Natural Resource Science and Management

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The Natural Resource Science and Management degree addresses the science, art, and craft of creating, managing, using, conserving, and repairing natural and human-dominated ecosystems. The degree will allow students to apply biological, physical, social, political, and managerial sciences to the conservation of plant and animal species in forests, grasslands, rivers and streams, and urban areas. The degree also develops students’ skills in working with diverse groups of people. Students with degrees in Natural Resource Science and Management work as fisheries biologists, foresters, interpreters, naturalists, and wildlife biologists for state and federal agencies, nature centers and museums, and consulting firms. Four emphasis areas are offered: Fisheries and Wildlife Sciences, Forest Resources, Human Dimensions, and Terrestrial Ecosystems. All students are encouraged to integrate their classroom learning experiences with research and internship experiences.

School of Natural Resources
The School of Natural Resources is one of six Divisions in the College of Agriculture, Food and Natural Resources. It is Missouri’s and the Midwest’s only school with comprehensive academic and research programs focused on biological, physical, and social aspects of natural resources science and management. The School applies an integrated, scientific approach to develop sustainable solutions to environmental challenges and to train the next generation of natural resources and recreation professionals and leaders. This integrated approach results in creative course offerings, enhanced educational opportunities, stimulation of novel research, advanced understanding of natural systems, and expanded knowledge and management of human interactions with the environment. The School is housed in the Anheuser-Busch Natural Resources Building containing state-of-the-art teaching, research and outreach extension facilities.

Faculty
Professor H. S. He**, S. Jose**, D. R. Larsen*, C. H. Nilon**
Associate Professor M. Morgan**, S. Wilhelm-Stanis**, H. E. Stelzer**
Assistant Professor A. Argerich*, M. Byrne*, S. Halsey*, B. O. Knapp**, J. Li*, R. North*, R. M. Rotman*, M. Weegman*
Extension Associate Professor R. A. Pierce II*
Teaching Associate Professor D. Vaught
Teaching Assistant Professor T. Strauch
Research Professor M. A. Gold**, R. Udawatta**
Research Associate Professor C. Lin**, M. C. Stambaugh**
Research Assistant Professor S. Bardhan*, T. Bonnot*, J. Whittier**, J. D. Wood*
Curators’ Emeritus Professor J. R. Jones**
Cooperative Assistant Professor D. Dey*, J. Kabrick**, L. S. Pile
Cooperative Associate Professor S.A Amelon**, E. B. Webb**

• Graduate Faculty Member - membership is required to teach graduate-level courses, chair master’s thesis committees, and serve on doctoral examination and dissertation committees.
• Doctoral Faculty Member - membership is required to chair doctoral examination or dissertation committees. Graduate faculty membership is a prerequisite for Doctoral faculty membership.

Undergraduate
• BS in Natural Resource Science and Management (http://catalog.missouri.edu/undergraduategraduate/collegeofagriculturefoodandnaturalresources/naturalresourcescienceandmanagement/bs-nat-resource-science-and-management/)
  • with emphasis in Fisheries and Wildlife Sciences (http://catalog.missouri.edu/undergraduategraduate/collegeofagriculturefoodandnaturalresources/naturalresourcescienceandmanagement/bs-nat-resource-science-and-management-emphasis-fish-wildlife-sciences/)
  • with emphasis in Forest Resources (http://catalog.missouri.edu/undergraduategraduate/collegeofagriculturefoodandnaturalresources/naturalresourcescienceandmanagement/bs-nat-resource-science-and-management-emphasis-forest-resources/)
  • with emphasis in Human Dimensions (http://catalog.missouri.edu/undergraduategraduate/collegeofagriculturefoodandnaturalresources/naturalresourcescienceandmanagement/bs-nat-resource-science-and-management-emphasis-human-dimensions/)
  • with emphasis in Terrestrial Ecosystems (http://catalog.missouri.edu/undergraduategraduate/collegeofagriculturefoodandnaturalresources/naturalresourcescienceandmanagement/bs-nat-resource-science-and-management-emphasis-terrestrial-ecosystems/)

Graduate
While the College of Agriculture, Food and Natural Resources does not offer a graduate degree specifically in Natural Resource Science Management, there are many options available for graduate studies in Natural Resources. Please refer to the list of graduate degrees on the Natural Resources (http://catalog.missouri.edu/undergraduategraduate/collegeofagriculturefoodandnaturalresources/naturalresources/graduatetext) section of the catalog for more information.

FOREST 2151: Dendrology
An introduction to the biology of trees, emphasizing identification in the field, taxonomy, ecology, geographic distribution and economic significance of forest species.
Credit Hours: 4
Prerequisites: BIO_SC 1200 or PLNT_S 2120

FOREST 2541: Forest Utilization
Field studies of logging and milling of timber.
Credit Hour: 1
Prerequisites: SOIL 2100, FOREST 2151
Corequisites: FOREST 2540, FOREST 2542, FOREST 2543, FOREST 2544 and FOREST 2545

FOREST 2542: Forest Measurement and Inventory
Field measurement of standing trees including diameter, height and age. Estimation of forest timber resources using a variety of sampling schemes and techniques. Introduction to Arcview and growth models.

Credit Hour: 1
Prerequisites: SOIL 2100, FOREST 2151
Corequisites: FOREST 2543 and FOREST 2544

FOREST 2543: Forest Ecology Field Studies
Field studies of vegetation, soils, habitats and ecological units. Application of ecological principles of natural resource management and understanding of natural and managed forested communities with an emphasis on southeastern Missouri.

Credit Hour: 1
Prerequisites: SOIL 2100 and FOREST 2151
Corequisites: FOREST 2542 and FOREST 2544

FOREST 2544: Introduction to Silviculture and Management
Management objectives and stand prescriptions, regeneration and intermediate silvicultural treatments, management on private and federal forest lands, tree evaluation and timber marking.

