ESM 215 - Landscape Ecology, Winter 2015

Ben Best

Mar 9, 2014

Contents

Logistics

- Instructor: Ben Best (bbest@nceas.ucsb.edu)
- Meeting times and locations, from January 5th to March 12th, 2015.
  - Lecture: Tuesdays 2:30 - 3:45 in Bren Hall 1424 (classroom)
  - Lab: Thursdays 2:30 - 3:45 in Bren Hall 3035 (GIS lab)

  - Office hours: Tuesdays noon - 2pm in GIS lab or Bren 3524

- Required textbook:

  Turner, M. G., Gardner, R. H., & O'Neill, R. V. (2001). *Landscape Ecology in Theory and Practice: Pattern and Process.* New York: Springer.

Overview

> The real voyage of discovery consists not in seeking new landscapes, but in seeing with new eyes.
> – Marcel Proust

Rather than cataloguing the variety of landscapes or ecosystems on earth, the field of Landscape Ecology (LE) provides methods to describe the interaction between spatial patterns and ecological processes for any landscape. We'll begin our "voyage of discovery" into this unique geographic perspective by exploring scaling issues, causal agents (physical, biotic and human) and metrics to quantify landscape pattern. Landscapes are hardly static, so understanding disturbance regimes and impacts is essential. Then we'll build up from habitats of individual species and connectivity across the landscape, to a multi-species community perspective, culminating in evaluating conservation plans that integrate LE concepts. Finally we'll review unique LE applications across disperate ecosystems, including seascapes and soundscapes.

Format

Our two weekly meeting times will be broken into lecture on Tuesdays in Bren Hall 1424 and labs on Thursdays in the GIS lab.

Lectures and Readings

Lectures (other than the first) will begin with a brief quiz on the assigned readings from the primary literature (not the textbook chapters). For the last 15 minutes of lecture, these assigned readings will be discussed. Discussions are to be led by one student per reading who will posit questions to the class, with the possibility of using visual aids (eg PowerPoint presentation). It is encouraged to highlight strengths and weaknesses in the paper, while providing contextual relevance to landscape ecology fundamentals and modern conservation applications. Students assigned to a reading can suggest an alternate reading up to a week before the lecture. In order to be approved it must be relevant to that week's lecture topic and be of sufficient quality.

For the remainder of lecture I will present concepts and examples from the textbook and primary literature, welcoming questions and comments throughout for a conversational tone.

Labs and Group Project

Weekly labs will apply analytical techniques towards Santa Barbara County as the backyard study area, and relate concepts from the preceding lecture. The first two labs will orient you to ArcGIS and R while conducting tasks related to assessing and forecasting landcover. I will provide introductions to these software. Those with past experience are encouraged to help their neighbor with less experience navigate the software (but not complete the assignment). Each student will build distribution and connectivity models for different species, all of which will be collated for use in the community lab.

The final conservation planning lab will be conducted as a group project. Each group will present on a different objective in the final lab meeting and turn in a report by the end of the following week.

During our scheduled Thursday lab sessions and besides the final lab reserved for presentation of group projects, I will introduce labs briefly, leaving as much time as possible to work through instructions and provide hands-on help. Colored stickies slapped to the top of a monitor will let you quietly flag whether you need help (red) or successfully completed a given step (green). Labs are due the following Wednesday at noon.

Field Trip

An optional weekend day trip to northern Santa Barbara County will allow us to seek these LE patterns and processes in the field. You'll get extra credit for attending and are encouraged to further sign up as a field guide by choosing a topic (geology, fire, birds, trees, etc), creating a one page field guide specific to Santa Barbara county and highlight objects on site.

In the modern vein of citizen science and crowd sourcing, expect to digitally record species observations via GPS enabled camera (ie smartphone) for submission to iNaturalist. Might enlist a quadcopter drone to capture aerial photography for comparison with satellite data.

Grading

item	points (% total)	#	total (% total)
present reading	5 (4%)	1	5 (4%)
quizzes	3 (2%)	9	27 (20%)
labs	10 (8%)	8	80 (61%)
group project	20 (15%)	1	20 (15%)

Extra credit points:

- field trip: +3
- field guide: +3

Makeup

Please notify me if you cannot attend or arrive late to a lecture. To make up points for the quiz, you will need to provide a summary of the readings and textbook chapters within the following week. You should define key concepts and present overall results, and it must be limited to 1 page. Outline form is acceptable.

