

# ECOLOGY AND EVOLUTIONARY BIOLOGY

The EBIO graduate program provides advanced training in a wide variety of biological disciplines ranging from biogeochemistry to community ecology to evolutionary genetics. The goal of the EBIO graduate program is to produce scientists, educators and citizens who are equipped with skills to build careers that advance knowledge about life on Earth. Graduates of the EBIO program are well-positioned to pursue a wide range of careers that include academia, science education, wildlife biology, conservation biology, resource management, environmental consulting and environmental law.

Our disciplinary strengths include behavior, ecology, genetics, morphology and systematics. Roughly half of the faculty focus on the adaptation and functioning of organisms in the context of environment, while the other half study higher levels of organization, including populations, communities and ecosystems. Our research programs have relevance for global change, conservation biology, and revealing fundamental mechanisms underlying the structural and functional adaptations of organisms.

Please contact [ebiograd@colorado.edu](mailto:ebiograd@colorado.edu) for additional information.

**Course code for this program is EBIO.**

## Master's Degree

- Ecology and Evolutionary Biology - Master of Arts (MA) (<https://catalog.colorado.edu/graduate/colleges-schools/arts-sciences/programs-study/ecology-evolutionary-biology/ecology-evolutionary-biology-master-arts-ma/>)

## Doctoral Degree

- Ecology and Evolutionary Biology - Doctor of Philosophy (PhD) (<https://catalog.colorado.edu/graduate/colleges-schools/arts-sciences/programs-study/ecology-evolutionary-biology/ecology-evolutionary-biology-doctor-philosophy-phd/>)

## Faculty

While many faculty teach both undergraduate and graduate students, some instruct students at the undergraduate level only. For more information, contact the faculty member's home department.

Adams, William ([https://experts.colorado.edu/display/fisid\\_103612/](https://experts.colorado.edu/display/fisid_103612/))  
Professor; PhD, Australian National University

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Associate Professor, Associate Chair; PhD, Colorado State University

Basey, John M. ([https://experts.colorado.edu/display/fisid\\_105539/](https://experts.colorado.edu/display/fisid_105539/))  
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Bonde, Erik K.  
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Bowers, M. Deane  
Professor, Chair; PhD, University of Massachusetts Amherst

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Seastedt, Timothy  
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Windell, John T.  
Professor Emeritus

Winston, Paul W.  
Professor Emeritus

## Courses

### EBIO 5000 (1) EBIO Colloquia

All first year EBIO graduate students are required to attend the EBIO Colloquia Series. Speakers from around the world and within the department cover topics in all areas of biology.

**Grading Basis:** Letter Grade

### EBIO 5030 (3) Limnology

Examines the ecology of inland waters, including a detailed consideration of physical, chemical and biological properties of freshwater ecosystems: origins and major characteristics of lakes and streams, survey of chemical and nutrient cycles in freshwater habitats and survey of biotic composition of freshwater environments. Important themes in modern freshwater ecology are considered, including energy flow, trophic structure, eutrophication and management of freshwater ecosystems.

**Equivalent - Duplicate Degree Credit Not Granted:** EBIO 4030

**Requisites:** Restricted to graduate students only.

**EBIO 5040 (3) Speciation**

The process by which new species arise is fundamental to understanding life's diversity, with implications for how we define and protect species. In this class, we will explore models of adaptive and non-adaptive speciation and how we test, find evidence for, and distinguish among these. Each class will include both a short lecture and discussion. Students will be able to choose and work on independent projects on any area of speciation research.

**Equivalent - Duplicate Degree Credit Not Granted:** EBIO 4040

**Requisites:** Restricted to graduate students only.

**Recommended:** Prerequisites EBIO 1220 and EBIO 3080.

**EBIO 5050 (4) Fish Biology**

Explores the tremendous diversity of this group, which includes eyeless catfish named after Satan and cast out of underground aquifers by artesian wells, loaches that cling to rocks in mountain torrents with fin-derived suction cups, lungfish in mud cocoons that metabolize their own muscles while waiting for the rains to return, degenerate male anglerfish that parasitize their mates in the blackness of ocean depths, and flying fish that glide above the surface of the open sea to escape the slashing bills of sailfish below. Lectures will cover form and function, evolution, the fossil record, reproduction and development, genetics, behavior, ecology, distribution, and conservation of fishes. The laboratory will stress fish identification, anatomy, and development.

