

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/previouscatalogs/2020-2021/collegeofagricultureandlifesciences/animal_ecology/) or forestry (<http://catalog.iastate.edu/previouscatalogs/2020-2021/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 biorenewable resources technology, ecology and evolutionary biology, environmental science, genetics, plant physiology, sustainable agriculture, or toxicology (see Index (<http://catalog.iastate.edu/previouscatalogs/2020-2021/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:

A ECL 231: Principles of Wildlife & Fisheries Conservation

Cr. 3. S.

Prereq: BIOL 211, BIOL 212, NREM 120

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.

A ECL 312: Ecology

(Cross-listed with BIOL, ENSCI). (3-3) Cr. 4. F.SS.

Prereq: BIOL 211, BIOL 211L, BIOL 212, and BIOL 212L

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.

A ECL 312I: Ecology

(Cross-listed with ENSCI, IA LL). Cr. 4. SS.

An introduction to the principles of ecology at the population, community and ecosystem level. Field studies of local lakes, wetlands and prairies are used to examine factors controlling distributions, interactions, and roles of plants and animals in native ecosystems.

A ECL 321: Fish Biology

(2-3) Cr. 3. S.

Prereq: A ECL 365

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.

A ECL 326I: Ornithology

(Cross-listed with IA LL). Cr. 2. SS.

The biology, ecology, and behavior of birds with emphasis on field studies of local avifauna. Group projects stress techniques of population analysis and methodology for population studies.

A ECL 333: Fisheries Techniques

(Cross-listed with NREM). (1-3) Cr. 2. F.

Prereq: BIOL 212

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.

A ECL 365: Vertebrate Biology

(Cross-listed with BIOL). (3-2) Cr. 4. F.

Prereq: BIOL 211, BIOL 211L, BIOL 212, BIOL 212L

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.

A ECL 366: Natural History of Iowa Vertebrates

(2-3) Cr. 3. S.

Prereq: BIOL 211, BIOL 211L, BIOL 212, BIOL 212L

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.

A ECL 371: Ecological Methods

(Cross-listed with BIOL). (2-3) Cr. 3. F.

Prereq: A ECL 312; STAT 101 or STAT 104

Quantitative techniques used in management of natural resources with emphasis on inventory and manipulation of habitat and animal populations.

A ECL 401: Intro to Aquatic Animal Medicine

(Cross-listed with B M S). (1-2) Cr. 1. S.

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.

A ECL 404I: Behavioral Ecology

(Cross-listed with IA LL). Cr. 4. Alt. SS., offered even-numbered years.

Prereq: Two semesters of biology

Animal coloniality, courtship, territoriality, predator defense, habitat selection, foraging, mating systems, and parental care will be examined in the field in order to evaluate various ecological and evolutionary theories of animal behavior.

A ECL 415: Ecology of Freshwater Invertebrates, Plants, and Algae

(Dual-listed with A ECL 515). (2-3) Cr. 3. Alt. F., offered even-numbered years.

Prereq: A ECL 312

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.

A ECL 418: Stream Ecology

(Dual-listed with A ECL 518). (Cross-listed with ENSCI). (2-3) Cr. 3. Alt. F., offered odd-numbered years.

Prereq: A ECL 486

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.

A ECL 419I: Vertebrate Ecology and Evolution

(Cross-listed with IA LL). Cr. 4. SS.

Field and laboratory study of representative vertebrates of northwestern Iowa. Observations and experimentation emphasize ecological histories by integrating concepts of functional morphology, behavioral ecology, and evolutionary biology.

A ECL 420I: Amphibians and Reptiles

(Cross-listed with IA LL). Cr. 2. Alt. SS., offered even-numbered years.

Prereq: Two semesters of biology

Ecology, behavior, and conservation biology of amphibians and reptiles with emphasis on their anatomy and morphology; temperature and water regulation; locomotion; life history; reproduction; population and community ecology; and conservation.

A ECL 425: Aquatic Insects

(Dual-listed with A ECL 525). (Cross-listed with ENT). (2-3) Cr. 3. Alt. S., offered odd-numbered years.

Prereq: BIOL 312 or equivalent

Morphology, ecology, diversity, and significance of aquatic insects, with emphasis on the collection, curation and identification of taxa in local streams and lakes.

A ECL 440: Fishery Management

(Dual-listed with A ECL 540). (2-3) Cr. 3. F.

Prereq: A ECL 312, A ECL 321, STAT 101 or STAT 104; credit or enrollment in A ECL 486

Biological basis of fishery management, fishery problems, and management practices for freshwater, anadromous, and marine fisheries.

A ECL 442: Aquaculture

(Dual-listed with A ECL 542). (3-0) Cr. 3. S.

Prereq: BIOL 211 and BIOL 212.

Concepts related to the culture of aquatic organisms including culture systems, water quality, nutrition, genetics, diseases, and marketing.

A ECL 451: Wildlife Ecology and Management

(2-3) Cr. 3. S.

Prereq: A ECL 371

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.

