VIVEKANANDA COLLEGE
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NAAC ACCREDITED ‘A’ GRADE

Topic: Concepts of Biosphere
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Name of the Department: Geography

Biosphere

The development of the term ‘Biosphere’ (Greek word ‘Bios’ mean life) is attributed to the English Geologist Eduard Suess (1831-1914) and the Russian Physicist Vladmir I. Vernadsky. The biosphere is one of the four layers that sorrounds the earth surface along with lithosphere (rock), hydrosphere (water), atmosphere (air) assimilates with the fourt one, i.e. obviously the biosphere (life). The biosphere is made up of the parts of Earth where life exists. The biosphere extends from the deepest root systems of trees to the dark environment of ocean trenches, to lush rain forests and high mountaintops.

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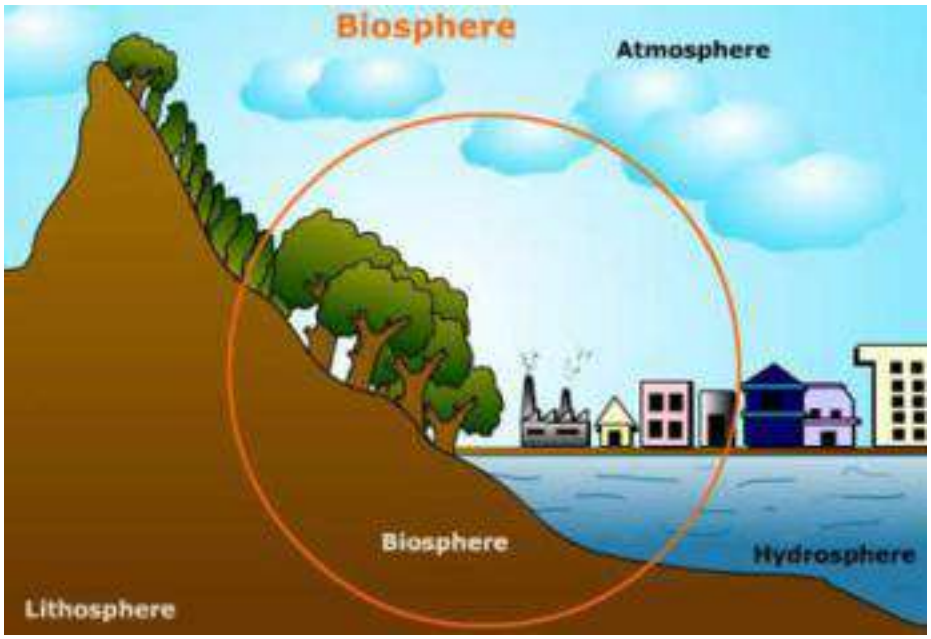
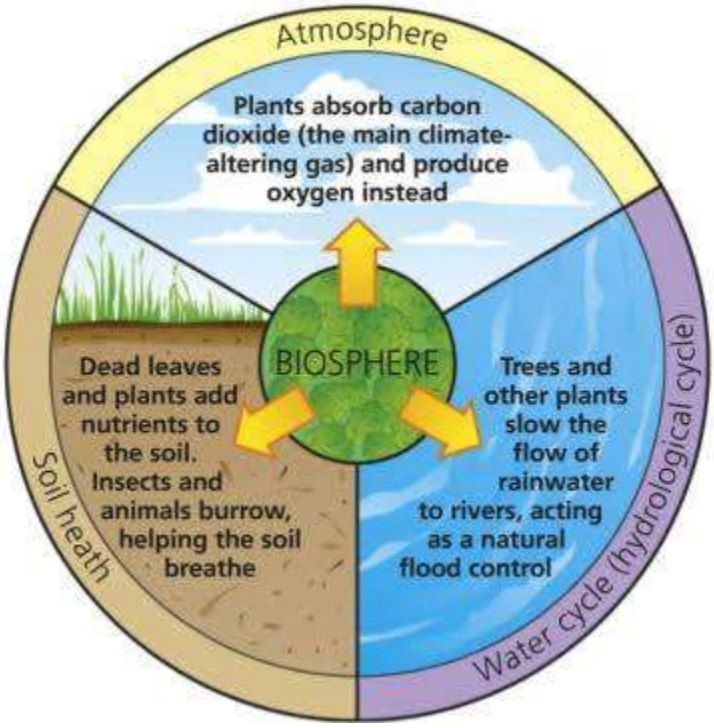


Scientists describe the Earth in terms of spheres. The solid surface layer of the Earth is the lithosphere. The atmosphere is the layer of air that stretches above the lithosphere. The

Earth's water—on the surface, in the ground, and in the air—makes up the hydrosphere.

Since life exists on the ground, in the air, and in the water, the biosphere overlaps all these spheres. Although the biosphere measures about 20 kilometers (12 miles) from top to bottom, almost all life exists between about 500 meters (1,640 feet) below the ocean's surface to about 6 kilometers (3.75 miles) above sea level.



