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Environment for General Studies UPSC

By Dhiraj Rajpurohit

ENVIRONMENT

The word 'environment' is derived from the old French word '**environer**' – which means to 'surround, enclose, and encircle'.

Environment means anything that surround us. It can be living things (biotic) or non-living (abiotic) things. It includes physical, chemical and other natural forces.



Environment includes the living and nonliving things that an organism interacts with, or has an effect on it. Living elements that an organism interacts with are known as biotic elements: animals, plants, etc., abiotic elements are non living things which include air, water, sunlight etc. Studying the environment means studying the relationships among these various things. An example of interactions between non-living and living things is plants getting their minerals from the soil and making food using sunlight. Predation, an organism eating another, is an example of interaction between living things.

These interactions shape the **habitat** and **ecosystem** of an organism.

Habitat

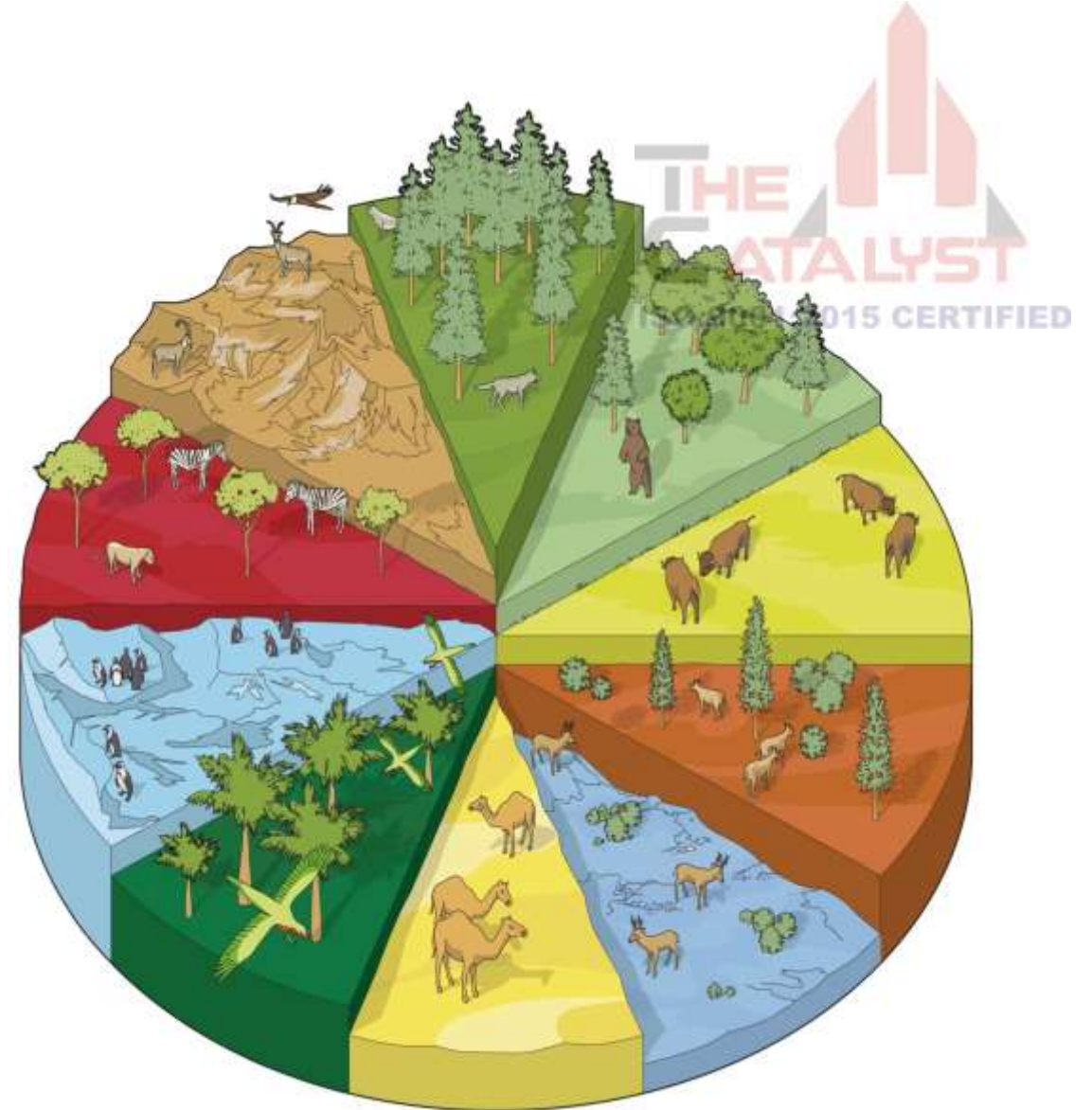
Habitat is the **physical environment in which an organism lives** (address of an organism).

