Ecology: Chapter-1 of Environment

Description

What is Ecology ?

â??Oikosâ?• translates to home and **â??logosâ?•** means study. Thus, **Ecology** is literally the study of natureâ??s home. It is defined as the scientific study of the interactions between living organisms and their environment.

It concerns the methods by which organisms are shaped by their environment and the manner in which they utilize environmental resources, encompassing energy flow and mineral cycling.

The foundations of ecology are deeply rooted in Natural History, dating back to the dawn of human civilization. Throughout history, humans have engaged with ecological principles, both consciously and unconsciously. In early societies, it was essential for every person to possess a thorough understanding of their environment to survive, including knowledge of natural forces and the flora and fauna surrounding them.

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Ancient Indian scriptures are replete with references to ecological principles. The venerable texts from the Vedic era, including the Vedas, Samhitas, Brahmanas, and the Aranyakas-Upanishads, are rich with mentions of ecological concepts. The Indian medical treatise, the Charaka-Samhita, along with the surgical text, the Sushruta-Samhita, demonstrate that individuals of that era possessed a comprehensive knowledge of plant and animal ecology.

The texts categorize animals based on their habits and habitats, describe land by the nature of its soil, climate, and vegetation, and detail plants characteristic of different areas. The Charaka Samhita includes insights that air, land, water, and seasons are essential for life, and emphasizes that contaminated air and water can harm health.

Whatâ??s Component of the Environment ?

The environment is described as the collective sum of living and non-living components, influences, and events that surround an organism.

All organisms, ranging from viruses to humans, are inherently reliant on other organisms and the environment for necessities such as food, energy, water, oxygen, shelter, and more.

The environment consists of both living (biotic) and non-living (abiotic) components. It is dynamic, with both biotic and abiotic factors constantly in flux and undergoing continuous change.

Abiotic Components

- Energy
- Temperature
- Water
- Atmosphere
- Topography
- Soil
- **Substratum:** Land is covered by soil and a wide variety of microbes, protozoa, fungi and small animals (invertebrates) thrive in it. Roots of plants pierce through the soil to absorb water and nutrients. Organisms can be terrestrial or aquatic. Terrestrial animals live on land. Aquatic plants, animals and microbes live in fresh water as well as in the sea. Some microbes live even in hot water vents under the sea.

Biotic Components

- Plants
- Decomposers
- Parasites
- Symbionts
- Animals
- Man
- Aquatic Wildlife

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Levels Of Organisms in ecology

There are six main levels of organisms in ecology as provided below

Biosphere
â??â??â?? **Biome**
â??â??â?? **Ecosystem**
â??â??â?? **Community**
â??â??â?? **Population**
â??â??â?? **Individual**

1. Indivisual

An organism is an individual entity capable of independent function, which may be a plant, animal, bacterium, fungus, etc. It consists of organs, organelles, or other components that collaborate to perform the diverse processes of life.

2. Population

Population is a group of organisms usually of the 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.

3. Community

If we look around ourself, we will notice that population of plants and animals seldom occur by themselves. The reason for this is quite obvious. 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.

A community is not fixed or rigid; communities may be large or small.

Types of Community

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(a) Major Community

These communities are large, well-organized, and relatively independent, relying solely on the sunâ??s energy from outside, and are not influenced by the inputs and outputs of neighboring communities.

E.g: tropical ever green forest in the North-East

(b) Minor Communities

These entities rely on neighboring communities and are commonly referred to as societies. They represent secondary aggregations within a larger community and, as such, are not entirely autonomous in terms of energy and nutrient dynamics.

E.g: A mat of lichen on a cow dung pad.

Structure of a community

In a community the number of species and size of their population vary greatly. A community may have one or several species.

The environmental factors determine the characteristic of the community as well as the pattern of organisation of the members in the community

The term â??structureâ?? refers to the characteristic pattern of a community, which is manifested in the roles of various populations, their distribution, the kinds of areas they occupy, the diversity of species within the community, and the range of interactions among them.