Origin of the Biosphere

The biosphere has existed for about 3.5 billion years. The biosphere's earliest life-forms, called prokaryotes, survived without oxygen. Ancient prokaryotes included single-celled organisms such as bacteria.

Some prokaryotes developed a unique chemical process. They were able to use sunlight to make simple sugars and oxygen out of water and carbon dioxide, a process called photosynthesis. These photosynthetic organisms were so plentiful that they changed the biosphere. Over a long period of time, the atmosphere developed a mix of oxygen and other gases that could sustain new forms of life.

The addition of oxygen to the biosphere allowed more complex life-forms to evolve. Millions of different plants and other photosynthetic species developed. Animals, which consume plants (and other animals) evolved. Bacteria and other organisms evolved to decompose, or break down, dead animals and plants.

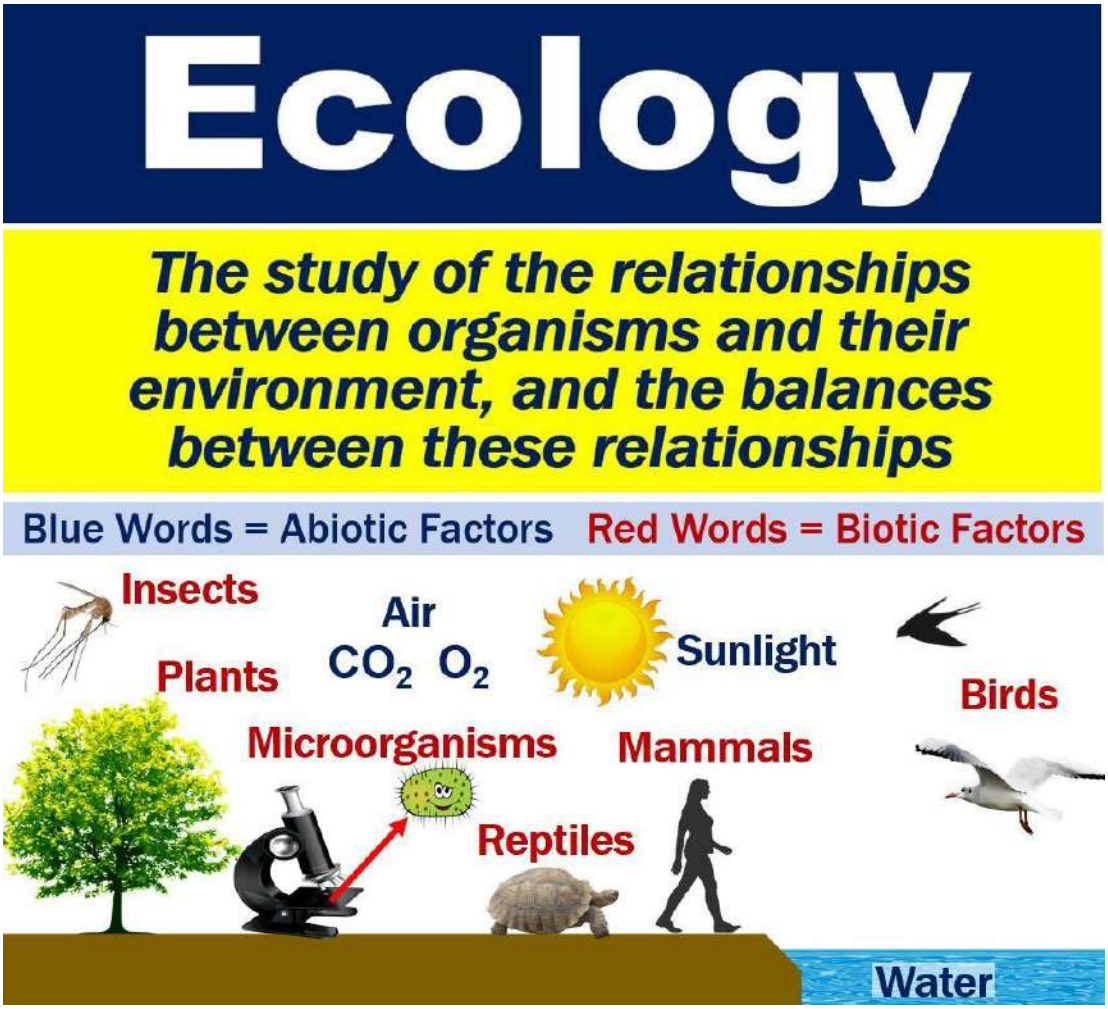
The biosphere benefits from this food web. The remains of dead plants and animals release nutrients into the soil and ocean. These nutrients are re-absorbed by growing plants. This exchange of food and energy makes the biosphere a self-supporting and self-regulating system.

The biosphere is sometimes thought of as one large ecosystem—a complex community of living and nonliving things functioning as a single unit. More often, however, the biosphere is described as having many ecosystems.