Credit Hour: 1
Prerequisites: SOIL 2100 and FOREST 2151
Corequisites: FOREST 2542 and FOREST 2543

FOREST 2545: Forest Management Planning
Preparation and presentation of a written forest management plan using material and data developed in prerequisite courses.

Credit Hour: 1
Prerequisites: SOIL 2100, FOREST 2151
Corequisites: FOREST 2540, FOREST 2541, FOREST 2542, FOREST 2543 and FOREST 2544 concurrently

FOREST 3207: Forest Fire Control and Use
Fundamentals of all phases of fire protection. Objectives and techniques in use of fire.

Credit Hours: 2

FOREST 3212: Forest Health and Protection
Fundamental concepts of forest pathology and forest entomology including emphasis on ecological principles and management strategies.

Credit Hours: 4
Recommended: FOREST 2151

FOREST 3212W: Forest Health and Protection - Writing Intensive
Fundamental concepts of forest pathology and forest entomology including emphasis on ecological principles and management strategies.

Credit Hours: 4
Recommended: FOREST 2151

FOREST 3290: Urban Forestry
The culture and management of trees in urban areas, including ownership patterns, species composition, growth environment, amenities provided and evaluation. One-day field trip required.

Credit Hours: 2
Prerequisites: FOREST 2151 or PLNT_S 2210

FOREST 3300: Problems in Forestry
Problems in Forestry

Credit Hour: 1-99

FOREST 3350: Special Readings in Forestry
Critical review of current literature and research in forestry, fisheries and wildlife, and methods of presenting research results.

Credit Hour: 1-99

FOREST 4320: Forest Ecology
Principles of community, ecosystem, and population ecology and examination of the influence of environmental factors and human activity on forest dynamics, composition, structure and function.

Credit Hours: 5
Prerequisites: At least Junior standing. Recommended FOREST 2151

FOREST 4320W: Forest Ecology - Writing Intensive
Principles of community, ecosystem, and population ecology and examination of the influence of environmental factors and human activity on forest dynamics, composition, structure and function.

Credit Hours: 5
Prerequisites: At least Junior standing
Recommended: FOREST 2151

FOREST 4330: Practice of Silviculture
(cross-leveled with FOREST 7330). Applied ecological principles, cultural practices, tree improvement techniques and treatments to forest stands and other lands for systematic production of goods and services.

Credit Hours: 4
Prerequisites: FOREST 4320
Recommended: FOREST 4375

FOREST 4350: Forest Economics
Economic principles applied to production/marketing of goods and services from forest land: emphasizes capital and land factors and investment alternatives related to time.

Credit Hours: 3
Prerequisites: ABM 1042 or ABM 1041 or ABM 2070

FOREST 4360: Photogrammetry, Inventory and Models
Applied course in the area of aerial photogrammetry, forest inventory, and forest growth models for developing, maintaining, and utilizing these tools in a forest management.

Credit Hours: 3
Recommended: NAT_R 3110
FOREST 4375: Forest Stand Dynamics
Examines the development of forest structure, the role of disturbance on forest change and the use of this knowledge in applying silvicultural systems. Both forest stand dynamics theories, structure diagrams, forest growth models, and long term data sets are used to understand stand dynamics.

Credit Hours: 3
Recommended: FOREST 4330

FOREST 4380: Forest Resource Management
Teaches resource managers how to develop a plan for the management of forest resources using managerial, economic, silvical and wildlife techniques for its enhancement and to meet the landowner's objectives.

Credit Hours: 3
Prerequisites: FOREST 4330 and FOREST 4350; Senior Standing only

FOREST 4385: Agroforestry I: Theory, Practice and Adoption
Understand biophysical, ecological, social and economic features of temperate and tropical agroforestry. Covers the basics of design, planning and implementation of agroforestry practices.

Credit Hours: 3
Prerequisites: Senior standing

FOREST 4390: Watershed Management and Water Quality
(cross-leveled with FOREST 7390). Hydrologic processes on wildland watersheds. Effects of forest land management on streamflow, erosion and water quality.

Credit Hours: 3
Prerequisites: MATH 1400; Senior standing only

FOREST 4940: Forestry Internship
Supervised professional experience with an approved public or private organization. May be repeated for credit. Graded on S/U basis only.

Credit Hour: 1-12
Prerequisites: Instructor's consent required

FOREST 4950: Forestry Undergraduate Research
Research apprenticeship with a faculty mentor. Students are expected to develop initial concept for the research, design experiments, collect data, and analyze data with faculty input, oversight, and guidance. Graded on A-F basis only.

Credit Hour: 1-4
Prerequisites: Senior standing, STAT 2530

FOREST 4994: Senior Honors Research in Forestry
Credit Hour: 1-3
Prerequisites: Instructor Consent Required

FOREST 4995: Senior Honors Research in Forestry
Credit Hour: 1-3
Prerequisites: instructor's consent

FOREST 7301: Topics in Forestry
Organized study of selected topics. Intended for upper-division and graduate students. Subjects and credit may vary from semester to semester.

Credit Hour: 1-99

FOREST 7320: Forest Ecology
(cross-leveled with FOREST 4320). Principles of community, ecosystem, and population ecology and examination of the influence of environmental factors and human activity on forest dynamics, composition, structure and function.

Credit Hours: 5
Prerequisites: FOREST 2151 or BIO_SC 3210 or instructor's consent

FOREST 7330: Practice of Silviculture
(cross-leveled with FOREST 4330). Applied ecological principles, cultural practices, tree improvement techniques and treatments to forest stands and other lands for systematic production of goods and services.

Credit Hours: 4
Prerequisites: FOREST 4320

FOREST 7350: Forest Economics
(cross-leveled with FOREST 4350). Economic principles applied to production/marketing of goods and services from forest land; emphasizes capital and land factors and investment alternatives related to time.

Credit Hours: 3
Prerequisites: Mathematics requirement completed; AG_EC 1041, or AG_EC 3080

FOREST 7360: Photogrammetry, Inventory and Models
(cross-leveled with FOREST 4360). Applied course in the area of aerial photogrammetry, forest inventory, and forest growth models for developing, maintaining, and utilizing these tools in a forest management.

