

ECOLOGY SEMINAR
Zoology 956
Spring Semester 2017

Forest Resilience in a Changing World

Course Description, Syllabus and Reading List

(Version 5 Jan 2017)

INSTRUCTOR:

Dr. Monica G. Turner, Zoology Department, 432 Birge Hall
(Tel: 262-2592; turnermg@wisc.edu)

CREDIT HOURS: 1 credit

MEETING TIME: Meets from 9:30 to 10:45 on Fridays in 447 Birge Hall

COURSE STRUCTURE:

This graduate seminar will follow a conventional format that emphasizes discussion of primary literature. Most class meetings will entail student-led discussion of assigned readings.

COURSE DESCRIPTION AND OBJECTIVES:

The term “resilience” is now widely used in a multiple contexts. Resilience has become prominent term in science as rates of environmental change continue to accelerate and future states of ecosystems become less certain. Resilience has also become a policy goal for forest management in the US and elsewhere. The concept is well developed in ecology, but it remains challenging to operationalize resilience concepts in real-world settings. There is little consensus about how forest resilience should be defined and measured for multiple responses at different spatial and temporal scales; how tipping points can be identified and abrupt changes anticipated; and how forest resilience can be assessed in social-ecological systems. This seminar will provide an in-depth introduction to forest resilience concepts and current research that uses resilience to understand and manage forests. The seminar will follow a conventional format that emphasizes reading and discussion of primary literature. Students must be prepared to read and discuss current literature, lead discussion of assigned readings at least once, and prepare a short talk summarizing what they have learned.

At the end of the semester, each student will present to the class his/her answers to the following questions (detailed instructions will follow):

1. What are three new insights that you learned from the seminar?
2. What are three most important take-home messages about the current state of the science on forest resilience?
3. What are three high-priority research questions or directions for making progress in the next 5-10 years on the topic of forest resilience in a changing world?

GRADING:

Grades will be based on leading (30%) and participating (60%) in class discussion, short unannounced reading quizzes (5%), speed talks (emphasizing synthesis points and future research direction) on the final day of class (5%). Numerical grades are assigned as follows: 92-100 (A), 88-91 (AB), 82-87 (B), 78-81 (BC). Attendance is required, and coming to class having read the assignments and being prepared to discuss is expected.

ABSENCE POLICY:

Attendance expected and is recorded at each class meeting. If you have an *anticipated* absence (e.g., planned conference travel or necessary field work), please let me know before the class that you will miss. If you are *unexpectedly* absent (e.g., illness), please inform me at your earliest convenience.

For classes that are missed, students are responsible for the material that was covered in class and must complete the readings. ***A summary of the assigned readings (one single-space page maximum for each assigned paper) should be submitted before (if possible) but no later than one week after the missed class.*** The summary should include a brief statement of what was covered in the paper, your thoughts on the primary contribution of the paper, any insights that were new for you, and questions that were raised in your mind by the paper.

READING ASSIGNMENTS:

This seminar emphasizes readings from the primary literature, with three papers assigned each week for discussion. ***Everyone is expected to have read the assignments before class and be prepared to discuss the papers.*** Responsibility for leading discussion will be rotated. Discussion leaders should raise questions or issues to be discussed; be prepared with an evaluation of the significant contributions of the paper; and facilitate discussion among the group (see additional notes below). ***Brief unannounced reading quizzes will be administered occasionally.***

PDFs of reading assignments are in Box:

<https://uwmadison.box.com/s/3egxb63xqjc5egqqkcmgn8nrt6sisx0a>

PARTICIPATING IN DISCUSSION:

Discussions are only effective when everyone is prepared and has perspectives to contribute. ***Everyone is expected to have read the assigned articles before class and given thought to the content and context.*** A good strategy for being prepared is to write down a couple of questions or observations about each paper as you are reading it. The class benefits from the diverse interests and backgrounds of the students, and we learn a lot by listening to one another.

LEADING DISCUSSION:

Students will have the opportunity to lead the class discussion of assigned readings. All students will have read the papers prior to class, so discussion leaders should **not** provide a detailed review of the paper. The discussion leader should provide a **very** brief summary of the main topic of the paper, just to remind everyone of which paper is being considered. Here are some tips for being effective at leading discussion.