Ecology

The word "ecology" ("Ökologie") was coined in 1866 by the German scientist Ernst Haeckel. Ecological thought is derivative of established currents in philosophy, particularly from ethics and politics.
Ecology is a branch of science including human science, population, community, ecosystem, and biosphere. Ecology is the study of organisms, environment and how the organisms interact with each other and their environment. It is studied at various levels such as organism, population, community, biosphere, and ecosystem.

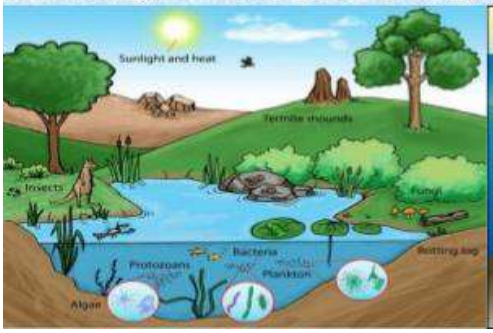
Ecologist's primary goal is to improve their understanding of life processes, adaptations and habitats, interactions and biodiversity of organisms.

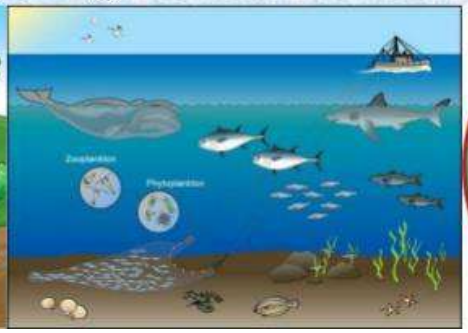


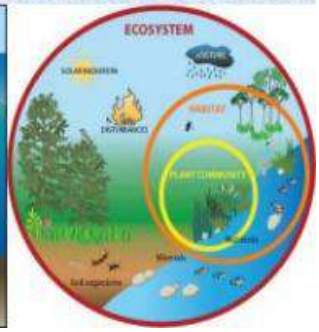
Ecosystem

No living organism lives alone, they associate with each other and have the functional relationship with external factors. It is understood that the structural and functional systems of communities and their environment is called an Ecology and Ecosystem. Ecology is a branch of science that deals with the study of a biosphere. In the biosphere distinct kinds of plants, animals, microorganisms, and other components surround us. The term ecosystem was initially proposed by **Arthur George Tansley in 1935**.

- Ecosystem: Defined area in which a community lives with interactions taking place among the organisms between the community and its non-living physical environment.
- An ecosystem is formed by the interactions between all living and non-living things







An ecosystem is composed of two types of components namely:

Biotic components

Abiotic components

1. Biotic components: The biotic components are the organic compounds and also known as living component of an ecosystem. There are subdivided into the following groups:

Producers

Consumers

Decomposers

Producers: These are food suppliers to all plants and green trees which are termed as producers. For example, all green plants and trees take carbon dioxide from the atmosphere, water from the soil, and sunlight from the sun. The plants undergo a chemical reaction and it is also known as photosynthesis. During photosynthesis, plants liberate oxygen into an environment which is essential for life. The below equation explains about the photosynthesis reaction and liberation of oxygen.

Consumers: Consumers are classified into four groups and they are:

Primary consumers

Secondary consumers

Tertiary consumers

Omnivores

Primary consumers: They depend only on plants for their food and they are called as herbivores. The examples of it are insects, flies, deer, and rabbit.