Many habitats make up the environment.

A single habitat may be common for more than one organism which have similar requirements.

For example, a single aquatic habitat may support a fish, frog, crab, phytoplankton and many others.

The various species sharing a habitat thus have the same 'address'. E.g. Forest, river etc.



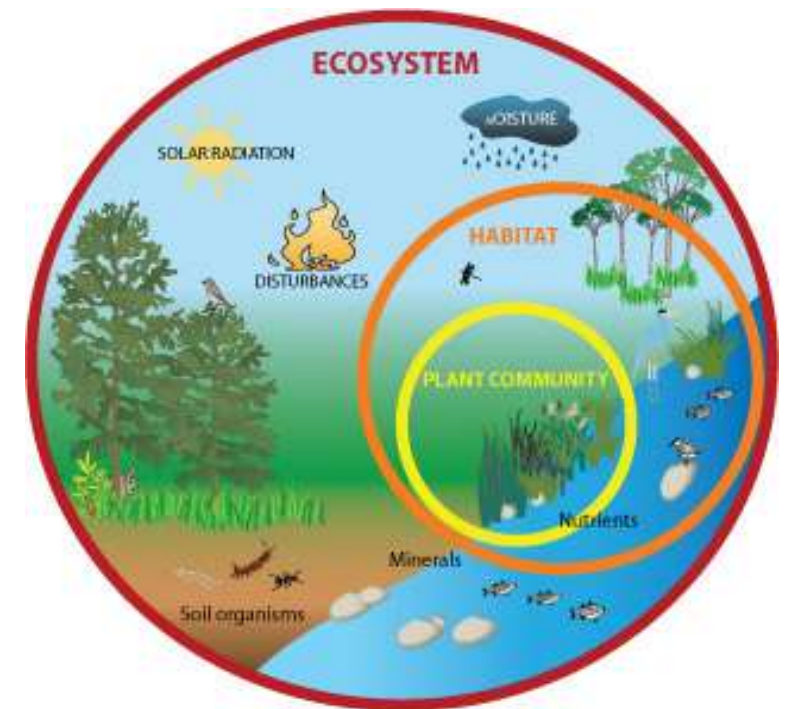
Ecosystem

An ecosystem is a **functional unit of nature (environment/biosphere)**, where living organisms (producers, consumers, and decomposers) interact among themselves and also with the surrounding physical environment.

In the ecosystem, biotic and abiotic components are linked together through **nutrient cycles** and **energy flows**.

Forest, grassland and desert are some examples of **terrestrial ecosystems**; pond, lake, wetland river and estuary are some examples of **aquatic ecosystems**.

Crop fields and an aquarium are human-made ecosystems.