What is Ecotone ?

An ecotone is a transitional area where two or more distinct ecosystems meet, such as mangrove forests, which serve as an ecotone between marine and terrestrial ecosystems.

Other examples are â?? Grassland, Estuary and River bank

4. 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.

Terrestrial Ecosystems	Aquatic Ecosystems
Forests	Fresh Water
Grasslands	Saline Water
Deserts	Marine Water

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

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Ecosystems differ significantly in size and components, yet each is a functional unit of nature. Every living thing within an ecosystem relies on other species and elements within that ecological community. Should one component of an ecosystem suffer damage or vanish, it impacts all other elements.

A healthy, or sustainable, ecosystem is characterized by a balance in which all elements can reproduce and thrive. An ecosystem can range in size from a solitary tree to an expansive forest.

5. Biome

The land-based portion of the biosphere can be divided into vast regions known as biomes, each distinguished by its climate, vegetation, wildlife, and prevailing soil types.

None of two biomes are alike. Climate defines the limits of a biome and the diversity of flora and fauna within each. Temperature and precipitation are the key climatic elements that influence these natural habitats.

S.No.	Name of Biome	Region	Flora and Fauna
1	Tundra	Northern and Southern most region of world adjoining the ice bound poles	Devoid of trees except stunted shrubs in the southern part of tundra biome, ground flora includes lichen, mosses and sedges. The typical animals are reindeer, arctic fox, polar bear, snowy owl, lemming, arctic hare, ptarmigan. Reptiles and amphibians are almost absent.
2	Taiga	Northern Europe, Asia and North America. Moderate temperature than tundra. Also known as boreal forest.	The dominating vegetation is coniferous evergreen mostly spruce, with some pine and firs. The fauna consists of birds, hawks, fur bearing carnivores, little mink, elks, puma, Siberian tiger, wolverine, wolves etc.
3	Temperate Deciduous Forest	Extends over Central and Southern Europe, Eastern North America, Western China, Japan, New Zealand etc. Moderate average temperature and abundant rainfall.	The flora includes trees like beech, oak, maple and cherry. Most animals are the familiar vertebrates and invertebrates. These are generally the most productive agricultural areas of the earth
4	Tropical rain forest	Tropical areas in the equatorial regions, which is abound with life. Temperature and rainfall high.	Tropical rainforest covers about 7% of the earth's surface & 40% of the world's plant and animal species. Multiple storey of broad-leafed evergreen tree species are in abundance. Most animals and epiphytic plants are concentrated in the canopy or tree top zones.
5	Savannah	Tropical region: Savannah is most extensive in Africa.	Grasses with scattered trees and fire resisting thorny shrubs. The fauna include a great diversity of grazers and browsers such as antelopes, buffaloes, zebras, elephants and rhinoceros; the carnivores include lion, cheetah, hyena; and mongoose, and many rodents.
6	Grassland	North America, Ukraine, etc. Temperate conditions with low rainfall.	Grasses dominate the vegetation. The fauna include large herbivores like bison, antelope, cattle, rodents, prairie dog, wolves, and a rich and diverse array of ground nesting bird.
7	Desert	Continental interiors with very low and sporadic rainfall with low humidity. The days are very hot but nights are cold.	The flora is drought resistance such as cactus, euphorbias, sagebrush. Fauna: Reptiles, Small Mammals and birds.

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Terrestrial Biom. Image: Shankar IAS

S.No	Aquatic ecosystem	Characteristics
1.	Fresh Water Ecosystem	Fresh water ecosystem are classified as lotic (moving water) or lentic (stagnant water). Lotic water system includes freshwater streams, spri rivulets, creeks, brooks, and rivers. Lentic water bodies include pools, some swamps, bogs and lakes. They vary considerably in physical, che and biological characteristics.
2.	Marine Ecosystem	Nearly three – quarter of earth's surface is covered by ocean with an a depth of 3,750 m and with salinity 35 ppt, (parts per thousand), about cent of which is sodium chloride.
3.	Estuaries	Coastal bays, river mouths and tidal marshes form the estuaries. In es fresh water from rivers meet ocean water and the two are mixed by a tides. Estuaries are highly productive as compared to the adjacent rive
4.	Coral reef	
5.	Mangrove	

Aquatic Ecosystem. Image: Shankar IAS

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Aquatic systems, though not classified as biomes, are categorized into distinct life zones characterized by regions with relatively unique plant and animal life. The primary distinctions among these aquatic zones stem from variations in salinity, dissolved nutrient levels, water temperature, and the depth to which sunlight can penetrate.

