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Zoology

The School of Biological Sciences offers graduate programs in Zoology leading to the Master of Science, Professional Science Masters, and Doctor of Philosophy degrees. The Professional Science Masters in Zoology is awarded on the basis of demonstrated scholarship, with emphasis on basic ecological knowledge, managing habitat for wildlife, and constituent consensus building. The Master of Science in Zoology and Doctor of Philosophy in Zoology degrees are awarded on the basis of demonstrated scholarship, with an emphasis on the ability to organize, conduct, and report original research. The program's graduate program is organized around five disciplinary areas: ecology & ecosystem studies; environmental toxicology; evolution, genetics, and population biology; fisheries biology & aquaculture; and wildlife ecology & management. These research groups draw heavily upon the expertise of faculty members affiliated with SIUC's Center for Fisheries, Aquaculture, and Aquatic Sciences and the Cooperative Wildlife Research Laboratory. Graduate research in Zoology is facilitated by SIUC's geographic location, notably its proximity to extensive national forests, wildlife refuges, state parks, and other natural areas of diverse physiography.

Admission

Application forms can be obtained via the program webpage (zoology.siu.edu/graduate/apply/). A completed program application includes: the form, transcripts of all previous college credits, an official score report for the Graduate Record Examination (GRE) General Test, and three letters of evaluation that address the applicant's academic abilities. A nonrefundable application fee must be submitted with the program application form. Applicants pay this fee when applying electronically to the Graduate School. Students who wish to be considered for a University fellowship must have a complete application on file by December 1. There are no other application deadlines, but early contact with the program is encouraged.

Applicants for P.S.M. in Zoology, M.S. in Zoology, and Ph.D. in Zoology programs must fulfill all admissions requirements of the Graduate School. Inquiries about Zoology graduate programs should be made to the Director of Graduate Studies in Zoology. Prospective applicants are strongly encouraged to make contact with faculty members in their area of research interest prior to submitting an application.

Applicants to the P.S.M. in Zoology with a concentration in Wildlife Administration and Management program must possess the following academic background: 24 credit hours (or equivalent) in courses covering the basic principles of zoology (including animal diversity, ecology, and evolution); 9 credit hours of physical sciences (physics, chemistry, soil science, geology — at least 2 disciplines must be represented); one year of college mathematics including college algebra and trigonometry (calculus and statistics are also desirable); be within 6 credit hours of meeting class requirements for a Certified Wildlife Biologist (details can be found on The Wildlife Society web page (wildlife.org/) after completion of program course requirements; an undergraduate grade point average of at least 3.0 (A=4.0). Applicants who do not meet these requirements will be considered on individual merit.

Applicants to the M.S. in Zoology program must possess the following academic background: 24 credit hours (or equivalent) in courses covering the basic principles of zoology (including animal diversity, genetics, ecology, and evolution); one year of college chemistry (organic and biochemistry are also desirable); one year of college mathematics including college algebra and trigonometry (calculus and statistics are also desirable); an undergraduate grade point average of at least 2.70 (A=4.0). Applicants with a GPA less than 2.70 will be considered on individual merit.

Applicants for the Ph.D. in Zoology degree must have a solid background in biological science, hold a master's degree, and have a grade point average in graduate work of 3.25 or above. Applicants with a graduate GPA less than 3.25 will be considered on individual merit. Direct entry to the Ph.D. in Zoology

program for students with only a bachelor's degree, or accelerated entry from the M.S. in Zoology program, is possible for students demonstrating exceptional potential.

Advisement and Progress Toward Degree

During the admission process and prior to registration, a student should consult with faculty members representing his or her area of interest to identify an advisor. Advisors will be assigned formally by the Director of Graduate Studies upon admission. A change in advisor later in the program must be coordinated and approved by the Director of Graduate Studies.

Each M.S. in Zoology student, in consultation with the advisor, must assemble an advisory committee to be approved by the Director of Graduate Studies before the end of the first semester of enrollment. For the M.S. in Zoology degree, the committee shall consist of at least three graduate faculty members, one of whom may be from outside the program, with the advisor serving as chair. For the Ph.D. in Zoology degree, the advisory committee shall consist of five graduate faculty members, one of whom must be from outside the program, with the advisor serving as chair. A program of study must be approved by the advisory committee and submitted to the Director of Graduate Studies no later than second semester of enrollment. A research proposal must be approved by the advisory committee and submitted to the Director of Graduate Studies no later than the third semester. Students may not register for ZOOL 599 or ZOOL 600 before their proposal is approved.

Master of Science (M.S.) in Zoology

All requirements of the Graduate School must be satisfied. At least 30 hours of graduate credit (15 credit hours at the 500-level) is required beyond the bachelor's degree, including 21 credit hours of graded coursework, two credit hours of ZOOL 589, six credit hours of ZOOL 599, and two or more courses in a specific area representing the research tool. A grade point average of 3.00 in graduate coursework must be maintained. Failure to meet this requirement will result in academic probation and loss of financial support from the program and School.

