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## 10. Environment and Ecology

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### **Abstract:**

*Environment refers to everything surrounding us where life process occurs while ecology represents the interaction of the ecosystem with its surrounding environmental factors. Several ecosystems together make an ecology that is further from the environment inside the biosphere. The ecology often describes the interaction between biotic and abiotic communities residing inside the ecosystem with their surroundings at a scientific level. Every ecosystem has its own food chain, biodiversity, and stability level. Different ecosystems together are connected with the food web which is highly affected by surrounding environmental factors and changes. Ecology is the scientific study of the biosphere and defines the interactions of living organisms to a physical and chemical composition of surrounding at a terrestrial, aquatic and atmospheric level along with energy flow. The proposed chapter contains an exhaustive study of the ecological concept, hierarchy, components, and biological interactions inside the biosphere.*

### **10.1 Introduction:**

**Environment, ecology, and ecosystem are interdependent for sustainable life on earth.** **Environment** represents several factors that affect the sustainability of living organisms on the earth's crust. Living organisms must live and sustain, to which a healthy ecosystem and environment are necessary. While **ecology** deals with the inter-relationship between living organisms with abiotic and biotic subsets of environments. Organisms and the environment are affected by each other i.e., any disturbance in the environment affects living organisms of the ecosystem and vice-versa. An ecosystem is a place where the interaction between biotic and abiotic factors exists i.e., forest ecosystem, aquatic ecosystem, and many more. Most often ecosystem is a known and **functional** unit of ecology. The ecosystem drives energy flows and biogeochemical cycles in the environment. The study of the relationship between ecology and the environment is important for the existence of mankind on the earth. A clear picture of the relationship between ecology is necessary because the negative human intervention i.e., desertification, forest degradation climate change, pollution, and so on, upshifted the destruction of the environment.

### **10.2 Concept of Ecology:**

The word ecology is derived from the Greek word *oikos* which means *a place to live*. Ecology represents the interaction between the biotic component; living organisms i.e., flora, fauna, and microbes, and the abiotic component; non-living organisms i.e., water, soil, air, temperature, and so on.

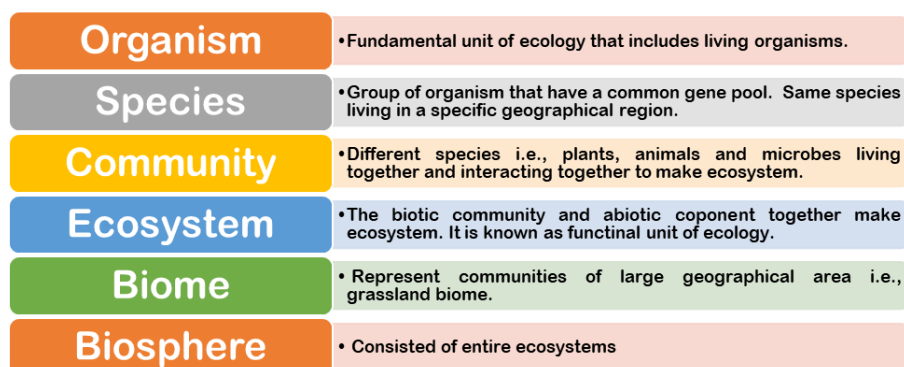
Some eminent scientists in the early ecological study:

- Ernst Haeckel - coined the word “Ecology”
- Reiter - first used the word “Ecology”
- Eugene Odum - Father of Modern Ecology
- Ramdeo Misra - Father of Ecology in India.

The ecological hierarchy represents the different levels from organism to the biosphere (Figure 10.1). The organism is the fundamental unit of ecology that includes most often living organisms. Species represent the group of living organisms from the same gene pool while the Population consisted of the same species residing in a specific geographical region. Mallet (1999) reported that Wilkins conceptually classified species into agamo-species, bio-species, eco-species evolutionary-species, genetic-species, morpho-species, and taxonomic-species (Table 10.1). Species are also categorized into Endemic-species, Keystone-species, and Critical-linked-species based on the occurrence, characteristics, and vital activity respectively.

