

Department of
Forest, Range, and Wildlife Sciences
 College of Natural Resources

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Professors John A. Bissonette, Leader, Utah Cooperative Fish and Wildlife Research Unit, landscape ecology, terrestrial vertebrate ecology; James E. Bowns, range ecology; F. E. "Fee" Busby, Dean of College of Natural Resources, effects of livestock grazing; Martyn M. Caldwell, Director Ecology Center, plant physiological ecology; Michael R. Conover, animal behavior, wildlife damage management; Raymond D. Dueser, Associate Dean of College of Natural Resources, terrestrial ecology, mammalian biology; James N. Long, forest ecology, silviculture; John C. Malechek, rangeland management; Frederick D. Provenza, range animal production; Neil E. West, rangeland desertification/condition/trend; Michael L. Wolfe, wildlife ecology and management; **Research Professor** Frederick F. Knowlton, Predator Ecology and Behavior Project, predator ecology, behavior and management; **Adjunct Professors** Douglas A. Johnson, plant ecophysiology; Jesse A. Logan, forest insect ecology, disturbance ecology, dynamical systems analysis; **Professors Emeriti** Thadis W. Box, range management; Theodore W. Daniel, silviculture; John A. Kadlec, wetlands ecology, wildlife management; Ronald M. Lanner, forest genetics, dendrology; Frederic H. Wagner, wildlife ecology, natural resources policy; John P. Workman, range economics; **Associate Professors** Frederick A. Baker, forest pathology, computer applications; Roger E. Banner, range extension specialist; Christopher A. Call, vegetation manipulation/management; Thomas C. Edwards, Jr., Utah Cooperative Fish and Wildlife Research Unit, spatial ecology, habitat modelling, biostatistics; Michael J. Jenkins, disturbance ecology and management, insects, fire, snow avalanches; Michael R. Kuhns, forestry extension specialist, urban forestry, tree physiology; Terry A. Messmer, fisheries and wildlife extension specialist, wild ungulate and waterfowl management, wetlands ecology, private land management, conservation communication; Brien E. (Ben) Norton, grazing ecology, international range management; R. Douglas Ramsey, remote sensing, geographic information systems, landscape ecology, spatial analysis; Eugene W. Schupp, plant population ecology and restoration ecology; Helga Van Miegroet, forest soils and biogeochemistry; **Extension Associate Professor** Charles W. Gay, Associate Vice President for Extension and Associate Director of Cooperative Extension; **Research Associate Professor** Leila McReynolds Shultz, plant taxonomy and geography; **Adjunct Associate Professors** Dale L. Bartos, range ecology; Mark W. Brunson, social science aspects of forest and rangeland management; conservation ecology, biometrics, spatial ecology; D. Layne Coppock, animal production systems/technology transfer and international pastoral development; John L. Crane Jr., environmental resource management; Thomas A. Jones, native grass breeding; Kenneth C. Olson, grazing livestock nutrition; James A. Pfister, poisonous range plants; Michael H. Ralphs, poisonous plants/grazing management; Robert H. Schmidt, wildlife policy, wildlife damage management; **Associate Professor Emeritus** Gar W. Workman, wildlife ecology and management; **Assistant Professors** Nicole L. McCoy, natural resource economics; Karen E. Mock, conservation genetics and applied molecular ecology; Ronald J. Ryel, plant physiological ecology; **Extension Assistant Professor** Richard C. Etchberger, Uintah Basin Campus, wildlife-habitat relationships, natural resources education; **Research Assistant Professors** Thomas J. DeLiberto, Predator Ecology and Behavior Field Station, veterinary medicine of wild species; Eric M. Gese, Predator Ecology and Behavior Field Station, predator behavior and ecology; **Non-tenure-track Assistant Professor** Barbara J. Bentz, forest entomology; **Adjunct Assistant Professors** Thomas A. Monaco, research ecologist; William C. Pitt, Acting Station Leader and wildlife research biologist, Predator Ecology and Behavior Field Station; **Assistant Professor Emeritus** Barrie K. Gilbert, wildlife ethology, behavioral ecology; **Adjunct Instructors** Carla G. Heister, natural resource library and information systems; Jon Keith Schnare, timber harvest planning and logging methods; **Lecturer** Laura O'Brien, remote sensing, geographic information systems, web-based instruction

Degrees offered: Bachelor of Science (BS), Master of Science (MS), and Doctor of Philosophy (PhD) in Forestry; BS in Rangeland Resources; BS in Fisheries and Wildlife; MS and PhD in Ecology; MS and PhD in Range Science; and MS and PhD in Wildlife Biology

Undergraduate emphases: *Fisheries and Wildlife*—Conservation Biology, Problem Wildlife Management, and Wildlife; *Rangeland Resources*—Rangeland Ecology, Rangeland Restoration, Rangeland Resource Specialist, and Rangeland Stewardship

Graduate specializations: *MS, PhD in Ecology*—Conservation Biology, Wildlife Ecology; *MS, PhD in Wildlife Biology*—Conservation Biology, Problem Wildlife Management, Wildlife Management

Undergraduate Programs

Objectives

The Department of Forest, Range, and Wildlife Sciences offers three undergraduate degrees: Forestry, Rangeland Resources, and Fisheries and Wildlife. These degree programs offer broad educational opportunities for students interested in the analysis and management of forest and rangeland ecosystems and their associated wildlife populations. The department's philosophy of education is to promote a broad interdisciplinary approach to natural resources analysis, management, and science.

Requirements

Admission Requirements. Admission requirements for the Department of Forest, Range, and Wildlife Sciences are the same as those described for the College of Natural Resources on pages 100-101.

