FISH, WILDLIFE AND CONSERVATION ECOLOGY

Undergraduate Program Information

Through lecture courses, labs, hands-on field experience and internships, the Department of Fish, Wildlife and Conservation Ecology will prepare you for a career in a variety of natural resource fields related to the conservation and management of wild animal populations and the natural systems they perpetuate. Award-winning professors will guide students in the study of how to manage fish and wildlife populations, their habitats, how their populations grow and contract, how different species influence the biotic community in which they live and how natural systems are affected by human activities.

Bachelor of Science in Fish, Wildlife and Conservation Ecology.

With the continuous growth of human populations and the ever dwindling of natural resources, natural resource professionals are needed now more than ever. Learn how to sustainably manage fish and wildlife populations and the habitats they utilize to ensure their long-term successful conservation. We offer two options within this degree. The Wildlife Ecology and Management option focuses on the ecology, conservation and management of wildlife (including mammals, birds, amphibians, and reptiles) in their natural habitats. The Aquatic Ecology and Management option focuses on the ecology, conservation and management of aquatic resources and the animals and plants found in them.

The department offers a minor in Wildlife Science for students majoring in other disciplines. The minor includes a minimum of 18 credit hours.

Bachelor of Science in Conservation Ecology

New Mexico State University offers an interdisciplinary, undergraduate program in Conservation Ecology. The goal of this program is to train biologists for the current and future challenges that we face in the conservation and wise use of natural resources. An overriding principle of the program is to provide a solid foundation in basic science coupled with a practical approach towards sustainability and stewardship. The curriculum encompasses several disciplines and includes a wide variety of courses from Fish, Wildlife and Conservation Ecology, Biology, and Geography.

This educational experience will provide students with an overview of global biodiversity and an understanding of the ecological and evolutionary processes that have created and sustained it. Courses in population and community ecology coupled with population viability analysis and risk assessment will give students the necessary background to understand the theory and development of these fields as well as the tools to tackle real-world problems. Courses in basic genetics, evolution, and conservation genetics will expose students to the importance of conserving genetic variation in order to maintain adaptive potential within populations, thereby sustaining the evolutionary process. Students will also receive background on wildlife law and environmental policy, information vital for assisting governing bodies in making decisions regarding the protection and wise use of our natural resources. Skills obtained in the application of geographic information systems, molecular genetics, and professional communication can also be acquired through various electives. If biochemistry is taken as an elective, this curriculum provides the necessary educational background for pre-vet requirements, thus preparing students for veterinary school and future jobs such as wildlife or zoo veterinarian, or conservation medicine practioner. In sum, we seek to provide undergraduate students with an education that will allow them the opportunity to contribute to the conservation of all life on Earth.

The department offers a minor in Conservation Ecology for students majoring in other disciplines. The minor includes 20 credits.

To graduate from the Department of Fish, Wildlife and Conservation Ecology, an overall grade point average of 2.0 is required in courses taken in the major field and in all courses taken at NMSU.

Graduate Program Information

Master of Science in Fish, Wildlife and Conservation Ecology.

The Department of Fish, Wildlife and Conservation Ecology (FWCE) offers graduate work leading to the Master of Science degree with a major in Fish, Wildlife and Conservation Ecology. Faculty members in the department also may advise Ph.D. candidates through the graduate program in the Department of Biology, Department of Animal and Range Sciences, Department of Plant and Environmental Sciences, as well as other Ph.D. granting departments. For additional information please see the graduate catalog entries for the respective departments.

Minimum qualifications for admission to the graduate program include the following:

- 3.0 grade-point average in the last two years of undergraduate work
- Students who are most competitive for admission are those with a combined average GRE score greater than 70th percentile on the verbal and quantitative parts of the GRE.
- Course work in zoology, botany and animal ecology and a basic appreciation of sustainable use of natural resources, with supporting courses in mathematics, chemistry, physics and written and oral communication.

Applicants should submit a written composition of approximately 350 words that indicates the applicant's reasons for pursuing advanced study, explains personal and educational goals, and any additional experiences (e.g., military or career) or skills that might provide a foundation for graduate study. Applicants should submit three letters of recommendation (it is preferred that at least two letters come from university instructors) along with official GRE scores (use NMSU code 4531). Applicants should also contact a faculty member in the department that they would like to work with as an advisor, and that faculty member needs to agree to serve as the student's advisor. Application forms, application fee and transcripts, GRE scores, letters of recommendation and letter of application should be submitted online to the Graduate School. Successful applicants will be selected from those who meet the criteria of grade-point average, GRE scores, and educational background described above and who appear to have professional promise as indicated by personal history and written references.

For the Master of Science degree, a minimum of 30 semester credits of graduate work in the major and related subjects is required, together with a thesis for most students. Of these credits, at least 15 must be in courses numbered 500 or above, and at least 15 must be for courses with the FWCE prefix. Those programs involving a thesis or research project include 4 to 6 credits of research (FWCE 598 Special Research Programs or FWCE 599 Master's Thesis). Students electing a minor in FWCE are required to take at least 9 credits in the minor field. A nonthesis option is

available to some students, depending on prior training and experience, and subject to approval by the advisor and department head.

All students in the program must complete the following requirements:

- A ST 505 Statistical Inference I or equivalent
- One semester of Graduate Seminar (FWCE 515 Graduate Seminar - may be repeated for credit)
- A minimum of 3 additional credits from the Quantitative Methods category in addition to A ST 505 Statistical Inference I (eligible courses listed below)
- One course each from the Ecological Concepts, Organismal Biology and Ecological Techniques categories (eligible courses listed below)
- 4 to 9 credits from the Independent Study category (eligible courses listed below)

In addition, a student may petition to have up to 3 credits of special topics courses (FWCE 548 Graduate Problems) to apply to one of the three areas. Courses other than those listed may be acceptable, given permission by the student's supervisory committee

Degrees for the Department

Bachelor Degree(s)