Schedule

1. Introduction

Jan 4	*Lecture*	Introduction to Landscape Ecology: history, overview
Jan 6	*Lab*	Touring landcover using ArcGIS

2. Scale

Jan 13	*Lecture*	Scaling issues in space and time
.	*Readings*	(Chave, 2013; D. L. Urban, O'Neill, & Shugart, 1987; Wiens, 1989) [Turner ch 1 & 2]
Jan 15	*Lab*	Landuse change over time using a Markov model in R

3. Agents

Jan 20	*Lecture*	Agents of landscape pattern: physical, biotic, human
.	*Readings*	(Davis, Dozier, & others, 1990; Swanson, Kratz, Caine, & Woodmansee, 1988; Wu, 2013) [Turner ch 4]
Jan 22	*Lab*	Physical controls on landscape vegetation using ArcGIS

4. Metrics

Jan 27	*Lecture*	Landscape metrics: geostatistics, fractals, percolation theory, neutral models, fragmentation processes
.	*Readings*	(Li & Wu, 2004; Swanson et al., 1988; Watt, 1947) [Turner ch 5 & 6]
Jan 29	*Lab*	Measuring edge effects in the landscape using FragStats

5. Disturbance

Feb 3	*Lecture*	Disturbance regimes: processes, succession and metrics
.	*Readings*	(Reice, 1994; Romme, Turner, Wallace, & Walker, 1995; Scheller & Mladenoff, 2007) [Turner ch 7]
Feb 5	*Lab*	Simulating fire regimes on forests using LANDIS

6. Species

Feb 10	*Lecture*	Organisms and landscape pattern: habitat selection, species distribution modeling
.	*Readings*	(J. Elith & Leathwick, 2009; Guisan et al., 2013; Robinson et al., 2011) [Turner ch 3 & 8]
Feb 12	*Lab*	Species distribution modeling using Maxent

7. Connectivity

Feb 17	*Lecture*	Connectivity of organisms in the landscape: species dispersal, metapopulation source-sink dynamics, graph theory, landscape genetics, agent-based models
.	*Readings*	(McRae, Dickson, Keitt, & Shah, 2008; D. L. Urban, Minor, Treml, & Schick, 2009; With & King, 2001) [Turner ch 8]

Feb 19	*Lab*	Connectivity modeling using Circuitscape

8. Communities

Feb 24	*Lecture*	Communities: species-area curves, island biogeography, beta gradients, diversity metrics, trophic interactions
.	*Readings*	(Fortin et al., 2005; Lamanna et al., 2014; D. Urban, Goslee, Pierce, Lookingbill, & others, 2002) [Turner ch 9]
Feb 26	*Lab*	Quantifying species diversity using Vegan in R

9. Planning

Mar 3	*Lecture*	Conservation planning in the context of landscape ecology: ecosystem services, coupled social-ecological systems, compensatory mitigation, climate change
.	*Readings*	(Groot, Alkemade, Braat, Hein, & Willemen, 2010; Nelson et al., 2009; Watson, Grantham, Wilson, & Possingham, 2011) [Turner ch 10]
Mar 5	*Lab*	Conservation planning using Marxan (group project)

10. Applications

Mar 10	*Lecture*	Case studies across urban, agricultural and coastal ecosystems, sustainable forestry, urban-wildland interface, future directions
.	*Readings*	(Grimaldi et al., 2014; Rouget, Cowling, Lombard, Knight, & Kerley, 2006; Thompson et al., 2014) [Turner ch 10 & 11]
Mar 12	*Lab*	Group project presentations

Readings

Chave, J. (2013). The problem of pattern and scale in ecology: What have we learned in 20 years? *Ecology Letters*, *16*, 4–16. doi:10.1111/ele.12048

Davis, F. W., Dozier, J., & others. (1990). Information analysis of a spatial database for ecological land classification. *Photogrammetric Engineering and Remote Sensing*, *56*(5), 605–613. Retrieved from http://people.eri.ucsb.edu/~fd/Pubs/davis_dozier_90.pdf

Elith, J., & Leathwick, J. (2009). Conservation prioritisation using species distribution modelling. *Spatial Conservation Prioritization: Quantitative Methods and Computational Tools*, 70–93.

Fortin, D., Beyer, H. L., Boyce, M. S., Smith, D. W., Duchesne, T., & Mao, J. S. (2005). Wolves influence elk movements: Behavior shapes a trophic cascade in yellowstone national park. *Ecology*, *86*(5), 1320–1330. doi:10.1890/04-0953

Grimaldi, M., Oszwald, J., Dolédec, S., Hurtado, M. del P., Miranda, I. de S., Sartre, X. A. de, … Lavelle, P. (2014). Ecosystem services of regulation and support in Amazonian pioneer fronts: Searching for landscape drivers. *Landscape Ecology*, *29*(2), 311–328. doi:10.1007/s10980-013-9981-y

Groot, R. S. de, Alkemade, R., Braat, L., Hein, L., & Willemen, L. (2010). Challenges in integrating the concept of ecosystem services and values in landscape planning, management and decision making. *Ecological Complexity*, *7*(3), 260–272. doi:10.1016/j.ecocom.2009.10.006

Guisan, A., Tingley, R., Baumgartner, J. B., Naujokaitis-Lewis, I., Sutcliffe, P. R., Tulloch, A. I. T., … Buckley, Y. M. (2013). Predicting species distributions for conservation decisions. *Ecology Letters*, *16*(12), 1424–1435. doi:10.1111/ele.12189

