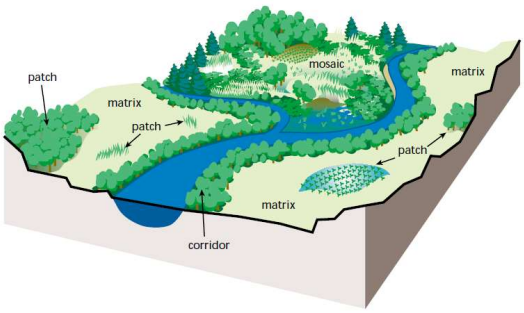
Landscape Ecology Summary



https://www.intechopen.com/books/advances-in-landscape-architecture/understanding-landscape-structure-using-landscape-metrics

Final Exam 2018

- 7:30 am-Noon, Thursday, May 10, ONLINE
- Exam format will be similar to the mid-term exam (multiple choice and short answer)
- The exam will be comprehensive but will emphasize the material presented since the mid-term exam.
- Material presented in lectures, labs, quizzes, and assigned readings.
- A study guide and quiz summary is posted on BbLearn.

Student Course Evaluations

Remember to fill out the Student Course Evaluation for REM429.

We carefully review evaluations and make changes to accommodate suggestions.

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 consider 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).

Definitions of "landscape ecology"

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 (pattern) for ecological processes.

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

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

Broad-scale environmental issues

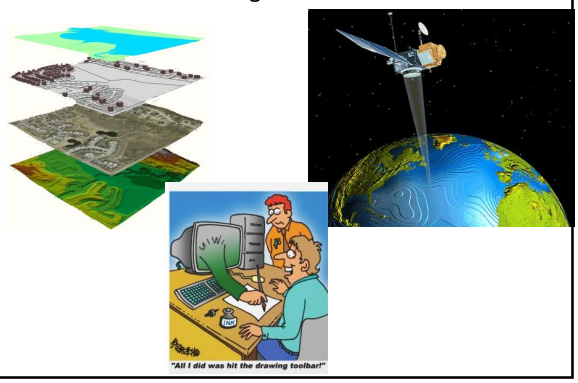
Realization of the importance of scale in ecology, particularly the broad scale

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

Osage Hills, Oklahoma: Changes in fire regime

Coastal oak woodland, California: Sudden Oak Death Syndrome

Landscape Ecology is completely dependent on technological advances



Commonly used terms in landscape ecology

Configuration:

Connectivity:

Corridor:

Edge:

Fragmentation:

Heterogeneity:

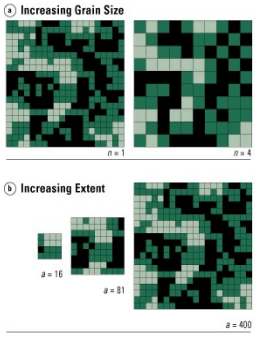
Pattern:

Scale:

Thematic scale:

Source: T,G & O 2001. Table 1.1

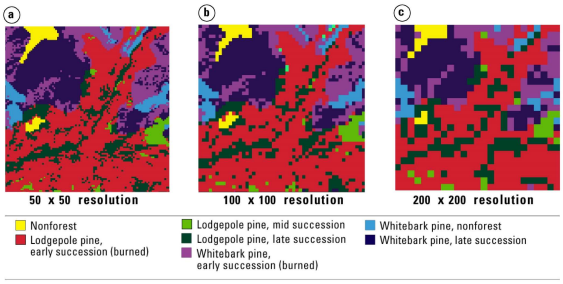
Scale?



- As grain size increases, smaller patches are no longer visible
- As extent increases you often find more patches and more patch types

Source: T,G & O 2001 Figure 2.2

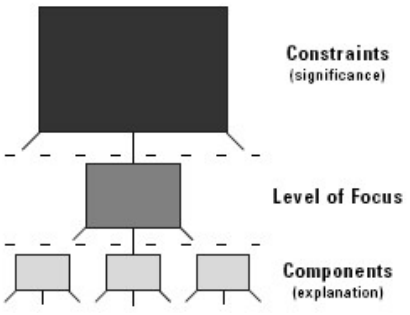
What is the recommended resolution and extent in a study?



The grain size should be <u>two to five</u> times smaller than the feature being analyzed and the extent should be <u>two to five</u> times larger than the largest patch.

