Landscape Ecology Tentative Course Schedule for January 2009 Offering

Monday (1/5): **Introduction to landscape ecology**

8:00-8:30 Introduction and overview of course

8:30-9:30 Introduction to landscape ecology [chapter 1]

Instructor: K. McGarigal

Assigned Reading: Turner et al. 2001 (Chapter 1)

Objective: Describe the focus of the science of landscape ecology, including its historical context and its contrast to other ecology disciplines. Highlight importance of landscape ecology in addressing current resource management topics.

Topics covered:

- What is landscape ecology
- History of landscape ecology
- Why it is important to resource managers

9:30-10:00 Discussion – Management concerns requiring landscape perspective

10:00-12:00 What is a landscape? [chapter 2]

Instructor: K. McGarigal

Assigned Reading: McGarigal (Lecture notes)

Objective: Provide a basic understanding of the concept of a "landscape" to serve as a foundation for understanding landscape ecology topics. Review basic approaches for defining a landscape. Highlight importance of landscape definition in resource management planning and analyses.

Topics covered:

- Landscape defined
- The landscape concept – composition, structure and function
- The digital challenge – importance of scale
- Landscape context

1:00-5:00 Lab exercise #1 – Defining the landscape: Part 1

Instructors: K. McGarigal and S. Cushman

Overview: In this exercise, students will experience the challenges associated with defining the case study landscape in an ecologically meaningful manner given real-world practical considerations (e.g., data limitations) and management objectives. Students will use GIS to create and evaluate alternative landscape definitions and discuss the challenges and implications of their decisions. In Part 1, students will focus on gaining familiarity with the case study landscape and the corresponding spatial data base and examine the sensitivity of landscape pattern analysis to landscape definition.

Tuesday (7/8): **Defining a landscape (models of landscape structure)**

8:00-9:00 Lab exercise #1 - Part 1 presentations & discussion (groups 1 &2 lead)

9:00-12:00 Models of landscape structure [chapter 3]

Instructor: K. McGarigal

Assigned Reading: McGarigal (Lecture notes)

Overview: Provide a basic description of several alternative models of landscape structure, including models based on point, categorical and continuous patterns. Highlight the importance of selecting a meaningful model for the question under consideration given the constraints of data availability and software tools available for analyzing pattern-process relationships.

Topics covered:
- Models of landscape structure
- Point pattern model
- Patch mosaic model - island biogeographic and landscape mosaic models
- Landscape gradient model
- Graph matrix model

1:00-5:00 Lab exercise #1 – Defining the landscape: Part 2

Instructors: K. McGarigal and S. Cushman

Overview: In this exercise, students will continue to explore the challenges associated with defining the case study landscape in a relevant manner. In Part 2, students will focus on constructing alternative models of landscape structure for the case study landscape based on the conceptual models discussed in lecture. Here the focus will be on translating the conceptual model of landscape structure into a real-world model that could serve as the basis for a meaningful landscape investigation or management application.

Wednesday (7/9): **Characterizing landscape patterns**

8:00-9:00 Lab exercise #1 - Part 2 presentations & discussion (groups 3 &4 lead)

9:00-11:00 Characterizing landscape patterns – conceptual foundation [chapter 4]

Instructor: K. McGarigal

Assigned Reading: Turner et al. 2001 (Chapter 5); Gustafson (1998)

Objective: Provide a basic understanding of how to characterize and quantify landscape pattern. Highlight importance of landscape definition in landscape pattern analysis and the difference between measured and functional heterogeneity.

Topics covered:
- Perspectives on categorical landscapes
- The importance of scale
- Landscape context
- Scope of analysis
- Levels of heterogeneity
- Components of landscape structure
- Structural versus functional metrics
- Theoretical behavior of metrics
- Metric redundancy: In search of parsimony
- Metric reference framework

11:00-12:00 Landscape metrics for categorical map patterns [chapter 5]

Instructor: K. McGarigal

Assigned Reading: Turner et al. 2001 (Chapter 5); McGarigal (Lecture notes)

Objective: Provide an overview of common landscape metrics and insights into their use and interpretation. Here, select a few of the more important metrics that highlight different aspects of landscape structure. Highlight the importance of selecting the "right" metric for the "right" problem.

Topics covered:
- Area/density/edge metrics
- Shape metrics
- Core area metrics
- Contrast metrics
- Contagion/interspersion metrics

- Isolation/proximity metrics
- Connectivity metrics
- Diversity metrics

1:00-5:00 Lab exercise #2 – Quantifying landscape patterns

Instructors: K. McGarigal and S. Cushman

Overview: In this exercise, students will learn to use the program FRAGSTATS and interpret the output in the context of the case study landscape. FRAGSTATS is a program for quantifying landscape patterns for categorical maps. Students will gain a practical understanding of how to select and compute landscape metrics. Specifically, students will quantify habitat loss and fragmentation due to roads and vegetation management in the case study landscape and identify the challenges and limitations of quantifying landscape patterns.

