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ECOSYSTEM AND ITS COMPONENTS

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Introduction:

Environment involves both living organisms and the non-living physical conditions. These two are inseparable but inter-related.

For food, shelter, growth and development, all life systems interact with the environment.

Environment is a life supporting system.

In the subject of ecology, the term ecosystem refers to the environment of life.

It is a self-sustaining, structural and functional unit of biosphere. An ecosystem may be natural or artificial, land-based or water-based. Artificial systems may include a cropland, a garden, a park or an aquarium.

In this episode, we are going to learn the following modules:

1. Definition of an Ecosystem
2. Biotic Components
3. Abiotic Components
4. Functions of an ecosystem
5. Processes of ecosystems

1. DEFINITION OF AN ECOSYSTEM

The term 'eco' refers to a part of the world and 'system' refers to the co-ordinating units.

The living organisms of a habitat and their surrounding environment function together as a single unit. This ecological unit is called as an 'ecosystem'.

An Ecosystem is a naturally occurring assemblage of life and the environment. The life is referred to the biotic community including the plants, animals and other living organisms. This is denoted as biocoenosis, The environment is the biotope encompassing the physical region of life.

The term ecosystem first appeared in a publication by the British ecologist Arthur Tansley, during 1935. An ecosystem may be of very different size. It may be a whole forest, as well as a small pond.

Different ecosystems are often separated by geographical barriers, like deserts, mountains or oceans, or are isolated otherwise, like lakes or rivers.

As these borders are never rigid, ecosystems tend to blend into each other. As a result, the whole earth can be seen as a single ecosystem, or a lake can be divided into several ecosystems, depending on the used scale.

The ecosystem is an open system. It receives energy from an outside source (the sun), as input, fixes and utilizes the energy and ultimately dissipates the heat into space as output.

An ecosystem has a physical environment, or factors, biological components and interactions between them. Any ecosystem is characterized by a set of abiotic and biotic factors, and functions.

The organisms in an ecosystem are usually well balanced with each other and with their environment.

Introduction of new environmental factors or new species can have disastrous results, eventually leading to the collapse of an ecosystem and the death of many of its native species.

The abstract notion of ecological health attempts to measure the robustness and capacity for recovery of a natural ecosystem.

Within an ecosystem, all living things have a habitat or the physical area in which they live.

The habitat of an organism may include many different areas. For Example, a mouse can be seen in a field, garden or even in a house.

Animals that migrate will have different habitats during different seasons. Some birds that live in a place during summer spend the winter in some other place.

Macro and Microecosystems:

The dimension and spread of an ecosystem may vary. Depending upon their existence and dimension, ecosystems are classified as Macroecosystems and Microecosystems. Dimensionally larger systems such as a forest or a lake are called as macroecosystems.

Life scientists and environmental biologists who are interested to evaluate the functional mechanisms of an ecosystem, may create an experimental setup in the field or in the laboratory. Such setup are considered to be microecosystems.

Depending upon their matrix of research, it may be a terrestrial microecosystem, or an aquatic microecosystem.

1. BIOTIC COMPONENTS

Biotic components - include all living organisms and their products.

This group includes all animals, plants, bacteria, fungi and their waste products like fallen leaves or branches or excreta.

Based on their activity, biotic components are classified into four categories as

- a) producers
- b) consumers
- c) transformers and
- d) decomposers.

Let us see these categories.

* Producers or autotrophs make their own food. Producers, such as plants, make food through a process called photosynthesis. This food is used by the plant for its own energy or may be eaten by consumers.

* Consumers or heterotrophs need to eat food that autotrophs have produced. There are different types of consumers. Herbivores eat plants. Carnivores eat animals. Omnivores eat both plants and animals.

* Decomposers are heterotrophs that break down the dead tissue and waste products. They play a very important role in the ecosystem because they recycle the nutrients. Bacteria and fungi are the main decomposers.

