

Ecosystem Management and Forestry

The Ecosystem Management and Forestry major is replacing the Forestry and Natural Resources major in the College of Natural Resources.

Bachelor of Science (BS)

Ecosystem Management and Forestry (EMF) focuses on the conservation and restoration of the earth's natural resources through hands-on study of the ecology, stewardship, and management of forest, woodland, and grassland ecosystems.

The program offers two specializations to choose from, and if the student chooses a specialization in Forestry, they can qualify to take the Registered Professional Forester's licensing exam in California.

- The **Forestry specialization** provides students with the ecological, quantitative, and social foundation to be the managers and leaders in the management of forests and forest resources. The Forestry specialization is accredited by the Society of American Foresters and provides four years of qualifying education or professional experience for licensing as a professional forester in California. The goals of the Forestry specialization are very closely associated with the educational requirements of the forestry profession and prepare our students for a variety of careers in forestry or closely related natural resource fields.
- The **Natural Resource Management specialization** provides students with greater flexibility to explore subjects in ecology, physical environment, monitoring and measurement, and management and policy. Students can choose to concentrate their studies in water management, ecology, climate change or design their own concentration based on interest.

Students in the program, regardless of concentration, have ample opportunity to acquire interdisciplinary skills in the ecology, stewardship, and management of ecosystems such as forests, woodlands, and grasslands. Within the program, students can choose to emphasize topics such as wildlife biology, water policy, fire science, ecosystem restoration, environmental justice, remote sensing and GIS, and rural sociology.

EMF graduates are well-prepared for graduate school and careers in environmental consulting, public agencies, non-profit conservation organizations, and private companies. Students also have the option of preparing for professional careers in forestry, wildlife, and range management.

Admission to the Major

Advice on admission for freshmen and transfer students can be found on the CNR Admissions Guide (<http://guide.berkeley.edu/archive/2018-19/undergraduate/colleges-schools/natural-resources/#admissiontext>) page or the CNR Prospective Student website (<https://nature.berkeley.edu/prospective-students>). Freshman students may apply directly to the major, or they may select the College of Natural Resource's undeclared option and declare the major by the end of their fourth semester. Transfer students may apply directly to the major through the UC application.

Information for current Berkeley students who would like to declare the major after admission, including information on a change of

major or change of college, please see chapter 6 of the College of Natural Resources Undergraduate Student Handbook (<https://nature.berkeley.edu/handbook>). (<https://nature.berkeley.edu/handbook>)

Honors Program

Students with a GPA of 3.6 or higher may enroll in the College of Natural Resources honors program (H196) once they have reached upper division standing. To fulfill the program requirements, students design, conduct, and report on an individual research project working with a faculty sponsor. For further information about registration for the honors symposium and the honors requirements, please see the College of Natural Resources website (http://nature.berkeley.edu/site/honors_program.php).

Minor Program

A minor in Forestry is available for students who are interested in learning about forestry and renewable resource management as an adjunct to their chosen fields. Students in many diverse majors such as business administration, integrative biology, and civil engineering may find this minor complementary to their professional career goals. For information regarding how to declare the minor, please contact the department.

Other Majors and Minors Offered by the Department of Environmental Science, Policy, and Management:

Conservation and Resource Studies (<http://guide.berkeley.edu/archive/2018-19/undergraduate/degree-programs/conservation-resource-studies>) (Major and Minor)

Environmental Sciences (<http://guide.berkeley.edu/archive/2018-19/undergraduate/degree-programs/environmental-sciences>) (Major only)

Molecular Environmental Biology (<http://guide.berkeley.edu/archive/2018-19/undergraduate/degree-programs/molecular-environmental-biology>) (Major only)

Society and Environment (<http://guide.berkeley.edu/archive/2018-19/undergraduate/degree-programs/society-environment>) (Major only)

Students in this major choose a specialization in Forestry or Natural Resource Management. The specific requirements for each specialization is outlined below. In addition to the University, campus, and college requirements, listed on the College Requirements tab, students must fulfill the below requirements specific to their major program.

