Ecosystem Ecology

EEB/EAS/ENVIRON 476 – Winter 2019
2437 Mason Hall
Tuesday-Thursday 10:00 to 11:30

INSTRUCTORS

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OVERVIEW AND GOAL

Ecosystem Ecology focuses on current theories regarding the control and function of aquatic and terrestrial ecosystems, the approaches and techniques being used to test these theories, and the application of theory to the management and restoration of ecosystems. The scope includes examples from terrestrial, marine, and freshwater ecosystems. Our goal is to develop students' understanding of the physical, chemical, and biological factors controlling the dynamics of aquatic and terrestrial ecosystems.

COURSE DESCRIPTION

Ecosystem Ecology is a lecture course focusing on understanding the physical, chemical and biological processes regulating the dynamics of terrestrial and aquatic ecosystems. We discuss classic and current topics in ecology that have built our understanding of ecosystem organization and function. The course integrates across disciplines of physiological, microbial, population, and community ecology to understand how and why ecosystems differ in composition, structure, and function, and how ecosystems change over time. Students are expected to have a solid background in biology and ecology. We also expect that students will be able to use general principles of mathematics, physics, chemistry, and biology as tools to understand ecological processes occurring at the ecosystem level.

The scope of the course includes examples from terrestrial, marine, and freshwater ecosystems. Selected topics for discussion include: "What are ecosystems and why are they so complex?"; "The principles of biogeochemistry - nutrient cycling, mass balance, and microbial function"; "Global ecology - are processes in ecosystems additive across a range of spatial scales?," "The use of chemical tracers of energy flow through organisms and their environment," and "Do species matter for ecosystem function?". There are two lecture periods per week involving a lecture and discussion focusing on assigned readings. *Class participation and interaction is an expectation during the lecture, and discussion portions of the class.*

Prerequisites include a course in general ecology and one 300/400-level course in aquatic or terrestrial ecology or permission of the instructors. Ecosystem Ecology is appropriate for graduate and advanced undergraduate students, and fills concentration requirements in the area of Ecology and Evolution (section II in the Biology Concentration) and elective requirements in the EEB and PitE concentrations.

Lectures will be supplemented with background reading from a series of classic and current research articles that have contributed to our understanding of ecosystem dynamics. *All reading material will be placed on our course Canvas site, and we expect you to read all assignments prior to attending lecture.*

GRADES

Grading is based on two mid-term and one final examination. In-class exams will focus on the students' ability to clearly and concisely explain and apply concepts developed in lecture. Thus, they will be composed of short and long essay-based questions. Course grades are distributed as follows:

Mid-Term First Exam	25%
Mid-Term Second Exam	25%
Final Exam	25%
Presentations	15%
Participation	5%
Questions	5%

The three exams will be graded on a 100 point scale. The final exam is cumulative, will build upon concepts developed during the first portion of the course, and will be given during the final exam period assigned to our course on April 30 from 1:30 to 3:30 pm. Final grades will be assigned based upon the point distribution outlined above, with consideration of other aspects of academic performance such as effort and improvement.

Presentations, Discussions and Participation:

During each class, small groups (2-3 students – each student will present twice over the full term) will provide a short presentation of the primary literature reading assigned for that class. The presentations will need to specifically address the following:

- Overview of paper
    - Topic/objective of study
    - The questions addressed by the study
    - Methods used to evaluate these questions
    - Results presented in the study – including explaining figures
    - The implications of the findings – including historical perspectives for some of the older papers
    - The key limitations, e.g., what could the authors have done differently to improve the study/manuscript and what are some reason why these extra steps were not taken.

- Provide 2 questions for group discussion

Following the presentations, we will break into groups and discuss the questions provided by the presenting group for ~20 minutes. This will be followed by a closing section where each group would have a person communicate to the class the group's overall take on each question, i.e., their thoughts, agreements and disagreements.

A score sheet (provided in canvas) will be used to grade each presentation. Presentations and discussions will be further explained in class at the beginning of the term.