- Conservation Ecology - Bachelor of Science in Conservation Ecology (https://catalogs.nmsu.edu/nmsu/agricultural-consumer-environmental-sciences/fish-wildlife-conservation-ecology/conservation-ecology-bachelor-conservation-ecology/)
- Fisheries and Wildlife Science (Aquatic Ecology and Management) - Bachelor of Science in Fish, Wildlife and Conservation Ecology (https://catalogs.nmsu.edu/nmsu/agricultural-consumer-environmental-sciences/fish-wildlife-conservation-ecology/fisheries-wildlife-science-aquatic-ecology-mgt-bachelor-science-fwce/)
- Fisheries and Wildlife Science (Wildlife Ecology and Management) - Bachelor of Science in Fish, Wildlife and Conservation Ecology (https://catalogs.nmsu.edu/nmsu/agricultural-consumer-environmental-sciences/fish-wildlife-conservation-ecology/fisheries-wildlife-science-wildlife-ecology-mgt-bachelor-science-fwce/)

Master Degree(s)

- Fish, Wildlife and Conservation Ecology - Master of Science (https://catalogs.nmsu.edu/nmsu/graduate-school/fish-wildlife-conservation-ecology-master-science-fwce/)

Doctoral Degree(s)

- Wildlife and Fisheries Ecology - Doctor of Philosophy (https://catalogs.nmsu.edu/nmsu/graduate-school/wildlife-fisheries-ecology-doctor-philosophy/)

Minors for the Department

- Conservation Ecology - Undergraduate Minor (https://catalogs.nmsu.edu/nmsu/agricultural-consumer-environmental-sciences/fish-wildlife-conservation-ecology/conservation-ecology-undergraduate-minor/)
- Fish, Wildlife and Conservation Ecology - Graduate Minor (https://catalogs.nmsu.edu/nmsu/graduate-school/fish-wildlife-conservation-ecology-graduate-minor/)
- Wildlife Science - Undergraduate Minor (https://catalogs.nmsu.edu/nmsu/agricultural-consumer-environmental-sciences/fish-wildlife-conservation-ecology/wildlife-science-undergraduate-minor/)

Regents Professor, Martha Desmond, Department Head

Professors Boeing, Desmond, Frey, Jones; ***Associate Professor*** Gebreselassie; ***Assistant Professors*** Hernandez-Gomez, Klein, Lawson, Laverty, Pregler, Young

M.J. Desmond, Ph.D. (University of Nebraska)– avian ecology and conservation; W.J. Boeing, Ph.D. (Louisiana State University)– aquatic ecology; J.K. Frey, Ph.D. (University of New Mexico)– ecology and conservation of mammals; F.A. Gebreselassie, Ph.D. (University of Bern Switzerland)- Capture-recapture models, Integrated population models; O. Hernandez-Gomez, Ph.D. (Purdue University)- disease ecology, herpetology, conservation genetics; K. Jones, Ph.D. (University of Wisconsin-Madison)- human dimensions of conservation, environmental economics, evidence-based conservation; Z. Klein, Ph.D. (University of Idaho)-fish ecology, fisheries management, fish conservation, population ecology; A. Lawson, Ph.D. (Clemson University)- vertebrate population ecology, analytical tool development; T. Laverty, Ph.D. (Colorado State University)- applied population, community and conservation ecology; K.C. Pregler, Ph.D. (Colorado State University)- population and evolutionary ecology, conservation biology; A. Young, Ph.D. (University of Idaho) - Wildlife Conservation and Management, Avian Ecology, Quantitative Ecology

Fish, Wildlife and Conservation Ecology Courses

FWCE 1110G. Introduction to Natural Resources Management
4 Credits (3+2P)
This class covers historical and current issues affecting the management of renewable natural resources with an emphasis on water, soil, rangeland, forest, fish, and wildlife resources. An emphasis is placed on the scientific method and critical thinking. In the laboratory students collect and analyze field data on topics covered above and write up each unit as a laboratory report.
Learning Outcomes

1. Students should be able to recall, describe and explain the laws, treaties and acts that have led to our current management of natural resources in the United States.
2. Students should recognize or explain what ecological processes are, the importance of ecological processes in maintaining ecosystem function and how human activities change ecological processes and the ecosystems dependent on those processes.
3. In each of the six course and lab modules (water quality, soils, forestry, rangelands, wildlife and fisheries) students should be able to recall, describe and explain basic terminology, fundamental ecological principles and management techniques and challenges.
4. Students should be able to interpret data presented graphically and in tables from class exercises and lectures.
5. Students should be able to solve problems scientifically through field data collection, laboratory analyses and the use of quantitative methods (basic statistics, tables and graphs).
6. Students should be able to communicate results from laboratory exercises (6 lab modules) orally and in writing.
7. Students will learn to apply scientific thinking to real world problems through in class discussion and short essays based on material from case studies presented in class and guest speakers.

FWCE 1120. Contemporary Issues in Wildlife and Natural Resources Management
3 Credits (3)
Ecological, socioeconomic, and political issues surrounding the management of our natural resources with an emphasis on fish and wildlife resources.

FWCE 2110. Principles of Fish and Wildlife Management
3 Credits (3)
Basic principles of fish and wildlife management including history, ecology, economics, and policy. Emphasis on wildlife and fisheries. Uses an ecosystem approach integrating living and nonliving resources.
Prerequisite(s): FWCE 1110G.
Learning Outcomes
1. The goal of this course is to provide a firm foundation in the principles of wildlife and fisheries management.
2. Material will include a background in biological principles geared towards animal populations, characteristics and management of the habitats utilized by fish and wildlife, techniques used to study and manage animals and their habitats, and aspects of the human dimension involved in wildlife and fisheries issues.
3. This course serves as a core requirement for degrees offered in the Department of Fish, Wildlife and Conservation Ecology and as a required course for degrees in other departments such as Rangeland Resources.

FWCE 301. Wildlife Ecology
3 Credits (3)
General ecological theory with emphasis on concepts including how organisms interact with their abiotic environment and with each other, population dynamics, community and ecosystem ecology, and biogeography. Emphasis on how these concepts relate to the management and conservation of vertebrates.
Prerequisite: BIOL 2610G.
Learning Outcomes
1. Students can describe major concepts and theories in ecology that relate to Fish and Wildlife conservation and management (niche, succession).
2. Students will understand population dynamics.
3. Students will learn concepts related to density dependence, population growth, and carrying capacity.
4. Students will learn concepts related to species interactions (predator prey-dynamics, intra- and inter-specific competition, mutualism, and disease dynamics).
5. Students will understand concepts related to the abiotic component of the ecosystem.
6. Students can articulate principles of fishery and wildlife management and apply ecological principles to conservation.