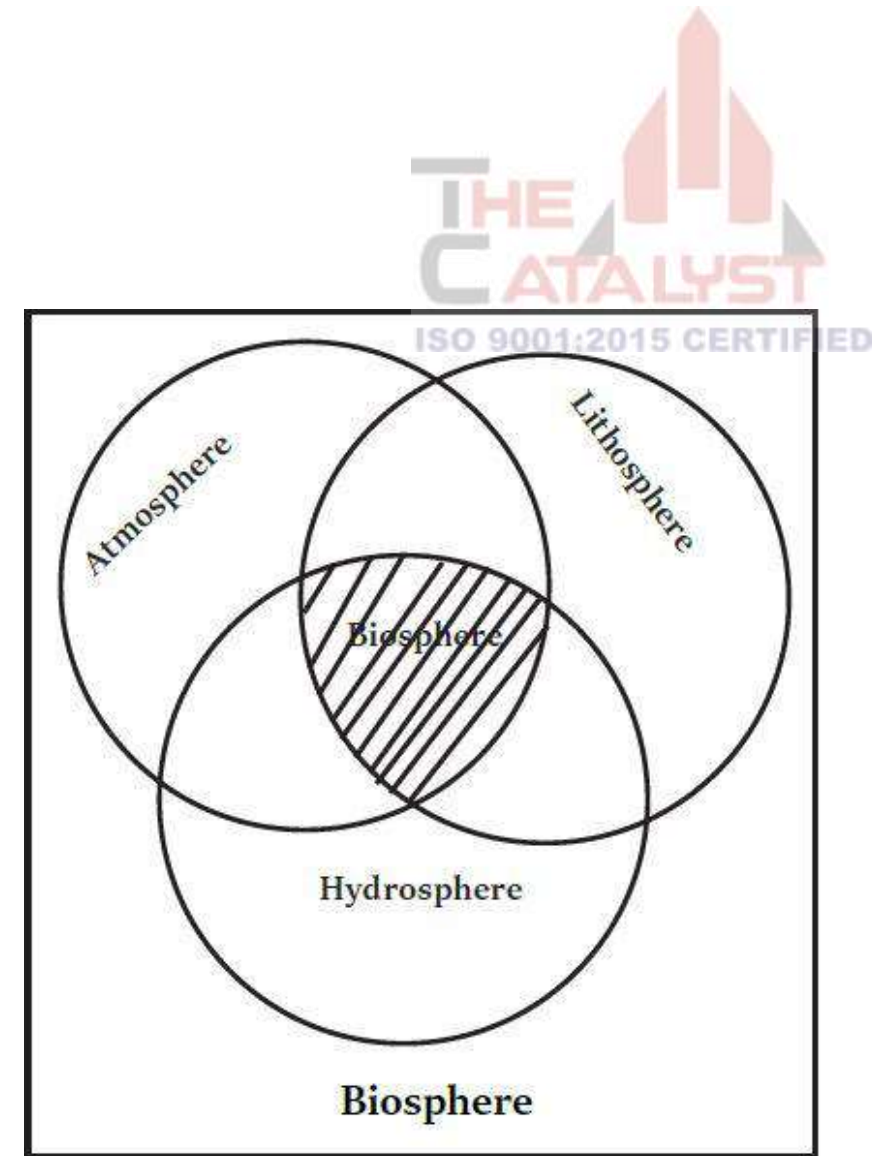


Biosphere

Biosphere is a **part of the earth where life can exist**. The biosphere is the biological component of earth which includes the **lithosphere, hydrosphere and atmosphere**.

The biosphere includes all living organisms on earth, together with the dead organic matter produced by them.

Biosphere is absent at extremes of the North and South poles, the highest mountains and the deepest oceans, since existing hostile conditions there do not support life (life is the characteristic feature of biosphere).



Difference between Ecology, Environment & Ecosystem

Ecology is the study of interactions between organisms, organisms and the surroundings occurring within an ecosystem or environment.

An **ecosystem** is a functional unit of the environment (mostly biosphere).

An **environment** is a group of ecosystems.



Components of an Ecosystem

The components of the ecosystem are categorized into **abiotic** or non-living and **biotic** or living components.

Both the components of the ecosystem and environment are the same.

Abiotic Components

Abiotic components are the inorganic and non-living parts which act as major limiting factors.

➤ Temperature

- A few organisms can tolerate and thrive in a wide range of temperatures (**eurythermal**).
- A vast majority of them are restricted to a narrow range of temperatures (**stenothermal**).

➤ Light

- The spectral quality of solar radiation is important for life.

➤ Rainfall

- Majority of biochemical reactions take place in an aqueous medium.

➤ Atmosphere

- 21% oxygen helps in the survival of many organisms; 78% nitrogen prevents spontaneous combustion and 0.038% carbon dioxide helps primary producers in the synthesis of carbohydrates.

➤ Organic compounds

- Proteins, carbohydrates, lipids etc. are essential for energy transfer in the living world.

➤ **Inorganic compound**

- Carbon, carbon dioxide, water, sulphur, nitrates, phosphates, and ions of various metals are essential for organisms to survive.

➤ **Altitude**

- Vertical zonation of vegetation is caused due to altitude.
- Change in temperature with altitude is a limiting factor.

➤ **Salinity**

- Some organisms are tolerant of a wide range of salinities (euryhaline).
- Others are restricted to a narrow range of salinities (stenohaline).

Biotic Components

- **Primary producers or Autotrophs** (self-nourishing)
 - Primary producers are green plants, certain bacteria and algae that carry out photosynthesis.
 - In the aquatic ecosystem, microscopic algae (plankton) are the primary producers.

- **Consumers or Heterotrophs or Phagotrophs** (other nourishing)
 - Consumers are incapable of producing their own food.
 - They depend on organic food derived from plants, animals or both.
 - Consumers can be divided into two broad groups namely micro and macro consumers.