Graduation Requirements. All Natural Resources core courses and all courses listed as major subject courses must be taken on an *A-B-C-D-F* basis. A grade of *C-* or better is required for all Forest, Range, and Wildlife Sciences courses used to meet the requirements for a major or minor in the department. The grade point average for all courses taught by the College of Natural Resources must be 2.5 or higher.

In addition to completing the University Studies course requirements, all students earning an undergraduate degree in the College of Natural Resources must complete six core courses (college core) in natural resource science and management: EnvS 2340 (BSS); Geog 1130 (BPS) or Geol 1150 (BPS); NR 2220, 3000, 3600 (QI), and 4000. Students must also complete a series of basic lower-division courses providing the disciplinary foundation for the natural resource professions before moving on to professional coursework. Some foundation and core courses may be used toward the University Studies requirements, as indicated by the University Studies designations listed in parentheses following the course numbers.

The first two years of study in the Department of Forest, Range, and Wildlife Sciences are designed to provide students with a sound background in the natural sciences, an introduction to the field of natural resources management, and an introduction to their respective major. The last two years are designed to provide an advanced understanding of natural resource management and science, depth concentration in the major, and experience with the integration of scientific and management concepts across a diversity of disciplines and management scenarios. Students are expected to enroll for 15 or more credits of coursework per semester.

Bachelor of Science in Forestry. Students must meet the course requirements for University Studies, the college core, and the majors curriculum listed below, including a required four-week summer camp (FRWS 3100). Supporting math and science courses include: Biol 1210, 1220 (BLS); Chem 1110; Engl 1010 (CL), 2010 (CL); Math 1100 (QL); Spch 1050 (CI); Stat 2000 (QI); USU 1300 (BAI). Forestry core courses include: AWER 3700; EnvS 1990 or FRWS 1990; EnvS 3300, 4000 (DSS), 4400, 5300; FRWS 3220, 3250, 3500, 4270, 4300, 4520, 4540, 5420 (CI), 5510; NR 5000; Soil 3000.

Bachelor of Science in Rangeland Resources. Students must meet the course requirements for University Studies, the college core, and the following majors curriculum. Supporting math and science courses include: Biol 1210, 1220 (BLS); Chem 1210, 1220 (BPS), 1230; Math 1100 (QL); Stat 2000 (QI) or 3000 (QI). Rangeland Resources core courses include: Econ 1550 (BSS); FRWS 1990, 2910, 3500, 4450, 4980, 5410 (QI/CI), 5610; Soil 3000.

For information about required courses in the emphasis areas, students should confer with a departmental advisor.

Rangeland Resources Minor. Students wishing to complete a minor in Rangeland Resources should contact the department head in NR 210.

Bachelor of Science in Fisheries and Wildlife. The Fisheries and Wildlife major is jointly administered by the Department of Forest, Range, and Wildlife Sciences (FRWS) and the Department of Aquatic, Watershed, and Earth Resources (AWER). Students interested in the Fisheries and Wildlife—Wildlife emphasis and the Fisheries and Wildlife—Problem Wildlife Management emphasis should declare the major in FRWS. Those interested in the Fisheries and Wildlife—Conservation Biology emphasis may declare the major in either FRWS or AWER.

Students in the Fisheries and Wildlife major must meet the course requirements for University Studies, the college core, and the following majors curriculum. Supporting math and science courses include: Biol 1210, 1220 (BLS); Chem 1210, 1220 (BPS), 1230, 1240; Math 1050 (QL), 1100 (QL); Phyx 2110; Stat 3000 (QI). Fisheries and Wildlife core courses include: AWER 3100 (CI), 3110, 4500; FRWS 3200 (CI), 3210, 3300, 3400, 4400 (or AWER 4510), 4980, and one management core course (see major requirement sheet for listing of courses). Elective courses are chosen in consultation with a faculty advisor and may include one of the following areas of emphasis.

Students pursuing the **Fisheries and Wildlife—Conservation Biology** emphasis are required to take Biol 3200 (QI), 5250 (CI); FRWS 5800. Students are also strongly encouraged to take AWER 6750.

Students pursuing the **Fisheries and Wildlife—Problem Wildlife Management** emphasis are required to take Biol 5560, 5580; FRWS 5100, 5300.

Students pursuing the **Fisheries and Wildlife—Wildlife** emphasis are required to take Biol 3400; Biol 5560 or 5580; FRWS 3500, 5070.

Fisheries and Wildlife Minor. The minor is designed for students with a strong background in biology. Approval of the department head and completion of a minimum of 19 credits are required. Course requirements include: AWER 3100 (CI); FRWS 3200 (CI); NR 2220, 3000; and two of the following courses: EnvS 4110; FRWS 3300, 3400, 5400.

Financial Assistance

The main opportunities for undergraduates to find financial support through grants, work-study, and loans are listed on pages 22-25 in the *Financial Aid and Scholarship Information* section. In addition, more than 30 scholarships for eligible students in the College of Natural Resources are listed on pages 37-38 of the same section. Some students may be able to find paid internships with private or governmental organizations, or work for a faculty

member on a research project. Interested persons should contact the department for more information on financial assistance for undergraduate students.

Additional Information

The undergraduate program may be tailored to individual student needs with the help of a faculty advisor. For additional information about the degree requirements, course sequencing, and departmental specialization options and their related coursework, as well as updated information describing current programs and courses offered by the Department of Forest, Range, and Wildlife Sciences, visit the Forest, Range, and Wildlife Sciences main office, Natural Resources 206, or visit <http://www.cnr.usu.edu> and link to the departmental website.

