ADVANCED LANDSCAPE ECOLOGY
Zoology/Forest/Botany 879

Course Description, Spring Semester 2016
[*Version 8 January 2016*]

COURSE WEB PAGE:
http://www.zoology.wisc.edu/courses/879/

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

CREDIT HOURS: 3

LEVEL: Open to graduate students.

PREREQUISITES:
- General Ecology (e.g., Zoo/Bot/For 460 or equivalent) ***is required***.
- Familiarity with landscape ecology (e.g., Principles of Landscape Ecology, For/Zoo/Bot 565 or equivalent) ***is required***.
- Familiarity with statistics is strongly recommended, and some knowledge of geographic information systems (GIS) and simulation modeling is desirable.

CLASS SIZE: Admission limited to 20 students.

MEETING TIME: The course will meet from **8:50 to 10:45 on Wednesdays and Fridays** in Birge Hall, room 158.

OBJECTIVES:
Landscape ecology is a sub-discipline of ecology that emphasizes spatial patterning–its causes, development, and importance for ecological processes. The field has grown tremendously and matured over the past 25 years. Landscape ecology often (but not always) focuses on ecological dynamics over large regions. Students will delve into the current concepts, methods, and applications of landscape ecology through (1) class lectures; (2) reading and discussion of literature reflecting state-of-the-art research in the field; (3) completion of hands-on exercises designed to provide experience with some of the quantitative tools of landscape ecology; (4) one take-home mid-term exam; and (5) completion of an independent research project that allows students to develop or apply these tools and concepts in their own studies.

The Advanced Landscape Ecology course emphasizes the current state-of-the-science of landscape ecology and covers common quantitative methods used in landscape ecology; it is recommended for advanced graduate students who are conducting research in this area and not for students who seek an introduction or general overview of the field. The 2-credit course, Principles of Landscape Ecology (565), taught in alternate springs by Dr. David J. Mladenoff provides an overview of the background and concepts of landscape ecology. The principles course provides an introduction for students who wish to gain familiarity with landscape ecology. ***Knowledge equivalent to what is covered in Principles of***

Landscape Ecology is assumed as the basis for Advanced Landscape Ecology. Students who have no background in landscape ecology should take 565 instead!

COURSE STRUCTURE:
Class meetings will generally include either a lecture followed by student-led discussion of assigned readings, or hands-on computational exercises designed to introduce students to the quantitative methods used in landscape ecology. ***Important: Because UW-Madison no longer makes the computer labs available for classes without a hefty hourly fee, students will need to bring their own laptops to class on Friday lab days. Mac computers should also be configured to run Windows programs, as some programs are written only for PCs.*** There are classes reserved for oral presentations of the independent projects at the end of the semester (those are always fun!)

ABSENCE POLICY:
Attendance 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 and let me know what happened.

For lecture/discussion classes that are missed, students are responsible for the material that was covered in class and for completing the readings. A summary of the assigned readings (one single-spaced page maximum for each assigned paper) should be submitted 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(s) of the paper, any insights that were new for you, and questions that were raised in your mind by the paper. I want your thoughts about the readings, not just a repetition of what the authors wrote.

For labs that are missed, students must still complete the lab exercise and turn in the report. Depending on the timing of the due dates and the travel/illness, the deadline may be extended. Students should check with me and confirm arrangements.

READING ASSIGNMENTS:
This course emphasizes readings from the recent primary literature, and four papers will be assigned each week for discussion. ***Every student is expected to have read the assignments before class and be prepared to discuss the papers; students should anticipate occasional short reading quizzes.*** Responsibility for leading discussion will be rotated among all students. 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 notes below). Readings from the primary literature will be on Learn@UW and can also always be accessed through the electronic collections of the library.

The 2nd edition of LANDSCAPE ECOLOGY IN THEORY AND PRACTICE (Turner and Gardner 2015) will be used as reference for the class. It is available in print and as an eBook from the Springer website. In addition, the library copy is on reserve at Steenbock, and another copy will stay on "local reserve" on the conference table in my lab (430 Birge Hall). You will especially need it for the quantitative chapters.

Turner, M. G., and R. H Gardner. 2015. LANDSCAPE ECOLOGY IN THEORY AND PRACTICE, 2nd edition. Springer, New York.

LEADING DISCUSSION:
Each student will have the opportunity to lead the class discussion of assigned weekly readings. All students will have read the papers prior to class, so discussion leader(s) should **not** provide a detailed review of the paper. The discussion leader(s) should provide a 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: ….

PARTICIPATING IN DISCUSSION:
Discussions are only effective for all when everyone is prepared and has perspectives to contribute. ***Everyone is expected to have read the assignment before class and given thought to the paper's 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. This class benefits tremendously from the diverse interests and backgrounds of the students, and we all learn a lot by listening to one another.