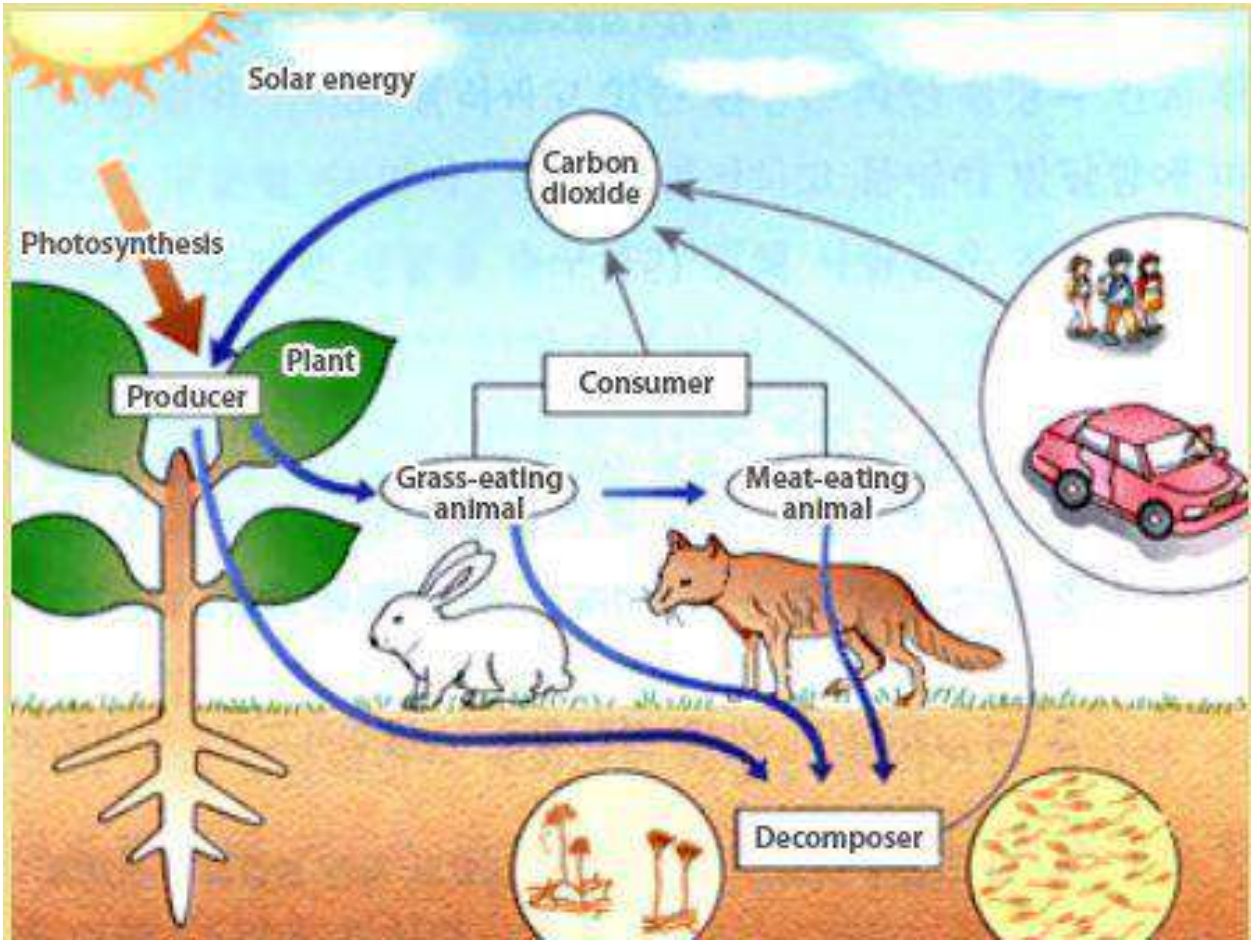
Secondary consumers: These are the animals which depend on herbivores for their food. The examples of it are frog, lizard, fish, and snake.

Tertiary consumers: Wild animals like tiger, lion, and fox feed on the animals and they are called as carnivores.

Omnivores: Human beings are classified as omnivores and they feed on plants and animals.

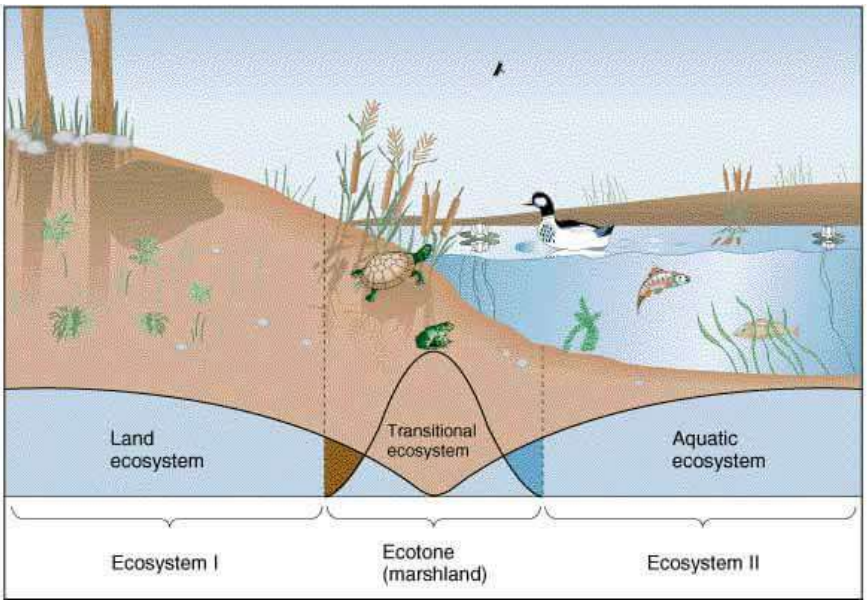
Decomposers: Decomposers feed on the dead bodies of plants and animals and convert them back as nutrients into the soil. Termites, ants and some other bacteria are called as decomposers. Animals such as frog, dog, wolf, and eagles are termed as decomposers. The decomposers not only act as scavengers to clean the dead bodies but also serves as parasites, participate to clean the ecological cycles.

2.Abiotic components: Abiotic components are the non-organic compounds and also known as non-living components of an ecosystem. The examples of these components are temperature, light, and soil.



