

## Bridge Course (After SEE)

### Ecology

- Ecology is the study of interrelationship and interaction of living organisms with themselves and with their environment.
- The term "Ecology" was first coined by German biologist Ernest Haeckel in 1869.
- The word ecology is derived from two Greek words; "*oikos*" meaning home and "*logo*" meaning understanding.

#### Ecology has two main branches

1. Autecology is the study of the reciprocal relationship between every stage of development of a population/species and its environment.
2. Synecology is the study of the reciprocal relationship between composition, organization and development of communities and their environment.

#### Ecosystem

- Ecosystem is the term that denotes the ecological system.
- The term 'ecosystem' was first used by the English ecologist A.G. Tansley in 1935.
- Ecosystem is the ecological unit that consists of self-regulating and self-sufficient systems characterized by living and nonliving components. The transfer of energy and transfer of materials from one feeding group to the other is the main event in every ecosystem.

#### Ecological Factors

The environmental factors which control distribution, abundance, growth and reproduction of living organisms are known as ecological factors. There are many ecological factors functioning independently or in an association.

#### Ecological factors are of two types:

##### A. Abiotic components:

The non-living ecological factors are called abiotic factors. These factors include organic and inorganic compounds. The basic abiotic factors are as follows.

1. Climatic Factors: Light, precipitation, temperature, wind atmospheric humidity.
2. Edaphic Factors: Soil water, soil aeration, soil type, soil temperature, soil particles.
3. Topographic factors: Altitude, slope, direction of slope.

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### B. Biotic Components:

Living components of an ecosystem are biotic components which can be classified on the basis of food relations as follows:

**a) Producers:**

They are autotrophs which can synthesize the food using light energy. Basically they are all the green plants.

**b) Consumers:**

They are heterotrophs which obtain energy from producers directly or indirectly. They can be further divided as:

**c) Primary Consumers:**

Those which derive their food directly from plants and Herbivores Example: deer, goat etc.

**d) Secondary Consumers:**

They eat other consumers and derive their energy from producers indirectly. They are called Carnivores. Example: wolf, snake etc.

**e) Tertiary Consumers:**

They eat secondary consumers and are also carnivores. They are top level carnivorous. Example: lion, tiger, etc.

**f) Decomposers:**

They feed on dead and decayed plants or animals. They decompose the dead organisms in its constituent components. Example; Fungi, Bacteria etc.

### Food Chain

Food chain is the representation of transfer of energy and materials through the food from one trophic level to the other in linear form. In a community the food and energy relationship can be studied in the linear form called a food chain. In a food chain, each stage represents a trophic level. The food chain includes the process of eating and being eaten.

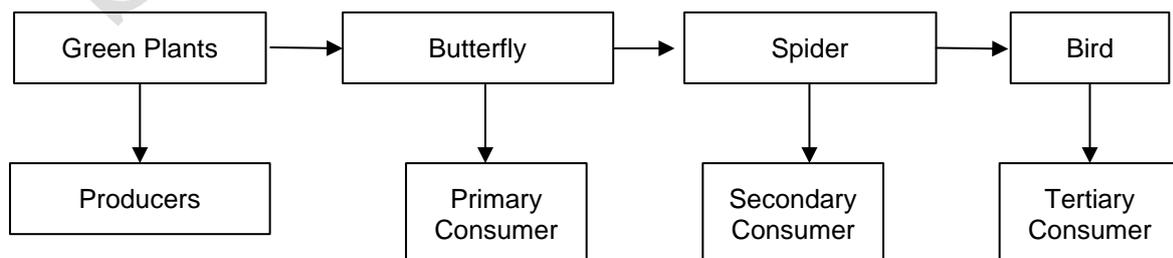


Figure: A simple food chain

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### Trophic Levels

- The various feeding levels from producers to consumers is called trophic level.
- There is a definite pattern in a food chain on the basis of which trophic structure is built.
- The energy flows only one way through various trophic levels.
- The total dry weight of organisms at a particular trophic level is called the Biomass.