General Guidelines

1. All courses taken to fulfill the major requirements below must be taken for graded credit, other than courses listed which are offered on a Pass/No Pass basis only. Other exceptions to this requirement are noted as applicable.
2. A minimum cumulative grade point average (GPA) of 2.0 is required.
3. A minimum GPA of 2.0 in upper division major requirements is required.
4. At least 15 of the 36 required upper division units must be taken in the College of Natural Resources (except for students majoring in Environmental Economics and Policy; please see the EEP major adviser for further information).
5. A maximum of 16 units of independent study (courses numbered 97, 98, 99, 197, 198, and 199) may count toward graduation, with a maximum of 4 units of independent study per semester.

6. No more than 1/3 of the total units attempted at UC Berkeley may be taken *Pass/Not Pass*. This includes units in the Education Abroad Program and UC Intercampus Visitor or Exchange Programs.
7. A maximum of 4 units of physical education courses will count toward graduation.

For information regarding residency requirements and unit requirements, please see the College Requirements tab.

Requirements for all Ecosystem Management and Forestry Majors

Lower division courses

Chemistry (pick one)

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| CHEM 1A & 1AL | General Chemistry and General Chemistry Laboratory |
| CHEM 3A & 3AL | Chemical Structure and Reactivity and Organic Chemistry Laboratory |

Biology

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| BIOLOGY 1B | General Biology Lecture and Laboratory [4] |
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Calculus (A-B series required)

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| MATH 16A & MATH 16B | Analytic Geometry and Calculus and Analytic Geometry and Calculus |
| MATH 1A & MATH 1B | Calculus and Calculus |
| MATH 10A & MATH 10B | Methods of Mathematics: Calculus, Statistics, and Combinatorics and Methods of Mathematics: Calculus, Statistics, and Combinatorics |

Statistics

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| STAT 20 or STAT 21 | Introduction to Probability and Statistics [4] Introductory Probability and Statistics for Business |
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Economics

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| ENVECON C1 or ECON 1 | Introduction to Environmental Economics and Policy [4] * Introduction to Economics |
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Physical Science

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| GEOG 40 or EPS 50 or GEOG N1 | Introduction to Earth System Science [4] The Planet Earth Global Environmental Change |
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GIS

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| ESPM 72 or ESPM C177 | Introduction to Geographic Information Systems [3] (offered every other year) GIS and Environmental Spatial Data Analysis |
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ESPM Core Requirements

ESPM Environmental Sciences Core: Select one from the following:

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| ESPM 2 | The Biosphere [3] |
| ESPM 6 | Environmental Biology [3] |
| ESPM C10 | Environmental Issues [4] |
| ESPM 15 | Introduction to Environmental Sciences [3] |

ESPM Social Sciences Core: Select on from the following:

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| ESPM C11 | Americans and the Global Forest [4] |
| ESPM C12 | Introduction to Environmental Studies [4] |
| ESPM 50AC | Introduction to Culture and Natural Resource Management [4] |
| ESPM 60 | Environmental Policy, Administration, and Law [4] |

Upper Division Core Courses

Upper division requirements for both specializations

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| ESPM 137 or INTEGBI 15 | Landscape Ecology [3] Ecology |
| ESPM 102C | Resource Management [4] |
| ESPM 183 | Forest Ecosystem Management and Planning [4] |

Forestry Specialization Requirements

The Forestry specialization provides students with the ecological, quantitative, and social foundation to be the managers and leaders in the management of forests and forest resources. The Forestry specialization is accredited by the Society of American Foresters and provides four years of qualifying education or professional experience for licensing as a professional forester in California. The goals of the Forestry specialization are very closely associated with the educational requirements of the forestry profession and prepare our students for a variety of careers in forestry or closely related natural resource fields.