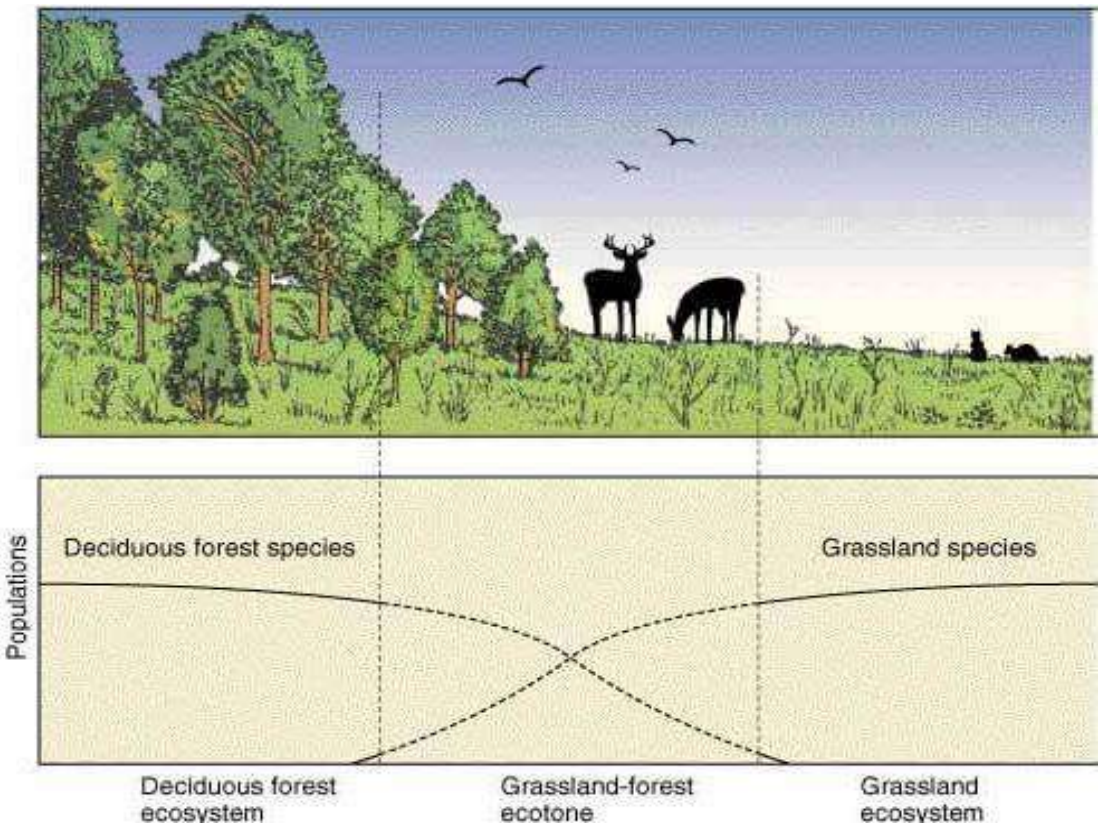
Ecotone

- An ecotone is a **zone of junction or a transition area** between two biomes (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.