O'Neill et al. 1996

Importance of hierarchical level

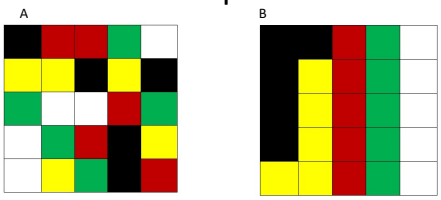


Source: T,G & O 2001. Figure 2.5

Causes of landscape pattern

- **Environmental conditions**
  - Topography, climate, geomorphology, soils, etc.
  - Regional biota
- **Secondary succession** as driven and affected by the biotic processes such as: mortality-natality (birth-death), dispersal, reproductive strategy, disease, herbivory, competition, etc.
- **Disturbance and stress:** human-caused and natural
- **Data and map resolution**
  - Spatial and temporal grain and extent
  - Thematic resolution: # of classes

Landscape metrics



What landscape has the highest patch richness?

What landscape has the highest diversity?

What landscape has the highest interspersion juxtaposition (IJI)?

What landscape has the highest contagion?

Types of landscape metrics:

1. Patch area
2. Patch perimeter
3. Patch shape
4. Core area metrics
5. Diversity and Evenness
6. Isolation/proximity indices
7. Contrast metrics
8. Interspersion metrics
9. Connectivity

Conceptual development of organism-spatial interactions

- Theory of island biogeography (MacArthur and Wilson 1963, 1967, MacArthur 1972)

The number of species on an island is dependent upon: the size of the island and the distance to the mainland source populations.

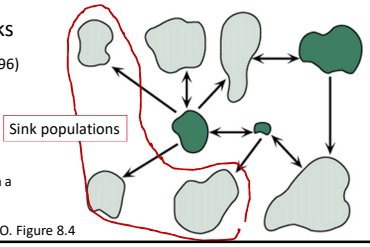
Immigration Rate is dependent upon: distance to mainland, and the size of the mainland source community (number of populations and size of populations)

Extinction Rate is dependent upon: available resources (island size)

Conceptual development of organism-spatial interactions

- Theory of island biogeography (MacArthur and Wilson 1963, 1967, MacArthur 1972)
- Metapopulation theory (Levins 1969, 1970)
- Sources and sinks (Pulliam 1988, Dias 1996)

Source habitats- reproduction is greater than mortality.
Sink habitats where reproduction is less than mortality, producing habitats that without immigration a species would go locally extinct.



T,G & O. Figure 8.4

Why are small populations vulnerable to decline and extinction?

Demographic stochasticity - *random variation in population parameters such as birth rate, death rate and sex ratio.*

Genetic stochasticity - *random genetic processes that can lead to a loss of genetic variation and a reduced capacity for a population to resist recessive lethal alleles, or to respond to changing environmental conditions.*

Environmental stochasticity - *random variation in environmental processes that can affect a population.*

Natural catastrophes such as floods, fire, drought, hurricanes and earthquakes, occur at irregular intervals and can have a major effect on population survival.

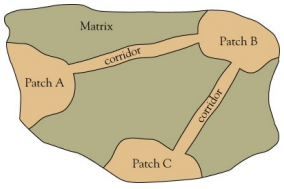
Source: Bennett 2003

Fragmentation has three recognized components:

1- Habitat loss

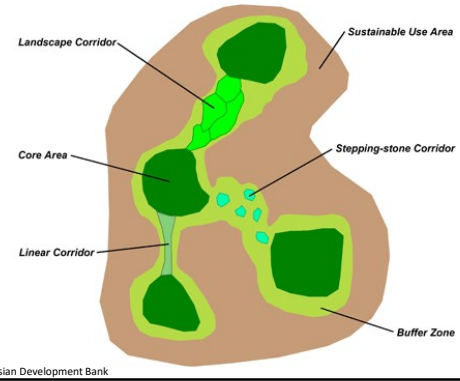
2- Reduction in the size of patches

3- Decreased connectivity between patches (habitat isolation)



Source: Barnes 2000

Biodiversity corridors



Source: Asian Development Bank

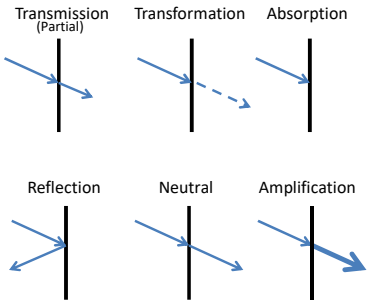
Ecological Boundaries: 4 Main Classes of Boundary Traits