Graduate Programs

Admission Requirements

The Department of Forest, Range, and Wildlife Sciences offers opportunities for graduate study through MS and PhD degree programs in Ecology, Forestry, Range Science, and Wildlife Biology. The department also offers opportunities to participate in a college-wide Master of Natural Resources (MNR) degree program administered through the College of Natural Resources. The MNR is described more fully on page 374.

The programs of instruction and research leading to graduate degrees in the department are available only to students meeting high scholastic standards who are accepted for study by the departmental faculty. Students desiring entrance to these graduate programs should contact the department head for information concerning eligibility.

USU School of Graduate Studies general admission requirements are described on pages 72-73. Applicants for graduate study in the department should have a bachelor's degree from an accredited college or university, a cumulative GPA of at least 3.0 (out of 4.0), and GRE scores (quantitative and verbal) above the 40th percentile. Foreign students should submit a TOEFL score of at least 550. Exceptions to these standards will be considered on a case-by-case basis. Written statements of interest help match applicants with faculty advisors. A faculty member must agree to serve as the major professor in order for an applicant to be accepted for study. Prospective students are encouraged to contact faculty members early in the application process to investigate mutual interests, projects, and prospects for financial support.

A natural resources baccalaureate degree is not required for admission to the department, although a sound background in the natural sciences is strongly recommended. Students lacking the requisite background will work with their supervisory committee to address deficiencies.

Degree Programs

The MS degree is offered for students motivated toward a management or administrative career in natural resources management. The MS may be obtained through either a Plan A (research thesis) or Plan B (nonthesis) program, as described on page 77. The **Plan A** option requires a thesis based on original research conducted by the student. The **Plan B** option is recommended for professional forestry, rangeland, or wildlife managers who do not

desire research training. The PhD degree is intended for students seeking a natural resources research or academic career. Comprehensive exams (both oral and written) are required in the doctoral program.

The minimum requirement for an MS degree is 30 credits, including at least 24 credits in residency and 6 credits of thesis research. The minimum requirement for a PhD degree is 60 approved graduate credits in addition to an MS degree, or 90 approved graduate credits with no MS degree. At least one year (a minimum of 32 credits), including a minimum of two consecutive semesters, of full-time registration must be in residence at USU.

With committee approval, graduate credit may be transferred from accredited graduate schools, provided the minimum residency requirement (including thesis and dissertation credit) at USU is met. Transfer credit, which must not have been used for any other degree, will be shown on official USU transcripts at completion of the degree.

Research

Cooperation with other departments and research centers of the University, as well as with government collaborators, permits strong graduate programs in all aspects of forest, range, and wildlife-related sciences. Particular mention should be made of the USU Ecology Center, in which the Forest, Range, and Wildlife Sciences Department is very active; the Utah Agricultural Experiment Station, which has a full program in both applied and basic research; the Utah Cooperative Fisheries and Wildlife Research Unit; the Predator Ecology and Behavior Field Station; the Jack H. Berryman Institute; the Center for Water Resources Research; the U.S. Forest Service Rocky Mountain Forest and Range Experiment Station; and the USDA Agricultural Research Service. The Institute for Land Rehabilitation, located within the department, acts as a clearinghouse of information on land reclamation, especially semiarid rangelands. The International Pastoral Production Institute, also located within the department, offers training in production systems for developing nations.

Financial Assistance

General aspects of financial support for graduate students at Utah State University are listed on pages 71-72 in the *Graduate Financial Assistance* section. This includes important information on the University-wide policies and terms of reference for research and teaching assistantships, graduate tuition obligations and benefits, Western Regional Graduate Programs, and competitive University-wide fellowships and scholarships. The College of Natural Resources also offers a limited number of Quinney Doctoral Fellowships for incoming doctoral students.

Graduate research assistantships may be available on a competitive basis to both MS and PhD students through major professors having contracts, grants, or other awards from the University, private sector, or government agencies. These assistantships vary in the amount of support offered, but they commonly offer a stipend to help cover living expenses and operating funds to carry out the research. Other benefits may include assistance with tuition and student health insurance, as well as opportunities to travel.

The department also has a few graduate teaching assistantships for students who help with teaching, grading, or recitation in large courses. These typically pay only a modest supplement on a semester basis, however, and are not sufficient to cover living expenses. Domestic PhD students on a research assistantship in some departmental degree programs are required to hold at least

one teaching assistantship during their program, to obtain experience in classroom (mainly undergraduate) instruction. MS students may also hold teaching assistantships, contingent upon availability of funds. Acceptance to pursue graduate study does not guarantee the student financial assistance.

Additional Information

For more information about graduate programs and departmental faculty and their research emphasis areas, as well as updated information describing current programs and courses offered by the Department of Forest, Range, and Wildlife Sciences, visit the Forest, Range, and Wildlife Sciences main office, Natural Resources 206, or visit <http://www.cnr.usu.edu> and link to the departmental website.