A ECL 454: Principles of Wildlife Disease

(Dual-listed with A ECL 554). (3-0) Cr. 3. S.

Prereq: Junior standing and at least 10 credits in biological sciences at the 300+ 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.

A ECL 455: International Wildlife Issues

(3-0) Cr. 3. Alt. F., offered even-numbered years.

Prereq: A ECL 365, A ECL 312 or graduate standing; NREM 120

Biological, political, social, and economic factors affecting the management of international wildlife resources.

Meets International Perspectives Requirement.

A ECL 457: Herpetology

(Cross-listed with BIOL). (2-0) Cr. 2. F.

Prereq: BIOL 351 or BIOL 365

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.

A ECL 457L: Herpetology Laboratory

(Cross-listed with BIOL). (0-3) Cr. 1. F.

Prereq: BIOL 351 or BIOL/A ECL 365; concurrent registration in BIOL 457 or A ECL 457

Laboratory to accompany Biology/Animal Ecology 457. Focus on survey methods, identification, relationships, distribution, habits, and habitats of amphibians and reptiles.

A ECL 458: Ornithology

(Cross-listed with BIOL). (2-0) Cr. 2. S.

Prereq: A ECL 365 or BIOL 351

Biology, evolution, ecology and taxonomy of birds. Emphasis on structure, physiology, behavior, communication, navigation, reproduction, and conservation.

A ECL 458L: Ornithology Laboratory

(Cross-listed with BIOL). (0-3) Cr. 1. S.

Prereq: BIOL 351 or AECL/BIOL 365. Concurrent enrollment in AECL/BIOL 458 is required.

Laboratory complements lecture topics with emphasis on external anatomy, identification and distribution of Midwest birds, and field trips.

A ECL 459: Mammalogy

(Cross-listed with BIOL). (2-0) Cr. 2. S.

Prereq: BIOL 351 or A ECL 365

Biology, ecology, and evolution of mammals. Emphasis on structure, physiological adaptation to different environments, behavior, reproduction, roles of mammals in ecosystems, and conservation.

A ECL 459L: Mammalogy Laboratory

(Cross-listed with BIOL). (0-3) Cr. 1. S.

Prereq: BIOL 351 or BIOL/AECL 365; concurrent enrollment in AECL 459 or BIOL 459 required.

Laboratory focus on identification, survey methods, distribution, habits, and habitats of mammals. Several field trips.

A ECL 471: Introductory Conservation Biology

(Cross-listed with BIOL). Cr. 3. S.

Prereq: BIOL 312

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.

A ECL 480: Studies in Marine Biology

Cr. 1-8. Repeatable. SS.

Courses taken at Gulf Coast Research Laboratory and other marine biological stations are transferred to Iowa State University under this number.

A ECL 486: Aquatic Ecology

(Dual-listed with A ECL 586). (Cross-listed with BIOL, ENSCI). (3-0) Cr. 3. F.

Prereq: Biol 312 or EnSci 381 or EnSci 402 or NREM 301

Structure and function of aquatic ecosystems with application to fishery and pollution problems. Emphasis on lacustrine, riverine, and wetland ecology.

A ECL 486L: Aquatic Ecology Laboratory

(Dual-listed with A ECL 586L). (Cross-listed with BIOL, ENSCI). (0-3) Cr. 1. F.

Prereq: Concurrent enrollment in BIOL 486

Field trips and laboratory exercises to accompany 486. Hands-on experience with aquatic research and monitoring techniques and concepts.

A ECL 489: Population Ecology

(Dual-listed with A ECL 589). (Cross-listed with BIOL). (2-2) Cr. 3. Alt. F., offered even-numbered years.

Prereq: BIOL 312, STAT 101 or STAT 104, a course in calculus, or graduate standing

Concepts and theories of population dynamics with emphasis on models of growth, predation, competition, and regulation.

Courses primarily for graduate students, open to qualified undergraduates:

A ECL 515: Ecology of Freshwater Invertebrates, Plants, and Algae
(Dual-listed with A ECL 415). (2-3) Cr. 3. Alt. F., offered even-numbered years.

Prereq: A ECL 312

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.

A ECL 516: Avian Ecology

(3-0) Cr. 3. Alt. S., offered even-numbered years.

Prereq: A ECL 365, A ECL 312, or graduate standing

Current topics and theories including avian breeding and foraging ecology, population biology, community structure, habitat selection, field methodologies, and data interpretation.

A ECL 518: Stream Ecology

(Dual-listed with A ECL 418). (Cross-listed with ENSCI). (2-3) Cr. 3. Alt. F., offered odd-numbered years.

Prereq: A ECL 486

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.

A ECL 520: Fisheries Science

(3-0) Cr. 3. Alt. S., offered odd-numbered years.

Prereq: A ECL 312, A ECL 321

Concepts, approaches, and techniques for assessment of recreational and commercial fisheries. Scope will range from individual fish to entire ecosystems, both freshwater and marine.

A ECL 523I: Fish Ecology

(Cross-listed with IA LL). Cr. 2. Alt. SS., offered even-numbered years.