Thursday (7/10): **Landscape models**

8:00-9:00 Lab exercise #2 presentations & discussion (groups 5 & 6 lead)

9:00-12:00 Landscape disturbance-succession models [chapter 6]

Instructor: E. Gustafson

Assigned Reading: Turner et al. 2001 (Chapter 3); Scheller and Mladenoff (2007)

Objective: Provide an overview of the varied types of dynamic landscape models and their applications for examining pattern-process relationships. Highlight the use of stochastic landscape disturbance-succession simulation models (e.g., LANDIS, LANDSUM, RMLANDS).

Topics covered:
- Introduction to landscape disturbance-succession models (LDSM's)
- Types and components of LDSM's
- Major LDSM's in use today
- Testing and validation of LDSM's
- Limitations of LDSM's
- Choosing the "best" LDSM

1:00-5:00 Lab exercise #3 – Quantifying HRV and current landscape departure: Part 1

Instructors: K. McGarigal and S. Cushman

Overview: In this exercise, students will use RMLANDS to quantify HRV and current departure in landscape structure for the case study landscape. Students will gain a practical

appreciation for the challenges associated with quantifying HRV and current departure and the importance of scale. Specifically, students will learn how to interpret current landscape departure within the scope and limitations of the analysis (e.g., scale of analysis). In Part 1, students will focus on assessing the model in terms of its adequacy, and examine the model equilibration in the HRV simulation and its meaning.

Friday (7/11): **Natural disturbance regimes and historic range of variability (HRV)**

8:00-9:00 Lab exercise #3 Part 1 presentations & discussion (groups 7 & 8 lead)

9:00-11:00 Disturbance and disturbance regimes [chapter 7]

Instructor: B. Keane

Assigned Reading: Turner et al. 2001 (Chapter 7); Reice (1994); Romme et al. (1995)

Objective: Provide an overview of natural disturbances as ecological drivers of landscape pattern and change. Understand the attributes of natural disturbance regimes, the ecological role of disturbance and the factors affecting disturbance regimes. Highlight the role of disturbance (with an emphasis on fire and insects/pathogens) in shaping landscapes and affecting biodiversity.

Topics covered:
- Characteristics of disturbance and disturbance regimes
- Landscape disturbance ecology
- Interactions and feedbacks among disturbances
- Management implications – vegetation management (disturbance emulation), intermediate disturbance hypothesis, minimum dynamic area concept, etc.

11:00-12:00 Historic range of variability (HRV) in landscape structure [chapter 8]

Instructor: K. McGarigal

Assigned Reading: Landres et al. (1999)

Objective: Provide an overview of HRV concepts and their application in landscape planning and management. Highlight the use of HRV in establishing context for the current landscape condition and its potential role in guiding specification of desired future landscape condition.

Topics covered:
- Introduction to HRV
- Methods for determining HRV and current departure
- Interpretations of HRV and current departure

- Importance of scale in HRV assessments
- Resource planning and management applications of HRV and current departure (e.g., LANDFIRE)

1:00-5:00 Lab exercise #3 – Quantifying HRV and current landscape departure: Part 2

Instructors: K. McGarigal and S. Cushman

Overview: In this exercise, students will continue to examine HRV and current departure in landscape structure for the case study landscape. In Part 2, students will focus on quantifying HRV and current departure and interpreting the findings.

Saturday (7/12): **Optional Field trip**

8:00-5:00 Field trip is tentative depending on interest

Monday (7/14): **Fire, fuels and climate agents**

8:00-9:00 Lab exercise #3 Part 2 presentations & discussion (groups 1 & 2 lead)

9:00-12:00 Fire, fuels and climate [chapter 9]

Instructor: J. Littell

Assigned Reading: Agee et al (2000)

Objective: Provide an overview of the interaction between fuels, climate, and fire and the role of management practices in the alteration of fire regimes. Highlight the role of fire and fuels management in shaping landscapes (patterns and change) and the ecological implications of these changes.

Topics covered:
- Fire and fuels management (how do we know what we think we know?)
- Review of factors influencing fire regimes
- Scientific basis for modifying forest structure to modify fire behavior
- Scaling up to landscape level fire management
- The future of fire and fuels management in the context of resource management

1:00-5:00 Lab exercise #4 – Management scenarios: Part 1

Instructors: K. McGarigal and S. Cushman

Overview: In this exercise, students will use RMLANDS to quantify the dynamics in landscape structure for the case study landscape under several alternative management

scenarios, for example representing different levels (e.g., spatial extent and configuration) of fuel treatments and their effectiveness (e.g., altered probabilities of initiation, spread and severity) under alternative climates. Students will gain a practical understanding of scenario analysis as an aid to forest planning and gain an appreciation for the challenges and limitations associated with interpretation of results. Specifically, students will learn how to conduct scenario analysis to compare the potential impacts of management actions aimed at controlling fire and insect/pathogen disturbance regimes. In Part 1, students will focus on creating alternative management scenarios that reflect meaningful management objectives and simulating those scenarios.

