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BIOLOGY 460W - SYLLABUS

Spring 2011

Biology 460 is a course in general Ecology. Ecology is a study of the relationships of organisms with their physical environment as well as the interactions among organisms. Although its roots are sunk deep in the studies of natural history, a discipline that goes back centuries, ecology is a relatively new discipline. Important elements of it can be found throughout the 18th century writings of Buffon, and some of its fundamental population concepts were employed by Charles Darwin in the 19th century. But it emerged as an independent science afterwards. The word *ecology* was coined in 1869 by Ernst Haeckel, a German embryologist who was an early advocate of Darwinism and who also gave us such gems as "ontogeny recapitulates phylogeny." The first highly influential English language textbook in ecology did not appear until the publication in 1927 of *Animal Ecology* by Charles Elton.

The modern development of ecology has come from botanists and zoologists working both in theoretical laboratory situations and with applied problems in the field. Much of the early impetus to the field came from late 19th and early 20th century botanists working on problems in terrestrial communities; one of their most important questions asked how communities were assembled and even questioned whether the concept of communities was valid. As you will learn in this course, those questions are still with us. Animal ecologists have been in the forefront of those trying to understand populations. Theoretical frameworks established in the mid-19th century were tested, amplified, and argued from early in the 20th century. These early population ecologists often were working in applied areas: human demographics and more recently economic (i.e., agricultural pest) entomology. Some of the debates that began in the 1930's and 1940's regarding the regulation of population size have been among the most compelling and the least resolved of the population questions. New theories and additional data contribute to a better understanding of these issues. And occasionally new ideas emerge that represent breaks with old paradigms. For instance plant ecologists, primarily in Great Britain, have questioned the concept of the "individual" and have suggested that we distinguish between *unitary* individuals (like ourselves) and *modular* individuals (plants and many animals). In the last few years, a rethinking of the nature of discontinuous populations has taken place and the concept of *metapopulations* has emerged. Such old precepts as the “balance of nature” have come under scrutiny: is there such a “balance”? how is it related to community dynamics? to diversity and stability? All these will be treated, at least briefly, in this course. The historical development of our understanding of ecology is important for anyone who wants to have a deep as well as broad knowledge of the science.

Consequently, references to classic papers will occasionally be given in class. Students are not required to read these papers unless there is a specific assignment, although several of them may be found in the optional "Foundations of Ecology" book. All that is good need not be old, so important new papers will also be cited for your own use.

The field of ecology is closely linked to other disciplines because in some ways ecology is the testing grounds for theories in many areas. Hybrid disciplines like Evolutionary Ecology, Ecological Genetics, Behavioral Ecology, and Physiological Ecology are well developed fields today. In Biology 460 you are presumed to have a working knowledge of genetics and evolution. Many of you have not had an organismal physiology course, however. Because the physical environment sets up so many of the conditions for life, and because physiological adaptations are the evolutionary response to these conditions, we will briefly examine physiological ecology in this course. This treatment will not assume any pre-existing upper division knowledge. Your text has some strength in this area, but will not cover everything mentioned in lecture. In this and all other areas, clear lecture notes will be important. In Biology 460 you will be introduced to these major units: (1) Physiological Ecology; (2) Ecological Energetics; (3) Population Ecology; and (4) Community Ecology. Some evolutionary ecology (of course all ecological relationships have evolutionary implications) and behavioral ecology will be treated along the way, but they will not constitute major sections of the course.

Smith and Smith (2001: Ch. 1; Ecology & Field Biology, 6th ed.; Harper & Row) in their overview of the science of ecology note various tensions that exist in ecology based on quite different viewpoints. The three major areas of endeavor which have led to our current level of knowledge are theoretical, laboratory, and field work. The theoretical work is highly mathematical. Mathematical models attempt to quantify relationships and provide testable predictions. It is advisable that you have completed a course in calculus before you take Ecology, but we will use it sparingly and you will not be required to call on those skills to do problems. However, problems will occur on tests from time to time. Decent arithmetic and algebraic abilities should be all you need *(see note below on the use of calculators on exams)*. Problems will also show up as laboratory assignments. These assignments are not intended to create busy work but to give you experience in manipulating numbers for understanding certain kinds of ecological relationships. Because ecological research collects a great deal of data, it is important to know when data are valuable; that is, when they are "significant." This is the domain of statistics. In laboratory you will be taught some basic statistics which will be helpful in this course. This in no way substitutes for a formal statistics treatment,

and students who are going on to graduate school or such careers as environmental consulting are encouraged to take our Biostatistics (Biology 301) course. Quantitative relationships are made far less burdensome by the use of a computer. In laboratory, you will (re-) learn to use a spreadsheet, including its graphics, on computers. We will shortly open our WebCT "page" for Ecology to facilitate the exchange of information, including lab assignments. We may occasionally provide laptop computers in lab; you will be expected to use computers outside of class. The use of these computer techniques is meant to make your life easier; their mastery and use on specified assignments is expected.