COFFEE AND SNACKS:
Coffee and snacks are key discussion lubricanst for graduate classes that meet in the morning, and we have a tradition of this in the Advanced Landscape Ecology class. Monica will provide coffee and tea; traditionally, we've had each student sign up for a day to bring a snack for each of the non-laboratory classes. Competition for the best tasting treat can be fierce! *Help from the class to set up and to clean up the coffee pot and the room at the end of each class period is encouraged and appreciated*. We are expected to leave the room in better order than we found it. Thanks for your cooperation in this!

LABORATORY EXERCISES:
A set of hands-on exercises will be assigned to provide students with experience in various aspects of landscape ecology, particularly the quantitative analyses and modeling often used in landscape ecology. Labs will take place during Friday class periods (see syllabus for dates). Concise written reports will be turned in for each exercise the following week.

Lab exercises will be from the forthcoming 2nd edition of LEARNING LANDSCAPE ECOLOGY (Gergel and Turner 2016). All lab assignments will be distributed as PDFs via the "My UW" web page, so there is no need to purchase the older book, which was published in 2002.

Gergel, S. E. and M. G. Turner, editors. *In preparation*. LEARNING LANDSCAPE ECOLOGY, 2nd edition. Springer-Verlag, New York.

Make sure ***always to read the lab exercise prior to coming to the class session***. You will not usually complete the lab during the time period, but you'll get going on it. Write-ups must be short—your gain comes from doing the lab and thinking about it, and I don't want to make extra busy work. Rule of thumb should be ~2 pages of prose (typed, single space, but excluding figures, tables and references) unless you are told otherwise. Write-ups are due the following week after the lab was completed. Instructions that are particular for each lab will be given in class.

INDEPENDENT PROJECTS:

Project Objectives: Students will use landscape-level theory or approaches in an area of particular interest to them, thereby allowing them to apply what they are learning to their own research. Ideally, the project provides an opportunity for students to augment their research (e.g., thesis or dissertation work). Students will also gain experience with the primary phases of conducting a research study: preparation of a proposal; execution of the study; preparation of a paper based on the study; and oral presentation of the results in the format suitable for a scientific meeting. All graduate students should have as many opportunities to "practice" all of these aspects of professional science as much as possible!

Topics: Recognizing that there is likely a wide array of interests represented in the class, the choice of topic for the project is not restricted. However, approval of a student's selection is required. Samples of projects might be: (1) analyses of spatial pattern of vegetation or land use in a study landscape; (2) synthesis of literature on how an organism responds to changes in habitat heterogeneity, with development of field-testable hypotheses, recommendations for conservation, or reserve design; (3) development of a model to address an interaction between pattern and process; (4) preparation of a management plan for a large heterogeneous landscape.

Format for Project Proposals: Proposals must be typewritten, double spaced with one-inch margins, with a **2-page maximum length** excluding references. The following should be clear and succinct: Introduction/Background; Question(s); Methods; and Expected Results. Proposals will be due in the fourth week of the semester.

Format for Project Reports: Reports must be double-spaced with one-inch margins, and will be due during finals week. Projects should **not exceed 10 pages** of main-body text excluding the cover sheet, abstract, references, figures, and tables. The format should follow that used for the journal LANDSCAPE ECOLOGY, which is available on the journal's website. Pay careful attention to ALL details in the instructions to authors (which you must do any time you submit your own manuscript for publication.)

Guidelines for Oral Presentations: Presentations should be 10 minutes in length, to be followed by a 5-minute question period. You should always time your talk in advance, as you would in preparation for a presentation at a scientific meeting. You may use Powerpoint. Make your presentation as you would for a scientific meeting; that is, provide general context, clearly state the question, describe your methods,

present results, and draw conclusions. Presentations will be done in class during the final two weeks of the semester. The 'audience' will also provide feedback to each presenter.

Due Dates: See course syllabus for due dates for project proposals, final papers, and presentation dates.

GRADING:
Grades will be based on the laboratory exercises (40%), class participation and leading discussion (10%), take-home midterm exam (15%), and the final project (35% total: oral presentation 5%, written report 30%). Generally, numerical grades are assigned as follows: 92-100 (A), 88-91 (AB), 82-87 (B), 78-81 (BC).

ADVANCED LANDSCAPE ECOLOGY
Syllabus, Spring 2016

Wednesdays (8:50-10:45): Lecture + discussion of readings from the recent primary literature
Fridays (8:50-10:45): Generally a lab exercise
Classes meet in 158 Birge Hall (all the way to the left [east] off the main 1st floor lobby).