- **Macro consumers**

- Herbivores are **primary consumers** which feed mainly on plants. E.g. sheep, rabbit, etc.
- **Secondary consumers** feed on primary consumers. E.g. wolves, dogs, snake, etc.
- Carnivores which feed on both primary and secondary consumers are called **tertiary consumers**. E.g. lion (can eat wolves), snakes etc.
- Omnivores are organisms which consume both plants and animals. E.g. man, bear, pig, etc.

- **Micro consumers or Saprotrophs** (decomposers or osmotrophs)

- They are bacteria and fungi which obtain energy and nutrients from dead organic substances (**detritus**).
- Earthworm and certain soil organisms are detritus feeders and help in the decomposition of organic matter and are called **detrivores**.

ECOLOGY

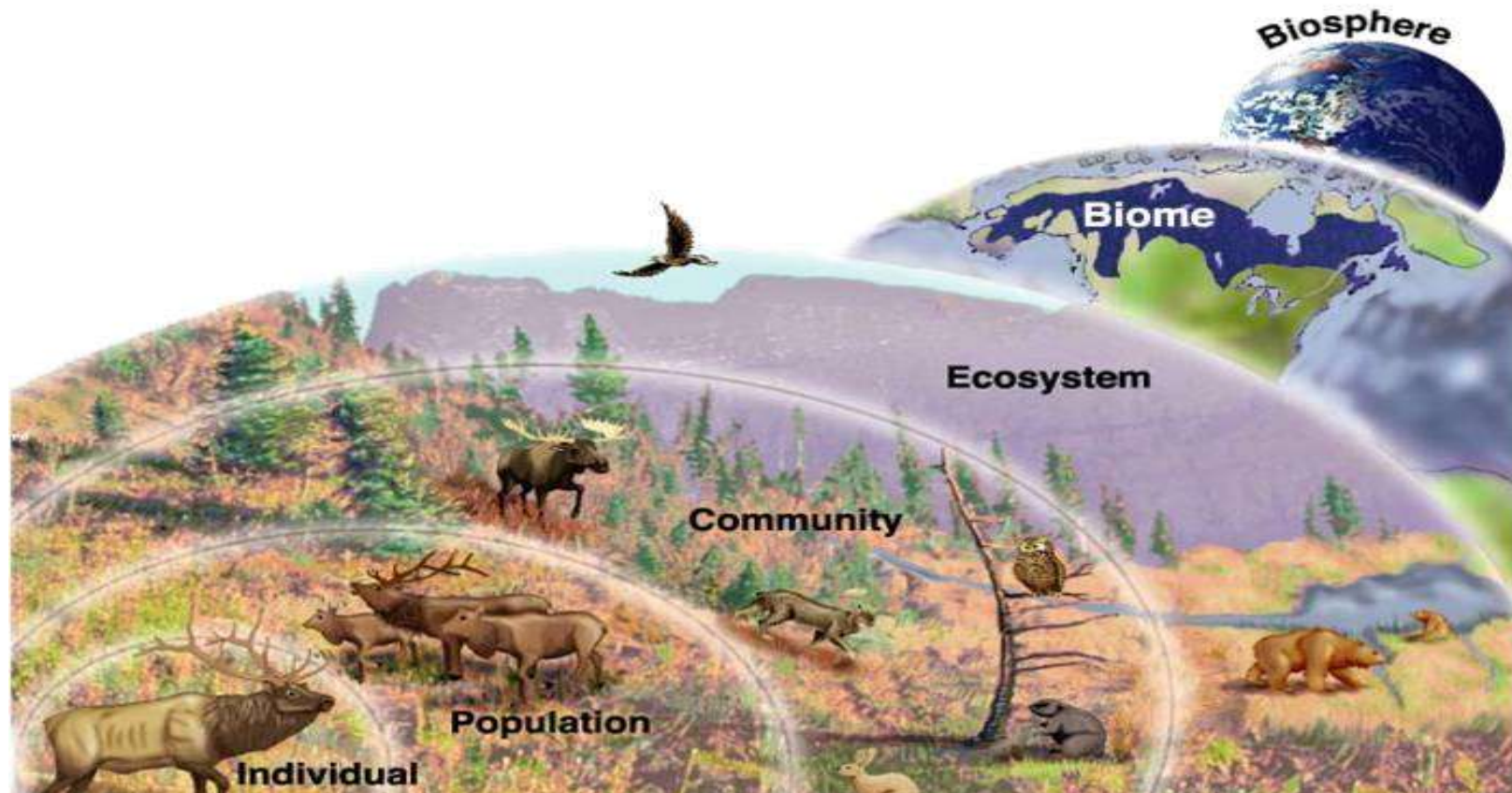
Ecology can be defined as a **scientific study of the interactions of organism with their physical environment and with each other.**

The term ecology is derived from the Greek word 'oikos' meaning 'house', combined with the word 'logy' meaning the 'science of' or 'the study of'. Literally, ecology is the study of the earth as a 'household', of plants, human beings, animals and micro-organisms. They all live together as interdependent components. The term ecology was first used by German zoologist **Ernst Haeckel** in 1869.

