

NATURAL RESOURCE ECOLOGY AND MANAGEMENT

The department addresses a broad spectrum of natural resource and environmental issues in a holistic approach to learning, discovery and engagement. Our vision of natural resources is that informed protection and management of natural resources involves an integration of biological, economic, and social considerations. Such an integrated and comprehensive approach to the education of future generations of natural resource managers and scientists is needed in order to sustain viable landscapes, facilitate strong communities, and produce desired goods, services, and functions from our natural resources.

Our educational mission for the undergraduate and graduate programs is to provide those learning experiences and opportunities that will ensure students can learn to function effectively in their chosen fields.

Central to that effective functioning are the abilities to:

- Identify, explain and critically evaluate their own beliefs, values and actions in relation to professional and societal standards of ethics.
- Anticipate, analyze and evaluate natural resource issues and opportunities, explaining the ecological, economic, and social consequences of natural resource actions at various scales and over time.
- Actively seek the input and perspectives of diverse stakeholders regarding natural resource problems and issues.
- Assess, analyze, synthesize, and evaluate information fairly and objectively.
- Work effectively, both individually and with others, on complex, value-laden natural resource problems that require holistic problem solving approaches.
- Formulate and evaluate alternative solutions to complex problems and recommend and defend best alternatives.
- Communicate clearly and effectively with all audiences using appropriate oral, visual, electronic, and written techniques.
- Recognize and interpret resource problems and opportunities across spatial scales from local to global.
- Appreciate cultural diversity and understand the impact of the global distribution of people and wealth on natural resource use and valuation.
- Exercise leadership skills as professionals and engaged citizens.
- Demonstrate creativity and innovation in identifying and pursuing opportunities that produce environmental, social, or economic value.
- Exercise life-long learning skills developed before graduation.

Undergraduate Study

The Department of Natural Resource Ecology and Management offers work for the Bachelor of Science degree with majors in animal ecology (http://catalog.iastate.edu/collegeofagricultureandlifesciences/animal_ecology/) or forestry (<http://catalog.iastate.edu/collegeofagricultureandlifesciences/forestry/>). The department participates in interdisciplinary programs in biology, environmental studies, international studies, and pest management. By proper selection of free and restricted elective courses, students can obtain a minor or a second major in these programs or other disciplines.

Contact the department for information about minors from the Department of Natural Resource Ecology and Management.

The Department provides numerous scholarships; application information is available in the departmental Student Services Center.

Graduate Study

The Department of Natural Resource Ecology and Management offers work for the degrees Master of Science and Doctor of Philosophy with majors in fisheries biology, forestry, and wildlife ecology. A non-thesis masters degree is available for students desiring a general degree program without thesis research. Students may also major in interdepartmental graduate majors in ecology and evolutionary biology, environmental science, genetics, plant physiology, sustainable agriculture, or toxicology (see Index (<http://catalog.iastate.edu/azindex/>)). All students are required to teach and conduct research as part of their training for the Ph.D. degree.

Fisheries Biology and Wildlife Ecology

Graduates have a broad understanding of the basic principles of animal biology, ecology and management, and relevant aspects of basic mathematics and natural sciences, computing applications, and personal and professional development. They are able to execute rigorous independent research, have developed problem-solving and critical-thinking skills, and can communicate effectively with scientific colleagues and the general public in both formal and informal settings.

Personnel of the U.S. Geological Survey's Iowa Cooperative Fish and Wildlife Research Unit contribute significantly to the graduate program of the department through teaching and research. Governmental agencies such as the U.S. Fish and Wildlife Service, Natural Resources Conservation Service and the Iowa Department of Natural Resources, and non-governmental agencies such as The Nature Conservancy and the Iowa Natural Heritage Foundation also contribute to the graduate program by funding research, providing in-kind support, and providing numerous formal and informal mentoring relationships.

No more than two dual-listed animal ecology courses may be applied for major graduate credit. Additional work is expected of students taking a dual-listed course for credit at the 500 level.

Forestry

The department offers programs leading to the degrees of Master of Science and Doctor of Philosophy with a major in forestry and minor work to students taking major work in other departments.

Graduates are skilled at defining a research problem in forestry, applying scientific principles and appropriate methods, and analyzing the results. They are capable of understanding the many facets of forest and wood science and are very knowledgeable in specific areas in forestry. They are able to deal with complex forestry problems, and where appropriate, they are capable of blending ecological, social, ethical, legal, and economic factors in the research process. They are very skilled at communicating, both in written and oral form, research results to professional and lay audiences. They are sensitive to cultural diversity and work effectively with peers, natural resource professionals, and the public.

The graduate program is open to, and suitable for, students who have majored in forestry or related natural resource fields. A non-thesis master's option is available.

The department participates in the Masters in Business Administration (M.B.A.), with specialization in the agriculture program administered by the College of Business, providing an opportunity to obtain an M.B.A. degree while taking advanced courses in forestry and maintaining contact with the profession of forestry.

Courses primarily for undergraduates:

AECL 2310: Principles of Wildlife & Fisheries Conservation

Credits: 3. Contact Hours: Lecture 3.

Prereq: BIOL 2110, BIOL 2120, and NREM 1200

Introduction to the principles of wildlife and fisheries management. Case studies will be explored along with assessment methods used to understand management including conservation of populations, species and communities, as well as habitat preservation and restoration. (Typically Offered: Spring)

AECL 3120: Ecology

(Cross-listed with BIOL 3120/ ENSCI 3120).

Credits: 4. Contact Hours: Lecture 3, Laboratory 3.

Prereq: BIOL 2110; (BIOL 2120 or BIOL 2510)

Fundamental concepts and principles of ecology dealing with organisms, populations, communities, and ecosystems. Laboratory and field exercises examine ecological principles and methods as well as illustrate habitats. (Typically Offered: Fall, Summer)

AECL 3210: Fish Biology

Credits: 3. Contact Hours: Lecture 2, Laboratory 3.

Prereq: AECL 3650

Biology, ecology, and evolution of fishes. Emphasis on structure, physiology, and behavior, including a focus on the conservation and management of fishes and their habitats. Laboratory focus on fish morphology, survey methods, identification, distribution, habits, and habitats of fishes. (Typically Offered: Spring)

AECL 3330: Fisheries Techniques

Credits: 2. Contact Hours: Lecture 1, Laboratory 3.

Prereq: BIOL 2120

Introduction to techniques used in the collection and interpretation of fish population data in the field and in the lab. Course objectives include an understanding of population survey methodology and improving student critical thinking and teamwork skills. Laboratory focuses on field trips and hands-on sampling experience. (Typically Offered: Fall)

AECL 3650: Vertebrate Biology

(Cross-listed with BIOL 3650).

Credits: 4. Contact Hours: Lecture 3, Laboratory 2.

Prereq: BIOL 2110 and BIOL 2110L

Evolution, biology, and classification of fish, amphibians, reptiles, birds, and mammals. Emphasis on a comparative analysis of the structure and function of organ systems. Laboratory exercises concentrate on morphology and identification of orders of vertebrates. (Typically Offered: Fall)

AECL 3660: Natural History of Iowa Vertebrates

Credits: 3. Contact Hours: Lecture 2, Laboratory 3.

Prereq: BIOL 2110 and BIOL 2110L

Vertebrate fauna of Iowa, including fishes, amphibians, reptiles, birds, and mammals. Species identification, habitat requirements, community structure and assessment, conservation issues that include historical population changes and value of wild animals to the region's ecological and economic health. (Typically Offered: Spring)

AECL 3710: Ecological Methods

(Cross-listed with BIOL 3710).

Credits: 3. Contact Hours: Lecture 2, Laboratory 3.

Prereq: AECL 3120; STAT 1010 or STAT 1040

Quantitative techniques used in management of natural resources with emphasis on inventory and manipulation of habitat and animal populations. (Typically Offered: Fall)

AECL 3720: Wildlife Population Methods

Credits: 4. Contact Hours: Lecture 1, Laboratory 8.

Prereq: BIOL 3120 or NREM 3110

Field-intensive study of population ecology. Emphasis on hands-on learning of study design and techniques to assess population trends in plants, invertebrates, and vertebrates inhabiting terrestrial and aquatic ecosystems. (Typically Offered: Summer)

AECL 3750: Marine Ecology and Ecosystems Dynamics

(Cross-listed with BIOL 3750/ ENSCI 3750).