Credit Hours: 3

FOREST 7375: Forest Stand Dynamics
(cross-leveled with FOREST 4375). Examines the development of forest structure, the role of disturbance on forest change and the use of this knowledge in applying silvicultural systems. Both forest stand dynamics theories, structure diagrams, forest growth models, and long term data sets are used to understand stand dynamics.

Credit Hours: 3
Prerequisites: FOREST 4330 or instructor's consent

FOREST 7380: Forest Resource Management
(cross-leveled with FOREST 4380). Teaches resource managers how to develop a plan for the management of forest resources using managerial, economic, silvical and wildlife techniques for its enhancement and to meet the landowner's objectives.

Credit Hours: 3
Prerequisites: FOREST 4330 and FOREST 4350
FOREST 7385: Agroforestry I: Theory, Practice and Adoption
(cross-leveled with FOREST 4385). Understand biophysical, ecological social and economic features of temperate and tropical agroforestry. Covers the basics of design, planning and implementation of agroforestry practices.

Credit Hours: 3

FOREST 7390: Watershed Management and Water Quality
(cross-leveled with FOREST 4390). Hydrologic processes on wildland watersheds. Effects of forest land management on streamflow, erosion and water quality.

Credit Hours: 3
Prerequisites: MATH 1400 or instructor's consent

FOREST 8050: Research in Forestry
Original research not leading to preparation of dissertation.

Credit Hour: 1-99

FOREST 8090: Masters Thesis Research in Forestry
Original investigation for presentation in a M.S. thesis. Graded on a S/U basis only.

Credit Hour: 1-10

FOREST 8385: Ecological Principles of Agroforestry
The course prepares students to develop an understanding of the complexity of agroforestry. Students will critically analyze classical and contemporary ecological theories and apply them in designing agroforestry practices to solve complex production and environmental issues. May be repeated for credit. Graded on A-F basis only.

Credit Hours: 3
Prerequisites: FOREST 4385 or FOREST 7385 or permission of instructor

FOREST 8390: Physical Hydrology
Students will obtain an understanding of hydrologic processes in terms of the occurrence, distribution and movement of water spanning the atmosphere and lithosphere. Students will have an opportunity to develop an understanding of physical processes governing mass and energy flux in wildland and anthropogenic systems. May be repeated for credit. Graded on A-F basis only.

Credit Hours: 3
Prerequisites: College Physics and Calculus I

FOREST 8395: Agroforestry Economics and Policy
This course discusses basic economic and financial principles, and their applications in agroforestry. Specifically, the discussion includes market demand and supply, market failure, non-market valuations, cost and benefit analysis, short term and long term economic analysis, economic valuation of ecosystem services, and the applications in agroforestry. Graded on A-F basis only.

Credit Hours: 3
Prerequisites: FOREST 4385 or FOREST 7385, ABM 1041 or permission of instructor

FOREST 8401: Topics in Forestry
Organized study of selected topics. Subjects and credit may vary from semester to semester.

Credit Hour: 1-99
Prerequisites: instructor's consent

FOREST 8430: Applied Silviculture
Ecological and economic factors affecting application of silviculture in each of eighteen forest regions in United States.

Credit Hours: 3
Prerequisites: FOREST 4330

FOREST 8450: Forest Soils
Physical, chemical and biological properties of forest soils in relation to tree growth.

Credit Hours: 3
Prerequisites: FOREST 4330 or instructor's consent

FOREST 8460: Advanced Forest Ecology
Lecture/discussion based course emphasizing contemporary and classic ecological studies and concepts in the context of current forest ecology issues and research. Prerequisites: undergraduate ecology course

Credit Hours: 3

FOREST 8490: Advanced Forest Management
Modern quantitative methods to facilitate decision-making in harvest scheduling and regulation, land use allocation, and production planning in natural resource management.

Credit Hours: 3
Prerequisites: FOREST 4380

FOREST 8515: Advanced Forest Biometrics
An introduction to the topics and philosophy of ecological modeling. The course will guide students through the process of developing a conceptual model, formalizing the model, formulating, parameterizing, and running the model as well as analyzing the results.

Credit Hours: 3
Prerequisites: STAT 7070 or instructor's consent

FOREST 8530: Ecosystem Management: The Human Dimension
Overview of cultural, social, political and economic dimensions of natural resource problems and issues from an ecologically grounded management perspective.

Credit Hours: 3
Prerequisites: NAT_R 4353 or equivalent

FOREST 8620: Plant-Water Relations

Credit Hours: 3
FOREST 9087: Seminar in Forestry
Discussions of current developments in Forestry, and critical study of research programs. Graded on S/U basis only.
Credit Hour: 1

FOREST 9090: Dissertation Research in Forestry
Original investigation for presentation in a doctoral dissertation. Graded on a S/U basis only.
Credit Hour: 1-10

F_W 1012: Introduction to Captive Wild Animal Management
(same as AN_SCI 1012). General introduction to housing, husbandry, behavior, genetics, nutrition, reproduction, animal health, and disease control of native and exotic species in zoological parks and other animal conservation facilities; emphasizes the role of captive animals in wildlife conservation. Graded on A-F basis only.
Credit Hours: 3
Prerequisites: MATH 1100, F_W 1100 or BIO_SC 1500
Recommended: NAT_R 1070 and one other course in biological or environmental science; sophomore standing or higher

F_W 1100: Introductory Zoology with Laboratory
(same as BIO_SC 1100). Introduces important principles and concepts of zoology. Emphasizes cell biology; evolution; genetics; ecology; structure, function, development of the organism.
Credit Hours: 5

F_W 2500: Introduction to Genetics and Evolution for Conservation
Basic principles and processes of genetics and evolution and their importance for management and conservation. Graded on A-F basis only.
Credit Hours: 3
Prerequisites: MATH 1100, F_W 1100 or BIO_SC 1500
Recommended: 5 hours Biological Sciences

