

The biosphere refers to that part of the earth in which all life forms exist. The biosphere can be called in other terms consisting of the world of living organisms together with the layers of soil, water and air on the surface of the earth. Thus biosphere consists of four parts :

1. Lithosphere (Land surface or soil)
2. Hydrosphere (Water bodies)
3. Atmosphere (Air)
4. Living organisms (like Plants and Animals)

The organisms or life forms in the biosphere vary in size from minute bacteria to large whales or huge trees. All organisms may

broadly be grouped under two categories—the plant kingdom and the animal kingdom. Under each category, there are several species. Human beings are just one of the species of the biosphere called the Homo Sapiens.

ECOSYSTEM

All organisms whether belonging to the plant kingdom or the animal kingdom interact with each other as well as with their physical environment. **Ecology** studies the interactions between organisms and their environment. **Ecosystem** is referred to as a complex system of interactions between organisms and the physical environment in any unit of

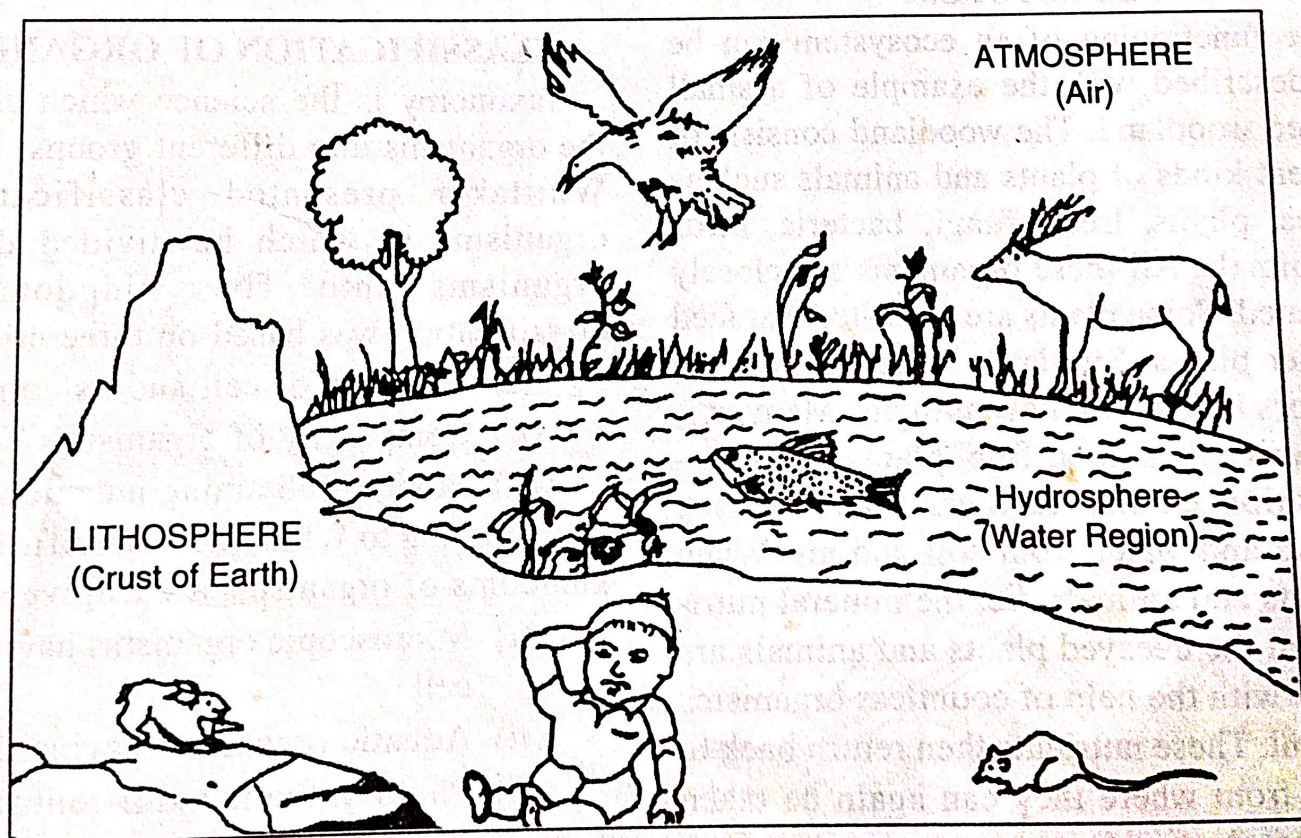


Fig. 16.1 The Structure of Biosphere

area. It could be of any size from a small pond to the Amazon rainforest or the entire world. (Fig. 16.1)

COMPONENTS OF AN ECOSYSTEM

All the ecosystems are made up of two main components.

