Biology 5222: Communities and Ecosystems **Fall 2006**

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Office hours: 9:30 - 12:00 Tues & Thurs

Overview. This course is an introduction to the principles of terrestrial community and ecosystem ecology and the functional consequences of biotic interactions within ecosystems. The primary focus will be on forests with comparisons to other terrestrial ecosystem types. In the lecture component of the course, students will explore:

- factors that influence plant species distributions and the associations of species in communities
- basic conceptual models of ecosystem function, including pathways of energy and nutrients in the environment and the development of ecosystems through time
- interactions between plants and decomposer organisms that modify nutrient uptake, availability, and storage
- influence of species/communities on ecosystem function
- the complexities of ecosystem response to environmental change

The laboratory in this course will be an introduction to characterization of communities and ecosystems, including:

- vegetation structure, species composition and relative abundance
- plant distribution in relation to environment
- soil development and properties
- major components of carbon and nutrient budgets

The lecture component is structured as several lectures followed by discussions of selected literature, and will have 3 exams plus a comprehensive final exam. Short written assignments will be required prior to discussions. The laboratory component of the course will include several data summaries, one written lab report, and a final paper. Labs include several Saturday field trips in the Boone area and one Sunday-Monday trip to the Coweeta field station near Otto, NC.

Reading. *Principles of Terrestrial Ecosystem Ecology* by Chapin, Matson, and Mooney is the required textbook for this course.

Terrestrial Ecosystems by Aber and Melillo is recommended as supplementary material. A copy is on reserve at the library.

The following reading materials are required for discussions and will be provided:

Sept 5: Poorter, L., and F. Bongers. 2006. Leaf traits are good predictors of plant performance across 53 rain forest species. Ecology 87: 1733-1743.

Sept 19: Suding, K.N., S.L. Collins, L. Gough, C. Clark, E.E. Cleland, K. L. Gross, D.G. Milchunas, and S. Pennings. 2005. Functional- and abundance-based mechanisms explain diversity loss due to N fertilization. Proceedings of the National Academy of Sciences 102: 4387-4392.

Oct 3: Baumeister, D., and R. M. Callaway. 2006. Facilitation by Pinus flexilis during succession: a hierarchy of mechanisms benefits other plant species. Ecology 87: 1816-1830.

Oct 12: Litvak, M.E., S. Miller, S. Wofsy, and M. Goulden. 2003. Effect of stand age on whole ecosystem CO_2 exchange in the Canadian boreal forest. Journal of Geophysical Research D 108: WFX6-1 - WFX6-11.

Nov 2: Vitousek, P.M., and W.A. Reiners. 1975. Ecosystem succession and nutrient retention: a hypothesis. BioScience 25: 376 - 381.

Goodale, C.L, J.D. Aber, and P.M. Vitousek. 2003. An unexpected nitrate decline in New Hampshire streams. Ecosystems 6: 75 - 86.

Nov 21: Treseder, K.K., and P. M. Vitousek. 2001. Effects of soil nutrient availability on investment in acquisition of N and P in Hawaiian rain forests. Ecology 82: 946 - 954.

Nov 28: Juice, S.M., T. J. Fahey, T.G. Siccama, C.T. Driscoll, E.G. Denny, C. Eagar, N.L. Cleavitt, R. Minocha, and A.D. Richardson. Response of sugar maple to calcium addition to northern hardwood forest. Ecology 87: 1267-1280.

The following reading materials are recommended as supplementary material and are on file in the classroom. Starred readings are available online through the ASU library webpage.

Aug 22: *Amundson, R., and H. Jenny. 1997. On a state factor model of ecosystems. BioScience 47: 536-543.

Aug 31: Loehle, C. 1988. Tree life history strategies: the role of defenses. Canadian Journal of Forest Research 18: 209-222.

*Lusk, C.H. 1999. Long-lived light-demanding emergents in southern temperate forests: the case of Weinmannia trichosperma (Cunoniaceae) in Chile. Plant Ecology 140: 111-115.

Sept 12: Whittaker, R.H. 1970. Communities and Ecosystems. The MacMillan Company. pp 34 - 46.

*Chapin, F.S. III, and G.R. Shaver. 1985. Individualistic growth response of tundra plant species to environmental manipulations in the field. Ecology 66: 564-576.

Sept 14: *Day, F.P., and C.D. Monk. 1974. Vegetation patterns on a southern Appalachian watershed. Ecology 55: 1064-1074.

*Elliott, K.J., J.M. Vose, W.T. Swank, and P.V. Bolstad. 1999. Long-term patterns in vegetation-site relationships in a southern Appalachian forest. Journal of the Torrey Botanical Society 126: 320-334.