First trophic level: Producers → The Autotrophs

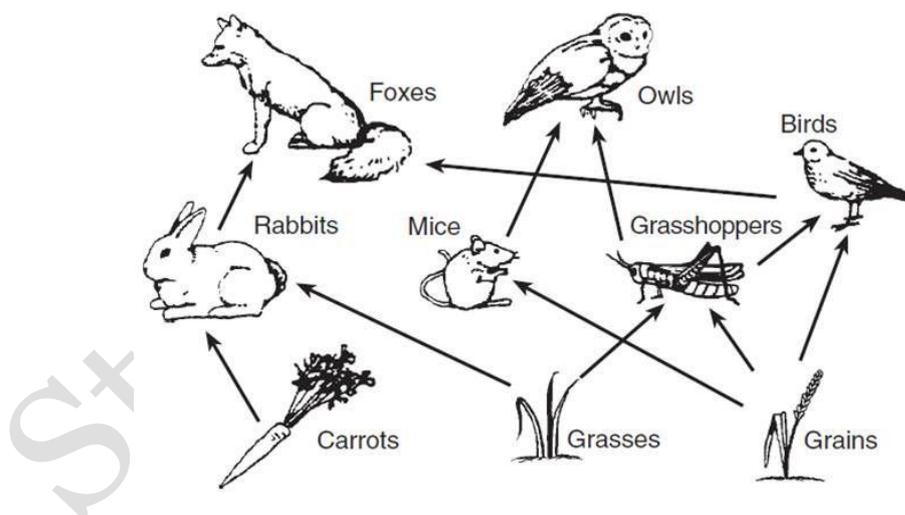
Second trophic level: Secondary consumers → Herbivores

Third trophic level: Secondary consumers → The Carnivores

Fourth trophic level: Tertiary consumers → Top carnivorous

### Food Web

A food web is a complicated form of food chains. It shows the pattern of energy or nutrient flow throughout a community. Many food chains exist in an ecosystem, but as a matter of fact these food chains are not independent and unidirectional. In an ecosystem one organism does not only depend upon the other organisms, but it may derive its food from more than one source. Even the same organism may be eaten by more than two organisms of higher trophic level.



### Productivity

The amount of energy that passes from one trophic level to the order is known as production. Green plants fix solar energy and accumulate it in organic forms such as carbohydrates, fats and proteins. The phenomenon of production of energy in a particular trophic level, in a given area in a given time is known as productivity. The productivity is measured as joules per meter square per day.

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### Ecological pyramid

There is some relationship between the numbers, biomass and energy contents of the primary producers, consumers of the first, second orders and so on to the top carnivores in any ecosystem. Diagrams of pyramids, known as ecological pyramids, represent these relationships.

These types of ecological pyramids can be visualized as follows:

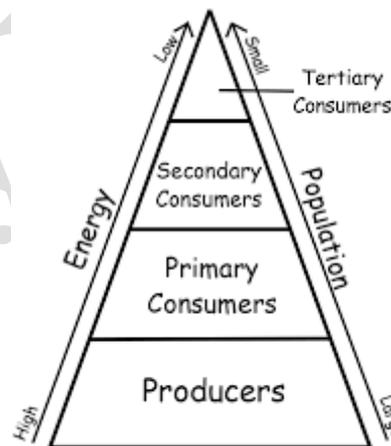
#### 1. Pyramid of numbers:

They show the relationship between the numbers of primary producers and consumers of different orders. E.g., Upright pyramid of numbers - grassland ecosystem, cropland ecosystem. Inverted pyramid of numbers-tree

#### 2. Pyramid of biomass:

The amount of biological material in different trophic levels in an ecosystem is termed as standing crop. If the quantity is expressed in terms of weight, it is called biomass. Pyramids of biomass show the quantitative relationship of the standing crops. E.g.: Upright pyramids of biomass are seen in grassland and forest ecosystems. Inverted pyramids of biomass are seen in the Pond ecosystem.

