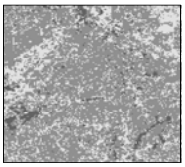
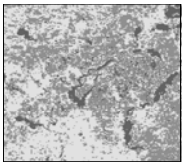
Landscape Ecology

Introduction

Ecology is the study of **interactions** among organisms and their **environment**

- Ecology has often assumed a non-spatial, homogeneous environment.
- The environment is extremely variable spatially.
- Interaction strength varies with distance.





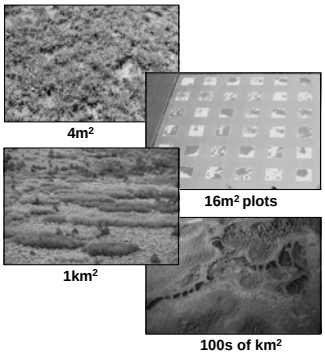
Definitions

Landscape: an area that is spatially heterogeneous in at least one area of interest.

Patch: the elements that make up a landscape.

Pattern: the **arrangement** and composition of the patches that compose a landscape

Definitions



Landscape Structure: spatial relationships among landscape elements

Landscape Function: how the elements act and interact

Landscape Change: alteration of the structure and function of the landscape over time

Landscape Management: the management of structure and function to achieve a desired condition

Key Landscape Ecology Questions

1. What processes create landscape pattern?
2. What are the consequences?
3. How do we measure pattern? At what scale?
4. How does pattern change through time?
5. How do we predict and manage pattern?

What else defines landscape ecology?

- Landscape ecology often (not always) focuses on broader scales than traditionally examined in ecology.
- Landscape ecology emphasizes variation in both *spatial* and *temporal* scales!

What else defines landscape ecology?

Landscape ecology often (not always) focuses on the role of humans in affecting patterns and processes.

Landscape ecology also recognizes that humans are but one agent affecting landscapes.

Landscape Ecology

Brief History

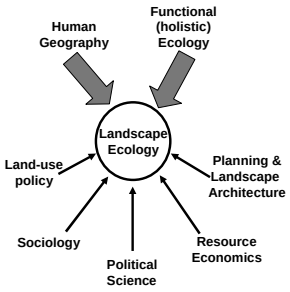
The European School

- "Original" landscape ecology
- Traced to Von Humboldt in 1807
- Russian physical geographers
  - Berg, Solnetsev
- "Landscape ecology" coined by Troll in 1939
- Emphasizes typology, classification, nomenclature, and deals mostly with human-dominated systems
- Also the foundations of hierarchical land classification

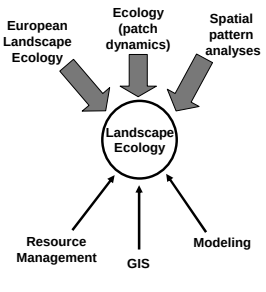
The North American School

- Much younger; effectively launched at Allerton Park, IL in 1983.
- Much stronger focus on natural systems, more a branch of ecology.
- Deals more with statistics, models, technology, and theory
- Found in Biology, Ecology, Forestry, and Natural Resources Departments in the US.

European vs N American



European School

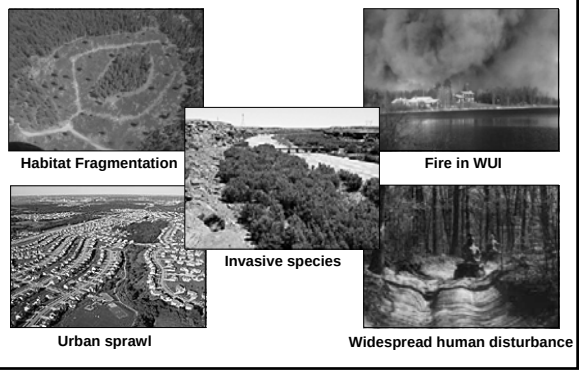


N American School

Why has Landscape Ecology emerged as a discipline?

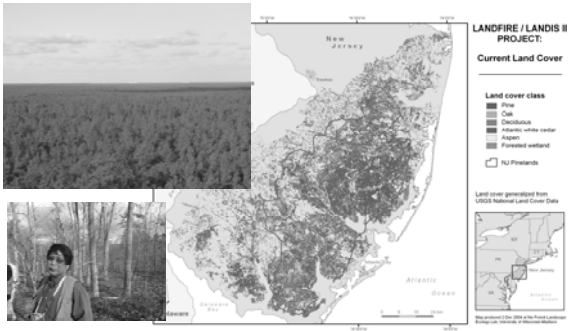
Why has landscape ecology emerged?