FWCE 325. Human Dimensions of Fish and Wildlife
3 Credits (3)
This course provides a foundational understanding of multiple perspectives in human dimensions of fish and wildlife. The course provides the information needed to identify stakeholders, engage them, understand their concerns, and communicate management plans effectively. Specific topics include the social, psychological, and economic underpinnings of human interactions with wildlife; qualitative and quantitative methods to gather information from people; and ethical considerations. Students will be challenged to approach human dimensions of wildlife issues from multiple perspectives. While this course is focused on fish and wildlife, the concepts covered about human dimensions will be relevant to a broader audience interested in environmental and natural resource conservation, management, or stewardship.
Learning Outcomes
1. Students will learn about human-wildlife conflicts and strategies to mitigate those conflicts.
2. Students will understand how human values, attitudes, and behaviors influence fish and wildlife management.
3. Students will become familiar with stakeholder engagement and communication techniques able to communicate with non-scientist stakeholders.
4. Students will learn to use logic and reasoning to arrive to reasonable conclusions.

FWCE 330. Natural History of the Vertebrates
4 Credits (3+1P)
This course provides students with a foundation in vertebrate natural history, including the evolution, ecology, behavior, anatomy, and physiology of extant and extinct vertebrates. Field trips may be required.
Prerequisite: BIOL 2610G and BIOL 2610L.
Learning Outcomes
1. Students can identify common vertebrate taxa, arrange them into phylogenetic order, and describe their anatomy and physiology.
2. Students understand the major precepts of evolutionary biology.
3. Students are proficient in the use and application of peer-review literature (access, proper use).
4. Students can communicate effectively via technical writing.
5. Students can disseminate information via oral communication.
6. Students will understand concepts related to the abiotic component of the ecosystem.

FWCE 355. Wildlife Management and Analysis
4 Credits (3+1P)
This course is intended to provide a broad overview of basic skills and statistical interpretation that are commonly used by biologists in performing management, research, and reporting functions in natural resource fields with an emphasis on terrestrial wildlife techniques, study design, and data processing/analysis. Field trips may be required.
Prerequisite: FWCE 301 and A ST 311 or consent of instructor.
Learning Outcomes
1. Students can describe major concepts and theories in ecology that relate to Fish and Wildlife conservation and management (niche, succession).
2. Students will understand population dynamics.
3. Students are familiar with techniques used to study fish and wildlife (common capture marking methods).
4. Students can visualize and summarize ecological data using graphs and descriptive statistics.
5. Students can perform basic data analysis and interpret results to draw meaningful conclusions.
6. Students are familiar with common statistical software (R).
7. Students will develop professional (field skills) and interpersonal skills (working in groups).

FWCE 357. Fisheries Management and Analysis
4 Credits (3+1P)
Lectures and laboratory exercises provide a broad overview of basic skills and techniques used for assessing and managing fish populations.
Prerequisite: FWCE 301 and A ST 311.

Learning Outcomes

1. Students can describe major concepts and theories in ecology that relate to animal conservation and management, especially niche, habitat, succession, etc.
2. Students will understand concepts related to population ecology, especially density dependence, population growth and dynamics, metapopulation dynamics, and carrying capacity.
3. Students have hands-on experience with techniques used to study fish and wildlife (common capture marking methods).
4. Students can understand and apply the methods used to measure abiotic and biotic variables.
5. Students can visualize and summarize ecological data using graphs and descriptive statistics.
6. Students can perform basic data analysis and interpret results to draw meaningful conclusions.
7. Students understand the law and policy underlying fish and wildlife management and conservation (North American Model, Public Trust Doctrine).

FWCE 391. Internship
1-3 Credits (1-3)
Professional work experience under the joint supervision of the employer and a faculty member. No more than 3 credits toward a degree.

Learning Outcomes

1. Students are familiar with techniques used to study fish and wildlife (common capture marking methods).
2. Students are familiar with methods used to measure environmental variables.
3. Student can design basic scientific experiments.
4. Students are familiar with the scientific method and its application.
5. Students will develop professional (field skills) and interpersonal skills (working in groups).
6. Students will become familiar with stakeholder engagement and communication techniques able to communicate with non-scientist stakeholders.

FWCE 393. Professional Experience and Communication
3 Credits (3)
Professional work experience under the supervision of employer and/or a faculty member. Written report and presentation is required. Students will learn oral and written communication, interviewing, and networking skills.
Prerequisite/Corequisite: FWCE 2110.

Learning Outcomes

1. Communicate effectively via technical writing.
2. Disseminate information via oral communication.
3. Learn to use logic and reasoning to arrive to reasonable conclusions.
4. Develop professional (field skills) and interpersonal skills (working in groups).

FWCE 402. Seminar in Natural Resource Management
1 Credit (1)
Review and discussion of current topics in natural resource management.
Prerequisite: Senior standing or above.

Learning Outcomes

1. Students can describe major concepts and theories in ecology that relate to FW conservation and management.
2. Students can articulate principles of fishery and wildlife management and apply ecological principles to conservation.
3. Students can understand concepts related to interconnectedness of habitat, abiotic factors, and Fish and Wildlife species common to the Southwest.
4. Students can disseminate information via oral communication.
5. Students will learn to use logic and reasoning to arrive to reasonable conclusions.
6. Students will understand population dynamics.
7. Students will understand concepts related to the abiotic component of the ecosystem.
8. Students will understand genetic concepts as they relate to FW management and conservation.
9. Students will understand how human values, attitudes, and behaviors influence fish and wildlife management. 1
10. Students will become familiar with stakeholder engagement and communication techniques able to communicate with non-scientist stakeholders. 1
11. Students are familiar with the law and policy underlining fish and wildlife management and conservation.