#### Pyramid of energy:



It represents the total quantity of energy. utilized by different trophic level organisms of an ecosystem in unit area over a set period of time. In shape it is always upright, as in most of the There is always a gradual decrease in the energy content at successive trophic levels from the producers to various consumers e.g., Grassland and aquatic ecosystems.

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### Ecological factors

Environment is a complex of many things (light, temperature, soil, water, etc.) which surrounds an organism. Each part of the environment that affects in a specific way the structure and the functioning of the organism and influences its growth is called factor or ecological factor.

All ecological factors may be grouped in four classes, which are:

1. **Climatic factors:** These include

- Light
- Temperature of air
- Rainfall (Precipitation) and
- Atmosphere (gasses and wind)

2. **Topographic factors:** These include

- Altitude
- Steepness and exposure of slopes etc.

3. **Edaphic factors:** These deal with physical properties of soil, drainage, soil nutrients, soil temperature, etc.

**Biotic factors:** These are all kinds of interactions between different forms of life, i.e., plants, animals, etc.

**Biosphere:** It is an area in which life on earth is possible. It includes all the living organisms and physical environment with which they interact. Biosphere is a combination of all the ecosystems that exist on earth. It is divided into 3 main parts.

- i. **Hydrosphere:** The aquatic portion of the biosphere is the hydrosphere.
- ii. **Lithosphere:** The crust, - the solid portion of earth like land masses, rocks, mountains etc. is the lithospheres.
- iii. **Atmosphere:** It forms a gaseous envelope over the hydrosphere and lithosphere.

## **THE BIOGEOCHEMICAL CYCLES**

The cyclic movement of elements from the biotic environment to the abiotic environment and again back to the biotic environment is known as biogeochemical cycle. It is also called inorganic-organic cycle. There are 30-40 elements required for growth and development of living organisms. There are three types of biogeochemical cycles:

1. Water Cycle (Hydrological Cycle).
2. Gaseous Cycle (Oxygen, Nitrogen, Carbon Cycles).
3. Sedimentary Cycle (Mineral Cycle).

### **The Carbon Cycle**

The cyclic flow of carbon from the abiotic world to the biotic world and again from the biotic world to the abiotic world is called the carbon cycle. Carbon is the most important element of the protoplasm. It is a major constituent of carbohydrates, proteins, fats and nucleic acid of all the organisms. It is present

- i. As CO<sub>2</sub> in air & the rocks.
- ii. As carbonates in the rocks.
- iii. As carbon in fossil fuels.

Plants take carbon from CO<sub>2</sub> for photosynthesis which then enters into other organisms through the food chain. The carbon is released back to the environment.

- i. As CO<sub>2</sub> released during respiration.
- ii. By decomposition of dead & decayed bodies.
- iii. By burning wood & fossil fuels.
- iv. By dissolution of carbonate rocks.
- v. By volcanic activity of rocks.

### **The oxygen Cycle**

The cyclic flow of oxygen from the abiotic world to the biotic world and again from the biotic world to the abiotic world is called the oxygen cycle. Oxygen occurs in the atmosphere as molecular oxygen O<sub>2</sub> and as compounds in N<sub>2</sub>O & CO<sub>2</sub> utilized during combustion and oxidative weathering of rocks.

- It is released as a byproduct of photosynthesis and in the form of compound CO<sub>2</sub> during decay of organisms.

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- Plants release  $O_2$  during photosynthesis and animals consume it during respiration thus maintaining a balance in nature. So that oxygen and carbon cycles are completely dependent on one another.

