Ecotones

The word Ecotone was coined by Alfred Russel Wallace, 1859 who first observed the abrupt boundary between two biomes.

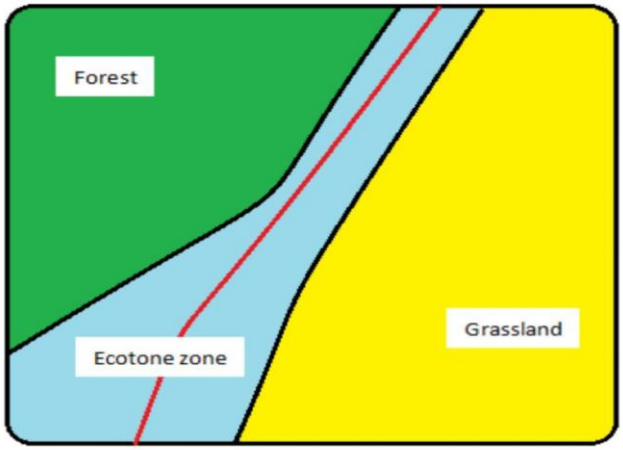
Ecotone is a transitional zone between two different ecosystems, where species from both ecosystems coexist and interact. It acts as a boundary and can vary in size, ranging from narrow to wide. Ecotones often display a unique combination of species and ecological processes that differ from those found in the adjacent ecosystems.

An ecotone is a transition area between two different ecological communities (biomes), where there is often a high degree of biodiversity and species richness.

Ecotones have distinct characteristics and features that contribute to their ecological importance. By understanding the significance of ecotones in ecosystems and the impact of human activities on them, we can develop effective conservation and management strategies.

What are ecotones?

When an ecosystem (or community) changes abruptly from one to another, that zone is called an ecotone. This is a fundamental characteristic of landscapes that is often studied by landscape ecologists. This zone can traverse long stretches along two ecosystems and is a place where characteristics of both ecosystems can be seen. Therefore, it makes for a completely different habitat!



A forest-grassland ecotone

The classic example of an ecotone is the transition from a forest to a grassland ecosystem. As the conditions of temperature and rainfall varies, you tend to see a slow change in the tree composition of the forest. Quite suddenly, the forest will give way to the open spaces of a grassland.

Features of Ecotones

1. It may be narrow (between grassland and forest) or wide (between forest and desert).
2. Ecotones exhibit a relatively high level of species diversity due to the overlapping of species from different ecosystems.
3. Represent a transition in the living conditions: both in habitats and niches.
4. Organisms from both communities face increasing environmental stresses(it is a zone of tension).
6. A sharp boundary or a gradual blending effect.
7. Diversity leads to stability in nature; with greater vegetation complexity and landscape elements, many different organisms can survive in ecotones.

For example, terrestrial organisms will come towards the river bank to drink water. Birds often thrive in these ecotones as they get fish for food.

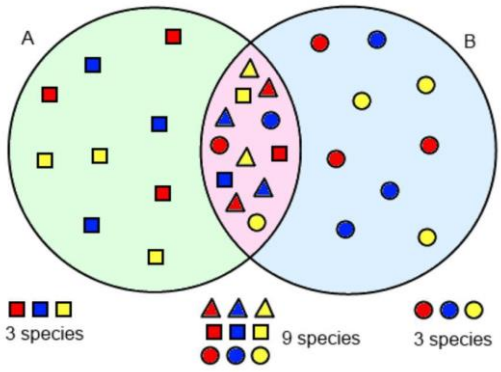
Ecotones are harsh conditions for interior organisms but zones of opportunities for edge organisms. Disturbances often create ecotones, but they also exist as natural transitions between biomes or ecosystems