- i. Summarize for yourself some of the important points about the paper. It's often useful to have a set of questions that you answer while planning discussion. For example, consider the following: What is the main conceptual contribution of the paper? Why might it be important or influential? Is it a representative example? Does it propose a new direction or idea? How does this paper relate to other papers or general concepts with which you are familiar? Are there any new approaches represented? Are there any problems with the study? How does this reflect the current state of the science?
- ii. Prepare in advance some open-ended questions that you can pose to the group to get the discussion going. Remember that questions with a "yes" or "no" answer do not facilitate a discussion! Feel free to call on people if there is silence!
- iii. Keep the discussion moving by including all members of the group (this means calling on reticent members of the group and gently redirecting away from individuals who may dominate the conversation) and by curtailing discussion that goes off into tangents or dead ends.
- iv. Try to summarize and synthesize as things go along. It's often helpful to use a mechanism like, "So far, we've identified the following main contributions of this paper:
....
- v. Be creative! Don't be reticent about trying out new approaches for catalyzing discussion, implementing some active exercises, and the like. Do not feel constrained to repeat the same structure as the classes before yours.

SYLLABUS

Date	Topic	Readings by week
Jan 20	Introduction, overview, logistics	Special feature in <i>Science</i> : • Appenzeller et al. 2015 news article • Lugo 2015 editorial
Jan 27	Context: Changing world	Special feature in <i>Science</i> : • Millar and Stephenson 2015 • Gauthier et al. 2015 • Trumbore et al. 2015
Feb 3	Context: Forest policy	Rist and Moen 2013 Raum and Potter 2015 Bone et al. 2016
Feb 10	Forest resilience concepts	Ghazoul et al. 2015 Newton and Cantarello 2015 Seidl et al. 2016
Feb 17	<i>No class</i>	--
Feb 24	Tipping points	Adams 2013 Staal et al. 2016 Laurance et al. 2011
Mar 3	Feedbacks	Bowman et al. 2015 Lloret et al. 2012 Knox and Clarke 2012
Mar 10	Assessing resilience	Müller et al. 2016 Perry et al. 2015
Mar 17	Forests: Boreal	Johnstone et al. 2010 Walker et al. 2017 Boucher et al. 2014
Mar 24	<i>Spring break</i>	--
Mar 31	Forests: Tropical	Brando et al. 2014 Levine et al. 2016 Staal et al. 2015
Apr 7	Forests: Temperate deciduous	Petritan et al. 2015 Hubbart et al. 2016 Stuart-Haintjemans et al. 2015
Apr 14	Forest social-ecological systems (SES)	Smith et al. 2012 Morzillo et al. 2015 Spies et al. 2014
Apr 21	Forest SES and wildfire	Smith et al. 2016 Alexandre et al. 2015 Waltz et al. 2015
Apr 28	Use and misuse of resilience	Messier et al. 2015 Fares et al. 2015 & Newton 2016 Lindenmeyer et al. 2016
May 5	Insights, research directions	Student/participant presentations

READING LIST

January 20 (Introduction)

- Appenzeller, T. 2015. The new north. *Science* 349:806-809.
Lugo, A. 2015. Forestry in the Anthropocene. *Science* 349:771

January 27 (Context: Changing world)

- Millar, C., and N. L. Stephenson. 2015. Temperate forest health in an era of emerging megadisturbance. *Science* 349: 823–6.
Gauthier, S., P. Bernier, T. Kuuluvainen, A. Z. Shvidenko, and D. G. Schepaschenko. 2015. Boreal forest health and global change. *Science* 349:819-922.
Trumbore, S., P. Brando, and H. Hartmann. 2015. Forest health and global change. *Science* 349: 814-818.

February 3 (Context: Forest policy)

- Rist, L., and J. Moen. 2013. Sustainability in forest management and a new role for resilience thinking. *Forest Ecology and Management* 310:416-427.
Raum, S., and C. Potter. 2015. Forestry paradigms and policy change: The evolution of forestry policy in Britain in relation to the ecosystem approach. *Land Use Policy* 49:462-470.
Bone, C., C. Moseley, K. Vinyeta, and R. P. Bixler. 2016. Employing resilience in the United States Forest Service. *Land Use Policy* 52:430-438.

February 10 (Forest resilience concepts)

- Ghazoul J., Z. Burivalova, J. Garcia-Ulloa, and L. A. King. 2015. Conceptualizing forest degradation. *Trends in Ecology and Evolution* 30: 622–32.
Newton, A. C., and E. Cantarello. 2015. Restoration of forest resilience: an achievable goal? *New Forests* 46:645-668.
Seidl, R., T. A. Spies, D. L. Peterson, et al. 2016. Searching for resilience: addressing the impacts of changing disturbance regimes on forest ecosystem services. *Journal of Applied Ecology* 53:120-129.