Tuesday (7/15): **Biological disturbance agents**

8:00-9:00 Lab exercise #4 Part 1 presentations & discussion (groups 3 & 4 lead)

9:00-12:00 Ecological consequences of landscape pattern – populations [chapter 12]

Instructor: B. Goodwin

Assigned Reading: Turner et al. 2001 (Chapter 8); With and King (2001)

Objective: Provide an overview of the consequences of landscape pattern to populations and species; principles of conservation biology. Highlight the influence of landscape pattern on population and metapopulation processes and population viability.

Topics covered:
- Populations and metapopulations
- Habitat loss and fragmentation
- Continuity and connectivity
- Spatially explicit population models (SEPM's)
- Population viability analysis (PVA)
- Population/species conservation – focal species approach (e.g., indicators), ecological process approach, landscape pattern approach, coarse- and fine-filter approach

1:00-5:00 Lab exercise #4 – Management scenarios: Part 2

Instructors: K. McGarigal and S. Cushman

Overview: In this exercise, students will continue to examine alternative management scenarios. In Part 2, students will focus on examining the impacts of their alternative scenarios on landscape structure and discussing the implications.

Wednesday (7/16): **Ecological consequences of landscape pattern – genetic diversity**

8:00-9:00 Lab exercise #4 Part 2 presentations & discussion (groups 5 & 6 lead)

9:00-12:00 Ecological consequences of landscape pattern – genetic diversity [chapter 11]

Instructor: M. Schwartz

Assigned Reading: Manel et al. 2003

Objective: Provide an overview of the emerging discipline of landscape genetics – the integration of population genetics and landscape ecology. Highlight the influence of landscape pattern on gene flow and the conservation of genetic diversity in the context of evolutionary processes.

Topics covered:
- Population genetics and genetic diversity
- How is genetic diversity lost
- Influence of landscape pattern on patterns of genetic diversity
- Role of landscape genetics in conservation and management

1:00-5:00 Lab exercise #5 – Metapopulation assessment: Part 1

Instructors: K. McGarigal and S. Cushman

Overview: In this exercise, students will use a spatially explicit metapopulation viability model to evaluate the impacts of alternative forest management scenarios on a metapopulation of marbled salamanders in western Massachusetts. Students will gain a practical understanding of metapopulation concepts and population viability analysis as an aid to forest planning and gain an appreciation for the challenges and limitations associated with the interpretation of results. Specifically, students will develop a forest management scenario involving commercial timber harvesting and evaluate the potential impacts on the marbled salamander metapopulation with the aim of trying to devise a management scenario that minimizes adverse impacts on the salamander while simultaneously achieving timber harvest objectives. In Part 1, students will create an initial management scenario, implement it in the simulation, and examine the results. Based on the results they will create and implement one or more alternative scenarios to improve on their performance.

Thursday (7/17): **Ecological consequences of landscape pattern – populations**

8:00-9:00 Open discussion

9:00-12:00 Biological disturbance agents [chapter 10]

Instructor: D. Six

Assigned Reading: Romme et al (1986), Parfitt (2007), and Castello et al. (1995)

Objective: Provide an overview of management practices directed towards insects and pathogens and the alteration of biological disturbance regimes. Highlight the role of treatments in shaping landscapes (patterns and change) and the ecological implications of these changes.

Topics covered:
- Forest health issues – insects and pathogens as agents of landscape pattern and change
- Forest health management practices affecting landscape pattern and process (e.g., salvage)
- Interactions and feedbacks affecting landscape pattern and process (e.g., climate)
- Ecological consequences of forest health management (e.g., species conservation)

1:00-5:00 Lab exercise #5 – Metapopulation assessment: Part 2

Instructors: K. McGarigal and S. Cushman

Overview: In this exercise, students will continue to examine the metapopulation viability impacts of the forest management scenarios. In Part 2, students will compare and contrast the results of their management scenarios and discuss the implications.

Friday (7/18): **Ecological consequences of landscape pattern – synthesis**

8:00-9:00 Lab exercise #5 presentations & discussion (groups 7 & 8 lead)

9:00-12:00 Ecological consequences of landscape pattern – synthesis [chapter 13]

Instructor: S. Cushman

Assigned Reading: Turner et al. 2001 (Chapter 8); Urban et al. (2002)

Objective: Provide an overview of the consequences of landscape pattern to communities; principles of community ecology. Highlight the influence of landscape pattern on community structure.

Topics covered:
- Communities - what are they and are they real?
- Niche concept and individual species-level focus
- Past, present and future communities
- Communities across the landscape
- Disturbance and community succession
- Fire, climate and community change
- Integrated community modeling
- Management and conservation

1:00-3:00 Course synthesis and discussion

Instructors: K. McGarigal and S. Cushman

Assigned Reading: Turner et al. 2001 (Chapters 10 & 11)

Objective: Provide a synthesis of the course. Highlight the key take-home messages of how landscape ecology applies to the management of national forests.

Topics covered:
- Key axioms of landscape ecology
- How to apply landscape ecology to national forest management

3:00 Course evaluation