F_W 2600: Ornithology
(same as BIO_SC 2600). Structure, identification, habits, importance of regional birds. Field work, lectures, lab.
Credit Hours: 5
Prerequisites: F_W 1100
Recommended: 5 hours Biological Sciences

F_W 2700: Ichthyology
A broad introduction to the biology and ecology of fishes. Emphasis will be placed on understanding the adaptations fishes exhibit to aspects of their environment.
Credit Hours: 4
Prerequisites: F_W 1100
Recommended: 8 hours Biological Sciences

F_W 2900: Principles of Wildlife Management
Expose students to the principles of wildlife management with emphasis on current issues faced by wildlife researchers and managers in the field. Graded on A-F basis only.
Credit Hours: 4
Recommended: NAT_R 1070 and one other course in biological or environmental science; sophomore standing or higher

F_W 3085: Problems in Fisheries and Wildlife
Individual problems studies to supplement regularly organized undergraduate courses in Fisheries and Wildlife. Proposal for problems study must be arranged by student and supervising faculty member prior to registration.
Credit Hour: 1-99
Prerequisites: consent of supervising faculty member

F_W 3600: Introduction to Conservation Biology
Introduction to principles of conservation biology. Application of ecological concepts and conservation biology principles to management of endangered species, biodiversity and threatened ecosystems.
Credit Hours: 3
Prerequisites: BIO_SC 3650 or BIO_SC 3400

F_W 3660: Mammalogy
Taxonomy, distribution, structure, habits, importance of mammals; emphasizes those of central United States.
Credit Hours: 4
Recommended: F_W 1100 and Junior standing

F_W 3700: Animal Behavior
Behavior allows animals to react promptly to environmental changes, and is how they interact with others and their surroundings. Because behaving is central to an animal's life, knowing about behavior is fundamental to understanding animal ecology and to conservation efforts.
Graded on A-F basis only.
Credit Hours: 3
Recommended: F_W 1100

F_W 3900: Ecology of Fishes
This course considers fishes' interactions with their environments in relation to survival, growth and population processes. The course is for mid- to upper-level undergraduates interested in fisheries science, management and fish conservation. May be repeated once for credit. Graded on A-F basis only.
Credit Hours: 3
Prerequisites: BIO_SC 1500 or F_W 1100; sophomore standing
Recommended: STAT 2500

F_W 4002: Topics in Fisheries and Wildlife - Biological
Organized study of selected topics intended primarily for senior-level students in Fisheries and Wildlife Sciences.
Credit Hour: 1-99

F_W 4200: Urban Wildlife Conservation
(cross-leveled with F_W 7200). Reviewing the theory and practice of applying ecological concepts to the management of wildlife species in urban areas.
Credit Hours: 3
Prerequisites: BIO_SC 3650 or FOREST 4320
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Description</th>
<th>Prerequisites</th>
</tr>
</thead>
<tbody>
<tr>
<td>F_W 4200W: Urban Wildlife Conservation - Writing Intensive</td>
<td>Reviewing the theory and practice of applying ecological concepts to the management of wildlife species in urban areas.</td>
<td>3</td>
<td>BIO_SC 3650 or FOREST 4320</td>
</tr>
<tr>
<td>F_W 4220: Human Dimensions of Fish and Wildlife Conservation</td>
<td>Overview of human dimensions approaches and methods as they are applied to issues in fish and wildlife conservation.</td>
<td>3</td>
<td>One 3000-level or above professional Fisheries and Wildlife management or techniques course</td>
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<tr>
<td>F_W 4300: Fisheries Management</td>
<td>Introduction to the scientific principles and techniques of fishery management. Integrates ecological principles with social, economic and legal considerations.</td>
<td>3</td>
<td>BIO_SC 3650 and STAT 2500</td>
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<tr>
<td>F_W 4400: Techniques for Fisheries Management and Conservation</td>
<td>Introduction to techniques (field and analytical/quantitative) used by fisheries and conservation biologists. Fosters understanding of techniques uses, advantages, limitations biases, and data interpretation. Extended weekly field outings require chest waders and life jackets. Graded on A-F basis only.</td>
<td>4</td>
<td>BIO_SC 3650; STAT 2500 or NAT_R 3110; F_W 2700 or F_W 4300</td>
</tr>
<tr>
<td>F_W 4400W: Techniques for Fisheries Management and Conservation - Writing Intensive</td>
<td>Introduction to techniques (field and analytical/quantitative) used by fisheries and conservation biologists. Fosters understanding of techniques uses, advantages, limitations biases, and data interpretation. Extended weekly field outings require chest waders and life jackets. Graded on A-F basis only.</td>
<td>4</td>
<td>BIO_SC 3650; STAT 2500 or NAT_R 3110; F_W 2700 or F_W 4300</td>
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<tr>
<td>F_W 4500: Animal Population Dynamics and Management</td>
<td>Quantitative modeling approach to examining principles and analysis techniques of fish and wildlife population dynamics. Emphasis on approaches useful in the management of exploited species.</td>
<td>3</td>
<td>MATH 1400; STAT 2500 or NAT_R 3110; BIO_SC 3650 or FOREST 4320</td>
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<tr>
<td>F_W 4600: Ecosystem Management</td>
<td>Explores the development and implementation of large-scale approaches to restoring and maintaining ecosystems for sustainability. Incorporates ecological, socio-economic, and institutional factors that influence natural management agencies. Graded on A-F basis only.</td>
<td>3</td>
<td>BIO_SC 3650 or FOREST 4320</td>
</tr>
<tr>
<td>F_W 4600W: Ecosystem Management - Writing Intensive</td>
<td>Explores the development and implementation of large-scale approaches to restoring and maintaining ecosystems for sustainability. Incorporates ecological, socio-economic, and institutional factors that influence natural management agencies. Graded on A-F basis only.</td>
<td>4</td>
<td>BIO_SC 3650</td>
</tr>
<tr>
<td>F_W 4650: Natural Resource Planning and Management</td>
<td>Students will be exposed to various natural resource planning tools. Students team will develop natural resource management plans with strategic and operational components for current conservation issues in Missouri. Plans will be critiqued by peers and outside professionals. Graded on A-F basis only.</td>
<td>4</td>
<td>FOREST 4320 or BIO_SC 3650 and senior standing</td>
</tr>
<tr>
<td>F_W 4700: Wildlife Ecology Methods</td>
<td>Techniques for conducting wildlife research. Graded on A-F basis only.</td>
<td>4</td>
<td>BIO_SC 3650 and STAT 2500</td>
</tr>
<tr>
<td>F_W 4700W: WILDLIFE METHODS - Writing Intensive</td>
<td>Techniques for conducting wildlife research. Graded on A-F basis only.</td>
<td>4</td>
<td>BIO_SC 3650 and STAT 2500</td>
</tr>
<tr>
<td>F_W 4800: Environmental Toxicology</td>
<td>Introduction to classes of chemicals, tools, methods, and approaches used in environmental toxicology. Emphasizes fundamentals of toxicology, dose-response relationships, evaluation of contaminant issues, strategies, and exposure analysis/toxicity assessment strategies in a risk assessment.</td>
<td>3</td>
<td>CHEM 1320</td>
</tr>
<tr>
<td>F_W 4810: Wildlife Disease Ecology</td>
<td>An introduction to the ecology of wildlife diseases. Topics include the definition of a disease, how to measure diseases, impacts on individuals and populations, and the role of disease in wildlife management and conservation.</td>
<td>3</td>
<td>BIO_SC 3650</td>
</tr>
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### F_W 4880: Waterfowl Ecology and Management
Ecology and management of North American waterfowl and their habitats. Laboratory exercises focus on identification, life histories, sex and age determination, and survey methods. Lectures cover taxonomy, ecology, behavior, population dynamics, harvest management, and habitat management and conservation. Graded on A-F basis only.

