RESTORATION ECOLOGY, PLB 443
T TH 10:00-11:20
ASA 118 (updated 1/19/2016)

Instructor: Prof. Sara Baer
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Office hours – Tuesday-Thursday 1-3 pm or by appointment (best to always make an appointment)

Text: There is no required text, but lectures will be drawn from the peer-reviewed literature and several chapters of the following books. Recommended readings related to lecture topics are listed on the course schedule.

Falk, D. A., M. A. Palmer, and J. B. Zedler. 2006. **Foundations of restoration ecology**. Island Press, Washington, USA.
Jordan, W. R., M. E. Giplin, and H. J. D. Aber, editors. 1987. **Restoration ecology: a synthetic approach to ecological research**. Cambridge University Press. Cambridge, UK.
Temperton, V. M., R. J. Hobbs, T. Nuttle, and S. Hale, editors. 2004. **Assembly rules and restoration ecology**. Island Press, Washington, USA.
Van Andel, J. and J. Aronson. 2006. **Restoration ecology**. Blackwell Science Publishing, Oxford, UK

Course Objectives. Using a hierarchical approach, from genes to ecosystems, this course will explore the relevance of current ecological theory to the practice of ecological restoration. Humans influence many the structure and function of ecosystems at a global scale. Restoration aims to improve populations, communities, and ecosystems degraded either directly or indirectly by human activities. The overall objective of this course is to provide students with ecological knowledge that can be applied to restorations across circumstances and systems. Specifically, this course will address the application of theories regarding minimal viable population sizes, metapopulation dynamics, community assembly, stability, altered stable states, and ecosystem functioning to the restoration of populations, communities, and ecosystems. The course will conclude consideration of targets for restoration and the challenge of restoration in face of global change.

Grading policy and point distribution. Grades will be determined from the total points earned out of the 500 possible points. Tests will cover lecture material, discussion reading, and class presentations. The standard grading scale will be used (100-90%=A; 89-80%=B; 79-70%=C; 69-60%=D; <60%=F) will be used to determine grades.

3 Exams (100 points each)	300 pts
Independent Paper	110 pts
Group Presentation	40 pts
Discussion – group attendance	20 pts
Discussion – participation	30 pts

Group Research and Independent Report: *Restoration Case-Study in the Context of Ecological Theory.* Teams of 3-4 students (mixed graduate and undergraduate) will research multiple aspects of a restoration project of their choice. Each student will be responsible for a different aspect. For example, one student may review ecological theory guiding restoration goals and objectives, another on principles guiding methods and assessment, and another on population, community or ecosystem response (assessment of restoration success). There is flexibility in the assignment of topics and they should be approved by the instructor.

Groups will gather information on restoration goals and approaches to specific to that restoration. This aspect of the research may require communication with practitioners. The goal, targets, and detailed restoration methods must be reported, even if they are not in the peer-reviewed literature and should be cited as "(Last Name, Initials *personal communication*)." Any publications or reports prepared by practitioners can also be cited. Relevant peer-reviewed articles from ecological and/or social science at the restoration site should be reviewed by each student. Each student report must include at least 10 relevant citations from the peer-reviewed literature. Any relevant figures, tables, and/or pictures can be included as appendices to this report (they do not count towards the total page requirement). Each student should develop a 9-10 page paper (not including literature cited or appended information) on their aspect of the restoration. Collectively, the group should cover the following: theoretical context, restoration goals and approaches learned from practitioners and conservation plans [or the like], restoration methods, and scientific or social assessment

of the restoration including evaluation of success, set-backs, and future challenges. Peer-review each other's papers. Although stand-alone papers will be evaluated, but 10 points of each student's grade will be based on the collective (group) review of the restoration.

Timeline.

Group identification	Feb. 4
Restoration topic	Feb. 11
Division of research	Feb. 18
Draft for peer-review	Mar. 24 (print out copies for your group members, bring to class, and distribute)
Due date:	April 7 (late paper final grades will be deducted 10% for each day late)
Presentation	See schedule

Format. All papers must be 9-10 pages (*not* including the cover page, citations, and any appendices), double spaced, 12 point Times New Roman font, with 1 inch margins. Literature cited must follow guidelines for the journal *Restoration Ecology*.

Presentation. Each group will deliver a presentation on their report. Presentations will be limited to 30 minutes with 5 minutes for questions (each person will participate in the presentation). Group presentations will be peer-reviewed by the class.