Sept 26: *Chapin, F.S. III, L.R. Walker, C.L. Fastie, and L.C. Sharman. 1994. Mechanisms of primary succession following deglaciation at Glacier Bay, Alaska. Ecological Monographs 64: 149-175.

Sept 28: Finegan, B. 1984. Forest Succession. Nature 312: 109-114.

*Taverna, K., R.K. Peet, and L.C. Phillips. 2005. Long-term change in ground-layer vegetation of deciduous forests of the North Carolina Piedmont, USA. Journal of Ecology 93: 202-213.

Oct 10: Goulden, M.L., J. W. Munger, S.-M. Fan, B.C. Daube, and S.C. Wofsy. 1996. Exchange of carbon dioxide by a deciduous forest: Response to interannual climate variability. Science 271: 1576 - 1578.

*Pregitzer, K.S., and E.S. Euskirchen. 2004. Carbon cycling and storage in world forests: biome patterns related to forest age. Global Change Biology 10: 2052-2077.

Oct 24: Bormann, F.H., G.E. Likens, and J.M. Melillo. 1977. Nitrogen budget for an aggrading northern hardwood forest ecosystem. Science 196: 981 - 983.

Vitousek, P.M., S. Hattenschwiller, L. Olander, and S. Allison. 2003. Nitrogen and nature. Ambio 31:97-101.

Oct 31: Hedin, L.O., J.J. Armesto, and A.H. Johnson. 1995. Patterns of nutrient loss from unpolluted, old-growth temperate forests: Evaluation of biogeochemical theory. Ecology 76:493-509.

Bernhardt, E.S., et al. 2005. Can't see the forest for the stream? In-stream processing and terrestrial nitrogen exports. BioScience 219: 219-230.

Nov 7: Chadwick, O.A., L.A. Derry, P.M. Vitousek, B.J. Heubert, and L.O. Hedin. 1999. Changing sources of nutrients during four million years of ecosystem development. Nature 397:491-497.

Nov 9: *Chapin, F.S. III, K. Autumn, and F. Pugnaire. 1993. Evolution of suites of traits in response to environmental stress. The American Naturalist 142: S78-S92.

*Vitousek, P.M. 1982. Nutrient cycling and nutrient use efficiency. American Naturalist 119: 553-572.

Nov 16: Eviner, V.T., F.S. Chapin III, and C.E. Vaughn. 2006. Seasonal variations in plant species effects on soil N and P dynamics. Ecology 87: 974-986.

Phillips, R. P., and T.J. Fahey. 2006. Tree species and mycorrhizal associations influence the magnitude of rhizosphere effects. Ecology 87: 1302-1313.

Grading. Grades in this course are based on a total of 750 points.

Lecture	
Lecture Exams: (75 points each * 3)	225
Final Exam	65
Written Assignments: (30 points each * 7)	210
Lecture total	500 points
Laboratory	
Biomass lab report:	50
Data summaries: (25 pts each * 3)	75
Ecosystem carbon paper	125
Laboratory total	250 points

Grades will be:	90-100%	A
	80 - 89%	B
	70 - 70%	C
	60 - 69%	D
	< 60%	F

Lecture Schedule (subject to change) **Bio 5222, Fall 2006**

Date	**Subject**	**Reading**: in Chapin, Matson, and Mooney (CMM), Aber and Melillo (A&M), or other material
Aug 22	Patterns of terrestrial vegetation	A&M ch. 2
Aug 24	State factors and soils	CMM pp 41-66; A&M ch. 2, 9
Aug 29	Plant growth requirements, resource acquisition	CMM pp 176-195, 105-115
Aug 31	Plant growth and life history traits	A&M ch.11, pp 171-182
Sept 5	Discussion: Correspondence between leaf traits and plant growth	Poorter and Bongers 2006
Sept 7	Convocation	
Sept 12	Plant species distributions	Whittaker (1970) pp 34 - 46
Sept 14	Processes shaping communities	
Sept 19	Discussion: N deposition and diversity	Suding et al. 2005
Sept 21	**Exam 1**	
Sept 26	Disturbance, primary succession	CMM pp 288-298
Sept 28	Secondary succession	CMM pp 288-298; A&M pp 392-397
Oct 3	Discussion: Heirarchical facilitation	Baumeister and Callaway 2006
Oct 5	Ecosystem productivity	
Oct 10	Ecosystem carbon balance	CMM pp 115-149, 293-295 A&M ch.3 and pp 183-198, 201-203
Oct 12	Discussion: Succession and carbon balance	Litvak et al. 2003
Oct 17	Decomposition	CMM pp 151-175; A&M ch. 12, 13
Oct 19	Fall Break	
Oct 24	Nutrient cycles	CMM pp 197-215; A&M ch.4, 14
Oct 26	**Exam 2**	
Oct 31	Nutrient dynamics over successional time	CMM pp 215-223; A&M ch.18
Nov 2	Discussion: Ecosystem nitrogen retention	Vitousek & Reiners 1975, Goodale et al. 2003
Nov 7	Nutrient dynamics over geologic time	A&M ch.22
Nov 9	Plant-soil interactions: nutrient use and feedbacks	A&M pp 191-201
Nov 14	Plant-soil interactions, fire, and boreal forest ecosystem dynamics	A&M ch.19
Nov 16	Plant-soil interactions: allocation	CMM pp 176-195; A&M ch.11, pp 171-182
Nov 21	Discussion: Plant response to nutrient availability	Treseder and Vitousek 2001
Nov 23	Thanksgiving Holiday	
Nov 28	Discussion: Complexities of sugar maple decline	Juice et al. 2006
Nov 30	**Exam 3**	
Dec 5	Discussion: Ecosystem challenges for the future	