**Credit Hours:** 3  
**Prerequisites:** F_W 2600; BIO_SC 3650; instructor's consent

### F_W 4910: Senior Seminar in Captive Wild Animal Management
(same as AN_SCI 4910). Investigates key issues in captive wild animal management, focusing on the role of animal caretakers in addressing the issues. Students are required to formulate informed opinions regarding these topics and communicate effectively about the subject matter. Graded on A-F basis only.

**Credit Hour:** 1  
**Prerequisites:** AN_SCI 1012 or F_W 1012; junior or senior standing

### F_W 4940: Fisheries and Wildlife Internship
Supervised professional experience with an approval public or private organization. May be repeated for credit. Graded on S/U basis only.

**Credit Hour:** 1-12  
**Prerequisites:** Fisheries and Wildlife majors only

### F_W 4950: Undergraduate Research in Fisheries and Wildlife
Individually directed field or laboratory research for students under faculty supervision. Project must be arranged by student and faculty member prior to registration.

**Credit Hour:** 1-99  
**Prerequisites:** consent of supervising faculty member

### F_W 7002: Graduate Topics in Fisheries and Wildlife
Organized study of selected topics intended primarily for graduate students in Fisheries and Wildlife Sciences. Graded on A-F basis only.

**Credit Hour:** 1-99

### F_W 7200: Urban Wildlife Conservation
(cross-leveled with F_W 4200). Reviewing the theory and practice of applying ecological concepts to the management of wildlife species in urban areas.

**Credit Hours:** 3  
**Prerequisites:** BIO_SC 3650 or FOREST 4320

### F_W 7220: Human Dimensions of Fish and Wildlife Conservation
Overview of human dimensions approaches and methods as they are applied to issues in fish and wildlife conservation.

**Credit Hours:** 3  
**Prerequisites:** One 3000-level or above professional management or techniques course or instructor consent

### F_W 7300: Fisheries Management
(cross-leveled with F_W 4300). Introduction to the scientific principles and techniques of fishery management. Integrates ecological principles with social, economic and legal considerations.

**Credit Hours:** 3  
**Prerequisites:** F_W 2600; BIO_SC 3650; instructor's consent

### F_W 7500: Animal Population Dynamics and Management
(cross-leveled with F_W 7500). Quantitative modeling approach to examining principles and analysis techniques of fish and wildlife population dynamics. Emphasis on approaches useful in the management of exploited species. Graded on A-F basis only.

**Credit Hours:** 3  
**Prerequisites:** MATH 1400; STAT 2500 or NAT_R 3110; BIO_SC 3650 or FOREST 4320

### F_W 7600: Ecosystem Management
(cross-leveled with F_W 4600). Explores the development and implementation of large-scale approaches to restoring and maintaining ecosystems for sustainability. Incorporates ecological, social-economic, and institutional factors that influence natural resource management agencies. Graded on A-F basis only.

**Credit Hours:** 4  
**Prerequisites:** BIO_SC 3650 or FOREST 4320

### F_W 7700: Wildlife Ecology Methods
(cross-leveled with F_W 4700). Techniques for conducting wildlife research. Graded on an A-F basis only.

**Credit Hours:** 4  
**Recommended:** Ecology and basic statistics course

### F_W 7800: Environmental Toxicology

**Credit Hours:** 3  
**Prerequisites:** CHEM 1320

### F_W 7810: Wildlife Disease Ecology
(cross-leveled with F_W 7810). An introduction to the ecology of wildlife diseases. Topics include the definition of a disease, how to measure diseases, impacts on individuals and populations, and the role of disease in wildlife management and conservation.

