

(NATR 8395 / GEOG 8815)
LANDSCAPE ECOLOGY & GIS ANALYSIS II
Winter Semester of Odd Year

1. Instructor Information

Dr. Hong S. He (203 ABNR Building, heh@missouri.edu)
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2. Course Description

Provide students with the principles and applications of landscape ecology and a firm understanding of spatial analysis techniques using GIS. Discuss metrics for spatial pattern and models for landscape-scale dynamics.

3. Grading and Course Policy

Class Projects (five of them)	50%
Final Project	20%
Classroom Participation and Paper Reading	30%

4. Course Organization

Course topics are usually scheduled as week-long blocks.

Lecture is on Monday 2:00 pm – 3:00 pm at ABNR 109

Lab is on Wednesday 10:00 am – 12:00 am at ABNR 109

5. Class Website

<https://blackboard.missouri.edu>

6. Goals of This Course

- Learn the theories and the core literatures of landscape ecology.
- Learn the actual techniques for analyzing spatial patterns.

7. Textbook

Landscape Ecology in Theory and Practice (M.G. Turner, R.H.Gardner and R.V. O'Neill).
Springer-Verlag, New York, 2001 (ISBN: 0-387-95123-7)

8. Student Responsibilities

- **Readings:** Select readings from the text and the primary literature will be assigned with each weekly unit. Every student is expected to have read the assignments before the lab meeting on Wednesday and be prepared to discuss the papers. Responsibility for leading a paper discussion will be rotated sequentially among all students. Discussion leaders should become familiar with background materials, raise questions or issues to be discussed, evaluate the significant contributions of the paper, and facilitate discussion among the group. Class readings will be posted on <http://Blackboard.missouri.edu>
- **Class Participation** is mandatory. This will take the form of participating in paper discussions and class projects. Students are welcome to ask the instructor/TA their particular questions in or after the class.

9. Class Schedule

Week	Lecture Topic	Lab Exercise / Paper Discussion
Principles of Landscape Ecology		
Week 01	Introduction to Landscape Ecology	Project 0 Warm up with ArcGIS
Week 02	Scale Concept and Hierarchy Theory	Paper Discussion
Quantify Landscape Patterns		
Week 03	Landscape Pattern Analysis and GIS	Paper Discussion
Week 04	Measuring Pattern: Metrics for Quantifying Landscape Pattern I	Project 1: Fragstats
Week 05	Measuring Pattern: Metrics for Quantifying Landscape Pattern II	Project 1: Cont. & Paper Discussion
Week 06	Landscape Pattern and Scales	Paper Discussion
Week 07	Neutral Landscape Model and the Use of NLM in Landscape Pattern Analysis	Project 2: RULE & Paper Discussion
Week 08	Measuring Pattern: Spatial Statistics	Project 3: SPP Analysis using R
Week 09	Midterm Exam	Project 3: Cont. & Paper Discussion
Week 10	Spatial Statistics and GIS Analysis	Project 4: ArcGIS
Formation of Landscape Patterns		
Week 11	Causes of Landscape Pattern – Relating Patterns with Processes	Paper Discussion
Week 12	Landscape Disturbance Dynamics	Paper Discussion
Models and Applications of Landscape Ecology		
Week 13	Introduction to Landscape Models	Paper Discussion
Week 14	Modeling Forest Landscape Succession and Management	Project 5: LANDIS
Week 15	Applications of Landscape Ecology	Paper Discussion
Final		
Week 16	Final Exam	

10. Reading list

Citations in **bold** font are the discussion papers. Citations in both *bold* and *Italic* font are the materials covered in lectures. Other citations are given for additional readings and assistance with associated lab exercises.

Week 1: Introduction to Landscape Ecology

Chapter 1, textbook

US-IALE. 2005. What is Landscape Ecology?

<http://www.usiale.org/whatisle/index.htm> Accessed August 15, 2007.

1. Damschen, E.I., Haddad, N.M., Orrock, J.L., Tewksbury, J.J., and Levey, D.J. 2006. Corridors increase plant species richness at large scales. *Science* 313(5791): 1284-1286.

2. Turner, M.G. 2005. Landscape ecology in North America: Past, present, and future. *Ecology* 86(8): 1967-1974.

Urban, D.L., O'Neill, R.V., and Shugart, H.H. 1987. Landscape Ecology. *BioScience* 37:119-127.

Pickett, S.T.A., and Cadenasso, M.L. 1995. Landscape ecology - spatial heterogeneity in ecological-systems. *Science* 269(5222): 331-334.

Tewksbury, J.J., Levey, D.J., Haddad, N.M., Sargent, S., Orrock, J.L., Weldon, A., Danielson, B.J., Brinkerhoff, J., Damschen, E.I., and Townsend, P. 2002. Corridors affect plants, animals, and their interactions in fragmented landscapes. *Proceedings of the National Academy of Sciences of the United States of America* 99(20): 12923-12926.

Week 2: Scale Concept and Hierarchy Theory

Chapter 2, textbook

3. Wiens, J.A. 1989. Spatial Scaling in Ecology. *Functional Ecology* 3:385–397.

4. Miller, J.R., Turner, M.G., Smithwick, E.A.H., Dent, C.L. and Stanley, E.H., 2004. Spatial extrapolation: The science of predicting ecological patterns and processes. *Bioscience*, 54:310-320.

Levin, S.A. 1992. The problem of pattern and scale in ecology. *Ecology* 73(6): 1943-1967.

