FS 543: Advanced Silviculture/FS 599 Advanced Silviculture Lab
Winter 2012

Instructors

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Course Description (from Catalog)

The scientific basis of forest regeneration and silviculture practices and prescriptions in immature and mature stands. REQ: Field trips. Lec/Lab. PREREQS: FOR 442, FOR 443

Learning Outcomes

As a result of fully participating in this course you will:

1. Have a basic understanding of complex adaptive systems theory in the context of natural resource management. This will be assessed through briefing papers and classroom discussions.
2. Be able to analyze and compare a variety of management approaches with the principles of complex adaptive systems. This will be assessed through classroom discussion, briefing papers, and lab assignments (FS599, see below).
3. Be able to synthesize complicated materials and communicate those syntheses to others inside and outside of your discipline. This will be assessed through classroom discussions and one-page briefing papers that link your area of expertise to a specific problem.
4. Be able to link information, management approaches, policy, and theories from multiple disciplines to develop management and/or policy recommendations. This will be assessed through briefing papers and lab assignments (FS599, see below).
5. Be able to develop and apply a set of tools and concepts (e.g., indicators, thresholds, etc.) to a specific place-based case. This will be assessed through lab assignments and in-class projects.
6. Have fun. This will be assessed through the number of times you laugh and smile during the course!

Course Readings

Puettmann, Klaus J., K. David Coates, and Christian Messier. 2009. *A Critique of Silviculture: Managing for Complexity*. Washington DC: Island Press.

Johnson, Neil. 2007. *Simply Complexity: A Clear Guide to Complexity Theory*. Oxford: Oneworld Publications.

Other readings will be posted on Blackboard, accessible online, or distributed in class.

Course Structure

After a brief introduction to complexity theory by the instructors, we will begin examining how ideas about complex systems and diversity can help us plan and implement natural resource management that integrates multiple goals and outcomes. The first four weeks of the course are focused on a quick introduction to the main ideas with the next six weeks devoted to peer-to-peer learning on specific topics related to understanding the complexity of natural resource systems. The course books will be read during the first four weeks to lay the ground work for looking at specific topics in the latter part of the course. Additional reading will include relevant book chapters and journal articles and posted to

Blackboard. You are responsible for completing the reading *before* the class session so you can participate meaningfully in discussions. Seminar discussions are only as rich as we make them by our engagement with the ideas developing in the readings and presentations.

Course Requirements and Evaluation

Attendance is required for all classes. If you must miss a session, please check with the instructor to turn in any assignments. There is no final exam for this course

Classroom Discussion (40 points) – Successful seminars are based on high quality discussions that reflect theoretical and methodological sophistication. They are one of the most important learning tools at this stage of your education and will continue to play a critical role in your professional life. You can earn up to 2 points per class period for a total of 40 points for engaged participation in these discussions. If you miss a class period, you cannot make up discussion points. **You do not automatically receive 2 points for just showing up to class.** Your discussion points will be assessed on how much you contribute to the class – the quality of questions you ask, the ability to link observations in the field to what we're reading and talking about, and the strength of synthesis and summaries you make. Come to class prepared—you will be expected to contribute thoughtful, informed comments to discussion in every class period and will be evaluated on this contribution. A class observer will be tracking participation and thinking about the sophistication of discussion participants (e.g., the kinds of questions you raise, your ability to synthesize material, how you bring in ideas from other topics, etc.). If you find that you don't have much to contribute to discussions, you might want to take notes on the readings, and prepare questions and observations prior to class so you are ready to participate. If this still doesn't work, please contact the instructors as soon as possible.

Briefing papers (20 points) –you will be asked to prepare four briefing papers over the course of the term to bring together ideas from class, the readings, and lab observations. Each briefing paper can earn up to five points. An excellent briefing paper will be short (two pages or so), have a cogent and appropriate argument/discussion, draw on multiple sources, and provide relevant references. These must be turned in on the due date for full credit.

Group presentation and discussion (20 points each/40 points total) – you will work with two different groups to present a concept related to the complexity of natural resource system. You will be responsible for helping students understand the concept through a lecture, discussion, media sources (e.g., videos), and/or interactive activities that let people grapple with the idea. You must work with your partner(s) and complete not only the reading for the course, but other reading that will help you master the concept. You can ask students to read additional information if you find something that will help clarify or explain the concept. Please give students as much as a week's notice that they will have additional reading. You will have the whole class period to make your presentation, do any exercises, and lead a discussion. Your job is to *engage* the members of the class. You will be evaluated on finding a way to communicate the concepts in the readings and whether your colleagues demonstrate a type of concept literacy by the end of the class period.".