1. **Abiotic Components** (Non-living components) : It includes physical environment along with the inorganic substances like carbon dioxide, nitrogen, oxygen, water, sulphur, calcium etc. and other elements present in them.

2. **Biotic Components** : (Living components) : The biotic community of an ecosystem includes three types of organisms :

- (i) Producer organisms include all the green plants
- (ii) Consumer organisms include all the animals
- (iii) Decomposer organisms include certain bacteria and fungi.

THE FUNCTIONING OF AN ECOSYSTEM

The functioning of an ecosystem can be best described with the example of a small isolated woodland. The woodland consists of different kinds of plants and animals such as grasses, plants, trees, fungi, bacteria, birds and animals. All these organisms are closely associated. Some plants are parasites that feed on other plants. Similarly some animals are predators living on fellow animals. Many animals derive their food from plants. These relationships extend further. Plants derive nutrients and water from soil and air. When the plants and animals die, the mineral nutrients from the decayed plants and animals are released with the help of countless organisms in the soil. These nutrients then return back to the soil from where they can again be taken up by the plants. Various components of the woodland thus interact with each other as well

as with their physical environment. Thus the ecosystem of the woodland consists of all kinds of life forms, such as plants and animals, and their physical environment and water with which they interact.

The key features of an ecosystem are the (1) *Cycling of matter* and (2) *Flow of energy* between various components. **Matter** consisting of elements and compounds move from one component of the ecosystem to another in a cyclic manner. For example, carbon, oxygen, nitrogen and water, all move between the atmosphere, the lithosphere the hydrosphere and biosphere. All life forms are made of primarily three most abundant elements—carbon, hydrogen and oxygen. These elements are called nutrients. Vast quantities of the major elements are found in large reserves in the atmosphere and in rocks. They enter the biosphere mainly through plants.

The ecosystem also functions due to energy transmission through its various components which make natural cycles operational. The sun is the main source of this energy.

CLASSIFICATION OF ORGANISMS

Taxonomy is the science which classifies the organisms into different groups. In 1969, Whittaker presented classification of organisms in which he divided different organisms into five kingdoms. His classification was based on three criteria.

- (i) Structure of cell and its complexity
- (ii) Complexity of organism's body
- (iii) Mode of obtaining nutrition

According to Whittaker's classification five kingdoms of organisms are as given below.

- (i) Microscopic organisms having single cell
- (ii) Aquatic organisms having uni-cell.
- (iii) Photosynthetic multi-cellular plants
- (iv) Multi-cellular decomposers
- (v) Multi-cellular animal consumers.

(i) **Microscopic organisms having single cell (Monera Kingdom)** : Bacteria belong to this kingdom whose cells are microscopic and there is no nucleus. By utilising light energy or energy from chemical reactions it manufactures its own food by reducing carbon dioxide.

(ii) **Aquatic Organisms having Uni cell (Protistan Kingdom)** : They are photosynthetic autotrophs and chief producers in oceans and fresh water lakes or rivers. They are called phytoplankton which are microscopic, floating photosynthetic organisms.

(iii) **Photosynthetic multicellular plants (Plantae Kindgom)** : This kingdom includes all the coloured, photosynthetic plants having multicells. They are found on the land, on sea shores, in lakes and in streams. Sea weeds form the main group such as algae, mosses, ferns and seed plants with or without flowers.

(iv) **Multicellular decomposers (Fungi)** : Fungi kingdom includes various kinds of multi cellular heterotrophic organisms. They are the major decomposers and they recycle the inorganic resources in the biosphere. Over 100,000 species of fungi are found in the world ranging from uni cellular yeast to complex like mushrooms.

(v) **Multicellular animal consumers (Animalia Kingdom)** : This kingdom is further subdivided into various small kingdoms which include sponges, snails, insects, starfishes, amphibians, birds, mammals etc.

Human beings called Homo sapiens are one of the species of animal kingdom. They have a capacity to modify the environment according to their needs because of highly developed brains and skilled hands. It is because of this quality human beings are more powerful than other animals.