Basic principles of fish interaction with the biotic and abiotic environment. Field methods, taxonomy, and biology of fish with emphasis on the fish fauna of northwestern Iowa.

A ECL 525: Aquatic Insects

(Dual-listed with A ECL 425). (Cross-listed with ENT). (2-3) Cr. 3. Alt. S., offered odd-numbered years.

Prereq: BIOL 312 or equivalent

Morphology, ecology, diversity, and significance of aquatic insects, with emphasis on the collection, curation and identification of taxa in local streams and lakes.

A ECL 526I: Advanced Field Ornithology

(Cross-listed with IA LL). Cr. 2. SS.

Prereq: Concurrent registration in IA LL 326I

Field study of birds of the upper Midwest; extended field trip to Minnesota and Wisconsin; individual or group project.

A ECL 531: Conservation Biology

(Cross-listed with EEOB). (3-0) Cr. 3. Alt. S., offered even-numbered years.

Prereq: BIOL 312; BIOL 313 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.

A ECL 531I: Conservation Biology

(Cross-listed with EEOB, IA LL). Cr. 4. Alt. SS., offered even-numbered years.

Prereq: IA LL 312I

Population-and community-level examination of factors influencing the viability of plant and animal populations from both demographic and genetic perspectives; assessment of biodiversity; design and management of preserves.

A ECL 535I: Restoration Ecology

(Cross-listed with EEOB, ENSCI, IA LL). Cr. 2. Alt. SS., offered even-numbered years.

Prereq: A course in ecology

Ecological principles for the restoration of native ecosystems; establishment (site preparation, selection of seed mixes, planting techniques) and management (fire, mowing, weed control) of native vegetation; evaluation of restorations. Emphasis on the restoration of prairie and wetland vegetation.

A ECL 540: Fishery Management

(Dual-listed with A ECL 440). (2-3) Cr. 3. F.

Prereq: A ECL 312, A ECL 321, STAT 101 or STAT 104; credit or enrollment in A ECL 486

Biological basis of fishery management, fishery problems, and management practices for freshwater, anadromous, and marine fisheries.

A ECL 542: Aquaculture

(Dual-listed with A ECL 442). (3-0) Cr. 3. S.

Prereq: BIOL 211 and BIOL 212.

Concepts related to the culture of aquatic organisms including culture systems, water quality, nutrition, genetics, diseases, and marketing.

A ECL 551: Behavioral Ecology

(2-2) Cr. 3. Alt. F., offered odd-numbered years.

Prereq: a course in ecology or animal behavior

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.

A ECL 554: Principles of Wildlife Disease

(Dual-listed with A ECL 454). (3-0) Cr. 3. S.

Prereq: Graduate classification

Ecological and epidemiological aspects of disease 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; relationship among wildlife, domestic animal, and human health.

A ECL 573: Techniques for Biology Teaching

(Cross-listed with EEOB, IA LL). Cr. 1-2. Repeatable. SS.

The development and implementation of laboratory exercises suitable for inclusion in elementary, middle, high school, and community college biology and environmental courses. Exercises will be built around common organisms and ecosystems in Iowa. Field trips.

A ECL 573A: Techniques for Biology Teaching : Animal Biology

(Cross-listed with EEOB, IA LL). Cr. 1-2. Repeatable. SS.

The development and implementation of laboratory exercises suitable for inclusion in elementary, middle, high school, and community college biology and environmental courses. Exercises will be built around common organisms and ecosystems in Iowa. Field trips.

A ECL 573G: Techniques for Biology Teaching: Limnology

(Cross-listed with EEOB, IA LL). Cr. 1-2. Repeatable. SS.

The development and implementation of laboratory exercises suitable for inclusion in elementary, middle, high school, and community college biology and environmental courses. Exercises will be built around common organisms and ecosystems in Iowa. Field trips.

A ECL 573I: Techniques for Biology Teaching: Insect Ecology

(Cross-listed with EEOB, IA LL). Cr. 1-2. Repeatable. SS.

The development and implementation of laboratory exercises suitable for inclusion in elementary, middle, high school, and community college biology and environmental courses. Exercises will be built around common organisms and ecosystems in Iowa. Field trips.

A ECL 573W: Techniques for Biology Teaching: Project WET

(Cross-listed with EEOB, IA LL). Cr. 1-2. Repeatable. SS.

The development and implementation of laboratory exercises suitable for inclusion in elementary, middle, high school, and community college biology and environmental courses. Exercises will be built around common organisms and ecosystems in Iowa. Field trips.

A ECL 586: Aquatic Ecology

(Dual-listed with A ECL 486). (Cross-listed with EEOB, ENSCI). (3-0) Cr. 3. F.

Prereq: Biol 312 or EnSci 381 or EnSci 402 or NREM 301

Structure and function of aquatic ecosystems with application to fishery and pollution problems. Emphasis on lacustrine, riverine, and wetland ecology.

A ECL 586L: Aquatic Ecology Laboratory

(Dual-listed with A ECL 486L). (Cross-listed with EEOB, ENSCI). (0-3) Cr. 1. F.