The lab section of Ecology includes both field and laboratory work. Although one of the goals of the lab is to illustrate subjects treated in lecture, it will not always be possible to tie them in time. That is because tides, which dictate some of our labs, and Spring Break control the order we must follow in presenting material. There will be an attempt, however, to coordinate lecture and lab. Because of the nature of our material, it is not always possible to have discrete lab exercises. Some must be continued in another lab (e.g., Animal Sampling and Mark-Recapture). Do not let that distress you. We do get into a few habitats on field trips, but for a more complete understanding of the communities that occur in San Diego County, students are encouraged to take Biology 361 (Ecological Communities of San Diego), which is offered every Spring. Our trip to the desert is an overnight trip. The overnight experience may allow us to put out mammal traps at night and get an early start (6:30 am) on our work. Additionally, it allows us a luxury that is otherwise unavailable in this course--the chance to commune with nature. We are gone over Friday night and return around dinnertime on Saturday, so the entire weekend is not used at a time when you may have other things happening. However, you should plan ahead so you do not end up spending most of what should be a fun trip worrying about an assignment in some other course.

As you can see, the laboratory has more than one function. It illustrates principles taught in lecture; it teaches quantitative skills ranging from problem-solving to basic computer skills and elementary statistics; and through field trips it introduces students to a few natural communities. Finally, the lab has one more important function. It provides an upper division writing ("W") experience that is part of the University's Writing Across the Curriculum plan. Two papers will be written. The first is based on a laboratory experiment in primary productivity. The second is based on a long-standing concern in the literature about the dispersion of certain shrubs in our desert. You will be expected to use literature citations in both papers. The Copley Library may not satisfy your needs, so you may want to consider car-pooling to San

Diego State University's library or the one at Scripps Institution of Oceanography (UCSD). However, do not discount our library altogether: some papers may be on Reserve for your use; other papers will be in our collection; still others are available online (especially through JSTOR); and a computer search of the literature is possible here. Your lab instructors will provide guidelines that will help you; in addition, a handy list of do's and don'ts of writing scientific papers may be available. The key to doing papers is to start early. Papers written at the last minute usually look like it.

BIOLOGY 460W Textbooks

Smith, R.L. and T.M. Smith. 2001. Ecology and Field Biology (6th ed.). Benjamin Cummings

McMillan, V.E. 2006. Writing Papers in the Biological Sciences (4th ed.). Bedford/St. Martin's

Real, L.A. and J.H. Brown. 1991. Foundations of ecology: classic papers with commentaries. Univ. Chicago Press. *(Optional text...very useful if you continue in ecology)*

Brower, J., J. Zar, and C. von Ende. 1998. Field and laboratory methods for general ecology (4th ed.). WCB McGraw-Hill.

Course Communication. In Ecology, we use Web CT. To access it, you must have a USD computer account; accounts on AOL, gmail, Yahoo, etc. will not work. This site should be checked regularly–information you need for (especially lab) assignments will be found there. But also check your e-mail regularly. It is possible that we will use a chat room in Web CT in addition to various course materials and assignments. Our office hours follow. If you find you cannot make those hours, feel free to make an appointment. Or write to us by e-mail if we do not use a chat room. Of course, if the issue is personal, e-mail us directly. Either way, we will endeavor to respond quickly to your questions.

And now a word about Academic Integrity...

From time to time, you will work in groups collecting data in lab, and the question of what is appropriate collaboration becomes important. Your lab instructors will normally give you specific instructions, but it is worth noting that the actual calculation of values from data and the development of specific figures and tables displaying them is typically considered an individual endeavor. So is the development of references for a written paper. We hope it is obvious to all that the writing of papers is to be an individual effort. Asking to look at a paper from a previous semester is the first step toward a violation of academic integrity. It may be that your instructors will be willing to provide you with so much help on your assignments that violations of academic integrity might not only be foolish but unnecessary. The key, once again, to sufficient help from instructors is timely work. Getting a quick start on assignments will be very important. All papers will be logged into Turnitin.com.

