BI 416 - Ecosystem Ecology and Global Change

MF 1-2 (AIC West 408), W 1-4 (Biology Rm. 415) **Winter 2010**

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Web site: http://fire.biol.wwu.edu/hooper/courses.html
Text: Chapin, Matson, and Mooney "Principles of Ecosystem Ecology"

NATURE OF THE COURSE:

Ecosystem ecology involves the study of energy and material flows through both the living (plants, animals, microbes) and non-living (water, soils, atmosphere) components of ecological systems. We will study the major element cycles (carbon, nitrogen, phosphorus) and patterns of energy flow through ecosystems, including differences among those fluxes and their controls for different ecosystems. A central theme of the course is the relationship of these ecosystem processes to many current environmental issues of global importance, such as elevated CO_2, global warming, enhanced nitrogen cycling, and loss of biodiversity.

This course will combine both lectures and discussions. The lectures, combined with readings from the textbook, are intended to give you a fundamental understanding of ecosystem concepts and theory. On Wednesdays, we will discuss papers from the current literature relevant to the topic from the previous lectures. One section of this course qualifies as a Writing Proficiency (WP) class, hence we will devote some time to the process of writing scientific papers as well.

The goals of this course are to

1) give you a firm understanding of the **concepts and mechanisms of ecosystem ecology**;

2) improve your abilities to **participate in discussion** of scientific literature, including **developing skills in critical thinking**;

3) **improve your writing skills**;

4) **introduce you to the primary literature** and some of the current "hot topics" being studied and debated in the field;

5) **enhance your understanding** of how human society is altering ecosystems, some of the problems that entails, and some of the solutions that might be possible.

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COURSE GRADE:

1. Your grade will be based on a total of 500 possible points for WP, 350 points for non-WP:

a. Write a research paper. 250 points for WP, 100 points non-WP. The paper for WP students will entail two drafts, with comments from fellow students and me after the first draft. Your grade for the paper will be based on 60 points for the first draft, 125 points for the final draft and 65 points for the quality of your comments on other students' papers. Non-WP students will only turn in their final draft (100 points) and will not participate in the review process. In either case, you will need a minimum of 15 references from the primary literature.

b. Discussion attendance and participation. 30 points. Discussion attendance and participation are mandatory and are important parts of this class. Failure to attend (without a pre-approved excuse) or participate in discussion will result in loss of 5 points per discussion missed. Missing more than 5 discussions results in loss of all 30 points.

c. Exams: 2 Midterms (60 points each) and a **comprehensive final exam** (100 points).

d. Late assignments lose 1/3 grade per day (i.e., going from a B+ to a B).

e. Academic dishonesty will not be tolerated. Assignments with plagiarism problems or cheating on exams can result in no credit, failing the class, or expulsion from the university. Questions about plagiarism? Ask me and/or see Western's web site: http://www.library.wwu.edu/ref/plagiarism.html.

2. Your final grade will be determined as a percentage of the point total:

		B+	87-89.9	C+	77-79.9	D+	67-69.9	F	0-59.9
A	93-100	B	83-86.9	C	73-76.9	D	63-66.9		
A-	90-92.9	B-	80-82.9	C-	70-72.9	D-	60-62.9		

BI 416 - Class schedule

Readings listed as CMM are chapters from the Chapin, Matson, and Mooney textbook.
Discussion readings are from the primary literature (see reading list, below).

Week	*Date*	*Topic*	*Reading*
1	W, 1/6	Course introduction, The Ecosystem Concept	CMM: 1
	F, 1/8	Climate	CMM: 2
2	M, 1/11	Climate (con't)	CMM: 2
	W, 1/13	Overview of the Carbon Cycle, Productivity	CMM: 15 (335-343), 6
	W, 1/13	*Discussion 1 – Ecosystem concept, climate* (one leader)	(Vitousek 1994, Brook 2005)
	F, 1/15	Controls on Gross Primary Productivity	CMM: 5
3	M, 1/18	**No Class – Martin Luther King, Jr. Day**	
	W, 1/20	Controls on Gross Primary Productivity **Paper topics due**	CMM: 5
	W, 1/20	*Discussion 2 – Carbon cycle 1* (one leader)	(Oberbauer et al. 2007)
	F, 1/22	Controls on Net Primary Productivity	CMM: 6
4	M, 1/25	Controls on Net Ecosystem Productivity	CMM: 6
	W, 1/27	Decomposition	CMM: 7
	W, 1/27	*Discussion 3 – Carbon cycle 2* (2 leaders)	(Wardle et al. 2004, Kitayama 2005, Wardle et al. 2005)
	F, 1/29	**Midterm 1**	
5	M, 2/1	Decomposition	CMM: 7
	W, 2/3	Decomposition	CMM: 7
	W, 2/3	*Discussion 4 – Decomposition* (one leader)	(Finzi and Schlesinger 2002)
	F, 2/5	Terrestrial nutrient cycles – nitrogen	CMM: 15 (343-348), 9
6	M, 2/8	Terrestrial nutrient cycles – nitrogen	CMM: 9
	W, 2/10	Nutrient cycling – Plant nutrient use	CMM: 8
	W, 2/10	*Discussion 5 – Nutrient cycling 1* (two leaders)	(Helfield and Naiman 2001, Helfield and Naiman 2003, Kirchhoff 2003)
	F, 2/12	Nutrient cycling – Plant nutrient use **Paper first drafts due**	CMM: 8
7	M, 2/15	**No Class – President's Day**	
	W, 2/17	Trophic dynamics	CMM: 4 (71-77), 11
	W, 2/17	*Discussion 6 – Nutrient cycling 2* (no leader)	(Funk and Vitousek 2007)
	F, 2/19	Trophic dynamics **Students finish commenting on first drafts**	CMM: 4 (71-77), 11
8	M, 2/22	Community effects on ecosystem properties	CMM: 12
	W, 2/24	Community effects on ecosystem properties **First drafts handed back**	CMM: 12
	W, 2/24	*Discussion 7 – Trophic dynamics* (one leader)	(Finlay and Vredenburg 2007)
	F, 2/26	**Midterm 2**	
9	M, 3/1	Community effects on ecosystem properties	CMM: 12
	W, 3/3	Temporal dynamics: Disturbance and succession	CMM: 13
	W, 3/3	*Discussion 8 – Biodiversity and ecosystem functioning* (2 leaders)	(Thompson et al. 2005; Cardinale et al. 2007)
	F, 3/5	Temporal dynamics: Disturbance and succession	CMM: 13
10	M, 3/8	Synthesis: Managing Ecosystems	CMM: 16
	W, 3/10	Synthesis: Managing Ecosystems	CMM: 16
	W, 3/10	*Discussion 9 – Disturbance* (one leader)	(Balshi et al. 2009)
	F, 3/12	*Discussion 10 – Ecosystem Services and Managing Ecosystems* (one leader) **Final drafts due**	(Nelson et al. 2009)
11	W, 3/17	**Final Exam – 10:30 a.m. – 12:30 p.m.**	