Credits: 3. Contact Hours: Lecture 3.

Prereq: BIOL 2110

Overview of the ecological processes, ecosystems, and biodiversity in marine environments. Ever-changing dynamics caused by environmental disturbances, internal forces, or by human impacts on species and ecosystems. (Typically Offered: Spring)

AECL 4060: Wildlife Camp

Credits: 3. Contact Hours: Lecture 1, Laboratory 6.

Prereq: BIOL 2110 and *Permission of Instructor; restricted to Animal Ecology majors*

Introduction to methods and career options in wildlife research and management through field work. Two-week field work experience followed by on-campus reflection, analysis and presentation of field data. (Typically Offered: Fall)

AECL 4150: Ecology of Freshwater Invertebrates, Plants, and Algae

Credits: 3. Contact Hours: Lecture 2, Laboratory 3.

Prereq: AECL 3120

Identification, biology, and ecological requirements of freshwater invertebrates, plants and algae. Additional emphases on community sampling methods and analysis, and use of organisms as tools for aquatic ecosystem health assessment. (Typically Offered: Fall)

AECL 4180: Stream Ecology

(Cross-listed with ENSCI 4180).

Credits: 3. Contact Hours: Lecture 2, Laboratory 3.

Prereq: AECL 4860

Biological, chemical, physical, and geological processes that determine the structure and function of flowing water ecosystems. Current ecological theories as well as applications to stream management for water quality and fisheries. Offered odd-numbered years. (Typically Offered: Fall)

AECL 4250: Aquatic Insects

(Cross-listed with ENT 4250).

Credits: 3. Contact Hours: Lecture 2, Laboratory 3.

Prereq: BIOL 3120

Morphology, ecology, diversity, and significance of aquatic insects, with emphasis on the collection, curation and identification of taxa in local streams and lakes. Offered odd-numbered years. (Typically Offered: Spring)

AECL 4350: Entomology Field Trip

(Cross-listed with ENT 4350).

Credits: 2. Repeatable, maximum of 2 credits.

Prereq: BIOL 3120; *Permission of Instructor*

Field trip to study insects of major terrestrial and aquatic ecosystems. Location and duration vary. ENT 3700 or ENT 4250 recommended. Offered irregularly. (Typically Offered: Spring, Summer)

AECL 4400: Fishery Management

Credits: 3. Contact Hours: Lecture 2, Laboratory 3.

Prereq: AECL 3120, AECL 3210, AECL 3330; STAT 1010 or STAT 1040; *Credit or Enrollment in AECL 4860*

Biological basis of fishery management, fishery problems, and management practices for freshwater, anadromous, and marine fisheries. (Typically Offered: Fall)

AECL 4420: Aquaculture

Credits: 3. Contact Hours: Lecture 3.

Prereq: BIOL 2110 and BIOL 2120

Concepts related to the culture of aquatic organisms including culture systems, water quality, nutrition, genetics, diseases, and marketing. (Typically Offered: Spring)

AECL 4510: Wildlife Ecology and Management

Credits: 3. Contact Hours: Lecture 2, Laboratory 3.

Prereq: AECL 3710

Ecological theory and practice of wildlife management, including, population ecology, habitat management, and current issues in the field. Course involves a series of case studies addressing actual wildlife issues using field and quantitative methods. (Typically Offered: Spring)

AECL 4540: Principles of Wildlife Disease

Credits: 3. Contact Hours: Lecture 3.

Prereq: *Junior standing and at least 10 credits in biological sciences at the 3000+ level*

Ecological and epidemiological aspects of diseases as they relate to wildlife populations. Topics to be covered include: major classes of disease; detection, description, monitoring, and management of disease; characteristics and interactions between disease agents and wildlife hosts; relationships among wildlife, domestic animal, and human health. (Typically Offered: Spring)

AECL 4550: International Wildlife Issues

Credits: 3. Contact Hours: Lecture 3.

Prereq: AECL 3650, AECL 3120 or *Graduate classification and NREM 1200*

Biological, political, social, and economic factors affecting the management of international wildlife resources. Meets International Perspectives Requirement. (Typically Offered: Fall)

AECL 4570: Herpetology

(Cross-listed with BIOL 4570).

Credits: 2. Contact Hours: Lecture 2.

Prereq: BIOL 3510 or BIOL 3650

Biology, ecology, and evolution of amphibians (salamanders, frogs, caecilians) and reptiles (lizards, snakes, tuatara, turtles, crocodilians). Emphasis on structure, physiological adaptation to different environments, behavior, reproduction, roles of amphibians and reptiles in ecosystems, and conservation. Laboratory focus on survey methods, identification, relationships, distribution, habits, and habitats of amphibians and reptiles. (Typically Offered: Fall)

AECL 4570L: Herpetology Laboratory

(Cross-listed with BIOL 4570L).

Credits: 1. Contact Hours: Laboratory 3.

Prereq: BIOL 3510 or *BIOL 365* or AECL 3650; *enrollment in BIOL 4570 or AECL 4570*

Laboratory to accompany Biology/Animal Ecology 4570. Focus on survey methods, identification, relationships, distribution, habits, and habitats of amphibians and reptiles. (Typically Offered: Fall)

AECL 4580: Ornithology

(Cross-listed with BIOL 4580).

Credits: 2. Contact Hours: Lecture 2.

Prereq: BIOL 3510 or AECL 3650

Biology, evolution, ecology and taxonomy of birds. Emphasis on structure, physiology, behavior, communication, navigation, reproduction, and conservation. (Typically Offered: Spring)

AECL 4580L: Ornithology Laboratory

(Cross-listed with BIOL 4580L).

Credits: 1. Contact Hours: Laboratory 3.

Prereq: BIOL 3510 or AECL 3650/BIOL 3650 and *Credit or concurrent enrollment in AECL 4580/BIOL 4580*

Laboratory complements lecture topics with emphasis on external anatomy, identification and distribution of Midwest birds, and field trips. (Typically Offered: Spring)

AECL 4590: Mammalogy

(Dual-listed with EEOB 5590). (Cross-listed with BIOL 4590).

Credits: 2. Contact Hours: Lecture 2.

Prereq: AECL 3650 or BIOL 3510

Biology, ecology, and evolution of mammals. Emphasis on structure, physiological adaptation to different environments, behavior, reproduction, roles of mammals in ecosystems, and conservation. (Typically Offered: Spring)

AECL 4590L: Mammalogy Laboratory

(Cross-listed with BIOL 4590L).

Credits: 1. Contact Hours: Laboratory 3.

Prereq: *BIOL 3510 or BIOL/AECL 3650; concurrent enrollment in BIOL 4590 or AECL 4590 required*

Laboratory focus on identification, survey methods, distribution, habits, and habitats of mammals. Several field trips. (Typically Offered: Spring)

AECL 4710: Introductory Conservation Biology

(Cross-listed with BIOL 4710).

Credits: 3. Contact Hours: Lecture 3.

Prereq: BIOL 3120

Examination of conservation issues from a population and community perspective. The role of genetics, demography, and environment in determining population viability, habitat fragmentation, reserve design, biodiversity assessment, and restoration ecology. (Typically Offered: Spring)

AECL 4800: Studies in Marine Biology

Credits: 1-8. Contact Hours: Lecture 8.

Repeatable.

Courses taken at Gulf Coast Research Laboratory and other marine biological stations are transferred to Iowa State University under this number. (Typically Offered: Summer)

AECL 4860: Aquatic Ecology

(Cross-listed with BIOL 4860/ ENSCI 4860).

Credits: 3. Contact Hours: Lecture 3.

Prereq: BIOL 3120 or ENSCI 3190 or ENSCI 4020 or NREM 3010

Structure and function of aquatic ecosystems with application to fishery and pollution problems. Emphasis on lacustrine, riverine, and wetland ecology. (Typically Offered: Fall)

AECL 4860L: Aquatic Ecology Laboratory

(Cross-listed with BIOL 4860L/ ENSCI 4860L).

Credits: 1. Contact Hours: Laboratory 3.

Prereq: *Concurrent enrollment in BIOL 4860*

Field trips and laboratory exercises to accompany 4860. Hands-on experience with aquatic research and monitoring techniques and concepts. (Typically Offered: Fall)

AECL 4890: Population Ecology

(Dual-listed with AECL 5890/ EEOB 5890). (Cross-listed with BIOL 4890).