FWCE 409. Introduction to Population Ecology
3 Credits (3)
This course introduces students to the fundamental concepts and principles of population ecology. It covers topics such as population growth and regulation, life history, species interactions, age-structured population models, and metapopulation dynamics. Students will develop skills in applying basic models and interpreting data, with introductory exposure to relevant software tools such as R and Program MARK. The course also emphasizes the role of population ecology in the management and conservation of animal populations.
Prerequisite: MATH 1430G and FWCE 2110.

Learning Outcomes

1. Describe and compare exponential and logistic models of population growth.
2. Construct and interpret simple life tables and basic matrix population models.
3. Explain factors influencing population regulation and viability.
4. Describe and analyze key species interactions (competition, predation) using graphical models.
5. Apply basic models to analyze population dynamics, including metapopulation dynamics.
6. Communicate core concepts and findings effectively through written assignments.

FWCE 425. Evidence-Based Conservation and Management
3 Credits (3)
This course will explore theories and concepts that are fundamental to applied conservation management and evaluation. There is increasing need to justify and evaluate conservation and management actions, and this course will provide students with the insight and knowledge on how to consult the best evidence in conservation planning and how to set up and evaluate a conservation action plan. This course also provides insight into systems thinking, which is needed to address the complex problems faced by conservation managers. Finally, this course teaches students a specific adaptive management framework that has been adopted by several leading conservation organizations and agencies. While this course is focused on biodiversity conservation, the concepts covered about systems thinking and applied conservation planning and management will be relevant to a broader audience interested in environmental and natural resources management or stewardship.

Learning Outcomes

1. Students will understand how human values, attitudes, and behaviors influence fish and wildlife management.
2. Students will learn to use logic and reasoning to arrive to reasonable conclusions.
3. Students can disseminate information via oral communication.
4. Students are proficient in the use and application of peer-review literature (access, proper use).

FWCE 430. Avian Field Ecology
4 Credits (3+1P)
Principles of avian ecology and management with an emphasis on taxonomy, physiology, behavior and field studies. Includes weekly field trips focusing on identification and behavior of Southwest birds.
Prerequisite: FWCE 2110.
Prerequisite/Corequisite: FWCE 330 or Consent of Instructor.
Learning Outcomes

1. Students can understand concepts related to interconnectedness of habitat, abiotic factors, and Fish and Wildlife species common to the Southwest.
2. Students are proficient in the use and application of peer-review literature (access, proper use).
3. Students are familiar with the scientific method and its application.
4. Students can identify common vertebrate taxa, arrange them into phylogenetic order, and describe their anatomy and physiology.
5. Students can communicate effectively via technical writing.
6. Students will learn to use logic and reasoning to arrive to reasonable conclusions.
7. Students will develop professional (field skills) and interpersonal skills (working in groups).
8. Students can perform basic data analysis and interpret results to draw meaningful conclusions.
9. Students will learn concepts related to species interactions (predator prey-dynamics, intra- and inter-specific competition, mutualism, and disease dynamics). 1
10. Students will understand genetic concepts as they relate to Fish and Wildlife management and conservation (population size, connectivity, inbreeding depression).

FWCE 431. Mammalogy
4 Credits (3+1P)
This course provides an overview of the biology of Class Mammalia, the mammals. We will cover the classification, distribution, anatomy, physiology, life history, and ecology of mammals in lecture and learn to identify mammal orders, families, and species in lab with an emphasis on those found in the Southwest. Field trips may be required.
Prerequisite: FWCE 2110 and FWCE 330 or consent of instructor.
Learning Outcomes

1. Students can understand concepts related to interconnectedness of habitat, abiotic factors, and Fish and Wildlife species common to the Southwest.
2. Students can identify common vertebrate taxa, arrange them into phylogenetic order, and describe their anatomy and physiology.
3. Students are proficient in the use and application of peer-review literature (access, proper use).
4. Students will learn concepts related to species interactions (predator prey-dynamics, intra- and inter-specific competition, mutualism, and disease dynamics).
5. Students can communicate effectively via technical writing.
6. Students can disseminate information via oral communication.

FWCE 432. Environmental Biology of Fishes
4 Credits (3+3P)
What makes a fish, a fish? Mechanisms of circulation, gas exchange, osmotic and ionic regulation, swimming, migration, reproduction, and chemoreception will be covered in this class. Taught with FWCE 532.
Prerequisite(s): CHEM 1215G and senior standing.

FWCE 434. Aquatic Contaminants and Toxicology
4 Credits (3+3P)
Basic principles and methodologies of aquatic toxicity testing; routes of exposure and modes of action; environmental legislation and ecological risk assessment. Taught with FWCE 534. Crosslisted with: ENVS 434.
Prerequisite(s): CHEM 1215G and senior standing.

FWCE 437. Wildlife Damage Management
3 Credits (3)
Introduction to basic need and appropriate methods for resolving human-wildlife conflicts and management of animal damage. Socioeconomic, ecological, and political factors. Field trips required. Taught with FWCE 537.
Prerequisite: BIOL 2610G, FWCE 2110, FWCE 301, FWCE 409.
Learning Outcomes

1. Students can articulate principles of fishery and wildlife management and apply ecological principles to conservation.
2. Students are familiar with the scientific method and its application.
3. Students can disseminate information via oral communication.
4. Students will learn to use logic and reasoning to arrive to reasonable conclusions.
5. Students will learn concepts related to density dependence, population growth, and carrying capacity.
6. Students will learn concepts related to species interactions (predator prey-dynamics, intra- and inter-specific competition, mutualism, and disease dynamics).
7. Students will learn about human-wildlife conflicts and strategies to mitigate those conflicts.
8. Students are proficient in the use and application of peer-review literature (access, proper use).

FWCE 442. Wildlife Disease Ecology and Management
4 Credits (3+1P)
This course will provide students with an understanding of the ecological and evolutionary complexity inherent to host-pathogen interactions in wildlife systems. FWCE 442/542 introduces students to parasite and pathogen diversity, core concepts in disease ecology (e.g., pathogen population dynamics, transmission, disease models, virulence), host-pathogen coevolution, community ecology of host-pathogen interactions, and the importance of pathogens in conservation and management. In the laboratory, students will learn basic techniques to isolate pathogens from living organisms, detect pathogens using molecular tools, and model disease outbreaks using bioinformatics. Field trips are required.
Prerequisite: FWCE 2110, FWCE 330.
Learning Outcomes

1. Students can describe major concepts and theories in ecology that relate to Fish and Wildlife conservation and management (niche, succession).
2. Students can articulate principles of fishery and wildlife management and apply ecological principles to conservation.
3. Students understand the major precepts of evolutionary biology.

