



# Landscape Ecology

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1. **Landscape**: an area that consists of more than one ecosystem.
2. **Ecosystem**: A group of various populations in one area and their interactions among each other and with their environment
3. **Heterogeneity**: A landscape with many different ecological patterns and structures.
4. **Pattern**: The ordered contents of a landscape.
5. **Structure**: Is a definition of the size and distribution of pattern.
6. **Scale** is a representation of actual distances and/or time frame of events.

7. **Patch**: A homogeneous area different to other areas around it. A patch is the lowest ranked unit of a landscape.
8. **Mosaic**: is a series of patches connected together directly or via *corridors*.
9. **Corridor**: A particular kind of patch connecting two separate patches.
10. **Edge**: In ecology, an edge is the area on the perimeter of a patch.
11. **Boundary**: The area including the edges of two adjacent, intersecting patches.

## 10. Types of boundaries:

1. Ecotone: Transitional zone between two communities.
2. Ecocline: The lines of different communities that exist within an ecotone.
3. Ecotope: similar area in an ecotone. They might be distinct and relatively far spaced but have similar characteristics and thus life structure.

11. **Disturbance**: an event that alters the process of change or stability of a patch or a mosaic of patches.

12. **Fragmentation**: The cutting and breaking up of a large patch into many smaller ones separated by a new and different kind of patch.

# **Elements of landscape**

- Natural
- Manmade

<b>Natural</b>	<b>Manmade</b>
Plants/vegetation	Brick
Water	Metal
Earth forms/landforms	Plastic
Timber	Glass
Stone	

- There are many varieties of **plant** materials such as:
  - Trees
  - Shrubs
  - Creepers and climbersLand covers .etc.
- **USES:**

<b>Environmental</b>	<b>Architectural</b>
<ol style="list-style-type: none"><li>1. Microclimate modifiers</li><li>2. Conservation belt</li><li>3. Erosion control</li><li>4. Retains ground water</li><li>5. Retains soil fertility</li><li>6. Prevents siltation</li></ol>	<ol style="list-style-type: none"><li>1. Enframingent</li><li>2. Scale induction</li><li>3. Creation of plaza</li><li>4. Defines pathway</li><li>5. Welcoming look and aesthetic appeal to the building</li></ol>

- **Plants** create outdoor rooms. Trees, shrubs, and ground covers can be used to emphasize the desirable **architectural lines and masses**.
- Plants can be used to **soften and balance** harsh and awkward architectural angles, masses and materials.



- **Water** is also another most important landscape element.
- Water bodies **improve the quality and the worth of the site**.it makes the site attractive.
- There are many types of water bodies :
  - 1.Fountains
  - 2.Pools
  - 3.Ponds
  - 4.Spouts
  - 5.Artificial waterfalls. etc.

**Water** flows inevitably, from the source to the receiving ocean basin. This continuity of rivulets, streams and rivers can be readily observed.

- **USES:**

1. Excellent land water interface gives an ecological home for the animals and plants.
2. Water runoff reduced.
3. Microclimate created.
4. Moisture level maintained.
5. Wetland, marshes, swampy areas are conserved.
6. Maintaining vegetation into wetlands.
7. Hydrological cycle maintained.
8. Site aesthetics are enhanced

- **Stones** are hard, impermeable, inorganic elements used extensively in landscape architecture.
- Stones are basically used for the following:
  1. Paving
  2. Retaining wall
  3. Stacked stone wall
  4. Sitting
  5. Shelters
  6. Parapets
  7. Bridges
  8. Sculptures
  9. Planters
  10. Boulders

# Landscape Ecology



- Landscape ecology is the study of structure, function, and change in a heterogeneous land area composed of interacting ecosystems.
- It is an interdisciplinary science dealing with the interrelationship between human society and our living space.