February 24 (Tipping points)

- Adams, M. A. 2013. Mega-fires, tipping points and ecosystem services: Managing forests and woodlands in an uncertain future. *Forest Ecology and Management* 294:250-261.
Staal, A., S. C. Dekker, C. Zu, and E. H. van Nes. 2016. Bistability, spatial interaction, and the distribution of tropical forests and savannas. *Ecosystems* 19:1080-1091.
Laurance, W. F., et al. 2011. The 10 Australian ecosystem most vulnerable to tipping points. *Biological Conservation* 144:1472-1480.

March 3 (Feedbacks)

- Bowman, D. M. J. S., G. L. W. Perry, and J. B. Marson. 2015. Feedbacks and landscape-level vegetation dynamics. *Trends in Ecology and Evolution* 30:255-260.
Lloret, F., A. Escudero, J. M. Iriondo, J. Martinez-Vilalta, and F. Valladares. 2012. Extreme climatic events and vegetation: the role of stabilizing processes. *Global Change Biology* 18:797-805.

Knox, K. J. E., and P. J. Clarke. 2012. Fire severity, feedback effects and resilience to alternative community states in forest assemblages. *Forest Ecology and Management* 265:47-54.

March 10 (Assessing resilience)

Müller, F., et al. 2016. Assessing resilience in long-term ecological data sets. *Ecological Indicators* 65:10-43.

Perry, G. L. W., J. M. Wilmschurst, J. Ogden, and N. J. Enright. 2015. Exotic mammals and invasive plants alter fire-related thresholds in southern temperate forested landscapes. *Ecosystems* 18:1290-1305.

March 17 (Forests: Boreal)

Johnstone, J. F., F. S. Chapin III, T. N. Hollingsworth, M. C. Mack, V. Romanovsky, and M. Turetsky. 2010. Fire, climate change and forest resilience in interior Alaska. *Canadian Journal of Forest Research* 40:1302-1312.

Walker, X. J., M. C. Mack, and J. F. Johnstone. 2016. Predicting ecosystem resilience to fire from tree ring analysis in black spruce forests. *Ecosystems* doi: 10.1007/s10021-016-0097-5.

Boucher, Y., P. Grondin, and I. Auger. 2014. Land use history (1840-2005) and physiography as determinants of southern boreal forests. *Landscape Ecology* 29:437-450.

March 31 (Forests: Tropical)

Brando, P. M., et al. 2014. Abrupt increases in Amazonian tree mortality due to drought-fire interactions. *Proceedings of the National Academy of Sciences* 111:6347-6352.

Levine, N. M., et al. 2016. Ecosystem heterogeneity determines the ecological resilience of the Amazon to climate change. *Proceedings of the National Academy of Sciences* 113:793-797.

Staal, A., S. C. Dekker, M. Hirota, and E. H. van Nes. 2015. Synergistic effects of drought and deforestation on the resilience of the south-eastern Amazon rainforest. *Ecological Complexity* 22:65-75.

April 7 (Forests: Temperate deciduous)

Petritan, I. C., B. Commarmot, M. L. Hobi, A. M. Petritan, C. Bigler, I. V. Abrudan, and A. Rigling. 2015. Structural patterns of beech and silver fir suggest stability and resilience of the virgin forest Sinca in the Southern Carpathians, Romania. 2015. *Forest Ecology and Management* 356:184-195.

Hubbart, J. A., R. Guyette, and R.-M. Muzika. 2016. More than drought: Precipitation variance, excessive wetness, pathogens, and the future of the western edge of the eastern deciduous forest. *Science of the Total Environment* 566-567:463-467.

Stuart-Haëntjens, E. J., P. S. Curtis, R. T. Fahey, C. S. Vogel, and C. M. Gough. 2015. Net primary production of a temperate deciduous forest exhibits threshold response to increasing disturbance severity. *Ecology* 96:2478-2487.

April 14 (Forest social-ecological systems)

Smith, J. W., R. L. Moore, D. H. Anderson, and C. Siderelis. 2012. Community resilience in southern Appalachia: A theoretical framework and three case studies. *Human Ecology* 40:341-353.