4. Students are familiar with techniques used to study fish and wildlife (common capture marking methods).
5. Student can design basic scientific experiments.
6. Students are proficient in the use and application of peer-review literature (access, proper use).
7. Students are familiar with the scientific method and its application.
8. Students can identify common vertebrate taxa, arrange them into phylogenetic order, and describe their anatomy and physiology.
9. Students can communicate effectively via technical writing. 1
10. Students can disseminate information via oral communication. 1
11. Students will develop professional (field skills) and interpersonal skills (working in groups). 1
12. Students can visualize and summarize ecological data using graphs and descriptive statistics. 1
13. Students can perform basic data analysis and interpret results to draw meaningful conclusions. 1
14. Students are familiar with common statistical software (R). 1
15. Students will understand population dynamics. 1
16. Students will learn concepts related to density dependence, population growth, and carrying capacity. 1
17. Students will learn concepts related to species interactions (predator prey-dynamics, intra- and inter-specific competition, mutualism, and disease dynamics).

FWCE 447. Wildlife Law and Policy
3 Credits (3)
Introduction to state and federal laws and policies for wildlife and the historical context for their development. Taught with FWCE 547.
Prerequisite: Junior or Senior level standing.
Learning Outcomes
1. Students will learn about human-wildlife conflicts and strategies to mitigate those conflicts.
2. Students will understand how human values, attitudes, and behaviors influence fish and wildlife management.
3. Students will become familiar with stakeholder engagement and communication techniques able to communicate with non-scientist stakeholders.
4. Students are familiar with the law and policy underlining fish and wildlife management and conservation (NAM, PTD).

FWCE 448. Problems
1-3 Credits (1-3)
Individual investigations in fishery or wildlife science. Maximum 3 credits per semester and a grand total of 6 credits. May be repeated up to 6 credits. Consent of Instructor required.
Prerequisite(s): 18 credits in WLSC.

FWCE 450. Special Topics
1-4 Credits (1-4)
Specific subjects and credits as announced in the Schedule of Classes. Maximum of 4 credits per semester. May be repeated up to 9 credits. Consent of Instructor required.

FWCE 457. Ecological Biometry
3 Credits (3)
This course introduces students to basic statistical methods used in ecology. Topics include data visualization, basic probability and probability distributions, estimation, hypothesis testing, and simple and multiple linear regression. Students will develop essential skills in summarizing and analyzing ecological data using R, a widely used open-source statistical software. Emphasis will be placed on practical application in ecological studies.
Prerequisite: MATH 1430G or MATH 1511G, A ST 311, FWCE 301.
Learning Outcomes
1. Demonstrate a solid understanding of basic statistical concepts and their application in ecology.
2. Summarize ecological data and create graphs and charts to effectively visualize it.
3. Apply common statistical methods to address real-world ecological questions.
4. Interpret results from statistical tests and draw inference from ecological data.
5. Develop skills in using R for ecological data analysis and visualization.
6. Communicate core statistical concepts and findings effectively through written assignments.

FWCE 459. Aquatic Ecology
4 Credits (4)
Ecological functions of plant and animal communities in aquatic ecosystems with emphasis on chemical and physical properties, productivity, species interactions, population dynamics, and concepts for diagnosing problems and restoring aquatic ecosystems. Taught with FWCE 559.
Prerequisite(s): FWCE 301 or BIOL 301, CHEM 1225G, MATH 1430G.

FWCE 464. Fish and Wildlife Management, Law, and Policy
3 Credits (3)
The course will focus on the policy and governance surrounding fish and wildlife management with the goal of preparing students for careers in fish and wildlife management.
Learning Outcomes
1. Students can apply the scientific method.
2. Students are proficient the finding, using and applying peer-review literature (access, proper use).
3. Students can communicate effectively via technical writing.
4. Students can disseminate information via oral communication.
5. Students understand the law and policy underlying fish and wildlife management and conservation (North American Model, Public Trust Doctrine).

FWCE 467. Herpetology
4 Credits (4)
Systematics, taxonomy, ecology, behavior, and conservation of amphibians and reptiles. Field trips required. Taught with FWCE 567.
Prerequisite(s): FWCE 330.

FWCE 471. GIS for Natural Resource Scientists
4 Credits (4)
Practical GIS class for students with little or no GIS experience. Class focuses on learning to use industry-standard software and applications in natural resource management. Taught with FWCE 571.
Learning Outcomes
1. Students can articulate principles of fishery and wildlife management and apply ecological principles to conservation.
2. Students can understand concepts related to interconnectedness of habitat, abiotic factors, and FW species common to the Southwest.
3. Students are familiar with methods used to measure environmental variables.
4. Students are familiar with the scientific method and its application.

5. Students will learn to use logic and reasoning to arrive to reasonable conclusions.
6. Students can perform basic data analysis and interpret results to draw meaningful conclusions.

FWCE 472. Wildlife Museum Internship
1-4 Credits (1-4)
Substantial directed work experience in various functions of the wildlife natural history museum developed by the student in consultation with the faculty curator. Internships may involve aspects of collection development and management, public education programs, or other related museum activities. Internship must be approved by the faculty curator. May be repeated up to 9 credits. Consent of Instructor required.
Prerequisite(s): BIOL 2610G and BIOL 2610L.