Credits: 3. Contact Hours: Lecture 2, Laboratory 2.

Prereq: BIOL 3120; (STAT 1010 or STAT 1040); (MATH 1510, 1600, 1650 or Graduate standing)

Concepts and theories of population dynamics with emphasis on models of growth, predation, competition, and regulation. Offered even-numbered years. (Typically Offered: Fall)

Courses primarily for graduate students, open to qualified undergraduates:

AECL 5150: Ecology of Freshwater Invertebrates, Plants, and Algae

Credits: 3. Contact Hours: Lecture 2, Laboratory 3.

Prereq: AECL 3120 or graduate standing

Identification, biology, and ecological requirements of freshwater invertebrates, plants and algae. Additional emphases on community sampling methods and analysis, and use of organisms as tools for aquatic ecosystem health assessment. (Typically Offered: Fall)

AECL 5160: Avian Ecology

Credits: 3. Contact Hours: Lecture 3.

Prereq: AECL 3650; AECL 3120; or graduate standing

Current topics and theories including avian breeding and foraging ecology, population biology, community structure, habitat selection, field methodologies, and data interpretation. Offered even-numbered years. (Typically Offered: Spring)

AECL 5180: Stream Ecology

(Cross-listed with ENSCI 5180).

Credits: 3. Contact Hours: Lecture 2, Laboratory 3.

Prereq: AECL 4860; or graduate standing

Biological, chemical, physical, and geological processes that determine the structure and function of flowing water ecosystems. Current ecological theories as well as applications to stream management for water quality and fisheries. Offered odd-numbered years. (Typically Offered: Fall)

AECL 5200: Fisheries Science

Credits: 3. Contact Hours: Lecture 3.

Prereq: AECL 3120; AECL 3210; or graduate standing

Concepts, approaches, and techniques for assessment of recreational and commercial fisheries. Scope will range from individual fish to entire ecosystems, both freshwater and marine. Offered odd-numbered years. (Typically Offered: Spring)

AECL 5250: Aquatic Insects

(Cross-listed with ENT 5250).

Credits: 3. Contact Hours: Lecture 2, Laboratory 3.

Prereq: BIOL 3120 or graduate standing

Morphology, ecology, diversity, and significance of aquatic insects, with emphasis on the collection, curation and identification of taxa in local streams and lakes. Offered odd-numbered years. (Typically Offered: Spring)

AECL 5310: Conservation Biology

(Cross-listed with EEOB 5310).

Credits: 3. Contact Hours: Lecture 3.

Prereq: BIOL 3120, BIOL 3130; or graduate standing

Examination of conservation issues from a population and a community perspective. Population-level analysis will focus on the role of genetics, demography, and environment in determining population viability. Community perspectives will focus on topics such as habitat fragmentation, reserve design, biodiversity assessment, and restoration ecology. Offered even-numbered years. (Typically Offered: Spring)

AECL 5400: Fishery Management

Credits: 3. Contact Hours: Lecture 2, Laboratory 3.

Prereq: AECL 3120; AECL 3210; AECL 3330; (STAT 1010 or STAT 1040); credit or enrollment in AECL 4860 or graduate standing

Biological basis of fishery management, fishery problems, and management practices for freshwater, anadromous, and marine fisheries. (Typically Offered: Fall)

AECL 5420: Aquaculture

Credits: 3. Contact Hours: Lecture 3.

Prereq: BIOL 2110; BIOL 2120 or graduate standing

Concepts related to the culture of aquatic organisms including culture systems, water quality, nutrition, genetics, diseases, and marketing. (Typically Offered: Spring)

AECL 5510: Behavioral Ecology

Credits: 3. Contact Hours: Lecture 2, Laboratory 2.

Prereq: (BIOL 3120 or NREM 3110 or BIOL 3540 or ANS 3360 or ANTHR 3170) or graduate classification

The study of how an animal's behavior affects its ability to survive and reproduce in its environment. Course topics, such as foraging behavior, sexual selection, parental care, etc., represent the interface of ecology, evolution, and behavior. Offered odd-numbered years. (Typically Offered: Fall)

AECL 5540: Principles of Wildlife Disease

Credits: 3. Contact Hours: Lecture 3.

Ecological and epidemiological aspects of diseases as they relate to wildlife populations. Topics to be covered include: major classes of disease; detection, description, monitoring, and management of disease; characteristics and interactions between disease agents and wildlife hosts; relationships among wildlife, domestic animal, and human health. (Typically Offered: Spring)

AECL 5860: Aquatic Ecology

(Cross-listed with EEOB 5860/ ENSCI 5860).

Credits: 3. Contact Hours: Lecture 3.

Prereq: BIOL 3120 or ENSCI 3810 or ENSCI 4020 or NREM 3010 or graduate classification

Structure and function of aquatic ecosystems with application to fishery and pollution problems. Emphasis on lacustrine, riverine, and wetland ecology. (Typically Offered: Fall)

AECL 5860L: Aquatic Ecology Laboratory

(Cross-listed with EEOB 5860L/ ENSCI 5860L).

Credits: 1. Contact Hours: Laboratory 3.

Prereq: Concurrent enrollment in BIOL 4860

Field trips and laboratory exercises to accompany 4860. Hands-on experience with aquatic research and monitoring techniques and concepts. (Typically Offered: Fall)

AECL 5890: Population Ecology

(Dual-listed with EEOB 4890/ AECL 4890). (Cross-listed with EEOB 5890).

Credits: 3. Contact Hours: Lecture 3.

Prereq: (BIOL 3120, STAT 1010 OR STAT 1040, MATH 1510 OR 1600 OR 1650) or graduate classification

Concepts and theories of population dynamics with emphasis on models of growth, predation, competition, and regulation. Offered even-numbered years. (Typically Offered: Fall)

AECL 5990: Creative Component

Credits: 1-30.

Prereq: Instructor Permission for Course

(Typically Offered: Fall, Spring, Summer)

Courses for graduate students:

AECL 6110: Analysis of Populations

Credits: 3. Contact Hours: Lecture 2, Laboratory 1.

Prereq: (BIOL 3120; STAT 5870; MATH 1510 or 1600 or 1650) or graduate classification

Quantitative techniques for analyzing vertebrate population data to estimate parameters such as density and survival. Emphasis on statistical inference and computing. Offered even-numbered years. (Typically Offered: Fall)

AECL 6980: Animal Ecology Teaching Practicum

Credits: 1-3. Repeatable.

Prereq: Instructor Permission for Course

Graduate student experience in the animal ecology teaching program. Offered on a satisfactory-fail basis only. (Typically Offered: Fall, Spring, Summer)

AECL 6990: Research

Credits: 1-30. Repeatable.

Prereq: Instructor Permission for Course

(Typically Offered: Fall, Spring, Summer)

Courses primarily for professional curriculum students:

AECL 7401: Intro to Aquatic Animal Medicine

(Dual-listed with AECL 4010). (Cross-listed with BMS 7401).

Credits: 1.

8-week course. Introductory course with focus on fin fish production, health and medicine. Course content will help define future roles for veterinarians, producers, and service providers. Emphasis will be placed on water-evaluation, anatomy, pathology, infectious diseases, nutrition, regulatory constraints in production, food safety, biosecurity and current research. Field trip to aquaculture facility. (Typically Offered: Spring)

Courses primarily for undergraduates:

FOR 2010: Forest Biology

Credits: 2. Contact Hours: Lecture 2.

Prereq: Concurrent enrollment in FOR 2020, FOR 2030, FOR 2040, FOR 2050, and FOR 2060

Discussion of ecological concepts, individual tree structure and growth, variation and diversity in tree populations. Physical environment of trees and forests, ecological processes in forest communities, and introduction to different regional forest communities. (Typically Offered: Fall)

FOR 2020: Sustainable Materials: Wood Utilization

Credits: 2. Contact Hours: Lecture 2.

Prereq: Concurrent enrollment in FOR 2010, FOR 2030, FOR 2040, FOR 2050, and FOR 2060

Basis for use of wood as an industrial raw material for lumber, composites, pulp and paper, energy and chemicals. Implications of use of alternative renewable and non-renewable materials for societal infrastructure and consumer goods. (Typically Offered: Fall)

FOR 2030: Resource Measurements/Evaluation

Credits: 2. Contact Hours: Lecture 2.