Prereq: Concurrent enrollment in BIOL 486

Field trips and laboratory exercises to accompany 486. Hands-on experience with aquatic research and monitoring techniques and concepts.

A ECL 589: Population Ecology

(Dual-listed with A ECL 489). (Cross-listed with EEOB). (2-2) Cr. 3. Alt. F., offered even-numbered years.

Prereq: BIOL 312, STAT 101 or STAT 104, a course in calculus, or graduate standing

Concepts and theories of population dynamics with emphasis on models of growth, predation, competition, and regulation.

A ECL 590: Graduate Independent Study

(Cross-listed with ANTHR, EEOB, IA LL). Cr. 1-4. Repeatable. SS.

Prereq: Graduate classification and permission of instructor

A ECL 590I: Special Topics: Graduate Independent Study

(Cross-listed with ANTHR, EEOB, IA LL). Cr. 1-4. Repeatable. SS.

Prereq: Graduate classification and permission of instructor

A ECL 599: Creative Component

Cr. arr.

Prereq: Nonthesis M.S. option only

Courses for graduate students:

A ECL 611: Analysis of Populations

(2-2) Cr. 3. Alt. F., offered even-numbered years.

Prereq: BIOL 312; STAT 401; a course in calculus

Quantitative techniques for analyzing vertebrate population data to estimate parameters such as density and survival. Emphasis on statistical inference and computing.

A ECL 698: Animal Ecology Teaching Practicum

Cr. 1-3. Repeatable. F.S.SS.

Prereq: Graduate classification in animal ecology and permission of instructor
Graduate student experience in the animal ecology teaching program.

Offered on a satisfactory-fail basis only.

A ECL 699: Research

Cr. arr. Repeatable.

A ECL 699I: Research

(Cross-listed with ANTHR, EEOB, GDCB, IA LL). Cr. 1-4. Repeatable.

Courses primarily for undergraduates:**FOR 201: Forest Biology**

(2-0) Cr. 2. F.

Prereq: Concurrent enrollment in FOR 202, FOR 203, FOR 204, FOR 205, and FOR 206

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.

FOR 202: Sustainable Materials: Wood Utilization

(2-0) Cr. 2. F.

Prereq: Concurrent enrollment in FOR 201, FOR 203, FOR 204, FOR 205, and FOR 206

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.

FOR 203: Resource Measurements/Evaluation

(2-0) Cr. 2. F.

Prereq: Concurrent enrollment in FOR 201, FOR 202, FOR 204, FOR 205, and FOR 206; MATH 140

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).

FOR 204: Forest Ecosystem Decision-Making

(2-0) Cr. 2. F.

Prereq: Concurrent enrollment in FOR 201, FOR 202, FOR 203, FOR 205, and FOR 206

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.

FOR 205: Integrated Forestry Laboratory

(0-8) Cr. 3. F.

Prereq: Concurrent enrollment in FOR 201, FOR 202, FOR 203, FOR 204, and FOR 206

Field and laboratory exercises integrating the evaluation and management of forest goods, services, and the processing of wood products.

FOR 206: Fall Forestry Camp

Cr. 4. F.

Prereq: Concurrent enrollment in FOR 201, FOR 202, FOR 203, FOR 204, and FOR 205

Three-week field camp to address topics and issues covered in 201, 202, 203, 204, and 205.

FOR 280: Wood Properties and Identification

(3-3) Cr. 4. S.

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.

FOR 283: Pesticide Application Certification

(Cross-listed with AGRON, ENT, HORT). (2-0) Cr. 2. S.

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.

FOR 290: Special Problems

Cr. 1-4. Repeatable.

Prereq: Freshman or Sophomore classification, permission of instructor

FOR 290A: Special Problems: Leadership in Forestry Teams (LIFT) Learning Community

Cr. 1-4. Repeatable.

Prereq: Freshman or Sophomore classification, permission of instructor

FOR 290B: Special Problems: Forest Ecosystem Management

Cr. 1-4. Repeatable.

Prereq: Freshman or Sophomore classification, permission of instructor

FOR 290C: Special Problems: Natural Resource Conservation

Cr. 1-4. Repeatable.

Prereq: Freshman or Sophomore classification, permission of instructor

FOR 290D: Special Problems: Urban and Community Forestry

Cr. 1-4. Repeatable.

Prereq: Freshman or Sophomore classification, permission of instructor

FOR 290E: Special Problems: Wood Science and Technology

Cr. 1-4. Repeatable.

Prereq: Freshman or Sophomore classification, permission of instructor

FOR 302: Silviculture

(3-3) Cr. 4. S.

Prereq: FOR 201, FOR 356, NREM 301

Manipulation of forest vegetation based on ecological principles for the production of goods and services.

FOR 356: Dendrology

(Cross-listed with BIOL). (2-2) Cr. 3. F.

Prereq: BIOL 211

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.

FOR 358: Forest Herbaceous Layer: Ecology and Identification.