Levels of Organizations in Ecology

The main levels of organisation of ecology are six and are as follows

1. Individual
2. Population
3. Community
4. Ecosystem
5. Biome
6. Biosphere



Individual

Organism is an individual living being that has the ability to act or function independently. It may be plant, animal, bacterium, fungi, etc.

Species are a **group** of living organisms consisting **of similar individuals** capable of exchanging genes or of interbreeding.



Population

Population is a group of organisms (same species), occupying a defined area during a specific time.

Population growth rate is the percentage variation between the number of individuals in a population at two different times. Therefore the population growth rate **can be positive or negative**.

The main factors that make population increase are **birth and immigration**. The main factors that make population decrease are **death and emigration**.



Community

In order to survive, individuals of any one species depend on individuals of different species with which they actively interact in several ways.

For eg: Animals require plants for food and trees for shelter. Plants require animals for pollination, seed dispersal, and soil microorganism to facilitate nutrient supply.

Communities in most instances are named after the dominant plant form (species).

For example: A grassland community is dominated by grasses, though it may contain herbs, shrubs, and trees, along with associated animals of different species.

Types of Community

On the basis of size and degree of relative independence communities may be divided into two types:

(a) Major Community

These are large-sized, well organized and relatively independent. They depend only on the sun's energy from outside and are independent of the inputs and outputs from adjacent communities. E.g: tropical ever green forest in the North-East

(b) Minor Communities

These are dependent on neighbouring communities and are often called societies. They are secondary aggregations within a major community and are not therefore completely independent units as far as energy and nutrient dynamics are concerned. e.g: A mat of lichen on a cow dung pad.

Ecosystem

An ecosystem is defined as a structural and functional unit of biosphere consisting of community of living beings and the physical environment, both interacting and exchanging materials between them.

It includes plants, trees, animals, fish, birds, micro-organisms, water, soil, and people.

Ecosystem can be as small as a single tree or as large as entire forest.

Biome

The terrestrial part of the biosphere is divisible into enormous regions called biomes, which are characterized, by climate, vegetation, animal life and general soil type. E.g. Rainforest biome or tundra biome.

No two biomes are alike.

The climate determines the boundaries of a biome and abundance of plants and animals found in each one of them. The most important climatic factors are temperature and precipitation.

Aquatic systems are not called biomes.

Biosphere

The biosphere includes all living organisms on earth, together with the dead organic matter produced by them.