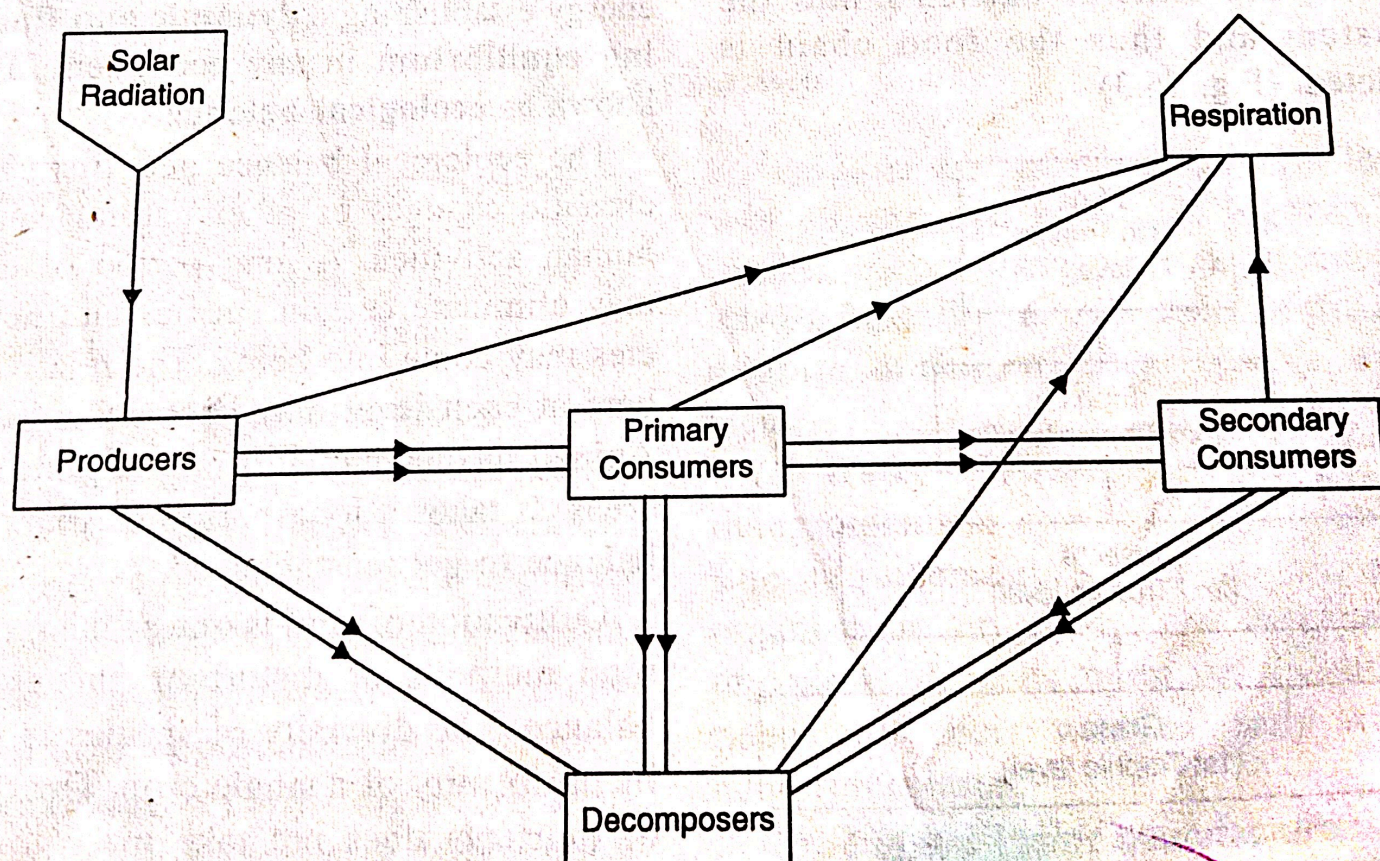


Fig. 16.2 The Flow of Energy through the Foodchain

FOOD CHAIN

The transfer of energy in the ecosystem takes place in a series of steps or levels, and is referred to as a food chain. (Fig. 16.2)

First level—Producers : Producers are, in fact, plants. They use light energy to convert carbon and water to produce carbohydrates by photosynthesis and also synthesise proteins and fats.

Second level—Primary Consumers (Herbivores) : These are plant eating animals such as cattle, deer, goat etc.

Third level—Secondary Consumers (Carnivores) : They feed on the primary consumers, e.g. as owl, lion, tiger etc.

Fourth level—Omnivores : Some of the species are called omnivores because they are both herbivores and carnivores. Human beings come under this category.

