University of Maryland
CENTER FOR ENVIRONMENTAL SCIENCE

Ecological Systems (Ecological Foundations)

3 credits

MEES660
Fall 2020

Course Objectives / Overview

A broad understanding of ecological concepts is required of all students who will take ecology courses within the MEES (Marine, Estuarine and Environmental Science) program. This course provides an introduction to the field of ecology for matriculating graduate students and prepares them for more advanced concepts. Students will be exposed to ecology both in theory and practice, through lectures, readings, and discussions with experts in relevant areas of ecology. In addition, students will complete several quantitative exercises. The concept of global change will be a constant, unifying thread throughout this course. As the footprint of human activities on ecological systems continues to expand during the Anthropocene, it has become critical for today's burgeoning scientists to understand the role of humans as drivers of ecological change at multiple scales. This course will provide students with the background to pursue advanced graduate level courses in their specialized areas of interest.

Expected Course Learning Outcomes

Students will learn basic theoretical concepts underpinning the field of ecology, and how these are applied to different ecological approaches. These include the following:

1. Thermodynamic principles regarding energy and conservation of mass, and how these apply from individual- to ecosystem-scales
2. Natural selection and its importance to individuals, populations, and communities
3. The two above are most critical, but other fundamental concepts to master include Liebig's law of the minimum, biodiversity, community assembly and niche theory
4. Concepts regarding the non-linear dynamics of ecosystems such as feedbacks, resilience, and regime shifts

Students will also build a strong foundation that includes basic tools and approaches to doing ecology that include

5. critically read, synthesize and integrate the scientific literature
6. conceptual modeling to illustrate problems and facilitate synthesis
7. writing and presenting, with a focus on a semester capstone project

INSTRUCTOR DETAILS:
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CLASS MEETING DETAILS:
Dates:
Times:
Originating Site:
IVN bridge number:
(*******)
Phone call in number:
(***)
Room phone number:
(*****)

CURRICULUM FULLFILMENT:
Fulfills a MEES Foundation Course requirement.

Prerequisites
N/A

Teaching Assistant
N/A

Course Assessment / Grading

Course grades will be assigned based on performance in the following:

1. quantitative exercises (25%)
2. two examinations (50%)
3. final paper (25%)

Students are expected to read all assigned material and participate in class discussions.

Tentative Weekly Course Schedule

[The format of this section will vary based on the design of your course, but our guidance is to aim for a clear and concise list and/or table that maps out all of the proposed list of topics to be covered and assignment assessments and deadlines to give students a sense of the course's content, organization and logical sequence of events.]

Date	Day	Instructor or Guest	Topic
31-Aug	Mon	Woodland / Hilderbrand	Course organization & the philosophy of science
2-Sep	Wed	Hilderbrand	What is ecology?
7-Sep	No Class		
9-Sep	Wed	Hilderbrand	Patterns: Biogeography, diversity
14-Sep	Mon	Hilderbrand	Energy sources, flows, cycles
16-Sep	Wed	Hilderbrand	Primary production, metabolism, physiology
21-Sep	Mon	Hilderbrand	Quant ex. 1 - Estimating Production – Introduction to R
23-Sep	Wed	Hilderbrand	Mechanisms of adaptation and evolution
28-Sep	Mon	Hilderbrand	Genetics
30-Sep	Wed	Hilderbrand	Life histories
5-Oct	Mon	Hilderbrand	Bioenergetics
7-Oct	Wed	Hilderbrand	Quant ex. 2 - Bioenergetics
12-Oct	Mon	Hilderbrand	Population dynamics
14-Oct	Wed	Woodland	Predator/prey dynamics
19-Oct	Mon	Woodland	Niche theory
21-Oct	Wed		Exam 1
26-Oct	Mon	Hilderbrand	Viability and persistence
28-Oct	Wed	Woodland	Quant ex. 3. – Predator/prey modeling
2-Nov	Mon	TBD	Invited expert
4-Nov	Wed	Woodland	Assembly rules
9-Nov	Mon	Woodland	Community dynamics
11-Nov	Wed	Woodland	Disturbance ecology
16-Nov	Mon	Woodland	Quant ex. 4 - Quantifying a community

18-Nov	Wed	TBD	Invited expert
23-Nov	Mon	Woodland	Diversity, stability, resilience
30-Nov	Wed	Woodland	Mass balance, flows
2-Dec	Mon	Woodland	Networks, transitions
7-Dec	Mon	Woodland	Emergent Properties
9-Dec	Wed	Woodland	Quant ex. 5 - Conceptual model
14-Dec	Mon	Woodland / Hilderbrand	Wrap up, help with papers
16 Dec	Wed		Papers due
16-22 Dec	?		Exam 2 (date TBD)

Required textbooks, reading and/or software or computer needs

No specific textbook is required. All readings will be posted online and distributed through Moodle.

There will be several quantitative exercises that will help to reinforce concepts introduced in lectures and readings while also helping to build their personal ecological toolbox. Methods will vary among exercises, but will include statistical and mathematical modeling fitting, exploring model behavior, and identifying and conceptualizing key model parameters. At the end of each exercise, a discussion period will allow students and faculty time to review the material presented. This could include a review of the methods introduced, results of the analyses, potential applications of the approaches, and (or) potential alternative approaches to problem solving. The first quantitative exercise will include an introduction to the statistical package "R." This program will be used throughout the remaining exercises.

Topics of the quantitative exercises are listed below. The number and topic of quantitative exercises may change during the semester

Exercise 1: Students will explore calculation of various metabolic rates such as respiration and gross primary production. Methods will include introduction to curve fitting and various steps to consider both individual and system level rates. Students will be introduced to the R programming language.

Exercise 2: This exercise will expose students to aspects of life history and bioenergetics modeling. Analyses will provide students with insight into the interactions between alternative life history strategies, bioenergetics and individual-level consequences.

Exercise 3: This quantitative exercise will focus on using a mechanistic model to explore Lotka-Volterra dynamics as a benchmark for describing predator-prey interactions.

Exercise 4: The quantitative activity for Module 4 will focus on computing metrics of diversity and introducing students to basic ordination techniques. Statistical treatments of univariate and multivariate community data will be discussed and students will be complete an R-based analysis of community data.

Exercise 5: We will engage in a conceptual modeling exercise in which groups of students will be responsible for constructing an ecosystem model that includes key processes and structures. Students will have an opportunity to present and discuss the specifics of their group's conceptual model.

Course Communication

All information, course documents and assignments will be made available to students on the MOODLE educational platform. Email correspondence will be used for some announcements and to facilitate group discussions or questions regarding assignments.

Resources

A course website will be provided on Moodle. : www.moodle.com/xxxxx]

Campus Policies

The University of Maryland Center for Environmental Science has drafted and approved of various academic and research-related policies by which all students and faculty must abide.

Please see especially Policy III-1.00: Policy on Faculty, Student and Institutional Rights and Responsibilities for Academic Integrity.

Course-Specific Policies and Expectations

In this course, we encourage students to use all peer-reviewed publications, textbooks or popular science resources necessary to inform their work and learn the material. We DO NOT allow students to use websites or services that compile answers from previous (or similar) exams & assignments, or that provide written or quantitative assistance on assignments. All work must be the individual student's own, original work. Submission of late work will not be accepted except in the presence of extenuating circumstances. These cases will be decided on a case-by-case basis and are up to the sole discretion of the instructors.