Discussion. Small discussion groups will be coordinated at the beginning of the semester. Each will contain graduate and undergraduate students. Each group is expected to meet and discuss the assigned papers *prior to the official class discussion*. Attendance must be taken among group members. Each group should bring at least two thought provoking questions to the class discussion. Each discussion period will include break-out sessions for groups to discuss thought provoking questions and come to consensus.

For your records (can be the same group)

DISCUSSION GROUP: names and email

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_____
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_____

RESEARCH GROUP: names and email

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Emergency Procedures. Southern Illinois University Carbondale is committed to providing a safe and healthy environment for study and work. Because some health and safety circumstances are beyond our control, we ask that you become familiar with the SIUC Emergency Response Plan and Building Emergency Response Team (BERT) program Emergency response information is available on posters in buildings on campus, available on BERT's website at www.bert.siu.edu, Department of Safety's website www.dps.siu.edu (disaster drop down) and in Emergency Response Guideline pamphlet. Know how to respond to each type of emergency. Instructors will provide guidance and direction to students in the classroom in the event of an emergency affecting your location. It is important that you follow these instructions and stay with your instructor during an evacuation or sheltering emergency. The Building Emergency Response Team will provide assistance to your instructor in evacuating the building or sheltering within the facility.

RESTORATION ECOLOGY COURSE SCHEDULE & READINGS

[subject to modification]

WEEK	TOPIC/BACKGROUND READING/DISCUSSION PAPERS
Jan 19	**Syllabus, organization of discussion groups** **INTRODUCTION: Why are we here?** Vitousek, P. M., H. A. Mooney, J. Lubchenco, and J. M. Melillo. 1997. Human domination of Earth's ecosystems. *Science* 277:494-499. Costanza, R., R. d'Arge, R. de Groot, S. Farber, M. Grasso, B. Hannon, K. Limburg, S. Naeem, R. V. O'Neill, J. Paruelo, R. G. Raskin, P. Sutton, and M. van den Belt. 1997. The value of the world's ecosystem services and natural capital. *Nature* 387: 253-260. Elser, J. J., and E. Bennett. 2011. A broken biogeochemical cycle. *Nature* 478:29-31.
Jan 21	**I. THE BEGINNING & SCOPE: History of restoration, definition of restoration ecology** Bradshaw, A. D. 1987. Restoration: an acid test for ecology. Pages 23-30 in W. R. Jordan, M. E. Giplin, and J. D. Aber, *Restoration Ecology: A Synthetic Approach to Ecological Research.* Cambridge University Press, UK. Ewel, J. J. 1987. Restoration is the ultimate test of ecological theory. Pages 31-34 in W. R. Jordan, M. E. Giplin, and J. D. Aber, *Restoration ecology: A synthetic approach to ecological research*. Cambridge University Press, UK. Harper, J. L. 1987. The heuristic value of restoration. Pages 35-46 in W. R. Jordan, M. E. Giplin, and J. D. Aber, *Restoration ecology: A synthetic approach to ecological research*. Cambridge University Press, UK. Baer, S. G. 2013. Restoration Ecology. In *Oxford Bibliographies in Ecology*. Edited by David Gibson. New York: Oxford University Press. http://www.oxfordbibliographies.com/
Jan 26	**I. THE BEGINNING & SCOPE (CONTINUED): Case study from the Platte River, Nebraska** **DISCUSS:** (1) Hardin, G. 1968. The tragedy of the commons. Science 162: 1243-1248. (2) Ellis, E. C. and N. Ramunkutty. 2008. Putting people on the map: anthropogenic biomes of the world. *Frontiers in Ecology & the Environment* 6: 439-437.
Jan 28	**Research group assignments** **DISCUSS:** (1) Dobson et al. 1997. Hopes for the future: restoration ecology and conservation biology. *Science* 5325: 515-522. (2) Elliot, R. Faking Nature. Pages 71-82 in W. Thorp (editor). *Environmental Restoration: Ethics, Theory and Practice*
Feb 2, 4	**II. POPULATIONS: Population ecology and genetics** Montalvo, A. M., et al. 1997. Restoration biology: a population biology perspective. *Restoration Ecology* 5:277-290. Lesica, P. and F. W. Allendorf. 1999. Ecological genetics and the restoration of plant communities: mix or match? *Restoration Ecology* 7:42-50. Falk, D. A. et al. 2006. Population and ecological genetics in restoration ecology. Pages 14-41, in D. A. Falk, M. A. Palmer, and J. B. Zedler (editors), *Foundations of Restoration Ecology*. Island Press, Washington, USA. Hedrick, P. 2006. 'Genetic restoration:' a more comprehensive perspective than 'genetic rescue.' *Trends in Ecology and Evolution* 20:100
Feb 9, 11	**II. POPULATIONS: Population ecology and genetics (continued)** **DISCUSS :** (1) Rice, K. J. and N. C. Emory. 2003. Managing microevolution: restoration in the face of global change. *Frontiers in Ecology & the Environment* 1:469-478. (2) Broadhurst et al. 2008. Seed supply for broadscale restoration: maximizing evolutionary potential. *Evolutionary Applications* 1: 587-597.
Feb 16, 18	**II. POPULATIONS: Minimal viable populations, metapopulation theory, re-introductions** Machinski, J. 2006. Implications of population dynamic and metapopulation theory for restoration. Pages 59-87, in D. A. Falk, M. A. Palmer, and J. B. Zedler (editors), *Foundations of Restoration Ecology*. Island Press, Washington, USA. Seddon, P.J., D. P. Armstrong, and R. F. Mooney. 2007. Developing the science of reintroduction biology. *Conservation Biology* 21: 303-312. **DISCUSS:** (1) Weeks et al. 2011. Assessing the benefits and risks of translocations in changing environments: a genetic perspective. *Evolutionary Applications* 4: 709-725. (2) Fahrig, L. 2001. How much habitat is enough? *Biological Conservation* 100 :65-74.
Feb 23	TBA
Feb 25	**EXAM 1**
Mar 1, 3	**III. COMMUNITIES: Application of community ecology theory to restoration** Palmer, M. A., R. F. Ambrose, and N. L. Poff. 1997. Ecological theory and community restoration ecology. *Restoration Ecology* 5:291-300.