Thesis

Students must prepare and defend a thesis based on the results of original research. The nature of the research is developed by the student in consultation with the advisor and advisory committee. The thesis is evaluated by the advisory committee and must be successfully defended before graduation. The defense consists of a presentation of thesis results in public seminar, followed by a closed session of oral evaluation by the advisory committee. A final version of the thesis must be approved by the advisory committee, the Director of Graduate Studies, the School Director, and the Graduate School. M.S. in Zoology candidates must follow all Graduate School procedures in applying for graduation and deposit one bound copy of their thesis with the program.

Professional Science Masters (P.S.M.) in Zoology

All requirements of the Graduate School must be satisfied. At least 30 hours of graduate credit (13 credit hours at the 500 level) is required beyond the bachelor's degree, including 24 credit hours of graded courses required by the program. A grade point average of 3.2 in graduate coursework must be maintained. Failure to meet this requirement will result in academic probation.

A capstone project consisting of a grant proposal presented to the agency providing the summer internship and approved by the Program Director must be completed prior to graduation.

Doctor of Philosophy (Ph.D.) in Zoology

All requirements of the Graduate School must be satisfied. Students entering the Ph.D. in Zoology program are expected to have taken courses in the broad areas of animal diversity & evolution, ecology, and cell biology & genetics. Admission to the Ph.D. in Zoology program requires two courses in two of

these areas and three courses in the third. Students may be admitted with deficiencies, but must acquire the necessary coursework as part of their doctoral studies.

There is no minimum credit-hour requirement beyond the Graduate School's residency and dissertation requirements. A student, in consultation with his or her advisory committee, prepares a program of study that includes courses (including two semesters of ZOO 589), seminars, and research. A research tool, consisting of at least two courses in a specific subject area, is required. A 3.25 grade point average in graduate coursework must be maintained. Failure to meet this requirement will result in loss of financial support from the program and School.

Preliminary Examinations

Written and oral examinations are taken after the tool requirement and major portion of any other formal coursework are completed, usually at the end of the second year of graduate study. The examinations focus on the student's area of research expertise as defined by the student, the advisor, and the advisory committee, and approved by the Director of Graduate Studies and the School Director. Administration and evaluation of these examinations is governed by the program's Preliminary Examination Policy. Students must pass both preliminary examinations to advance to candidacy.

Dissertation

Students must prepare and defend a dissertation based on the results of original research. The nature of the research is developed by the student in consultation with the advisor and advisory committee. Students must register for at least 24 credit hours of ZOO 600 Research and Dissertation (only six credit hours are permitted prior to candidacy). The dissertation is evaluated by the advisory committee.

Final Examination

With the approval of the advisory committee, the candidate requests the Director of Graduate Studies to schedule a dissertation defense. The defense consists of a presentation of dissertation results in a public seminar, followed by a closed session of oral evaluation of the student's dissertation research by the advisory committee. A final version of the dissertation must be approved by the advisory committee, the Director of Graduate Studies, the School Director, and the Graduate School.

Graduation

Ph.D. in Zoology candidates must follow all Graduate School procedures in applying for graduation and deposit one bound copy of their dissertation with the program.

Ecology Concentration

Students opting to declare Ecology as a concentration shall follow the same program as students in the Ph.D. in Zoology degree program that do not declare a concentration subject to the following: The Seminar in Ecology (PLB 589A) or equivalent (equivalent agreed upon by the student's committee) must be taken once each year until a student achieves candidacy. The research tool shall be statistics. The student's advisory committee shall consist of at least two members from outside of the Zoology program.

Zoology Courses

ZOO403 - Bee Identification Short Course Pollinator diversity and conservation is a growing environmental concern for state and federal land managers, private industry, NGO, and municipalities. However, studies and management of pollinators are hampered by a shortage of taxonomic expertise in hyper-diverse insect taxa such as bees, which number over 800 species in the eastern U.S., over 4,000 species nationwide, and over 20,000 species worldwide. Therefore, taxonomic identification of major groups of pollinating insects is both a marketable job skill and valuable research tool. The course is designed to introduce students to the biology and identification of bees, with a focus on the bee diversity of the eastern U.S. The course will provide the necessary background in bee morphology and ecology to

allow students to use traditional dichotomous keys, interactive keys, and field guides to identify common families, genera, and species of bees. Lab fee: \$50. Credit Hours: 2

ZOOL405 - Systematic Biology Estimation, analysis, and interpretation of phylogenetic trees; concepts, delimitation, and description of species; biological taxonomy and systems of classification; application of phylogenetics to the study of evolution. Prerequisites: BIOL 304; MATH 106 or 108 with grades of C or better. Credit Hours: 3

ZOOL407 - Parasitology Principles, collection, identification, morphology, life histories, and control measures. Two lectures and two 2-hour laboratories per week. Prerequisite: ZOOL 220 with a grade of C or better. Laboratory/Field Trip fee: \$15. Credit Hours: 4