# Landscape Defined



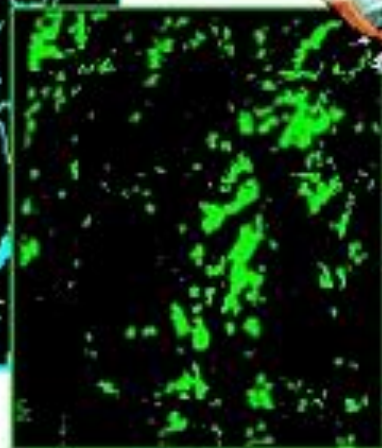
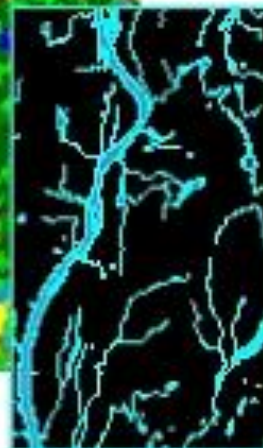
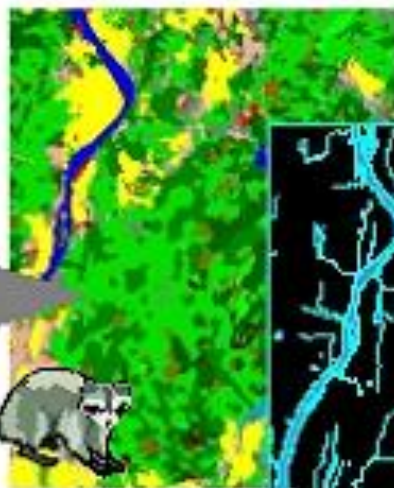
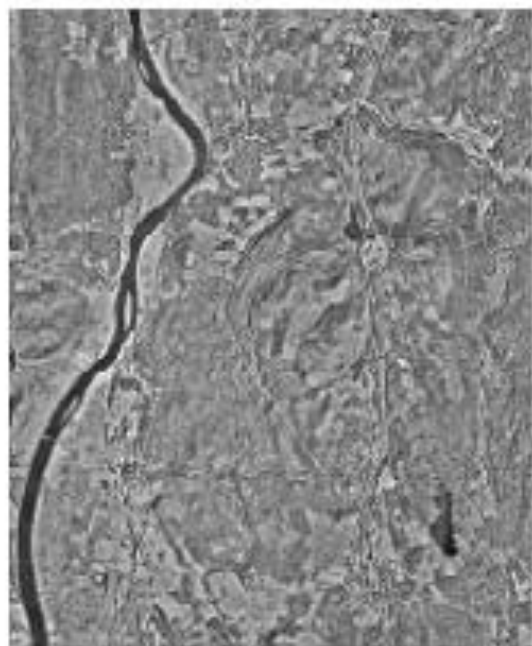
- From an *ecological* perspective, a landscape is a mosaic of interacting ecosystems (at any scale); an area spatially heterogeneous in at least one factor of interest.





# Landscape Defined

- From a *wildlife* perspective, a landscape is a heterogenous distribution of habitat (patches or gradients).



# Landscape Defined

How About...

- From a *silvicultural* perspective?
- From a *fuels* (fire management) perspective?
- From a *hydrological* perspective?
- From a *recreational* perspective?
  - Other perspectives?





# Landscape Defined – Key Point



- A landscape is not necessarily defined by its size; rather it is defined by a spatially heterogeneous area relevant to the phenomenon under consideration.



## Landscape Defined – In Practice



- **HOWEVER**, from a *management* perspective, it is most useful to consider landscapes as having a large extent (1,000's-10,000's of hectares) composed of an interacting mosaic of ecosystems and encompassing populations of many species.





# The Landscape Concept – Structure & Function

- Landscapes vary markedly in *structure* (pattern) and *function* (process) due to natural and anthropogenic factors.



Colorado

Massachusetts



- Landscapes vary in the role of humans in creating and affecting the patterns and processes.



Colorado

Idaho



# **Scale and heterogeneity** (incorporating composition, structure, and function)

- A main concept in landscape ecology is scale.
- Scale represents the real world as translated onto a map, relating distance on a map image and the corresponding distance on earth.
- Scale is also the spatial or temporal measure of an object or a process, or amount of spatial resolution.