	Menninger, H. L. and M. A. Palmer. 2006. Restoring ecological communities: from theory to practice. Pages 88-112, in D. A. Falk, M. A. Palmer, and J. B. Zedler (editors), *Foundations of Restoration Ecology*. Island Press, Washington, USA. **DISCUSS:** (1) (2) Pa¨ rtel, M., R. Szava-Kovats and M. Zobel. 2011. Dark diversity: shedding light on absent species. *TREE* 26: 124-127.
Mar 8, 10	**III. COMMUNITIES: Assembly rules** Lockwood, J. L. and C. L. Samuels. 2004. Assembly models and the practice of restoration. Pages 55-70 in V. M. Temperton, R. J. Hobbs, T. Nuttle, and S. Hale (editors), *Assembly Rules and Restoration Ecology*. Island Press, Washington, USA. White, P. S. and A. Jentsch. 2004. Disturbance, succession, and community assembly in terrestrial plant communities. In V. M. Temperton, R. J. Hobbs, T. Nuttle, and S. Hale, editors. *Assembly Rules and Restoration Ecology*. Island Press, Washington, USA. Temperton, V. M. and R. J. Hobbs. 2004. The search for ecological assembly rules and its relevance to restoration ecology. Pages 34-54 in V. M. Temperton, R. J. Hobbs, T. Nuttle, and S. Hale (editors), *Assembly rules and restoration ecology*. Island Press, Washington, USA. **DISCUSS:** (1) Trowbridge, W. B. 2007. The role of stochasticity and priority effects in floodplain restoration. *Ecological Applications* 17: 1312-1324, (2) Grman et al. 2013. Confronting contingency in restoration: management and site history determine outcomes of assembling prairies, but site characteristics and landscape context have little effect**.** *Journal of Applied Ecology* 50: 1234-1243.
	MARCH 14-18 SPRING BREAK – NO CLASSES
Mar 22 , 24	**III. COMMUNITIES: Diversity/stability/resilience theory applied to restoration and invasive species** D'Antonio, C. M. and J. C. Chambers. 2006. Using ecological theory to manage or restore ecosystems affected by invasive plant species. Pages 260-279 in D. A. Falk, M. A. Palmer, and J. B. Zedler (editors), *Foundations of Restoration Ecology*. Island Press, Washington, USA. **DISCUSS:** (1) Coomes et al. 2003. Factors preventing recovery of New Zealand forests following control of invasive deer. *Conservation Biology* 17: 450-459. (2) Funk et al. 2007
Mar 29	**TBA**
Mar 31	**EXAM 2**
Apr 5, 7	**IV. ECOSYSTEMS: The ecosystem concept, thresholds and gradients** Hobbs, R. J. and D. A. Norton. 2004. Ecological filters, thresholds, and gradients in resistance to ecosystem assembly. Pages 72-95 in V. M. Temperton, R. J. Hobbs, T. Nuttle, and S. Hale, editors. *Assembly Rules and Restoration Ecology*. Island Press, Washington, USA. Bradshaw, A. D. 2004. The role of nutrients and the importance of function in the assembly of ecosystems. Pages 325-340 in V. M. Temperton, R. J. Hobbs, T. Nuttle, and S. Hale, editors. *Assembly Rules and Restoration Ecology*. Island Press, Washington, USA. Baer, S. G. in press. Nutrients as determinant and endpoints of restoration. In D. A. Falk, M. A. Palmer, and J. B. Zedler (editors), *Foundations of Restoration Ecology* (2nd edition). Island Press, Washington, USA. **DISCUSS:** (1) Silva, L. C. R., R. S. Correa, T. A. Doane, E. I. P. Pereira, and W. R. Horwath. 2013. Unprecedented carbon accumulation in mined soils: the synergistic effect of resource input and plant species invasion. *Ecological Applications* 23:1345-1356. (2) Lindig-Cisneros, R., J. Desmond, K. E. Boyer, and J. B. Zedler. 2003. Wetland restoration thresholds: can a degradation transition be reversed with increased effort? *Ecological Applications* 13:193-205.
Apr 12, 14	**IV. ECOSYSTEMS: Restoring function, alternative stable states, and relationships with diversity** Suding, K. N. and K. L. Gross. 2006. The dynamic nature of ecological systems: multiple states and restoration trajectories. Pages 190-209 in D. A. Falk, M. A. Palmer, and J. B. Zedler (editors), *Foundations of Restoration Ecology*. Island Press, Washington, USA. Naeem, S. 2006. Biodiversity and ecosystem functioning in restored ecosystems: extracting principles for a synthetic perspective. Pages 210-237, in D. A. Falk, M. A. Palmer, and J. B. Zedler (editors), *Foundations of Restoration Ecology*. Island Press, Washington, USA. Baer, S. G., L. Heneghan, and V. Eviner. 2012. Applying soil ecological knowledge to restore ecosystem services. Pages 377-393 in *Soil Ecology and Ecosystem Services*. Edited by Diana H. Wall et al. Oxford, UK: Oxford University Press. **DISCUSS**: (1) Callaway et al. 2003. Species-rich plantings increase biomass and nitrogen accumulation in a wetland restoration experiment. *Ecological Applications* 13: 1626-1639. (2) Whitham et al. 2006. A framework for community and ecosystem genetics: from genes to ecosystems. *Nature* 7:510-523.
Apr 19	**IV. ECOSYSTEMS: The role of hydrology in restoring ecosystems**

