University of Idaho
College of Natural Resources

Landscape Ecology

FOR/REM 429: Landscape Ecology

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MW 8:30 – 9:20 am in Admin 227
F CNR26 8:30 – 10:20 am (section 1)
10:30 am – 12:20 pm (section 2)

Course Topics

Through lecture, discussion and lab exercises, we will explore:

- Ecological relationships of biotic communities in heterogeneous environments
- Implications of pattern over time and space
- Importance of the landscape scale in determining ecosystem diversity and function in forests and rangelands
- Broad-scale management and conservation issues

Learning outcomes

- Define and properly use concepts and theories in landscape ecology
- Discuss the relationships of landscape ecology to other types of ecology
- Address current issues in Landscape Ecology, e.g. linkages and corridors, fragmentation, disturbance susceptibility, ecosystem management from a landscape perspective
- Appreciate the potential of landscape analysis software packages
- Analyze and interpret landscape pattern relevant to conservation and management issues
- Communicate orally and in writing the ecological and management implications of landscape pattern and change

Grades

Mid-term exam	Lab reports 5x8% each	Landscape project (oral presentation)	Landscape project (Final report-written)	Attendance (Daily quiz average – 3 lowest scores dropped)	Final exam
15%	40%	5%	5%	5%	20%

- The results from the 5 labs will be submitted in lab report. Refer to respective lab worksheets for each lab.
- The landscape project report will be written in a technical report format. Follow the Writing Guide for organization, format of tables, figures, references, use of metric units, scientific names, etc. The Writing Guide is available on the class web site in BbLearn.
- Grading rubriks are provided on BbLearn
- Lab reports and final project must be submitted through BbLearn as a single MS Word document. Incorporate all figures and tables into this one document (10%/day deduction for late assignments)

Labeling of files

Mid-term exam	Lab reports 5x8% each	Landscape project (oral presentation)	Landscape project (Final report-written)	Attendance (Daily quiz average – 3 lowest scores dropped)	Final exam
15%	40%	5%	5%	5%	20%

Please label all files submitted through BbLearn with the following information:

- Last name
- First initial
- The assignment name

So my submission for the first lab report would look like this:

'Strand_E_REM_429_Harvest_Lite'

What is **landscape ecology**?

…….what is the difference between **landscape ecology**, **systems ecology** and **community ecology**?

What is a Landscape?

Area that is heterogeneous in at least one factor of interest

Turner et al. 2001 Springer-Verlag

Definitions of "**landscape**"

The landscape is a heterogeneous land area composed of a cluster of interacting ecosystems that is repeated in similar form throughout (Forman & Godron 1986). The landscape consists of 3 basic elements or structural units: matrix, patches, corridors.

"Can be considered a spatially heterogeneous area." The landscape is a function of 1) structure, 2) function and 3) change (Turner 1989).

"A terrestrial landscape is a mosaic of heterogeneous land forms, vegetation types, and land uses" (Urban et al. 1987).

"A landscape is an area that is spatially heterogeneous in at least one factor of interest" (Turner et al. 2001).

Is moss on a rock a Landscape?

Ecology?

Ecology is the scientific study of the interactions between organisms and their environment.

Landscape Ecology

The term *Landscape Ecology* was coined by the German researcher Carl Troll in 1939

Originated in the sciences of regional geography and vegetation science

Coincided with the novel perspective of aerial photography

Landscape Ecology?

A sub-discipline of ecology, focusing on spatial relationships and the interactions between patterns and processes (Dr. David J. Mladenoff, University of Wisconsin-Madison)

The study of the structure, function and change in a heterogeneous land area composed of interacting ecosystems (Foreman&Gordon 1986)

The investigation of ecosystem structure and function at the landscape scale (Urban et al 1987)

The study of the effect of pattern on process at any scale (Turner 1989)

Definitions of "landscape ecology"

"The study of landscapes- its spatial patterns and how they develop" (Urban et al. 1987).

Landscape ecology emphasizes two aspects that distinguish it from other sub-disciplines within ecology (Turner et al. 2001):

a: Explicitly addresses the importance of spatial configuration for ecological processes.

b: Often focuses on spatial extents that are much broader than those traditionally studied in ecology.

How is **landscape ecology** different than **community ecology** and **systems ecology**?

Definitions of a "community"

1. An association of interacting populations, usually defined by the nature of their interactions or the place in which they live (Ricklefs 1990).