Fifth level—Decomposers : They are non-green micro organisms like some bacteria and fungi which feed on the decaying organic matter derived from all levels. They help in recycling the mineral nutrients into the ecosystem and thus the food chain is completed. (Fig. 16.3)

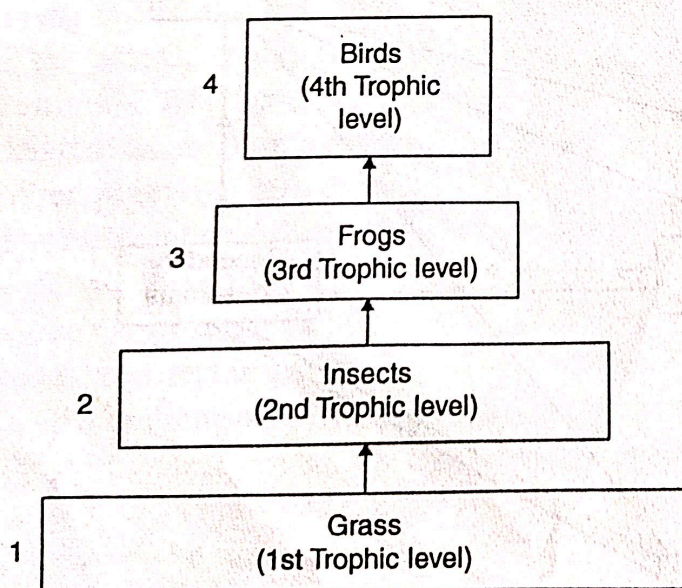


Fig. 16.3 Diagram Shows Trophic levels in a food chain : Grass → Insects → Frogs → Birds

FOOD WEB

The network of a large number of food chains existing in an ecosystem is called a food web. A large number of food chains exist in a community of living organisms in an ecosystem such as a grassland, a forest, a pond or a crop field. Many of these food chains are interconnected by species which occur in more than one food chain. (Fig. 16.4)

There is loss of energy at each energy transfer in various trophic levels of organisms which goes into the environment and remains unutilized. Thus, when we move from the first trophic level to the second trophic level of herbivores and the third trophic level of carnivores, the amount of energy available gradually decreases. This explains why most of the food chains are limited to four or five levels and why animals at higher level of the food chain have to depend over a larger area to obtain the required food.

In a natural state, there is a perfect harmony between the various cycles and flow of energy establishing a **dynamic and fluctuating equilibrium** in any ecosystem. This is known as **ecological balance**.

The ecological balance gets disturbed by climatic changes or other natural causes or human activities. A long period of drought may eliminate certain species and new species may come into being. The relative numbers at each level may become imbalanced. Animal species and birds may migrate to other areas. It takes a long period of years for the balance to get reestablished.

Cultivation of land is one of the most common methods of disturbing the ecological balance. The diversity of species is replaced by uniformity of a single crop. The recycling of nutrients does not take place in the soil layer. The ecosystem becomes unstable and fragile.