FWCE 482. Ichthyology
4 Credits (3+1P)
Fishes are an incredibly diverse group and have evolved numerous anatomical, physiological, behavioral, and ecological adaptations. In an effort to better understand how fish function within a broader ecosystem, we will take a holistic view of the group. We will first focus on the phylogeny, physiology, and anatomy of fishes such that we can better understand fishes within an ecological context in the later part of the course. Collectively, our treatment of fish should provide a broad overview that will improve your understanding of the form, function, and ecology of fishes.
Prerequisite: FWCE 330 or consent of instructor.
Learning Outcomes
1. Students will understand concepts related to conservation biology, especially the drivers of biodiversity patterns, biodiversity crisis and its causes, extinction vortex, etc.
2. Students will understand concepts related to the abiotic component of the ecosystem (biomes, lentic zones, nutrient cycling), with an emphasis on global change.
3. Students can identify common vertebrate taxa, arrange them into phylogenetic order, and describe their anatomy, physiology, and natural history.
4. Students can interpret and understand analytical results.

FWCE 509. Population Ecology
3 Credits (3)
This course introduces students to the fundamental theories and quantitative methods of population ecology. It covers topics such as population growth and regulation, demographic analysis, species interactions, and spatial population dynamics. Students will gain hands-on experience in applying these concepts by implementing relevant models and analytical techniques using the open-source statistical software R and Program MARK.
Learning Outcomes
1. Develop and apply deterministic and stochastic population growth models.
2. Construct and interpret life tables and matrix population models.
3. Assess population viability and metapopulation dynamics.
4. Examine species interactions using competition and predation models.
5. Apply quantitative methods to estimate population abundance and survival rates.

FWCE 510. Wildlife Ecology Teaching Practicum
3 Credits (3)
This doctoral-level practicum provides hands-on experience in teaching undergraduate courses in wildlife and fisheries ecology. Students will engage in course planning, instructional delivery, and assessment under faculty supervision. Emphasis is placed on applying evidence-based teaching practices, communicating ecological concepts effectively, and fostering inclusive learning environments. Participants will also reflect on their teaching, receive feedback, and develop a professional teaching portfolio. Designed for future educators and academic professionals, this course prepares students for teaching roles in higher education and science communication. May be repeated once for credit with departmental approval.
Prerequisite: Doctoral standing in the Department of Fish, Wildlife and Conservation Ecology.
Learning Outcomes
1. The students will effectively communicate scientific information verbally and in written format.
2. The students will understand how to conduct scholarly and professional activities in an ethical manner.
3. The students will demonstrate thorough knowledge of their chosen disciplines within fish, wildlife and conservation ecology.

FWCE 512. Scientific Writing
3 Credits (3)
This graduate-level course will guide students through the development of a scientific manuscript suitable for submission to a peer-reviewed journal. We will cover the structure of a scientific paper, how to approach drafting each section, as well as give guidance on the submission and peer-review process, and other ethical considerations such as coauthorship. By the end of this course each student will have produced a manuscript based on their research focus.
Learning Outcomes
1. The students will effectively communicate the importance of their research, research hypotheses, data collection and analytical methods, and study conclusions.
2. The students will effectively communicate their research in writing.

FWCE 515. Graduate Seminar
1 Credit (1)
Current topics.

FWCE 523. Model Selection and Multimodel Inference in Ecology
2 Credits (2)
This course will introduce students to the theory and practice of model selection and multimodel inference in ecology. Both techniques are widely used in ecology, natural resources, and related disciplines and have become essential tools in gaining reliable inference from data. A substantial number of novel model selection techniques have emerged in recent years, and are accompanied by their unique drawbacks and potential pitfalls. The objective of this class if to provide students with background knowledge to select the appropriate model selection and inferential tools and interpret the results with confidence and accuracy. The course will comprise a mixture of short lectures, lab exercises, and discussions of the primary literature. There are no course prerequisites, though students are encouraged to have successfully completed at least one semester of graduate-level statistics.
Learning Outcomes
1. Students will demonstrate theoretical and practical understanding of data analysis methods employed.
2. Students will correctly interpret the results of their data analyses.

3. The students will select and use the most appropriate research methodologies and technologies to address the research questions in their thesis/proposal.

FWCE 524. Structured Decision Making in Fish and Wildlife Management
3 Credits (3)
This course will introduce students to the theory and application of structured decision making (SDM). SDM incorporates human-centered values into the decision making process, identifies a set of actions to achieve those values, and creates models that connect actions to outcomes. Though SDM has long been used in business contexts, SDM has recently been applied to diverse problems in wildlife and fisheries management at local, state, and federal levels. Unlike other decision processes that strive to separate management and scientific endeavors, SDM is a collaborative process that unites managers and scientists, and adds transparency to decision making to promote buy-in and trust. The course will comprise a mixture of lectures, discussions of the primary literature, lab exercises, and mock workshop sessions.
Learning Outcomes
1. Students will demonstrate theoretical and practical understanding of the data analysis methods employed.
2. Students will correctly interpret the results of their analyses.
3. Students will select and use the most appropriate research methodologies and technologies to address the research hypothesis in their thesis/proposal.

FWCE 525. Evidence-Based Conservation and Management
3 Credits (3)
This course will explore theories and concepts that are fundamental to applied conservation management and evaluation. There is increasing need to justify and evaluate conservation and management actions, and this course will provide students with the insight and knowledge on how to consult the best evidence in conservation planning and how to set up and evaluate a conservation action plan. This course also provides insight into systems thinking, which is needed to address the complex problems faced by conservation managers. Finally, this course teaches students a specific adaptive management framework that has been adopted by several leading conservation organizations and agencies. While this course is focused on biodiversity conservation, the concepts covered about systems thinking and applied conservation planning and management will be relevant to a broader audience interested in environmental and natural resources management or stewardship.
Learning Outcomes
1. The students will effectively communicate the importance of their research, research hypotheses, data collection and analytical methods, and study conclusions.
2. The students will effectively communicate their research orally.
3. The students will develop professional working relationships with colleagues and agency personnel.

FWCE 526. Demographic Modeling and Bayesian Inference in Modern Wildlife Management
3 Credits (3)
This course introduces students to the practical application of demographic models in wildlife management. It explores how wildlife laws and regulations are created in the United States, how science is being formally incorporated into the regulatory process, and how advanced quantitative methods are used to connect wildlife ecology with wildlife law. Students will gain hands-on experience using popular software such as R and JAGS to implement these methods within a Bayesian framework.
Learning Outcomes
1. Explain how wildlife laws and regulations are developed and informed by science.
2. Apply advanced demographic models to analyze real-world wildlife datasets.
3. Demonstrate proficiency in statistical software for Bayesian analysis.
4. Interpret and effectively present quantitative findings for management decisions.