## **Components of scale**

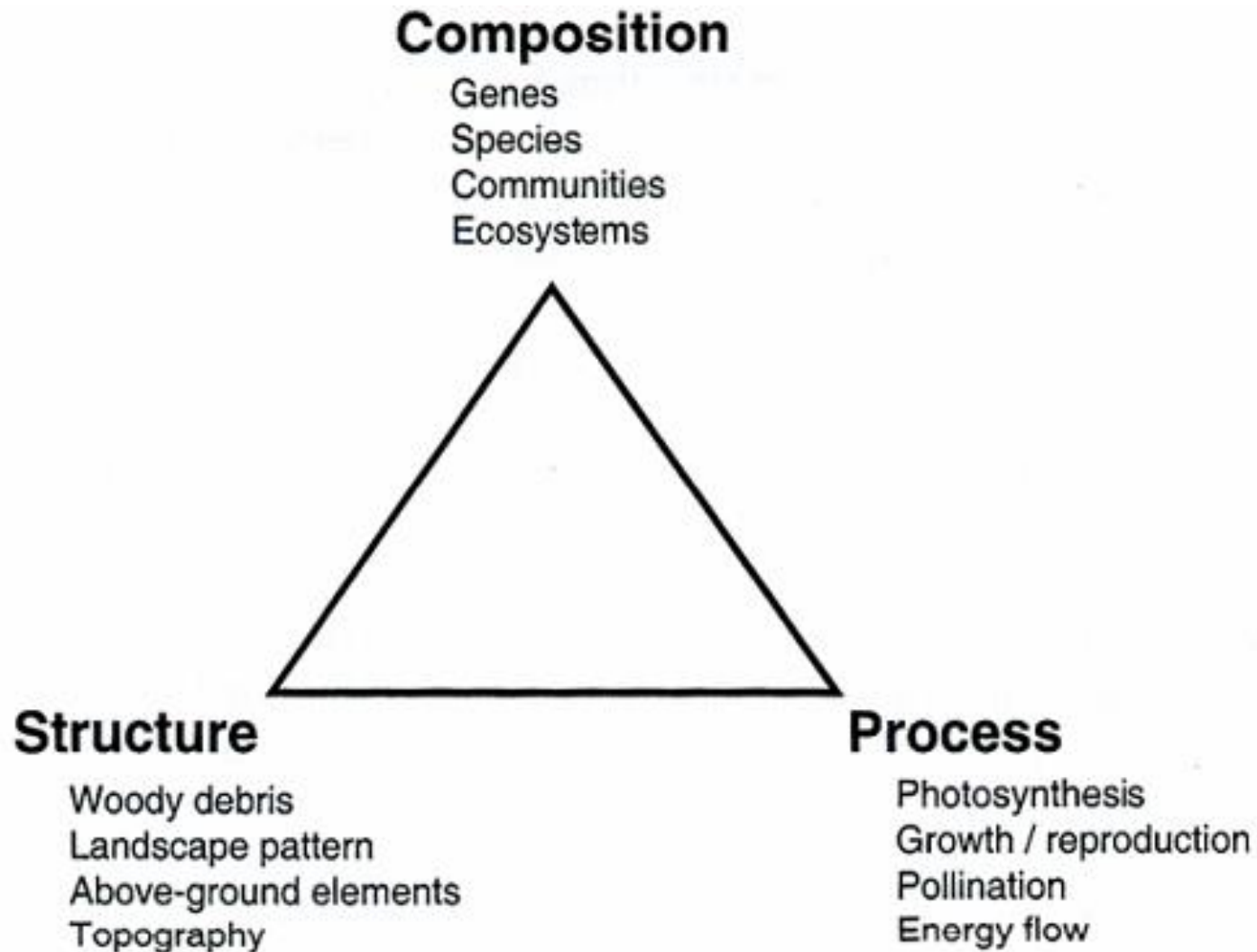
- include composition, structure and function, which are all important ecological concepts.