Prereq: Concurrent enrollment in FOR 2010, FOR 2020, FOR 2040, FOR 2050, and FOR 2060; MATH 1400

Survey techniques involved in quantification, valuation, and evaluation of tree and stand growth and other variables in the forest environment (e.g., recreational use, wildlife habitat value, biomass, and solid wood). (Typically Offered: Fall)

FOR 2040: Forest Ecosystem Decision-Making

Credits: 2. Contact Hours: Lecture 2.

Prereq: Concurrent enrollment in FOR 2010, FOR 2020, FOR 2030, FOR 2050, and FOR 2060

Methods of decision-making related to forest ecosystems including communications, teams and conflict resolution. Current issues relating to public, private, and urban forests; quantification of processes, services, and goods produced by the forest and expected by the public such as wildlife, water, range, recreation, wilderness, biodiversity, as well as wood and fiber products. (Typically Offered: Fall)

FOR 2050: Integrated Forestry Laboratory

Credits: 3. Contact Hours: Laboratory 8.

Prereq: Concurrent enrollment in FOR 2010, FOR 2020, FOR 2030, FOR 2040, and FOR 2060

Field and laboratory exercises integrating the evaluation and management of forest goods, services, and the processing of wood products. (Typically Offered: Fall)

FOR 2060: Fall Forestry Camp

Credits: 4.

Prereq: Concurrent enrollment in FOR 2010, FOR 2020, FOR 2030, FOR 2040, and FOR 2050

Three-week field camp to address topics and issues covered in 2010, 2020, 2030, 2040, and 2050. (Typically Offered: Fall)

FOR 2800: Wood Properties and Identification

Credits: 4. Contact Hours: Lecture 3, Laboratory 3.

Properties of wood and how they relate to its successful use. Comparative anatomical characteristics, scientific nomenclature, and hand lens identification of commercially important North American woods. (Typically Offered: Spring)

FOR 2830: Pesticide Application Certification

(Cross-listed with AGRON 2830/ ENT 2830/ HORT 2830).

Credits: 2. Contact Hours: Lecture 2.

Core background and specialty topics in agricultural, and horticultural pesticide applicator certification. Students can select certification categories and have the opportunity to obtain pesticide applicator certification at the completion of the course. Commercial pesticide applicator certification is emphasized. (Typically Offered: Spring)

FOR 2900A: Special Problems: Leadership in Forestry Teams (LIFT) Learning Community

Credits: 1-4. Repeatable.

Prereq: Freshman or Sophomore classification, permission of instructor

FOR 2900B: Special Problems: Forest Ecosystem Management

Credits: 1-4. Repeatable.

Prereq: Freshman or Sophomore classification, permission of instructor

FOR 2900C: Special Problems: Natural Resource Conservation

Credits: 1-4. Repeatable.

Prereq: Freshman or Sophomore classification, permission of instructor

FOR 2900D: Special Problems: Urban and Community Forestry

Credits: 1-4. Repeatable.

Prereq: Freshman or Sophomore classification, permission of instructor

FOR 2900E: Special Problems: Wood Science and Technology

Credits: 1-4. Repeatable.

Prereq: Freshman or Sophomore classification, permission of instructor

FOR 3020: Silviculture

Credits: 4. Contact Hours: Lecture 3, Laboratory 3.

Prereq: FOR 2010 or NREM 3010 or AECL 3120

Manipulation of forest vegetation based on ecological principles for the production of goods and services. (Typically Offered: Spring)

FOR 3560: Dendrology

(Cross-listed with BIOL 3560).

Credits: 3. Contact Hours: Lecture 2, Laboratory 2.

Prereq: BIOL 2110

Identification and ecology of North American woody plant species. Importance of woody plants in timber production and wildlife habitat. Historical conditions of North American forest regions will also be addressed. (Typically Offered: Fall)

FOR 3580: Forest Herbaceous Layer: Ecology and Identification.

Credits: 1.

Survey of the major plant families, general, and representative species of the forest herbaceous layer. Functional ecology and restoration. (Typically Offered: Spring)

FOR 4160: Forest Insects and Diseases

(Cross-listed with PLP 4160).

Credits: 3. Contact Hours: Lecture 2, Laboratory 2.

Nature of insects and pathogens of forest and shade trees; their role in the dynamics of natural and managed forest ecosystems; and the management of indigenous and exotic pests. Laboratory experience working with insect and fungal pests of trees. (Typically Offered: Fall)

FOR 4420: Dynamics of Forest Stands

(Dual-listed with FOR 5420).

Credits: 3. Contact Hours: Lecture 2, Laboratory 3.

Prereq: FOR 3020; NREM 3010; (STAT 1010 or STAT 1040)

Change in forest species composition and structure at the stand and landscape scales resulting from site quality, tree growth, competition, succession, and disturbance. Methods for assessing tree growth and reconstructing past stand development. Applications to forest and savanna management. Offered even-numbered years. (Typically Offered: Fall)

FOR 4510: Forest Resource Economics and Quantitative Methods

Credits: 4. Contact Hours: Lecture 3, Laboratory 3.

Prereq: FOR 2030

Application of economic principles to forest resource management considering both market and non-market goods and services. Methods of identifying and specifying problems in the management and use of forest resources. Application of mathematical and statistical models to the solution of managerial problems. (Typically Offered: Spring)

FOR 4520: Ecosystem Management: Integrating Ecology, Society, and Policy

(Dual-listed with FOR 5520/ NREM 5520). (Cross-listed with NREM 4520).

Credits: 3. Contact Hours: Lecture 2, Laboratory 3.

Prereq: Junior or Senior classification; (NREM 1200 or BIOL 1730)

Principles of planning, regulating, and decision-making associated with public and private lands, with consideration of forest, grassland, wetland, and freshwater aquatic ecosystems. Integrated natural resources management within ecological, social, economic and policy constraints. (Typically Offered: Spring)

FOR 4540: Forestry Practicum

Credits: 3. Contact Hours: Lecture 1, Laboratory 4.

Prereq: Senior classification

Integrated decision-making related to the conservation, management, and preservation of private and public forests, wildlands, urban/community forests, and/or the production and utilization of wood products. Student teams work with a client and develop management plans that incorporate ecological, social, economic, ethical, and institutional/political factors. Effective teamwork, written/oral/visual communication, and problem-solving stressed. Multiple trips to project site and client. (Typically Offered: Spring)

FOR 4750: Urban Forestry

(Cross-listed with HORT 4750).

Credits: 3. Contact Hours: Lecture 2, Laboratory 3.

Prereq: Junior or senior classification, 3 credits in BIOL

Discussion of establishment and management of woody perennials in community-owned urban greenspaces, consideration of urban site and soil characteristics, plant physiology, plant culture, urban forest valuation, inventory methods, species selection, and urban forest maintenance (health care and pest management). (Typically Offered: Fall)

Courses primarily for graduate students, open to qualified undergraduates:

FOR 5420: Dynamics of Forest Stands

(Dual-listed with FOR 4420).

Credits: 3. Contact Hours: Lecture 2, Laboratory 3.

Prereq: Graduate Standing or Permission of Instructor

Change in forest species composition and structure at the stand and landscape scales resulting from site quality, tree growth, competition, succession, and disturbance. Methods for assessing tree growth and reconstructing past stand development. Applications to forest and savanna management. Offered even-numbered years. (Typically Offered: Fall)

FOR 5520: Ecosystem Management

(Dual-listed with FOR 4520/ NREM 4520). (Cross-listed with NREM 5520).

Credits: 3. Contact Hours: Lecture 2, Laboratory 3.

Principles of planning, regulating, and decision-making associated with public and private lands, with consideration of forest, grassland, wetland, and freshwater aquatic ecosystems. Integrated natural resources management within ecological, social, economic and policy constraints. (Typically Offered: Spring)

FOR 5990A: Creative Component: Forest Biology

Credits: 1-12. Repeatable, maximum of 12 credits.

Prereq: Instructor Permission for Course

FOR 5990B: Creative Component: Forest Biometry

Credits: 1-12. Repeatable, maximum of 12 credits.

Prereq: Instructor Permission for Course

FOR 5990C: Creative Component: Forest and Recreation Economics

Credits: 1-12. Repeatable, maximum of 12 credits.

Prereq: Instructor Permission for Course

FOR 5990D: Creative Component: Forest Management and Administration

Credits: 1-12. Repeatable, maximum of 12 credits.

Prereq: Instructor Permission for Course

FOR 5990E: Creative Component: Wood Science

Credits: 1-12. Repeatable, maximum of 12 credits.