**Equivalent - Duplicate Degree Credit Not Granted:** EBIO 4050

**Requisites:** Restricted to graduate students only.

**EBIO 5060 (3) Landscape Ecology**

Studies distributional patterns of communities and ecosystems, ecological processes that affect those patterns, and changes in pattern and process over time. Consideration of spatial and temporal scales in ecological analyses is required to understand and predict response to broad-scale environmental change.

**Equivalent - Duplicate Degree Credit Not Granted:** EBIO 4060

**Requisites:** Restricted to graduate students only.

**EBIO 5080 (4) Freshwater Phycology**

Algae are a non-monophyletic group of organisms that play critical roles in ecosystem structure and function. They have a long history of being used in a variety of ways by the human species, but are increasingly being applied to modern issues of understanding water quality and climate change, engineering at the nano scale and in the production of renewable biofuels.

**Equivalent - Duplicate Degree Credit Not Granted:** EBIO 4080

**Requisites:** Restricted to graduate students only.

**EBIO 5100 (3) Advanced Ecology**

Emphasizes specific aspects of ecology based on specialties of faculty. One or more courses are offered most semesters. Topics have included dynamics of mountain ecosystems, tundra ecology, ethnoecology, population dynamics, tropical and insular biology, ecology of fishes, quantitative plant ecology, and arctic and alpine environments. May use animals and/or animal tissues.

**Equivalent - Duplicate Degree Credit Not Granted:** EBIO 4100

**Repeatable:** Repeatable for up to 6.00 total credit hours. Allows multiple enrollment in term.

**Requisites:** Restricted to graduate students only.

**EBIO 5120 (2-4) Advanced Ecology**

Emphasizes specific aspects of ecology based on specialties of faculty. One or more courses are offered most semesters. Topics have included dynamics of mountain ecosystems, tundra ecology, ethnoecology, population dynamics, tropical and insular biology, ecology of fishes, quantitative plant ecology and arctic and alpine environments. May use animals and/or animal tissues.

**Equivalent - Duplicate Degree Credit Not Granted:** EBIO 4120

**Repeatable:** Repeatable for up to 7.00 total credit hours. Allows multiple enrollment in term.

**EBIO 5150 (1-2) Techniques in Ecology**

Emphasizes application of modern ecological techniques, such as stream biology, aquatic biology, environmental measurement and control, and techniques in geoecology.

**Equivalent - Duplicate Degree Credit Not Granted:** EBIO 4150

**Repeatable:** Repeatable for up to 7.00 total credit hours. Allows multiple enrollment in term.

**EBIO 5155 (4) Ecosystem Ecology**

Integrates information from physics (energetics), chemistry (element properties) and biology (evolutionary traits, photosynthetic pathways) to understand the structure and functioning of ecosystems. Provides an analysis of biotic community responses and feedbacks to environmental change drivers. Strong focus on water, nutrient cycling and carbon dynamics of diverse terrestrial and aquatic landscapes.

**Equivalent - Duplicate Degree Credit Not Granted:** EBIO 4155, ENVS 5155 and ENVS 4155

**Requisites:** Restricted to graduate students only.

**Grading Basis:** Letter Grade

**EBIO 5190 (1) Diversity and Inclusion**

Topics have included: implicit bias, privilege, inclusive pedagogy, inclusive hiring practices, inclusive mentoring, barriers facing undergraduate students, barriers facing graduate students, fairness of the GRE.

**Repeatable:** Repeatable for up to 8.00 total credit hours.

**Requisites:** Restricted to graduate students only.

**EBIO 5240 (3) Advanced Topics in Animal Behavior**

Covers special areas of ethology such as sociobiology, animal communication, cognitive ethology, human ethology, moral and ethical issues.

**Recommended:** Prerequisite EBIO 3240.

**EBIO 5270 (3) Population Genetics**

Provides an in-depth introduction to population genetics. Lectures, discussions and labs will focus on exploring how evolutionary processes shape genetic variation through time and space and how population-level evolutionary processes can be inferred from patterns of genetic variation. While learning basic population genetic theory we will investigate current topics in the field and work with simulated and real data.

**Equivalent - Duplicate Degree Credit Not Granted:** EBIO 4270

**Grading Basis:** Letter Grade

**EBIO 5290 (4) Phylogenetics and Comparative Biology**

Reviews the principles and methodology of phylogenetic inference using molecular data. Emphasizes the application of comparative approaches to hypothesis testing in evolution, ecology and medicine and provides a broad foundation in both theory and practice of phylogenetics.