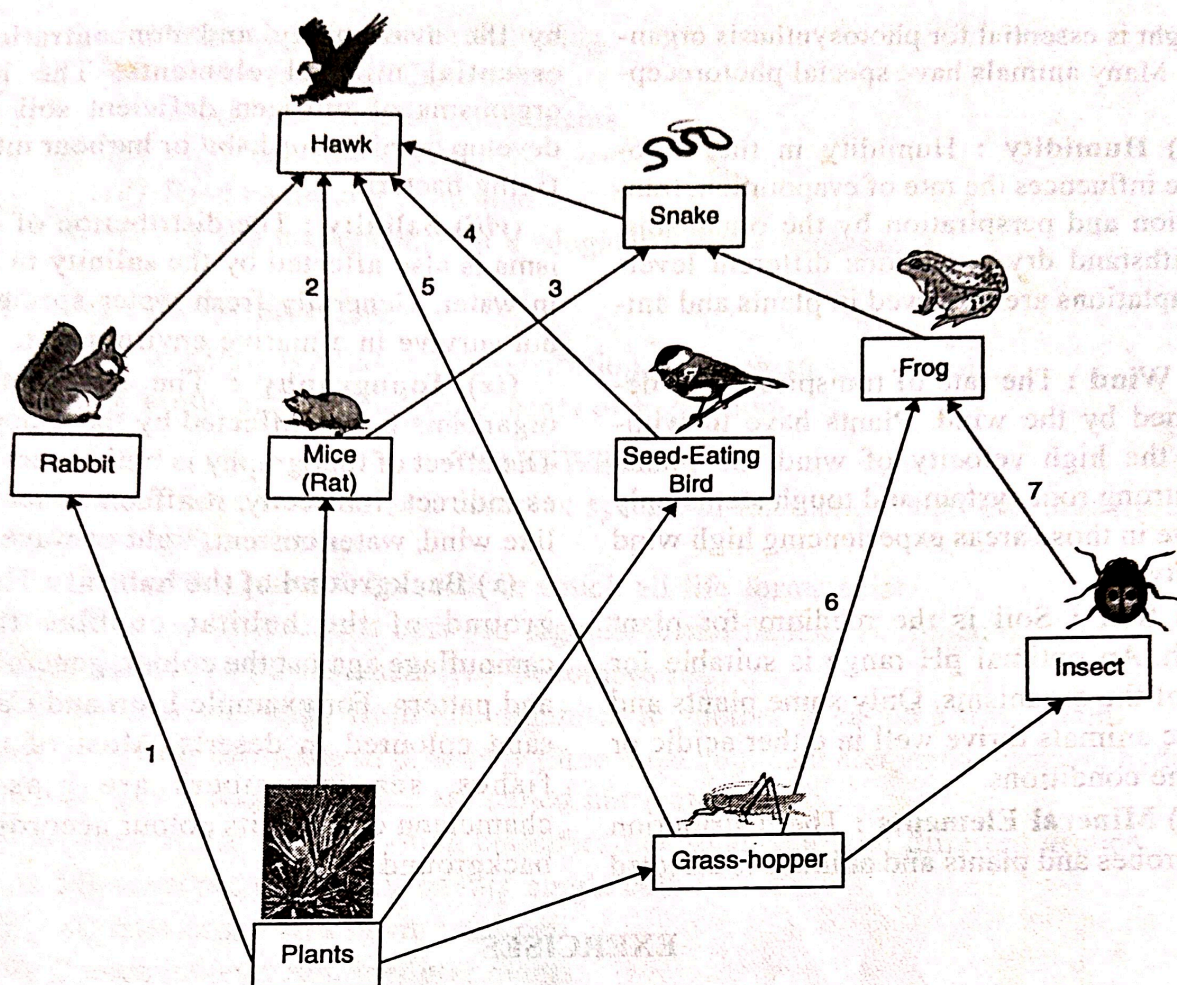


Fig. 16.4 Food -Web

An understanding of the inter relationships which exist between different species of plants and animals in an ecosystem is necessary for maintaining the ecological balance.

ABIOTIC COMPONENTS

The climatic and edaphic factors are the most important abiotic factors. Temperature, humidity, rain and snowfall are the important climatic factors whereas the soil and substratum are the main edaphic factors. The following are the most important abiotic factors:

(i) Temperature : Living organisms adapt themselves to the extremes of temperature, and can survive only in a narrow range of temperature which allows their metabolism.

For example the polar bear can live in very cold regions, and in deserts animals come outside out of their burrows to avoid the intense heat. Some birds and mammals also migrate during winters towards warmer areas.

(ii) Water : Water is the basis of life for living organisms and especially aquatic life. The requirement of water varies from organism to organism. The distribution of organisms depends upon the extent of the need and their way of adaptation for conserving water.

(iii) Light : Plants manufacture their own food with the help of sunlight. This is called the process of photosynthesis. That's why

sunlight is essential for photosynthesis organisms. Many animals have special photoreceptors.

(iv) Humidity : Humidity in the atmosphere influences the rate of evaporation, transpiration and perspiration by the organisms. To withstand dry conditions different levels of adaptations are observed in plants and animals.

(v) Wind : The rate of transpiration is determined by the wind. Plants have to withstand the high velocity of wind. So plants with strong root system and tough stems only survive in those areas experiencing high wind velocity.

(vi) Soil : Soil is the medium for plant growth. An optimal pH range is suitable for most of the organisms. Only some plants and aquatic animals thrive well in either acidic or alkaline conditions.

(vii) Mineral Elements : The distribution of microbes and plants and animals is affected

by the availability and concentration of essential mineral elements. The living organisms of nitrogen deficient soil either develop carnivorous habit or harbour nitrogen fixing bacteria.

(viii) Salinity : The distribution of organisms is also affected by the salinity in soil or in water. Generally fresh water species cannot survive in a marine environment.

(ix) Topography : The distribution of organisms is also affected by the topography. The effect of topography is both direct as well as indirect. Indirectly, it affects other factors like wind, water current, light or wave action.

(x) Background of the habitat : The background of the habitat enables them to camouflage against the colour, general texture and pattern. For example Lion and Camel are sand coloured in deserts. Most of the jelly fishes, sea cucumbers are glassy. The chameleon changes its colour according to its background.