ZOO 725 – Ecosystem Concepts

Instructor: Grace Wilkinson | Credits: 3 | Enrollment: 20 students maximum
Suggested pre-requisites: Graduate/Professional standing, ZOO 460 or equivalent

Catalog Description: Scope and objectives of ecosystem ecology; roles of theory, long-term studies, comparative studies, and large-scale experiments; scaling problems; ecosystem services and ecological economics; adaptive ecosystem assessment and management.

Goals: The course is a survey of the current problems and concepts in ecosystem science, a major branch of ecology focusing on the interactions of all the living and non-living entities in a specified place. The overarching goal is to help students develop a critical perspective of today's major research issues in ecosystem science and apply these concepts to data and in their own research. Topics include primary production, decomposition, cycling of major elements, large-scale biotic processes, models of ecosystem interactions and feedbacks, and theoretical ideas about the dynamics of complex systems.

Course Structure:
In-person meetings: The class will meet twice a week for 1.5 hours per meeting. The first meeting of the week will be an intensive lecture on the weekly topic. The second meeting of the week will be divided between student-led paper discussion (from papers assigned for the annotated bibliography) and an activity designed to apply the concepts learned that week to a data set or problem.

Outside of class: Students will compile an annotated bibliography of all the assigned primary literature readings, complete reflections on the in-class activities each week, and complete a semester-long course project. These assignments are described below.

> **Annotated Bibliography:** Each student will maintain an annotated bibliography of observations and questions about the assigned readings (book chapters and journal articles). A typical entry will consist of a brief summary of the main points from the article, plus 2-4 questions prompted by the article. The bibliographic entry will be completed prior to the paper discussion each week.
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> **Activity Reflections:** Students will be asked to respond to a series of questions related to the in-class data or problem-based activity performed each week. This may include creating and interpreting figures, posing a hypothesis and designing a study to test it, and/or responding to questions about the week's topic.
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> **Course Project:** Students will gain practical research experience by conducting a semester-long project to synthesize an area of ecosystem research *or* design a research project to investigate an emerging ecosystem question (should be related to their thesis). The project consists of a pre-proposal, proposal, presentation, and written report.

Grade Criteria:
- 25% Annotated Bibliography
- 25% Activity write-ups
- 40% Course Project
- 10% Participation and leading paper discussion

Example Course Schedule

Week	Weekly Topic	Example Readings	Example Activity Topics
1	Introduction to Ecosystem Science	Weathers Ch 1 & 9, Levin et al. (1998)	Mass balance
2	Primary and Secondary Production	Weathers Ch 2, Chapin et al. (2006)	Ecosystem metabolism
3	Decomposition & Mineralization	Weathers Ch 4, Heathcote et al. (2015)	Redox reactions
4	Carbon Cycling	Weathers Ch 5 & 6, Cole et al. (2007)	Ocean iron fertilization
5	Elemental Cycling (N & P)	Weathers Ch 7 & 8, Song et al. (2017)	Coupled biogeochemical cycles
6	Stoichiometry and ecosystem processes	Maranger et al. (2018)	Evolutionary drivers of ecosystem processes
7	Predation and ecosystem processes	Estes et al. (2011), Atwood et al. (2013)	Trophic cascades, disease dynamics
SPRING BREAK			
8	Spatial complexity	Weathers Ch 10, Scholes et al. (2017)	Scaling and uncertainty
9	Approaches to studying ecosystems	Pace et al. (2019), Hasler (1957), Carpenter (1996)	Study design, measuring structure vs. function
10	Abrupt Change in Ecosystems	Ratajczak et al. (2018), Turner et al. (2020)	Detecting abrupt change
11	Resilience and Regime Shifts	Holling (1973), Scheffer et al. (2013)	Early warning indicators
12	Climate change and ecosystems	Weathers Ch 12 & 13, Grimm et al. (2013)	LTER data exploration
13	Ecosystem Management & Policy	Weathers Ch 15, Rockstrom et al. (2009)	Write a policy brief
14	**Project presentations**	**--**	**--**

Textbooks:

Weathers, KC, DL Strayer, GE Likens (2021) Fundamentals of Ecosystem Science, 2nd Edition. ISBN: 978-0-12-812762-9.

Chapin, FS, PA Matson, PM Vitousek (2011) Principles of Terrestrial Ecosystem Ecology, ISBN: 978-1-4419-9504-9