**Equivalent - Duplicate Degree Credit Not Granted:** EBIO 4290

**Requisites:** Restricted to graduate students only.

**Grading Basis:** Letter Grade

**EBIO 5320 (3) Current Topics in Evolutionary Biology**

Examines six major themes on contemporary evolutionary research: population genetics, natural selection and adaptation, molecular evolution, evolution and development, phylogenetic systematics, and macroevolution. Emphasizes recent primary literature and sophisticated mastery.

**Requisites:** Restricted to graduate students only.

**EBIO 5340 (4) Conservation Biology and Practice in Brazil's Atlantic Forest**

Field Studies. Examines the application of conservation principles in the Atlantic Forest of Brazil, a 'biodiversity-in-crisis' setting. Explores successful conservation strategies integrated with efforts to alleviate socioeconomic issues. Three-week Maymester, Study Abroad Global Seminar.

**Equivalent - Duplicate Degree Credit Not Granted:** EBIO 4340 and ENVS 4340 and ENVS 5340

**Recommended:** Prerequisite EBIO 2040 or ENVS 2000 or 2000/higher-level course in ANTH, EBIO, ENVS, EVEN, GEOG, IAFS or other discipline related to ecology or sustainability.

**Grading Basis:** Letter Grade

**EBIO 5360 (3) Lifestyle Medicine**

Student will self-select a semester-long personalized project for researching and learning about a topic they are passionate about in the context of the impact of environment and lifestyle on human health and wellbeing. Students will have continuous access to one-on-one instructor support and feedback, and credit will be given for completion of specific milestones throughout the semester.

**Equivalent - Duplicate Degree Credit Not Granted:** EBIO 4360

**EBIO 5370 (3) Genetically Engineered Organisms**

Explores the genetic engineering of microorganisms, fungi, plants, animals, coral reefs, and humans from the many demonstrated and anticipated benefits to the various concerns that have been raised by the explosive growth of research in this area. The course will be largely student-driven, in that each student will pursue different areas to research and present to the class. Students are encouraged to pursue a topic about which an interest and/or passion can be developed! Previously offered as a special topics course.

**Equivalent - Duplicate Degree Credit Not Granted:** EBIO 4370

**EBIO 5410 (4) Biological Statistics**

Lect. and lab. Offers a demanding, problems-oriented methods course in statistical inference procedures, assumptions, limitations, and applications emphasizing techniques appropriate to realistic biological problems. Includes data file management using interactive computing techniques.

**Equivalent - Duplicate Degree Credit Not Granted:** EBIO 4410

**Requisites:** Restricted to graduate students only.

**EBIO 5420 (3) Computational Biology**

Covers a wide range of techniques for simulating biological systems, developing computer programs and scripts to interact with data and making research shareable and reproducible.

**Equivalent - Duplicate Degree Credit Not Granted:** EBIO 4420

**Grading Basis:** Letter Grade

**EBIO 5440 (4) Animal Developmental Diversity**

Surveys development in a range of vertebrate and invertebrate systems to reconstruct the common bilaterian ancestor, and elucidate the developmental genetic changes underlying animal diversification. Lab focuses on vertebrate embryos and explores key methods in evolutionary developmental biology including in situ hybridization, embryo microinjection, and transgenesis.

**Equivalent - Duplicate Degree Credit Not Granted:** EBIO 4440 and MCDB 4441 and MCDB 5441

**Requisites:** Restricted to graduate students only.

**EBIO 5460 (1-5) Special Topics**

Familiarizes students with specialized areas of biology.

**Equivalent - Duplicate Degree Credit Not Granted:** EBIO 4460

**Repeatable:** Repeatable for up to 9.00 total credit hours. Allows multiple enrollment in term.

**Requisites:** Restricted to graduate students only.

**EBIO 5500 (4) Plant Biodiversity and Evolution**

Surveys plant types emphasizing diagnostic features of plants in general and major taxa in particular. Focuses on identity, morphology, anatomy, reproduction, ecology, geography, evolution, fossil record, and economic use of taxa.

**Equivalent - Duplicate Degree Credit Not Granted:** EBIO 4500

**EBIO 5510 (4) Plant Anatomy and Development**

Lect. and lab. Introduces structures of seed plants, especially angiosperms, and developmental history of these structures. Studies cell types, and their location and function in plant tissues and organs. The laboratory provides an opportunity to examine plant tissues and to prepare tissues for examination by the light microscope. Stresses role of plant structures in the living plant.