ZOOL408 - Herpetology Taxonomic groups, identification, morphology, and natural history of amphibians and reptiles. Two lectures and one 2-hour laboratory per week. Prerequisite: ZOOL 220 with a grade of C or better. Laboratory/Field Trip fee: \$15. Credit Hours: 3

ZOOL410 - Conservation Biology An introduction to patterns of global biodiversity and threats to that diversity. Course emphasizes how principles from numerous biological disciplines are involved in conserving and managing biodiversity, and how social, economic, and political factors affect conservation strategies. Prerequisites: BIOL 307 and MATH 106 or 108 with grades of C or better. Credit Hours: 3

ZOOL411 - Environmental Risk Assessment Risk assessment can be defined as the process of assigning magnitudes and probabilities to the adverse effects of human activities or natural catastrophes. Prerequisites: BIOL 307 and CHEM 340 with grades of C or better. Credit Hours: 3

ZOOL413 - The Invertebrates Structure, phylogeny, distinguishing features and habitats of the invertebrates. Two lectures and two 2-hour laboratories per week. Prerequisite: ZOOL 220A or ZOOL 220. Laboratory/Field Trip fee: \$15. Credit Hours: 4

ZOOL414 - Freshwater Invertebrates Taxonomic groups, identification, distribution, and habitats of the North American freshwater invertebrate fauna. Two lectures, two 2-hour laboratories per week. Prerequisite: ZOOL 220A or ZOOL 220. Laboratory/Field Trip fee: \$15. Credit Hours: 4

ZOOL415 - Limnology (Same as PLB 416) Lakes and inland waters; the organisms living in them, and the factors affecting these organisms. Two lectures and one 4-hour laboratory alternate weeks. Prerequisite: BIOL 307 with a grade of C or better. Laboratory/Field Trip fee: \$15. Credit Hours: 3

ZOOL425 - Invertebrate Paleontology and Paleocology (Same as GEOL 425) Concepts of paleontology and paleocology. Emphasis on functional morphology, lifestyles and habitats of fossil invertebrates and algae. The nature and evolution of marine and coastal paleocommunities. The effects of extinction events on paleocommunities and biodiversity. Laboratory. Field trips required. Prerequisite: GEOL 325 or ZOOL 220 with grade of C or better. Expense will vary in proportion to distance traveled and locations visited and will be determined before each semester. Field trip fee not to exceed \$199. Credit Hours: 3

ZOOL426 - Comparative Endocrinology (Same as ANS 426, PHSL 426) Comparison of mechanisms influencing hormone release, hormone biosynthesis, and the effects of hormones on target tissues, including mechanisms of transport, receptor kinetics, and signal transduction. Prerequisites: ANS 331 or ZOOL 220 or PHSL 310 with a grade of C. Laboratory/Field Trip fee: \$15. Credit Hours: 3

ZOOL432 - Principles of Toxicology This course will introduce students to the main topics in the field of toxicology. The emphasis will be on understanding physiological, biochemical, and molecular mechanisms of toxicity. Prerequisites: BIOL 200A and BIOL 200B; or BIOL 211, BIOL 212, and BIOL 213; with grades of C or better. Credit Hours: 3

ZOOL433 - Comparative Animal Physiology (Same as PHSL 433) Variations of physiological processes in animal phyla, comparison with human physiology, and physiological adaptation to environmental variation. Review of basic physiological principles and comparative aspects of mechanism and function. Prerequisites: BIOL 200A or BIOL 211; BIOL 200B or BIOL 213, or PHSL 310; with grades of C or better. Credit Hours: 3

ZOOL435 - Pollination Ecology (Same as PLB 435) This course will be an evolutionary and ecological examination of the interactions between plants and pollinators. Topics include pollination syndromes, plant breeding systems, pollinator foraging, learning, and behavior, specialized vs. generalized relationships, coevolution/cospeciation, chemical ecology, honey beekeeping & agricultural pollination, and conservation implications of pollinator relationships. Labs will provide hands-on experience in methods of investigating plant breeding systems, plant reproductive ecology, pollinator behavior and efficacy, pollen analysis, floral scent chemistry, and floral phenology. Prerequisite: BIOL 307 (General Ecology) or equivalent with a grade of C or better. For graduate students and senior undergraduates. Lab fee: \$75. Credit Hours: 3

ZOOL438 - Plant and Animal Molecular Genetics Laboratory (Same as PLB 438, PSAS 438, AGSE 438, CSEM 438) Arabidopsis and Drosophila model organisms, training in laboratory safety, reagent preparation, phenotype analysis, genetics, DNA and RNA analysis, PCR, cDNA construction, cloning and sequencing. Includes plant and bacterial transformation, and population level analysis of genetic variation using RAPD markers in grasses and Alu insertion in humans. Two 2-hr labs and one 1-hr lecture per week. Prerequisite: BIOL 305 or equivalent or consent of instructor. Lab fee: \$30. Credit Hours: 3