**Table 10.1: Wilkins Classification of Species**

Sr. No.	Category	Concept of Classification
1.	Agamo-species	Asexual organisms
2.	Bio-species	Sexual organisms
3.	Eco-species	Ecological niches of life forms
4.	Evolutionary-species	The molecular lineage of organisms
5.	Genetic-species	Gene pool of the organism
6.	Morpho-species	The phenotypic character of an organism
7.	Taxonomic-species	Taxonomy



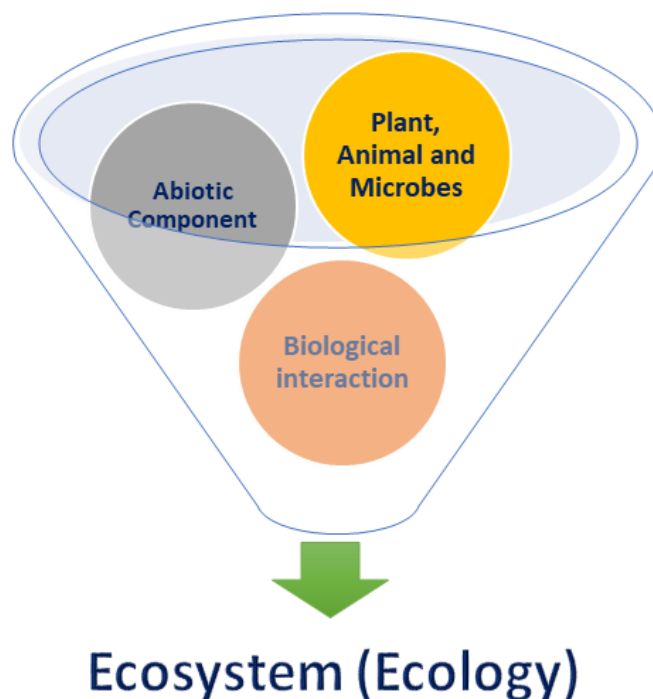
**Figure 10.1: Ecological Hierarchy**

A community is a group of diverse species inhabited in a specific region and interacting with each other for sustainable life. The biotic and abiotic communities reside together to make an ecosystem which is a crucial component of ecology. Biome represents the communities of huge geographical regions. The biosphere exhibits entire ecosystems hence regarded as a zone of life.

### **10.3 Ecological Niche and Habitat:**

An ecological niche is an environment for species that best suited them for growth and reproduction. A habitat is a geographical region occupied by a group of species or communities.

An ecosystem is a place where interaction happens between living organisms and non-living components to build a healthy life span (Figure 10.2). Individual species require defined abiotic and biotic factors as well as tolerance levels. A term called adaptation also plays an important role in the survival mechanism of species.



**Figure 10.2: Biological Interaction between Biotic and Abiotic Component in The Ecosystem**

The characteristics of a community inhabited in a specific niche are influenced by temperature, nutrient availability, and predators. The study of ecological niche and habitat explains the adaptation of species or communities in a particular habitat under its niche.

#### **10.4 Biotic and Abiotic Components of Ecology:**

Biotic components include living organisms that are classified into producers, consumers, and decomposers. A producer is autotrophs who make food on their own. Autotrophs are grouped into photo-autotrophs and chemo-autotrophs.

Photo-autotrophs mainly include plants and most ancient bacteria called cyanobacteria which get their food from sunlight. Most of the algae are also autotrophs however some microalgae that can grow in dark are heterotrophs. Chemo-autotrophs come under chemotrophs.

Chemotrophs are those who fulfill their nutritional need from inorganic and organic matter. Methanogens, iron oxidizers, sulfur reducers, anaerobic ammonia oxidizers, and thermophiles are the major groups of microbes included under chemo-autotrophs. Archaea have extreme adaptability to get nutrients from harsh environments like sea vents. Chemo-autotrophs include bacteria, archaea, and some fungi.

Ecology has diverse study areas viz., autecology, applied ecology, behavioral ecology, community ecology, gynecology, global ecology, molecular ecology, population ecology, synecology, system ecology, and so on (Figure 10.3). Autecology denotes species adaptations in the ecological niche. Applied ecology is conserved and the use of species of economic importance. Behavioral ecology deals with the behaviors of species to adapt to their niche.