**Credit Hours:** 3  
**Prerequisites:** instructor's consent

### F_W 7880: Waterfowl Ecology and Management

**Credit Hours:** 3  
**Prerequisites:** F_W 2600; BIO_SC 3650; instructor's consent
F_W 8001: Topics in Fisheries and Wildlife
Organized study of selected topics. Subjects and credit may vary from semester to semester.
Credit Hour: 1-99
Prerequisites: instructor's consent

F_W 8050: Non-Thesis Research in Fisheries and Wildlife
Independent research not leading to a thesis.
Credit Hour: 1-99

F_W 8085: Graduate Problems in Fisheries and Wildlife
Individualized problems studies to supplement regularly organized graduate courses in Fisheries and Wildlife.
Credit Hour: 1-5
Prerequisites: consent of supervising faculty member

F_W 8087: Masters Seminar in Fisheries and Wildlife
Discussions of current developments in forestry, fisheries and wildlife, and critical study of research programs.
Credit Hour: 1

F_W 8090: Masters Thesis Research in Fisheries and Wildlife
Research leading to a thesis or dissertation. Graded on a S/U basis only.
Credit Hour: 1-99

F_W 8300: Professional Development and Communications
Intended to foster professional growth and development of graduate students. The course will present a rigorous introduction to professionalism, ethics, career development, and professional communications skills and techniques. Graded on A-F basis only.
Credit Hour: 1-3

F_W 8460: Wetland Ecology
A survey of the wetlands of North America; emphasis on nutrient dynamics, habitat structure, management, legislation and regulations, and man's impacts.
Credit Hours: 3
Prerequisites: NAT_R 4100, BIO_SC 3650 and instructor's consent

F_W 8510: Ecology, Conservation, and Environmental Justice
The goal of this course is to introduce graduate students in natural resource management and conservation biology to the ecological and management concepts that underlie environmental justice issues, and to explain how broader environmental justice concepts are relevant to natural resource and conservation fields. Graded on A-F basis only.
Prerequisites: one undergraduate course from the following list of disciplines: ecology, natural resource management, conservation biology, sociology or equivalent.
Credit Hours: 2

F_W 8520: Stream Ecology
Ecological principles applied to flowing waters. Emphasis on ecological processes within algal, invertebrate and fish communities. The influence of geomorphic processes, hydrologic principles and physical-chemical factors on the biota.
Credit Hours: 3

F_W 8530: Quantitative Ecology
Methods to assess space use patterns, animal abundance and population status are drawn into quantitative framework for making ecological inferences. Practical application and limitations of techniques are emphasized through analysis and interpretation of field and simulated data.
Credit Hours: 4
Recommended: F_W 4500 or equivalent

F_W 8901: Selected Topics in Fisheries and Wildlife Sciences for Doctoral Students
Organized study of selected topics for PhD students in Fisheries and Wildlife Sciences. Subjects and credits may vary from semester to semester. Graded on A-F basis only.
Credit Hour: 1-4
Prerequisites: PhD standing and instructor consent

F_W 9087: PhD Seminar in Fisheries and Wildlife
Discussions of current developments in forestry, fisheries and wildlife, and critical study of research programs.
Credit Hour: 1

F_W 9090: Ph. D. Dissertation Research in Fisheries and Wildlife
Research leading to a thesis or dissertation. Graded on a S/U basis only.
Credit Hour: 1-99

NAT_R 1040: Conservation Studies
A one-week field experience in natural resource management issues - soil and water conservation, air pollution, fish and wildlife habitat requirements, importance of forest ecosystems. Limited to high school students who have completed their junior year and taken the PSAT or equivalent. Graded on S/U basis only.
Credit Hour: 1

NAT_R 1060: Ecology and Conservation of Natural Resources
Introduction to the principles of resource and conservation describing the foundation of the variety of natural resources and conservation practices used to protect and maintain these resources.
Credit Hours: 3

NAT_R 1070: Ecology and Renewable Resource Management
Introduction to ecological principles and their relationship to resource use and management.
Credit Hours: 3
Prerequisites: restricted to Natural Resources majors

NAT_R 2002: Topics in Natural Resources - Biological
Organized study of selected topics. Subjects and credit may vary from semester to semester.
NAT_R 2080: Outdoor Recreation Consortium
Outdoor Recreation Consortium is a collaborative course taught by MU, North Carolina State University, Penn State University, East Carolina University, Texas A&M University and Western Illinois University. The course uses Great Smoky Mountains National Park as a case study for understanding the relationship between ecosystem management, natural resource management, tourism, and outdoor recreation. This course is based around a one week trip to the Smokies. Graded on A-F basis only.

Credit Hours: 2
Prerequisites: NAT_R 1070 or PRST 2111 or ENV_SC 1100 and permission of instructor

NAT_R 2160: Issues in Natural Resources and the Environment
This course provides an introduction to ecological and environmental challenges in natural resource management in our rapidly changing world. Topical discussions will provide students with informed perspectives of several contemporary issues that affect the sustainability of our natural resources.

Credit Hours: 3
Recommended: This course is recommended as an introductory course for non-science majors

NAT_R 2325: Introduction to Geographic Information Systems
Cover basic theories and techniques of GIS; including vector and raster data representation, vector data digitizing, attribute data input, map projection, layout database manipulation, terrain analysis and spatial interpolation.

Credit Hours: 3
Prerequisites: NAT_R 1070 or instructor's consent

NAT_R 3110: Natural Resource Biometrics
Sampling methods and analysis as applied to a variety of natural resources, including fisheries, range, recreation, forests, water and wildlife.

Credit Hours: 3
Recommended: STAT 2500 or equivalent

NAT_R 3200: Hydrologic Measurement Techniques
Students will be introduced to field methods and tools used by water resource and environmental science professionals. Students will sample and measure hydrologic and environmental variables, learn about data storage systems, and access and analyze data. Course may be repeated for credit. Graded on A-F basis only.

Credit Hour: 1
Prerequisites: MATH 1100 or permission of instructor

NAT_R 3290W: Hydrologic Measurement Techniques - Writing Intensive
Students will be introduced to field methods and tools used by water resource and environmental science professionals. Students will sample and measure hydrologic and environmental variables, learn about data storage systems, and access and analyze data. Course may be repeated for credit. Graded on A-F basis only.