Edge Effects

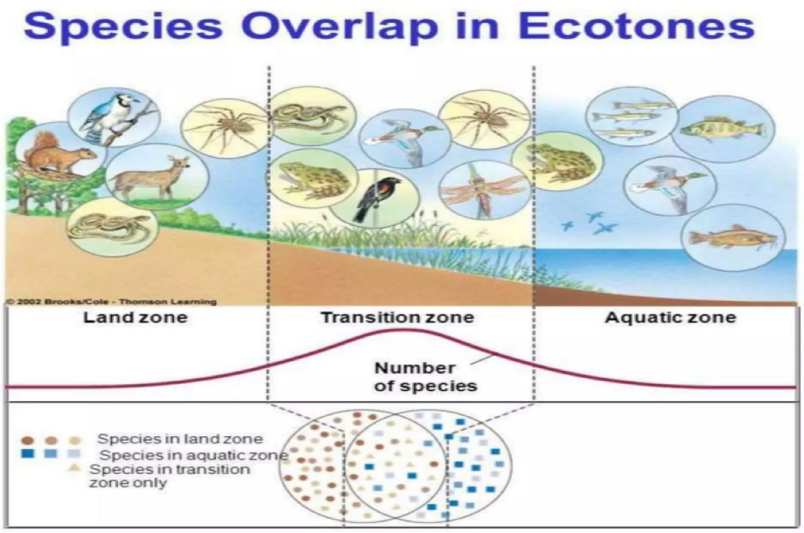
Disturbances can fragment ecosystems and create **edge effects** **which refers to the changes in population or community structures that occur at the boundary of two habitats (ecotones).**

An edge effect describes the differing abiotic and biotic conditions that exist at a border between contrasting environments in an ecosystem – the increased light, greater wind and temperature extremes and lower humidity at the boundaries of fragments favor some plant species over others (native colonizing species or invasive species)– this can make the combination of species present near the boundary different from that inside the fragment and occur abundantly in this zone and known as **edge species.**

Edges arise where two or more habitat types come into contact as here in Pennsylvania, United States.

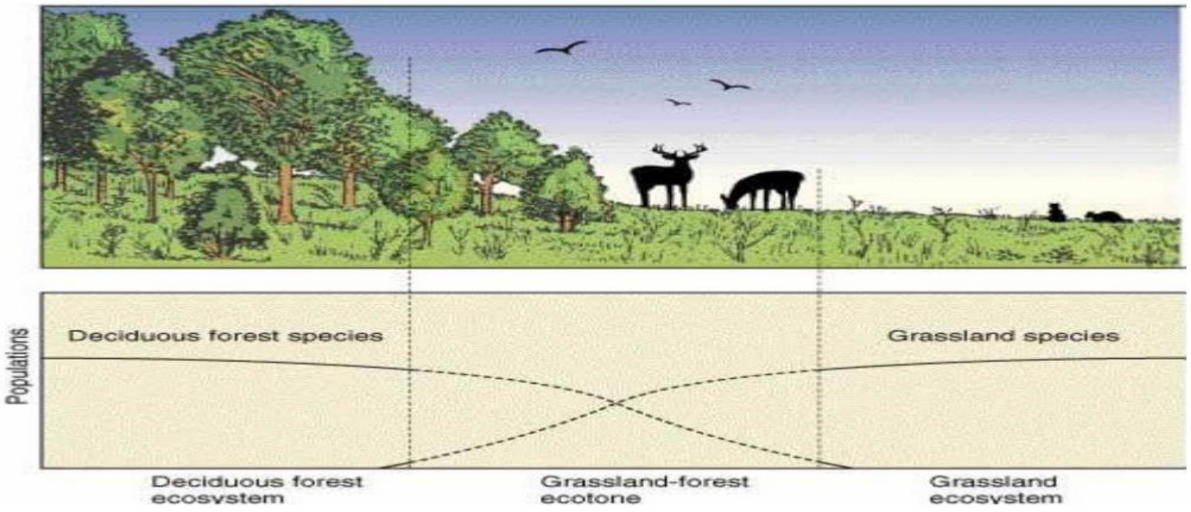


For example the density of birds is greater in the ecotone between the forest and the desert.



Types of Edge effect

1. Inherent—Natural features stabilize the border location.
2. Induced—Transient natural disturbances (e.g., fire or flood) or human related activities, subject borders to successional changes over time.
3. Narrow—One habitat abruptly ends and another begins (e.g. an agricultural field).
4. Wide(ecotone) —A large distance separates the borders of two clearly and purely definable habitats based upon their physical conditions and vegetation, and in between there exists a large transition region.
5. Convoluted — The border is non-linear.
6. Perforated — The border has gaps that host other habitats.