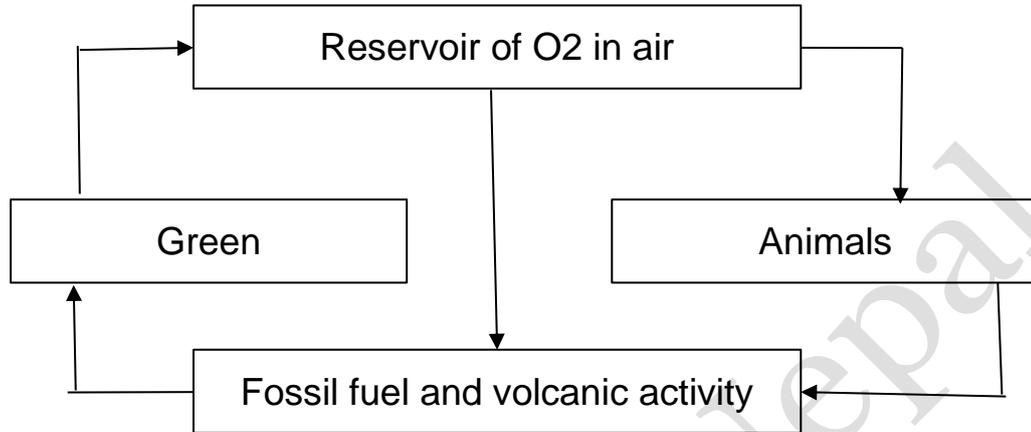


Figure: oxygen cycle

### The Nitrogen Cycle

Nitrogen is essential to life. It is a major constituent of Proteins, nucleic acids and chlorophyll molecules of the cell." Plants cannot utilize the free atmospheric nitrogen. It should be converted into nitrogen containing compounds. The cyclic flow of Nitrogen from the abiotic world to the biotic world and again from the biotic world to the abiotic world is called the nitrogen cycle.

- 1) Nitrogen fixation:** The process of conversion of atmospheric nitrogen as follows: nitrogen into nitrates & nitrites is called nitrogen fixation. It takes
  - a) Biological Fixation**  
Nitrogen - fixing bacteria → clostridium, Azotobacter and Rhizobium
  - b) Electrochemical and Photochemical fixation:**  
By the action of lightening of oxygen & nitrogen.
  - c) Industrial fixation:** By Haber's process.
- 2) Nitrogen used by plants & animals:**  
Plants take nitrate from the soil and form proteins, when animals eat plants, the proteins are converted into animal proteins.
- 3) Decomposition by Microorganisms:**

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By ammonifying bacteria, they convert wastes and decayed and dead bodies to **ammonia** or ammonium compounds.

**4) Nitrifying bacteria:**

*Nitrosomonas, Nitrobacter.* They convert ammonium salts into nitrites and nitrates.

**5) Denitrifying bacteria:**

*Pseudomonas.* It converts nitrates into molecular nitrogen which goes to the atmosphere.

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### BIODIVERSITY

- Biodiversity can be defined as the variety and variability of life forms, levels and combinations existing within the living world or in a particular area.
- Ecosystem diversity is the variety and frequency of distinct ecosystems including the variety of habitats, biotic communities and their change in composition and structure over time.
- Species diversity refers to the variety of species found within a particular geographical area.
- It is estimated that there are about 30 million living species around the world.

There are various ways to describe species diversity

- **Species richness:** Total number of species within a geographical area.
- **Species evenness:** Relative abundance of species in various categories. It is also known as Taxonomic Diversity.
- **Species Dominance:** Expression of most abundant species as dominant species.
- **Genetic Diversity:** The differences among the population of a single species is called genetic diversity.

#### Floral Diversity of Nepal

Though a thorough study has not been performed in Nepal, the plants and animals found in Nepal are very diverse. Floral diversity means the variety of plants found within a geographical area.

#### Floral diversity of Nepal

Group of organisms	Number of Species
Lichens	465
Mycota (Fungi)	1666
Algae	687
Bryophyta	853
Pteridophyta	380
Gymnosperm	27
Angiosperm	5806

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### **Gymnosperms**

- 27 species have been identified in Nepal.
- Cycas, Gnetum, Pinus, Podocarpus, Cedrus, Taxus, Juniperus, Ephedra etc. are some of the species of Gymnosperms found in Nepal.

### **Angiosperms**

- Nepal is regarded as one of the richest places for Angiospermic flora.
- There are about 5806 reported species of Angiosperms in Nepal.
- The largest family is Composite followed by Orchidaceae and Leguminosae.