Forestry Field Program

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| ESPM 105A | Sierra Nevada Ecology [4] |
| ESPM 105B | Forest Measurements [1] |
| ESPM 105C | Silviculture and Utilization [3] |
| ESPM 105D | Forest Management and Assessment [3] |

Forestry Required Courses

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| ESPM 102B & 102BL | Natural Resource Sampling and Laboratory in Natural Resource Sampling |
| ESPM 102D or ESPM 60 | Climate and Energy Policy [4] Environmental Policy, Administration, and Law |
| ESPM 108A | Trees: Taxonomy, Growth, and Structures [3] |
| ESPM 134 | Fire, Insects, and Diseases in Forest Ecosystems [3] |
| ESPM 182 | Forest Operations Management [3] (offered every other year) |
| ESPM 185 | Applied Forest Ecology [4] |

Forestry Elective

(Select two)

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| ESPM 120 | Science of Soils [3] |
| ESPM 121 | Development and Classification of Soils [3] |
| ESPM C129 | Biometeorology [3] |
| LD ARCH 110 | Ecological Analysis [3] |
| LD ARCH C188 | Geographic Information Systems [4] |

Natural Resource Management Specialization Requirements

The Natural Resource Management specialization provides students with greater flexibility to explore subjects in ecology, physical environment, monitoring and measurement, and management and policy. Students can choose to concentrate their studies in water management, ecology, climates change or design their own concentration based on interest.

Choose One:

Choice A

- Either the Forestry Field program (ESPM 105A-D) or Biology and Geomorphology of Tropical Islands (ESPM C107) **AND**

- Three additional approved courses by and Ecosystem Management and Forestry Faculty

Choice B

Complete an approved six course resource concentration track or design your own six course concentration with EMF faculty approval with at least one elective from each of the following categories

Natural Resource Management Choice B course list

| Ecosystem Knowledge | |
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| ESPM 108A | Trees: Taxonomy, Growth, and Structures [3] |
| ESPM 108B | Environmental Change Genetics [3] |
| ESPM 111 | Ecosystem Ecology [4] |
| ESPM 112 | Microbial Ecology [3] |
| ESPM 113 | Insect Ecology [3] |
| ESPM 114 | Wildlife Ecology [3] |
| ESPM 115C | Fish Ecology [3] |
| ESPM 116B | Grassland and Woodland Ecology [4] |
| ESPM 120 | Science of Soils [3] |
| ESPM 121 | Development and Classification of Soils [3] |
| ESPM C129 | Biometeorology [3] |
| ESPM 131 | Soil Microbiology and Biogeochemistry [3] |
| ESPM C180 | Air Pollution [3] |
| Ecosystem Measurement and Assessment | |
| ESPM 102B & 102BL | Natural Resource Sampling and Laboratory in Natural Resource Sampling |
| ESPM 164 | GIS and Environmental Science [3] |
| ESPM 173 | Introduction to Ecological Data Analysis [3] |
| ESPM 174 | Design and Analysis of Ecological Research [4] |
| LD ARCH 110 | Ecological Analysis [3] |
| LD ARCH C180 | Geographic Information Systems [4] |
| Ecosystems Value and Policy | |
| ESPM 102D | Climate and Energy Policy [4] |
| ESPM 155AC | Sociology and Political Ecology of Agro-Food Systems [4] |
| ESPM 162A | Health, Medicine, Society and Environment [4] |
| ESPM 163AC | Environmental Justice: Race, Class, Equity, and the Environment [4] |
| ESPM 168 | Political Ecology [4] |
| ESPM 169 | International Environmental Politics [4] |
| Ecosystem Management | |
| ESPM C103 | Principles of Conservation Biology [4] |
| ESPM C104 | Modeling and Management of Biological Resources [4] |
| ESPM 134 | Fire, Insects, and Diseases in Forest Ecosystems [3] |
| ESPM 152 | Global Change Biology [3] |
| ESPM 158 | Biodiversity Conservation in Working Landscapes [4] |
| ESPM C167 | Environmental Health and Development [4] |
| ESPM 181A | Fire Ecology [3] |
| ESPM 182 | Forest Operations Management [3] |
| ESPM 185 | Applied Forest Ecology [4] |

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| ESPM 186 | Management and Conservation of Rangeland Ecosystems [4] |
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Possible concentrations in Natural Resource Management:

Water & Watershed: ESPM 120 Science of Soils, ESPM 164 GIS and Environmental Science, ESPM 182 Forest Operations Management, ESPM 102D Climate and Energy Policy, EPS 117 Geomorphology, CIV ENG 103 Introduction to Hydrology

Wildlife Conservation and Management: ESPM 102D Climate and Energy Policy, ESPM C103 Principles of Conservation Biology, ESPM 106 American Wildlife: Management and Policy in the 21st Century, ESPM 114 Wildlife Ecology, ESPM 115C Fish Ecology, ESPM 173 Introduction to Ecological Data Analysis

Management in Changing Climate: ESPM 102D Climate and Energy Policy, ESPM C129 Biometeorology, ESPM 152 Global Change Biology, ESPM 173 Introduction to Ecological Data Analysis, ESPM 181A Fire Ecology, ENVECON C175 The Economics of Climate Change

Human Dimension of Natural Resource Management: ESPM 114 Wildlife Ecology, ESPM 160AC American Environmental and Cultural History, ESPM 164 GIS and Environmental Science, ESPM C167 Environmental Health and Development, ESPM 168 Political Ecology, ENVECON 153 Population, Environment, and Development

Students who have a strong interest in an area of study outside their major often decide to complete a minor program. These programs have set requirements and are noted officially on the transcript in the memoranda section, but they are not noted on diplomas.

General Guidelines

1. All courses taken to fulfill the minor requirements below must be taken for graded credit.
2. A minimum grade point average (GPA) of 2.0 is required for courses used to fulfill the minor requirements.
3. No more than one course may be used to simultaneously fulfill requirements for a student's major and minor programs.

Completing the Forestry and Natural Resources Minor Program

- Students must complete at least five courses taken from the predetermined list below. No substitutions will be permitted.
- No more than one lower division course for the minor
- The courses taken must total at least 12 semester units.

Requirements

Core courses:

At least one core courses required for the minor

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| ESPM 105D | Forest Management and Assessment [3] |
| ESPM 182 | Forest Operations Management [3] |
| ESPM 183 | Forest Ecosystem Management and Planning [4] |
| ESPM 185 | Applied Forest Ecology [4] |

Electives (four courses):

ESPM 182, ESPM 183, and ESPM 185 may also be used as electives.

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| ESPM C11 | Americans and the Global Forest [4] |
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| ESPM 50AC | Introduction to Culture and Natural Resource Management [4] |
| ESPM 60 | Environmental Policy, Administration, and Law [4] |
| ESPM 72 | Introduction to Geographic Information Systems [3] |
| ESPM 102B | Natural Resource Sampling [2] |
| ESPM 102C | Resource Management [4] |
| ESPM 102D | Climate and Energy Policy [4] |
| ESPM 108A | Trees: Taxonomy, Growth, and Structures [3] |
| ESPM 108B | Environmental Change Genetics [3] |
| ESPM 116C | Tropical Forest Ecology [3] |
| ESPM C129 | Biometeorology [3] |
| ESPM 134 | Fire, Insects, and Diseases in Forest Ecosystems [3] |
| ESPM 155AC | Sociology and Political Ecology of Agro-Food Systems [4] |
| ESPM 172 | Remote Sensing of the Environment [3] |
| ESPM 181A | Fire Ecology [3] |
| ESPM 184 | Agroforestry Systems [3] |

UC Forestry Summer Field Program at Baker Forest ¹

The three Forestry Camp courses (ESPM 105A, ESPM 105B, ESPM 105C) may be used toward the minor.

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| ESPM 105A | Sierra Nevada Ecology [4] |
| ESPM 105B | Forest Measurements [1] |
| ESPM 105C | Silviculture and Utilization [3] |

¹ For more information and to download application materials, please see the College of Natural Resource's website (<http://forestrycamp.berkeley.edu>).

