daniel Prober  
The technology and use of energy. Impacts on the environment, climate, security, and economy. Application of scientific reasoning and quantitative analysis. Intended for non–science majors with strong backgrounds in math and science. Enrollment limited to 24. For application instructions, visit the course site on Classes*v2 (http://classesv2.yale.edu). QR, SC

**EVST 102b / CHEM 102b / ENVE 202b, Introduction to Green Chemistry**  
Paul Anastas  
Overview of the basic concepts and methods needed to design processes and synthesize materials in an environmentally benign way. Related issues of global sustainability. Case studies that suggest possible solutions for the serious environmental and toxicological issues currently facing industry and society. Intended for non–science majors with a basic high school background in chemistry and physics, as well as high school algebra. Does not satisfy premedical chemistry requirements or requirements for the Chemistry major.

**Core Courses**

**HUMANITIES AND SOCIAL SCIENCES**

* EVST 120b / AMST 163b / HIST 120b / HSHM 204b, *American Environmental History*  
Paul Sabin  
Ways in which people have shaped and been shaped by the changing environments of North America from precolonial times to the present. Migration of species and trade in commodities; the impact of technology, agriculture, and industry; the development of resources
in the American West and overseas; the rise of modern conservation and environmental movements; the role of planning and impact of public policies. 

* EVST 282b, Perception and Conservation of Landscapes  
Staff  
Exploration of historical antecedents and contemporary manifestations of landscape aesthetic through focused readings, discussions, and formal presentations. Study of how this aesthetic has informed and continues to inform and guide, both implicitly and explicitly, decisions about which landscapes to conserve and protect.

EVST 340b / ECON 330b, Economics of Natural Resources  
Robert Mendelsohn  
Microeconomic theory brought to bear on current issues in natural resource policy. Topics include regulation of pollution, hazardous waste management, depletion of the world's forests and fisheries, wilderness and wildlife preservation, and energy planning. After introductory microeconomics.  
QR, SO

* EVST 345a / ANTH 382a / F&ES 384a, Environmental Anthropology  
Michael Dove  
History of the anthropological study of the environment: nature-culture dichotomy, ecology and social organization, methodological debates, politics of the environment, and knowing the environment.  
SO

ENVIRONMENTAL SCIENCE

EVST 201a / G&G 140a, Atmosphere, Ocean, and Environmental Change  
Ronald Smith  
Physical processes that control Earth's atmosphere, ocean, and climate. Quantitative methods for constructing energy and water budgets. Topics include clouds, rain, severe storms, regional climate, the ozone layer, air pollution, ocean currents and productivity, the seasons, El Niño, the history of Earth's climate, global warming, energy, and water resources. Must be taken concurrently with EVST 202L.  
QR, SC

* EVST 202La / G&G 141La, Laboratory for Atmosphere, Ocean, and Environmental Change  
Ronald Smith  
Laboratory and field exercises to accompany EVST 201. Must be taken concurrently with EVST 201.  
SC  
½ Course cr

EVST 223a / E&EB 220a, General Ecology  
Ann Staver and David Vasseur  
The theory and practice of ecology, including the ecology of individuals, population dynamics and regulation, community structure, ecosystem function, and ecological interactions at broad spatial and temporal scales. Topics such as climate change, fisheries management, and infectious diseases are placed in an ecological context. Prerequisite: MATH 112 or equivalent.  
SC

Intermediate and Advanced Courses

The following courses have been approved for developing areas of concentration. Other courses may be suitable for designing an area of concentration with permission of the director of undergraduate studies.

EVST 191a, Trees: Environmental Biology and Global Significance  
Craig Brodersen  
Underlying principles that govern tree biology in both time and space. The biophysics of energy balance, water transport, and gas exchange, from individual plant organs to the tree and forest canopy; principles of cells and membranes; the fundamental differences between plant and animal cells; regional and global patterns in forest dynamics; implications of disruptions in the biotic and abiotic environment. Case studies focus on understanding forests and forest products and their global significance.  
SC

* EVST 200b / G&G 115b, Earth System Science  
Jeffrey Park  
A survey of geoscience. Interaction of lithosphere, hydrosphere, atmosphere, and Earth's deep interior; natural controls on environment and climate in past, present, and future; rocks, minerals, glaciers, earthquakes, and volcanoes; natural hazards and natural resources. (Formerly G&G 200)  
SC

EVST 211b / G&G 211b / HIST 416b / HSHM 211b, Global Catastrophe since 1750  
William Rankin  
A history of the geological, atmospheric, and environmental sciences, with a focus on predictions of global catastrophe. Topics range from headline catastrophes such as global warming, ozone depletion, and nuclear winter to historical debates about the age of the Earth, the nature of fossils, and the management of natural resources. Tensions between science and religion; the role of science in government; environmental economics; the politics of prediction, modeling, and incomplete evidence.  
HU

* EVST 212a / E&EB 390a / PLSC 212a, Democracy and Sustainability  
Michael Fotos  
Democracy, liberty, and the sustainable use of natural resources. Concepts include institutional analysis, democratic consent, property rights, market failure, and common pool resources. Topics of policy substance are related to human use of the environment and to U.S. and global political institutions.  
SO

* EVST 234La, Field Science: Environment and Sustainability  
L. Kealoha Freidenburg  
A field course that explores the effects of human influences on the environment. Analysis of pattern and process in forested ecosystems; introduction to the principles of agroecology, including visits to local farms; evaluation of sustainability within an urban environment. Weekly field trips and one weekend field trip.  
SC