Apr 21	**DISCUSS:** (1) Craig et al. 2008. Stream restoration strategies for reducing river nitrogen loads. *Frontiers in Ecology & the Environment* 6: 529-538, (2) Zedler, J. 2003. Wetlands at your service: reducing impacts of agriculture at the watershed. *Frontiers in Ecology & the Environment* 1: 65-72. (3) Hey, D. L., J. A. Kostel, W. G. Crumpton, W. J. Mitsch, and B. Scott. 2012. The roles and benefits of wetlands in managing reactive nitrogen. *Journal of Soil and Water Conservation* 67:47A-53A. Groups 1, 2 present
Apr 26	Groups 3, 4 present
Apr 28	Groups 5, 6 present
May 3, 5	**V. GLOBAL CHANGE: Challenges facing restoration & targets** Hobbs, R. J. and J. A. Harris. 2001. Restoration ecology: repairing the Earth's ecosystems in the new millennium. *Restoration Ecology* 9:239-246. Harris, J. A., R. J. Hobbs, E. Higgs, and J. Aronson. 2006. Ecological restoration and global climate change. *Restoration Ecology* 14: 170-176. **DISCUSS**: (1) Hobbs et al. 2006. Novel ecosystems: theoretical and management aspects of the new ecological world order. *Global Ecology and Biogeography* 15:1-7; (2) Hobbs et al. 2011. Intervention Ecology: Applying Ecological Science in the Twenty-first Century. *BioScience* 61:442-450.
	FINAL EXAM: TUESDAY MAY 10, 10:15 AM