Mission

The Ecosystem Management and Forestry (EMF) major at the University of California at Berkeley is designed to train tomorrow's leaders in ecosystem science, policy, and management with an emphasis on the ecology, stewardship, and management of forest, woodland, and grassland ecosystems. The program combines a foundation in the relevant natural and social sciences with explicit hands-on learning opportunities. Students completing this major will be prepared to engage policymakers and the public on the role and value of nature in our rapidly changing world.

The EMF major includes both a Forestry concentration that is accredited by the Society of American Foresters (SAF) and Natural Resource Management (NRM) concentration (SAF accreditation pending)

The Forestry concentration provides four years of qualifying education or professional experience for licensing as a professional forester in California. The goals of the Professional Forestry specialization are very closely associated with the educational requirements of the forestry profession and prepare our students for careers in forestry or closely related natural resource fields. When students graduate the EMF major with a Forestry concentration from UC Berkeley, they will have the basic knowledge and skills to assess and manage forest resources.

The Natural Resource Management concentration trains students how to solve ecosystem problems that require interdisciplinary skills. Students can choose to emphasize such topics as wildlife biology, water policy, fire science, ecosystem restoration, environmental justice, remote sensing, and GIS, or rural sociology. Students who graduate the EMF major with an NRM concentration are well-positioned to tackle current

environmental challenges (climate change, fire, sudden oak death, exurban development, drought, and novel ecosystems) while working in industry, government or environmental organizations.

Learning Goals for the Major Forestry Concentration

Knowledge and skills are based on the four major subject areas required by the Society of American Foresters. These four subject areas and the basic competencies expected of students are as follows.

1. Ecology and Biology

- Competencies must be documented as an:
 - Understanding of taxonomy and ability to identify forest species, their distribution, and associated habitat requirements.
 - Understanding of soil properties and processes, hydrology, water quality, and watershed functions.
 - Understanding of ecological concepts and principles including the structure and function of ecosystems, plant and animal communities, competition, diversity, population dynamics, succession, disturbance, and nutrient cycling.
 - Ability to make ecosystem, forest, and stand assessments.
 - Understanding of plant and animal physiology and the effects of climate, fire, pollutants, moisture, nutrients, genetics, insects and diseases on ecosystem health and productivity.

2. Measurement of Forest and Natural Resources

- Competencies must be documented as an:
 - Ability to identify and measure land areas and conduct spatial analysis.
 - Ability to design and implement comprehensive inventories that meet specific objectives using appropriate sampling methods and units of measurement.
 - Ability to analyze inventory data and project ecosystem conditions.

3. Management of Forest and Natural Resources

- Competencies must be documented as an:
 - Ability to develop and apply silvicultural and restoration prescriptions appropriate to management objectives including methods of establishing and influencing the composition, growth, and quality of forests and wildlands and understand the impacts of those prescriptions.
 - Ability to analyze the economic, environmental, and social consequences of resource management strategies and decisions.
 - Ability to develop management plans with specific multiple objectives and constraints.
 - Understanding of the valuation procedures, market forces, processing systems, transportation and harvesting activities

that translate human demands for timber-based and other consumable natural resource products into the availability of those products.

- Understanding of the valuation procedures, market, and non-market forces that avail humans the opportunities to enjoy non-consumptive products and services of forests and wildlands.
- Understanding of the administration, ownership, and organization of forest and resource management enterprises.

4. Resource Policy, Economics, and Administration

- Competencies must be documented as an:
 - Understanding of resource policy and the processes by which it is developed.
 - Understanding of how federal, state, and local laws and regulations govern the practice of forestry and resource management.
 - Understanding of professional ethics and recognition of the responsibility to adhere to ethical standards in decision-making on behalf of clients and the public.
 - Ability to understand the integration of technical, financial, human resources, and legal aspects of public and private enterprises.