Laboratory Schedule (subject to change) **Bio 5222, Fall 2006**

Date	Subject	Assignments
Aug 28	No lab	
Sept 4	Labor Day; no lab	
Sept 9	State factors and forest composition: field trip to Linville Gorge (all day **Saturday**)	
Sept 18	Introduction to Ecosystem Carbon study: overstory biomass	Summary of overstory biomass data due in class **5 Oct**
Sept 25	No lab	
Sept 30	Forest succession and biomass: field trip to the Gilley Property (all day **Saturday**)	lab report due **16 Oct**
Oct 9	Ecosystem carbon: belowground storage	Summary of soil C data due **13 Nov**
Oct 15-16	Field trip to Coweeta (leave **Sunday**, return Monday PM)	
Oct 23	No lab	
Oct 28	Environmental gradients: field trip to Mt Jefferson (all day **Saturday**)	
Nov 6	Lab work and data analysis	
Nov 13	Ecosystem carbon: coarse woody debris, litterfall collection	Summary of CWD, litterfall, data due **29 Nov**
Nov 20	Lab work and data analysis	Ecosystem C paper due **6 Dec**
Nov 27	No lab	
Dec 4	No lab	

A short guide to writing paper critiques for Communities and Ecosystems

A written critique is due for each paper that is assigned for discussion. You should write one single combined critique when 2 papers are discussed on the same day. Critiques are due at the beginning of class on the day of the discussion.

The goals of writing critiques in this class are to encourage thorough comprehension of:

1. the rationale or motivation for the study. Why is there interest in the topic of study? What information or ideas led the authors to arrive at the question or hypothesis addressed in the study?

2. the results or findings. What was learned? What new information has been gained? Go beyond summarizing the results to be truly critical. Did the study really address the rationale as introduced? Did the study really find what it claims to have found? Are alternate interpretations possible?

3. the contribution of this work to the field of ecosystem science. Interpret the findings in a broader context. What have we learned in the general field of ecosystem ecology? How do these results aid our interpretation of broader or more general ecological theories or questions? Sometimes the biggest impacts of scientific studies stem from unexpected findings, findings that contradict previous work, or findings that are not readily interpreted within existing conceptual frameworks. What important questions are raised by the findings of the study?

Based on these goals, it should be clear that the critique is not meant to be a summary; rather, it requires far more thought and interpretation on your part. It requires that you develop and write your *own* ideas about the contributions and/or shortcomings of a particular study in the broader context. It is also worth realizing that writing several iterations of a critique may be necessary if you are to progress beyond a simple summary, to arrive at your own ideas.

Reading the assigned papers will introduce us to a variety of new methods used in ecosystem studies. These are certainly of interest and there is ample opportunity to draw them into your critiques. For example, the methods employed might be a valuable part of your discussion if you believe that the topic at hand could have been better addressed with a different approach, or that questions regarding the methods are a source of uncertainty in interpretation of results. Perhaps you don't understand a method at all, or how it was employed in the particular study. This could direct some of your interpretation as well.

Discussion in class will be a good time to pull together everyone's thoughts on the scientific rationale, merit, and contributions of a study. It will also be an excellent time to pursue any methodological questions that you have. Discussion is not restricted to these topics - it is also an opportunity to peruse philosophical aspects of science, to discuss application to public policy or management, or to open up discussion to any other angle of interest as long as it is related in some way to the process of science.