BI 416 - Primary Discussion Papers

Balshi, M. S., A. D. McGuire, P. Duffy, M. Flannigan, D. W. Kicklighter, and J. Melillo. 2009. Vulnerability of carbon storage in North American boreal forests to wildfires during the 21st century. Global Change Biology **15**:1491-1510.

Brook, E. J. 2005. Tiny bubbles tell all. Science **310**:1285-1287.

Cardinale, B. J., J. P. Wright, M. W. Cadotte, I. T. Carroll, A. Hector, D. S. Srivastava, M. Loreau, and J. J. Weis. 2007. Impacts of plant diversity on biomass production increase through time because of species complementarity. Proceedings of the National Academy of Science USA **104**:18125-18128.

Finlay, J. C., and V. T. Vredenburg. 2007. Introduced trout sever trophic connections in watersheds: Consequences for a declining amphibian. Ecology **88**:2187-2198.

Finzi, A. C., and W. H. Schlesinger. 2002. Species control variation in litter decomposition in a pine forest exposed to elevated CO_2. Global Change Biology **8**:1217-1229.

Funk, J. L., and P. M. Vitousek. 2007. Resource-use efficiency and plant invasion in low-resource systems. Nature **446**:1079-1081.

Helfield, J. M., and R. J. Naiman. 2001. Effects of salmon-derived nitrogen on riparian forest growth and implications for stream productivity. Ecology **82**:2403-2409.

Helfield, J. M., and R. J. Naiman. 2003. Effects of salmon-derived nitrogen on riparian forest growth and implications for stream productivity: Reply. Ecology **84**:3399-3401.

Kirchhoff, M. D. 2003. Effects of salmon-derived nitrogen on riparian forest growth and implications for stream productivity: Comment. Ecology **84**:3396-3399.

Kitayama, K. 2005. Comment on "Ecosystem properties and forest decline in contrasting long-term chronosequences". Science **308**:633b.

Nelson, E., G. Mendoza, J. Regetz, S. Polasky, H. Tallis, D. R. Cameron, K. M. A. Chan, G. C. Daily, J. Goldstein, P. M. Kareiva, E. Lonsdorf, R. Naidoo, T. H. Ricketts, and M. R. Shaw. 2009. Modeling multiple ecosystem services, biodiversity conservation, commodity production, and tradeoffs at landscape scales. Frontiers in Ecology and the Environment **7**:4-11.

Oberbauer, S. F., C. E. Tweedie, J. M. Welker, J. T. Fahnestock, G. H. R. Henry, P. J. Webber, R. D. Hollister, M. D. Walker, A. Kuchy, E. Elmore, and G. Starr. 2007. Tundra CO2 fluxes in response to experimental warming across latitudinal and moisture gradients. Ecological Monographs **77**:221-238.

Thompson, K., A. P. Askew, J. P. Grime, N. P. Dunnett, and A. J. Willis. 2005. Biodiversity, ecosystem function and plant traits in mature and immature plant communities. Functional Ecology **19**:355-358.

Vitousek, P. M. 1994. Beyond global warming: ecology and global change. Ecology **75**:1861-1876.

Wardle, D. A., L. R. Walker, and R. D. Bardgett. 2004. Ecosystem properties and forest decline in contrasting long-term chronosequences. Science **305**:509-513.

Wardle, D. A., L. R. Walker, and R. D. Bardgett. 2005. Response to comment on "Ecosystem properties and forest decline in contrasting long-term chronosequences". Science **308**:633c.