Syllabus BIEB 174 "Ecosystems and Global Change"
Winter quarter 2010
Lectures T/Th 12:30-1:50 p.m., Center 115
Final exam Tuesday March 16th 11:30-2:29, location TBA

Faculty: Elsa Cleland, Assistant Professor

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Office hours: Fridays 1-3, Muir Biology room 1115, Monday and Wednesday afternoons also available via phone by appointment

Teaching Assistants:

Katherine LeVan, kelevan@ucsd.edu

Discussion sections: Mondays 10-10:50 a.m. HSS 2150– 11-11:50 a.m. CSB 005
Office hours: Tuesdays 2:30 –4:30 pm Muir Biology room 2145

Claire Wainwright, cwainwri@ucsd.edu

Discussion sections: Wednesdays 1-1:50 pm HSS 1305, 2-2:50 pm CSB 005
Office hours: Thursdays 2:30 – 4:30 pm, Muir Biology room 1115

Course description:
This course will teach the principles of terrestrial ecosystem ecology, and will use examples from recent research to help students understand how global environmental changes are altering processes from leaf-level ecophysiology to global-scale cycling of carbon, water and nutrients.

Why you should take this course:
In recent decades human activities have altered ecosystems around the globe, through changes in climate, land use, and nutrient cycling. Understanding the impacts of these global changes requires a background in ecosystem ecology. Ecosystem ecology is a field that scales phenomena from physiological processes within plant leaves, to global biogeochemical cycles of carbon, nitrogen and water. "Ecosystems and Global Change," will teach the fundamental concepts of ecosystem ecology, while using examples from current research in the field of environmental science. Thus, the course is designed to fulfill two primary goals: providing depth to students who want training in ecosystem science in an upper division course towards their EBE major, and providing breadth in environmental science to students in other science majors.

Prerequisites
BILD 1, 2, & 3. This is an upper division course and will build on concepts from the introductory course series. While not required, introductory chemistry and physics courses will be helpful.

Textbook
The course uses an excellent and inexpensive textbook ($50 new, $40 used, in paperback): "Principles of Terrestrial Ecosystem Ecology" by Chapin, Matson & Mooney (2002), Springer.

Lectures

Attendance in lectures is required to do well in this course. Lecture slides will be posted on WebCT by the day of each lecture, but not all material presented verbally in lectures will be contained in these slides. **Please turn off all cell phones at the start of lecture.**

Discussion sections:

Discussion sections are required, and are designed so that students can gain experience in activities that are not possible in a large lecture setting. In discussion sections students will have the opportunity to think critically and creatively, and communicate ideas both verbally and in writing. Hence, while discussion sections offer a chance to ask questions and explore the weekly concepts more deeply, in general the lecture materials *will not be summarized again in discussion sections*.

Grading & Assessment:

Several forms of assessment will be utilized, to reinforce ideas throughout the quarter and also so that there is not too much emphasis put on any one assignment or exam. More information about these assessments will be discussed in lecture/discussion sections and will be placed on WebCT.

25% Midterm exam ($1^{st}$-$5^{th}$ weeks of the quarter)
30% Final exam ($6^{th}$ – $10^{th}$ weeks plus integrating concepts from across the quarter)
15% Clicker quizzes (3 multiple choice quizzes in lecture, each worth %5)
10% Lecture participation
Assessed via iClicker questions, answers do not need to be correct, this is a learning activity, full credit will be given if at least 75% of questions are answered in at least 12 of 15 lectures (starting in week 3), this allows flexibility for late adds, illnesses or other emergencies.
20% Discussion Section (9 meetings during the 10 week quarter)
9% Weekly review questions (written answers turned in during section)
9% Section participation (attendance & discussion)
2% Sample exam question assignments- Students will create one sample exam question (with complete answer) to be submitted during discussion section before the midterm (1%) and final (1%). At least one of these sample questions will appear on each exam, providing an incentive for you to think of interesting questions, and form review groups to share them.

Please note that there will be no make-up exams, or quizzes. If you miss a quiz, midterm or final exam, then you will be required to documentation of illness or unavoidable emergency. Without such documentation, you will receive a failing grade for that assessment. For missed quizzes or midterms, and with valid documentation, the proportion of your grade that is based on your final exam will be increased to cover the assessment that was missed. For a missed final exam and with valid documentation, you will be expected to take the final orally or you will receive an incomplete for the course. Students wishing to have questions from exams re-graded need to submit a written request specifying the questions in dispute and the reason for the re-grade. If you miss discussion section due to a documented illness or emergency, you must submit your

review questions by email by the end of the week to have full credit. The proportion of your grade that is based on your final will increase to account for the missed discussion participation points in the case of documented illness or emergency, otherwise these points will be forfeited.