ZOOL444 - Ecological Analysis of Communities (Same as PLB 444) Includes concepts and methods pertaining to the analysis of ecological data. Approaches will include a variety of methods for analyzing multivariate ecology, diversity, pattern, and spatial data. Laboratory will include the computer application of these concepts and methods to field situations. Two lectures and one 4 hour lab per week. Prerequisite: PLB/ZOOL 360, BIOL 307. Lab fee: \$15. Credit Hours: 4

ZOOL458 - Multiple Stressors in Ecology In this class, students will use a step-by-step approach to evaluate an environmental issue or human concern compounded by climate change. The evaluation will begin with a conceptual model of the problem, followed by planned management strategies based on collaborative decision making. The class is designed to foster quantitative reasoning, include that reasoning in research, and articulate findings in terms that foster collaborative management and outreach. Examples of potential projects include climate change impacts in concert with disease propagation, habitat quality and quantity, pollutant uptake in ectotherms, coral bleaching, changing human coastal communities, or fire incidence. Credit Hours: 3

ZOOL461 - Mammalogy Taxonomic characteristics, identification, and natural history of mammals. Two 1-hour lectures and one 2-hour laboratory per week. Prerequisite: ZOOL 220B or ZOOL 220. Laboratory/Field Trip fee: \$10. Credit Hours: 3

ZOOL462A - Waterfowl Ecology and Management (Lecture) This class will explore the pertinence of basic life history theory and ecological principles to waterfowl management. Lecture topics include but are not limited to waterfowl life histories (i.e., productivity and mortality), foraging ecology, nutrition, habitat use, habitat management, migration, and the influence of harvest. Prerequisites: ZOOL 220, BIOL 307 with minimum grades of C. Co-requisite: ZOOL 462B. Credit Hours: 2

ZOOL462B - Waterfowl Ecology and Management (Laboratory) This laboratory will meet 1 day/week for 2 hours. The primary objective will be waterfowl identification with a secondary emphasis on wetland plant identification and field techniques in waterfowl research and management. There will be 2-3 Saturday field trips. Prerequisites: none. Laboratory/field trip fee: \$20. Credit Hours: 1

ZOOL464 - Wildlife Administration and Policy Responsibilities of private, state, and federal natural resources management agencies. Legal and political processes in areas of wildlife and natural resources. Three lectures per week. Special approval needed from the instructor. Credit Hours: 3

ZOOL465 - Ichthyology Anatomy, physiology, sensory biology, behavior, taxonomy, evolution, zoogeography, and ecology of fishes. Two lectures and one 2-hour laboratory per week. Prerequisite: ZOOL 220 with a grade of C or better. Laboratory/Field Trip fee: \$10. Credit Hours: 3

ZOOL466 - Fish Management Sampling, age and growth, dynamics, habitat improvement, manipulation of fish populations, and management of freshwater and marine fish stocks. Two lectures per week and one 4-hour laboratory alternate weeks. Offered Fall term. Prerequisite: 10 hours of biological science or consent of instructor. Credit Hours: 3

ZOOL467 - Ornithology Classification and recognition of birds and the study of their songs, nests, migratory habits, and other behavior. One lecture and one four-hour laboratory per week. Prerequisite: ZOOL 220B or ZOOL 220. Laboratory/Field Trip fee: \$10. Credit Hours: 3

ZOOL468 - Wildlife Biology Principles Basic concepts of wildlife ecology and management. Includes lectures on ecological physiology, population dynamics, and wildlife management strategies. Prerequisite: ZOOL 220, BIOL 307. Credit Hours: 3

ZOOL469 - Wildlife Techniques Field-oriented course with instruction in techniques for management of wild species and their habitat. One 1 1/2-hour lecture and one 3-hour laboratory per week, two of which may be field trips on Saturdays. Prerequisite: ZOOL 220A,B or ZOOL 220. Laboratory/Field Trip fee: \$30. Credit Hours: 3

ZOOL471 - Entomology Structure, classification, and life histories of insects. Two lectures and two 2-hour laboratories per week. Prerequisite: ZOOL 220A or ZOOL 220. Laboratory/Field Trip fee: \$10. Credit Hours: 4

ZOOL472 - Introduction to Systems Biology (Same as PLB 471) The experimental and bioinformatics analysis of large genomic and post-genomic data sets. The goal is integration of gene regulation, protein interaction, metabolite and hormonal signaling molecules into an understanding of basic cellular circuitry networks. Examine redundancy, robustness and decision making in biological systems. Prerequisite: BIOL 305 or CS 330. Lab fee: \$15. Credit Hours: 3

ZOOL477 - Aquaculture (Same as ANS 477) Production of food, game, and bait fishes. Design of facilities, chemical and biological variables, spawning techniques, diseases and nutrition. Two lectures per week and one four-hour laboratory on alternate weeks. Prerequisites: BIOL 200A or BIOL 211 or ZOOL 118 or ANS 121 with grade of C or better. Credit Hours: 3