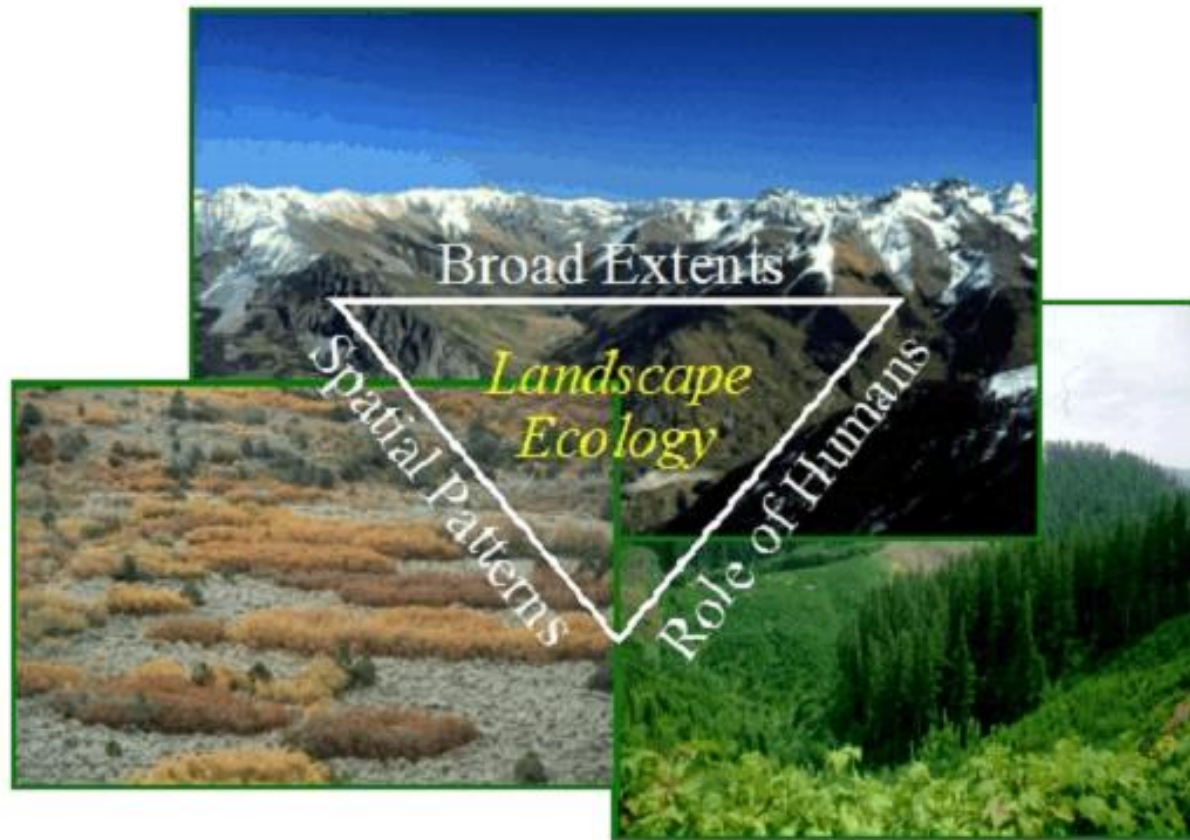
# Principles of Landscape Ecology

- To understand landscape ecology, we have to focus on some of its important principles: landscape composition, structure, function, and change.
  - Composition involves the genetic makeup of populations, identity and abundance of species in the ecosystem, and the different types of communities present.

- Structure involves the variety of habitat patches or ecosystems and their patterns—the size and arrangement of patches, stands, or ecosystems—including the sequence of pools in a stream, vertical layering of vegetation.
- Function involves climatic, geological, hydrological, ecological, and evolutionary processes such as seed dispersion or gene flow.
- Change involves the continual state of flux present in ecosystems.