NAT_R 3400: Water Quality and Natural Resource Management
(same as ENV_SC 3400). Introduction to broad aspects of water quality science, management, and policy. Topics include aquatic ecology, eutrophication, lake and coastal management, water supply and treatment, watershed management with respect to agriculture and urban development, and toxicology. Graded on A-F basis only.

Credit Hours: 3
Recommended: CHEM 1320 and ENV_SC 1100 or NAT_R 1070

NAT_R 4001: Topics in Natural Resources
Organized study of selected topics. Subjects may vary from semester to semester.

Credit Hour: 1-99

NAT_R 4024: Foundations of Environmental Education
(same as ENV_SC 4024; cross-leveled with NAT_R 7024). This course provides a theoretical foundation to environmental education (EE). The purpose of this course is to develop knowledge and skills for developing quality, age-appropriate EE for students in both formal and non-formal education setting. The emphasis is on EE curriculum materials, resources, and programs that can be used with students in settings at classrooms, nature centers, museums, and parks. This course involves training in the Missouri Department of Conservation Discover Nature School educational materials, and in observing and teaching EE lessons in a local nature center. Graded on A-F basis only.

Credit Hours: 3
Prerequisites: BIO_SC 1010 or ENV_SC 1100 or NAT_R 1060 or NAT_R 1070 or NAT_R 2160 or Instructor's consent

NAT_R 4100: Lake Ecology
(same as ENV_SC 4100; cross-leveled with NAT_R 7100). Ecology of inland waters with emphasis on productivity. Graded on A-F basis only.

Credit Hours: 3
Recommended: senior standing or BIO_SC 3650

NAT_R 4300: Methods in Aquatic Ecology
(same as ENV_SC 4300; cross-leveled with ENV_SC 7300, NAT_R 7300). Methods used for quantitative assessment of water quality and quantity in inland waters. Graded on A-F basis only.

Credit Hours: 3
Recommended: Senior standing or BIO_SC 3650 and ENV_SC 4100 or NAT_R 4100 or NAT_R 4200 or FOREST 4390 or NAT_R 3400

NAT_R 4353: Natural Resource Policy/Administration
This course examines law, policy, and administration related to public lands and natural resources in the United States. The focus of this course is U.S. federal decision-making; we will also discuss Missouri state-level processes and selected topics in international environmental governance. Substantive policy areas addressed by this course include: public lands, wildlife and fisheries, water resources, forests, and energy and mineral resources. This course uses case studies to illustrate historical and contemporary natural resource management challenges. It also addresses topics on governance such as public participation, the role of
lobbyists, campaign finance, and the use of technology to improve policy-making. This course will use a variety of teaching methods, including lecture and classroom discussion, guest speakers, map quizzes, and a natural resources book club.

**Credit Hours:** 3  
**Prerequisites:** senior standing or instructor's consent

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**NAT_R 4365: GIS Applications**  
Introduces logical thinking and techniques in applying GIS to practical problems. Covers general GIS functionalities, Arc View Spatial Analyst including georeference, terrain analysis, hydrological analysis, grid, and remote sensing image processing.

**Credit Hours:** 3  
**Prerequisites:** GEOG 3040 or NAT_R 2325

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**NAT_R 4385: Landscape Ecology and GIS Analysis I**  
(same as GEOG 4810). Examination of the landscape-scale approach to biodiversity, ecosystem dynamics, and habitat management. Particular emphasis on the use of Geographic Information Systems to analyze the spatial dimension of ecological patterns and processes.

**Credit Hours:** 3  
**Prerequisites:** GEOG 3040 or NAT_R 2325

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**NAT_R 7001: Topics in Natural Resources**  
Organized study of selected topics. Subjects may vary from semester to semester.

**Credit Hour:** 1-99

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**NAT_R 7024: Foundations of Environmental Education**  
(cross-leveled with NAT_R 4024, ENV_SC 4024). This course provides a theoretical foundation to environmental education (EE). The purpose of this course is to develop the knowledge and skills for developing quality, age-appropriate EE for students in both formal and non-formal education setting. The emphasis is on EE curriculum materials, resources, and programs that can be used with students in settings at classrooms, nature centers, museums, and parks. This course involves training in the Missouri Department of Conservation Discover Nature School educational materials, and in observing and teaching EE lessons in a local nature center. Graded on A-F basis only.

**Credit Hours:** 3

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**NAT_R 7100: Lake Ecology**  
(same as ENV_SC 7100; cross-leveled with ENV_SC 4100 and NAT_R 4100). Ecology of inland waters with emphasis on productivity. Graded on A-F basis only.

**Credit Hours:** 3  
**Recommended:** BIO_SC 3650

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**NAT_R 7300: Methods in Aquatic Ecology**  
(same as ENV_SC 7300; cross-leveled with NAT_R 4300, ENV_SC 4300). Methods used for quantitative assessment of water quality and quantity in inland waters. Graded on A-F basis only.

**Credit Hours:** 3  
**Recommended:** senior standing or BIO_SC 3650. ENV_SC/NAT_R 4100 OR 3400 OR FOR 4390

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**NAT_R 7353: Natural Resource Policy/Administration**  
(cross-leveled with NAT_R 4353). This course examines law, policy, and administration related to public lands and natural resources in the United States. The focus of this course is U.S. federal decision-making; we will also discuss Missouri state-level processes and selected topics in international environmental governance. Substantive policy areas addressed by this course include: public lands, wildlife and fisheries, water resources, forests, and energy and mineral resources. This course uses case studies to illustrate historical and contemporary natural resource management challenges. It also addresses topics on governance such as public participation, the role of lobbyists, campaign finance, and the use of technology to improve policy-making. This course will use a variety of teaching methods, including lecture and classroom discussion, guest speakers, map quizzes, and a natural resources book club.

**Credit Hours:** 3  
**Prerequisites:** GEOG 3040, NAT_R 1080 and NAT_R 1090, or instructor's consent

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**NAT_R 8001: Topics in Natural Resources**  
Organized study of selected topics. Subjects may vary from semester to semester.