ZOOL478 - Animal Behavior Biological basis of the behavior of animals. Two lectures and one 2-hour laboratory per week. Prerequisite: One year of biological science or permission of instructor. Credit Hours: 3

ZOOL485 - Special Topics in Zoology Examination of topics of special interest not available in other departmental courses. Offered in response to student need and faculty availability. Special approval needed. Credit Hours: 2-4

ZOOL490 - Energetics, Food Webs, and Ecosystems (Same as PLB 490) This course places conservation of particular species into the context of community and ecosystem management. Approaches to quantifying energy needs of individual species will be extended to models of trophic networks among multiple species. Food web structure and function, species interactions, and resilience to species loss species invasions, and environmental changes will be examined in light of landscape processes. Prerequisite: BIOL 307 or consent of instructor. Credit Hours: 3

ZOOL505 - Wildlife Administration and Management Constituencies This class will explore what motivates individuals to pursue outdoor activities, why individual user groups are often extremely passionate about their individual outdoor activity, how outdoor activities impact wildlife populations and habitat, outdoor ethics, how to safely interact with individuals who are often in possession of firearms or other potentially dangerous tools that are used for hunting, and how to resolve conflicts between user groups. Credit Hours: 2

ZOOL510 - Evolutionary Biology An introductory survey of evolutionary biology at the graduate level, emphasizing conceptual issues in evolutionary genetics, adaptation, systematics, and macroevolution. Prerequisite: BIOL 305 or equivalent. Credit Hours: 3

ZOOL521 - Stream Ecology The physical, chemical, and biological factors affecting organisms in streams. Two lectures per week and one four-hour laboratory alternate weeks. Prerequisite: ZOOL 415. Special approval needed from the instructor. Credit Hours: 3

ZOOL530 - Wildlife Diseases Introduction to the causes and nature of diseases of wildlife with emphasis on wild mammals and birds. The relationship of disease to the population ecology of species will be

emphasized further. Two lectures and one two-hour laboratory per week. Offered Spring term. Special approval needed from the instructor. Credit Hours: 3

ZOOL533 - Aquatic Toxicology This course will provide an overview of concepts and methodology for conducting tests in the field of aquatic toxicology. Specific topics to be covered include: acute and chronic bioassays, bioaccumulation tests including biotransformation processes and toxicokinetics, and modeling techniques using Quantitative Structure Activity Relationships and fugacity modeling. This class is recommended for students interested in learning about the applied methodology used in the rapidly evolving field of aquatic toxicology. Prerequisite: BIOL 307 and CHEM 340 or equivalent, or instructor's permission. Credit Hours: 4

ZOOL534 - Wildlife Habitat Analysis Physical, biological and behavioral factors that influence habitat use and selection by wild vertebrate populations. Landscape level analysis of wildlife habitats. Modeling habitat suitability, environmental impact and wildlife population dynamics with habitat data. Application and use of remote sensing and geographic information systems in natural resource management and habitat evaluation. One two-hour lecture and one two-hour laboratory per week. Special approval needed from the instructor. Credit Hours: 3

ZOOL535 - Quantitative Zoogeography This course focuses on spatial analyses from the perspective of the organism (or a group of organisms) and the role of the environment in shaping its distribution. The course will cover topics associated with species distribution modeling, biodiversity quantification, landscape genetics, animal movement analyses, home range quantification, and landscape conservation prioritization from the perspective of conserving a single species. Prerequisite: familiarity with GIS and consent of instructor. Credit Hours: 3

ZOOL536 - Spatial Analysis in Ecology This course provides the ecological, GIS and statistical foundations needed to perform spatial analyses of ecological data at the landscape level. The course will cover the conceptual basis and practical application of GIS-based techniques for accounting for spatial autocorrelation, data reduction, batch processing of analyses (in Python, ArcGIS and R), spatial interpolation of spatial data, and building mixed predictive models aimed at assessing landscape level processes. Prerequisite: familiarity with GIS and consent of instructor. Credit Hours: 3

ZOOL540 - Stable Isotopes in Ecology This course will introduce students to fundamentals of stable isotope biogeochemistry, analytical techniques, and interpretation and analysis of stable isotope data. Students will become acquainted with a diverse array of applications of stable isotopes in ecological research in terrestrial and aquatic systems. Two lectures or discussions per week. Prerequisite: 6 hours of chemistry, 10 hours of biological science. Special approval needed from the instructor. Credit Hours: 3

ZOOL542 - Evolution in the Anthropocene This graduate level course focuses on our contemporary understanding of the impacts of expanding urban and agricultural environments, climate change, and other major components of the Anthropocene on the evolution of wild populations. It is more critical than ever for scientists to examine how anthropogenic factors impact natural populations. This is a conceptually broad course which covers topics ranging from landscape genetics, ecological genetics, evolutionary ecology, and phylogenetics. Credit Hours: 3