Landscape ecology, as the name implies, is the study of landscapes; specifically, the composition, structure and function of landscapes.





Landscape ecology is perhaps best distinguished by its focus on: 1) spatial heterogeneity, 2) broader spatial extents than those traditionally studied in ecology, and 3) the role of humans in creating and affecting landscape patterns and process.



# Landscape Ecology.....*focus on spatial heterogeneity and pattern*



- How to characterize it...
- Where it comes from...
- How it changes over time...
- Why it matters...
- How humans manage it...



# Landscape Ecology.....*focus on broader spatial extents*



- Landscape ecology OFTEN focuses on spatial extents that are much larger than those traditionally studied in ecology...but the emphasis is on spatial pattern at the relevant scale.





# Landscape Ecology.....*focus on the role of humans*



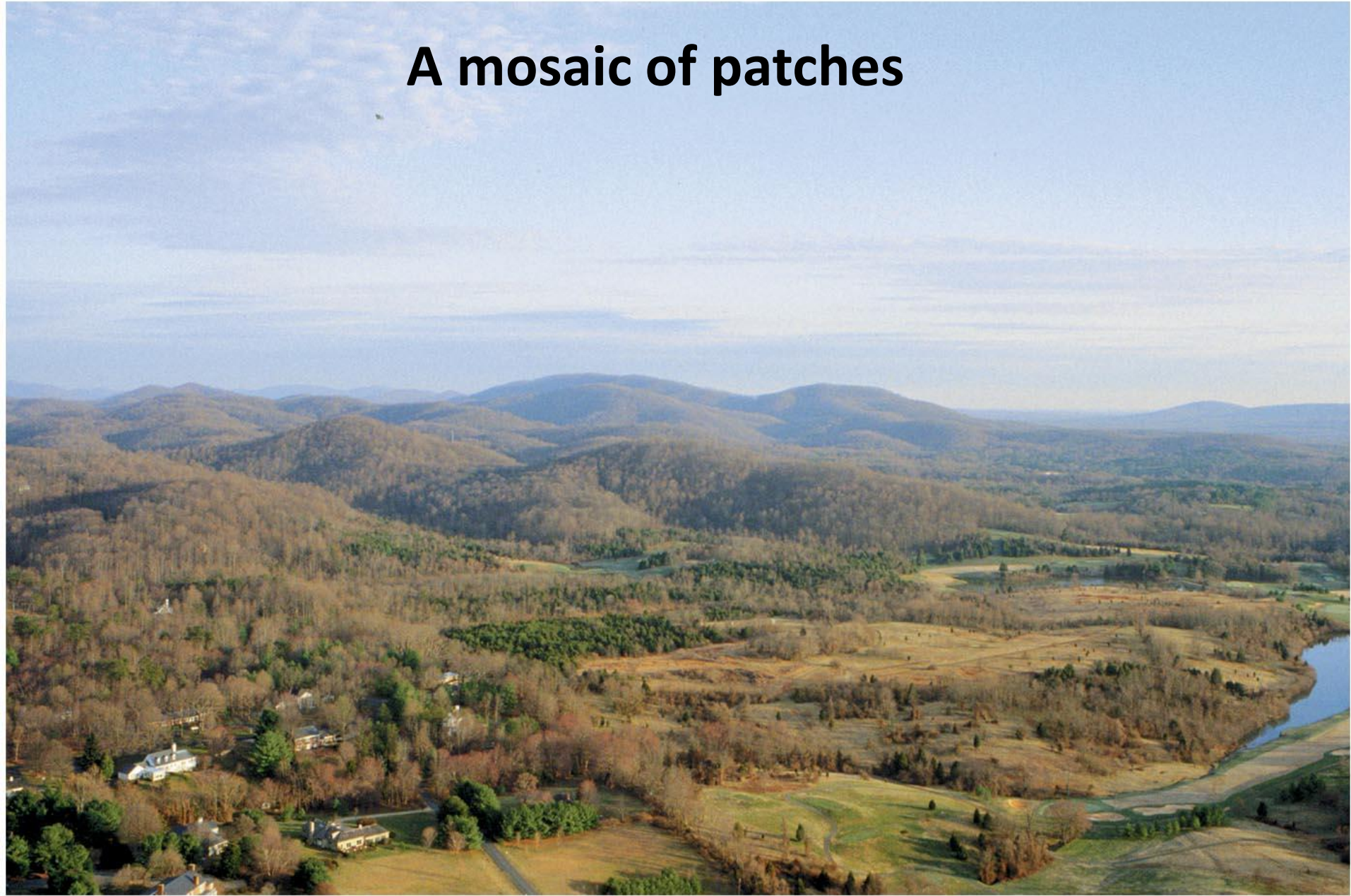
- Landscape ecology OFTEN focuses on the role of humans in creating and affecting landscape patterns and processes...but humans are but one, albeit dominant, agent.