Dates	Topics, labs (blue), due dates (red)	Text chap.	Discussion readings or Lab
Wed Jan 20	Course overview and logistics	--	--
Fri Jan 22	Scope of landscape ecology; foundations and scale concepts	1	McIntyre et al. 2013, Eros and Campbell Grant 2015, Jelinski 2015, Jenerette and Shen 2012
Wed Jan 27	Causes of landscape pattern	2	Phillips 2007, Jackson 2006, Lawler et al. 2015, Boucher et al. 2014,
Fri Jan 29	Lab #1 *Introduction to Markov models*	--	Urban; also see Takada et al. 2010
Wed Feb 3	Quantifying pattern I: why, data and errors, caveats, start metrics	4	Li and Wu 2004, Cushman et al. 2008, Wedding et al. 20011, Simova and Gdulova 2012
Fri Feb 5	Lab #2, *Understanding landscape metrics, part 1* *Lab #1 write up due.*	--	Cardille & Turner
Wed Feb 10	Quantifying pattern II: landscape metrics and interpretation; using multiple metrics	4	Burnicki 2012, Eigenbrod et al. 2011, Remmel and Csillag 2003, Kupfer 2012
Fri Feb 12	Lab #2, continued *Independent project proposals due.*	--	Cardille & Turner
Wed Feb 17	Spatial statistics: what, why and how	5	Gundale et al. 2006, Vasquez et al. 2012, Anderson et al. 2013, McGuire et al. 2014
Fri Feb 19	Lab #3, *Scale detection using semivariograms and autocorrelograms* *Lab #2 write up due.*	--	Palmer
Wed Feb 24	Landscape models: spatial models and neutral landscape models	3	Gardner and Urban 2007, Gustafson 2013, Keane et al. 2015, Daniel and Frid 2012
Fri Feb 26	Lab #4, *Neutral landscape models* *Lab #3 write up due.*	--	Gardner

Wed Mar 2	Landscape scenarios and ecosystem services	9 (pp 347-376)	Gagne et al. 2015, Eigenbrod et al. 2011, Byrd et al. 2015, Blank et al. 2016
Fri Mar 4	Lab #5, *PEWI web game for land-use decision making* *Lab #4 write up due.*	--	People in Ecosystems Watershed Integration (PEWI)
Wed Mar 9	Disturbance and landscapes I: reciprocal pattern-process, thresholds, interactions *[Take-home midterm distributed]*	6	Paritsis et al. 2013, Meentemeyer et al. 2012, Parks et al. 2015, Hessburg et al. 2015
Fri Mar 11	Lab #6, *Disturbance and landscape structure, part I* *Feedback on Lab #5 due*	--	Turner & Simard
Wed Mar 16	Disturbance and landscapes II: management and historical range of variability	6	Pickell et al. 2013, Duncan et al. 2010, Seidl et al. 2014, Bowman et al. 2015
Fri Mar 18	Lab #6, cont'd *Midterm exam due.*	--	Turner & Simard
Mar 21-Mar 25	**Spring Break – No classes!**	**--**	**--**
Wed Mar 30	Organisms and landscape pattern I	7	Villard and Metzger 2014, Driscoll et al. 2013, McCune and Vellend 2016, Saura et al. 2014
Fri Apr 1	Lab #7, *Landscape connectivity and network analysis* *Lab #6 write up due.*	--	Lookingbill & Minor
Wed Apr 6	Organisms and landscape pattern II	7	Hall and Beisinger 2014, Jackson and Fahrig 2014, Martin et al. 2013, Thaker et al. 2011
Fri Apr 8	Lab #8, *Advances in quantifying landscape connectivity* *Lab #7 write up due.*	--	Saura et al.; also see Saura et al. 2011
Wed Apr 13	Ecosystem processes	8	Massol et al. 2011, Murray et al. 2014, Cheruvilil et al. 2013, Buffam et al. 2011
Fri Apr 15	Lab #9, *Heterogeneity in ecosystem services* *Lab #8 write up due.*	--	Kirby et al.
Wed Apr 20	Landscape management and sustainability	--	Wiens 2013, Lindenmayer and Cunningham 2013, Del Castillo 2015, Renard et al. 2015
Fri Apr 22	Future directions in landscape ecology *Lab #9 write up due.*	10	Groffman et al. 2014, Turrini and Knop 2015, Hahn et al. 2014, Heffernan et al. 2014

Wed Apr 27	Student presentations	--	TBA
Fri Apr 29	Student presentations	--	TBA
Wed May 4	Student presentations	--	TBA
Fri May 6	Student presentations	--	TBA
Mon May 9	*Final written project report due by 4:00 pm CDT in hard copy.*	--	

ADVANCED LANDSCAPE ECOLOGY (879)
Readings, Spring 2016

TEXT

Turner, M. G. and R. H. Gardner. 2015. LANDSCAPE ECOLOGY IN THEORY AND PRACTICE, 2nd edition. Springer-Verlag, New York. (*See syllabus for chapter assignments*.)

