

## Lecture 08: Introduction To Ecology and Environment

### Introduction

Man has been interested in ecology in a practical sort of way since early in his history. In primitive society, every individual, to survive, need to have definite knowledge of his environment i.e. of the force of nature and of the plants and animals around him.

Ecology is one of the popular areas of sciences in biology. It is a pluralistic science in the sense that it depends on a wide variety of methods and approaches rather than on a limited range of techniques and concepts. Even if, it is thought as part of biology, one important way in which ecology differs from most other branches of biology is that it can be properly appreciated or studied only through a multidisciplinary approach involving close cooperation from expertise in several disciplines.

### I. Definition of Ecology

The term “*Ecology*” is derived from two Greek words ‘oikos’ meaning house and ‘logos’ meaning study. It was coined by Ernest Haeckel. Eugene Pleasants Odum, the famous ecologist defined ecology as ‘the study of structure and function of nature’. In simple terms, ecology is the branch of biology that deals with the scientific study of the interactions among organisms and their physical environment. These two components of ecology namely, Organisms and their physical environment are related and interdependent. These components function as a system in an organized way. Environment influences and modifies the organisms; also organisms influence and modify the environment. And accordingly different ecosystems are formed.

Another way of defining *Ecology* is to look at the levels of biological organizations. The molecules of life are organized in specific ways to form **cells**; cells are grouped in to **tissues**; and tissues are arranged to produce functional organs. The body organs are integrated to produce **organ system**, and the entire array of these systems constitutes an **organism**. Organisms exist not just as a single individual, but in-groups called **population**. The various populations of organisms that interact with one another to form a **community**; interdependent communities of organisms interact with the physical environment to compose an ecosystem. Finally, all the ecosystems of the planet are combined to produce a level of organization known as the **biosphere**. Ecology is concerned with the levels of organization beyond that of individual organism; i.e. population, community, ecosystem, and biosphere.

*Ecology* includes the following levels of biological organization:

- **Species level:** Species is a group of individuals that are genetically linked with each other. They can interbreed to produce fertile young ones.
- **Population level:** Population is a group of organisms belonging to the same species. Populations live in same region and interact with one another.
- **Community level:** Community is the group of populations of different species living in a particular area. Populations of a community interact with one another.
- **Ecosystem:** It consists of all the communities of an area. An ecosystem is made of the biotic and abiotic factors in an area.
- **Biosphere:** Is the narrow zone where the life exists on Earth. It is everything about life on earth i.e it is the place where humans, animals, plants, microorganisms live and interact with each other.

## **II. Definition of Environment**

*Environment* is defined as sum total of all biotic and abiotic factors that influence an organism during its survival and reproduction. Mainly there are following two types of environments:

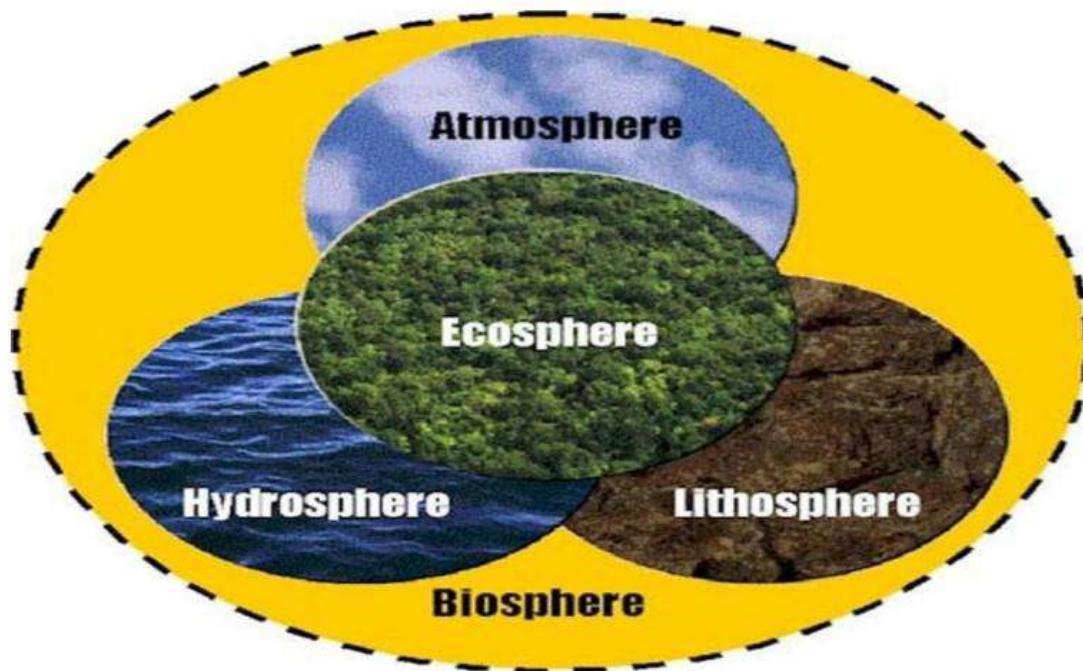
- **Abiotic environment:**  
It is also known as physical or natural environment. The non-living natural surroundings like air, water, land are the part of the physical environment. Climatic factors like sunshine, rainwater, precipitation, moisture, humidity, pressure etc. are also abiotic factors.
- **Biotic environment:**  
It is also known as biological or organic environment. This environment is responsible for the growth, reproduction and maintenance of the living organisms. Biological environment mainly includes living part of the earth.