(Cross-listed with NREM). (0.5-1) Cr. 1. S.

Prereq: BIOL 212

Survey of the major plant families, general, and representative species of the forest herbaceous layer. Functional ecology and restoration.

FOR 416: Forest Insects and Diseases

(Cross-listed with PL P). (3-0) Cr. 3. F.

Prereq: 8 credits in biological sciences, including BIOL 211 or equivalent.

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.

FOR 416L: Forest Insects and Diseases Laboratory

(Cross-listed with PL P). (0-3) Cr. 1. F.

Prereq: 8 credits in biological sciences, including BIOL 211 or equivalent.

Credit or enrollment in PL P 416.

Laboratory experience working with insect and fungal pests of trees.

FOR 442: Dynamics of Forest Stands

(Dual-listed with FOR 542). (2-3) Cr. 3. Alt. F., offered even-numbered years.

Prereq: NREM 301, FOR 302, STAT 101 or their equivalents

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.

FOR 451: Forest Resource Economics and Quantitative Methods

(3-3) Cr. 4. S.

Prereq: FOR 203, MATH 150

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.

FOR 452: Ecosystem Management

(Dual-listed with FOR 552). (Cross-listed with NREM). (2-3) Cr. 3. S.

Prereq: Senior classification, and NREM 120 or its equivalent

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.

FOR 454: Forestry Practicum

(1-4) Cr. 3. S.

Prereq: 20 credits in student's major at 300 level or above

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.

FOR 475: Urban Forestry

(Cross-listed with HORT). (2-3) Cr. 3. F.

Prereq: Junior or senior classification, 3 credits in biology

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).

Courses primarily for graduate students, open to qualified undergraduates:

FOR 542: Dynamics of Forest Stands

(Dual-listed with FOR 442). (2-3) Cr. 3. Alt. F., offered even-numbered years.

Prereq: NREM 301, FOR 302, STAT 101 or their equivalents

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.

FOR 552: Ecosystem Management

(Dual-listed with FOR 452). (Cross-listed with NREM). (2-3) Cr. 3. S.

Prereq: Senior classification, and NREM 120 or its equivalent

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.

FOR 599: Creative Component

Cr. 1-12. Repeatable, maximum of 12 credits.

FOR 599A: Creative Component: Forest Biology

Cr. 1-12. Repeatable, maximum of 12 credits.

FOR 599B: Creative Component: Forest Biometry

Cr. 1-12. Repeatable, maximum of 12 credits.

FOR 599C: Creative Component: Forest and Recreation Economics

Cr. 1-12. Repeatable, maximum of 12 credits.

FOR 599D: Creative Component: Forest Management and Administration

Cr. 1-12. Repeatable, maximum of 12 credits.

FOR 599E: Creative Component: Wood Science

Cr. 1-12. Repeatable, maximum of 12 credits.

Courses for graduate students:**FOR 696: Research Seminar**

(Cross-listed with AGRON, BBMB, GDCB, HORT, PLBIO). Cr. 1. Repeatable. Research seminars by faculty and graduate students. Offered on a satisfactory-fail basis only.

FOR 699: Research

Cr. 1-12. Repeatable, maximum of 12 credits.

FOR 699A: Research: Forest Biology - Wood Science

Cr. 1-12. Repeatable, maximum of 12 credits.

FOR 699B: Research: Forest Biometry

Cr. 1-12. Repeatable, maximum of 12 credits.

FOR 699C: Research: Forest Economics

Cr. 1-12. Repeatable, maximum of 12 credits.

FOR 699D: Research: Forest Management and Administration

Cr. 1-12. Repeatable, maximum of 12 credits.

FOR 699E: Research: Wood Science

Cr. 1-12. Repeatable, maximum of 12 credits.

FOR 699F: Research: Plant Physiology

Cr. 1-12. Repeatable, maximum of 12 credits.

Courses primarily for undergraduates:**NREM 104: Practical Work Experience**

Cr. R.

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

NREM 110: Orientation in Natural Resource Ecology and Management

Cr. 1. F.

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.

NREM 111: NREM Transitions Learning Community Seminar

(1-0) Cr. 1. Repeatable. F.S.

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.

NREM 120: Introduction to Renewable Resources

(Cross-listed with AGRON, ENV S). (3-0) Cr. 3. F.S.

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.

NREM 130: Natural Resources and Agriculture

(Cross-listed with ENV S). (3-0) Cr. 3. S.

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.

NREM 207: Natural Resource Management under the North American Model of Conservation

(1-0) Cr. 1. F.

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.

NREM 211: Careers in Natural Resources

Cr. 1. F.S.

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.

NREM 240: Quantitative Problem Solving in Natural Resources

Cr. 3. S.

Prereq: STAT 101 or STAT 104, or permission from the 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.

NREM 270: Foundations in Natural Resource Policy and History

(Cross-listed with ENV S, L A). (3-0) Cr. 3. F.

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.

NREM 301: Natural Resource Ecology and Soils

(Cross-listed with ENSCI). (3-3) Cr. 4. F.

