

**BIOLOGY 201 FALL SEMESTER 2010
ECOLOGY AND EVOLUTION**

INSTRUCTORS: **Dr. Lauren Buckley**
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LECTURES: **9:30-10:45 Tuesday and Thursday, Coker 201. Come to class, learn and enjoy!!**

RECITATION AND FIELD TRIPS: You must be registered for one of the following sections: 701-709 (NOTE: 601-609 sections are for Drs. Burch and Pfennig's BIOL 201 course).

BIOLOGY 201 WEBSITE: **Blackboard** will be the primary medium for communications in this class outside of lecture. In your web browser type in: **blackboard.unc.edu**, then log in with your onyen and password. Biology 201 Section 007 Ecology and Population Biology will come up (and your recitations too). If you are registered and the course doesn't appear contact us.

PHILOSOPHICAL BACKGROUND FOR ECOLOGY AND EVOLUTION:

G.E. Hutchinson wrote a book called *The Ecological Theatre and The Evolutionary Play*. In it, he points out that the drama of evolution is played out in an ecological context. Ecological processes like interactions with the physical environment, competition, and predation are the mechanisms that drive evolution. The actors in the evolutionary drama are ecological entities (populations). Since all biological processes are ultimately part of evolution, ecology and evolution are intimately intertwined. The ecological interactions of populations, species, communities and ecosystems all have evolutionary consequences. All environmental issues have an ecological basis and both ecological and evolutionary consequences. Global warming, ozone depletion, deforestation, overpopulation, etc. result from the actions and interactions between organisms and their environment. Species frequently must adapt to changed environmental conditions via evolution and acclimation or face extinction.

UNIFYING THEMES:

Two concepts help unify this course. One is the role of **diversity**. We will consider many types of diversity from diversity of life, and its evolution during the history of the earth, to genetic diversity (the variety of genotypes in a population or species), which fuels evolution; to species diversity (the variety of species in a natural community), which stabilizes ecosystem

processes. Diversity is fundamental to evolution, population biology and ecology. The other unifying concept is **spatial and temporal heterogeneity**. All systems are variable in space and time. This idea underlies the development of new species, genetic drift, predator-prey dynamics, coexistence of competing species, seasonality, and the structure and dynamics of communities and ecosystems. We will organize the course by using these conceptual threads to weave a coherent understanding of the interrelationships between ecology and evolution.

COURSE OBJECTIVES:

Our goal for Biology 201 is to teach you to understand the process of evolution and the processes that govern the distribution and dynamics of ecological systems. We will explore the problems and challenges of understanding how organisms interact with each other and their environment.

Ultimately we want you to understand how evolutionary and ecological systems work. We want to teach you to **think ecologically and evolutionarily**. We don't want you to spit back what we say. We want you to demonstrate your understanding. We want you to understand how evolution works and how species evolve and how evolution is ongoing and visible in the modern world. We want you to learn to see the world as a series of complex populations and species, each interacting with the environment and each other. Each one shapes and is shaped by its environment. We will give you the groundwork for future study in Ecology and Evolutionary Biology. We want you to become acutely aware of environmental problems and we want you to understand the ecology, which underlies the environmental issues.

Who are your instructors?

Chris Willett-

This will be my 9th year here in the Biology department at UNC. Before coming to UNC I was in San Diego for 3 years (where I started working on evolution in a copepod species), preceded by a stint in upstate NY at Cornell for graduate school (working on the evolution of pheromone communication and speciation in moths) after having grown up in Michigan. My research focuses on evolutionary genetics and I am currently working most extensively with an intertidal invertebrate (a copepod species) as a model for studying speciation and adaptation. Two questions that I am addressing in this species are how do populations of copepods adapt to local conditions in their environment (particularly thermal environment) and what are the genetic changes that underlie the initial stages of reproductive isolation and speciation.

Lauren Buckley-

I joined the biology faculty in January 2009 after conducting graduate research at Stanford and holding postdoctoral fellowships at the National Center for Ecological Analysis and Synthesis and the Santa Fe Institute. My research group combines modelling, field and lab collection of ecological and physiological data, and ecoinformatics to examine how biology (morphology, physiology, and life history) determines an organism's response to environmental change. While most previous research has concerned reptiles and amphibians, we are currently expanding our focus to include butterflies and grasshoppers. Additional research uses ecoinformatic analyses to generalize understanding of how physiology constrains broad-scale patterns of abundance, diversity, and species turnover.

COURSE ORGANIZATION: This course is divided into two main parts:

In **Part I, Evolutionary Biology**, we start with an examination of the development of the concept of evolution and the primary mechanism of evolution (i.e. natural selection) before turning to population genetics and gaining an understanding of how natural selection and other

evolutionary forces operate at the population level. Typically when we think of selection we think of survival, but in fact reproduction (and obtaining reproductive opportunities) is equally important; we will spend some time studying this form of selection, sexual selection. Related to this we will also touch on the evolution of death (how can senescence evolve?) This half of the course will finish with macroevolution which is an examination of patterns of evolution above the species level. Here we will consider speciation (the process of one species splitting into two species) which is the engine that drives the diversification of life. We will also consider adaptive radiations on a small scale and a large scale (the diversity of life on earth) and how we can reconstruct the evolutionary history of these radiations (through phylogenetics). Finally we will end by examining an evolutionary radiation with only one surviving, extant species, *Homo sapiens*.