## **III. Biosphere**

The biosphere is any part of the Earth where organisms live, broadest level of ecological study, includes all of Earth's ecosystems.

## IV. Components of Biosphere

Basically biosphere includes three main components namely:



### 1. Abiotic components:

These include all the non-living elements of the biosphere. Though these are non-living elements they are critical for the survival of all the living organisms. Abiotic components include:

- **Lithosphere:** Solid part of the Earth's crust
- **Atmosphere:** Gaseous part of the Earth
- **Hydrosphere:** Liquid part of the Earth

The area where all these components mingle with each other is the perfect area for the development of the organic life.

### 2. Biotic components:

These include all the living elements of the biosphere. The main elements are plants, animals, microorganisms and human beings.

- **Plants:** Plants are the primary producers and hence are very important. They produce their own food through the process of photosynthesis and are called autotrophs. Plants

also help in recycling of organic matter. Hence they also act as a source of energy for all living organisms.

- **Animals:** Animals are the primary consumers. As they do not produce their own food and depend on other sources for food, they are called heterotrophs. Animals use the organic matter from the plants as food. They transform the food into energy and utilize it for growth and development.
- **Microorganisms:** It includes virus, bacteria, algae, fungi etc. They are the major class of decomposers as they decompose the dead and decaying matter. By this process of decomposing they obtain their food.

### 3. Energy components:

The major source of energy on earth is the sun. Energy component is the vital part of the biosphere. Without this energy component, life is difficult on our planet Earth. It is with the help of this energy component that regeneration and reproduction is made possible. Just like machines, all living organisms use this energy component to work and to convert one form of energy to another form.

## V. Ecosystem

Ecosystem is the structural and functional unit of ecology where living organisms interact with each other and also with the surrounding physical environment. In other words, it is the whole community in which plants and animals live together. For example, Tropical rain forest with its trees, animals etc. make up the ecosystem. In the year 1935, Arthur George Tansley coined the term ecosystem. According to Tansley, ecosystem consists of organisms and inorganic components in a relatively stable equilibrium. As per E P Odum, ecosystem is the basic functional unit of organisms and their environment interacting with each other.

In an ecosystem, biotic and abiotic components are inseparably inter-related. These components interact with each other. As ecosystem is an open system, the energy and the components can easily flow throughout the boundaries.

## VI. Components of Ecosystem

### I. Abiotic components:

It is the nonliving component of the ecosystem. The abiotic components of the ecosystem include basic inorganic elements and compounds like soil, water, oxygen and a variety of organic compounds.

Some physical factors like humidity, wind and water currents, solar energy etc. are also abiotic components.

## II. Biotic components:

It is the living component of the ecosystem. In terms of nutrition, biotic components can be grouped as autotrophs and heterotrophs. Autotrophs include green plants which make their own food with the help of sunlight and other inorganic matter. Heterotrophs include non-green plants and all animals which depend on autotrophs for their food needs.

✚ On a broader scale biotic components includes producers, consumers and decomposers.

1. **Producers:** Producers are the autotrophic elements of the ecosystem. They use radiant energy of the sun during the process of photosynthesis whereby carbon dioxide is assimilated and the light energy is converted into chemical energy.