What is Niche ?

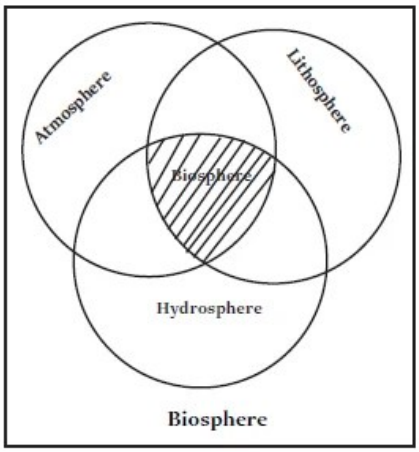
A niche is the unique functional role or place of a species in an ecosystem. It is a description of all the biological,physical and chemical factors that a species needs to survive, stay healthy and reproduce.

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 â?? Where it lives.
2. Food niche â?? What it eats or decomposes & what species it competes with.
3. Reproductive niche â?? How and when it reproduces.
4. Physical & Chemical niche â?? Temperature, land shape, land slope, humidity & other requirement.

6. Biosphere



The biosphere is a region of Earth where life is possible, encompassing the highly interactive zones of the atmosphere (air), hydrosphere (water), and lithosphere (land).

The biosphere is a slender layer enveloping the Earthâ??s surface. Imagining the Earth as an apple, the biosphere would be comparable to the thickness of its skin.

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Life thrives in the biosphere from 200 metres (660 feet) beneath the oceanâ??s surface up to approximately 6,000 metres (20,000 feet) above sea level.

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Types of Consumers

Biotic components consist of living entities such as plants, animals, and microbes. These organisms are categorized based on their functional roles as either producers or consumers.

a) Primary producers â?? Autotrophs (selfnourishing)

- Primary producers are basically green plants (and certain bacteria and algae).
- They produce carbohydrates from simple inorganic substances such as carbon dioxide and water, utilizing sunlight through the process of photosynthesis. This not only serves their own needs but also indirectly provides sustenance to other non-producers.
- In terrestrial ecosystem, producers are basically herbaceous and woody plants, while in aquatic ecosystem producers are various species of microscopic algae.

b) Consumers â?? Heterotrophs or phagotrophs (other nourishing)

- Consumers are incapable of producing their own food (photosynthesis).
- They depend on organic food derived from plants, animals or both.
- Consumers can be divided into two broad groupsnamely micro and macro consumers.

(i) Macro consumers

- They feed on plants or animals or both and are categorised on the basis of their food sources.
- **Herbivores** are primary consumers which feed mainly on plants e.g. cow, rabbit.
- Secondary consumers feed on primary consumers e.g. wolves.
- **Carnivores** which feed on secondary consumers are called tertiary consumers e.g. lions which can eat wolves.
- **Omnivores** are organisms which consume both plants and animals e.g. human, monkey.

(ii) Micro consumers â?? Saprotrophs (decomposers or osmotrophs)

- Bacteria and fungi obtain energy and nutrients by breaking down dead organic matter (detritus) from plants and animals.
- The byproducts of decomposition, like inorganic nutrients released into the ecosystem, are recycled by being utilized by producers..
- Earthworms, along with certain soil organisms like **nematodes** and **arthropods**, are detritus feeders. They play a crucial role in the decomposition of organic matter and are known as detritivores.

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Thank You. Next Chapter: Functions of Ecosystem

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