Forest, Range, and Wildlife Sciences Courses (FRWS)

FRWS 1990. Professional Orientation. Introduction to forestry, range, wildlife, and related careers. Offers new students an orientation to College of Natural Resources faculty, college and University programs, careers in natural resources, and professional societies. (1 cr) (F)

FRWS 2200 (BLS). Ecology of Our Changing World. Foundations of ecological and evolutionary relationships of organisms with other organisms and with the physical environment, emphasizing populations, communities, and ecosystems. Integration of basic science with applications of science to understanding human interactions with the environment. (3 cr) (F,Sp) ©

FRWS 2210. Basic Wildfire Suppression. Trains individuals in basic wildfire behavior and suppression. Qualifies student to function as a member of a wildfire suppression crew. (2 cr) (Sp)

FRWS 2250. Introductory Internship/Co-op. Introductory-level educational experience in internship/cooperative education position approved by department. (1-3 cr) (F,Sp,Su) ®

FRWS 2300. Mushroom Identification. Lecture course covering taxonomy, ecology, and importance of macro and micro fungi. Also taught as Biol 2300. (1 cr) (F)

FRWS 2310. Mushroom Identification Lab. Lab course acquainting students with basic fungal taxonomic groups. Students collect, preserve, and identify fungi they collect. Edible fungi prepared and eaten. Also taught as Biol 2310. (1-2 cr) (F) ®

FRWS 2910. Professional Leadership Seminar. Development of professional leadership and communication skills, including mission statements, time management, and team building. (1 cr) (F)

FRWS 3050 (DSC). Ecology of Logan Canyon and Vicinity. Examines natural and human-caused changes in biological and physical features in the local landscape through time. Emphasizes how ecological knowledge and a sense of place can help people to better understand local environmental issues. Also taught as Geol 3050. (3 cr) (F)

FRWS 3100. Natural Resources Field Experience. Fundamentals of ecology and field practice for natural resource managers, including basic measurements and field orientation. Graded pass/fail only. (6 cr) (Su)

FRWS 3200 (CI). Wildlife Diversity. Natural history (identification, distribution, life history, physiology, and behavior) of North American vertebrates, especially game birds and mammals and threatened species. Emphasis on ecological, behavioral, and evolutionary aspects of special relevance to management. Prerequisite: Biol 1220. (3 cr) (Sp)

FRWS 3210. Wildlife Diversity Laboratory. Laboratory and field course in species identification; techniques of sex/age determination; and interpretation of morphological, physiological, and behavioral adaptations. Prerequisite: FRWS 3200 (may be taken concurrently). (1 cr) (Sp)

FRWS 3220. Biology of Woody Plants. Introduction to biology of woody plants, including their morphological, anatomical, physiological, and reproductive attributes; evolutionary relationships; distribution patterns; and utility to humans. Prerequisite: Biol 1220 or permission of instructor. (4 cr) (F)

FRWS 3250. Forest Ecology. Principles and concepts of forest ecology. Forest environments, woody plant ecophysiology, forest ecosystem structure and function, and forest community ecology. (4 cr) (F)

FRWS 3300. Management Aspects of Wildlife Behavior. Principles, concepts, and mechanisms of animal behavior, emphasizing behavioral ecology, development, and comparative aspects of special relevance to management of fish and wildlife. (3 cr) (F)

FRWS 3400. Fish and Wildlife Populations. Explores fundamentals of how and why animal populations change over time. Strong quantitative approach used to show how these fundamentals apply to fisheries and wildlife management. Prerequisites: NR/Biol 2220, Math 1100. (3 cr) (F)

FRWS 3500. Computer Applications in Natural Resources. Advanced spreadsheet, graphics, aerial photography, and Geographic Information Systems for natural resource management. (3 cr) (F)

FRWS 3750. Geographic Applications in Remote Sensing. Overview of remote sensing systems, including principles, techniques, and applications of both aerial photography and satellite images. Provides information needed to understand and apply remote sensing to a wide range of resource applications. (3 cr) (Sp)

FRWS 4000. Fundamentals of Grazing Land Management. Explores ecological basis for sustainable land use under grazing by domestic and native herbivores. Explains how to translate knowledge of grazing impacts into rangeland management guidelines. (3 cr) (Sp)

FRWS 4050. Urban Fish and Wildlife Management. Concentrates on: understanding impacts of urbanization on wildlife and habitat; developing basic understanding of wildlife needs; completing urban wildlife habitat inventory; and preparing urban wildlife conservation and management plan. (3 cr) (F,Sp,Su) ©

FRWS 4200. Wildlife Law Enforcement. Review of principles of state and federal statute regulations pertaining to fish and wildlife. Discussion of rights of the individual, apprehension of violators, and collection of evidence and its use in court. (2 cr) (F)

FRWS 4250. Advanced Internship/Co-op. Advanced-level educational experience in internship/cooperative education position approved by department. (1-9 cr) (F,Sp,Su) ®

FRWS 4270. Silviculture. Application of principles and concepts from forest ecology to control the establishment, composition, structure, and growth of forests to achieve the objectives of management. Prerequisite: FRWS 3250. (4 cr) (F)

FRWS 4300. Forest Measurements. Measurements of timber in log, tree, and stand; log rules and scaling; statistical methods useful in analyzing forest data; and timber cruising practices. Prerequisites: Stat 2000, Math 1100, NR 3600, FRWS 3500. (3 cr) (Sp)

FRWS 4400. Terrestrial Ecology Laboratory. Field and laboratory analysis of terrestrial populations, communities, and ecosystems, with emphasis on hypothesis testing and decision-making. Prerequisites: NR/Biol 2220 (may be taken concurrently), Stat 3000. (3 cr) (F)

FRWS 4450. Rangeland Plants. Identification, ecology, and uses of plants on rangelands of western North America. (3 cr) (F)

FRWS 4520. Wildland Fire Management and Planning. Fire as a resource management tool, with applications in forest, range, and wildlife management. Fire ecology, policy, prescription planning, economics, behavior, and management. (2 cr) (Sp—2nd Half)

FRWS 4540. Forest Harvest and Utilization. Elements of timber harvest systems, including policies and practices for minimizing biophysical impacts. Utilization of wood resources. (2 cr) (F)

FRWS 4810. Directed Reading in Wildlife Damage Management. Focuses on wildlife damage management, especially as it reflects on both positive and negative human-wildlife interactions. For this reading course, students work with instructor to develop appropriate and rigorous reading program. (2 cr) (F,Sp,Su) ©