The Lab Section is listed separately under FS599, but integrated into the classwork. Students need to sign up for FS599 to get the most out of FS543.

Schedule

Week/Date	Topic	Reading (Starting week 4, groups will assign additional or other readings)	Assignments
1 1/10/12	Introduction to Course – goals and objectives Introduction to Complex Adaptive Systems		Begin reading *A Critique of Silviculture* and *Simply Complexity* in addition to readings assigned for class period. Lots of reading upfront to get ready for heady discussions later.
1/12/12	Introduction to Social Science: history, theories, and methods	http://www.science20.com/evolutionary_economics/return_karl_popper_social_science_really_different_natural_science Paradigms and problems: The practice of social science in natural resource management: http://www.treesearch.fs.fed.us/pubs/34686	
2 1/17/12	Introduction to Silviculture Diversity - why, how to measure, where does it come from, limitations	*A Critique of Silviculture*	Briefing paper 1 due: How can your field/discipline and/or experience connect to the concepts and ideas of complex adaptive systems? How are researchers and practitioners dealing with issues related to complex adaptive systems?
1/19/12	Diversity and complexity	*Simply Complexity*	
3 1/24/12	Methodological Issues 1: Quantification, Scaling, Methodological Individualism,	Forest Stewardship Council certification standards: http://www.fscus.org/images/documents/standards/FSC-US%20Forest%20Management%20Standard%20v1.0.pdf Scale Mismatches in Social-Ecological Systems : Causes , Consequences , and Solutions By G S Cumming et al. , D H M Cumming, C L Redman 2006 (pdf on blackboard)	

	1/26/12	Methodological Issues 2: Wicked Problems, Post-Normal Science, and Uncertainty	POST-NORMAL SCIENCE - Environmental Policy under Conditions of Complexity: http://www.nusap.net/sections.php?op=viewarticle&artid=13 Information Tools for Environmental Policy Under Conditions of Complexity: http://www.eea.europa.eu/publications/ISSUE09	
4	1/31/12	Resistance, resilience, adaptability: adaptation to current conditions vs adaptability to change	Operational approaches to managing forests… by Stephens et al. 2010 How innovation and entrepreneurship can conquer uncertainty and complexity: learning about the unexpected by Reschke et al. 2010	Briefing paper 2 due: How can we use natural resource management as a case study of utilizing complex system theory? What are the major strength and the major challenges linking these two fields?
	2/02/12	Planning tools: scenario planning Decision making	Overview of scenario planning: Briggs et al. 2010 For an example of a management plan, see http://www.kaslocommunityforest.org/index.php?option=com_docman&Itemid=55 – download the Final KDCSF Project Summary	Not confirmed as of 1/4/12
5	2/07/12	Planning tools: Adaptive management	Required Readings: TBA Group:	Suggested Readings: Adaptive Comanagement for Building Resilience in Social–Ecological Systems by Olson et al. 2004
	2/09/12	Modeling: using simulations and models to understand complex systems.	Required Readings: TBA Group:	Suggested Readings: Modeling approach in ecosystem research and management by Hauhs and Lange 2004 CREATE Proposal, UQuAM
6	2/14/12	Thresholds – warning signals, management	Required Readings: TBA Group:	Suggested Readings: Ecological threshold Groffman et al. 2006 Threshold indicators: Scheffer et al. 2009