Lamanna, C., Blonder, B., Violle, C., Kraft, N. J. B., Sandel, B., Šímová, I., … Enquist, B. J. (2014). Functional trait space and the latitudinal diversity gradient. *Proceedings of the National Academy of Sciences*, *111*(38), 13745–13750. doi:10.1073/pnas.1317722111

Li, H., & Wu, J. (2004). Use and misuse of landscape indices. *Landscape Ecology*, *19*(4), 389–399. Retrieved from http://link.springer.com/article/10.1023/B:LAND.0000030441.15628.d6

McRae, B. H., Dickson, B. G., Keitt, T. H., & Shah, V. B. (2008). Using circuit theory to model connectivity in ecology, evolution, and conservation. *Ecology*, *89*(10), 2712–2724. Retrieved from http://www.esajournals.org/doi/abs/10.1890/07-1861.1

Nelson, E., Mendoza, G., Regetz, J., Polasky, S., Tallis, H., Cameron, D., … Shaw, M. (2009). Modeling multiple ecosystem services, biodiversity conservation, commodity production, and tradeoffs at landscape scales. *Frontiers in Ecology and the Environment*, *7*(1), 4–11. doi:10.1890/080023

Reice, S. R. (1994). Nonequilibrium determinants of biological community structure. *American Scientist*, 424–435. Retrieved from http://www.jstor.org/stable/29775279

Robinson, L. M., Elith, J., Hobday, A. J., Pearson, R. G., Kendall, B. E., Possingham, H. P., & Richardson, A. J. (2011). Pushing the limits in marine species distribution modelling: Lessons from the land present challenges and opportunities. *Global Ecology and Biogeography*, *20*(6), 789–802. doi:10.1111/j.1466-8238.2010.00636.x

Romme, W. H., Turner, M. G., Wallace, L. L., & Walker, J. S. (1995). Aspen, elk, and fire in northern Yellowstone Park. *Ecology*, *76*(7), 2097–2106. Retrieved from http://www.esajournals.org/doi/abs/10.2307/1941684

Rouget, M., Cowling, R. M., Lombard, A. T., Knight, A. T., & Kerley, G. I. (2006). Designing Large-Scale Conservation Corridors for Pattern and Process. *Conservation Biology*, *20*(2), 549–561. doi:10.1111/j.1523-1739.2006.00297.x

Scheller, R. M., & Mladenoff, D. J. (2007). An ecological classification of forest landscape simulation models: Tools and strategies for understanding broad-scale forested ecosystems. *Landscape Ecology*, *22*(4), 491–505. doi:10.1007/s10980-006-9048-4

Swanson, F. J., Kratz, T. K., Caine, N., & Woodmansee, R. G. (1988). Landform effects on ecosystem patterns and processes. *BioScience*, 92–98. Retrieved from http://www.jstor.org/stable/1310614

Thompson, I. D., Okabe, K., Parrotta, J. A., Brockerhoff, E., Jactel, H., Forrester, D. I., & Taki, H. (2014). Biodiversity and ecosystem services: Lessons from nature to improve management of planted forests for REDD-plus. *Biodiversity and Conservation*, *23*(10), 2613–2635. doi:10.1007/s10531-014-0736-0

Urban, D. L., Minor, E. S., Treml, E. A., & Schick, R. S. (2009). Graph models of habitat mosaics. *Ecology Letters*, *12*(3), 260–273. doi:10.1111/j.1461-0248.2008.01271.x

Urban, D. L., O'Neill, R. V., & Shugart, J., Herman H. (1987). Landscape Ecology: A hierarchical perspective can help scientists understand spatial patterns. *BioScience*, *37*(2), 119–127. doi:10.2307/1310366

Urban, D., Goslee, S., Pierce, K., Lookingbill, T., & others. (2002). Extending community ecology to landscapes. *Ecoscience*, *9*(2), 200–212. Retrieved from http://www.academia.edu/download/30440457/urban_etal_2002.pdf

Watson, J. E. M., Grantham, H. S., Wilson, K. A., & Possingham, H. P. (2011). Systematic Conservation Planning: Past, Present and Future. In R. J. Ladle & R. J. Whittaker (Eds.), *Conservation Biogeography* (pp. 136–160). John Wiley & Sons, Ltd. Retrieved from http://onlinelibrary.wiley.com/doi/10.1002/9781444390001.ch6/summary

Watt, A. S. (1947). Pattern and process in the plant community. *The Journal of Ecology*, 1–22. Retrieved from http://www.jstor.org/stable/2256497

Wiens, J. A. (1989). Spatial Scaling in Ecology. *Functional Ecology*, *3*(4), 385–397. Retrieved from http://www.jstor.org/stable/2389612

With, K. A., & King, A. W. (2001). Analysis of landscape sources and sinks: The effect of spatial pattern on avian demography. *Biological Conservation*, *100*(1), 75–88. doi:10.1016/S0006-3207(00)00209-3

Wu, J. (2013). Landscape sustainability science: Ecosystem services and human well-being in changing landscapes. *Landscape Ecology*, *28*(6), 999–1023. doi:10.1007/s10980-013-9894-9