We expect student interaction routinely during lecture, in the form of asking the instructors for clarification and answering instructor questions to the class, as well as during the discussion section of the class. Each student will be graded for this participation as 5% of their total grade.

In addition to participation for each discussion, each student is required to submit two questions on the discussion reading. Questions are due at midnight the day before class and should be submitted on Canvas. Questions are meant to facilitate discussion, so students are expected to have access to their questions during class.

DATE	TOPIC	Lecturer	Lecture Readings	Presenting Group and Reading
10-Jan	**I. Introduction to Ecosystem Ecology (Course Administration)**	Allgeier & Zak		
15-Jan	Historical Development of Ecosystem Concepts	Zak	Tansley 1935	Group 1; Mellilo et al. 2017
17-Jan	Historical Development of Ecosystem Concepts II	Zak	Odum 1969	Group 2;
22-Jan	Holism versus Reductionism	Zak		Group 3; Schlesigner 1990
24-Jan	**II. Introduction to Terrestrial Ecosystem Ecology**	Zak		Group 4; Reich et al. 2006
29-Jan	The Carbon Balance of Terrestrial Plants	Zak	Mooney 1972	Group 5; Pan et al. 2011
31-Jan	The Carbon Balance of Terrestrial Ecosystems	Zak	Rosenzwieg 1968	Group 6; Baccini et al. 2017
5-Feb	Resource Availability - Above and Belowground Allocation	Zak	Hendricks et al. 1993	Group 7; Reich et al. 2016
7-Feb	Change following Disturbance	Zak	Vitousek & Reiners 1975	Group 8; Schuur et al. 2009
12-Feb	Nutrient Cycling: General Concepts and Microbial	Zak		Group 9;

	Processing			Zak et al. 2011
14-Feb	Nutrient-Use Efficiency, Decomposition, and Feedbacks	Zak	Vitousek 1982	Group 10; Vitousek and Walker 1989
19-Feb	Trophic level interactions and impacts on nutrient cycling	Zak		Group 11; Peschel et al. 2015
21-Feb	**Exam 1**			
26-Feb	**III. Landscape Linkages between Terrestrial and Aquatic Systems**	Allgeier		Group 12; Pace et al. 2004
28-Feb	**IV. Introduction to Aquatic Ecosystem Ecology**	Allgeier		Group 1; Peterson et al. 2001
5-Mar	**Spring Break**			
7-Mar	**Spring Break**			
12-Mar	Introduction to Aquatic Ecosystem Ecology II	Allgeier		Group 2; Allgeier et al. 2014
14-Mar	Carbon Balance and Primary Production of Aquatic Systems	Allgeier	Aufdenkampe et al. 2011	Group 3; Eyre et al. 2018
19-Mar	Element Cycling and its Relation to Primary Production	Allgeier	Elser et al. 2007	Group 4; Finlay et al. 2013
21-Mar	Impacts of Land-Water Transfers on Aquatic Ecosystems	Allgeier		Group 5; Wallace et al. 1997
26-Mar	Landscape-level interactions between aquatic systems	Allgeier		Group 6; Sabo et al. 2017
28-Mar	**Exam 2**			
2-Apr	**V. Synthesis and Integration of Concepts** - Biodiversity and Ecosystem Function – Do Species Matter?	Zak	Kaiser 2000; Naeem et al. 1994; Tilman et al. 1996, 2001; Huston 1997; Loreau 2001	Group 7; Hector et al. 1999
4-Apr	Biodiversity and Ecosystem Function – Do Species Matter?	Zak		Group 8; Duffy et al. 2017

9-Apr	Case study	Allgeier		Group 9;
11-Apr	Introduction to Stable Isotopes	Allgeier		Group 10;
16-Apr	Human Modification of Global N and C Cycles	Allgeier	Galloway et al. 2008	Group 11; Holtgrieve et al. 2011
18-Apr	Global Ecology –Biological Feedbacks and modeling	Allgeier	Lui et al. 2015	Group 12; Troell et al. 2014
23-Apr	Course Summary and Synthesis	Zak & Allgeier		
30-Apr	**Final Exam 1:30 to 3:30 pm**			