- Origin and maintenance
- Spatial Structure
- Function
- Temporal dynamics

Strayer et al. 2003

Boundary Function

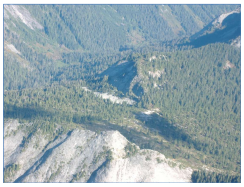
- Transmission
(wind speed is reduced across a forest boundary)
- Transformation
(transformation at oxic-anoxic boundaries)
- Absorption
(the waves at the surf zone)
- Reflection
(the approaching organism turns around, e.g. a fence)
- Neutral
(no effect on the phenomenon at study)
- Amplification
(increased flux at the boundary)



Strayer et al. 2003

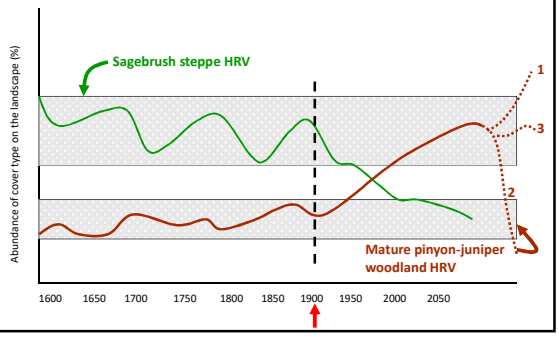
Temporal Dynamics

- Does the boundary change in structure or function over time?
- Mobility (is the boundary stationary or moving)?
- What is the age and history of the boundary?



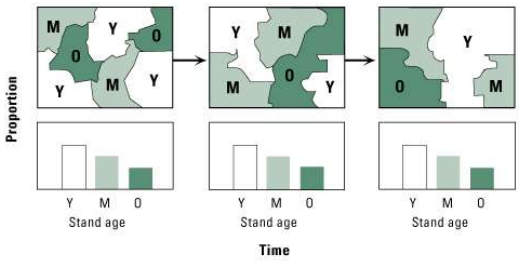
Strayer et al. 2003

Historical Range of Variability (HRV)



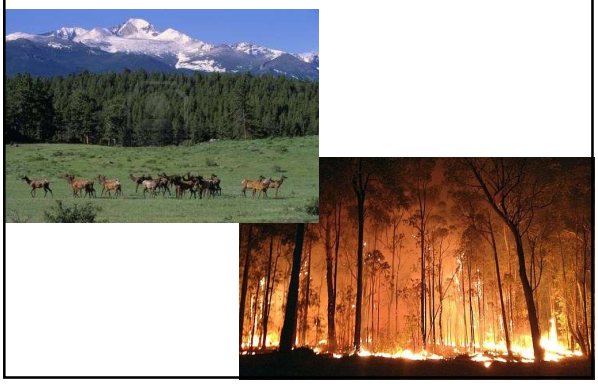
Shifting steady-state concept

Is this system at steady-state over the observed time period?



Source: T, G & O 2001. Figure 7.14

Disturbance versus Stress



Disturbance regimes terminology

Frequency	Mean or median number of events occurring at an average point/time period
Intensity	Physical energy of the event/area/time (e.g., heat released/area/time period, wind speed for storms)
Residuals	Organisms or propagules that survive the disturbance event
Return interval	Mean or median time between disturbances, the inverse of frequency
Rotation period	Mean time needed to disturb an area equivalent to the study area
Severity	Effect of the disturbance on organisms, community or ecosystem
Size	Area disturbed, can be expressed as "mean area"

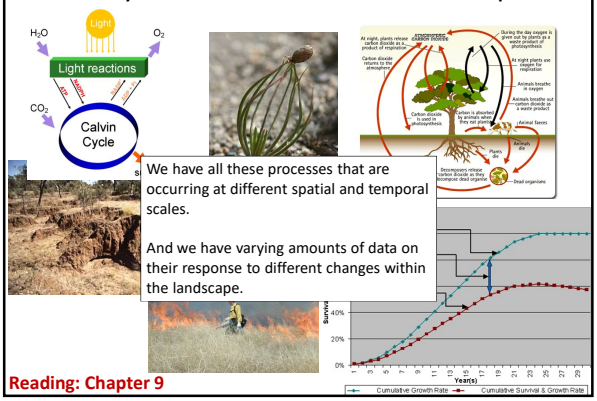
Source: T,G & O 2001, Table 7.1

Disturbance regimes terminology

Continuity	The uniformity of severity of the disturbance across the entire affected area
Synergistic effects	The effects of an earlier disturbance on the response to another disturbance, it may be of the same or different type of disturbance

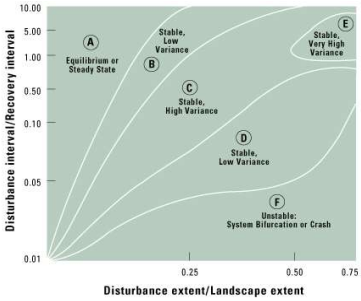
What are some examples of synergistic effects?