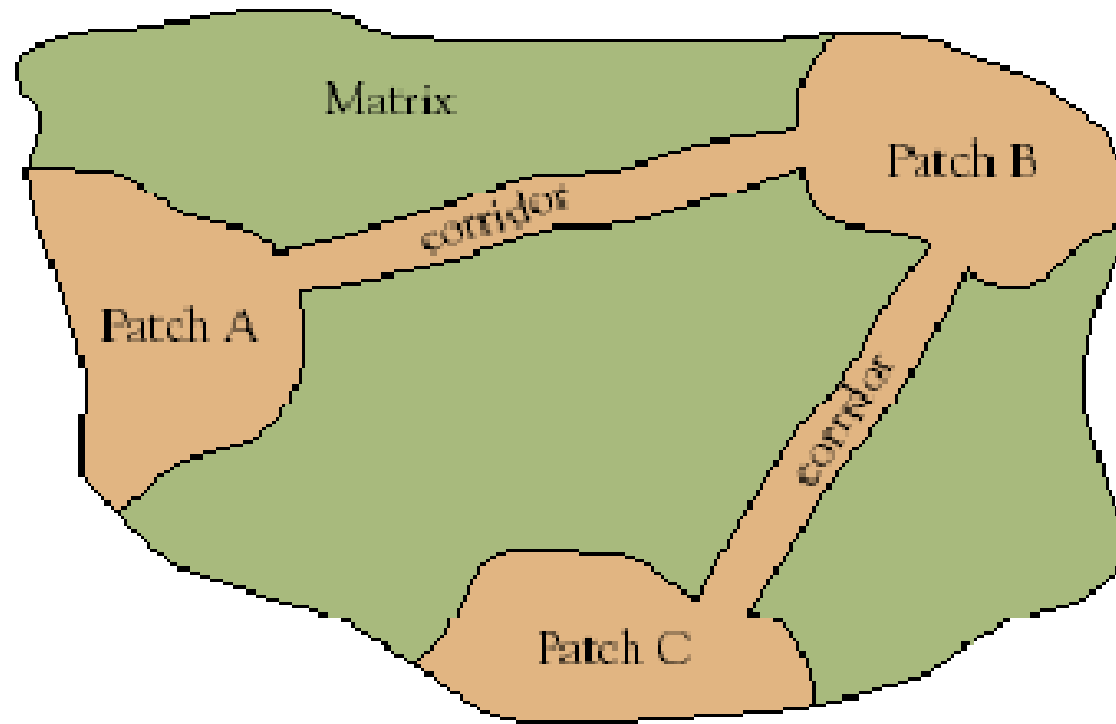
- A landscape consists of three main components: a matrix, patches, and corridors.
- If we understand these components and their interrelationships, we can make better management decisions at the landscape level.



# A mosaic of patches



## Landscape structure



*Landscapes consist of the matrix (the dominant feature), patches, and corridors that connect the patches.*

- The matrix, the dominant component in the landscape, is the most extensive and connected landscape type, and it plays the dominant role in landscape functioning.
- If we try to manage a habitat without considering the matrix, we will likely fail to provide what wildlife need in that area.