Natural Resource Management Concentration

Knowledge and skills are based on the four major subject areas required by the Society of American Foresters. These four subject areas and the basic competencies expected of students are as follows:

1. Fundamental Knowledge of Ecosystem Components and Ecosystem Functioning

- Competencies must be documented as an:
 - Knowledge of the elements of botany, zoology, entomology, plant pathology, plant physiology, and genetics essential to an understanding of higher-order ecological processes.
 - An understanding of taxonomy and systematics and an ability to identify dominant and/or ecologically significant components of the flora and fauna of ecosystems at regional to continental scales.
 - Knowledge of the important life history characteristics of dominant and special-concern species.
 - Knowledge of soil properties and processes, hydrology, water quality, and watershed functions.
 - An understanding of ecological concepts and principles including the structure and function of ecosystems, plant and animal communities, competition, diversity, population dynamics, succession, disturbance, and nutrient cycling;
 - An understanding of the effects of climate, fire, pollutants, moisture, nutrients, insects and diseases, and other

environmental factors on ecosystem health and functioning at local and landscape scales.

2. Measurement and Assessment of Ecosystem Components, Properties, and Functioning

- Competencies must be documented as an:
 - Ability to identify, measure, and map land areas and conduct spatial analyses.
 - Ability to design and implement accurate inventories and assessments of dominant or critical ecosystem components and services, ecosystem properties, and indicators of ecosystem health, including trees and other vegetation, vertebrate fauna, biodiversity, soil and water resources, timber, and recreational opportunities.
 - Ability to summarize and statistically analyze inventory and assessment data, evaluate the status of important ecosystem components, describe and interpret interactions and relationships, and project future ecosystem conditions.

3. Identification and Evaluation of Management Objectives

- Competencies must be documented as an:
 - Understanding of the valuation procedures, including market and nonmarket forces, that apply to ecosystem goods and services such as timber, water, recreational opportunities, carbon and nutrient cycling, and plant and animal biodiversity.
 - Ability to explain the relationships between demand, costs of production, and availability of those goods and services.
 - Ability to describe procedures for measuring stakeholder values and managing conflicts in the evaluation and establishment of management objectives.
 - Ability to evaluate and understand the economic, ecological, and social trade-offs of alternative land uses and ecosystem management decisions at local, regional, and global scales.
 - Knowledge and understanding of environmental policy as applied to ecosystems and the processes by which it is developed.

4. Management Planning, Practice, and Implementation

- Competencies must be documented as an:
 - Ability to develop and apply prescriptions for manipulating the composition, structure, and function of ecosystems to achieve management objectives, and to understand the impacts of those prescriptions at local and landscape scales.
 - Ability to identify and control or mitigate specific threats to ecosystems such as insects, diseases, fire, pollutant stressors, and invasive plants or animals.
 - Knowledge of the methods and procedures unique to the production of ecosystem goods and services such as timber, recreation, water, and wildlife populations.

- Ability to describe the process of adaptive management and its application to the management of ecosystems.
- Understanding of how federal, state, and local laws and regulations apply to management practice.
- Ability to develop management plans with specific objectives and constraints that are responsive to ownership or stakeholder goals and demonstrate clear and feasible linkages between current condition and desired future condition.
- Understanding of professional ethics, including the SAF Code, and recognition of the responsibility to adhere to ethical standards in the practice of natural resource management on behalf of clients and the public.
- Ability to integrate the knowledge, understanding, and skills from prior coursework in the development of collaborative solutions to realistic management problems.

In the College of Natural Resources, we provide holistic, individual advising services to prospective and current students who are pursuing major and minors in our college. We assist with a range of topics including course selection, academic decision-making, achieving personal and academic goals, and maximizing the Berkeley experience. If you are looking to explore your options, or you are ready to declare a major, double major, or minor, contact the undergraduate adviser for your intended major. Visit the College of Natural Resources website (<http://nature.berkeley.edu/advising/undergraduate-advising>) to explore all of our advising services.

Undergraduate Adviser

Ginnie Sadil
gsadil@berkeley.edu
260 Mulford Hall
510-642-7895

Contact Ginnie via email to schedule an appointment or visit 260 Mulford Hall for drop-in advising. Advising hours are weekdays 9:00 a.m. to 12:00 a.m. and 1:00 p.m. to 4:00 p.m. Closed Wednesday from 9:00 a.m. to 12:00 p.m.