Ecosystem Processes in the Landscape



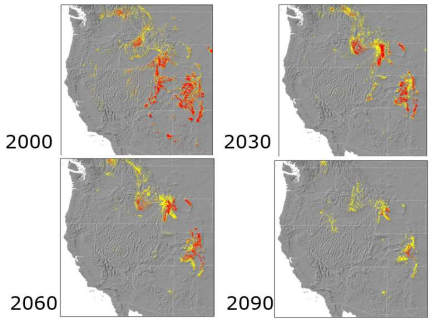
Reading: Chapter 9

System stability



Consider an ecosystem that encompasses a very large area. Disturbances are small (generally < 10% of the land area) and infrequent (every 100 years). The recovery time is slow, it takes 30 years to return to pre-fire conditions. What is the stability of the ecosystem?

Climate change



Conservation Approaches

Relationship between three conservation approaches that land managers may undertake and possible responses of individual species to environmental disruptions.

Component redundancy- suggests that in natural systems greater ecosystem resilience, despite changing climates, may be achieved by increasing species and community redundancy,

Functional redundancy- is the idea that different components of a system can fulfill the same functions, thereby producing the same result.

Increased connectivity- suggests that success is achieved by ensuring that suitable habitats are always within easy reach of one another.

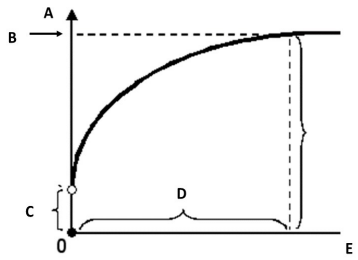
Dunwiddie et al. 2009

Lessons from the 2015 Soda Fire

- Seed from warmer sites had higher success
- Weather after seeding is important, more success if cooler wetter year after seeding
- Better records of the source of seeds and where they are planted is needed

Germino 2017

Semivariogram



Nugget

Sill

Semivariance

Lag distance

Influence range

Definition of "biological invasive species":

A species whose introduction and subsequent in an ecosystem alters how that ecosystem functions. The changes caused may be related to: competition for resources, species recruitment, nutrient cycling, probability of disturbance or many other ecosystem processes.

The presence of the biological invasive species results in the partial or complete replacement of the native community.

Most ecologists reserve this term for non-native species, but it has also been applied to native species in some instances.

Related terms that are often confused with Biological Invasive Species

Exotic species-

Weed-

Noxious weed-

Ecology of Human-Dominated Landscapes

Rural Iowa

Seattle, Washington

Why is the ecology of human-dominated landscapes important?

Agriculture and Biodiversity – How?

- Avoid converting sensitive or priority habitats to agricultural production.
- Where possible, restore sensitive habitats using native vegetation that historically occupied the site, focusing on areas identified by landscape scale plans.
- Maintain vegetation around water bodies to provide functioning ecological systems that support fish and wildlife.
- Manage habitats on farms/ranches with an eye toward the larger landscape and needs of wide-ranging species; connected patches are generally best, however, some species need large continuous areas.
- Prevent the introduction and spread of invasive species of plants and animals.
- Manage crop and rangelands to meet the habitat needs of fish and wildlife.
- Develop a working knowledge of the native plants and animals found in the area and if possible monitor for selected indicator species from different groups.

foodalliance.org

What is ecosystem resilience?

Ecosystem resilience is the capacity of an ecosystem to tolerate disturbance without collapsing into a qualitatively different state that is controlled by a different set of processes.

A resilient ecosystem can withstand shocks and rebuild itself when necessary.

Resilience in social systems has the added capacity of humans to anticipate and plan for the future.

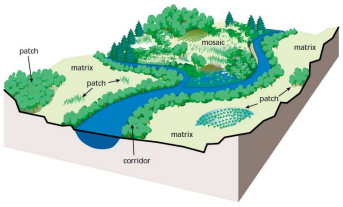
Landscape ecology can contribute to a variety of applications including:

- land use planning
- land management
- risk assessment
- broad-scale monitoring

Applications of landscape ecology require integration and synthesis.

There will never be enough data.

Decisions will have to be made without full certainty.



Grand Challenges of Landscape Ecology

Thank you for participating in Landscape Ecology this semester!

REM 429 is open for student evaluations through Sunday 6-MAY-18

Fill out the evaluation, tell us what you like, and give suggestions for how we could improve the course.