In **Part II, Ecology**, we will focus on how organisms interact with their environment and with each other. We will investigate how the physical environment determines the distribution of energy and nutrients in ecosystems. We will then address how individual organisms interact with the environment via physiology and how these interactions are shifting in response to human alteration of the environment. We will consider how aggregates of individuals (populations) grow and are regulated by the environment. We will then shift to focusing on interactions between multiple species (competition, predation, and mutualism). We will examine how these interactions result in communities of organisms. We will investigate how these communities are structured (i.e., what determines species composition and biodiversity?), how they function and change over time, and how they are distributed across landscapes.

EXAMS AND COURSE GRADING

Midterm I.....	20% (Sept. 23 th)
Midterm II.....	22% (Nov. 4 th)
Lecture Questions.....	3%
Final Exam.....	40% (Dec. 17 th)
Recitation.....	15%
	100%

Lecture questions will be in-class questions answered by using the **Poll Everywhere** system along with your cell phone or computer. Instructions for registering and using this system can be found on blackboard. There will be no make-ups for these questions for absences or technical glitches, but credit will be given for two missed days for each half of the course (or for the days with the lowest score).

The final is cumulative, but the midterms are not. Examination grades will be posted on the gradebook of the blackboard website. Half of the final will test the last section of ecology lectures and half will be a cumulative final from the entire course. For each lecture, there will be a list of lecture goals, posted in advance on blackboard. You should use these goals as a study guide to prepare for the exams.

Regrades: Grades in both lecture and recitation (including final course grades) will be changed only in the event that a question was mis-graded or if points were totaled incorrectly. Regrades must be requested in writing (i.e. on paper, either computer-printed or clearly hand-written, NOT emailed) and submitted two weeks from when the exam or assignment was returned to you (your exams will be returned in recitation). Regrades must be given to the professor or put in his/her mailbox. We reserve the right to regrade any portion of an exam submitted for a regrade, and to either add or subtract points to correct grading errors.

We believe in the Honor Code and will enforce it. Read up on the Honor Code on the UNC Website (<http://honor.unc.edu/honor/index.html>).

Sept. 2	Population genetics and selection -Intro to single-locus selection models -Maintenance of polymorphism	F-Ch6: 182-210
7	Mutation, migration, and selection -Mutation and selection -Gene flow	F-Ch5: 144-160, Ch6: 210-218, Ch7: 225-232
9	Migration, genetic drift, and selection -Migration/selection balance -Genetic drift and population size	F-Ch7: 242-249
14	Genetic drift and molecular evolution -Neutral theory -Molecular clocks -Selection at the molecular level	F-Ch7: 249-257, 262-264, Ch4: 132-133
16	Sexual selection and levels of selection -Mating systems and operational sex ratio -Male-male competition and female choice -Selection between genes -Selection between organelles/cells	F-Ch11: 401-434, Ch10: 392-395, Ch15: 576-584
21	Levels of selection (cont.) -Group and species selection -Kin selection -Evolution of altruistic behavior	F-Ch12: 447-462, 471-477
23	<u>MIDTERM EXAM #1</u> [The exam will cover material covered in lecture through Sept. 21nd]	
28	Phylogenetics and the comparative method -Building and understanding trees -Using the comparative method	F-Ch2: 50-60, Ch4: 111-131, 133- 137, Ch10: 376-381
30	Species and speciation -Species definitions -Isolating mechanisms -Role of geography in speciation	F- Ch16: 605-633
Oct. 5	Adaptive radiations and diversity -Explosive speciation on islands -Extinction, fossil record -History of life, macro trends	F-Ch17: 660-675, Ch18: 689-721, Ch19: 725-735
7	Human evolution -Recent ancestry of humans -Origin of modern humans	F-Ch20: 753-791
Oct. 12	NO CLASS- UNIVERSITY DAY	

14	Evolution and Disease (Willett) -Evolution of flu virus -Evolution of virulence	F-Ch14: 529-545
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Remaining lectures Buckley. All readings below are chapters in Molles. Lecture goals will be posted on Blackboard prior to class. Specific page numbers that are the required readings will be indicated where appropriate. Otherwise, entire chapters should be read.

	19	Introduction to ecology and the environment	M 1,2,3
	21	<i>Fall Break – No Class</i>	
	26	Ecosystem Ecology	M 18,19
	28	Physiological Ecology: temperature and water	M 5,6
Nov.	2	Physiological ecology: energy and nutrients	M 7
	4	<u>MIDTERM EXAM #2</u> [Covers the lectures from Sept. 28th through Oct. 28th so it will cover 5 lectures by Dr. Willett and 4 by Dr. Buckley]	
	9	Global ecology	M 23
	11	Population dynamics and life histories	M 10,12
	16	Population growth and regulation	M11
	18	Competition	M 13
	23	Exploitation (predation, herbivory, disease) and mutualism	M14,15
	25	<i>Thanksgiving—No Class</i>	
	30	Community ecology	M 17
Dec.	2	Species abundance, distribution, and diversity	M 16
	7	Landscape and geographic ecology	M 20, 21, 22
	17	<u>FINAL EXAM</u> 8:00-11:00 AM	