- The characteristics of matrix structure are the density of the patches (porosity), boundary shape, networks, and heterogeneity.
- If an area has been broken up but the patches are fairly close together, the patches are still dense enough to be useful for animal movement.



# Patches

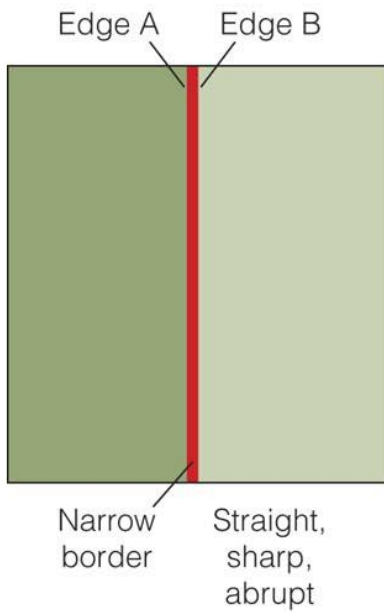
- Patches are nonlinear surface areas that differ in vegetation and landscape from their surroundings.
- They are units of land or habitat that are heterogeneous when compared to the whole.
- They include four different types: disturbance, remnant, environmental resource, and introduced

- Disturbance patches are either natural or artificial. They result from various activities, including agriculture, forestry, urbanization, and weather. If left alone, a disturbance patch will eventually change until it combines with the matrix.
- Remnant patches result when humans alter the landscape in an area and then leave parcels of the old habitat behind. Remnant patches are generally more ecologically stable and persist longer than disturbance patches.
- Environmental resource patches occur because of an environmental condition.

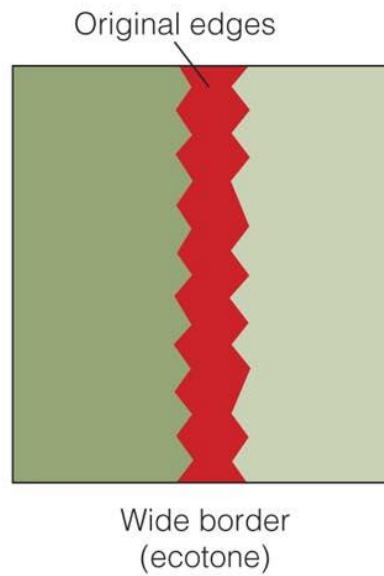
- Introduced patches are ones in which people have brought in nonnative plants or animals or rearranged native species.

Animals moving from one area to another can also bring in these nonnative elements.

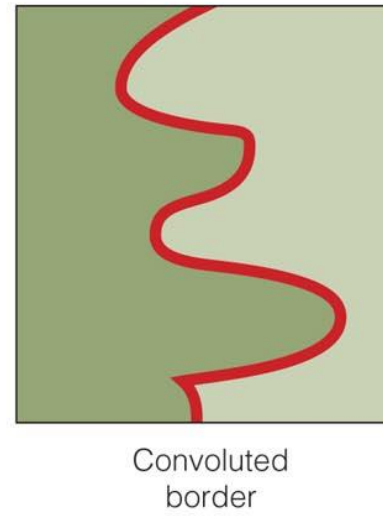
# Borders between patches



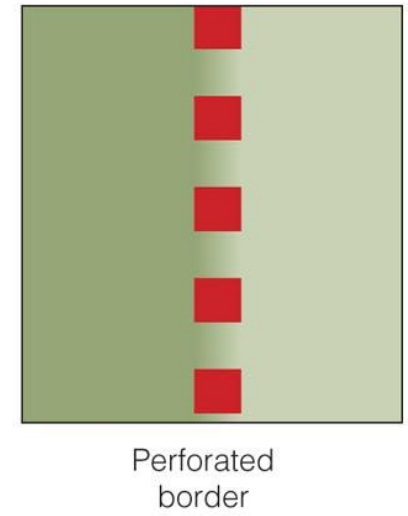
(a)