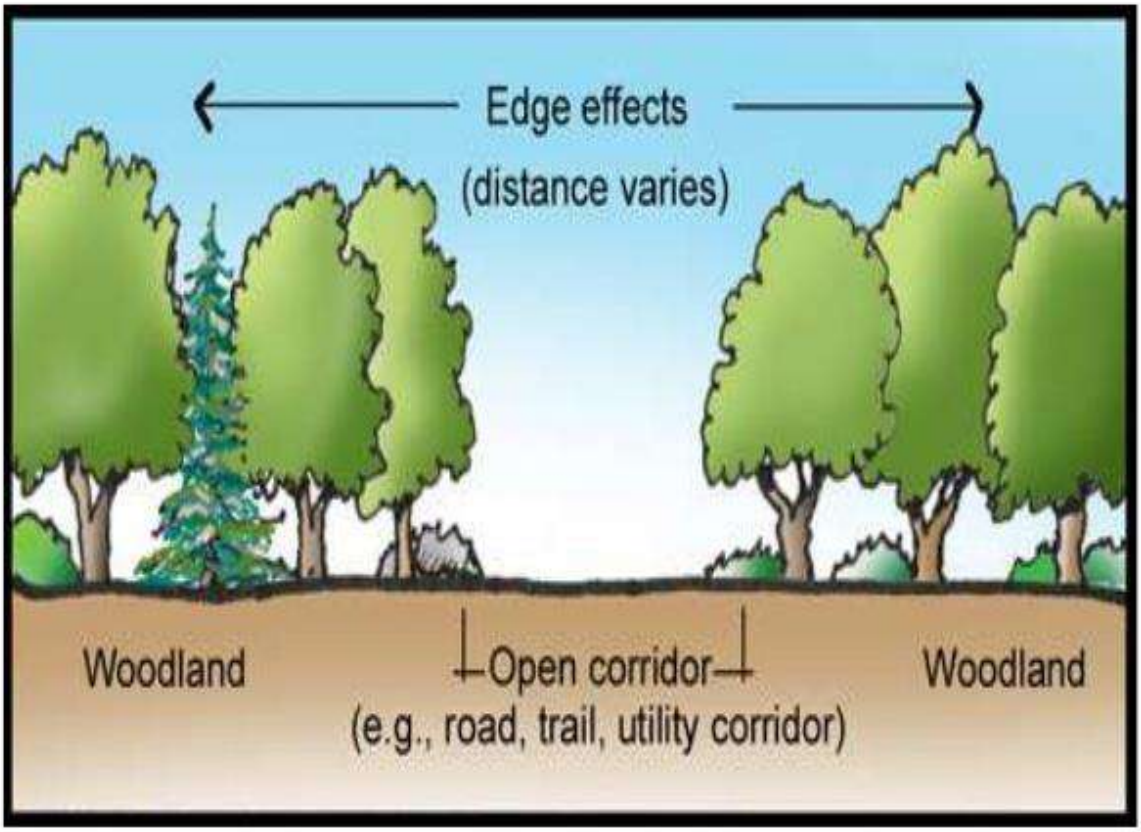
Ecocline

- 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 (halocline), depth, etc.).

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.



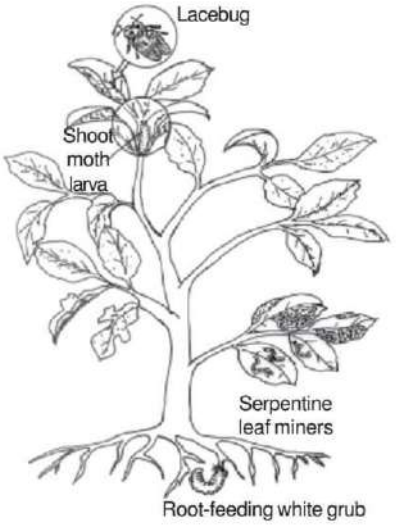
Ecological Niche

- Niche refers to the **unique functional role and position of a species in its habitat or ecosystem**.
- The functional characteristics of a species in its habitat is referred to as "niche" in that common habitat.
- In nature, many species occupy the same habitat, but they perform different functions:

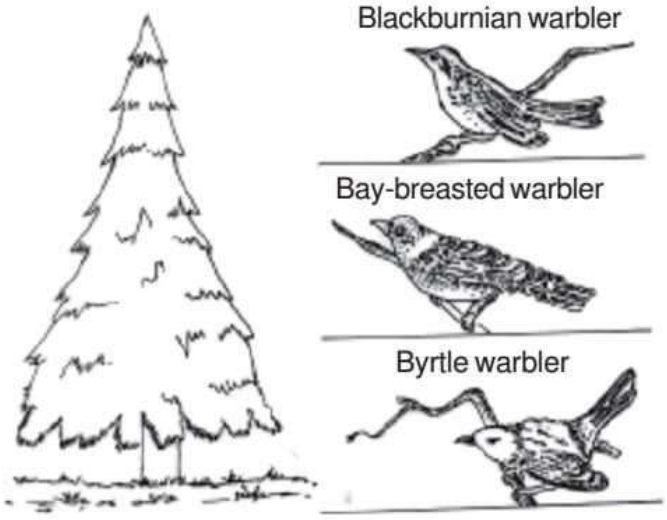
1. habitat niche – where it lives, food niche – what is eats or decomposes & what species it competes with,
2. reproductive niche – how and when it reproduces,

3. physical & chemical niche – temperature, land shape, land slope, humidity & another requirement.

- Niche plays an important role in the **conservation of organisms**. If we have to conserve species in its native habitat, we should have knowledge about the **niche requirements of the species**.



Different species of insects feeding on different parts of the same plant



The three species of warbler birds search for insects as food in the forest at different levels in the tree and so occupy different niches

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.

Biomes:

Biomes are defined as "the world's major communities, classified according to the predominant vegetation and characterized by adaptations of organisms to that particular environment" (Campbell 1996). The importance of biomes cannot be overestimated. Biomes have changed and moved many times during the history of life on Earth. More recently, human activities have drastically altered these communities. Thus, conservation and preservation of biomes should be a major concern to all. For further information, please consult the references page.

Whittaker's parameters for classifying biome-types

Whittaker, seeing the need for a simpler way to express the relationship of community structure to the environment, used what he called "gradient analysis" of ecocline patterns to relate communities to climate on a worldwide scale. Whittaker considered four main ecoclines in the terrestrial realm.

There are following kinds of biomes and biotic regions are being found globally:

1. Intertidal levels: The wetness gradient of areas that are exposed to alternating water and dryness with intensities that vary by location from high to low tide
2. Climatic moisture gradient
3. Temperature gradient by altitude
4. Temperature gradient by latitude

