TOPIC: ECOSYSTEM

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CHAPTER 2
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CONCEPT OF ECOSYSTEM

In biology, an ecosystem is a community of organisms and their physical environment. The notion of an ecosystem recognizes the many ways that an organism interacts with and depends on various parts of its environment. The ecosystem idea generalizes the "food chain" and "food web" concepts, allowing for more relationships than just consumption. For example, plants provide not just food for animals but also shelter, shade, moisture, etc.

While organisms in an ecosystem may be engaged in competition or predation, the concept focuses on interdependence - one organism's reliance on another or on the ecosystem as a whole.

The idea of an ecosystem has been adopted for social and economic systems. An "ecosystem" is the environment that a company is part of, including suppliers, partners, consumers, and the

underlying structure and behavior of the technology, markets and social context. Framing economic interactions as being an ecosystem promotes establishing alliances with companies that might have been seen as competitors. There are many possible economic relationships, just as there are many possible relationships between organisms in a biological ecosystem.

An ecosystem is, therefore, defined as a natural functional ecological unit comprising of living organisms (biotic community) and their non-living (abiotic or physio chemical) environment that interact to form a stable self-supporting system. A pond, lake, desert, grassland, meadow, forest etc. are common examples of ecosystems.

Structure and Function of an Ecosystem:

Each ecosystem has two main components:

(1) Abiotic (2) Biotic

(1) ABIOTIC COMPONENTS:

The non living factors or the physical environment prevailing in an ecosystem form the abiotic components. They have a strong influence on the structure, distribution, behaviour and inter-relationship of organisms. Abiotic components are mainly of two types:

(a) Climatic Factors: Which include rain, temperature, light, wind, humidity etc.

(b) Edaphic Factors: Which include soil, pH, topography minerals etc.

The functions of important factors in abiotic components are given below:-

Soils are much more complex than simple sediments. They contain a mixture of weathered rock fragments, highly altered soil mineral particles, organic matter, and living organisms. Soils provide nutrients, water, a home, and a structural growing medium for organisms. The vegetation found growing on top of a soil is closely linked to this component of an ecosystem through nutrient cycling.

The atmosphere provides organisms found within ecosystems with carbon dioxide for photosynthesis and oxygen for

respiration. The processes of evaporation, transpiration and precipitation cycle water between the atmosphere and the Earth's surface.

Solar radiation is used in ecosystems to heat the atmosphere and to evaporate and transpire water into the atmosphere. Sunlight is also necessary for photosynthesis. Photosynthesis provides the energy for plant growth and metabolism, and the organic food for other forms of life.

Water is the medium by which mineral nutrients enter and are trans-located in plants. It is also necessary for the maintenance of leaf turgidity and is required for photosynthetic chemical reactions. Plants and animals receive their water from the Earth's surface and soil. The original source of this water is precipitation from the atmosphere.

(2) BIOTIC COMPONENTS:

The living organisms including plants, animals and micro-organisms (Bacteria and Fungi) that are present in an ecosystem form the biotic components.

On the basis of their role in the ecosystem the biotic components can be classified into three main groups:

(A) Producers

(B) Consumers

(C) Decomposers or Reducers.

(A) Producers:

The green plants have chlorophyll with the help of which they trap solar energy and change it into chemical energy of carbohydrates using simple inorganic compounds namely water and carbon dioxide. This process is known as photosynthesis. As the green plants manufacture their own food they are known as Autotrophs.

(B) Consumers:

The animals lack chlorophyll and are unable to synthesize their own food. Therefore, they depend on the producers for their food. They are known as Heterotrophs (i.e. heteros = other, trophos = feeder)

The consumers are of four types:

(a) Primary Consumers or Herbivores:-

These are the animals which feed on plants or the producers. They are called herbivores.

Examples are rabbit, deer, goat, cattle etc.

(b) Secondary Consumers or Primary Carnivores:-

The animals which feed on the herbivores are called the primary carnivores. Examples are cats, foxes, snakes etc.

(c) Tertiary Consumers:-

These are the large carnivores which feed on the secondary consumers. Example Wolves.

(d) Omnivores:-

These are the largest carnivores which feed on the tertiary consumers and are not eaten up by any other animal. Examples are lions and tigers.

(C) Decomposers or Reducers:-

Bacteria and fungi belong to this category. They breakdown the dead org anic materials of producers (plants) and consum ers (animals) for their food and release to the environment the simple inorganic and organic substances produced as by-products of their m etabolisms.

These simple substances are reused by the producers resulting in a cyclic exchange of materials between the biotic com munity and the abiotic environment of the ecosystem.

The decomposers are known as Sapr otrophs (i.e., sapros = rotten, trophos = feeder).