2. **Consumers:** These are the members of the ecosystem which consume the food prepared by the producers and hence are called as consumers. The following are different classes included in consumers:

a. **Primary consumers:** These are herbivorous animals which are dependent on the green plants for their food. For example, insects, cow, deer, buffalo, goat etc.

b. **Secondary consumers:** These are carnivorous and omnivorous animals which feed on primary consumers and producers or both. For example, sparrows, fox, crow, snake etc.

c. **Tertiary consumers:** These are the top carnivorous animals which feed on other carnivorous, herbivorous and omnivorous animals. For example, lion, tiger, vulture, hawks etc.

3. **Decomposers and transformers:** These are living components of the ecosystem. Decomposers and transformers help to maintain the dynamic structure of ecosystems. The decomposers attack dead remains of producers and consumers. Decomposers degrade the complex organic substances into simpler compounds. Whereas the transformers change the organic compounds into inorganic forms that are suitable for reuse by the producers or green plants. For example, Fungi and Bacteria.

## VII. Energy Flow within an Ecosystem

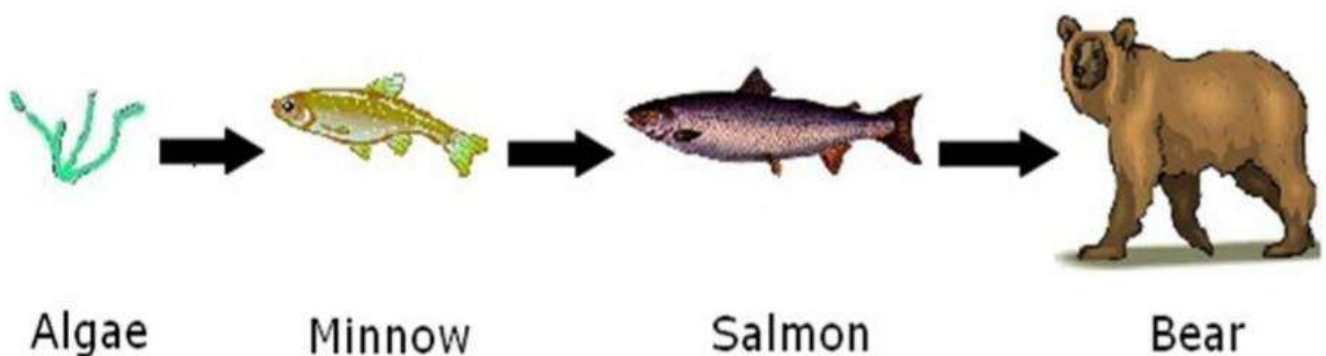
All of the energy that comes to earth comes from the sun. Which means the process has to start with some kind of plant, doing photosynthesis. From there herbivores eat the plant and carnivores eat the herbivores. It is a simple interaction that passes energy up the food chain. In the absence of light,

organisms can use chemical energy to produce carbohydrates, which is called chemosynthesis. This happens in deep ocean plant, which cannot get sunlight from the sun!