WEEKLY DISCUSSION READINGS

Friday, January 22 – Scope of landscape ecology, conceptual issues, scale, foundations

McIntyre, N. E., L. R. Iverson, and M. G. Turner. 2013. A 27-yr perspective on landscape ecology from the US-IALE annual meeting. (Editorial) Landscape Ecology 28:1845-1848. *[Short, entertaining (perhaps?) editorial on trends in US-IALE meetings.]*

Eros, T., and E. H. Campbell Grant. 2015. Unifying research on the fragmentation of terrestrial and aquatic habitats: patches, connectivity and the matrix in riverscapes. Freshwater Biology 60:1487-1501. *[Landscape ecology is not all "land;" the concepts developed in landscape ecology are also applied in aquatic and marine systems. This paper talks generally about landscape ecology concepts and applications, but in a different system.]*

Jelinski, D. E. 2015. On a landscape ecology of a harlequin environment: the marine landscape. (Editorial) Landscape Ecology 30:1-6. [*Another treatment of landscape ecology concepts from a non-terrestrial viewpoint.]*

Jenerette, G. D., and W. Shen. 2012. Experimental landscape ecology. Landscape Ecology 27:1237-1248. [*Nice overview of the role of experimentation in landscape ecology, and a good theme to keep in mind throughout the semester*.]

Wednesday, January 27 – Causes of landscape pattern

Background:

Hermy, M. and K. Verheyen. 2007. Legacies of the past in the present-day forest biodiversity: a review of past land-use effects on forest plant species composition and diversity. Ecological Research 22:361-271. *[There is a large and fascinating body of European work focused on the very long-term legacies of historical land use on contemporary ecosystems, and this review provides an excellent entrée into that literature. Some studies have even documented land-use legacies that date back 1000 yrs to land use during Roman occupation!]*

For discussion:

Phillips, J. D. 2007. The perfect landscape. Geomorphology 84:159-169. [*Really interesting conceptual paper that makes the point that every landscape is unique, and many contingencies lead to the development of any particular landscape pattern*.]

Jackson, S. T. 2006. Vegetation, environment and time: the origination and termination of ecosystems. Journal of Vegetation Science 17:547-557. [*Good thinking on long-term change and links to paleoecology*.]

Lawler, J. J., D. D. Ackerly, C. M. Albano, M. G. Anderson, S. Z. Dobrowski, J. L. Gill, N. E. Heller, R. L. Pressey, E. W. Sanderson, and S. B. Weiss. 2015. The theory behind, and the challenges of, conserving nature's stage in a time of rapid change. Conservation Biology 29:618-629. [*Nice*

synthesis of multiple factors that drive species assemblages and are themselves changing; addresses a shifting template and requires a landscape perspective.]

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. *[Example of an empirical study that evaluates causes of landscape pattern, here the distribution of forest age structure and species composition.]*

Wednesday, February 3 Quantifying pattern I

Good background (highly recommended):

Li, H., and J. F. Reynolds. 1995. On definition and quantification of heterogeneity. Oikos 73:280-284. *[Nice conceptual treatment of heterogeneity; older paper, but good food for thought on what is being quantified.]*

Gustafson, E. J. 1998. Quantifying landscape spatial pattern: What is the state of the art? Ecosystems 1:143-156. [*Relatively recent article addressing spatial analyses recognizing both categorical and continuous measures.]*

For discussion:

Li, H. and J. Wu. 2004. Use and misuse of landscape indices. Landscape Ecology 19:389-399. *[Synthesis of issues associated with quantifying landscape patterns.]*

Cushman, S. A., K. McGarigal, and M. C. Neel. 2008. Parsimony in landscape metrics: strength, universality and consistency. Ecological Indicators 8:691-703. *[Addresses the correlations among metrics and unique contributions of different kinds.]*

Wedding, L. M., C. A. Lepczyk, S. J. Pittman, A. M. Friedlander and S. Jorgensen. 2011. Quantifying seascape structure: extending terrestrial spatial pattern metrics to the marine realm. Marine Ecology Progress Series 427:219-232. [*Applications are not only terrestrial!*]

Símová, P. and K. Gdulová. 2012. Landscape indices behavior: A review of scale effects. Applied Geography 34:385-394. [*There are a fair number of empirical papers documenting the consequences of changing grain and extent on landscape metrics, and this paper provides an overview*.]