Prereq: BIOL 211, BIOL 211L; FOR 201 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.

NREM 303: Internship

Cr. 1-3. Repeatable, maximum of 6 credits. F.S.SS.

Prereq: Permission of department mentor and sophomore standing

Placement with county conservation boards, camps, zoos, parks, etc., for experience as interpreters, rangers, and technicians.

NREM 303I: Undergraduate Internships

(Cross-listed with IA LL). Cr. 1-5. Repeatable. SS.

Prereq: Permission of instructor and sophomore standing

Placement with county conservation boards, camps, parks, etc. for experience as interpreters, rangers, and technicians.

NREM 305: Seminar

(2-0) Cr. 1-3. Repeatable. F.S.

Prereq: Permission of instructor

Current topics in natural resources or related issues.

NREM 311: Field Ecology in Montana

Cr. 4. SS.

Prereq: BIOL 211, 211L, 212, 212L or equivalent and permission of instructors

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.

NREM 315: Genetics for Natural Resource Managers.

(3-0) Cr. 3. F.

Prereq: Prereq: Biol 211 and 212.

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.

NREM 330: Principles of Interpretation

(2-3) Cr. 3. S.

Prereq: 6 credits in biological sciences

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.

NREM 333: Fisheries Techniques

(Cross-listed with A ECL). (1-3) Cr. 2. F.

Prereq: BIOL 212

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.

NREM 345: Natural Resource Photogrammetry and Geographic Information Systems

(Cross-listed with ENSCI). (2-3) Cr. 3. S.

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.

NREM 357: Midwestern Prairie Plants

(1-2) Cr. 1. F.

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.

NREM 358: Forest Herbaceous Layer: Ecology and Identification.

(Cross-listed with FOR). (0.5-1) Cr. 1. S.

Prereq: BIOL 212

Survey of the major plant families, general, and representative species of the forest herbaceous layer. Functional ecology and restoration.

NREM 380: Field Ecology Research and Teaching

Cr. 3. F.

Prereq: Completion or current enrollment in A ECL/BIOL/ENSCI 312 or NREM 301; or eligibility for admission into Elementary Education program

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.

NREM 385: Natural Resource Policy

(Dual-listed with NREM 585). (3-0) Cr. 3. S.

Prereq: Graduate classification or permission of instructor

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.

NREM 390: Fire Ecology and Management

(3-0) Cr. 3. F.

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.

NREM 402: Watershed Hydrology

(Dual-listed with NREM 502). (Cross-listed with ENSCI, GEOL, MTEOR).

(2-3) Cr. 3. F.

Prereq: Four courses in physical or biological sciences or engineering; junior standing

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.

NREM 407: Watershed Management

(Dual-listed with NREM 507). (Cross-listed with ENSCI, ENV S). (3-3) Cr. 4. S.

Prereq: A course in general biology

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.

NREM 408I: Aquatic Ecology

(Dual-listed with NREM 508I NREM 408I). (Cross-listed with IA LL). Cr. 4. SS.

Prereq: Courses in ecology, chemistry, and physics

Analysis of aquatic ecosystems; emphasis on basic ecological principles; ecological theories tested in the field; identification of common plants and animals.

NREM 446: Integrating GPS and GIS for Natural Resource Management

(Dual-listed with NREM 546). (Cross-listed with ENSCI). (2-3) Cr. 3. F.

Prereq: 12 credits in student's major at 300 level or above, NREM 345 or equivalent experience with ArcGIS

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.

NREM 452: Ecosystem Management

(Dual-listed with NREM 552). (Cross-listed with FOR). (2-3) Cr. 3. S.

Prereq: Senior classification, and NREM 120 or its equivalent

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.

NREM 460: Controversies in Natural Resource Management

(Cross-listed with ENV S). (3-0) Cr. 3. F.S.

Prereq: NREM 120, and A ECL 312 or NREM 301, 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.

NREM 466: Ecosystem Service Management

(Dual-listed with NREM 566). (Cross-listed with ENSCI, ENT). (3-0) Cr. 3.

Alt. S., offered odd-numbered years.

Prereq: permission of instructor

Land use and conservation techniques for improving ecosystem services including: pollination of crops, biological control of pests, prevention of erosion and water quality improvement.

NREM 485: Undergraduate Seminar

Cr. 1. Repeatable, maximum of 2 times. F.S.

Prereq: Junior or Senior classification in Animal Ecology or Forestry majors (instructor may grant permission for students in other majors to register for course)

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.

NREM 489: Survey of Remote Sensing Technologies

(Dual-listed with NREM 589). (Cross-listed with E E, GEOL, MTEOR). (3-0) Cr. 3. F.

Prereq: Four courses in physical or biological sciences or engineering

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

NREM 489L: Satellite Remote Sensing Laboratory

(Dual-listed with NREM 589L). (Cross-listed with E E, GEOL, MTEOR). (0-3) Cr. 1. F.