PRODUCERS:

Producers are called energy transducers. They convert solar energy into chemical energy, with the help of organic and inorganic substances.

The producers are called as autotrophic (auto = self; troph = nourishing) organisms.

They are capable of synthesizing food from non-living inorganic compounds.

They are largely represented by green plants on land (trees, grasses, crops) and phytoplanktons on water.

CONSUMERS :

Consumers are the organisms, whose food requirement are met by feeding on other organisms. They consume the food materials prepared by the producers (autotrophs). Hence, consumers are called as heterotrophic organisms. Animals belong to this category.

Depending upon their food habits, consumers are classified into primary, secondary and tertiary consumers.

The **PRIMARY CONSUMERS** are solely feed on plants. Herbivores are plant eaters - grasshopper, rabbit, goat, sheep are primary consumers.

The **SECONDARY CONSUMERS** feed on some primary consumers.

Carnivores-are flesh eaters. Eg. - Hawks ,Tiger and Lion.

Omnivores (Biophages) - eat both vegetables and flesh(cockroaches, fox, humans).

Secondary consumers are those which predate on primary consumers. Eg. several species of insects and fishes.

TERTIARY CONSUMERS are the predators of predators. They are mostly larger animals.

TRANSFORMERS :

Transformers are certain types of bacteria . They attack on materials excreted by other living organisms (even dead plants and animals). They transform the above into either organic or inorganic substances. These substances are suitable for the nutrition of green plants.

Transformers help in recycling the nutrients which came as waste already.

DECOMPOSERS :

They are also called as microconsumers. They depend on dead organic matter for their food . They are chiefly micro organisms like bacteria and fungi. They break the complex organic matter found in plant and animal bodies, and release simple substances . These substances will be used by autotrophs once again.

Some invertebrate animals like protozoa and earthworms use these dead organic matter for their food. They are called as secondary decomposers.

3. ABIOTIC COMPONENTS

The abiotic components are the non-living components of the ecosystem. They are of three categories

1. Climatic and physical factors -air, water, soil and sunlight; rainfall, temperature, humidity, soil texture and geomorphic conditions.
2. Inorganic substances- There are various nutrient elements and compounds, such as carbon, nitrogen, sulfur, phosphorous, carbon-di-oxide, water, etc. These are involved in the cycling of materials in the ecosystems.
3. Organic compounds- These are proteins, carbohydrates, lipids, humic substances, etc. They largely form the living body and link the abiotic compounds with the biotic factors.

The abiotic factors determine the type of organisms that can successfully live in a particular area.

Some of the major non-living factors of an ecosystem are:

Sunlight

Water

Temperature

Oxygen

Soil

Air

* Sunlight is necessary for photosynthesis; it influences organisms and their environment; it has a profound effect on the growth and development of life.

* Water is the elixir of life; all living things require water for their survival, but some can live with lesser amounts

* Temperature -- all living things have a range of temperatures in which they can survive; beyond those limits it will be difficult for them to live.

* Oxygen -- many living things require oxygen; it is necessary for cellular respiration, a process used to obtain energy from food; others are actually killed by the presence of oxygen (certain bacteria)

* Soil -- the type of soil, pH, amount of water it holds, available nutrients, etc determine what type of organism can successfully live in or on the soil; for example, cacti live in sand, cattails in soil saturated with water.

The inorganic substances like nitrates, carbonates and phosphates occur either freely or in the form of compounds dissolved in water and soil.

Some of them are recycled by micro-organisms on the dead bodies of plants and animals.

4. FUNCTIONS OF AN ECOSYSTEM:

A system is an organization that functions in a particular method. The functions of an ecosystem include

- 1) Flow of energy through the medium of living organisms and their activities
- 2) Food chains
- 3) Biodiversity and biomass
- 4) Circulation and transformation of elements and nutrients
- 5) Development and evolution and
- 6) Control.

Energy is also consumed by the autotrophs at cellular level for the reactions related to

1. growth
2. development
3. maintenance and

4. reproduction.