FRWS 4950. Special Topics. Individual study and research upon selected problems. Prerequisite: Advisor approval. (1-3 cr) (F,Sp,Su) ®

FRWS 4960. Directed Readings. Individual reading research on forest, range, and wildlife science readings. Prerequisite: Departmental approval. (1-3 cr) (F,Sp,Su) ®

FRWS 4970. Undergraduate Research. Individual or team research. Prerequisite: Advisor approval. (1-3 cr) (F,Sp,Su) ®

FRWS 4980. Undergraduate Seminar. Intended to bring upperclassmen up-to-date on topics in forest, range, and wildlife sciences. (1 cr) (F,Sp) ®

***FRWS 5000. Predator Ecology and Management.** Reviews biology, ecology, theory, management, and policy issues involving large vertebrate predators. Uses case histories to explore predation theory, population ecology, natural history, and management strategies. (3 cr) (Sp)

FRWS 5070 (d6070).¹ Range Wildlife Relations. Explores interactions on rangelands between wild and domestic ungulates, as well as other wildlife forms around the world, but with emphasis on western North America. Prerequisite: NR 3000 or equivalent. (3 cr) (F)

FRWS 5100. Wildlife Management Laboratory. Familiarizes students with variety of wildlife management and research techniques and strategies, including techniques to catch, mark, and restrain wild animals; monitoring wildlife populations; measuring physiological parameters; measuring habitat variables; assessing and preventing wildlife damage; and interpreting and analyzing biological data. (3 cr) (F)

FRWS 5150. Conflict Management in Natural Resources. Introduction to conflict management techniques for those involved in natural resource management. (2 cr) (Sp)

FRWS 5220 (d7220). Community-based Conservation Partnerships. Seeks to infuse ecology with applied conservation and management approaches. Conservation and management of natural resources requires an understanding of ecological rela-

tionships and strategies for working with diverse stakeholders. PhD-level students present their research. (3 cr) (Sp)

FRWS 5250 (d6250). Remote Sensing of Land Surfaces. Basic principles of radiation and remote sensing. Techniques for ground-based measurements of reflected and emitted radiation, as well as ancillary data collection to support airborne and satellite remote sensing studies in agriculture, geography, and hydrology. Prerequisites: Basic calculus and physics. Also taught as BIE 5250/6250 and Bmet 5250/6250. (4 cr) (Sp)

****FRWS 5270. Principles and Practices of Intensive Silviculture.** Familiarizes student with silvicultural methods appropriate for intensive forest management, including artificial regeneration and the assessment and control of basic growth and yield relations. Prerequisite: FRWS 4270. (3 cr) (Sp)

***FRWS 5290. Pastoral Production Systems.** Interdisciplinary approaches to understanding the dynamics of pastoral systems in economically developed and less-developed settings. Influences of culture, economics, and environment on resource management. Change and sustainability in pastoral systems. Innovations to enhance productivity or better mitigate risk. (3 cr) (Sp)

FRWS 5300 (d7300). Wildlife Damage Management Principles. Explains current legal, ethical, and biological principles for the control and/or management of problem vertebrate species. (3 cr) (Sp)

FRWS 5350 (d6350). Wildland Soils. Application of basic principles of soil science to wildland ecosystems. Effects of disturbance and land use on wildland soil properties. Role of soils in natural resource management. Prerequisites: Chem 1110; Soil 3000, and one additional upper-division Soils course, or permission of instructor. Also taught as Soil 5350/6350. (3 cr) (Sp)

FRWS 5400. Community and Ecosystem Concepts in Fisheries and Wildlife Management. Reviews factors controlling number of species, and their absolute and relative abundances in different habitats. Analyzes how species influence ecosystem structure and function (e.g., productivity, nutrient cycling, etc.). (3 cr) (Sp)

FRWS 5410 (CI, QI). Vegetation Analysis for Livestock and Wildlife. Methods and analytical procedures for measuring and assessing vegetation used by livestock and wildlife as forage and cover. Prerequisite: Stat 2000 or equivalent. (4 cr) (F)

FRWS 5420 (CI). Forest Pathology. Nature, cause, and management of forest diseases. Also taught as Biol 5420. (2 cr) (Sp)

FRWS 5430. Advanced Forest Pathology. In-depth exploration of forest pathology issues, focusing on ecosystem-level processes. (2 cr) (Sp)

FRWS 5450 (d7450). Wildlife Sociobiology. Examines wildlife communication, reproductive tactics, mating systems, parent-offspring conflicts, and social behavior. (3 cr) (Sp)

FRWS 5460. Avalanche and Snow Dynamics. Fundamentals of snow and avalanche dynamics. Avalanche safety, forecasting, hazard evaluation, and control. (2 cr) (Sp—first half)

FRWS 5510. Forest Entomology. Basic insect taxonomy, life histories, structure, and function. Ecological relationships, recognition, and management of insects of economic importance to forestry. Prerequisite: Basic entomology or biology. (2 cr) (F—1st Half)

FRWS 5610. Wildland Ecosystems. Structure, function, dynamics, classification, and multiple-resource management of terrestrial ecosystems found in the

Intermountain West. Prerequisites: Introductory courses in soils, plant identification, and ecology. (3 cr) (Sp)

FRWS 5630. Range Vegetation Manipulation and Management. Changing composition, structure, and productivity of range vegetation for multiple-use purposes by use of biological, chemical, mechanical, and pyric methods. Prerequisite: Course in general ecology. (3 cr) (F)

***FRWS 5640 (d7640). Riparian Ecology and Management.** Explores structure and function of riparian ecosystems and management options for maintaining sustainable ecological function. Prerequisite: NR/Biol 2220, AWER 3700. (3 cr) (Sp)