2. An assemblage of plants, animals, bacteria and fungi that live in an environment, interact with one another, and form a distinctive living system with its own composition, structure, environmental relations, development and functions (Whittaker 1975).

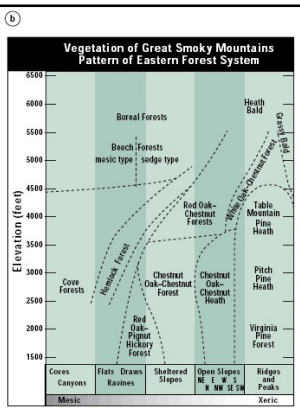
3. Each community is characterized by a particular species composition, vertical structure, patterns of change over time biomass, energy flow and nutrient cycling (Kimmins 1987).

Most community definitions include characteristics related to:

1. **Composition of multiple populations**
2. **Environmental and composition homogeneity**
3. **Interactions between species**

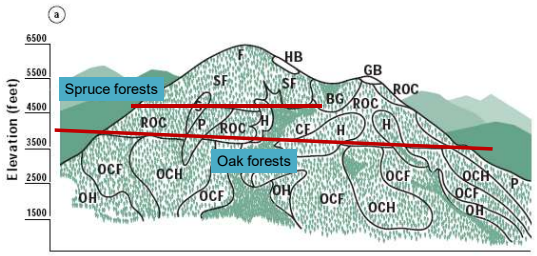
An assumption of homogeneity is implied in most definitions.

Mixed prairie and juniper woodland, western North Dakota



Typical gradient analysis result using a community ecology approach placing vegetation types into a biophysical relationship.

Figure 1.4a. Topographic distribution of vegetation types in the Great Smoky Mountains (T,G & O 2001, Whittaker 1956)



Spatial relationships of vegetation types on an idealized mountain in the Great Smoky Mountains.

BG= beech gap, CF= cove forest, F= Frasier fir, G= grassy bald, H= hemlock forest, HB= heath bald, OCF= chestnut oak-chestnut forest, OCH= chestnut oak chestnut heath, P= pine forest, pine heath, ROC= red oak-chestnut oak forest, S= spruce forest, SF= spruce-fir forest, WOC= white oak-Chestnut forest.

Figure 1.4a. Topographic distribution of vegetation types in the Great Smoky Mountains (T,G & O 2001, Whittaker 1956)

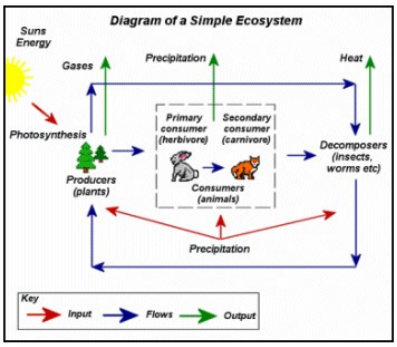
Definitions of "ecosystem"

"Not only the organism-complex, but the whole complex of physical factors forming what we call the environment" (Tansley 1935, suggested the term).

"The biotic component and its environment treated together as a functional system of complementary relationships, and transfer and circulation of energy and matter" (Whittaker 1975).

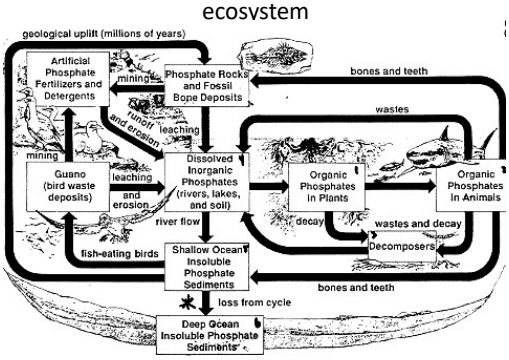
"Any unit that includes all of the organisms in a given area interacting with the physical environment so that a flow of energy leads to a clearly defined trophic structure, biotic diversity, and material cycles (i.e., exchange of materials between living and non-living parts within the system)" (Odum 1971).

Simplified diagram of an ecosystem



Source: http://www.ibgeography.com/ecosystems/index.html

Diagram of the flux of phosphorus through the ecosystem



http://www2.mcdaniel.edu/Biology/eco/biogeo/biogeochemical.html.