Wednesday, February 10 – Quantifying pattern II

Burnicki, A. C. 2012. Impact of error on landscape pattern analyses performed on land-cover change maps. Landscape Ecology 27:713-729. [*Accuracy of the data used in any landscape analysis will influence the results, and this is especially important when you want to quantify how landscapes change over time*.]

Eigenbrod, F., S. J. Hecnar and L. Fahrig. 2011. Sub-optimal study design has major impacts on lanscape-scale inference. Biological Conservation 144:298-305. [*Lays out practical issues associated with using landscape metrics as predictors*]

Remmel, T. K. and F. Csillag. 2003. When are two landscape pattern indices significantly different? Journal of Geographical Systems 5:331-351. [*Addresses the key issue of statistical significance when comparing metrics, which has been problematic in many studies*.]

Kupfer, J. A. 2012. Landscape ecology and biogeography: Rethinking landscape metrics in a post-FRAGSTATS landscape. Progress in Physical Geography 36:400-420. [*Nice paper for synthesis points and discussion of metrics based on network theory*.]

Wednesday, February 17 – Spatial statistics

Gundale, M. J., K. L. Metlen, C. E. Fiedler and T. H. DeLuca. 2006. Nitrogen spatial heterogeneity influences diversity following restoration in a ponderosa pine forest, Montana. Ecological Applications 16:479-489. [*Uses spatial statistics to relate resource heterogeneity to plant community patterns*.]

Vasquez, G. M., S. Grunwald and D. B. Myers. 2012. Associations between soil carbon and ecological landscape variables at escalating spatial scales in Forida, USA. Landscape Ecology 27:355-367. [*Geostatistics are increasingly used to quantify spatial heterogeneity in soil attributes*.]

Anderson, D. P., M. G. Turner, S. M. Pearson, T. P. Albright, R. K. Peet and A. Wieben. 2013. Predicting *Microstegium vimineum* invasion in natural plant communities of the southern Blue Ridge Mountains, USA. Biological Invasions 15:1217-1230. [*Example of how spatial autocorrelation in the residuals of an analysis that includes many environmental co-variates can be informative about landscape dynamics, here an incipient invasion process*.]

McGuire, K. J., C. E. Torgersen, G. E. Likens, D. C. Buso, W. H. Lowe, and S. W. Bailey. 2014. Network analysis reveals multiscale controls on streamwater chemistry. Proceedings of the National Academy of Sciences 111:7030-7035. [*Uses spatial statistics to explore land-water relationships in a stream network setting*.]

Wednesday, February 24 – Landscape models

Good background (highly recommended):

Strayer D. L., H. A. Ewing and S. Bigelow. 2003. What kind of spatial and temporal details are required in models of heterogeneous systems? *Oikos* 102:654-62. [*Excellent treatment of the issues associated with introducing spatial complexity into models*.]

For discussion:

Gardner, R. H., and D. L. Urban. 2007. Neutral models for testing landscape hypotheses. Landscape Ecology 22:15-29. [*Gardner was lead author of the original neutral landscape model paper; this is a nice summary of the current state of those models, which you will run in lab*.]

Gustafson, E. J. 2013. When relationships estimated in the past cannot be used to predict the future: using mechanistic models to predict landscape ecological dynamics in a changing world. Landscape Ecology 28:1429-1437. *[Commentary by a forest landscape ecologist who has been developing and applying spatial models. This is really important to consider as scientists try to model no-analog future conditions.]*

Keane, R. E., D. McKenzie, D. A. Falk, E. A. H. Smithwick, C. Miller, and L-K B. Kellogg. 2015. Representing climate, disturbance and vegetation interactions in landscape models. Ecological Modelling 309-310:33-47. [*Nice review of landscape models in context of a current/timely topic in landscape modeling and management.]*

Daniel, C. J., and L. Frid. 2012. Predicting landscape vegetation dynamics using state-and-transition simulation models. Proceeding of the First Landscape Stand-and-Transition Simulation Modeling Conference. USFS General Technical Report PNW-GTR-869. [*State-and-transition models are another type of simulation model that can be used for landscape projections*.]