FWCE 530. Large Mammal Ecology, Conservation and Management
3 Credits (3)
This course will cover aspects of large mammal ecology, management and conservation. Will include aspects of foraging ecology, resource and habitat selection, competition and resource partitioning, predation and population dynamics. Taught with FWCE 436.
Learning Outcomes
1. Students possesses the ability to develop and articulate appropriate research hypotheses consistent with the overall goals of the thesis research project.
2. The students will effectively communicate their research in writing.

FWCE 531. Mammalogy
4 Credits (3+1P)
Classification, identification, anatomy, physiology, life history, and ecology of mammals. Field trips required.
Learning Outcomes
1. Students will demonstrate theoretical and practical understanding of the data analysis methods employed.
2. Students will effectively communicate their research in writing.
3. Students will effectively communicate their research orally.

FWCE 532. Environmental Biology of Fishes
4 Credits (3+3P)
What makes a fish, a fish? Mechanisms of circulation, gas exchange, osmotic and ionic regulation, swimming, migration, reproduction, and chemoreception will be covered in this class. Taught with FWCE 432; however, students are responsible for all requirements in FWCE 432, plus additional assignments.

FWCE 535. Special Topics
1-4 Credits (1-4)
Specific subjects to be announced in the Schedule of Classes. Maximum of 4 credits per semester. No more than 9 credits toward a degree.

FWCE 537. Wildlife Damage Management
3 Credits (3)
Introduction to basic need and appropriate methods for resolving human-wildlife conflicts and management of animal damage. Socioeconomic, ecological, and political factors. Field trips required. Taught with FWCE 437. Students are responsible for all requirements for FWCE 437 plus additional work. Prerequisite(s): BIOL 2610G, FWCE 2110, FWCE 301 and FWCE 409

FWCE 540. Wildlife Habitat Relationships
4 Credits (4)
The study of wildlife-habitat relationships primarily seeks to describe how the distribution and abundance of resources used for food, cover and security, and constraints on the use of these resources influence the distribution of animals. This course will cover aspects of animal behavior related to how animals select habitat, theoretical models of habitat selection, the influence of inter- and intra-specific interactions on habitat selection, habitat quality, study designs for wildlife-habitat studies, modeling habitat selection and data analyses.

Learning Outcomes

1. Students can select and use the most appropriate data analysis methodologies given the research design and hypothesis being tested.
2. Students will demonstrate theoretical and practical understanding of the data analysis methods employed.
3. Students will correctly interpret the results of their data analyses.
4. Students will effectively communicate their research in writing.

FWCE 541. Conservation Genetics
3 Credits (3)
This course will provide a broad introduction to the use of molecular markers to address questions in ecology, evolution, behavior, and especially conservation. We will begin by learning about genetic variation and basic population genetic principles, then we will explore the applications of genetic markers for understanding relatedness, population structure, and conservation of biodiversity. Finally, we will discuss how to apply and interpret molecular approaches in conservation.

Learning Outcomes

1. Students will demonstrate theoretical and practical understanding of the data analysis methods employed.
2. Students will correctly interpret the results of their data analyses.
3. The students will effectively communicate the importance of their research, research hypotheses, data collection and analytical methods, and study conclusions.
4. The students will effectively communicate their research in writing.
5. The students will effectively communicate their research orally.

FWCE 542. Wildlife Disease Ecology and Management
4 Credits (3+1P)
This course will provide students with an understanding of the ecological and evolutionary complexity inherent to host-pathogen interactions in wildlife systems. FWCE 442/542 introduces students to parasite and pathogen diversity, core concepts in disease ecology (e.g., pathogen population dynamics, transmission, disease models, virulence), host-pathogen coevolution, community ecology of host-pathogen interactions, and the importance of pathogens in conservation and management. In the laboratory, students will learn basic techniques to isolate pathogens from living organisms, detect pathogens using molecular tools, and model disease outbreaks using bioinformatics. Field trips are required.
Prerequisite: FWCE 2110, FWCE 330.

Learning Outcomes

1. The students can formulate a scientifically sound study/research design linking the overall goals of the thesis research project with the research hypothesis.
2. Students can select and use the most appropriate data analysis methodologies given the research design and hypothesis tested.
3. The students will select and use the most appropriate research methodologies and technologies to address the research hypothesis in their thesis/proposal.
4. The students will effectively communicate the importance of their research hypothesis, data collection and analytical methods, and study conclusions.
5. The students will effectively communicate their research in writing.
6. The students will effectively communicate their research orally.
7. The students will develop professional working relationships with colleagues and agency personnel.

FWCE 546. Conservation Social Sciences
3 Credits (3)
This course provides an overview of social science concepts and research important to the conservation and management of wildlife and natural resources. The course will introduce students to the social, psychological, and economic underpinnings of human dimensions research, and specific approaches used to change human behaviors to improve conservation outcomes. Some of the approaches covered in the course include economic incentives, behavioral nudges, and community-based conservation. Additionally, the course will provide an overview of the methods used by conservation social scientists including participatory, qualitative, and quantitative methods. Students will be challenged to approach human dimensions issues from multiple perspectives. The concepts covered about human dimensions will be relevant to a broad audience interested in environmental and natural resource conservation, management, and stewardship.

Learning Outcomes

1. The students will select and use the most appropriate research methodologies and technologies to address the research hypotheses in their thesis/proposal.
2. The students will effectively communicate the importance of their research, research hypotheses, data collection and analytical methods, and study conclusions.
3. The students will effectively communicate their research in writing.

FWCE 547. Wildlife Law and Policy
3 Credits (3)
Introduction to state and federal laws and policies for wildlife and the historical context for their development. Taught with FWCE 447.

FWCE 548. Graduate Problems
1-3 Credits (1-3)
Individual studies in fishery and wildlife sciences. Maximum of 3 credits per semester. No more than 6 credits of this course and FWCE 598, combined, toward a degree. May be repeated up to 6 credits.