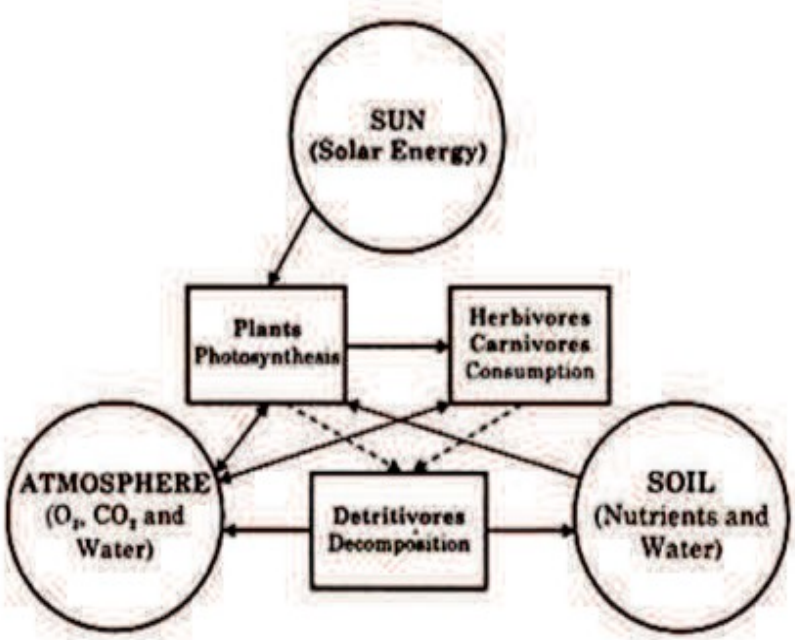

Fig. 3.4 Relationship within an Ecosystem

3.4.2 ENERGY FLOW

Energy flow (also called calorific flow) refers to the flow of energy in ecosyste ms through the food chain. It generally occurs in the following sequence:

Solar energy (an abiotic factor) is converted to chemical energy, when green plants convert carbon dioxide from the air and water from the earth, into glucose. Solar energy enters the ecosystem through the process of photosynthesis, which takes

place in green plants, algae and bacteria, which are called primary producers.

These producers form the first tropic level of the pyramid. The producers o btain 100% of their energy from the sun. The plants are consumed by plant eating animals known as herbivores. Such herbivorous animals are the primary consumers, which form the next trophic level of the pyramid. The primary consumers are able to obtain only 10% of the total solar energy that was initially obtained by the plants.

Secondary consumers are thos e that feed on the primary consumers. They are the predators and form the next trophic level. They are either carnivorous or omnivorous. Carnivores only fee d on other animals, while omnivores consume both animals and plants. The secondary consumers obtain only 1% of the solar energy. The secondary consumers are eaten by the tertiary consumers, which get about 0.1% of the energy.

The final role in the energy ch ain is played by decomposers, whose primary function is to break down all organic matter be longing to both the producers and consumers, b oth the cases, and undigested food excreted by these organisms. The

decomposed organic matter is released back into the soil as nutrients or into the air as gases.

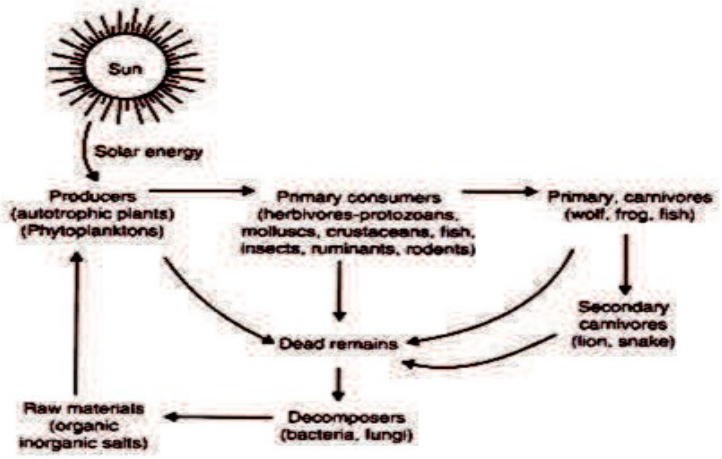

Fig. 3.5 Flow of energy at different levels of ecosystem

FOOD CHAIN

The feeding relationship between different organisms through which energy is transferred step-by-step from producers to t he consumers is called the food chain.

In the ecosystem, green plants alone are able to trap in solar energy and convert it into chemical energy. The chemical energy is locked up in the various organic com pounds, such as carbohydrates, fats and proteins, present in the green plants. Since virtually all other living organisms depend upon green p lants for their energy, the efficiency of plants in any given area in capturing solar energy sets the upper limit to long-term energy flow and biological activity in the community.

