EVSC 4250, EVSC 7559 Ecosystem Ecology

Syllabus – Spring Semester 2013

Location: New Cabell Hall 415, 12:30-13:45 Tuesday/Thursday

Instructor: Michael Pace
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Readings: Readings will be based on a text as well as individual papers posted on Collab. The text is *Fundamentals of Ecosystem Science*, edited by Weathers, Strayer, and Likens.

Grading: Students grades will be based on two in-class exams (25% each), a presentation (20%), a journal (20%), class attendance and participation (10%).

Journals are due Feb. 15, Mar. 7, and Apr. 16. Journals are described in a separate handout.

Office Hours: I'm available to answer questions and help with class material and assignments. Please make an appointment via email.

Week 1 – January 15 and 17: Introduction to Course and the Ecosystem Concept

What is ecosystem ecology? What is the ecosystem concept? What approaches and concepts do ecosystem scientists use? What are the big questions/big issues in ecosystem ecology? What are ecosystem services?

Chapters 1 and 9 in Weathers et al.

Levin, S.A. 1998. Ecosystems and the biosphere as complex adaptive systems. Ecosystems 1: 431-436.

Daily, G.C. and others. 1997. Ecosystem services: benefits supplied to human societies by natural ecosystems. Issues in Ecology 2

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Week 2 – January 22 and 24: Production in Ecosystems

How is energy formed and dissipated in ecosystems? What controls primary production and why do ecosystems differ in production? What controls the productivity of consumers?

Chapters 2 and 3 in Weathers et al.
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Hamilton J.G., DeLucia E.H., George K., Naidu S.L., Finzi A.C. and Schlesinger W.H. 2002. Forest carbon balance under elevated CO_2**.** Oecologia 131: 250-260.

Cebrian, J. 2004. Role of first-order consumers in ecosystem carbon flow. Ecology Letters 7: 232-240.

Post, D.M., M.L. Pace, N.G. Hairston, Jr. 2000. Ecosystem size determines food-chain length in lakes. Nature 405: 1047-1049.

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Week 3 – January 29 and 31: Decomposition and Elemental Stoichiometry

What controls the degradation of materials in ecosystems? What are element cycles? How do elements interact and influence ecosystems dynamics? What is stoichiometry and why does it matter?

Chapters 4 and 5 in Weathers et al.

Davidson E.A. and I.A. Janssens. 2006. Temperature sensitivity of soil carbon decomposition and feedbacks to climate change. Nature 440:165-173.

Schlesinger, W.H., J.J. Cole, A.C. Finzi, and E.A. Holland. 2011. Introduction to coupled biogeochemical cycles. Frontiers in Ecology and Environment 9: 5-8

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Week 4 - February 5 and 7: Carbon

How do ecosystems form, cycle, dissipate, and store carbon? How is carbon cycling related to climate change? How might ecosystem carbon cycling change in the future?

Chapter 6 in Weathers et al.

Kintisch, E. 2007. Should Oceanographers Pump Iron? Science 318:1368-1370.

King, A.W., D.J. Hayes, D.N. Huntzinger, T.O. West, and W.M. Post. 2012. North American carbon dioxide sources and sinks: attribution, magnitude, and uncertainty. Frontiers in Ecology and Environment 10: 512-519.

Battin, T.J., S. Luyssaert, L.A. Kaplan, A.K. Aufdenkampe, A. Richter, and L.J. Tranvik. 2009. The boundless carbon cycle. Nature Geoscience 2: 598-600.

McLeod, E., G.L. Chumura, S. Bouillon, R. Salm, M. Bjork, C.M Duarte, C.E. Lovelock, W.H. Schlesinger, and B. Silliman. 2011. A blueprint for blue carbon: toward an improved understanding of the role of vegetated coastal habitats in sequestering CO_2. Frontiers in Ecology and Environment 9: 552-560.

Journals Due – February 14

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Week 5 – February 12 and 14: Nitrogen and Phosphorus

How do nutrients limit ecosystems? How does nutrient limitation vary among freshwater, marine, and terrestrial ecosystems?

Chapters 7 and 8 in Weathers et al.

Cleland , E.E**.** and W.S. Harpole. 2010. Nitrogen enrichment and plant communities. Year in Ecology and Conservation Biology, Annuals of the New York Academy of Sciences 1195 : 46-61.

Elser, J. J., M. E. S. Bracken, E. E. Cleland, D. S. Gruner, W. S. Harpole, H. Hillebrand, J. T. Ngai, E. W. Seabloom, J. B. Shurin, and J. E. Smith. 2007. Global analysis of nitrogen and phosphorus limitation of primary producers in freshwater, marine and terrestrial ecosystems**.** Ecol. Lett. 10: 1135-1142.

Elser, J.J. 2012. Phosphorus: a limiting nutrient for humanity? Current Opinion in Biotechnology 23: 833-838.

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Week 6 – February 19 and 21: Ecosystem Controls

How are ecosystems regulated by internal and external processes? What is the importance of feedback? How is spatial and temporal heterogeneity important?

Chapters 10 and 11 in Weathers et al.

February 21 Test 1

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Week 7 – February 26 and 28: Predators

How do predators regulate ecosystems? What are the impacts of predators and what happens when predators are lost or restored?

Pace, M.L. 2013. Trophic cascades. Encyclopedia of Biodiversity, Edited by S. Levin. Elsevier (in press).

Estes, J.A. and others. 2011. Trophic downgrading of planet earth. Science 333: 301-306.

Croll, D.A., J.L. Maron, J.A. Estes, E.M. Danner, G.V. Byrd. 2005. Introduced predators transform subarctic islands from grasslands to tundra. Science 307: 1959-1961.