Week 3: Landscape Pattern Analysis and GIS

Chapter 5, textbook

5. Gustafson, E.J., 1998. Quantifying landscape spatial pattern: What is the state of the art? *Ecosystems*, 1:143-156.

6. Li, H.B. and Wu, J.G., 2004. Use and misuse of landscape indices. *Landscape Ecology*, 19:389-399.

Neel, M.C., McGarigal, K. and Cushman, S.A., 2004. Behavior of class-level landscape metrics across gradients of class aggregation and area. *Landscape Ecology*, 19:435-455.

Tischendorf, L., 2001. Can landscape indices predict ecological processes consistently? *Landscape Ecology*, 16:235-254.

Week 4: Measuring Pattern I

No readings

Week 5: Measuring Pattern II

7. He, H.S., DeZonia, B.E. and Mladenoff, D.J., 2000. An aggregation index (AI) to quantify spatial patterns of landscapes. *Landscape Ecology*, 15:591-601.

Bogaert, J., Myneni, R.B. and Knyazikhin, Y., 2001. A mathematical comment on the formulae for the aggregation index and the shape index. *Landscape Ecology*, 17:87-90.

Week 6: Landscape Pattern and Scales

8. Wu, J.G., Shen, W.J., Sun, W.Z. and Tueller, P.T., 2002. Empirical patterns of the effects of changing scale on landscape metrics. *Landscape Ecology*, 17:761-782.

9. O'Neill, R.V., Hunsaker, C.T., Timmins, S.P., Jackson, B.L., Jones, K.B., Riitters, K.H. and Wickham, J.D., 1996. Scale problems in reporting landscape pattern at the regional scale. *Landscape Ecology*, 11:169-180.

Week 7: Neutral Landscape Model

Chapter 6, textbook

10. With, K.A. and King, A.W., 1997. The use and misuse of neutral landscape models in ecology. *Oikos*, 79:219-229.

Gardner, R.H. and Urban, D.L., 2007. Neutral models for testing landscape hypotheses. *Landscape Ecology*, 22:15-29.

Gardner, R.H. 1999. RULE: Map Generation and a Spatial Analysis Program. In Landscape Ecological Analysis: Issues and Applications, ed. J.M. Klopatek, and R.H. Gardner, pp. 280-303 New York: Springer-Verlag.

Week 8: Measuring Pattern: Spatial Statistics

Dale, M.R.T., Dixon, P., Fortin, M.J., Legendre, P., Myers, D.E. and Rosenberg, M.S., 2002. Conceptual and mathematical relationships among methods for spatial analysis. *Ecography*, 25:558-577.

Fortin, M.-J. 1999. Spatial statistics in landscape ecology. Pp. 253-279. in: Klopatek, J.M. & Gardner R.H. (eds). Landscape Ecological Analysis. Issues and Applications. Springer-Verlag.

11. Wagner, H.H. and Fortin, M.J., 2005. Spatial analysis of landscapes: Concepts and statistics. *Ecology*, 86:1975-1987.

Yang, J., He, H.S., Shifley, S.R. and Gustafson, E.J., 2007. Spatial patterns of modern period human-caused fire occurrence in the Missouri Ozark Highlands. *Forest Science*, 53:1-15.

Week 10: Spatial Statistics and GIS Analysis

Lichstein, J.W., Simons, T.R., Shiner, S.A. and Franzreb, K.E., 2002. Spatial autocorrelation and autoregressive models in ecology. *Ecological Monographs*, 72:445-463.

Rossi, R.E., Mulla, D.J., Journel, A.G. and Franz, E.H., 1992. Geostatistical tools for modeling and interpreting ecological spatial dependence. *Ecological Monographs*, 62:277-314.

Week 11: Causes of Landscape Pattern

Chapter 4, textbook

12. Foster, D.R., 1992. Land-use history (1730-1990) and vegetation dynamics in Central New-England, USA. *Journal of Ecology*, 80:753-772.

13. Wimberly, M.C. and Ohmann, J.L., 2004. A multi-scale assessment of human and environmental constraints on forest land cover change on the Oregon (USA) coast range. *Landscape Ecology*, 19:631-646.

Week 12: Landscape Disturbance Dynamics

Chapter 7, textbook

14. Mermoz, M., Kitzberger, T. and Veblen, T.T., 2005. Landscape influences on occurrence and spread of wildfires in Patagonian forests and shrublands. Ecology, 86:2705-2715.

15. Schoennagel, T., Veblen, T.T. and Romme, W.H., 2004. The interaction of fire, fuels, and climate across rocky mountain forests. Bioscience, 54:661-676.

van Langevelde, F., van de Vijver, C., Kumar, L., van de Koppel, J., de Ridder, N., van Andel, J., Skidmore, A.K., Hearne, J.W., Stroosnijder, L., Bond, W.J., Prins, H.H.T. and Rietkerk, M., 2003. Effects of fire and herbivory on the stability of savanna ecosystems. Ecology, 84:337-350.

Week 13: Introduction to Landscape Models

Chapter 3, textbook

16. Jackson, L.J., Trebitz, A.S. and Cottingham, K.L., 2000. An introduction to the practice of ecological modeling. Bioscience, 50:694-706.

Baker, W.L. 1989. A review of models of landscape change. Landscape Ecology 2: 111-133.

Week 14: Modeling Forest Landscape Succession and Management

He, H.S. and Mladenoff, D.J., 1999. Spatially explicit and stochastic simulation of forest-landscape fire disturbance and succession. Ecology, 80:81-99.

Week 15: Applications of Landscape Ecology

Chapter 10, textbook

17. Iverson, L.R. and Prasad, A.M., 2007. Using landscape analysis to assess and model tsunami damage in Aceh province, Sumatra. Landscape Ecology, 22:323-331.

Knight, R.L., and P.B. Landres. 2002. Central concepts and issues of biological conservation. Pages 22-33 in K.J. Gutzwiller, ed. Applying landscape ecology in biological conservation. Springer, New York.