FWCE 557. Ecological Biometry
3 Credits (3)
This course introduces students to fundamental descriptive and inferential statistical methods commonly used in ecological research. Topics include data visualization, estimation, hypothesis testing, and statistical modeling. Students will develop essential skills in summarizing and analyzing ecological data using R, a powerful open-source statistical software. Emphasis will be placed on practical applications of statistics to real-world problems in ecology.

Learning Outcomes

1. Demonstrate a critical understanding of fundamental statistical concepts in ecological contexts.
2. Summarize and visualize ecological data.
3. Apply a range of statistical methods to address real-world ecological problems.
4. Interpret statistical findings and draw inference from ecological data.
5. Demonstrate proficiency in using R for ecological data analysis and visualization.

FWCE 558. Nonthesis Project
1-6 Credits (1-6)
Independent study to satisfy nonthesis project requirement. Maximum of 6 credits toward degree. Available only to nonthesis students. May be repeated up to 6 credits.

FWCE 559. Aquatic Ecology
4 Credits (3+1P)

Ecological functions of plant and animal communities in aquatic ecosystems with emphasis on chemical and physical properties, productivity, species interactions, population dynamics, and concepts for diagnosing problems and restoring aquatic ecosystems. Taught with FWCE 459.

Prerequisite: FWCE 301 or BIOL 301, CHEM 1225G, MATH 1430G.

Learning Outcomes

1. Students can possesses the ability to develop and articulate appropriate research hypotheses consistent with the overall goals of the thesis research project.
2. Students can select and use the most appropriate data analysis methodologies given the research design and hypothesis being tested.
3. The students will effectively communicate the importance of their research, research hypotheses, data collection and analytical methods, and study conclusions.
4. The students will effectively communicate their research in writing.
5. The students will effectively communicate their research orally.
6. The students will select and use the most appropriate research methodologies and technologies to address the research hypotheses in their thesis/proposal.
7. Students will correctly interpret the results of their data analyses.
8. Students can formulate a scientifically sound study/research design linking the overall goals of the thesis research project with the research hypothesis.

FWCE 567. Herpetology
4 Credits (3+1P)

Systematics, taxonomy, ecology, behavior and conservation of amphibians and reptiles. Field trips required. Taught with FWCE 467.

Learning Outcomes

1. The students can formulate a scientifically sound study/research design linking the overall goals of the thesis research project with the research hypothesis.
2. Students will demonstrate theoretical and practical understanding of the data analysis methods employed.
3. The students will select and use the most appropriate research methodologies and technologies to address the research hypothesis in their thesis/proposal.
4. The students will effectively communicate the importance of their research hypothesis, data collection and analytical methods, and study conclusions.
5. The students will develop professional working relationships with colleagues and agency personnel.

FWCE 571. GIS for Natural Resource Scientists
4 Credits (4)

Practical GIS class for students with little or no GIS experience. Class focuses on learning to use industry-standard software and applications in natural resource management. Taught with FWCE 471.

Learning Outcomes

1. Students can select and use the most appropriate data analysis methodologies given the research design and hypothesis being tested.
2. Students will demonstrate theoretical and practical understanding of the data analysis methods employed.
3. Students will correctly interpret the results of their data analyses.
4. Students will select and use the most appropriate research methodologies and technologies to address the research hypotheses in their proposal.

FWCE 582. Ichthyology
4 Credits (4)

Fishes are an incredibly diverse group and have evolved numerous anatomical, physiological, behavioral, and ecological adaptations. In an effort to better understand how fish function within a broader ecosystem, we will take a holistic view of the group. We will first focus on the phylogeny, physiology, and anatomy of fishes such that we can better understand fishes within an ecological context in the later part of the course. Collectively, our treatment of fish should provide a broad overview that will improve your understanding of the form, function, and ecology of fishes. Taught with FWCE 482.

Learning Outcomes

1. Students understand the major precepts of evolutionary biology.
2. Students can understand concepts related to interconnectedness of habitat, abiotic factors, and FW species common to the Southwest.
3. Students can identify common vertebrate taxa, arrange them into phylogenetic order, and describe their anatomy and physiology.
4. Students can communicate effectively via technical writing.
5. Students will develop professional (field skills) and interpersonal skills (working in groups).

FWCE 598. Special Research Programs
1-3 Credits (1-3)

Individual investigations, either analytical or experimental. Maximum of 3 credits per semester. No more than 6 credits of this course and FWCE 548, combined, toward a degree. Not available to students in the nonthesis program. May be repeated up to 6 credits.

FWCE 599. Master's Thesis
1-9 Credits (1-9)

Thesis. May be repeated up to 30 credits. Thesis/Dissertation Grading.

FWCE 690. Doctoral Seminar
1 Credit (1)

This doctoral-level seminar provides an interdisciplinary forum for engaging with a distinguished seminar series featuring guest speakers from academia, government agencies, national laboratories, non-governmental organizations (NGOs), and industry. Through weekly presentations and discussions, students gain exposure to cutting-edge research, policy-relevant insights, and real-world applications across a range of fields. The course emphasizes critical analysis, cross-sector dialogue, and professional development. Students will prepare for and respond to each seminar through guided readings, written reflections, and facilitated discussions. Designed to foster intellectual breadth and career-relevant perspectives, this seminar supports doctoral students in connecting their research to broader societal challenges and opportunities. May be repeated up to 2 credits.

Learning Outcomes

1. Students will demonstrate theoretical and practical understanding of the data analysis methods employed.
2. Students will correctly interpret the results of their data analyses.
3. The students will select and use the most appropriate research methodologies and technologies to address the research hypotheses in their thesis/proposal.
4. The students will effectively communicate the importance of their research, research hypotheses, data collection and analytical methods, and study conclusions.

5. The students will develop professional working relationships with colleagues and agency personnel.

FWCE 699. Doctoral Research
1-18 Credits (1-18)
Research units that are preformed prior to the students comprehensive exam. May be repeated up to 88 credits.
Learning Outcomes
1. Students will be able to formulate hypotheses and conduct research.
2. Students will demonstrate thorough knowledge of their chosen discipline in Fish, Wildlife and Conservation Ecology.

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