The specific functional processes of an ecosystem include

- a) photosynthesis,
- b) decomposition,
- c) predator - prey relations (herbivory, carnivory, parasitism and
- d) symbiosis.

Directly or indirectly the ecosystem's functional concept is useful in the management of renewable resources such as forests, watersheds, fisheries, wildlife and agricultural crops and stock.

5. THE INTERNAL PROCESS

Photosynthesis (Ps) and respiration (Rp) are the two major processes involved in the production and transformation of energy. The rate of photosynthesis increases by an increase of temperature. Many other factors influence the process of photosynthesis. However, it is involved

- 1) in the intake of radiant energy and CO₂ and
- 2) release of oxygen. Respiration is involved in the uptake of oxygen and release of CO₂ and energy.

In the absence of light, Ps is arrested but Rp continues. In the presence of light Ps and Rp work together. The total synthesis of organic matter resulting from the exposure of light can give the Gross Primary Production.

The amount of organic matter stored after expenditure (in terms of respiration) is called as the Net Primary Production. Hence, Primary Production is the amount of organic carbon and **Primary Productivity is the rate of production.**

The net primary productivity is also called as apparent photosynthesis or net assimilation. The grain, straw, stalks, roots, etc harvested from a paddy field (after a growing season) comprise the net primary production.

It is well known that animals are not capable of synthesizing their food. So, they have to rely upon other plants and animals for their food. There are two biological processes involved in animal life.

They are 1. Metabolism and 2. Growth.

They require energy which is obtained from the ingestion of food. The food, which is in excess of the metabolic needs, is used to produce animal tissue. This process is known as secondary production. It is estimated by measuring the increase in weight or size of the animals over a period of time.

So, secondary productivity is the amount of new organic matter stored by the consumers or the heterotrophs. It is a function of the amount of primary production in an ecosystem. The total quantity of organic matter present at any given time in an ecosystem, is called as the biomass.

Life in Ecosystems need a continuous supply of energy for survival. Almost all the energy available to us on earth comes from the sun. The radiation gives heat and light. The uneven heat develops the wind to blow. The radiation evaporates water into the air and the evaporated molecules are returned back as rain.

Plants are fundamental to all life on earth. Because, plants have the ability to trap solar energy falling over them and use this energy to build living tissues. This process is called photosynthesis.

During this process, the inorganic energy - poor molecules (CO₂ and water) are converted into organic -rich food molecules (sugars). In this way, plants do not need to depend on other organisms. Hence, they are treated as self

nourishers or autotrophs. Animals can not use the sun in this way. So, they are dependent, directly (or) indirectly, on plants for food. Hence, animals are treated as other nourishers or heterotrophs.

The energy used during photosynthesis by plants is not lost. Sugar is a product of photosynthesis. This sugar contains stored chemical energy and can be burnt to produce heat. Now, in this process, CO₂ and water are released as by-products. Sugar combines with oxygen inside the living cells and produce some output, under a slow rate. This process is called as respiration. It releases the 'energy in the form of complex molecules for use in maintaining the cell functions.

Plants are engaged in both photosynthesis and respiration. Animals can not make their own food. They must eat other organisms to obtain the energy rich molecules for survival. Therefore, they are the major consumers. Animals are technically called as heterotrophs (other - nourishing).

Habitat destruction:

A forest is a living world for organisms and plants. Due to some events, a change in the setup may occur which will ultimately affect the ecosystem.

For example, cutting the trees in a forest is considered to be a habitat destruction:

This activity

- a) destroys the homes of some animals,
- b) increases the amount of light that reaches the forest floor,
- c) reduces the amount of food for organisms that depend on those trees,
- d) reduces the amount of carbon dioxide taken from the air and oxygen released into it.

As a result of this habitat destruction, some organisms may become threatened, endangered and eventually extinct.

Hence, it is necessary to preserve the ecosystems.