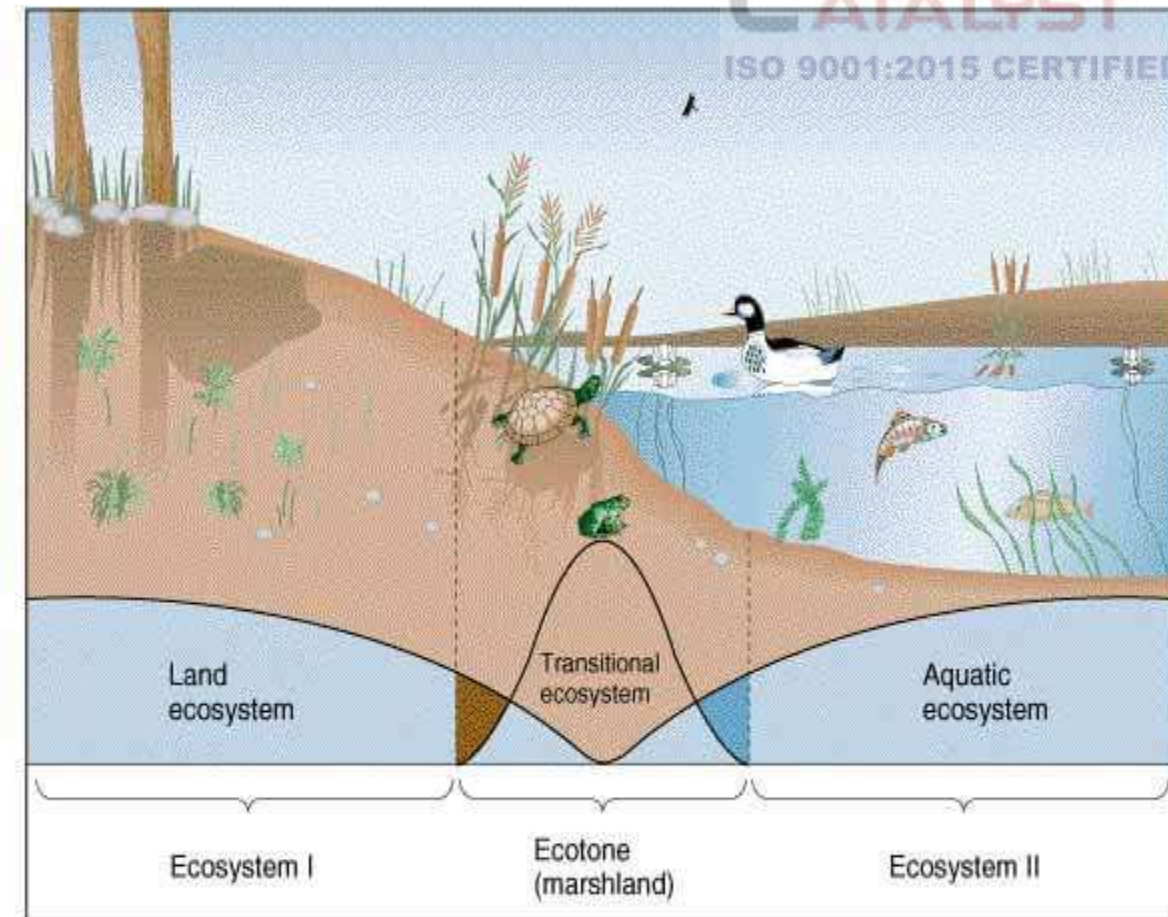
Ecotone

Ecotone is a **zone of junction between two or more diverse ecosystems.**

Ecotone is the zone where two communities meet and integrate.

For e.g. the **mangrove forests** represent an ecotone **between marine and terrestrial ecosystem.**

Other examples are **grassland (between forest and desert)**, **estuary (between fresh water and salt water)** and **riverbank or marshland (between dry and wet).**



Characteristics of Ecotone

- It may be narrow (between grassland and forest) or wide (between forest and desert).
- It has conditions intermediate to the adjacent ecosystems. Hence it is a **zone of tension**.
- Usually, the number and the population density of the species of an outgoing community decreases as we move away from the community or ecosystem.
- A well-developed ecotone contains some organisms which are entirely different from that of the adjoining communities.

Edge Effect – Edge Species

Edge effect refers to the changes in population or community structures that occur at the boundary of two habitats (ecotone).

Sometimes the number of species and the population density of some of the species in the ecotone is much greater than either community. This is called **edge effect**.

The organisms which occur primarily or most abundantly in this zone are known as **edge species**.

In the terrestrial ecosystems edge effect is especially applicable to birds.

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

Ecocline

Ecocline is a zone of gradual but continuous change from one ecosystem to another when there is no sharp boundary between the two in terms of species composition.

Ecocline occurs across the environmental gradient (gradual change in abiotic factors such as altitude, temperature (thermocline), salinity (halo- cline), depth, etc.).

Ecological Niche

A niche is the **unique functional role or place of a species in an ecosystem**. It is a description of all the biological, physical and chemical factors that a species needs to survive, stay healthy and reproduce.

A niche is unique for a species, which means **no two species have exact identical niches**. Niche plays an important role in conservation of organisms.

Types of Niche

1. Habitat niche – where it lives
2. Food niche – what it eats or decomposes & what species it competes with
3. Reproductive niche – how and when it reproduces.
4. Physical & chemical niche – temperature, land shape, land slope, humidity & other requirement.

Difference between niche and habitat

The habitat of a species is like its 'address' (i.e. where it lives) whereas niche can be thought of as its "profession" (i.e. activities and responses specific to the species).

A niche is unique for a species while many species share the habitat.

No two species in a habitat can have the same niche. This is because of the competition with one another until one is displaced.

For example, a large number of different species of insects may be pests of the same plant, but they can co-exist as they feed on different parts of the same plant.