Wednesday, March 2 – Landscape scenarios and ecosystem services

Gagne, S. A., F. Eigenbrod, D. G. Bert, G. M. Cunnington, L. T Olson, A. C. Smith, and L. Fahrig. 2015. A simple landscape design framework for biodiversity conservation. Landscape and Urban

Planning 136:13-27. [*Current example of how researchers (and managers) are using quantitative landscape analyses and models for landscape planning and design.]*

Eigenbrod, F., V. A. Bell, H. N Davies, A. Heinemeyer, P. R. Armsworth and K. J. Gaston. 2011. The impact of projected increases in urbanization on ecosystem services. Proc. Roy. Soc. B 278:3201-3208. [*Uses two contrasting landscape scenarios of urbanization, densification vs. sprawl in the UK, through 2031, then evaluates their implications for selected ecosystem services. Illustrates the approach of looking at each extreme to see where differences may lie, rather than a complex set of alternatives. Good first step to take in many studies*.]

Byrd, K. B., L. E. Flint, P. Alvarez, C. F. Casey, B. M. Sleeter, C. E. Soulard, A. L. Flint, and T. L. Sohl. 2015. Integrated climate and land-use change scenarios for California ecosystem services: wildlife habitat, soil carbon, and water supply. Landscape Ecology 30:729-750. [*West-coast example of comparing among different landscape scenarios to anticipate supply of a set of ecosystem services under alternate conditions*.]

Blank, P. J., C. L. Williams, D. W. Sample, T. D. Meehan, and M. G. Turner. 2016. Alternative scenarios of bioenergy crop production in an agricultural landscape and implications for bird communities. Ecological Applications (In press). [*Wisconsin-based example of quantitative landscape scenarios in which landscape composition and configuration are varied, and ecosystem services are considered along with biodiversity responses (grassland birds).]*

Wednesday, March 9 – Disturbance and landscapes I

Paritsis, J., A. Holz, T. T. Veblen, and T. Kitzberger. 2013. Habitat distribution modeling reveals vegetation flammability and land use as drivers of wildfire in SW Patagonia. Ecosphere DOI: 10.1890/ES12-00378.1. [*Vulnerability to disturbance may vary with landscape position; this paper considers a variety of independent variables that may aid spatial prediction of probability of fire occurrence*.]

Meentemeyer, R. K., S. E. Haas, and T. Vaclavik. 2012. Landscape epidemiology of emerging infectious diseases in natural and human-altered ecosystems. Annual Review of Phytopathology 50:379-402. [*Landscape or spatial epidemiology has emerged as an interesting area of research that overlaps with landscape ecology and disturbance*.]

Parks, S. A., L. M. Holsinger, C. Miller, and C. R. Nelson. 2015. Wildland fire as a self-regulating mechanism: the role of previous burns and weather in limiting fire progression. Ecological Applications 25:1478-1492. [*Effects of landscape pattern on the spread of disturbance, as well as how disturbances interact on the landscape, are long-standing themes in landscape ecology*.]

Hessburg, P. F., D. J. Churchill, A. J. Larson, R. D. Haugo, C. Miller, T. A. Spies, M. P. North, N. A. Povak, R. T. Belote, P. H. Singleton, W. L. Gaines, R. E. Keane, G. H. Aplet, S. L. Stephens, P. Morgan, P. A. Bisson, B. E. Rieman, R. B. Salter, and G. H. Reeves. 2015. Restoring fire-prone Inland Pacific landscapes: seven core principles. Landscape Ecology 30:1805-1835. [*Thoughtful paper focused on landscape-level prescriptions for restoration planning*.]

Wednesday, March 16 – Disturbance and landscapes II

Background:

Fraterrigo, J. M. and J. A. Rusak. 2008. Disturbance-driven changes in the variability of ecological patterns and processes. Ecology Letters 11:756-770. [*Nice conceptual treatment focused on gaining insights from variability, along with practical guidance on how to assess it*.]

For discussion:

Pickell, P. D., D. W. Andison, and N. C. Coops. 2013. Characterizations of anthropogenic disturbance patterns in the mixedwood boreal forest of Alberta, Canada. Forest Ecology and Management 304:245-253. [*Evaluates forest landscapes relative to attempts to mimic natural disturbances and remain within the HRV*.]

Duncan, S. L., B. C. McComb, and K. N. Johnson. 2010. Integration ecological and social ranges of variability in conservation of biodiversity: past, present, and future. Ecology and Society Vol15/iss1/art5/. [*Adds the social part of the equation to the HRV concept*.]

Seidl, R., W. Rammer, and T. A. Spies. 2014. Disturbance legacies increase the resilience of forest ecosystem structure, composition, and functioning. Ecological Applications 24:2063-2077. [*Uses a spatially explicit simulation model to evaluate effects of different proportions of study landscape in remnant patches on vegetation trajectories. Considers stand and landscape-level responses*.]

Bowman, D. M. J. S., G. L. W. Perry, and J. B. Marston. 2015. Feedbacks and landscape-level vegetation dynamics. TREE 30:255-260. [*Feedbacks on the landscape between post-disturbance vegetation and future disturbance occurrence/severity is a hot topic*.]