				Briefing paper 3 due: What's the status of modeling in your discipline/field? What are the opportunities and challenges for using different kinds of models to explore problems in your field?
2/16/12	Understanding novel ecosystems, (i.e., no analogue)	Required Readings: TBA	Group:	Suggested Readings: Management of novel ecosystems: Seastedt et al. 2008 Societal challenges: Franklin and Johnson 2011 and Bridgewater et al. 2011 (have pdfs)
7 2/21/12	Ecosystems dynamics, panarchy cycle	Required Readings: TBA	Group:	Suggested Readings: Overview how panarchy cycle relates to forests: Drever et al. 2006
2/23/12	Redundancy – the role of overlap within and across scales	Required Readings: TBA	Group:	Suggested Readings: Pedersen et al. 1998
8 2/28/12	Governance issues – collective decision making, institutions, and regulations	Required Readings: TBA	Group:	Suggested Readings: Ecological Thresholds: The Key to Successful Environmental Management or an Important Concept with No Practical Application by Groffmann et al. 2006 Early-warning signals for critical transitions by Scheffer et al. 2009
3/01/12	Networks – random, scale free	Required Readings: TBA	Group:	Suggested Readings: Ecological Networks – beyond food webs. Ings et al. 2009 (have pdf) Nework – modularity, flow: C. Webb and Bodin 2009, Chapter 3 in Norberg and Cumming 2009. Social networks as a source of resilience – Hahn et al. 2009, Chapter 4 in Norberg and Cumming 2009 (can scan in)
9 3/06/12	Plant traits: function-response type groups	Required Readings: TBA	Group:	Suggested Readings: Function-response groups scaling: Suding et al. 2008

				Briefing paper 4 due: Re-write the catalog description for this class using 50 words or less (real requirement). Provide a description or explanation of your class description.
3/08/12	Human perceptions and attitudes: Exotic species –	Required Readings: TBA	Group:	Suggested Readings: Chew and Hamilton 2010 Kubeck, Lach, and Chan 2011: Exploring stakeholders' attitudes and beliefs regarding behaviors that prevent the spread of invasive species
10 3/13/12	Lab presentations			
3/15/12	Debrief – Lessons learned, best practices, etc.			

Lab Section FS599

Learning outcome:

1. Be able to apply theoretical concepts about complex adaptive systems to place-based cases.
2. Be able to develop tools and approaches to link theoretical concepts to practical applications.
3. Be able to communicate theories and applications to a wide variety of audiences in written and oral form.

Lab meetings will be organized to accommodate students' schedules. As a lab object we utilize the Oak Creek Portion of McDonald/Dunn Forest (McD), also labeled Theme 4 in http://www.cof.orst.edu/cf/forests/mcdonald/plan/files/mcdunn_plan.pdf,. The purpose is not to develop a management plan, but to develop a proposal for the College of Forestry to manage the Oak Creek area as a complex adaptive system. This proposal should be based on the theoretical concepts discussed in class. It should include indicators and tools that will help manage the ability of the forest ecosystem to adapt to future changes, while providing desired ecosystem goods and services.

To get started, we will send out a doodle and schedule a field trip (2 to 3 hours) with a staff member of the CoF School Forest. This will familiarize students with the forests and initiate discussions and ideas. Students will be assigned to groups of 5 to 6 students to ensure a variety of backgrounds and expertise in each group. After the initial field trips, groups can (self) organize their activities independently, but we encourage to consult the instructors (and other resources) along the way. By the end of week 4 each group will provide an action plan, including schedule, list of resources, and planned focus of the proposal. Detailed schedules and activities will be worked out by the students. Interaction with other experts on and off campus is encouraged, e.g., Drs. Rosenberger and Needham just finished a survey of recreational users of McD, Dr. Kellogg has investigated the layout and harvesting challenges and costs when switching to small group harvesting, etc.). This could also include interactions with interested public groups. The proposal could cover a variety of topics, including:

- a resilience assessment of ecological and social conditions,
- measures, indicators, or standards for ecological and social adaptability,
- critical thresholds, warning signals, risks and regime shifts indicators
- multiple futures scenario planning
- a stakeholder forum for problem framing, planning, and monitoring activities
- adaptive management strategies, including monitoring and iterative decision making process, and/or a
- landscape assessment.

The final products include a general group write-up of the lab activities and outcomes in proposal form (maximum 5 pages of text + list of resources, etc.) (60 pts). In addition, each student will be also responsible for a write-up of specific aspects in the proposal that are related to his/her expertise (~ 1 page, 20 pts). The proposal also will be presented by the group to the whole class (20 pts.) in the last week of the quarter. We will discuss opportunities to present the proposal to a wider set of interested audiences

Additional readings:

a) Complexity

Bak, P. 1996, *How Nature Works: The Science of Self-Organized Criticality*, New York: Copernicus.

Camazine, S., J.-L. Deneubourg, N. R. Franks, J. Sneyd, G. Theraulaz, and E. Beonabeau. (2001). *Self-organization in biological systems.* Princeton, NJ: Princeton University Press.