Prereq: Completion or concurrent enrollment in MTEOR/GEOL/NREM/EE 489/589

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

NREM 490: Independent Study

Cr. 1-4. Repeatable, maximum of 4 credits.

Prereq: Junior or senior classification, permission of instructor

NREM 490A: Independent Study: Animal Ecology

Cr. 1-4. Repeatable, maximum of 4 credits.

Prereq: Junior or senior classification, permission of instructor

NREM 490B: Independent Study: Forestry

Cr. 1-4. Repeatable, maximum of 4 credits.

Prereq: Junior or senior classification, permission of instructor

NREM 490E: Independent Study: Entrepreneurship

Cr. 1-4. Repeatable, maximum of 4 credits.

Prereq: Junior or senior classification, permission of instructor

NREM 490H: Independent Study: Honors Program

Cr. 1-4. Repeatable, maximum of 4 credits.

Prereq: Junior or senior classification, permission of instructor

NREM 490I: Iowa Lakeside Laboratory

(Cross-listed with ANTHR, IA LL). Cr. 1-6. Repeatable, maximum of 9 credits.

Prereq: 8 credits in biology and permission of instructor

Research opportunities for undergraduate students in the biological sciences. No more than 9 credits in Biol 490 may be counted toward graduation and of those, only 6 credits may be applied to the major.

NREM 496: Travel Course

(Dual-listed with NREM 596). Cr. 1-5. Repeatable, maximum of 3 times.

Prereq: Permission of instructor

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 496A: Travel Course: International

(Dual-listed with NREM 596A). Cr. 1-5. Repeatable, maximum of 3 times.

Prereq: Permission of instructor

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 496B: Travel Course: Domestic

(Dual-listed with NREM 596B). Cr. 1-5. Repeatable, maximum of 3 times.

Prereq: Permission of instructor

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 498: Cooperative Education

Cr. 1-3. F.S.SS.

Prereq: Permission of departmental chair

Required of all cooperative education students. Students must register prior to commencing each work period.

Courses primarily for graduate students, open to qualified undergraduates:

NREM 502: Watershed Hydrology

(Dual-listed with NREM 402). (Cross-listed with ENSCI, GEOL, MTEOR). (2-3) Cr. 3. F.

Prereq: Four courses in physical or biological sciences or engineering; junior standing

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.

NREM 504: Forest Landscapes, Wildlife, and Silviculture

(2-3) Cr. 3. Alt. F., offered odd-numbered years.

Prereq: Permission of instructor

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.

NREM 505: Seminar

(2-0) Cr. 1-3. Repeatable, maximum of 3 times. F.S.

Prereq: Permission of instructor or graduate classification

Current topics in natural resources research and management.

NREM 507: Watershed Management

(Dual-listed with NREM 407). (Cross-listed with ENSCI). (3-3) Cr. 4. S.

Prereq: A course in general biology

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.

NREM 508I: Aquatic Ecology

(Cross-listed with ENSCI, IA LL). Cr. 4. SS.

Prereq: Courses in ecology, chemistry, and physics

Analysis of aquatic ecosystems; emphasis on basic ecological principles; ecological theories tested in the field; identification of common plants and animals.

NREM 533: Erosion and Sediment Transport

(Cross-listed with A B E, ENSCI). (2-3) Cr. 3. Alt. F., offered even-numbered years.

Prereq: C E 372 or GEOL/ENSCI/MTEOR 402, MATH 166 or equivalent

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.

NREM 535: Restoration Ecology

(Cross-listed with EEOB, ENSCI). (2-3) Cr. 3. Alt. F., offered even-numbered years.

Prereq: BIOL 366 or BIOL 474 or graduate standing

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.

NREM 542: Introduction to Molecular Biology Techniques

(Cross-listed with B M S, EEOB, FS HN, GDCB, HORT, NUTRS, V MPM, VDPAM). Cr. 1. Repeatable. F.S.SS.

Sessions in basic molecular biology techniques and related procedures. Offered on a satisfactory-fail basis only.

NREM 542A: Introduction to Molecular Biology Techniques: DNA Techniques

(Cross-listed with B M S, BBMB, EEOB, FS HN, GDCB, HORT, NUTRS, V MPM, VDPAM). Cr. 1. Repeatable. F.S.

Includes genetic engineering procedures, sequencing, PCR, and genotyping. Offered on a satisfactory-fail basis only.

NREM 542B: Introduction to Molecular Biology Techniques: Protein

(Cross-listed with B M S, BBMB, EEOB, FS HN, GDCB, HORT, NUTRS, VDPAM). Cr. 1. Repeatable. S.SS.

Prereq: Graduate classification

Techniques. Includes: fermentation, protein isolation, protein purification, SDS-PAGE, Western blotting, NMR, confocal microscopy and laser microdissection, Immunophenotyping, and monoclonal antibody production. Sessions in basic molecular biology techniques and related procedures. Offered on a satisfactory-fail basis only.

NREM 542C: Introduction to Molecular Biology Techniques: Cell Techniques

(Cross-listed with B M S, BBMB, EEOB, FS HN, GDCB, HORT, NUTRS, V MPM, VDPAM). Cr. 1. Repeatable. F.S.