FRWS 5650. Urban/Community Forestry. Social, biological, and administrative aspects of managing urban/community forests, including field and classroom exercises and a management planning project. (3 cr) (Sp)

FRWS 5660 (d6660). Principles of Geographic Information Systems. Advanced introductory course in geographic information systems (GIS), with a focus on applications to natural resource research and management. Primary objective is learning basic functions of a GIS for use in data manipulation, data presentation, data inquiry, spatial analysis, modeling, and conversion of data into formats for use in other applications, such as reports and statistical analysis. For more information, visit the following website: <http://online.usu.edu/catalog>. (3 cr) (F,Sp,Su)

FRWS 5670 (d6670). Principles of Remote Sensing. Graduate-level introductory course covering principles, techniques, and applications of remote sensing. Designed to provide background necessary to make real use of remote sensing technologies in a variety of natural resource applications, or to stand alone as an up-to-date overview for those having a general interest in remote sensing technologies. For more information, visit the following website: <http://online.usu.edu/catalog>. (3 cr) (F,Sp,Su)

FRWS 5680 (d6680). Natural Resource Applications of Geographic Information Systems and Remote Sensing Technologies. Using the principles presented in the introductory courses, students in this project-based course research, apply, and evaluate geographic information systems and remote sensing technologies in relation to real-world, natural resource applications. Prerequisites: FRWS 5660/6660 and 5670/6670. For more information, visit the following website: <http://online.usu.edu/catalog>. (3 cr) (F,Sp,Su)

FRWS 5710. Disturbance Ecology in Forested Systems. Examines effects of disturbance on forest ecosystems. (3 cr) (Sp)

FRWS 5750 (d6750). Applied Remote Sensing. Covers the application of remote sensing to landcover mapping and resource monitoring at a quantitative level. Students instructed on the effects of atmosphere and surface interaction on the reflectance collected by electro-optical sensors, as well as on the proper use and interpretation of various calibration and classification algorithms. (3 cr) (Sp)

FRWS 5800. Genetics in Conservation and Management. Provides general background in conservation genetics. Lectures include some introductory population genetics and molecular techniques, theory, and evolution. After acquiring general understanding of these topics, students are exposed to molecular techniques during built-in hands-on laboratory experience. Recommended prerequisites: Evolution, population genetics, and/or genetics. (3 cr) (Sp)

****FRWS 5860. Poisonous Range Plants Affecting Livestock.** Poisonous plants of rangelands and their effects on grazing animals, especially livestock. Management practices to reduce or prevent poisoning. Also taught as ADVS 5860. (2 cr) (Sp)

****FRWS 6000. Grazing Systems.** Overview and analysis of various strategies for managing grazing on rangelands. Special attention given to ecological mechanisms by which a particular grazing system may benefit livestock production or the sustainability of rangeland resources. (2 cr) (Sp)

FRWS 6050. Rangeland Fire Ecology and Fire Prescription Development. Provides understanding of the role prescribed and natural fires have in western U.S. rangeland plant communities, and when fire can be used to achieve a specific plant community. Students learn basics of fire behavior and ignition techniques, and how to write prescribed fire use plans. (3 cr) (Su)

FRWS 6070 (d5070). Range Wildlife Relations. Explores interactions on rangelands between wild and domestic ungulates, as well as other wildlife forms around the world, but with emphasis on western North America. Prerequisite: NR 3000 or equivalent. (3 cr) (F)

FRWS 6100 (d7100). Topics in Physiological Ecology of Wildlife. Explores physiological ecology of wildlife, focusing on sensory factors influencing habitat selection, foraging, and mate choice. Prerequisites: Introductory coursework in biology, behavior, anatomy, and chemistry. Prerequisite: Permission of instructor. (3 cr) (Sp)

***FRWS 6150 (d7150). Concepts in Habitat Selection and Foraging Behavior.** Explores fundamental concepts of how animals choose resources within their environment. Employs various optimization models to derive principal hypotheses, design relevant experiments, and interpret field data. Explores real-world applications through extensive readings, commentaries, and problem sets. Prerequisite: NR/Biol 2220 or equivalent. (3 cr) (Sp)

FRWS 6180. Molecular Population Genetics Laboratory. Application of molecular techniques to population genetics, ecology, and systematics. Includes experimental and sampling design, and data analysis. Prerequisite: Biol 5170/6170 or permission of instructor. Also taught as Biol 6180. (5 cr) (F)

****FRWS 6200. Biogeochemistry of Terrestrial Ecosystems.** Inputs, outputs, and cycling patterns of major nutrients. Emphasis on mechanisms for transformations, factors influencing process rates, and the impacts of management and global change on nutrient cycles and air and water quality. Prerequisites: Biol 1220, Soil 3000, Chem 2300 or 2310, or permission of instructor. Also taught as Biol 6200 and Soil 6200. (3 cr) (F)

FRWS 6240. Graduate Internship/Co-op. Graduate-level educational experience in internship/cooperative education position approved by department. (1-9 cr) (F,Sp,Su) ®

FRWS 6250 (d5250). Remote Sensing of Land Surfaces. Basic principles of radiation and remote sensing. Techniques for ground-based measurements of reflected and emitted radiation, as well as ancillary data collection to support airborne and satellite remote sensing studies in agriculture, geography, and hydrology. Prerequisites: Basic calculus and physics. Also taught as BIE 6250/5250 and Bmet 6250/5250. (4 cr) (Sp)