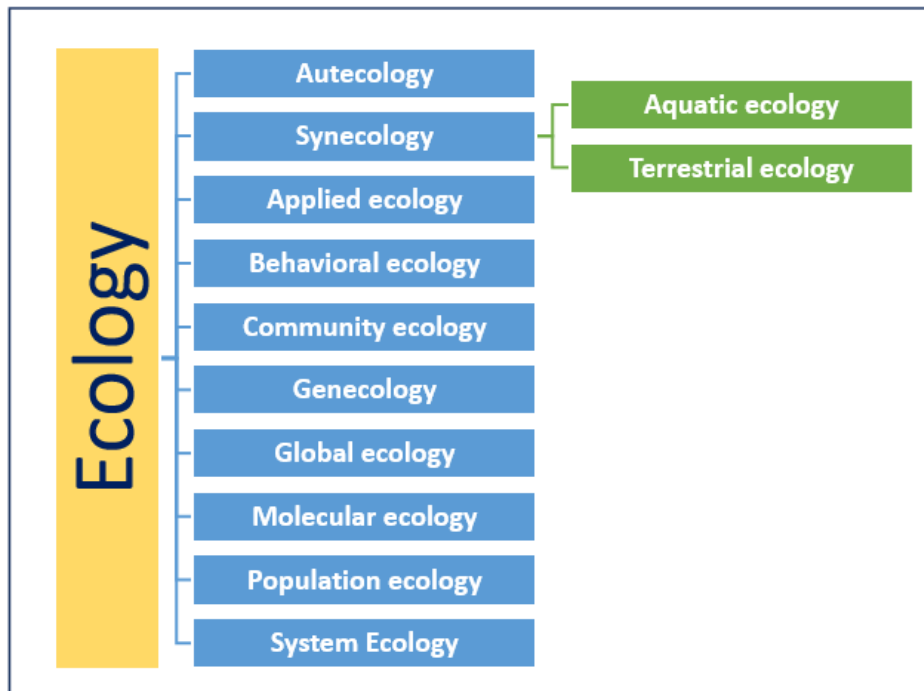
Community ecology exhibits the interaction between different species residing in an ecosystem. Genecology deals with the study of genetic variation among species, communities, and the population of the environment. Global ecology is the study of an entire ecosystem in the biosphere. Molecular ecology is the study of the ecosystem at the molecular level. Population ecology is the study of the group of organisms belonging to the same species in their ecological niche. Synecology exhibit how various species interact with the surrounding ecosystem. System ecology deals with the comprehensive study of the structure and function of an ecosystem using modern mathematical tools, and computer and advanced statistical tools.

#### **10.5 Biological Interactions:**

The living organisms exist together to fulfill their needs i.e., food and security. The interaction may be mutual or parasitism. Some important interactions of the ecosystem are mentioned below:

1. **Amensalism:** It is like pathogenicity where one individual is getting harmed and another individual grows and reproduces.
2. **Commensalism:** One individual is benefited and another one is neutral.
3. **Mutualism:** both individuals are getting benefitted from each other.
4. **Competition:** two individuals competing for the same nutritional sources.
5. **Predation:** one individual predate another one.

6. **Parasitism:** unlike amensalism, the parasite is getting benefitted but the host might not harm.



**Figure 10.3: Areas of Ecological Study**

### 10.6 Ecology Enrich Environment:

Healthy ecology promotes a sustainable environment which played a crucial role in a healthy human society. A comprehensive study of ecosystem and ecology provides deep insights into the interconnection and level of decency between human beings and the environment. A healthy ecosystem is played a vital role to serve food, safe water, clean air, biodiversity, and a good climate. The environmentalism movement was initiated against environmental degradation. This movement is depending on ecology protection so the focus has been made to aware people of the relationship between human and their surrounding ecosystem. The environment has an atmosphere, lithosphere, hydrosphere, and biotic community as major components and presently these need to be saved.

The environment is categorized into Geographical and Anthropogenic environments. Geographical means a natural environment where no human interference such as dense forests, mountains, deserts, and oceans. The climatic factors i.e., cyclones, storms, and volcanoes are also beyond human interference. This geographical environment still serves a larger portion of the economy. The anthropogenic environment was made by humans to make a shelter for a society like lush green residential colonies. The anthropogenic environment is further classified into the inner and outer environment. The inner environment is a social heritage that reflects the traditions and culture of the individual

society whereas the outer environment is man-made forest and resorts where the natural ecosystem is created for human, animal, plant, and microbes. The ecosystem and environment are interdependent.

### **10.7 Conclusion:**

Anthropogenic activities cause harm to natural ecosystems that result from biodiversity loss. Climate change is another factor that affects the ecosystem in terms of trophic energy flow and the biogeochemical cycle. This might severely affect the ecological communities like plants, animals, and soil microbial diversity. Climate change affects ecological viability through long-term warming and dryness, promotes physiological stress (i.e., acidification), and increases hydrological issues. Maladaptation is vulnerable to climate change and it has often a negative impact. Anthropogenic forestation is an example of maladaptation. Major environmental issues that severely affect the ecosystem are desertification, greenhouse gas, heavy metal pollution, increased population, nature exploitation, water pollution and scarcity, rigorous animal farming, extensive use of biocide in crop fields, habitat destruction, radioactive pollution, rapid industrialization, urbanization, and ocean trash.

### **10.8 Further Readings:**

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