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

NREM 542D: Introduction to Molecular Biology Techniques: Plant Transformation

(Cross-listed with B M S, BBMB, EEOB, FS HN, GDCB, HORT, NUTRS, V MPM, VDPAM). Cr. 1. Repeatable. S.

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

NREM 542E: Introduction to Molecular Biology Techniques: Proteomics

(Cross-listed with B M S, BBMB, EEOB, FS HN, GDCB, HORT, NUTRS, V MPM, VDPAM). Cr. 1. Repeatable. F.

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

NREM 542F: Introduction to Molecular Biology Techniques: Metabolomics

(Cross-listed with B M S, BBMB, EEOB, FS HN, GDCB, HORT, NUTRS, V MPM, VDPAM). Cr. 1. Repeatable. F.

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.

NREM 542G: Introduction to Molecular Biology Techniques: Genomic

(Cross-listed with B M S, BBMB, EEOB, FS HN, GDCB, HORT, NUTRS, V MPM, VDPAM). Cr. 1. Repeatable. S.

Offered on a satisfactory-fail basis only.

NREM 546: Integrating GPS and GIS for Natural Resource Management

(Dual-listed with NREM 446). (Cross-listed with ENSCI). (2-3) Cr. 3. F.

Prereq: 12 credits in student's major at 300 level or above, NREM 345 or equivalent experience with ArcGIS

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.

NREM 552: Ecosystem Management

(Dual-listed with NREM 452). (Cross-listed with FOR). (2-3) Cr. 3. S.

Prereq: Senior classification, and NREM 120 or its equivalent

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.

NREM 566: Ecosystem Service Management

(Dual-listed with NREM 466). (Cross-listed with ENSCI, ENT). (3-0) Cr. 3. Alt. S., offered odd-numbered years.

Prereq: permission of instructor

Land use and conservation techniques for improving ecosystem services including: pollination of crops, biological control of pests, prevention of erosion and water quality improvement.

NREM 570: Advanced Decision-making in Natural Resource Allocation

(2-2) Cr. 3. Alt. S., offered even-numbered years.

Prereq: FOR 451 or two courses in economics

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.

NREM 571: Agroforestry Systems

(Dual-listed with NREM 471). (Cross-listed with SUSAG). (3-0) Cr. 3. Alt. S., offered even-numbered years.

Prereq: 6 credits in biological science at 300 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.

Meets International Perspectives Requirement.

NREM 580: Research Orientation

(2-0) Cr. 2. F.

Prereq: 20 credits in biological sciences and a course in statistics

Research design, proposal preparation, and technical writing.

NREM 585: Natural Resource Policy

(Dual-listed with NREM 385). (3-0) Cr. 3. S.

Prereq: Graduate classification or permission of instructor

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.

NREM 589: Survey of Remote Sensing Technologies

(Dual-listed with NREM 489). (Cross-listed with E E, GEOL, MTEOR). (3-0) Cr. 3. F.

Prereq: Four courses in physical or biological sciences or engineering

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

NREM 589L: Satellite Remote Sensing Laboratory

(Dual-listed with NREM 489L). (Cross-listed with E E, GEOL, MTEOR). (0-3) Cr. 1. F.

Prereq: Completion or concurrent enrollment in MTEOR/GEOL/NREM/EE 489/589

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

NREM 590: Special Topics

Cr. 1-4. Repeatable, maximum of 4 credits.

Prereq: Permission of instructor

NREM 590A: Special Topics: Animal Ecology

Cr. 1-4. Repeatable, maximum of 4 credits.

Prereq: Permission of instructor

NREM 590B: Special Topics: Forestry

Cr. 1-4. Repeatable, maximum of 4 credits.

Prereq: Permission of instructor

NREM 593: Workshop

Cr. 1-3. Repeatable.

Prereq: Graduate classification

NREM 596: Travel Course

(Dual-listed with NREM 496). Cr. 1-5. Repeatable, maximum of 3 times.

Prereq: Permission of instructor

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

NREM 596A: Travel Course: International

(Dual-listed with NREM 496A). Cr. 1-5. Repeatable, maximum of 3 times.

Prereq: Permission of instructor

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 596B: Travel Course: Domestic

(Dual-listed with NREM 496B). Cr. 1-5. Repeatable, maximum of 3 times.

Prereq: Permission of instructor

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 598: Natural Resource Ecology and Management Teaching Practicum

Cr. 1. F.S.SS.

Prereq: Graduate classification as M.S. candidate in a NREM major 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.

NREM 599: Creative Component

Cr. arr.

Courses for graduate students:**NREM 600: Seminar**

Cr. 1. Repeatable. F.S.

Current topics in natural resources research and management.

NREM 698: Natural Resource Ecology and Management Teaching Practicum

Cr. 1. F.S.

Prereq: Graduate classification as a Ph.D. candidate in a NREM major 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.

NREM 699: Research

Cr. 1-12. Repeatable, maximum of 12 credits.