Commonly used terms in landscape ecology

1.	Configuration:	Specific arrangement of spatial elements
2.	Connectivity:	Spatial continuity of a habitat or cover type across a landscape
3.	Corridor:	A relatively narrow strip of a particular type that differs from adjacent areas on both sides
4.	Edge:	That portion of a cover type near its perimeter
5.	Fragmentation:	Breaking up of a habitat into smaller disconnected parcels
6.	Heterogeneity:	Quality or state of consisting of dissimilar elements
7.	Matrix:	Background cover types within a landscape
8.	Scale:	Spatial or temporal dimension of an object or process, characterized by both grain and extent

Source: T,G & O 2001. Table 1.1

Central concepts of landscape ecology

1. Ecological processes
2. Spatial pattern / Landscape heterogeneity
3. Scale – spatial and temporal
4. Role of humans
5. Specific reference to organisms and/or processes

Why has Landscape Ecology emerged as a distinct area of study?

Broad-scale environmental issues (e.g. species conservation, wildfire, invasive species)

Realization of the importance of scale in ecology

Technological advances- remote sensing, geographic information systems, increased computing power

Landscape ecologists focus on 5 key areas:

1. Pattern of patches on the landscape
2. Interchange of energy, materials, nutrients, and organisms between patches
3. Disturbance (natural and human-caused), succession and other factors causing landscape change
4. Effects of spatial and temporal scale
5. Design and management

What biotic and abiotic processes are responsible for the formation and dynamics of landscape patterns?

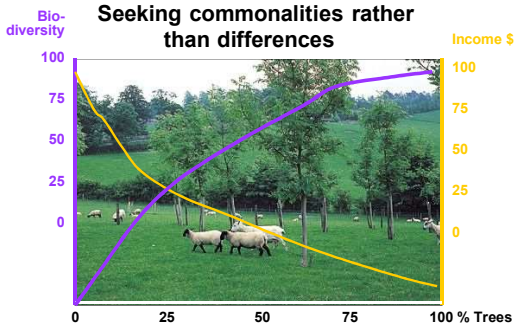
At what scale does spatial structure emerge on landscapes?

www.k-state.edu/withlab/landecol/index.html

How does spatial pattern affect ecological processes, such as the movement of organisms (or the flow of water, materials or nutrients) across landscapes?

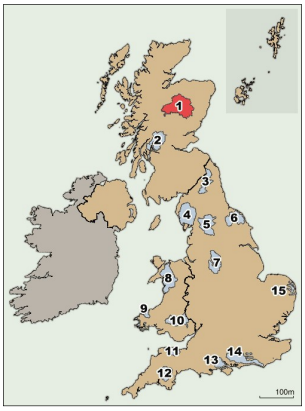
www.k-state.edu/withlab/landecol/index.html

How does landscape structure affect the spread of disturbances, such as fire or disease or invasive species?



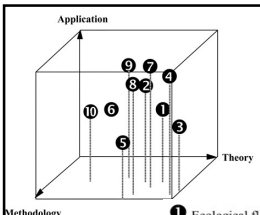
How can a landscape ecological perspective contribute to better resource or land management

www.k-state.edu/withlab/landecol/index.html



What can landscape ecology contribute to the conservation of biodiversity?

Reserve selection

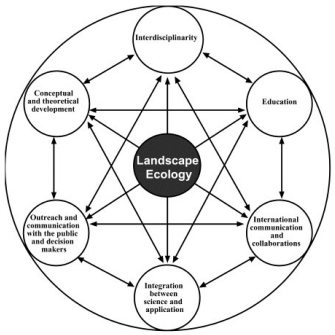


Top 10 research topics in Landscape Ecology in the 21st Century

1. Ecological flows in landscape mosaics
2. Causes, processes, and consequences of land use and land cover change
3. Nonlinear dynamics and landscape complexity
4. Scaling
5. Methodological development
6. Relating landscape metrics to ecological processes
7. Integrating humans and their activities into landscape ecology
8. Optimization of landscape pattern
9. Landscape conservation and sustainability
10. Data acquisition and accuracy assessment

Wu and Hobbs 2002

Directions of advancement



Common land mapping unit terminology used in landscape ecology

Patch	**Ecosystem**	**Polygon**
Land use type	**Stand**	**Landscape**
Watershed	**Community**	**Cover type**

Remember:
Quiz on this lecture at the next lecture.