Chapin III, F. S., G. P. Kofinas, and C. Folke, Editors. (2009). *Principles of Ecosystem Stewardship: Resilience-based Natural Resource Management in a Changing World*. NY: Springer Verlag.

Gunderson, L., C. R. Allen, and C. S. Holling, Editors. (2010). *Foundations of Ecological Resilience*. Washington, DC: Island Press.

Gunderson, L.H., and C.S. Holling. (2002). *Panarchy: Understanding Transformations in Human and Natural Systems*. Washington, DC: Island Press.

Johnson, N. (2009). *Simply Complexity : A Clear Guide to Complexity Theory*. Oxford, UK : Oneworld (reprint).

Levin, S. A. (1999). *Fragile Dominion*. Cambridge, MA.: Helix Book, Perseus Publishing,

Nicolis, G., and I. Prigonine. (1977). *Self-Organization in Non-equilibrium Systems*. NY: Wiley Press.

Miller, J.H. and S.E. Page. (2007). *Complex Adaptive Systems: An Introduction to Computational Models of Social Life*. Princeton, NJ: Princeton University Press.

Mitchell, M. (2009). *Complexity: A Guided Gour*. Oxford, UK: Oxford University Press.

Norberg, J., and G.S. Cumming (eds.). (2008). *Complexity Theory for a Sustainable Future*. NY: Columbia University Press.

Page, S.E. (2010). *Diversity and Complexity*, Princeton, NJ: Princeton University Press.

Scheffer, M. (2009). *Critical Transitions in Nature and Society*. Princeton, NJ: Princeton University Press.

Schmitz, O.J. (2010). *Resolving Ecosystem Complexity*. Princeton, NJ: Princeton University Press.

Solé, R.V., and J. Bascompte. (2006). *Self-Organization in Complex Ecosystems.* Princeton, NJ: Princeton University Press.

Waldrop, M.M. (1992). *Complexity: The Emerging Science and the Border of Order and Chaos*. NY: Touchstone.

Walters, C. (1986). *Adaptive Management of Renewable Resources*. NY: Macmillian Publishing.

Waltner-Toews, D., J. J. Kay, et al., Eds. (2008). *The Ecosystem Approach: Complexity, Uncertainty, and Managing for Sustainability.* NY: Columbia University Press.

b) Social Systems and Complexity

Ash, Neville, Hernan Blanco, Claire Brown, Keisha Garcia, Thomas Henrichs, Nicholas Lucas, Clara Raudsepp-Hearne, R. David Simpson, Robert Scholes, Thomas Tomich, Bhaskar Vira, and Monika Zurek. (2010). *Ecosystems and Human Well-Being: A Manual for Assessment Practitioners*. Washington, DC: Island Press.

Berkes, Fikret and Carl Folke. (1998). *Linking Social and Ecological Systems: Management Practices and Social Mechanisms for Building Resilience*. Cambridge, UK: Cambridge University Press.

Byrne, D. (1998). *Complexity Theory and the Social Sciences: An Introduction*. London: Routledge.

Johnson, Steven. (2001). *Emergence: The Connected Lives of Ants, Brains, Cities, and Software*. NY: Scribner.

Levin, Simon. (1999). *Fragile Dominion: Complexity and the Commons*. Cambridge, MA: Perseus Publishing.

McDonnell, Mark and Steward Pickett. (1993). *Humans as Components of Ecosystems: The Ecology of Subtle Human Effects and Populated Areas*. NY: Springer-Verlag.

Meadows, Donella. (2008) *Thinking in Systems: A Primer*. White River Junction, VT: Chelsea Green Publishing Company.
Miller, J.H. and S.E. Page. (2007). *Complex adaptive systems: An introduction to computational models of social life*. Princeton, NJ: Princeton University Press.
Mitchell, Sandra. (2009). *Unsimple Truths: Science, Complexity and Policy*. Chicago: University of Chicago Press.
Moldan, Bedrich and Suzanne Billharz. (1997). *Sustainability Indicators: Report of the Project on Indicators of Sustainable Development*. Chichester: John Wiley and Sons.
Sawyer, R. Keith. (2005). *Social Emergence: Societies as Complex Systems*. Cambridge, UK: Cambridge University Press.
Slovic, Paul. (2000). *The Perception of Risk*. London: Earthscan.
Watts, Duncan. (2003). *Six Degrees: The Science of a Connected Age*. NY: Norton.