Morzillo, A. T., C. R. Colocousis, D. K. Munroe, K. P. Bell, S. Martinuzzi, D. B. Van Berkel, M. J. Lechowicz, B. Rayfield, and B. McGill. 2015. "Communities in the middle": Interactions

between drivers of change and place-based characteristics in rural forest-based communities. *Journal of Rural Studies* 42:79-90.

Spies, T. A., E. M. White, J. D. Kline, A. P. Fischer, A. Ager, J. Bailey, J. Bolte, J. Koch, E. Platt, C. S. Olsen, D. Jacobs, B. Shindler, M. M. Steen-Adams, and R. Hammer. 2014. Examining fire-prone forest landscapes as coupled human and natural systems. *Ecology and Society* 19(3): 9.

April 21 (Forest SES and wildfire)

Smith, A. M. S., et al. 2016. The science of fire-scapes: Achieving fire-resilient communities. *BioScience* 66:130-146.

Alexandre, P. M., M. H. Mockrin, S. I. Stewart, R. B. Hammer, and V. C. Radeloff. 2015. Rebuilding and new housing development after wildfire. *International Journal of Wildland Fire* 24:138-149.

Walter, A. E. M., M. T. Stoddard, E. L. Kalier, J. D. Springer, D. W. Huffman, and A. S. Meador. 2014. Effectiveness of fuel reduction treatments: Assessing metrics of forest resiliency and wildfire severity after the Wallow Fire, AZ. *Forest Ecology and Management* 334:43-52.

April 28 (Use and misuse of resilience)

Messier, C., K. Puettmann, R. Chazdon, K. P. Andersson, V. A. Angers, L. Brotons, E. Filotas, R. Tittler, L. Parrott, and S. A. Levin. 2015. From management to stewardship: Viewing forests as complex adaptive systems in an uncertain world. *Conservation Letters* 8:368-377.

Fares, S. 2015. Five steps for managing Europe's forests. *Nature* 519:407-409.

Newton, A. C. 2016. Biodiversity risks of adopting resilience as a policy goal. *Conservation Letters* 9:369-376.

Lindenmayer, D., C. Messier, and C. Sato. 2016. Avoiding ecosystem collapse in managed forest ecosystems. *Frontiers in Ecology and the Environment* 14:561-568.

ADDITIONAL REFERENCES

(good papers that did not make it into the assigned readings)

Alongi, D. M. 2008. Mangrove forests: Resilience, protection from tsunamis, and responses to global climate change. *Estuarine Coastal and Shelf Science* 76:1-13.

Benson, M. H., and A. S. Garmestani. 2011. Can we manage for resilience? The integration of resilience thinking into natural resource management in the United States. *Environmental Management* 48:392-399.

Buma, B., and C. A. Wessman. 2011. Disturbance interactions can impact resilience mechanisms of forests. *Ecosphere* 2:1-13.

Craven, D., E. Filotas, V. A. Angers, and C. Messier. 2016. Evaluating resilience of tree communities in fragmented landscapes: linking functional response diversity with landscape connectivity. *Diversity and Distributions* 22:505-518.

DeRose, R. J., and J. N. Long. 2014. Resistance and resilience: A conceptual framework for silviculture. *Forest Science* 60:1205-1212.

Derroire, G., et al. 2016. Resilience of tropical dry forests – a meta-analysis of changes in species diversity and composition during secondary succession. *Oikos* 125:1386-1397.