Wednesday, March 30 – Organisms and landscapes I

Background reading (great FYI for those interested in these topics):

Fahrig L. 2003. Effects of habitat fragmentation on biodiversity. Annual Review of Ecology, Evolution and Systematics 34:487-15. [*Classic reference on relative importance of habitat area vs. configuration (i.e., loss vs. fragmentation); also, there are many excellent publications from Fahrig and her students that include modeling and empirical study and a large variety of taxa.]*

Thornton, D. H., L. C. Branch and M. E. Sunquist. 2011. The influence of landscape, patch, and within-patch factors on species presence and abundance: a review of focal patch studies. Landscape Ecology 26:7-18. *[Excellent review of published studies, highlights importance of study design.]*

Fahrig, L., J. Baudry, L. Brotons, F. G. Burel, T. O Crist, R. J. Fuller, C. Sirami, G. M. Siriwardena and J.-L. Martin. 2011. Functional landscape heterogeneity and animal biodiversity in agricultural landscapes. Ecology Letters 14:101-112. [*Considers quantifying landscape pattern for a given purpose, and does a nice job describing structural vs. functional connectivity. This is a key distinction – landscape structure does not equate to how an organism uses the landscape*.]

For discussion:

Villard, M.-A., and J. P. Metzger. 2014. Beyond the fragmentation debate: a conceptual model to predict when habitat configuration really matters. Journal of Applied Ecology 51:309-318. [*On ongoing issue remains – is it landscape composition or configuration that is important? When does fragmentation per se matter? Recent follow up to ideas in Fahrig 2003*.]

Driscoll, D. A., S. C. Banks, P. S. Barton, D. B. Lindenmayer, and A. L. Smith. 2013 Conceptual domain of the matrix in fragmented landscapes. TREE 28:605-613. [*Interesting because of the emphasis on the matrix, which is sometimes overlooked when focus is on habitat patches.]*

McCune J. L. and M. Vellend. 2016. Using plant traits to predict the sensitivity of colonizations and extirpations to landscape context. Oecologia 178:511-524. [*Landscape ecology has long focused on how composition and configuration affect species or guilds; the recent emphasis on plant traits offers additional response variables to consider in analyses. This study also illustrate effects of landscape context*.]

Saura S., O. Bodin, and M.-J. Fortin. 2014. Stepping stones are crucial for species' long-distance dispersal and range expansion through habitat networks. Journal of Applied Ecology 51:171-182.

[*Network analysis and methods for assessing or restoring habitat connectivity for different species continues to get attention, especially in highly modified settings. This also illustrates an application of the network approaches we will explore in lab.*]

Wednesday, April 6 – Organisms and landscapes II (landscape genetics; species interactions)

Background reading:

Manel, S. and R. Holderegger. 2013. Ten years of landscape genetics. TREE 28:614-621. [*Landscape genetics has become a big deal with lots of potential remaining. This literature has grown tremendously, and the application of molecular techniques to understand species distributions and migration patterns, or to assess local selective forces, is very promising.]*

Dormann, C. F., O. Schweiger, I. Augenstein and many others. 2007. Effects of landscape structure and land-use intensity on similarity of plant and animal communities. Global Ecology and Biogeography 16:774-787. [*Example of recent studies moving beyond single-species analysis to consider communities.*]

Tscharntke, T., J. M. Tylianakis, T. A. Rand, R. K. Didham, L. Fahrig, et al. 2012. Landscape moderation of biodiversity patterns and processes – eight hypotheses. Biological Reviews 87:661-685. [*Synthesizing landscape effects on biodiversity, good ideas within!*]

For discussion:

Hall, L. A., and S. R. Beisinger. 2014. A practical toolbox for design and analysis of landscape genetics studies. Landscape Ecology 29:1487-1504. [*It is important to be aware of the capabilities offered by landscape genetics studies.*]

Jackson, N. D. and L. Fahrig. 2014. Landscape context affects genetic diversity at a much larger spatial extent than population abundance. Ecology 95:871-881. [*Nice integration of landscape genetics, population abundance, and scale.*]

Martin, E. A., B. Reineking, B. Seo, and I. Steffan-Dewenter. 2013. Natural enemy interactions constrain pest control in complex agricultural landscapes. Proceedings of the National Academy of Sciences 110:5534-5539. [*Landscape research on species interactions has been growing. This is an interesting study demonstrating effects of landscape complexity on the interactions between different natural enemies; also demonstrates an experimental approach.*]