c) Silviculture

Barrett, J. W. (ed.). (1994). *Regional Silviculture of the United States, 2nd Edition.* NY: Wiley.
Daniel, T. W., J. A. Helms, and F. S. Baker. (1979). *The Practice of Silviculture*. NJ: McGraw-Hill.
Kohm, K. A. and J. F. Franklin. (1997). *Creating a forestry for the 21st century. The Science of Ecosystem Management.* Washington, DC: Island Press.
Kelty, M., Larson B.D., and C.D. Oliver (edts.) (1992). *The Ecology and Silviculture of Sixed Species Stands*. Kluwer Academic Publ.
Lavender, D.P., R. Parish, C.M. Johnson, G. Montgomery, A. Vyse, R.A. Wilis and D. Winston. (1990). *Regenerating British Columbia's Forests*. UBC Press: Vancouver.
Nyland, R. (2002). *Silviculture: Concept and Application,2nd edition*. NJ: McGraw Hill.
Oliver, C. D. and B. D. Larson. (1996). *Forest Stand Dynamics*. NY: Wiley and Sons, Inc..
Smith, D. M., Larson, B. C, Kelty, M J. and P. M. S. Ashton. (1997). *The Practice of Silviculture: Applied Ecology 9th Edition*. NY: Wiley and Sons, Inc.
Puettmann, K.J., K.D. Coates, and C. Messier. (2009). *A Critique of Silviculture: Managing forDcomplexity*. Washington, DC: Island Press.
U. S. Forest Service. 1990-1991. *Silvics of North America.* Volume 1 and 2. Agriculture Handbook 654. This book can also be found on the web: http://www.na.fs.fed.us/spfo/pubs/silvics_manual/table_of_contents.htm
U. S. Forest Service. (1974). *Seeds of Woody Plants in the United States*. Agriculture Handbook 450.
Young, J. A. and C. G. Young. (1992). *Seeds of Woody Plants in North America*. Portland, OR: Dioscorides Press.

d) Forest Ecology

Barnes, B. V., D. R. Zak, S. R. Denton, and S. H. Spurr. (1998). *Forest Ecology*, *4th edition*. NY: John Wiley & Sons.
Chapin III, F. S., Matson, P.A., Mooney, H.A. (2002)**.** *Principles of Terrestrial Ecosystem Ecology* Corr. 2nd printing, 2004. NY: Springer Verlag.
Hunter, M. L. (1990). *Wildlife, Forests, and Forestry: Principles of Managing Forests for Biological Diversity*. NJ: Prentice_Hall.
Hunter, M. L., Ed. (1999). *Maintaining Biodiversity in Forest Ecosystems*. Cambridge, UK: Cambridge University Press.
Kimmins, H. (1992). *Balancing Act: Environmental Issues in Forestry*. Vancouver, BC: University of British Columbia Press.

Kimmins, J. P. (1997). *Forest Ecology: A Foundation for Sustainable Management.* NJ: Prentice Hall.
Lambers, H., F.S. Chapin and T.L. Pons. (1998). *Plant Physiological Ecology.* NY: Springer Verlag.
Perry, D. A. (1994). *Forest Ecosystems*. Baltimore, MD: The John Hopkins University Press.
Waring, R. H. and S. W. Running. (1998). *Forest Ecosystems. Analysis at multiple scales.* Academic Press.