Courses for graduate students:**FOR 6960: Research Seminar**

(Cross-listed with AGRON 6960/ BBMB 6960/ PLBIO 6960/ GDCB 6960/ HORT 6960).

Credits: 1. Contact Hours: Lecture 1.

Repeatable.

Research seminars by faculty and graduate students. Offered on a satisfactory-fail basis only. (Typically Offered: Fall, Spring)

FOR 6990A: Research: Forest Biology - Wood Science

Credits: 1-12. Repeatable, maximum of 12 credits.

Prereq: Instructor Permission for Course

FOR 6990B: Research: Forest Biometry

Credits: 1-12. Repeatable, maximum of 12 credits.

Prereq: Instructor Permission for Course

FOR 6990C: Research: Forest Economics

Credits: 1-12. Repeatable, maximum of 12 credits.

Prereq: Instructor Permission for Course

FOR 6990D: Research: Forest Management and Administration

Credits: 1-12. Repeatable, maximum of 12 credits.

Prereq: Instructor Permission for Course

FOR 6990E: Research: Wood Science

Credits: 1-12. Repeatable, maximum of 12 credits.

FOR 6990F: Research: Plant Physiology

Credits: 1-12. Repeatable, maximum of 12 credits.

Prereq: Instructor Permission for Course

Courses primarily for undergraduates:**NREM 1040: Practical Work Experience**

Credits: Required.

Three months of relevant work experience in natural resources, animal ecology, or forestry. Study at a summer biological station may be applicable. See advisor for specific requirements and approval process.

NREM 1100: Orientation in Natural Resource Ecology and Management

Credits: 1. Contact Hours: Lecture 1.

Orientation to the University and to the Department of Natural Resource Ecology and Management. Discussion of departmental learning outcomes, strategies for academic success and academic planning. Offered on a satisfactory-fail basis only. (Typically Offered: Fall)

NREM 1110: NREM Transitions Learning Community Seminar

Credits: 1. Contact Hours: Lecture 1.

Repeatable.

Enrollment limited to members of the NREM Transitions Learning Community. Designed to assist new transfer students and continuing sophomore students with their transition to the academic expectations and professional development aspects of the natural resource program. Offered on a satisfactory-fail basis only. (Typically Offered: Fall, Spring)

NREM 1150: Explorations in Natural Resource Ecology & Management

Credits: 1. Contact Hours: Lecture 1.

Prereq: (Animal Ecology or Forestry major); Permission of Instructor

Interact with faculty in the Department of Natural Resource Ecology and Management through lectures, discussions, and field experiences. Offered during the second half of Spring semester. (Typically Offered: Spring)

NREM 1200: Introduction to Renewable Resources

(Cross-listed with AGRON 1200/ ENVS 1200).

Credits: 3. Contact Hours: Lecture 3.

Overview of soil, water, plants, and animals as renewable natural resources in an ecosystem context. History and organization of resource management. Concepts of integrated resource management. (Typically Offered: Fall, Spring)

NREM 1300: Natural Resources and Agriculture

(Cross-listed with ENVS 1300).

Credits: 3. Contact Hours: Lecture 3.

Survey of the ecology and management of fish, forest, and wildlife resources in areas of intensive agriculture, with emphasis on Iowa. Conservation and management practices for private agricultural lands. Designed for nonmajors. (Typically Offered: Spring)

NREM 2070: Natural Resource Management under the North American Model of Conservation

Credits: 1. Contact Hours: Lecture 1.

Introduction to North American model of conservation, current funding for natural resource management, role of hunting and angling in the North American model, critique and refinement of the model for the 21st century, and introduction to natural resource leadership, and outdoor skills and recreation. Offered on a satisfactory-fail basis only. (Typically Offered: Fall)

NREM 2110: Careers in Natural Resources

Credits: 1. Contact Hours: Lecture 1.

Prereq: Sophomore classification

Career planning exploration in natural resources. Discussion of the job application process, including techniques for successful interviewing and development of an effective resume. Offered on a satisfactory-fail basis only. (Typically Offered: Fall, Spring)

NREM 2400: Quantitative Problem Solving in Natural Resources

Credits: 3. Contact Hours: Lecture 2, Laboratory 2.

Prereq: (STAT 1010 or STAT 1040) or Permission of Instructor

Applied quantitative problem-solving skills for natural resource management. Focus on group and individual exercises, with practical problems in geography, hydrology, forestry and ecology. Laboratory includes field data collection and computer data processing and modeling. (Typically Offered: Spring)

NREM 2500: Environmental Geography

(Cross-listed with AGRON 2500/ ENVS 2500/ ENSCI 2500).

Credits: 3. Contact Hours: Lecture 3.

The distribution, origins and functions of the earth's physical systems and the spatial relationship between human activity and the natural world. (Typically Offered: Fall)

NREM 2700: Foundations in Natural Resource Policy and History

(Cross-listed with ENVS 2700/ LA 2700).

Credits: 3. Contact Hours: Lecture 3.

The development of natural resource conservation philosophy and policy from the Colonial Era to the present. North American wildlife, forestry, and environmental policy; national parks and other protected lands; federal and state agencies. Relationship to cultural contexts, including urban reform and American planning movement. Discussion of common pool resources, public and private lands. (Typically Offered: Fall)

NREM 3010: Natural Resource Ecology and Soils

(Cross-listed with ENSCI 3010).

Credits: 4. Contact Hours: Lecture 3, Laboratory 3.

Prereq: BIOL 2110, BIOL 2110L; FOR 2010 or a second course in biology
Effects of environmental factors on ecosystem structure and function using forest, prairie and agricultural ecosystems as models. Special emphasis is given to soil-forming factors and the role of soil in nutrient and water cycling and ecosystem dynamics. Additional emphasis is given to human influences on natural ecosystems and the role of perennial plant communities in agricultural landscapes. (Typically Offered: Fall)

NREM 3030: Internship

Credits: 1-3. Repeatable, maximum of 6 credits.

Prereq: Permission of Instructor; Sophomore classification

Placement with county conservation boards, camps, zoos, parks, etc., for experience as interpreters, rangers, and technicians. (Typically Offered: Fall, Spring, Summer)

NREM 3050: Seminar

Credits: 1-3. Contact Hours: Lecture 3.

Repeatable.

Current topics in natural resources or related issues. (Typically Offered: Fall, Spring)

NREM 3110: Field Ecology in Montana

Credits: 4. Contact Hours: Lecture 2, Laboratory 6.

Prereq: (BIOL 2110; BIOL 2110L; BIOL 2120; BIOL 2120L); Permission of Instructor

Fundamental concepts and principles of ecology dealing with organisms, populations, communities, and ecosystems. Taught at NREM's Rod and Connie French Conservation Education Camp in western Montana. Emphasizes hands-on learning of principles and methods in the field. (Typically Offered: Summer)

NREM 3130: Native Land, Water, and Resources

(Cross-listed with AMIN 3130).

Credits: 3. Contact Hours: Lecture 3.

Examines Native land rights, water rights, and natural resources. Topics may include Native relations to landscapes, cultural resources and infrastructure projects, land rights, water usage agreements, and resource policies as they apply to on- and off-reservation Native communities. AMIN 2100 recommended. Offered even-numbered years. Meets U.S. Diversity Requirement. (Typically Offered: Spring)

NREM 3150: Genetics for Natural Resource Managers

Credits: 3. Contact Hours: Lecture 3.

Prereq: BIOL 2110 and BIOL 2120

Introduction into how genetic techniques and technologies can aid the management of the earth's biotic resources. Topics include an overview of DNA structure, function and inheritance; tools and techniques for measuring genetic diversity; genetic management of wild and captive populations: DNA forensics as management tool. The goal of this course is to prepare managers/biologists to interpret genetic data as they relate to natural resource conservation. (Typically Offered: Fall)

NREM 3180: Introduction to Ecosystems

(Cross-listed with AGRON 3180/ BIOL 3180/ ENSCI 3180).

Credits: 3. Contact Hours: Lecture 3.

Prereq: 12 credits in AECL, AGRON, BIOL, CHEM, FOR, GEOL, NREM

Biological and physical processes affecting material and energy flows in natural and managed ecosystems. Understanding and predicting climate and management impacts on ecosystem services and sustainability. (Typically Offered: Spring)

NREM 3300: Principles of Interpretation

Credits: 3. Contact Hours: Lecture 2, Laboratory 3.