Thaker, M., A. T. Vanak, C. R. Owen, M. B. Ogden, S. M. Niemann and R. Slotow. 2011. Minimizing predation risk on a landscape of multiple predators: effects on the spatial distribution of African ungulates. Ecology 92:398-407. [*Paper on how spatial heterogeneity influences pred-prey interaction in an African landscape with multiple predators and multiple prey.*]

Wednesday, April 13 – Ecosystem processes

Massol, F., D. Gravel, N. Mouquet, M. W. Cadotte, T. Fukami and M. A. Liebold. 2011. Linking community and ecosystem dynamics through spatial ecology. Ecology Letters 14:313-323. [*Conceptual paper attempting to bridge distinct avenues of inquiry.*]

Murray, B. D., C. R. Webster, and J. K. Bump. 2014. A migratory ungulate facilitates cross-boundary nitrogen transport in forested landscapes. Ecosystems 17:1002-1013. [*Animals are often vectors of nutrient movements across heterogeneous landscapes, affecting heterogeneity of nutrient pools and transformations.*]

Cheruvelil, K. S., P. A. Soranno, K. E. Webster, and M. T. Bremigan. 2013. Multi-scaled drivers of ecosystem state: quantifying the importance of the regional spatial scale. Ecological Applications

23:1603-1618. [*A lot of work has been conducted on understanding landscape effects on surface waters and the scales and predictors of variation among lakes*.]

Buffam, I., M. G. Turner, A. Desai, P. J. Hanson, J. Rusak, N. Lottig and S. R. Carpenter. 2011. Integrating aquatic and terrestrial components to construct a complete carbon budget for a north temperate lake district. Global Change Biology 17:1193-1211. [*Example of building a regional budget that includes all major ecosystem types; focus here is on spatial heterogeneity of vertical fluxes*.]

Wednesday, April 20 —Landscape management and sustainability

Background reading:

Turner, B. L., II, and P. Robbins. 2008. Land-change science and political ecology: similarities, differences and implications for sustainability science. Annual Review of Environmental Resources 33:295-316. [*Great review that compares what we typically think of in landscape ecology with a social-science perspective*.]

For discussion:

Wiens, J. A. 2013. Is landscape sustainability a useful concept in a changing world? Landscape Ecology 28:1047-1052. [*John Wiens has been a leading thinker for >40 yrs, and these are some of his current thoughts*.]

Lindenmayer, D. B. and S. A. Cunningham. 2013. Six principles for managing forests as ecologically sustainable ecosystems. Landscape Ecology 28:1099-1110. [*Lindenmayer has done a lot of excellent and creative work; this conceptual paper nicely highlights lessons from landscape ecology for forest landscape management*.]

Del Castillo, R. F. 2015. A conceptual framework to describe the ecology of fragmented landscapes and implications for conservation and management. Ecological Applications 25:1447-1455. [*More thoughts on managing "working landscapes" and addressing tradeoffs*.]

Renard, D., J. M. Rhemtulla, and E. M. Bennett. 2015. Historical dynamics in ecosystem service bundles. Proceedings of the National Academy of Sciences 112:13411-13416. [*Nice study integrating land-use change, supply of ecosystem services, and consideration of variation over both space and time in a mixed-use landscape. These issues are fundamental to studies of landscape sustainability*.]

Friday, April 22 – Future directions in landscape ecology

Groffman, P. M., and many others. 2014. Ecological homogenization of the urban USA. Frontiers in Ecology and the Environment 12:74-81. [*Urban landscape ecology offers many opportunities for landscape ecologists to contribute to understanding how spatial patterns change, and how patterns in the urban landscape influence ecological processes*.]

Turrini, T., and E. Knop. 2015. A landscape ecology approach identifies important drivers of urban biodiversity. Global Change Biology 21:1652-1667. [Pattern-process interactions can be explored in urban settings; here the focus is on biodiversity.]

Hahn, M. B., E. S. Gurley, J. E. Epstein, M. S. Islam, J. A. Patz, P. Daszak, and S. P. Luby. 2014. The role of landscape composition and configuration on *Pteropus giganteus* roosting ecology and Nipah virus spillover risk in Bangladesh. American Journal of Tropical Medicine and Hygiene 90:247-255. [*The intersection of landscape ecology and human health issues, including infectious diseases, is an exciting interdisciplinary frontier. Again, lots of opportunity to explore these new dimensions!]*

Heffernan, J. B. and many others. 2014. Macrosystems ecology: understanding ecological patterns and processes at continental scales. Frontiers in Ecology and the Environment 12:5-14. [*Macrosystems ecology builds quite a bit on foundations of landscape ecology, including scaling issues and studies of large areas. Macrosystems is on the rise as NEON data come online and agencies like NSF emphasize continental-scale ecology. Where does landscape ecology fit in?*]