**Equivalent - Duplicate Degree Credit Not Granted:** EBIO 4510

**EBIO 5511 (3) Microbial Ecology**

Aims to gain an understanding of the critical roles that microbes play in the biosphere, and why they play those roles. We start with with fundamental concepts (e.g. microbial physiology and evolution) and build up to an understanding of how the biosphere functions (e.g. biogeochemistry and nutrient dynamics at the ocean-sediment interface) by reading both current and classical literature in the field.

**Equivalent - Duplicate Degree Credit Not Granted:** EBIO 4511

**EBIO 5520 (4) Flowering Plant Diversity**

Emphasizes the morphology, evolution, classification, phylogeny, natural history, identification, and economic importance of plants, with a focus on flowering plants (angiosperms). Because flowering plants are dominant and keystone features of both our natural and developed world, capacity to understand them from an evolutionary and ecological perspective is an important skill for anyone interested in field biology, ecology, evolution, environmental resource management, or simply in being a good steward to the land and to your society.

**Equivalent - Duplicate Degree Credit Not Granted:** EBIO 4520 and MUSM 5520

**Requisites:** Restricted to graduate students only.

**Grading Basis:** Letter Grade

**EBIO 5560 (4) The Lichen Biome**

Focuses on lichens as biologically diverse hubs of interactions, and will cover numerous dimensions of diversity within the symbiosis (algae, bacteria, and ecological and evolutionary relationships therein) and beyond it (diversity of lichen symbioses in nature, their functions, and conservation).

**Equivalent - Duplicate Degree Credit Not Granted:** EBIO 4560

**Requisites:** Restricted to graduate students only.

**EBIO 5600 (4) Evolutionary Ecology**

Evaluates how interactions within species, among species and between species and the environment evolve over time. Emphasizes the development of scientific skills, including ecological, genetic and statistical tools for testing hypotheses in evolutionary ecology. Lab activities include research projects that quantify natural selection, gene flow and phenotypic plasticity in natural systems, and a semester-long class experiment examining plant dispersal.

**Equivalent - Duplicate Degree Credit Not Granted:** EBIO 4600

**Grading Basis:** Letter Grade

**EBIO 5620 (4) Mycology: the Biology of Fungi**

A broad taxonomic and biological survey of fungi. This is an upper division lecture, field, and lab-based course designed for biology majors interested in microbial science. Field and Laboratory components include two lab practicals in which students identify macro- and micro-fungi, preparation of a fungal specimen collection, and the use of light microscopy for identification and visualization of fungal structures.

**Equivalent - Duplicate Degree Credit Not Granted:** EBIO 4620

**Recommended:** Prerequisite graduate students with background in General Biology (equivalent of EBIO 1210, EBIO 1230, EBIO 1220, EBIO 1240), Ecology (equivalent of EBIO 2040), Evolution (equivalent of EBIO 3080) and Genetics (equivalent of EBIO 2070).

**Grading Basis:** Letter Grade

**EBIO 5660 (4) Insect Biology**

Lect. and lab. Introduction to evolution, ecology, physiology, and behavior of insects. Emphasizes how insects have solved problems, such as maintaining water balance or finding food, that are shared by all animals but for which there may be unique solutions among the insects. Agricultural and human health problems relative to entomology are discussed. Uses animals and/or animal tissues.

**Equivalent - Duplicate Degree Credit Not Granted:** EBIO 4660

**Requisites:** Restricted to graduate students only.

**EBIO 5700 (3) Quantitative Genetics**

Explores how the differences at the DNA level impact variability within and among individuals, and how that variation is shaped by interactions with environments. Quantitative genetics covers a range of topics, but in this course we will focus on the methods and approaches to investigate complex traits, those influenced by many genes and environmental factors, emphasizing the evolutionary forces that shape variation. We will analyze real genetic data (human, plant, mouse, etc.), and prepare our findings as written manuscripts or oral presentations. Some familiarity with basic genetic principles is assumed. Previously offered as a special topics course.

**Equivalent - Duplicate Degree Credit Not Granted:** EBIO 4700

**Requisites:** Restricted to graduate students only.

**EBIO 5740 (3) Biology of Amphibians and Reptiles**

Comparative morphology, taxonomy, ecology, behavior and geographic distribution of amphibians and reptiles. Uses animals and animal tissue.

**Equivalent - Duplicate Degree Credit Not Granted:** EBIO 4740

**EBIO 5750 (4) Ornithology**

Lect., lab, and field trips. Presents origin, evolution, ecology, physical and behavioral characteristics and taxonomy of orders and families of birds of North America; field work with local species emphasizing avian ecology. Uses animals and/or animal tissues.