- Donato, D. C., B. J. Harvey, and M. G. Turner. 2016. Regeneration of lower-montane forests a quarter-century after the 1988 Yellowstone Fires: a fire-catalyzed shift in lower treelines? *Ecosphere* 7(8) Article e01410.
- Drever, C. R., G. Peterson, C. Messier, Y. Bergeron, and M. Flannigan. 2006. Can forest management based on natural disturbances maintain ecological resilience? *Canadian Journal of Forest Research* 36:2285-2299.
- Enright, N. J., J. B. Fontaine, D. M. J. S. Bowman et al. 2015. Interval squeeze: altered fire regimes and demographic responses interact to threaten woody species persistence as climate changes. *Frontiers in Ecology and the Environment* 13: 265–72.
- Harvey, B. J., D. C. Donato and M. G. Turner. 2016. High and dry: Postfire drought and large stand-replacing burn patches reduce postfire tree regeneration in subalpine forests. *Global Ecology and Biogeography* 25:655-669.
- Hoffman, W. A., E. L. Geiger, S. G. Gotsch, D. R. Rossatto, L. C. R. Silva, et al. 2012. Ecological thresholds at the savanna-forest boundary: how plant traits, resources and fire govern the distribution of tropical biomes. *Ecology Letters* 15:759-768.
- Hughes, T. P. C. Linares, V. Dakos, I. A. van de Leemput, and E. H. van Nes. 2013. Living dangerously on borrowed time during slow, unrecognized regime shifts. *Trends in Ecology and Evolution*. 28:149-155.
- Johnstone, J. F., C. D. Allen, J. F. Franklin, L. E. Frelich, B. J. Harvey, P. E. Higuera, M. C. Mack, R. K. Meentemeyer, M. R. Metz, G. L. W. Perry, T. Schoennagel, and M. G. Turner. 2016. Changing disturbance regimes, climate warming and forest resilience. *Frontiers in Ecology and the Environment* 14:369-378.
- Lenton, T. M., H. Held, E. Kriegler, J. W. Hall, W. Lucht, et al. 2008. Tipping elements in the Earth's climate system. *Proceedings of the National Academy of Sciences* 105:1786-1793.
- Lindenmayer, D. B., R. J. Hobbs, G. E. Likens, C. J. Krebs, and S. C. Banks. 2011. Newly discovered landscape traps produce regime shifts in wet forests. *Proceedings of the National Academy of Sciences* 108:15887-15891.
- Mamet, S. D., K. P. Chun, J. M. Metsaranta, A. G. Barr, and J. F. Johnstone. 2015. Tree rings provide early warning signals of jack pine mortality across a moisture gradient in the southern boreal forest. *Environmental Research Letters* 10:084021.
- Mann, D., T. S. Rupp, M. A. Olson, P. A. Duffy. 2012. Is Alaska's boreal forest now crossing a major ecology threshold? *Arctic, Antarctic, and Alpine Research* 44:319-331.
- Rammer, W., and R. Seidl. 2015. Coupling human and natural systems: Simulating adaptive management agents in dynamically changing forest landscapes. *Global Environmental Change* 35:475-485.
- Reyer, C., P. O., N. Brouwers, A. Rammig, B. W. Brook, J. Epila, et al. 2015. Forest resilience and tipping points at different spatio-temporal scales: approaches and challenges. *Journal of Ecology* 103:5-15.
- Sasaki, T., T. Furukawa, Y. Iwasaki, M. Seto, and A. Mori. 2015. Perspectives for ecosystem management based on ecosystem resilience and ecological thresholds against multiple and stochastic disturbances. *Ecological Indicators* 57:395-408.
- Scheffer, M. A., M. Hirota, M. Holmgren, H. E. Van Nes, and F. S. Chapin III. 2012. Thresholds for boreal biome transitions. *Proceedings of the National Academy of Sciences*. 109:21384-21389.
- Scheffer, M., S. Carpenter, V. Dakos and E. van Nes. 2015. Generic indicators of ecological resilience. *Annual Review of Ecology Evolution and Systematics* 46:145-167.

- Seidl, R. 2014. The shape of ecosystem management to come: Anticipating risks and fostering resilience. *BioScience* 64:1159-1169.
- Stephens, S. L., J. K. Agee, P. Z. Fulé, M. P. North, W. H. Romme, T. W. Swetnam, and M. G. Turner. 2013. Managing forests and fire in changing climates. *Science* 342:41-42.
- Tepley, A. J., T. T. Veblen, G. L. W. Perry, G. H. Stewart, and C. E. Naficy. 2016. Positive feedbacks to fire-driven deforestation following human colonization of the South Island of New Zealand. *Ecosystems* 19:1325-1344.
- Thrush, S., J. Hewitt, P. Dayton, G. Coco, A. M. Lohrer, A. Norkko, J. Norkko, and M. Chiantore. 2009. Forecasting the limits of resilience: integrating empirical research with theory. *Proceedings of the Royal Society B* 282:3209-3217.
- Turner, M. G. 2010. Disturbance and landscape dynamics in a changing world. *Ecology* 91:2833-2849.
- Westerling, A. L., M. G. Turner, E. A. H. Smithwick, W. H. Romme, and M. G. Ryan. 2011. Continued warming could transform Greater Yellowstone fire regimes by mid-21st century. *Proceedings of the National Academy of Sciences* 108:13165-13170.