Prereq: 6 credits in BIOL

History, objectives, forms, and techniques of interpretation in the settings of county, state, national parks, and zoos. Principles of effective communication as they apply to natural resource fields including wildlife management, forestry, and wildlife rehabilitation. Planning and use of effective communications and outreach campaigns to manage and conserve natural resources. (Typically Offered: Spring)

NREM 3450: Natural Resource Photogrammetry and Geographic Information Systems

(Cross-listed with ENSCI 3450).

Credits: 3. Contact Hours: Lecture 2, Laboratory 3.

Prereq: Junior classification

Measurement and interpretation of aerial photos in resource management. Introduction to Geographic Information Systems (GIS) using ArcGIS including digitizing, development and query of attribute tables, georeferencing, and use of multiple GIS layers in simple spatial analyses. (Typically Offered: Spring)

NREM 3570: Midwestern Prairie Plants

Credits: 1.

Offered 1st half semester only. Survey of the major plant families, genera, and representative species of Midwestern prairies with emphasis on plant identification. Prairie management for multiple species of plants and wildlife. (Typically Offered: Fall)

NREM 3750X: Environmentalism in Music

Credits: 1. Contact Hours: Lecture 1.

Environmentalism (environmental or ecological activism) is a common topic in popular music. In this seminar, students choose recorded music with an environmental or ecological theme, present their piece to the class, and lead a discussion focused on interpreting lyrics and sound. Through analysis of music from diverse eras, genres, and cultures, students learn about historical events, evaluate attitudes and actions regarding natural resource stewardship and biodiversity preservation, and explore concepts of environmental justice and human dependence on healthy ecosystems for physical and emotional well-being. (Typically Offered: Spring)

NREM 3800: Field Ecology Research and Teaching

Credits: 3. Contact Hours: Lecture 2, Laboratory 3.

Prereq: BIOL 2110 or Department Permission

Students work in teams to conduct ecological research projects at a local field site, and develop related teaching modules/lesson plans. Research and teaching activity objectives, methods, and results are shared with diverse audiences as presentations, written reports, and web-based documents, and used to engage K-12 students and community members via field days and visits to schools and other institutions. (Typically Offered: Fall)

NREM 3850: Natural Resource Policy

(Dual-listed with NREM 5850).

Credits: 3. Contact Hours: Lecture 3.

Development, theory and practice of natural resource policy. Integrative approach with topical policy studies in North American wildlife, forestry, and water. Policy formation, the role of science, introduction to federal law compliance. (Typically Offered: Spring)

NREM 3900: Fire Ecology and Management

Credits: 3. Contact Hours: Lecture 3.

Characteristics and role of fire in forest ecosystems. Major topics covered include fuels, fire weather, fire behavior, fire danger rating systems, fire control, prescribed burning, and fire dynamics in major ecosystem types. (Typically Offered: Fall)

NREM 4020: Watershed Hydrology

(Dual-listed with GEOL 5020/ ENSCI 5020/ MTEOR 5020/ NREM 5020).

(Cross-listed with ENSCI 4020/ MTEOR 4020/ GEOL 4020).

Credits: 3. Contact Hours: Lecture 2, Laboratory 3.

Examination of watersheds as systems, emphasizing the surface components of the hydrologic cycle. Combines qualitative understanding of hydrological processes and uncertainty with quantitative representation. Laboratory emphasizes field investigation and measurement of watershed processes. (Typically Offered: Fall)

NREM 4070: Watershed Management

(Cross-listed with ENSCI 4070/ ENVS 4070).

Credits: 4. Contact Hours: Lecture 3, Laboratory 3.

Prereq: 1 course in BIOL

Managing human impacts on the hydrologic cycle. Field and watershed level best management practices for modifying the impacts on water quality, quantity and timing are discussed. Field project includes developing a management plan using landscape buffers. (Typically Offered: Spring)

NREM 4460: Integrating GPS and GIS for Natural Resource Management

(Dual-listed with NREM 5460/ ENSCI 5460). (Cross-listed with ENSCI 4460).

Credits: 3. Contact Hours: Lecture 2, Laboratory 3.

Prereq: 12 credits in student's major (AECL/FOR) at 3000 level or above

Emphasis on the use of GPS as a data collection tool for GIS. Basic theory of GPS. Use of Global Positioning System technology for spatial data collection and navigation. Post-processing and real-time correction of GPS data. GPS data transfer to GIS for mapping applications. Use of GIS to construct waypoints for use in GPS navigation. (Typically Offered: Fall)

NREM 4520: Ecosystem Management: Integrating Ecology, Society, and Policy

(Dual-listed with FOR 5520/ NREM 5520). (Cross-listed with FOR 4520).

Credits: 3. Contact Hours: Lecture 2, Laboratory 3.

Prereq: Junior or Senior classification; (NREM 1200 or BIOL 1730)

Principles of planning, regulating, and decision-making associated with public and private lands, with consideration of forest, grassland, wetland, and freshwater aquatic ecosystems. Integrated natural resources management within ecological, social, economic and policy constraints. (Typically Offered: Spring)

NREM 4550: Stream restoration

(Dual-listed with NREM 5550).

Credits: 2. Contact Hours: Lecture 2.

Prereq: CE 3720 or GEOL 4020 or NREM 4070 or AECL 4180 or ABE 4310
interdisciplinary introduction to the science and practice of stream restoration, with emphasis on restoring physical and biological integrity and ecosystem services to streams and riparian corridors. Lecture highlights philosophical, scientific, and engineering principles. Offered odd-numbered years. (Typically Offered: Fall)

NREM 4550L: Stream Restoration Lab

(Dual-listed with NREM 5550L).

Credits: 1. Contact Hours: Laboratory 3.

Prereq: CE 3720 or GEOL 4020 or NREM 4070 or AECL 4180 or ABE 4310
Introduction to measurement and analysis of stream form and function for restoration and rehabilitation. Includes field data collection, map and image analysis, and computation for assessment of channel stability, biotic integrity, and recovery potential. Offered odd-numbered years. (Typically Offered: Fall)

NREM 4600: Controversies in Natural Resource Management

(Cross-listed with ENVS 4600).

Credits: 3. Contact Hours: Lecture 3.

Prereq: AECL 3120 or NREM 3010, NREM 1200, and Junior classification
Analysis of controversial natural resource issues using a case approach that considers uncertainty and adequacy of information and scientific understanding. Ecological, social, political, economic, and ethical implications of issues will be analyzed. (Typically Offered: Fall, Spring)

NREM 4660: Ecosystem Services

(Dual-listed with ENSCI 5660/ NREM 5660). (Cross-listed with ENSCI 4660).

Credits: 3. Contact Hours: Lecture 2, Discussion 1.

Prereq: 15 credits in AECL, AGRON, BIOL, CHEM, FOR, GEOL, NREM
Ecosystem services are the societal benefits provided by natural and managed ecosystems. Benefits such as provision of food, purification of air and water, and regulation of climate are essential to human survival and prosperity, but rely upon maintenance of healthy ecosystems. This course will cover the science, policy, and practice of ecosystem services assessment and management, with a special focus on biodiversity, water quality, food production, and climate. Offered odd-numbered years. (Typically Offered: Spring)

NREM 4710: Agroforestry Systems

(Dual-listed with NREM 5710/ SUSAG 5710).

Credits: 3. Contact Hours: Lecture 3.

Prereq: 6 credits in biological science at 3000 level or above
Concepts of sustainable land use, agroecological dynamics, and component interactions of agroforestry systems. Agroforestry systems in temperate and tropical regions. Design and evaluation techniques for agroforestry systems. Ecological, socioeconomic and political aspects of agroforestry. Offered even-numbered years. Meets International Perspectives Requirement. (Typically Offered: Spring)

NREM 4830: Science + Design: Interpretation of Natural Resources in Montana

(Cross-listed with ARTGR 4830).

Credits: 3. Contact Hours: Lecture 1, Studio 4.

Prereq: Enrollment in ARTGR major; ARTGR 2710 or BIOL 2110; Permission of Instructor.

Interdisciplinary service-learning. Design and production of natural resource related interpretive signs for Montana natural areas. Field-work experience followed by on-campus studio. (Typically Offered: Fall)

NREM 4850: Undergraduate Seminar

Credits: 1. Contact Hours: Lecture 1.