Academic integrity

Academic integrity is taken extremely seriously at all universities, and UCSD is no exception. Any student caught cheating will fail the course. Please note that because iClickers will be used for formal assessment related to student grades, it is considered a serious infraction to answer iClicker questions for another student using their iClicker, and would lead to both students failing the course. For information on academic integrity at UCSD: http://www.senate.ucsd.edu/manual/appendices/app2.htm

Schedule of lectures, readings, and assessments:

Week 1:
No discussion section in week 1

Jan 5th: Ch. 1 The Ecosystem Concept
Overview and history of ecosystem ecology; controls over ecosystem processes; human-caused changes in Earth's ecosystems.
Jan 7th: Ch. 2 Earth's Climate System
Earth's energy budget; atmosphere, oceans, landforms & vegetation contributions to climate; temporal variability in climate; ecosystem distribution in relation to climate

Week 2:
Discussion section: Review questions for Ch. 1 & 2

Jan 12th: Ch. 3 Geology and Soils
Controls over soil formation & loss; soil profiles, horizons & classification; soil properties in relation to ecosystem functioning.

Jan 14th: Ch. 4 Terrestrial Water and Energy Balance
Ecosystem water inputs and losses; water movements among soil, roots, leaves, canopies; evapotranspiration and the energy balance

Week 3:
Discussion section: Review questions for Ch. 3 & 4

Jan 19th Ch. 5 Carbon inputs to Terrestrial Ecosystems
Photosynthetic pathways (C3, C4, CAM); net photosynthesis in the leaf; limitation by light, CO2, water and nitrogen; influence of temperatures, gross primary production (GPP) controls and measures.

Jan 21st Ch. 6 Production Processes (Quiz 1)

Plant respiration; net primary production (NPP); allocation of growth to different tissues; tissue turnover; global distribution of biomass and NPP; net ecosystem production (NEP) and controls

Week 4:
Discussion section: Review questions for Ch. 5 & 6, and answers to quiz 1

Jan 26th Ch. 7 Decomposition Processes
Biological breakdown of litter by bacterial, fungi and animals; Litter breakdown through chemical and physical processes; environmental and enzymatic controls over decomposition; long-term carbon storage in soils

Jan 28th Ch. 8 Plant Nutrient Use
Macro- and micro-nutrient requirements for plant growth; nutrient movement in soils; uptake by plant roots & mycorrhizal symbionts; nutrient losses through senescence, leaching and herbivory

Week 5:
Discussion section: Review questions for Ch. 7 & 8, turn in mid-term sample questions & answers

Feb 2nd Ch. 9 Terrestrial Nutrient Cycling
Nitrogen (N) inputs to ecosystems, biological N-fixation and human-caused N deposition; N mineralization and pathways of loss; other nutrient cycles (Phosphorus, sulfur, essential cations); interactions among nutrient cycles

Feb 4th Midterm, covering the first 5 weeks of instruction

Week 6:
Discussion section: Ch. 9 review questions and discussion of the midterm

Feb 9th: Ch. 10 Aquatic Carbon and Nutrient Cycling
Fundamental differences between terrestrial and aquatic ecosystems; carbon and nutrient cycling in oceans, lakes, rivers & streams

Feb 11th Ch. 11 Trophic Dynamics
Plant-based trophic systems versus detritus-based trophic systems; assimilation efficiencies; food webs and trophic cascades

Week 7
Discussion section: Review questions for Ch. 10 & 11

Feb 16th Special topic: Ecological Stoichiometry
Concept of multiple-nutrient stoichiometry at various levels of organization, from molecules to whole organisms. Reading: Elser et al. 1996 “Organism size, life-history, and N:P Stoichiometry” Bioscience 46:674-684

Feb 18th Ch. 12 Community Effects on Ecosystem Processes (Quiz 2)

The functional trait concept; species-effects on ecosystems, climate and disturbance regimes; relationship between biodiversity and ecosystem function

Week 8

Discussion section: Review questions for Ch. 12 and Stoichiometry lecture, discuss answers for Quiz 2

Feb 23rd Ch. 13 Temporal Dynamics

Inter-annual versus long-term fluctuations in ecosystem processes; disturbance cycles and the successional process

Feb 25th Ch. 14 Landscape Heterogeneity and Ecosystem Dynamics

Spatial variation in ecosystem patterns and processes; concepts of state-factors and interactive controls; patch dynamics on the landscape; movement of plants and animals; human land-use change; issues for scaling from smaller to larger scales of observation or prediction

Week 9

Discussion section: Review questions for Ch. 13 & 14

Mar 2nd Ch. 15 Global Biogeochemical Cycles

Global carbon cycle and long-term changes in atmospheric $CO_2$; terrestrial carbon sinks; global nitrogen, phosphorus, sulfur and water cycles; consequences of human-alterations of global biogeochemical cycling

Mar 4th Ch. 16 Managing and Sustaining Ecosystems (Quiz 3)

Concepts in ecosystem management: natural variability, resilience, stability; application for managing forests, fisheries, endangered species; ecological restoration; valuation of ecosystem goods and services

Week 10

Discussion section: Review questions for Ch. 15 & 16, discuss answers for quiz 3, turn in sample exam questions

Mar 9th Special topic: Evidence of global climate change

Reading: Summary for policy makers, IPCC Fourth Assessment Report

Mar 11th Special topic: Climate Change and Southern California Ecosystems

Reading: San Diego Focus 2050 report, pages 1-26

Final Exam – Tuesday Mar 16th

Focus on second 5 weeks, along with critical thinking and integration of concepts from the whole quarter