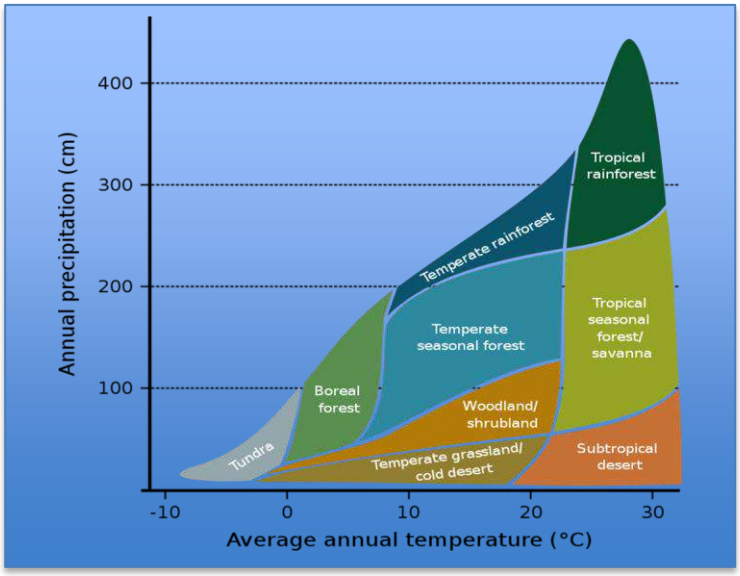
Along these gradients, Whittaker noted several trends that allowed him to qualitatively establish biome-types:

- The gradient runs from favorable to the extreme, with corresponding changes in productivity.
- Changes in physiognomic complexity vary with how favorable of an environment exists (decreasing community structure and reduction of stratal differentiation as the environment becomes less favorable).
- Trends in the diversity of structure follow trends in species diversity; alpha and beta species diversities decrease from favorable to extreme environments.
- Each growth-form (i.e. grasses, shrubs, etc.) has its characteristic place of maximum importance along the ecoclines.

- The same growth forms may be dominant in similar environments in widely different parts of the world.

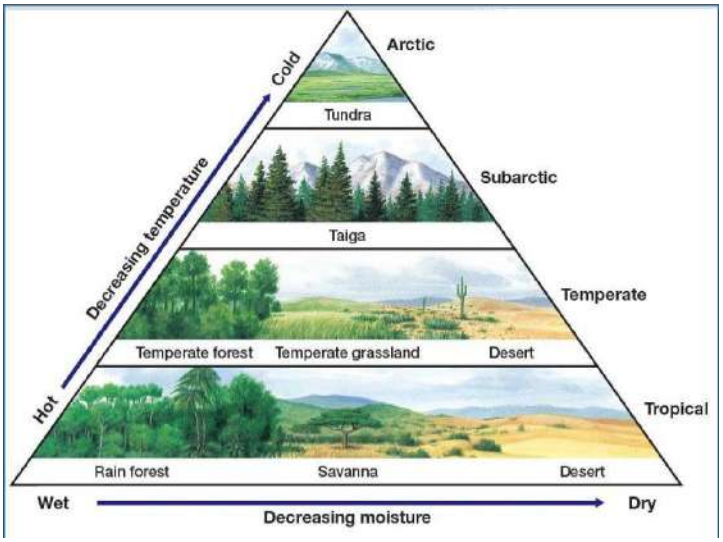
Whittaker summed the effects of gradients (3) and (4) to get an overall temperature gradient and combined this with a gradient (2), the moisture gradient, to express the above conclusions in what is known as the Whittaker classification scheme. The scheme graphs average annual precipitation (x-axis) versus average annual temperature (y-axis) to classify biome-types.