EVST 242a, Ecosystems and Landscapes  
Peter Raymond and Oswald Schmitz  
Introduction to concepts in ecosystem and landscape ecology. Topics include element cycling, food web interactions, species-area relationships, whole system metabolism, and models of biodiversity. Understanding of ecological patterns and processes at multiple scales in order to study, manage, and conserve species and ecosystems. None.  
SC
* EVST 244a, Coastal Environments in a Changing World  Mary Beth Decker
The effects of human action and natural phenomena on coastal marine ecosystems. Methods used by coastal scientists to address environmental issues; challenges associated with managing and conserving coastal environments. Priority to Environmental Studies majors; open to nonmajors as space permits.  SC

* EVST 247b / EP&E 497b / PLSC 219b, Politics of the Environment  Peter Swenson
Historical and contemporary politics aimed at regulating human behavior to limit damage to the environment. Goals, strategies, successes, and failures of movements, organizations, corporations, scientists, and politicians in conflicts over environmental policy. Focus on politics in the U.S., including the role of public opinion; attention to international regulatory efforts, especially with regard to climate change.  SO

* EVST 258a / AMST 258a, Wilderness in the North American Imagination  Michelle Morgan
The idea of wilderness in American history, art, film, public policy, and literature, from the Puritans to the present. Authors include Thoreau, Faulkner, Jack London, Mary Rowlandson, Aldo Leopold, and Rachel Carson. A weekend field trip is held early in the term.  HU

* EVST 261a / F&ES 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

EVST 292a, Sustainability in the Twenty-First Century  Daniel Esty
Sustainability as an overarching framework for life in the twenty-first century. Ways in which this integrated policy concept diverges from the approaches to environmental protection and economic development that were pursued in the twentieth century. The interlocking challenges that stem from society’s simultaneous desires for economic, environmental, and social progress despite the tensions across these realms.  SO

* EVST 311a, Environmental Communication for Public Engagement & Policy  Paul Lussier
Analysis, assessment, and application of narrative strategies to the communication of climate and energy science toward public policy engagement and action. Emerging interdisciplinary theory and research in narratology, sociology, and psychology, as well as cultural, education, and media sciences.  SO

* EVST 312b, Advanced Science Communications with Impact  Paul Lussier
Exploration of advanced theoretical frameworks for the practice of science communication. Focus on methods that speak to stakeholder values across government and civil society. Application of strategies to several case projects in partnership with professionals across multiple sectors. EVST 311 (or precursor CSES 310) is recommended, but not expressly required.  WR

* EVST 321b / ANTH 320b / ARCG 320b / MMES 320b / NELC 320b, From Babylon to Bush  Harvey Weiss
Analysis of Mesopotamian transformations from the earliest agriculture villages to the earliest cities, states, and civilization, to the earliest empires, as well as the region-wide collapses that punctuated these developments. Forces that drove these uniquely early Mesopotamian developments. Essential archaeological questions, including why each transformation happened, developed, and evolved. The end of the Ottoman empire and the British (1917) and American (1991, 2003) invasions.  HU, SO

* EVST 324b / FRES 34b, 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

* EVST 348b, Yellowstone and Global Change  Susan Clark
Introduction to sustainability issues in natural resource management and policy, using the Greater Yellowstone ecosystem as a case study. Topics include large carnivores, wildlife conservation, parks, energy, and transportation. Priority to Environmental Studies majors.

* EVST 352b, Food and Documentary  Ian Cheney
Survey of contemporary public debates and current scientific thinking about how America farms and eats explored through the medium of documentary film. Includes a brief history of early food and agrarian documentaries, with a focus on twenty-first century films that consider sustainable food.

* EVST 362b / ARCG 362b / G&G 362b, 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. Prerequisites: college-level physics or chemistry, two courses in geology and natural science of the environment or equivalents, and computer literacy.  QR, SC

* EVST 390a / NELC 390a, Agriculture: Origins, Evolution, Crises  Harvey Weiss
Analysis of the societal and environmental drivers and effects of plant and animal domestication, the intensification of agroproduction, and the crises of agroproduction: land degradation, societal collapses, sociopolitical transformation, sustainability, and biodiversity.  SO
* **EVST 400b / E&EB 275b, Biological Oceanography**  Mary Beth Decker
Exploration of a range of coastal and pelagic ecosystems. Relationships between biological systems and the physical processes that control the movements of water and productivity of marine systems. Anthropogenic impacts on oceans, such as the effects of fishing and climate change. Includes three Friday field trips. Enrollment limited to 15.  SC

* **EVST 424a / ANTH 406a / PLSC 420a, Rivers: Nature and Politics**  James Scott
The natural history of rivers and river systems and the politics surrounding the efforts of states to manage and engineer them.  SO

* **EVST 473b / ANTH 473b / ARCG 473b, Abrupt Climate Change and Societal Collapse**  Harvey Weiss
The coincidence of societal collapses throughout history with decadal and century-scale drought events. Challenges to anthropological and historical paradigms of cultural adaptation and resilience. Examination of archaeological and historical records and high-resolution sets of paleoclimate proxies.  HU, SO

**Departmental Seminars**

* **EVST 290b / F&ES 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.

**Senior Project**

* **EVST 496a or b, Senior Research Project and Colloquium**  Staff
Independent research under the supervision of members of the faculty, resulting in a senior essay. Students meet with peers and faculty members regularly throughout the fall term to discuss the progress of their research. Projects should offer substantial opportunity for interdisciplinary work on environmental problems. Students typically complete a two-term senior essay, but students completing the requirements of two majors may consider a one-term senior project.