**Credit Hour:** 1-99

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**NAT_R 8024: Program Development and Evaluation in Informal Settings**  
This advanced level course focuses on designing, conducting, and analyzing quantitative educational research data and evaluation studies that measure the impact and effectiveness of environmental education and/or STEM education programs. Applied statistics in educational research will be taught. Evaluation is a set of approaches and techniques used to make judgments about the effectiveness or quality of a program or treatment; to inform decisions about its design, development, and implementation. This course provides theoretical background and techniques of program development and evaluation. This course will use practice using qualitative and quantitative data for data analysis and manuscript writing. This is designed for those who will be working in leadership or supervisory capacities to gain skills in conducting needs assessments, designing programs, and conducting formative and summative evaluations of these programs for citizen science, inquiry-based learning, place-based program, students-centered, science outreach program, and nature explore study programs. By the end of the semester, students will have a ready-to-submit manuscript completed. Graded on A-F basis only.

**Credit Hours:** 3  
**Prerequisites:** ENV_SC 4024 or NAT_R 4024 or NAT_R 7024
NAT_R 8050: Masters Non-Thesis Research in Natural Resources
Research credits associated with a non-thesis M.S. project. May be repeated for credit. Graded on S/U basis only.
Credit Hours: 1-10
Prerequisites: restricted to Masters students in the School of Natural Resources

NAT_R 8090: Master Thesis Research in Natural Resources
Research credits leading to M.Sc. thesis. May be repeated for credit. Graded on S/U basis only.
Credit Hours: 1-10
Prerequisites: Restricted to Masters students in the School of Natural Resources

NAT_R 8290: Hydrologic Measurement and Synthesis
Students are introduced to methods fundamental to measuring hydrologic processes, and assessing physical data, including field measurement, and data logging and acquisition information systems. Students will gain experience analyzing and synthesizing hydrologic data using tools commonly used by water resource professionals. May be repeated for credit. Graded on A-F basis only.
Credit Hours: 3
Prerequisites: MATH 1100, STAT 2530, PHYSCS 1210. If deficient in prerequisite courses, or unsure of qualification, contact instructor for consent

NAT_R 8300: Urban Biodiversity, Conservation, and Planning
The importance of urban biodiversity is debated by many in the conservation community. Some researchers and managers focus on threats to biodiversity associated with urbanization and land use change. In contrast to this approach people who live in, study, or care about cities: ecologists, wildlife managers, conservation biologists, planners, and local residents have debated what biodiversity means in urban settings. Recent literature on biodiversity in cities notes the range of ecological, social, and cultural meanings of urban biodiversity and stresses the importance of defining the setting and scales at which biodiversity is being assessed. This approach to urban biodiversity has documented the importance of conservation of rare species and habitats but also the importance of managing the range of habitats in and around where people live, work, and play. This course builds on the work of the NSF-funded Urban Biodiversity Research Coordination Network (UrBioNet), with course modules taught by UrBioNet steering committee members.
Credit Hours: 3
Recommended: Coursework in ecology, conservation / management or planning will be helpful in this course

NAT_R 8325: Introduction to Geographic Information Systems
Cover theories and techniques of GIS; including vector and raster data representation, vector data digitizing, attribute data input, map projection, layout database manipulation, terrain analysis and spatial interpolation.
Credit Hours: 3
Prerequisites: Instructor's consent

NAT_R 8395: Landscape Ecology and GIS Analysis II
(same as GEOG 8815). Provide students with principles and applications of landscape ecology and firm understandings of spatial analysis techniques using GIS. Discuss metrics for spatial pattern and models for landscape-scale dynamics.
Credit Hours: 3
Prerequisites: NAT_R 4365; FOREST 4320 or equivalent; basic statistics; instructor's consent
Recommended: GEOG 4810 or GEOG 7810

NAT_R 8450: Advanced Limnology
This graduate course will cover the physical, chemical, and biological processes of lakes and streams emphasizing biological production, water quality, and emerging issues. This seminar-style graduate course will familiarize students with the limnological literature. Students will learn how to critically read, interpret, and evaluate journal publications. They will learn the publication process from beginning to end with the opportunity to provide perspectives and assessments of emerging manuscripts in the limnological field. Graded on A-F basis only.
Credit Hours: 3
Recommended: NAT_R 4100 or NAT_R 7100

NAT_R 8500: Qualitative Research
Introduces students to qualitative field research from design, data collection, analysis, reporting, and peer-reviewed publication. Readings emphasize qualitative methods in a variety of social and behavioral sciences to address environmental problems.
Credit Hours: 3
Recommended: PRST 8430

NAT_R 860: International Comparative Rural Policy
(same as PUB_AF 8860. AAE 8860). Compares the rural policy objectives and implementation strategies of various countries, and assesses these policies in terms of economic, social, environmental outcomes and their implications for international relations. Includes 2-weeks of study Abroad. May be repeated for credit. Graded on A-F basis only.
Credit Hours: 3

NAT_R 9001: Topics in Natural Resources
Organized study of selected topics. Subjects and topics may vary from semester to semester. Graded on S/U basis only.
Credit Hour: 1-10
Prerequisites: instructor's consent. Restricted to School of Natural Resources Graduate Students

NAT_R 9090: Dissertation Research in Natural Resources
Research leading to a dissertation and Ph.D. in the School of Natural Resources. Graded on S/U basis only.
Credit Hour: 1-10
Prerequisites: Restricted to PhD students in the School of Natural Resources

NAT_R 9490: Ecohydrology: Contemporary Topics
A series of discussions centered on primary literature within disciplines relevant to the participants. All Natural Resources disciplines are encouraged to participate (e.g., ecology, wildlife, fisheries, recreation /
tourism, hydrology, atmospheric sciences, soils, etc.) with emphasis on interdisciplinary research (i.e. integrated natural, social and/or physical scientific research). May be repeated for credit. Graded on A-F basis only.

Credit Hour: 1