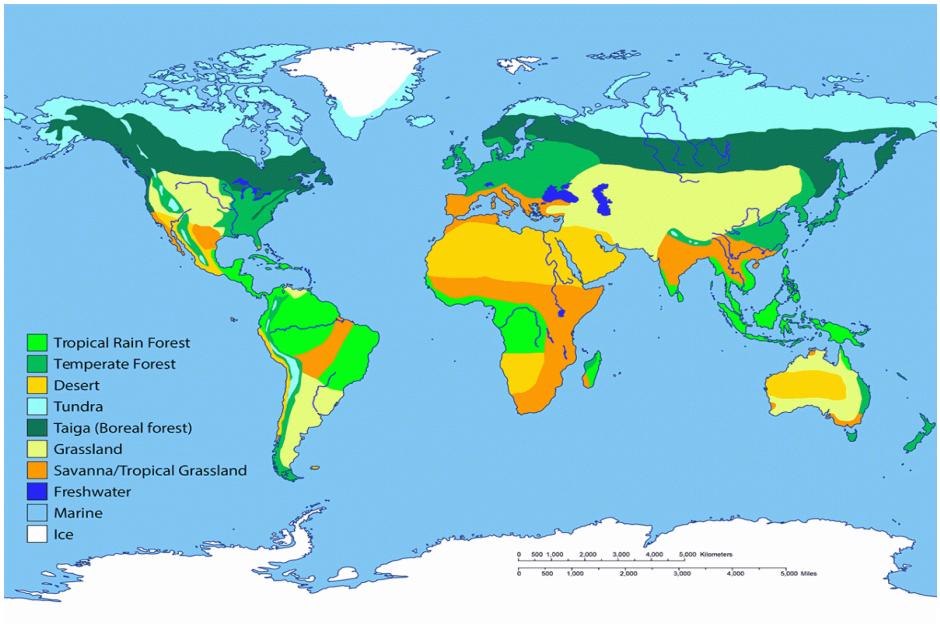
Biome-types

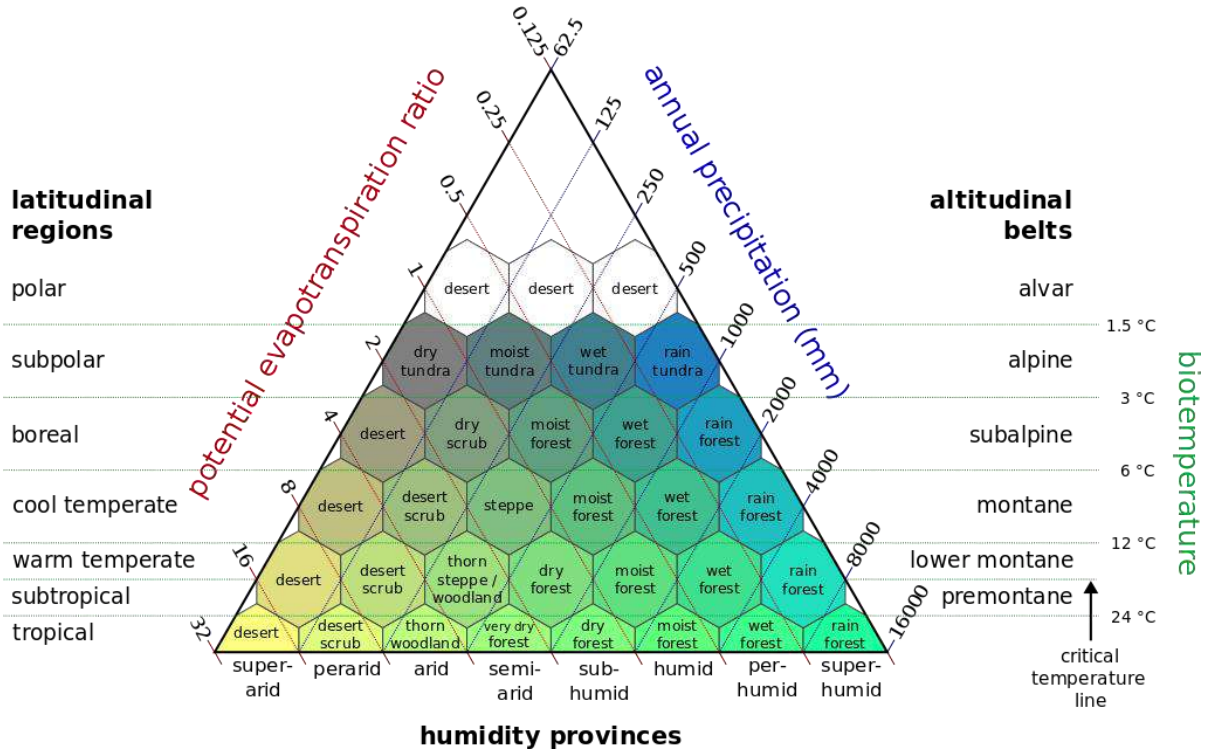


1. Tropical rainforest
2. Tropical seasonal rainforest
    - deciduous
    - semi-deciduous
3. Temperate giant rainforest
4. Montane rainforest
5. Temperate deciduous forest
6. Temperate evergreen forest
    - Needle leaf
    - Sclerophyll
7. Subarctic-subalpin needle-leaved forests (taiga)
8. Elfin woodland
9. Thorn forests and woodlands
10. Thorn scrub
11. Temperate woodland

12. Temperate shrub lands
    - deciduous
    - heath
    - sclerophyll
    - subalpine-needle leaf
    - subalpine-broadleaf
13. Savanna
14. Temperate grassland
15. Alpine grasslands
16. Tundra
17. Tropical desert
18. Warm-temperate desert
19. Cool temperate desert scrub
20. Arctic-alpine desert
21. Bog
22. Tropical fresh-water swamp forest
23. Temperate fresh-water swamp forest
24. Mangrove swamp
25. Salt marsh
26. Wetland







The given model is indicating about the Holdridge life zone classification scheme. Although conceived as three-dimensional by its originator, it is usually shown as a two-dimensional array of hexagons in a triangular frame.

There's another growing type of biome named as 'Anthropogenic Biomes' in contemporary times being mentioned by the ecologists. As humans have altered global patterns of biodiversity and ecosystem processes. As a result, vegetation forms predicted by conventional biome systems can no longer be observed across much of Earth's land surface as they have been replaced by crop and rangelands or cities. Anthropogenic biomes provide an alternative view of the terrestrial biosphere based on global patterns of sustained direct human interaction with ecosystems, including agriculture, human settlements, urbanization, forestry and other uses of land. Anthropogenic biomes offer a new way forward in ecology and conservation by recognizing the irreversible coupling of human and ecological systems at global scales and moving us toward an understanding of how best to live in and manage our biosphere and the anthropogenic biomes we live in.