**Equivalent - Duplicate Degree Credit Not Granted:** EBIO 4750

**EBIO 5760 (4) Mammalogy**

Lect., lab, and field studies. Discusses origin, evolution and adaptation, geographic distribution, ecology and taxonomy of mammals; field and laboratory study of Coloradan species. Uses animals and/or animal tissues.

**Equivalent - Duplicate Degree Credit Not Granted:** EBIO 4760 and MUSM 5760

**Requisites:** Restricted to graduate students only.

**EBIO 5800 (3) Critical Thinking in Biology**

Lect. and discussion. Explores controversial issues, historical themes, or emerging developments in biology. Consult the EBIO Undergraduate Advising Center for current listings.

**Equivalent - Duplicate Degree Credit Not Granted:** EBIO 4800

**Repeatable:** Repeatable for up to 12.00 total credit hours. Allows multiple enrollment in term.

**Requisites:** Restricted to graduate students only.

**Recommended:** Prerequisite minimum of 14 hours of EBIO course work.

**EBIO 5820 (1) Graduate Writing Seminar**

Enhances writing proficiency, using graduate writing projects to implement the course concepts. Offers understanding of conventions and strategies used in scientific writing to prepare students for academic and professional communication. Department enforced requisite, basic proficiency in English as a written language.

**Requisites:** Restricted to graduate students only.

**EBIO 5840 (1-6) Independent Study (Master's Level)**

Instructor consent required.

**Repeatable:** Repeatable for up to 6.00 total credit hours. Allows multiple enrollment in term.

**Requisites:** Restricted to graduate students only.

**EBIO 6000 (1) Seminar: Introduction to Biological Research**

Discusses areas of biological research represented in EBIO. Required of all first-year graduate students in EBIO.

**Requisites:** Restricted to graduate students only.

**EBIO 6100 (1-3) Seminar in Environmental Biology**

**Equivalent - Duplicate Degree Credit Not Granted:** EBIO 6120

**Repeatable:** Repeatable for up to 7.00 total credit hours. Allows multiple enrollment in term.

**Requisites:** Restricted to graduate students only.

**EBIO 6120 (1-3) Seminar in Environmental Biology**

**Equivalent - Duplicate Degree Credit Not Granted:** EBIO 6100

**Repeatable:** Repeatable for up to 7.00 total credit hours. Allows multiple enrollment in term.

**EBIO 6200 (1-3) Seminar in Population Biology**

**Repeatable:** Repeatable for up to 7.00 total credit hours. Allows multiple enrollment in term.

**Requisites:** Restricted to graduate students only.

**EBIO 6210 (1-3) Seminar in Population Biology**

**Repeatable:** Repeatable for up to 7.00 total credit hours. Allows multiple enrollment in term.

**EBIO 6300 (1-3) Seminar in Organismic Biology**

**Repeatable:** Repeatable for up to 7.00 total credit hours. Allows multiple enrollment in term.

**Requisites:** Restricted to graduate students only.

**EBIO 6840 (1-7) Independent Research (Master's Level)**

Instructor consent required.

**Repeatable:** Repeatable for up to 7.00 total credit hours. Allows multiple enrollment in term.

**Requisites:** Restricted to graduate students only.

**EBIO 6940 (1) Master's Candidate for Degree**

Registration intended for students preparing for a thesis defense, final examination, culminating activity, or completion of degree. Instructor consent required.

**Requisites:** Restricted to graduate students only.

**EBIO 6950 (1-6) Master's Thesis**

Instructor consent required.

**Repeatable:** Repeatable for up to 7.00 total credit hours. Allows multiple enrollment in term.

**Requisites:** Restricted to graduate students only.

**EBIO 7840 (1-6) Independent Study (Doctoral Level)**

**Repeatable:** Repeatable for up to 6.00 total credit hours. Allows multiple enrollment in term.

**Requisites:** Restricted to graduate students only.

**EBIO 8840 (1-6) Independent Research (Doctoral Level)**

**Repeatable:** Repeatable for up to 6.00 total credit hours. Allows multiple enrollment in term.

**Requisites:** Restricted to graduate students only.

**EBIO 8990 (1-10) Doctoral Dissertation**

Instructor consent required.

**Repeatable:** Repeatable for up to 30.00 total credit hours.

**Requisites:** Restricted to graduate students only.