Repeatable, maximum of 2 times.

Prereq: Major in Animal Ecology or Forestry; Junior or Senior classification; Permission of Instructor

Weekly seminars on current research topics in natural resource ecology and management. Style and best practice in oral research communication. Skills and principles for evaluating research merit and quality of technical communication. Offered on a satisfactory-fail basis only. (Typically Offered: Spring)

NREM 4890: Survey of Remote Sensing Technologies

(Cross-listed with EE 4890/ ENSCI 4890/ GEOL 4890/ MTEOR 4890).

Credits: 3. Contact Hours: Lecture 3.

Electromagnetic-radiation principles, active and passive sensors, multispectral and hyperspectral sensors, imaging radar, SAR, thermal imaging, lidar. Examples of applications. Also offered online S. (Typically Offered: Fall)

NREM 4890L: Satellite Remote Sensing Laboratory

(Cross-listed with EE 4890L/ GEOL 4890L/ MTEOR 4890L).

Credits: 1. Contact Hours: Laboratory 3.

Prereq: Completion or concurrent enrollment in MTEOR/GEOL/ NREM/EE 4890/5890

Processing and analysis of satellite sensor data (optical and radar). Provides practical applications in an environmental context. (Typically Offered: Fall)

NREM 4900A: Independent Study: Animal Ecology

Credits: 1-4. Repeatable, maximum of 4 credits.

Prereq: Restricted to Junior or Senior classifications, Instructor permission required

NREM 4900B: Independent Study: Forestry

Credits: 1-4. Repeatable, maximum of 4 credits.

Prereq: Restricted to Junior or Senior classifications, Instructor permission required

NREM 4900E: Independent Study: Entrepreneurship

Credits: 1-4. Repeatable, maximum of 4 credits.

Prereq: Restricted to Junior or Senior classifications, Instructor permission required

NREM 4900H: Independent Study: Honors Program

Credits: 1-4. Repeatable, maximum of 4 credits.

Prereq: Restricted to Junior or Senior classifications, Instructor permission required

NREM 4960A: Travel Course: International

(Dual-listed with NREM 5960A).

Credits: 1-5. Repeatable, maximum of 3 times.

Prereq: Instructor Permission for Course

Limited enrollment. Extended field trips to study ecological and management topics in varied environments. Location and duration of trips will vary. Pre-trip sessions arranged. Trip expenses paid by students. Meets International Perspectives Requirement.

NREM 4960B: Travel Course: Domestic

(Dual-listed with NREM 5960B).

Credits: 1-5. Repeatable, maximum of 3 times.

Prereq: Instructor Permission for Course

Limited enrollment. Extended field trips to study ecological and management topics in varied environments. Location and duration of trips will vary. Pre-trip sessions arranged. Trip expenses paid by students.

NREM 4980: Cooperative Education

Credits: 1-3. Repeatable.

Prereq: Department Chair Permission for Course

Required of all cooperative education students. Students must register prior to commencing each work period. Offered on a satisfactory-fail basis only. (Typically Offered: Fall, Spring, Summer)

Courses primarily for graduate students, open to qualified undergraduates:

NREM 5020: Watershed Hydrology

(Dual-listed with GEOL 4020/ ENSCI 4020/ MTEOR 4020/ NREM 4020).

(Cross-listed with ENSCI 5020/ MTEOR 5020/ GEOL 5020).

Credits: 3. Contact Hours: Lecture 2, Laboratory 3.

Examination of watersheds as systems, emphasizing the surface components of the hydrologic cycle. Combines qualitative understanding of hydrological processes and uncertainty with quantitative representation. Laboratory emphasizes field investigation and measurement of watershed processes. (Typically Offered: Fall)

NREM 5040: Forest Landscapes, Wildlife, and Silviculture

Credits: 3. Contact Hours: Lecture 2, Laboratory 3.

Desired forest habitat conditions for fish and wildlife. Silvicultural approaches to protecting/improving such habitats. Focus on key forest elements related to animal species, groups and overall diversity. The lab focuses on team observations and discussions of diverse habitats including one weekend field trip. Offered odd-numbered years. (Typically Offered: Fall)

NREM 5050: Seminar

Credits: 1-3. Contact Hours: Lecture 3.

Repeatable, maximum of 3 times.

Current topics in natural resources research and management. (Typically Offered: Fall, Spring)

NREM 5070: Watershed Management

(Cross-listed with ENSCI 5070).

Credits: 4. Contact Hours: Lecture 3, Laboratory 3.

Managing human impacts on the hydrologic cycle. Field and watershed level best management practices for modifying the impacts on water quality, quantity and timing are discussed. Field project includes developing a management plan using landscape buffers. (Typically Offered: Spring)

NREM 5330: Erosion and Sediment Transport

(Cross-listed with ABE 5330/ ENSCI 5330).

Credits: 3. Contact Hours: Lecture 2, Laboratory 3.

Soil erosion processes, soil loss equations and their application to conservation planning, sediment properties, initiation of sediment motion and over land flow, flow in alluvial channels and theory of sediment transport, channel stability, reservoir sedimentation, wind erosion, BMPs for controlling erosion. Offered even-numbered years. (Typically Offered: Fall)

NREM 5350: Restoration Ecology

(Cross-listed with EEOB 5350/ ENSCI 5350).

Credits: 3. Contact Hours: Lecture 2, Laboratory 3.

Theory and practice of restoring animal and plant diversity, structure and function of disturbed ecosystems. Restored freshwater wetlands, forests, prairies and reintroduced species populations will be used as case studies. Offered even-numbered years. (Typically Offered: Fall)

NREM 5420A: Introduction to Molecular Biology Techniques: DNA Techniques

(Cross-listed with BMS 5420A/ EEOB 5420A/ FSHN 5420A/ GDCB 5420A/ HORT 5420A/ BBMB 5420A/ NUTRS 5420A/ VDPAM 5420A/ VMPM 5420A).

Credits: 1. Contact Hours: Lecture 0.5, Laboratory 1.

Repeatable.

Includes genetic engineering procedures, sequencing, PCR, and genotyping. Offered on a satisfactory-fail basis only. (Typically Offered: Fall, Spring)

NREM 5420B: Introduction to Molecular Biology Techniques: Protein

(Cross-listed with BMS 5420B/ EEOB 5420B/ FSHN 5420B/ GDCB 5420B/ HORT 5420B/ BBMB 5420B/ NUTRS 5420B/ VDPAM 5420B).

Credits: 1. Contact Hours: Lecture 0.5, Laboratory 1.

Repeatable.

Includes: immunophenotyping, ELISA, flow cytometry, microscopic techniques, image analysis, confocal, multiphoton and laser capture microdissection. Offered on a satisfactory-fail basis only. (Typically Offered: Spring, Summer)

NREM 5420C: Introduction to Molecular Biology Techniques: Cell Techniques

(Cross-listed with BMS 5420C/ EEOB 5420C/ FSHN 5420C/ GDCB 5420C/ HORT 5420C/ BBMB 5420C/ NUTRS 5420C/ VMPM 5420C/ VDPAM 5420C).

Credits: 1. Contact Hours: Laboratory 2.

Repeatable.

Includes: immunophenotyping, ELISA, flow cytometry, microscopic techniques, image analysis, confocal, multiphoton and laser capture microdissection. ular biology techniques and related procedures. Offered on a satisfactory-fail basis only. (Typically Offered: Fall, Spring)

NREM 5420D: Introduction to Molecular Biology Techniques: Plant Transformation

(Cross-listed with BMS 5420D/ EEOB 5420D/ FSHN 5420D/ GDCB 5420D/ HORT 5420D/ BBMB 5420D/ NUTRS 5420D/ VMPM 5420D/ VDPAM 5420D).

Credits: 1. Contact Hours: Lecture 0.5, Laboratory 1.

Repeatable.

Includes: Agrobacterium and particle gun-mediated transformation of tobacco, Arabidopsis, and maize, and analysis of transformants. Offered on a satisfactory-fail basis only. (Typically Offered: Spring)

NREM 5420E: Introduction to Molecular Biology Techniques: Proteomics

(Cross-listed with BMS 5420E/ EEOB 5420E/ FSHN 5420E/ GDCB 5420E/ HORT 5420E/ BBMB 5420E/ NUTRS 5420E/ VMPM 5420E/ VDPAM 5420E).