The food manufactured by the green plants is utilized by themselves and also by herbivores. Animals feed repeatedly. Herbivores fall prey to some carnivorous animals. In this way one form of life supports the other form. Thus, food from one trophic level reaches to the other trophic level and in this way a chain is established. This is known as food chain.

A food chain may be defined as the transfer of energy and nutrients through a succession of organisms through repeated process of eating and being eaten. In food chain initial link is a green plant or producer which produces chemical energy available to consumers. For example, marsh grass is consumed by grasshopper, the grasshopper is consumed by a bird and that bird is consumed by hawk.

Marsh grass → grasshopper → bird → hawk

grass→ grasshopper→ mouse → owl

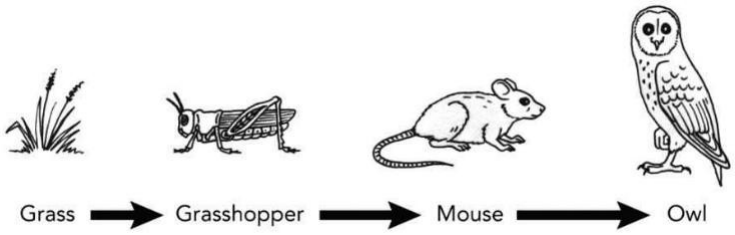

Fig .3.6 Food chain

FOOD WEB

Many food chains exist in an ecosystem, but as a matter of fact these food chains are not independent. In ecosystem, one organism does not depend on another. The resources are shared specially at the beginning of the chain. The marsh plants are eaten by variety of insects, birds, mammals and fishes and some of the animals are eaten by several predators.

Similarly, in the food chain grass → mouse → snakes → owls, sometimes mice are not eaten by snakes but directly by owls. This type of interrelationship interlinks the individuals of the whole community. In this way, food chains become interlinked. A complex of interrelated food chains makes up a food web. Food web maintains the stability of the ecosystem. The greater

the number of alternative pathways the more stable is the community of living things. Fig. --- illustrates a food web in ecosystem.

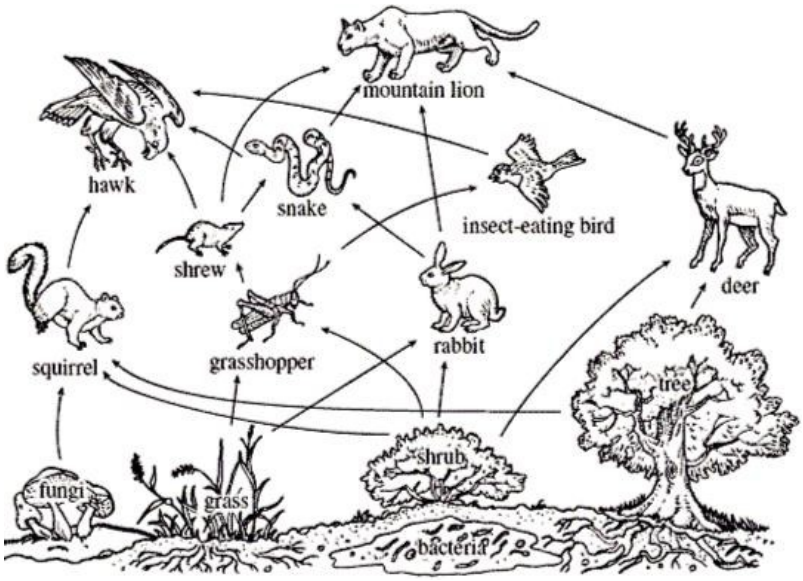

Fig. 3.7 Food web

TROPIC STRUCTURE

Tropic structure is a tiered structure of the organism in an ecosystem, with each level representing those organisms that share a similar function and food source. Trophic structure diagrams also depict the energy transfer from on trophic level to the next. By organizing the estuary into a trophic structure, we are given an indication of the productivity of the estuary. Productivity is basically the ability of the estuary to yield organic matter. A productive estuary is one that has high diversity, high survival rates, little to no invasive species, and whose organisms continually carry out life processes; in other words, the estuary is sustainable. Freshwater inflows are fundamentally linked to estuarine productivity.

This trophic structure looks at the aquatic ecosystem from a bottom up point of view. The bottom tier organisms, or primary producers, are the most energy efficient, while the top tiger, or top predators, are the least energy efficient. Primary producers produce their own food, making them more energy efficient, while top fish or predators require many organisms, making them less energy efficient. Another way to say this is that predators have a much higher energy demand than do phytoplankton. The trophic structure in the figure below shows an ecosystem functioning by interrelationships and life processes. Freshwater inflows balance the estuaries by providing hydrological requirements for the organisms.