Ecocline is a zone of gradual and continuous change- from one ecosystem to another. When there is no sharp boundary between two in terms of species composition. It occurs across the environmental gradient. For example

1. Thermocline: gradual change in temperature.

2. Halocline: gradual change in salinity.

Formation of ecotones

An ecotone can basically be formed in two ways:

1. Natural Ecotones- can be formed through abiotic factors such as changes in soil composition. Ecotones are very common on mountain ranges due to a wide variety of climatic conditions observed on the slopes of mountains.

2. Human interaction Ecotones- can also be formed as a result of human interaction. For example, the transition between areas of forest and cleared land.

FIG:- NATURAL ECOTONE

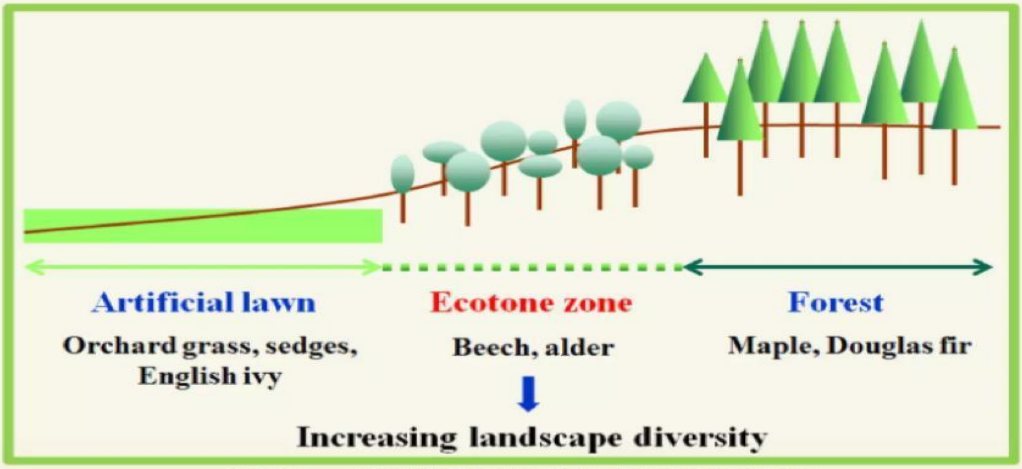


FIG:- ARTIFICIAL ECOTONE

Importance of Ecotones in Ecosystems

Ecotones play a crucial role in maintaining biodiversity and facilitating ecological processes:

1. The Ecotone has the characteristics of two bordering ecosystem. As a result, it has a very high density of organisms and variety of species can be found in an ecotone.
2. They act as a bridge for gene - flow from one community to other and provide habitat to large number of species..

3. An ecotone act as a buffer – zone protecting the neighboring ecosystem from possible environmental damage. For example Mangrove forests provide a natural buffer against Tsunamis and a wetland could absorb pollutants to prevent them from entering into an estuary.

4. Ecotones can act as indicators of ecological health and changes in environmental conditions. They may be sensitive to changes in climate, land use, or pollution, providing early signals of ecosystem stress or alteration.