Credits: 1. Contact Hours: Lecture 0.5, Laboratory 1.

Repeatable.

Includes: two-dimensional electrophoresis, laser scanning, mass spectrometry, and database searching. Offered on a satisfactory-fail basis only. (Typically Offered: Fall)

NREM 5420F: Introduction to Molecular Biology Techniques: Metabolomics

(Cross-listed with BMS 5420F/ EEOB 5420F/ FSHN 5420F/ GDCB 5420F/ HORT 5420F/ BBMB 5420F/ NUTRS 5420F/ VMPM 5420F/ VDPAM 5420F).

Credits: 1. Contact Hours: Lecture 0.5, Laboratory 1.

Repeatable.

Includes: metabolomics and the techniques involved in metabolite profiling. For non-chemistry majoring students who are seeking analytical aspects into their biological research projects. Offered on a satisfactory-fail basis only. (Typically Offered: Fall)

NREM 5420G: Introduction to Molecular Biology Techniques: Genomic

(Cross-listed with BMS 5420G/ EEOB 5420G/ FSHN 5420G/ GDCB 5420G/ HORT 5420G/ BBMB 5420G/ NUTRS 5420G/ VMPM 5420G/ VDPAM 5420G).

Credits: 1. Contact Hours: Lecture 0.5, Laboratory 1.

Repeatable.

Sessions in basic molecular biology techniques and related procedures. Offered on a satisfactory-fail basis only. (Typically Offered: Spring)

NREM 5460: Integrating GPS and GIS for Natural Resource Management

(Dual-listed with NREM 4460/ ENSCI 4460). (Cross-listed with ENSCI 5460).

Credits: 3. Contact Hours: Lecture 2, Laboratory 3.

Emphasis on the use of GPS as a data collection tool for GIS. Basic theory of GPS. Use of Global Positioning System technology for spatial data collection and navigation. Post-processing and real-time correction of GPS data. GPS data transfer to GIS for mapping applications. Use of GIS to construct waypoints for use in GPS navigation. (Typically Offered: Fall)

NREM 5520: Ecosystem Management

(Dual-listed with FOR 4520/ NREM 4520). (Cross-listed with FOR 5520).

Credits: 3. Contact Hours: Lecture 2, Laboratory 3.

Principles of planning, regulating, and decision-making associated with public and private lands, with consideration of forest, grassland, wetland, and freshwater aquatic ecosystems. Integrated natural resources management within ecological, social, economic and policy constraints. (Typically Offered: Spring)

NREM 5550: Stream Restoration

(Dual-listed with NREM 4550).

Credits: 2. Contact Hours: Lecture 2.

interdisciplinary introduction to the science and practice of stream restoration, with emphasis on restoring physical and biological integrity and ecosystem services to streams and riparian corridors. Lecture highlights philosophical, scientific, and engineering principles. Offered odd-numbered years. (Typically Offered: Fall)

NREM 5550L: Stream Restoration Lab

(Dual-listed with NREM 4550L).

Credits: 1. Contact Hours: Laboratory 3.

Introduction to measurement and analysis of stream form and function for restoration and rehabilitation. Includes field data collection, map and image analysis, and computation for assessment of channel stability, biotic integrity, and recovery potential. Offered odd-numbered years. (Typically Offered: Fall)

NREM 5660: Ecosystem Services

(Dual-listed with ENSCI 4660/ NREM 4660). (Cross-listed with ENSCI 5660).

Credits: 3. Contact Hours: Lecture 2, Discussion 1.

Ecosystem services are the societal benefits provided by natural and managed ecosystems. Benefits such as provision of food, purification of air and water, and regulation of climate are essential to human survival and prosperity, but rely upon maintenance of healthy ecosystems. This course will cover the science, policy, and practice of ecosystem services assessment and management, with a special focus on biodiversity, water quality, food production, and climate. Offered odd-numbered years. (Typically Offered: Spring)

NREM 5700: Advanced Decision-making in Natural Resource Allocation

Credits: 3. Contact Hours: Lecture 2, Laboratory 2.

Analytical approach to economic aspects of forest resource management problems. Theory and application of economic decision-making criteria to traditional and modern forest resource management issues. Current problems in the allocation of forest resources. Offered even-numbered years. (Typically Offered: Spring)

NREM 5710: Agroforestry Systems

(Dual-listed with NREM 4710/ SUSAG 4710). (Cross-listed with SUSAG 5710).

Credits: 3. Contact Hours: Lecture 3.

Concepts of sustainable land use, agroecological dynamics, and component interactions of agroforestry systems. Agroforestry systems in temperate and tropical regions. Design and evaluation techniques for agroforestry systems. Ecological, socioeconomic and political aspects of agroforestry. Offered even-numbered years. Meets International Perspectives Requirement. (Typically Offered: Spring)

NREM 5830: Science + Design: Interpretation of Natural Resources in Montana

(Cross-listed with ARTGR 5830).

Credits: 3. Contact Hours: Lecture 1, Studio 4.

Interdisciplinary service-learning. Design and production of natural resource related interpretive signs for Montana natural areas. Field-work experience followed by on-campus studio. (Typically Offered: Fall)

NREM 5850: Natural Resource Policy

(Dual-listed with NREM 3850).

Credits: 3. Contact Hours: Lecture 3.

Development, theory and practice of natural resource policy. Integrative approach with topical policy studies in North American wildlife, forestry, and water. Policy formation, the role of science, introduction to federal law compliance. (Typically Offered: Spring)

NREM 5890: Survey of Remote Sensing Technologies

(Cross-listed with EE 5890/ ENSCI 5890/ GEOL 5890/ MTEOR 5890).

Credits: 3. Contact Hours: Lecture 3.

Electromagnetic-radiation principles, active and passive sensors, multispectral and hyperspectral sensors, imaging radar, SAR, thermal imaging, lidar. Examples of applications. Also offered online S. (Typically Offered: Fall)

NREM 5890L: Satellite Remote Sensing Laboratory

(Cross-listed with EE 5890L/ GEOL 5890L/ MTEOR 5890L).

Credits: Required. Contact Hours: Laboratory 3.

Processing and analysis of satellite sensor data (optical and radar). Provides practical applications in an environmental context. (Typically Offered: Fall)

NREM 5900A: Special Topics: Animal Ecology

Credits: 1-4. Repeatable, maximum of 4 credits.

Prereq: Instructor Permission for Course

NREM 5900B: Special Topics: Forestry

Credits: 1-4. Repeatable, maximum of 4 credits.

Prereq: Instructor Permission for Course

NREM 5930: Workshop

Credits: 1-3. Repeatable.

NREM 5960A: Travel Course: International

(Dual-listed with NREM 4960A).

Credits: 1-5. Repeatable, maximum of 3 times.

Limited enrollment. Extended field trips to study ecological and management topics in varied environments. Location and duration of trips will vary. Pre-trip sessions arranged. Trip expenses paid by students.

NREM 5960B: Travel Course: Domestic

(Dual-listed with NREM 4960B).

Credits: 1-5. Repeatable, maximum of 3 times.

Limited enrollment. Extended field trips to study ecological and management topics in varied environments. Location and duration of trips will vary. Pre-trip sessions arranged. Trip expenses paid by students.

NREM 5980: Natural Resource Ecology and Management Teaching Practicum

Credits: 1.

Prereq: Graduate classification and Permission of Instructor

Graduate student experience in teaching. Student must plan and present at least one unit of subject matter in a course or extension workshop.

Teaching practicum must be documented by the student and approved by the student's POS committee. Offered on a satisfactory-fail basis only. (Typically Offered: Fall, Spring, Summer)

NREM 5990: Creative Component

Credits: 1-30. Repeatable.

Courses for graduate students:

NREM 6000: Seminar

Credits: 1. Contact Hours: Lecture 1.

Repeatable.

Current topics in natural resources research and management. (Typically Offered: Fall, Spring)

NREM 6980: Natural Resource Ecology and Management Teaching Practicum

Credits: 1.

Prereq: Graduate classification and Permission of Instructor

Graduate student experience in teaching. Student must plan and present substantive subject matter for a minimum of three weeks in lecture and/or laboratory formats, or a series of extension seminars/workshops.

Teaching practicum must be documented by the student and approved by the student's POS committee. Offered on a satisfactory-fail basis only. (Typically Offered: Fall, Spring)

NREM 6990: Research

Credits: 1-12. Repeatable, maximum of 12 credits.