Hebblewhite, M. and others. 2005. Human activity mediates a trophic cascade caused by wolves. Ecology 86: 2135-2144.

Donlan and others. 2006. Pleistocene rewilding: An optimistic agenda for Twenty-First century conservation. American Naturalist 168:660-681.

Prugh, L.R., C.J. Stoner, C.W. Epps, W.T. Bean, W.J. Ripple, A.S. Laliberte, and J.S. Brashares. 2009. The rise of the mesopredator. BioScience 59: 779-791

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Week 8 – March 5 and 7: Ecosystems and Disease

Diseases and Ecosystems – How do diseases impact ecosystems? How do ecosystems promote or inhibit disease risk? Can ecosystems be managed to moderate disease?

Chapter 13 in Weathers et al.

Yates, T.L. and others. The ecology and evolutionary history of an emergent disease: hantavirus pulmonary syndrome. BioScience 52: 989-998.

Kessing, F.R. and others. 2010. Impacts of biodiversity on the emergence and transmission of infectious diseases. Nature 468: 647-652

Journals Due – March 7

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Spring Break No Class, March 12 and 14

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Week 9 – March 19 and 21: Ecosystem Change

What factors are driving ecosystem change? How are human and natural systems coupled?

Chapter 12 in Weathers et al.

Foley, J. and others. 2005. Global consequences of land use. Science 309: 570-574.

Strayer, D. 2010. Alien species in fresh waters: ecological effects, interactions with other stressors, and prospects for the future. Freshwater Biology 55: 152-174.

Edburg, S.I., J.A. Hicke, P.D. Brooks, E.G. Pendall, B.E. Ewers, U. Norton, D. Gochis, E.D. Gutmann, and A.J.H. Meddens. 2012. Cascading impact of bark beetle-caused tree mortality on coupled biogeophysical and biogeochemical processes. Frontiers in Ecology and Enviroment 10: 416-424.

Chapin F.S., J.T. Randerson, A.D. McGuire, J.A. Foley, and C.B. Field. 2008. Changing feedbacks in the climate-biosphere system. Frontiers in Ecology and the Environment 6: 313-320.

Chapin, F.S. and others. 2008. Increasing wildfire in Alaska's boreal forest: Pathways to potential solutions of a wicked problem. BioScience 58: 531-540.

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Week 10 – March 26 and 28: Regime Shifts: A Dramatic Form of Ecosystem Change

What are regime shifts? How can regime shifts be detected and avoided?

Carpenter, S.R. 2003. Regime shifts in lake ecosystems: patterns and variation (Chapter 1). International Ecology Institute, Oldendorf, Germany.

DeYoung, B., M. Barange, G. Beaugrand, R. Harris, R.I. Perry, M. Scheffer, and F. Werner. 2008. Regime shifts in marine ecosystems: detection, prediction, management. Trends in Ecology and Evolution 23: 402-409

Lawrence, D., P. D'Odorico, L. Diekmann, M. DeLonge, R. Das, and J. Eaton. 2007. Ecological feedbacks following deforestation create the potential for a catastrophic ecosystem shift in a tropical dryland forest. Proceedings of the National Academy of Sciences 104: 20696-20701.

Hirota, M., M. Holmgren, E.H. Van Nes, M. Scheffer. 2011. Global resilience of tropical forest and savanna to critical transitions. Science 334: 232-235

Scheffer, M., J. Bascompte, W. A. Brock, V. Brovkin, S. R. Carpenter, V. Dakos, H. Held, E. H. van Nes, M. Rietkerk, and G. Sugihara. 2009. Early-warning signals for critical transitions. Nature 461:53-59.

Carpenter, S.R., J.J. Cole, M.L. Pace, R. Batt, W.A. Brock, T. Cline, J. Coloso, J.R. Hodgson, J.F. Kitchell, D.A. Seekell, L. Smith, and B. Weidel. 2011. Early warnings of regime shifts: a whole-ecosystem experiment. Science 332: 1079-1082.

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Week 11 – April 2 and 4: Ecosystems and Human Well Being

How are ecosystem related to human well being? How are ecosystem services changing? How can ecosystems be managed? What uncertainties inhibit decision making? How will ecosystems change in the future and how will these changes impact human well being?

Millenium Ecosystem Assessment. 2005. Ecosystems and Human Well Being: Synthesis, pages 26-63 (Chapter 1-3).

*Millenium Ecosystem Assessment. 2005. Ecosystems and Human Well Being: Synthesis, pages 64-102 (Chapter 4-9)

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Week 12 – April 9 and 11: Ecosystem Stewardship; Science and Policy, and the Future of Ecosystems

Chapin and others. 2009. Ecosystem stewardship: sustainability strategies for a rapidly changing planet.

Sarewitz, D. 2004. How science makes environmental controversies worse. Environmental Science and Policy 7: 385-403.

Nystrom, M. and others. 2012. Confronting feedbacks of degraded marine ecosystems. Ecosystems 15: 695-710.

Biggs, R. and others. 2010. Preparing for the future: teaching scenario planning at the graduate level. Frontiers in Ecology and Environment 8: 267-273.

Carpenter, S.R., E.A. Levitt., G.D. Peterson, E.M. Bennett, T.D. Beard, J.A. Cardille, and G.S. Cumming. Future of the lakes: scenarios for the future of Wisconsin's Northern Highland Lake District.

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Week 13 – April 16 and 18 Frontiers

Chapter 17 in Weathers et al.

Palmer and others. 2004. Ecology for a crowded planet. Science 304: 1251-1252.

Journals Due – April 16

****Presentations****

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Week 14 - April 23 and 25

****Presentations****

Synthesis of the Course

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Week 15

April 30 Test 2
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