ZOOL550 - Analysis of Vertebrate Populations This course provides instruction in the estimation of demographic parameters including but not limited to occurrence, abundance, mortality, birth, growth, philopatry, emigration, and immigration. Students will be introduced to and provided detailed instruction in the use of Program MARK to analyze data from individually marked organisms. Prerequisite: a course in statistics. Credit Hours: 3

ZOOL556 - Phylogenetics (Same as ANTH 556, MBMB 556, and PLB 556) An advanced introduction to modern methods of phylogenetic inference, emphasizing both theoretical background concepts and numerical approaches to data analysis. Topics include properties of morphological and molecular characters, models of character evolution, tree estimation procedures, and tree-based testing of evolutionary hypotheses. Special approval needed from the instructor. Credit Hours: 3

ZOOL557 - Biostatistics (Same as PLB 557) Basic biostatistics procedures used by researchers in life sciences and related fields. Topics include descriptive statistics, probability and distributions, statistical

models, likelihood methods, experimental design, analysis of variance, regression, correlation, and the use of statistical software. Credit Hours: 4

ZOOL558 - Advanced Biostatistics (Same as PLB 558) Advanced biostatistical procedures used by researchers in life sciences and related fields. Topics include multiple and logistic regression, randomization tests, jackknife and bootstrap, Mantel tests, BACI designs, MANOVA, repeated measures analysis and the use of statistical software. Prerequisite: ZOOL 557, PLB 557 or equivalent. Credit Hours: 4

ZOOL559 - Analytical Techniques in Toxicology This is an advanced class for graduate students interested in the analytical tools used in the field of Environmental Toxicology. Prerequisite: CHEM 340 with C or better. Credit Hours: 4

ZOOL564 - Aquaculture Techniques (Same as ANS 564) Practical experience in aquaculture techniques. Course consists of modules which require student participation in hands-on experience, (e.g., spawning, induction of spawning, production of fry, operation and grading, diagnosis and treatment of parasites and diseases, and transporting of fish). One credit for completion of two modules. Register any semester, one year to complete elected number of modules. Written report and examination required for each module. Cost incurred by student varies with modules selected. Prerequisite: ZOOL 477 or ANS 477 or consent of instructor. Credit Hours: 1-2

ZOOL565 - Environmental Physiology of Fish Synthesis of effects of pollutants on physiological processes of fish. Course begins with an overview of fish physiology. Topics include: concepts, methods, and measurements in aquatic toxicology; histopathological, physiological, and behavioral responses to pollutants; and toxicity of heavy metals, organics, particulates and other pollutants. Three lectures per week. Prerequisite: ZOOL 465 or consent of instructor. Credit Hours: 3

ZOOL568 - Fisheries Stock Assessment Methods of characterizing harvested fish populations including mortality rates, age growth analysis, population sampling, yield models, habitat evaluation procedures and creel survey techniques. Three one-hour meetings per week. Prerequisite: ZOOL 466 with a grade of C or better or consent of instructor. Credit Hours: 3

ZOOL569 - Advanced Fisheries Management Advanced topics related to the management of fisheries including urban fisheries, native American fisheries, freshwater commercial fisheries, Great Lakes fisheries, impact of power generating plants on fishes, and in-depth consideration of indices of community structure and current topics in fish management. Three lectures per week. Prerequisite: ZOOL 466 or consent of instructor. Credit Hours: 3

ZOOL570 - Advanced Aquaculture (Same as ANS 570) Special topics in aquaculture and practical methods for the production of coldwater, coolwater, warmwater, and tropical aquatic species. Prerequisite: ZOOL 477 or ANS 477 or equivalent with a grade of C or better. Credit Hours: 3

ZOOL571 - Fish Reproduction and Breeding (Same as ANS 571) Principles of finfish reproductive strategies, reproductive physiology and captive breeding. The role of genetics and the use of biotechnology and various breeding techniques in breeding programs will also be emphasized. The purpose of this course is to develop an understanding of fish reproduction and breeding techniques and to gain an appreciation of the complexity involved in managing a hatchery breeding program. Two lectures a week and one four-hour lab alternate weeks. Prerequisite: ZOOL 477 or ANS 477 or equivalent with a grade of C or better. Credit Hours: 3

ZOOL573 - Physiological Ecology The role of physiological, morphological, and behavioral adaptations and adjustments in the ecology of vertebrate organisms with special emphasis on examining the energy balance and environment as it influences vertebrate ecology. Two hours of lecture and one two-hour laboratory. Prerequisite: BIOL 307 or equivalent. Special approval needed from the instructor. Credit Hours: 3

ZOOL574 - Internship in Wildlife Administration and Management A minimum 2-month full-time internship will be conducted at a Fish and Wildlife Refuge, National Forest, State Wildlife Area, or other private or publicly held land trust. During the time of the internship, daily activities of the students will be supervised by agency personnel. In collaboration with agency personnel, students will be required to write and submit a land improvement proposal to an appropriate funding agency. Internships must be

approved by the Director of the Professional Science Master's program in Zoology. Grading will be based on a rubric outlining student performance during the day to day activities internship and the final land improvement proposal. Credit Hours: 1-6