FRWS 6270. Advanced Silviculture. In forestry, there is a trend toward more complex silviculture to implement increasingly complex stand-level objectives. This course covers important techniques used in the development and implementation of silvicultural prescriptions for this sort of stand management. Prerequisite: Permission of instructor. (3 cr) (Sp)

FRWS 6350 (d5350). Wildland Soils. Application of basic principles of soil science to wildland ecosystems. Effects of disturbance and land use on wildland soil properties. Role of soils in natural resource management. Prerequisites: Chem 1110; Soil 3000, and one additional upper-division Soils course, or permission of instructor. Also taught as Soil 6350/5350. (3 cr) (Sp)

FRWS 6400. Ecology of Animal Populations. Growth, fluctuation, balance, and control of animal populations. Prerequisite: NR/Biol 2220 or equivalent. (4 cr) (Sp)

FRWS 6420. Vegetation Sampling Design. Advanced intrastand vegetation sampling design and elementary (nonmultivariate) between stand comparisons, primarily

for research purposes. Prerequisites: Stat 5200; FRWS 6770 (or concurrent enrollment). (4 cr) (F)

FRWS 6500. Biometry: Design and Analysis of Ecology Research. Examines research design from statistical perspective, showing how data analysis is largely determined by research design and its implementation. Reviews statistical tools for analysis of ecological data in the context of design. Prerequisite: Graduate standing. (4 cr) (F)

FRWS 6510. Topics in Spatial Ecology. Seminars on analysis and interpretation of spatially explicit ecological data. Topics vary yearly, and range from spatial statistics to assessing uncertainty in environmental information systems to spatial analyses of plant and animal populations. Prerequisite: Graduate-level course in statistics. (1-3 cr) (Sp) ®

FRWS 6610. Regional Terrestrial Ecosystems. Synthesis of structural functional and regulatory processes and their interactions with humans in terrestrial ecosystems found in the Intermountain West and Great Plains. Prerequisites: NR/Biol 2220, Soil 3000; or equivalent courses. (3 cr) (Sp)

FRWS 6660 (d5660). Principles of Geographic Information Systems. Advanced introductory course in geographic information systems (GIS), with a focus on applications to natural resource research and management. Primary objective is learning basic functions of a GIS for use in data manipulation, data presentation, data inquiry, spatial analysis, modeling, and conversion of data into formats for use in other applications, such as reports and statistical analysis. For more information, visit the following website: <http://online.usu.edu/catalog>. (3 cr) (F,Sp,Su)

FRWS 6670 (d5670). Principles of Remote Sensing. Graduate-level introductory course covering principles, techniques, and applications of remote sensing. Designed to provide background necessary to make real use of remote sensing technologies in a variety of natural resource applications, or to stand alone as an up-to-date overview for those having a general interest in remote sensing technologies. For more information, visit the following website: <http://online.usu.edu/catalog>. (3 cr) (F,Sp,Su)

FRWS 6680 (d5680). Natural Resource Applications of Geographic Information Systems and Remote Sensing Technologies. Using the principles presented in the introductory courses, students in this project-based course research, apply, and evaluate geographic information systems and remote sensing technologies in relation to real-world, natural resource applications. Prerequisites: FRWS 5660/6660 and 5670/6670. For more information, visit the following website: <http://online.usu.edu/catalog>. (3 cr) (F,Sp,Su)

FRWS 6700. Forest Ecology. Structure and function of forest ecosystems. Woody plant ecophysiology, environmental biophysics, population and community ecology of forests. Forest vegetation dynamics and succession. Prerequisite: NR/Biol 2220 or equivalent. (3 cr) (Sp)

FRWS 6710 (d7710). Landscape Ecology. Focuses on landscape-scale patterns and processes, and ways of understanding ecological complexity. Explores conceptual underpinnings of larger-scale ecology. Emphasizes understanding of current peer-reviewed literature. (3 cr) (Sp)

FRWS 6740. Physical Processes in Remote Sensing. Assures that students are well-versed in the science and technology of remote sensing. Covers various algorithms and their ability to extract biophysical information from remotely sensed images. Helps students gain firm knowledge of the capabilities and limitations of these algorithms and their use in understanding landscape level biophysical interactions. (3 cr) (F)

FRWS 6750 (d5750). Applied Remote Sensing. Covers the application of remote sensing to landcover mapping and resource monitoring at a quantitative level. Students instructed on the effects of atmosphere and surface interaction on the

reflectance collected by electro-optical sensors, as well as on the proper use and interpretation of various calibration and classification algorithms. (3 cr) (Sp)

FRWS 6770. Plant Community Ecology. Theory and concepts of plant community ecology. Plant community composition, distribution in space, and dynamics in time. Species environmental response models, competition theory, statistical predictive models, and concepts of multivariate analysis in plant ecology. Prerequisites: NR/Biol 2220 or equivalent; and ecology core courses (may be taken concurrently). (3 cr) (F)

FRWS 6800 (d7800). Forest, Range, and Wildlife Sciences Departmental Seminar. Review of current research by graduate students and faculty. (1 cr) (F,Sp) ®

***FRWS 6850 (d7850). Population Ecology.** Using framework of mathematical modeling, reviews basic ecological processes (e.g., competition, predation, and environmental stresses) that determine numbers of individuals in plant and animal populations. (3 cr) (Sp)

FRWS 6870. Ecology Seminar. The Ecology Center schedules regular seminars throughout the school year with ecological scientists from other institutions participating. Ecology majors are required to attend a minimum of 10 such lectures. Students should register for fall semester, but attend through spring semester. Also taught as AWER 6870, EnvS 6870, and Biol 6870. (1 cr) (F) ®