e) Scenario Planning

American Planning Association (2010). *Policy Guide on Planning and Climate Change.* http://www.planning.org/policy/guides/pdf/climatechange/pdf.
Biggs, Reinette, Matthew W Diebel, David Gilroy, Amy M Kamaraine1, Matthew S Kornis, Nicholas D Preston, Jennifer E Schmitz, Christopher K Uejio, Matthew C Van De Bogert, Brian C Weidel, Paul C West, David PM Zaks, and Stephen R Carpenter (2010). Preparing for the future: teaching scenario planning at the graduate level. *Frontiers* 8(5): 267-273.
Chermack, Thomas. (2011). *Scenario Planning in Organizations*. San Francisco: Berrett-Koehler Publishing.
Envision: A spatially distributed, multi-agent based framework for policy assessment and alternative futuring. http://envision.bioe.orst.edu/.
Hulse, David, Allan Branscom, Chris Enright, and John Bolte. (2009). Anticipating floodplain trajectories: a comparison of two alternative futures approaches. *Landscape Ecology* 24:1067–1090.
Kok, Kasper, Dale S. Rothman, and Mita Patel. (2006). Multi-scale narratives from an IA perspective: Part I. European and Mediterranean scenario development. *Futures* 38: 261–284.
Kok, Kasper, Mita Patel, Dale S. Rothman, and Giovanni Quaranta. (2006). Multi-scale narratives from an IA perspective: Part II. Participatory local scenario development. *Futures* 38: 285–311.
Peterson, G. D., T. D. Beard Jr., B. E. Beisner, E. M. Bennett, S. R. Carpenter, G. S. Cumming, C. L. Dent, and T. D. Havlicek. (2003). Assessing future ecosystem services: a case study of the Northern Highlands Lake District, Wisconsin. *Conservation Ecology* 7(3): 1.

f) Uncertainty

Halpern, Joseph. (2003). *Reasoning about Uncertainty*. Cambridge, MA: MIT Press.
Kahneman, Daniel, Paul Slovic, and Amos Tversky. (1982). *Judgment Under Uncertainty: Heuristics and Biases*. Cambridge, UK: Cambridge University Press.
Ludwig, Donald, Ray Hilborn, and Carl Walters. (1993). Uncertainty, Resource Exploitation, and Conservation: Lessons from History. *Science* 260(5104): 17-36.
Rittell, Horst and Melvin Webber (1973). Dilemmas in a General Theory of Planning. *Policy Sciences* 4: 155-169.
Tversky, Amos and Daniel Kahneman (1974). Judgment under Uncertainty: Heuristics and Biases. *Science* 185(4157): 1124-1131.
Webber, Edward and Anne Khadamian (2008). Wicked Problems, Knowledge Challenges, and Collaborative Capacity Builders in Network Settings. *Public Administration Review* 68(2): 334-349.

g) Thresholds

Allen, C. D., C. Birkeland, et al. (2009). Thresholds of Climate Change in Ecosystems: Final Report, Synthesis and Assessment Product 4.2. Ecology and Society. Lincoln NE, US Geological Survey.
Andersen, T., J. Carstensen, et al. (2009). Ecological thresholds and regime shifts: approaches to identification. *Trends in Ecology & Evolution* 24(1): 49-57.

Bestelmeyer, B. T. (2006). Threshold concepts and their use in rangeland management and restoration: the good, the bad, and the insidious. *Restoration Ecology* 14(3): 325-329.

Folke, C., S. Carpenter, et al. (2004). Regime shifts, resilience, and biodiversity in ecosystem management. *Annual Review of Ecology Evolution and Systematics* 35: 557-581.

Gladwell, Malcolm. 2002. *The Tipping Point: How Little Things Can Make a Big Difference*. NY: Little Brown.

Groffman, Peter, Jill S. Baron, Tamara Blett, Arthur J. Gold, Iris Goodman, Lance H. Gunderson, Barbara M. Levinson,Margaret A. Palmer, Hans W. Paerl, Garry D. Peterson, N. LeRoy Poff, David W. Rejeski, James F. Reynolds, Monica G. Turner, Kathleen C. Weathers, and John Wiens. 2006. Ecological Thresholds: The Key to Successful Environmental Management or an Important Concept with No Practical Application? *Ecosystems* 9(1): 1-13.

Huggett, Andrew. 2005. The Concept and Utility of "Ecological Thresholds" in Biodiversity Conservation. *Biological Conservation* 124(3): 301-310.

Scheffer, M. (2009). *Critical Transitions in Nature and Society*. Princeton, NJ: Princeton University Press.

Scheffer, M., J. Bascompte, et al. (2009). Early-warning signals for critical transitions. *Nature* 461(7260): 53-59.

Suding, K. N. and R. J. Hobbs (2009). Threshold models in restoration and conservation: a developing framework. *Trends in Ecology & Evolution* 24(5): 271-279.

van Nes, E. H. and M. Scheffer (2007). Slow Recovery from Perturbations as a Generic Indicator of a Nearby Catastrophic Shift. *The American Naturalist* 169(6): 738-747.