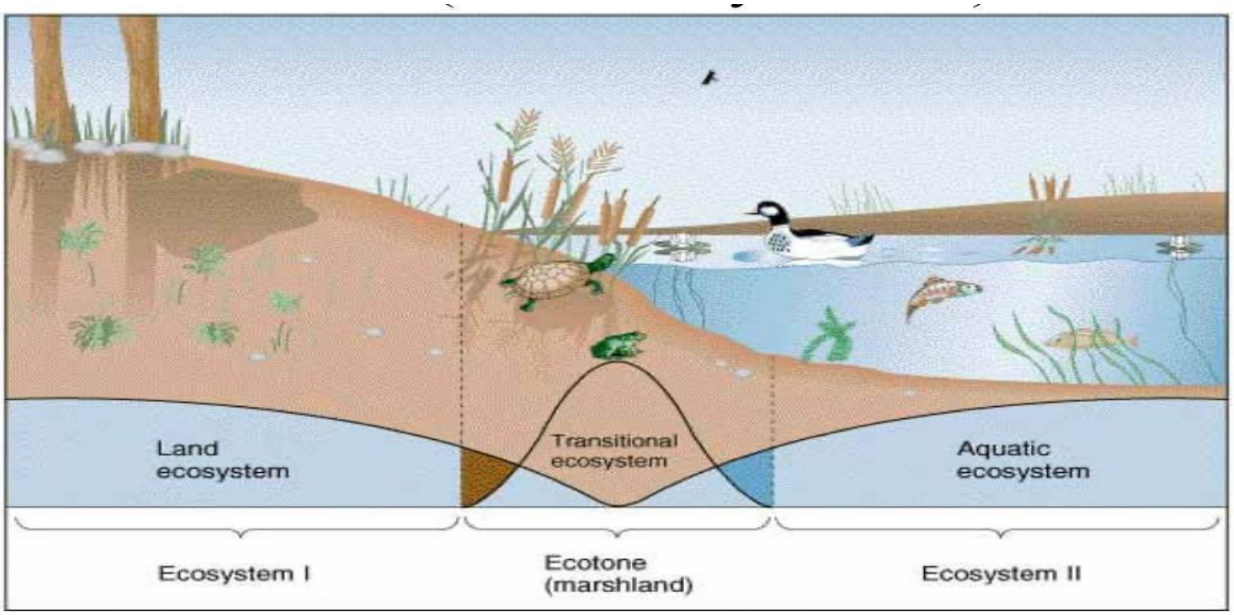
5. Ecological Services: Like other biodiverse areas, ecotones provide essential ecological services, such as water purification, soil formation, and carbon sequestration, which are vital for environmental health and human well-being.

6. Research and Education: For scientists and educators, ecotones provide valuable opportunities for research and learning about ecological processes, species interaction, and habitat management.

Examples of Ecotones in Nature

1. **Mangrove forest transition zones :**between marine and terrestrial ecosystem.
2. **Riverbanks or marshlands:** between dry and wet.
3. **Coastal dunes:** between land and ocean ecosystems,
4. **Mountain tree lines:** The zone between forested and alpine ecosystems.
5. **Estuary:** between freshwater and saltwater.
6. Grassland: between desert and forest.

"The blending of two ecosystems in an ecotone creates a unique tapestry of life, providing opportunities for interactions and adaptations that enrich the overall ecological fabric."



Human Impact on Ecotones

Human activities such as urbanization, agriculture, and infrastructure development can disrupt and fragment ecotones, resulting in habitat loss and species decline. Human activities have significance impact on ecotones often leading to ecological imbalances. These are some effects:

1. Habitat Fragmentation: Development activities like urbanization, agriculture, and road construction fragment habitats, altering or destroying ecotones. This fragmentation can impede the movement of species, reduce genetic diversity, and disrupt ecological processes.

2. Pollution: Pollution from industrial, agricultural, and urban sources can degrade ecotones. Chemical pollutants, plastics, and other waste materials can disrupt the delicate balance of these transition zones, affecting both terrestrial and aquatic species.

3. Climate Change: Climate change alters temperature and precipitation patterns, impacting ecotones. These changes can shift the boundaries of ecosystems, leading to the loss of species that are adapted to specific conditions in ecotones.

4. Introduction of Invasive Species: Human activities can introduce non-native species into ecotones, which may become invasive. These species can outcompete native flora and fauna, leading to reduced biodiversity.

5. Resource Exploitation: Overexploitation of resources like water, timber, and minerals can lead to degradation of ecotones. Such practices can lead to soil erosion, habitat loss, and a decline in ecosystem services.

6. Altered Fire Regimes: Changes in land use and climate can alter natural fire regimes, impacting ecotone areas significantly. This can lead to either an increase in fire frequency and intensity or suppression of natural fires, both of which can have profound ecological impacts.

Understanding and mitigating these impacts is crucial for conserving ecotones and maintaining ecological balance.