Unfortunately, the proliferation of electronic devices from cell phones to graphing calculators to palm pilots and blackberries has led to new ways to violate academic integrity on an exam. Consequently, the Biology Department has decided that no such device can be used or even be available on an exam. We have bought calculators that will be passed out for your use on any exam where they are needed. These are the only calculators that may be used on a test in Ecology or any other Biology course.

Learning Outcomes. We should share certain learning expectations in this course. When you leave the course, you should be able to

- understand the nature of the physical environment and how it sets the conditions of life
- describe the way energy and nutrients move in a community or ecosystem
- explain how populations operate and interact with other populations
- identify and understand the major characteristics of communities
- use null hypotheses and statistics to test for ecological differences
- write a scientific paper

Finally, both of your instructors are very glad that you have chosen Ecology as one of your courses. We hope you find it stimulating and rewarding. We look forward to many interesting hours together this semester.

APPENDIX

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INSTRUCTORS AND GRADING POLICIES FOR BIOLOGY 460W

INSTRUCTORS

Lecture - Hugh I. Ellis (ellis@sandiego.edu)
Office: ST 478, ext. 4075
Office Hours: MWF 11:00 am - 12:00 noon
Tu 10:00 am - 12:00 noon

Lab - Paul Kemp (section 1) (pkemp@sandiego.edu)
Office: ST 433, ext. 4074
Office Hours: TuTh 11:30 am - 1:30 pm

Hugh I. Ellis (section 2) *see above*

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GRADING

Midterms (@20%).....40%
Final (cumulative).....25%
Laboratory
(Paper 1 - 12%)
(Paper 2 - 15%)
(Homework - 8%).....35%

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EXAM SCHEDULE**

Midterm 1 - Fri., March 4
Midterm 2 - Fri., April 15
Final Exam - Fri., May 13 (2:00 to 4:00 pm)

** Midterm dates tentative

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Spring 2011

Hugh I. Ellis
ST 478
Office: MWF 11-12, Tu 10-12

ECOLOGY LECTURE TOPICS

Topic	Readings*
I. INTRODUCTION	
A. Ecology: A General Framework	Chs. 1, pp. 479-480
B. Review of Natural Selection & Adaptation	Ch. 5
II. THE PHYSICAL ENVIRONMENT	
A. Climate and Other Factors	Ch. 2 & 32, pp. 43-44
B. Responses to Climate	
1. Biomes and Aquatic Regimes	pp. 544-555, Chs. 28-31
2. Heat Exchange and Microclimate	Handout, pp. 32-40
3. Physiological Adaptations	Chs. 7-8; III A-C (ff. p. 158)
C. Soil	Ch. 4
III. ENERGY FLOW & NUTRIENT CYCLING	
A. Light & Photosynthesis	pp. 480-481, Ch. 6
B. Primary Production	Ch. 24
C. Utilization of Energy: Food Chains/Webs and Trophic Pyramids	p. 84, Chs. 24 & 9
D. Secondary Production	Ch. 24
E. Nutrient Cycling	pp. 54-56, Chs. 25 & 26
IV. POPULATIONS	
A. Density, Dispersion, and Dispersal	pp. 161-168
B. Life Tables and Demography	pp. 168-180
C. Population Growth	Ch. 11
D. Population Regulation	
1. Overview and Life Histories	Ch. 13
2. Intraspecific Controls	Ch. 12
3. Interspecific Controls	
a. Competition	Ch. 14
b. Predation, etc.	Chs. 15-16
4. Other Interactions	Chs. 17-18
V. COMMUNITIES	
A. Community Identity, Structure & Diversity	Ch. 20, pp. 404, 428-434, 552-559
B. Succession	Ch. 21, pp. 434-444
C. Perturbations	
1. Problems in Conservation	pp. 450-463, VIIA-D
2. Disturbance	pp. 463-475

*Smith, R. L. and T.M. Smith. 2001. Ecology & Field Biology, 6th ed. Benjamin-Cummings.

NOTE: Additional readings may be put on reserve in Copley Library or on the course WebCT.