ZOOL576 - Seminar in Ecology (Same as PLB 589A) Discussions of current and historical research and literature in various subject areas of ecology. Credit Hours: 1

ZOOL577 - Population Ecology Principles of population dynamics as related to animals, with application to management and conservation of animal populations. Areas of emphasis include (A) an introduction to mathematical models and graphical theory of population dynamics, (B) application of theory to population management & conservation, and (C) empirical approaches to studying population persistence and regulation. Prerequisite: BIOL 307 or consent of instructor. Credit Hours: 3

ZOOL578 - Population Genetics (Same as PLB 578) Genetic structure of populations, factors causing changes and principles governing rate and direction of change. Three lectures per week. Prerequisite: BIOL 304 or equivalent, and BIOL 305 or equivalent. Credit Hours: 3

ZOOL579 - Molecular Genetics Techniques Practical experience in molecular genetics techniques currently used in zoology for population genetic analysis and for molecular systematics. Emphasis will be on methods for allozyme, mtDNA and nuclear DNA analysis. Class projects will focus on experimental design, data collection and analysis. Special approval needed from the instructor. Credit Hours: 3

ZOOL580 - Current Topics in Evolution (Same as ANTH 580, MBMB 580) The Evolution Discussion Group meets weekly throughout the year to discuss current evolutionary literature and the research of participants. All students and faculty with an interest in evolutionary biology are welcomed to participate. Credit Hours: 1

ZOOL581 - Zoological Literature Diversity and functions of zoological literatures, scientific writing and the publication process. Two lectures per week. Restricted to graduate status in a biological science. Credit Hours: 2

ZOOL582 - Graduate Zoology Seminar Special topics in zoology. Consult department for each semester's topic. One meeting per week. Special approval needed from the instructor and department. Credit Hours: 1

ZOOL584 - Conservation Genetics Application of principles from evolutionary and ecological genetics to conservation biology, fishery management, wildlife management, and aquaculture. Includes an overview of classical, molecular, population and quantitative genetics leading to an understanding of how managers can conserve genetic diversity and evolutionary potential of natural and captive populations. Prerequisite: BIOL 305 or consent of instructor. Credit Hours: 3

ZOOL585E - Seminar: Reasoning in Ecology Conceptual issues in ecology and ecological research. Credit Hours: 3

ZOOL585G - Seminar in Parasitology Advanced study of special topics in zoology. Credit Hours: 3

ZOOL585Z - Seminar in Selected Topics Advanced study of special topics in zoology. Special approval needed from the instructor or department. Credit Hours: 3

ZOOL586 - Fisheries Seminar Contemporary topics, literature, and oral and written communication in fisheries science. Enrollment required for zoology graduate students specializing in fisheries science for all fall and spring semesters until degree requirements are completed, unless exempted by the student's academic advisor. Only one 586 credit hour, however, may be used to satisfy degree requirements. One meeting per week. Credit Hours: 1

ZOOL588 - Wildlife Seminar Contemporary topics, literature, and oral and written communication in wildlife ecology. Enrollment required for zoology graduate students specializing in wildlife ecology for all Fall and Spring semesters until degree requirements are completed. Only four 588 credit hours, however, may be used to satisfy degree requirements. One meeting per week. Credit Hours: 1

ZOOL589 - Zoology Colloquium Regularly scheduled presentations by invited seminar speakers on topics of current research interest in Zoology. Graded S/U. Only two credits of 589 may be used to satisfy degree requirements. Restricted to graduate status in Zoology. Credit Hours: 1

ZOOL593 - Individual Research Investigation in zoology other than those for theses. Only three hours may be credited toward a degree. Some costs may be borne by the student. Credit Hours: 1-12

ZOOL596 - Research Graded S/U only. Credit may not be used toward a degree in Zoology. Special approval needed from the instructor. Credit Hours: 1-12

ZOOL597 - Advanced Zoological Techniques Individualized techniques or experimental procedures to prepare for dissertation research. May be taken at another university. Number of credits determined by committee. Graded on S/U basis following final report submitted to major adviser. Restricted to admission to Ph.D. degree program in Zoology. Special approval needed from the major adviser. Credit Hours: 1-12

ZOOL598 - Research Paper Research paper for Master of Science degree for Biological Sciences major. Some cost may be borne by the student. Graded S/U only. Special approval needed from the instructor. Credit Hours: 1-6

ZOOL599 - Research and Thesis Thesis for Master of Science degree. Only six hours may count toward the degree. Some cost may be borne by student. Graded S/U only. Special approval needed from the instructor. Credit Hours: 1-36

ZOOL600 - Research and Dissertation Research and dissertation for Doctor of Philosophy degree. Some cost may be borne by student. Graded S/U only. Special approval needed from the instructor. Credit Hours: 1-32