### **VIII. Food chains**

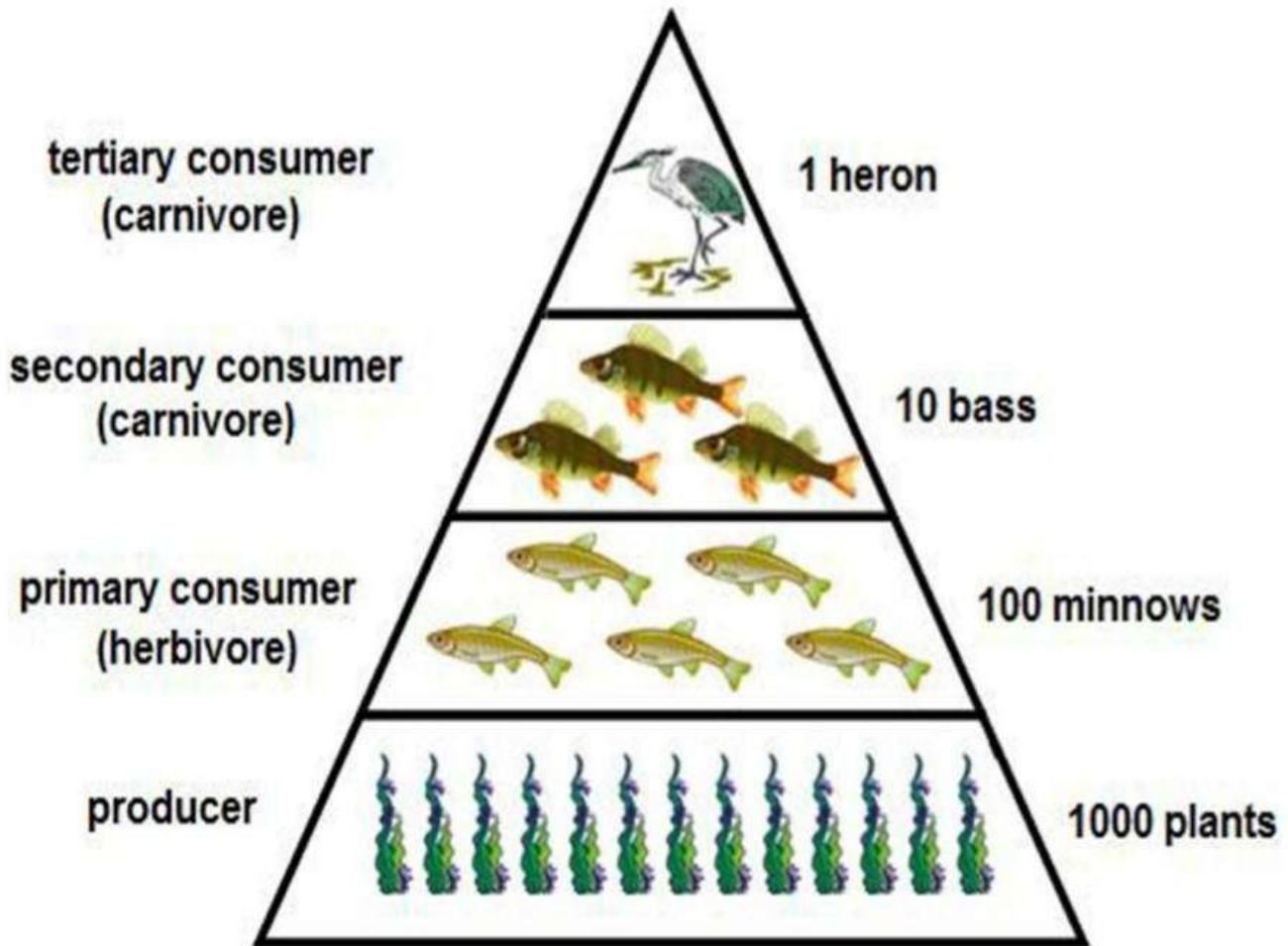
- ❖ Describe the energy flow between species within an ecosystem.
- ❖ Producers use energy from the sun to make food and therefore start the chain.
- ❖ The arrows represent the direction of energy flow, pointing from the organism being consumed to the organism receiving the energy.

#### **Sample of food chain**



### **IX. Energy Pyramid**

- ❖ A diagram that shows the relative amounts of energy located within each trophic level.
- ❖ Most of the energy in an energy pyramid is used or lost as heat energy as it moves up the pyramid, therefore each level in an energy pyramid has less energy available to it than the level below (only about 10% of the energy produced at each level is available to the one above it).
- ❖ Producers are the foundation of all pyramids.



## X. Symbiosis

- ❖ An interaction between individuals of different biological species.
- ❖ One of the organisms receive a benefit from the interaction, the other can either receive a benefit, be harmed, or not be affected in any way.
- ❖ Three main kinds of symbiotic relationships: commensalism, mutualism, and parasitism.

### Symbiosis Chart

Interaction	Species A	Species B
<u>Commensalism</u>	Receives benefit	Not affected
<u>Mutualism</u>	Receives benefit	Receives benefit
<u>Parasitism</u>	Receives benefit	Harmed

- ❖ Commensalism: One organism benefits and the other is neither helped nor harmed in a commensalistic relationship.
- ❖ Mutualism: Both organisms benefit in a mutualistic relationship. Ex. flowers and pollinators.
- ❖ Parasitism: One organism benefits and the other is harmed in a parasitic relationship.

### **Other relationships**

- ❖ Predator/Prey: predator hunts, kills, and eats prey.
- ❖ Competition: two organisms compete for the same resources, ex. food, water, shelter, space.
- ❖ Cooperation: an interaction where organisms work together, ex. wolf packs.

### **XI. Human impacts**

- ❖ Human activities can change the balance in Earth's processes; careless human activity can also alter or destroy habitats and damage ecosystems.
- ❖ Humans hurt the Earth through pollution, resource use, and introduction of invasive species
- ❖ Humans can also help the Earth through conservation and preservation.