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### Conservation of Natural Resources

The natural resources are the resources on the earth that are not created by man but found naturally. Natural resources are required for survival not only for human beings but also for a variety of life forms. The components of atmosphere, hydrosphere and lithosphere supporting all the creatures make the natural resources.

Wildlife is defined as the uncultivated flora and undomesticated fauna among the plants and animals, found in their natural habitats or wild habitats. Wildlife provides economic and recreational benefits to man. The wildlife conservation is mainly concerned with preservation and protection of wildlife, both flora and fauna in their natural habitats.

#### Importance of wildlife resources

Every civilization is rooted in natural and biological resources. Wildlife provides directly and indirectly the material basis of human life. The following are the importance of wildlife.

##### 1. Ecological Balance

Every component of the ecosystem (biotic component and abiotic component) plays a very important role in regulating the ecological balance. Destruction of one species may affect a number of other species dependent on that.

##### 2. Human consumption:

Humans have used plants and animals for thousands of years. The most important conventional use of biodiversity is as foods, medicines and industrial products. Wild species of plants and animals are economically most important for human life, as they are used in various ways.

##### 3. Forest Products:

Forest products are essential requirements for every human civilization. Wood for construction, firewood as fuel, maintaining oxygen and carbon dioxide concentration, promoting Rainfall, maintaining soil fertility and providing habitat for large numbers of animals are- some important aspects of forests, which furnish the important component of wildlife.

**4. Natural beauty:** The wildlife carries a greater aesthetic value. It comprises the natural beauty for the entire world. People take natural beauty for recreation. Tourism industry operates on the natural beauty, which is one of the important economical components.

##### 5. Scientific Value:

Wildlife resources provide various types of scientific knowledge regarding the biological world. The biologists can understand the ecological knowledge, relationships, behavior of every part of nature.

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**6. Genetic Value:** The wildlife provides many useful genes that are used for plant and animal breeding. The natural gene bank (collection of different genes) may be very important for the biologists to create novel varieties of plants and animals. The novel varieties constitute the better yielding capacities and the better adaptability.

### Endangered and threatened species:

The plant or animal species are called endangered if they are in danger of extinction if the causal factors continue to operate. Large number of flora and fauna has become endangered due to human activities and human overpopulation.

The plant or animal species are called threatened if the species are rare, and endangered. The World Conservation Union (IUCN) categorized the following threat categories for wildlife resources.

- **Extinct (Ex):** This category is given to the species which are not definitely located in the wild during the past 50 years.
- **Endangered (E):** The species which are in danger in the ongoing natural environmental condition.
- **Rare (R):** This category includes the species with small world populations that are at present "Endangered" Or "vulnerable" but are at risk. These species are found in small numbers only in limited habitats.
- **Indeterminate:** The species are likely to move into the endangered category in the near future. This category includes exploitation. plants or animals whose population is decreasing because of over
- **Threatened (T):** The category threatened is used to those species which are considered to belong to any one of the above categories (endangered, vulnerable, rare, indeterminate)

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### ENDANGERED WILDLIFE OF NEPAL

There are 27 species of mammals, nine species of birds and three species of reptile, which are given legal protection Under national parks and wildlife Act. 1973. Some of the endangered Flora and Fauna are listed as below:

SN	Common Name	Scientific Name
1	Red Panda	<i>Ailurus fulgens</i>
2	Snow leopard	<i>panthera uncia</i>
3	Bengal Tiger	<i>Panthera tigris</i>
4	One horned Rhinoceros	<i>Rhinoceros unicornis</i>
5	Himalayan Musk Deer	<i>Moschus chrysogaster</i>
6	Dolphin	<i>Platanista gangetica</i>
7	Swamp Deer	<i>Cervus duvauceli</i>
8	Asiatic Elephant	<i>Elephas maximus</i>
9	Four horned Antelope	<i>Tetracerus quadricornis</i>