ZOOL601 - Continuing Enrollment For those graduate students who have not finished their degree programs and who are in the process of working on their dissertation, thesis, or research paper. The student must have completed a minimum of 24 hours of dissertation research, or the minimum thesis, or research hours before being eligible to register for this course. Concurrent enrollment in any other course is not permitted. Graded S/U or DEF only. Credit Hours: 1

ZOOL699 - Postdoctoral Research Must be a Postdoctoral Fellow. Concurrent enrollment in any other course is not permitted. Credit Hours: 1

Zoology Faculty

Anderson, Frank E., Professor, Ph.D., University of California, Santa Cruz, 1998; 1999. Invertebrates, molecular systematics, molecular evolution.

Bastille-Rousseau, Guillaume, Assistant Professor, Ph.D., Trent University, 2014; 2020. Wildlife, spatial, population, and behavioral ecology.

Boyles, Justin G., Associate Professor, Ph.D., Indiana State University, 2009; 2011. Conservation physiology.

Brooks, Marjorie, Associate Professor, Ph.D., University of Wyoming, 2003; 2009. Limnology, biogeochemistry, toxicology.

Brown, Jason L., Assistant Professor, Ph.D., East Carolina University, 2009; 2016. Integrated ecological, evolutionary, genetic, and geospatial analysis.

Eichholz, Michael W., Professor, Ph.D., University of Alaska, 1998; 2002. Waterfowl, wetland ecology.

Garvey, James E., Professor, Ph.D., Ohio State University, 1997; 2000. Fisheries biology.

Heist, Edward J., Professor, Ph.D., College of William and Mary, 1994; 1998. Population genetics, conservation genetics, fishery management.

Ibrahim, Kamal, Associate Professor, Ph.D., Cambridge University, 1989; 2001. Population genetics.

Jimenez-Ruiz, F. Agustin, Associate Professor and Director of Graduate Studies, Ph.D., University of Nebraska-Lincoln, 2004; 2009. Parasitology.

Lovvorn, James R., Professor, Ph.D., University of Wisconsin-Madison, 1987; 2009. Waterbird ecology, food webs.

Lydy, Michael J., Professor, Ph.D., Ohio State University, 2001. Aquatic toxicology.

Narr, Charlotte, Assistant Professor, Ph.D., Trent University, 2016; 2020. Freshwater ecology, ecological stoichiometry, and host-parasite interactions.

Reeve, John, Associate Professor, Ph.D., University of California Santa Barbara, 1985; 2000. Quantitative ecology.

Warne, Robin W., Assistant Professor, Ph.D., University of New Mexico, 2008; 2011. Physiological ecology.

Whitledge, Gregory, Professor, Ph.D., University of Missouri, 2001; 1995. Fish ecology and management.

Emeriti Faculty

Anthony, Terence R., Associate Professor, Emeritus, M.D., University of Chicago, 1968; and Ph.D., University of Chicago, 1975; 1971.

Brandon, Ronald A., Professor, Emeritus, Ph.D., University of Illinois, 1962; 1963.

Burr, Brooks M., Professor, Emeritus, Ph.D., University of Illinois, 1977; 1977.

Englert, DuWayne C., Professor, Emeritus, Ph.D., Purdue University, 1964; 1963.

Feldhamer, George A., Professor, Emeritus, Ph.D., Oregon State University, 1977; 1984.

Halbrook, Richard S., Associate Professor, Emeritus, Ph.D., Virginia Polytechnic Institute and State University, 1990; 1993.

Heidinger, Roy C., Professor, Emeritus, Ph.D., Southern Illinois University Carbondale, 1970; 1970.

King, David G., Associate Professor, Emeritus, Ph.D., University of California, San Diego, 1975; 1977.

Kohler, Christopher C., Professor, Emeritus, Ph.D., Virginia Polytechnic Institute, 1980; 1981.

Krajewski, Carey, Professor and Chair, Ph.D., University of Wisconsin-Madison, 1988; 1990.

LeFebvre, Eugene A., Associate Professor, Emeritus, Ph.D., University of Minnesota, 1962; 1966.

McPherson, John E., Jr., Professor, Emeritus, Ph.D., Michigan State University, 1968; 1969.

Muhlach, William L., Associate Professor, Emeritus, Ph.D., University of Illinois at Chicago, 1986; 1987.

Shepherd, Benjamin A., Professor, Emeritus, Ph.D., Kansas State University, 1970; 1969.

Sparling, Donald W., Associate Professor, Emeritus, Ph.D., University of North Dakota, 1979; 2004.

Stahl, John B., Associate Professor, Emeritus, Ph.D., Indiana University, 1958; 1966.

Thomas, Richard H., Associate Professor, Ph.D., University of Arizona, 1985; 2004.

Waring, George H., Professor, Emeritus, Ph.D., Colorado State University, 1966; 1966.

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