FRWS 6900. Graduate Special Topics. Offers credit for special assignments, reading, and seminars beyond regularly scheduled courses. (1-6 cr) (F,Sp,Su) ®

FRWS 6910. Directed Study. Offers credit for special assignments, reading, and seminars beyond regularly scheduled courses. (1-6 cr) (F,Sp,Su) ®

FRWS 6960. Graduate General Ecology. General concepts, history, and issues in all major areas of the science of ecology including: environmental biophysics; and physiological, behavioral, evolutionary, community, ecosystem, and applied ecology in both terrestrial and aquatic environments. Also taught as AWER 6960, Biol 6960, and EnvS 6960. (5 cr) (F)

FRWS 6970. Thesis Research. Original research for MS degree on a problem in rangeland resources. (1-12 cr) (F,Sp,Su) ®

FRWS 6990. Continuing Graduate Advisement. (1-9 cr) (F,Sp,Su) ®

FRWS 7000. Theory and Applications of Rangeland Ecosystem Management. Application of range management principles, new theory, and public policy to on-the-ground decision-making in public and private lands. Field trips required. (3 cr) (F)

***FRWS 7030. Plant-Herbivore Interactions.** Emphasizes principles of self-organization as applied to plant (tolerance and avoidance of herbivory) and herbivore (food and habitat selection) behavior. Stresses importance of history and ongoing interactions with the environment in understanding the dynamics of plant-herbivore interactions. (3 cr) (Sp,Su)

FRWS 7100 (d6100). Topics in Physiological Ecology of Wildlife. Explores physiological ecology of wildlife, focusing on sensory factors influencing habitat selection, foraging, and mate choice. Prerequisites: Introductory coursework in biology, behavior, anatomy, and chemistry; and permission of instructor. (3 cr) (Sp)

***FRWS 7150 (d6150). Concepts in Habitat Selection and Foraging Behavior.** Explores fundamental concepts of how animals choose resources within their environment. Employs various optimization models to derive principal hypotheses, design relevant experiments, and interpret field data. Explores real-world applications

through extensive readings, commentaries, and problem sets. Prerequisite: NR/Biol 2220 or equivalent. (3 cr) (Sp)

***FRWS 7200. Plant Physiological Ecology.** Plant response to environmental factors; includes environmental biophysics, physical and physiological factors influencing productivity, water use, resistance to stress, reproduction, establishment of plants, and competition with neighboring plants. (3 cr) (Sp)

FRWS 7220 (d5220). Community-based Conservation Partnerships. Seeks to infuse ecology with applied conservation and management approaches. Conservation and management of natural resources requires an understanding of ecological relationships and strategies for working with diverse stakeholders. PhD-level students present their research. (3 cr) (Sp)

FRWS 7300 (d5300). Wildlife Damage Management Principles. Explains current legal, ethical, and biological principles for the control and/or management of problem vertebrate species. (3 cr) (Sp)

FRWS 7310. Developing Careers in Research. Seeking research positions, research funding, the grant proposal and publication process, research directions and career paths, budgeting, the tenure process, and research outside of universities. (1 cr) (F)

FRWS 7400. Plant Population Ecology. Dynamics of plant populations as influenced by interactions with their abiotic and, especially, biotic environments. Topics include dormancy and germination strategies, intra- and interspecific competition, facilitation, disturbance, herbivory, pathogenic and mutualistic fungi, pollination, seed dispersal, and vegetative reproduction. (3 cr) (F)

****FRWS 7420. Analysis of Vegetation Patterns.** Advanced treatment of vegetation sampling, classification, and ordination between stands over landscapes, designed primarily for researchers. Prerequisites: EC (core), FRWS 6420, 6770, Stat 5200, and familiarity with computers. (5 cr) (Sp)

FRWS 7450 (d5450). Wildlife Sociobiology. Examines wildlife communication, reproductive tactics, mating systems, parent-offspring conflicts, and social behavior. (3 cr) (Sp)

FRWS 7640 (d5640). Riparian Ecology and Management. Explores structure and function of riparian ecosystems and management options for maintaining sustainable ecological function. Prerequisite: NR/Biol 2220, AWER 3700. (3 cr) (Sp)

FRWS 7710 (d6710). Landscape Ecology. Focuses on landscape-scale patterns and processes, and ways of understanding ecological complexity. Explores conceptual underpinnings of larger-scale ecology. Emphasizes understanding of current peer-reviewed literature. (3 cr) (Sp)

FRWS 7800 (d6800). Forest, Range, and Wildlife Sciences Departmental Seminar. Review of current research by graduate students and faculty. (1 cr) (F,Sp) ®

***FRWS 7850 (d6850). Population Ecology.** Using framework of mathematical modeling, reviews basic ecological processes (e.g., competition, predation, and environmental stresses) that determine numbers of individuals in plant and animal populations. (3 cr) (Sp)

FRWS 7900. Graduate Special Topics. Offers credit for special assignments, reading, and seminars beyond regularly scheduled courses. (1-6 cr) (F,Sp,Su) ®

FRWS 7910. Directed Study. Offers credit for special assignments, reading, and seminars beyond regularly scheduled courses. (1-6 cr) (F,Sp,Su) ®

FRWS 7970. Dissertation Research. Original research and study for PhD degree on a problem in range science. (1-12 cr) (F,Sp,Su) ®

FRWS 7990. Continuing Graduate Advisement. (1-9 cr) (F,Sp,Su) ®

¹Parenthetical numbers preceded by *d* indicate a *dual* listing.

® Repeatable for credit. Check with major department for limitations on number of credits that can be counted for graduation.

© This course is also offered by correspondence through Continuing Education Independent and Distance Education.

*Taught 2002-2003.

**Taught 2003-2004.