Walker, B. and J. Meyers (2004). Thresholds in ecological and social-ecological systems: a developing database. *Ecology and Society* 9(2).

h) Resilience

Anderies, J. M., B. H. Walker, et al. (2006). Insight, exploring resilience in social- ecological systems: fifteen weddings and a funeral: case studies and resilience based management. *Ecology and Society* 11(1): 21-33.

Benson, M. and A. Garmestani (2011). Can We Manage for Resilience? The Integration of Resilience Thinking into Natural Resource Management in the United States. *Environmental Management* 48(3): 392-399.

Brand, F. S. and K. Jax (2007). Focusing the meaning(s) of resilience: Resilience as a descriptive concept and a boundary object. *Ecology and Society* 12(1).

Burton, P. J. (2010). Striving for Sustainability and Resilience in the Face of Unprecedented Change: The Case of the Mountain Pine Beetle Outbreak in British Columbia. *Sustainability* 2(8): 2403-2423.

Carpenter, S., B. Walker, et al. (2001). "From metaphor to measurement: Resilience of what to what?" *Ecosystems* 4(8): 765-781.

Chapin III, F. S., G. P. Kofinas, et al., Eds. (2009). *Principles of ecosystem stewardship: Resilience-based natural resource management in a changing world*. NY: Springer Verlag.

Chapin III, F. S., A. D. McGuire, et al. (2010). Resilience of Alaska's boreal forest climate change. *Canadian Journal of Forest Research* 40: 1360-1370.

Cordonnier, T., B. Courbaud, et al. (2008). Permanence of resilience and protection efficiency in mountain Norway spruce forest stands: a simulation study. *Forest Ecology and Management*.

Cropp, R. and A. Gabric (2002). Ecosystem adaptation: Do ecosystems maximize resilience? *Ecology* 83(7): 2019-2026.

Fischer, J., G. D. Peterson, et al. (2009). Integrating resilience thinking and optimisation for conservation. *Trends in Ecology & Evolution* 24(10): 549-554.

Folke, C., S. Carpenter, et al. (2004). Regime shifts, resilience, and biodiversity in ecosystem management. *Annual Review of Ecology Evolution and Systematics* 35: 557-581.
Gunderson, L., C. R. Allen, et al., Eds. (2010). *Foundations of ecological resilience*. Washington, DC: Island Press.
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Hamilton, E. H. and S. Haeussler (2008). Modeling stability and resilience after slashburning across a sub-boreal to subalpine forest gradient in British Columbia. *Canadian Journal of Forest Research-Revue Canadienne De Recherche Forestiere* 38(2): 304-316.
Holling, C. S. (1973). Resilience and Stability of Ecological Systems. *Annual Review of Ecology and Systematics* 4: 1-23.
Janssen, M. A., O. Bodin, et al. (2006). Toward a network perspective of the study of resilience in social-ecological systems. Ecology and Society 11(1).
Kahan, J.H., A.C. Allen, and J.K. George. (2009) An operational framework for resilience. *Journal of Homeland Security and Emergency Management* 6(1): Article 83.
Kinzig, A. P., P. Ryan, et al. (2006). "Insight: Exploring resilience in social-ecological systems: Resilience and regime shifts: assessing cascading effects." *Ecology and Society* **11**(1): 20.
Kinzig, A. P., P. Ryan, et al. (2006). Resilience and regime shifts: Assessing cascading effects. *Ecology and Society* 11(1): 23.
Lance, G. H. (2000). Ecological resilience-In theory and application. *Annual Review of Ecology, Evolution and Systematics* 31: 425-439.
Nelson, D. R., W. N. Adger, et al. (2007). Adaptation to Environmental Change: Contributions of a Resilience Framework. *Annual Review of Environment and Resources* 32(1): 395-419.
Simon Brand, F. and K. Jax (2007). Focusing the meaning(s) of resilience: resilience as a descriptive concept and a boundary object. *Ecology and Society* 12(1): 23.
Thrush, S. F., J. E. Hewitt, et al. (2009). Forecasting the limits of resilience: integrating empirical research with theory. *Proceedings of the Royal Society B: Biological Sciences* 276(1671): 3209-3217.
Walker,Brian and David Salt (2006). *Resilience Thinking*: *Sustaining Ecosystems and People in a Changing World.* Washington, DC: Island Press.
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