(b)



(c)



(d)

# Corridors

- Corridors are linear landscape elements that can be defined on the basis of structure or function.
- Forman and Godron (1986) define corridors as **“narrow strips of land which differ from the matrix on either side. Corridors may be isolated strips, but are usually attached to a patch of somewhat similar vegetation.”**
- Three different types of structural corridors exist:
  - (1) **Line corridors**, in which the width of the corridor is too narrow to allow for interior environmental conditions to develop;
  - (2) **Strip corridors**, in which the width of the corridor is wide enough to allow for interior conditions to develop; and
  - (3) **Stream corridors**, which are a special category.

# Corridors on the basis of their function in the landscape

- **Habitat Corridor.** - Linear landscape element that provides for survivorship, natality, and movement (i.e., habitat), and may provide either temporary or permanent habitat. Habitat corridors **passively increase landscape connectivity** for the focal organism(s).
- **Facilitated Movement Corridor.**—Linear landscape element that provides for survivorship and movement, but not necessarily natality, between other habitat patches. Facilitated movement corridors **actively increase landscape connectivity** for the focal organism(s).
- **Barrier or Filter Corridor.**—Linear landscape element that prohibits (i.e., barrier) or differentially impedes (i.e., filter) the flow of energy, mineral nutrients, and/or species across (i.e., flows perpendicular to the length of the corridor). Barrier or filter corridors **actively decrease matrix connectivity** for the focal process.
- **Source of Abiotic and Biotic Effects on the Surrounding Matrix.**—Linear landscape element that **modifies the inputs of energy, mineral nutrients, and/or species** to the surrounding matrix and thereby effects the functioning of the surrounding matrix.

# Ecotones, ecoclines and ecotopes

- A type of boundary is the **ecotone** or the transitional zone between two communities.
- Ecotones can arise **naturally** (lakeshore) or can be **human-created** (a cleared agricultural field from a forest).
- The **ecotonal community** retains characteristics of each bordering community and often contains species not found in the adjacent communities.
- Classic examples of ecotones include forest to marshlands transitions, forest to grassland transitions, or landwater interfaces in forests.

- An **ecocline** is another type of landscape boundary, but it is a gradual and continuous change in environmental conditions of an ecosystem or community.
- Ecoclines help explain the distribution and diversity of organisms within a landscape because certain organisms survive better under certain conditions, which change along the ecocline.
- They contain heterogeneous communities which are considered more environmentally stable than those of ecotones.



- An **ecotope** is a spatial term representing the smallest ecologically distinct unit in mapping and classification of landscapes.
- Relatively homogeneous, they are spatially explicit landscape units used to stratify landscapes into ecologically distinct features.
- They are useful for the measurement and mapping of landscape structure, function and change over time and to examine the effects of disturbance and fragmentation.

# Disturbance and fragmentation

- Disturbance is an event that significantly alters the pattern of variation in the structure or function of a system.
- Fragmentation is the breaking up of a habitat, ecosystem, or landuse type into smaller parcels.
- Disturbance is generally considered a natural process.
- Fragmentation causes land transformation, an important process in landscapes as development occurs.
- An important consequence of repeated, random clearing (whether by natural disturbance or human activity) is that **contiguous cover can break down into isolated patches.**
- This happens when the area cleared exceed a critical level, which means that landscapes exhibit two phases: **connected and disconnected.**

***Fragmentation can also be thought of  
as “a disruption of continuity”***



Original Landscape



Modified Landscape



Fragmentation



Effects  
On



Landscape Patterns:

- Size of Tracts
- Shape of Tracts
- Degree of Isolation

Biotic Phenomena:

- Species Richness
- Population Size
- Nest Predation
- Nest Parasitism
- Animal Behavior



# Main underlying Causes of Fragmentation

- Agriculture
- Urban development
- Logging
- Mining
- Roads
- Hydroelectric dams
- Groundwater extraction



Source: Bureau of Land Management/ photo by Robyn Hertz