#1: Spatial scale of environmental problems has increased



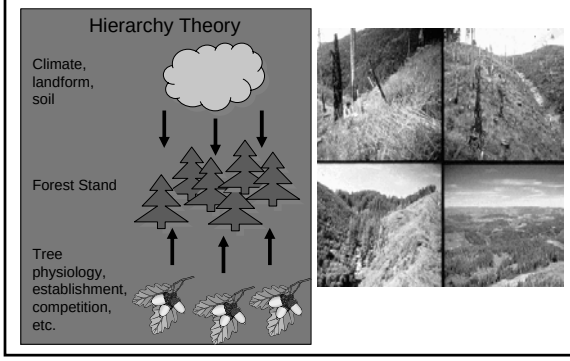
Why has landscape ecology emerged?

#2: A growing appreciation of spatial context



Why has landscape ecology emerged?

#3: Development of the necessary theories



Why has landscape ecology emerged?

#4: Concepts of disturbance have changed

Equilibrium paradigm ----------> Dynamic paradigm

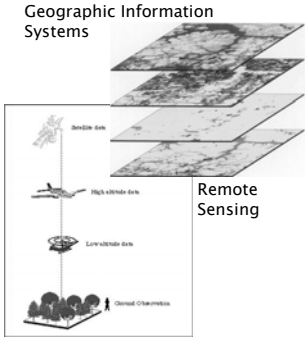
- ✓ Species composition is relatively constant in a community.
- ✓ Disturbance and succession alter communities but are less important than the climax community itself.
- ✓ Ecosystems can be understood within the context of the ecosystem itself, because the ecosystem is self-contained and controlled internally

- ✓ Species composition may (or may not) reach equilibrium based on interactions between disturbance and communities.
- ✓ Disturbance is an essential part of ecosystems and ecosystem dynamics.
- ✓ Ecosystems must be understood within a larger spatial and temporal context, because ecosystems are open systems and incorporate disturbances at multiple scales

Why has landscape ecology emerged?

#5: Technological advances

Geographic Information Systems



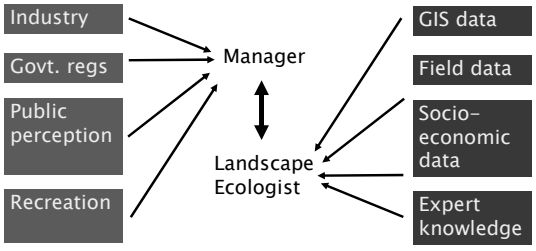
Remote Sensing

The Internet, Available Data

Models, Programming, Computing Power
- OOD
- Modularity
- Dynamic

Why has landscape ecology emerged?

#6: Management needs applied ecology



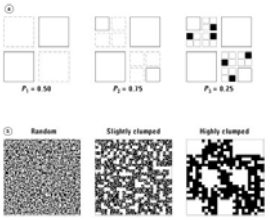
Landscape ecology 'scales up' ecological data/knowledge to a scale that is meaningful to management.

Landscape ecology: Tools and concepts

Landscape Ecology Concepts

- Scale and hierarchy theory
- Finding the correct scale for a study
- Detecting/characterizing landscape structure
- Agents of pattern: physical templates, biotic processes, disturbance
- Implications of structure to organisms, communities, and ecosystems
- Landscape dynamics – centered on landscapes as well as organisms
- Applied landscape ecology: conservation, land use, planning

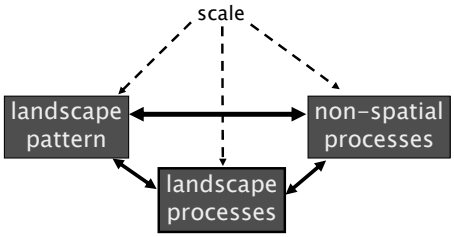
Landscape ecology: Tools and concepts



Tools:

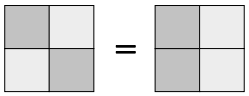
- Markov transition models
- IAN and landscape metrics
- Neutral landscape models
- Percolation theory
- Basic simulation modeling
- Historical range of variability and management in disturbed landscapes
- Individual-based modeling

Pattern and Process

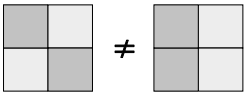


Pattern and Process

If a process is NOT a function of pattern, then it is a *non-spatial* process.



If a process is a function of pattern, then it is a spatial, or *landscape process*.



Landscape Processes and Ecology