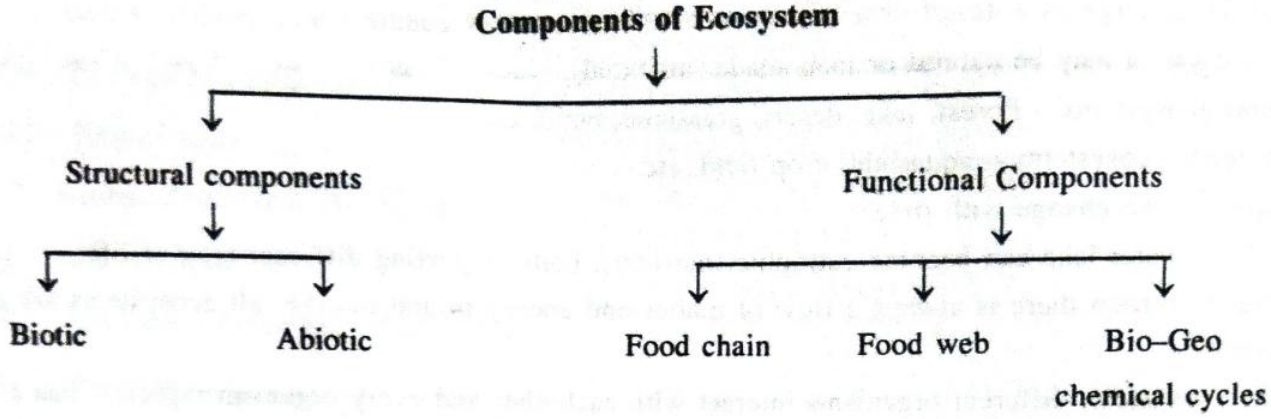
1.4 COMPONENTS OF ECOSYSTEM :

An ecosystem comprises of two basic components :

(a) Structural components

(b) Functional components



- **Structural components of ecosystem :**

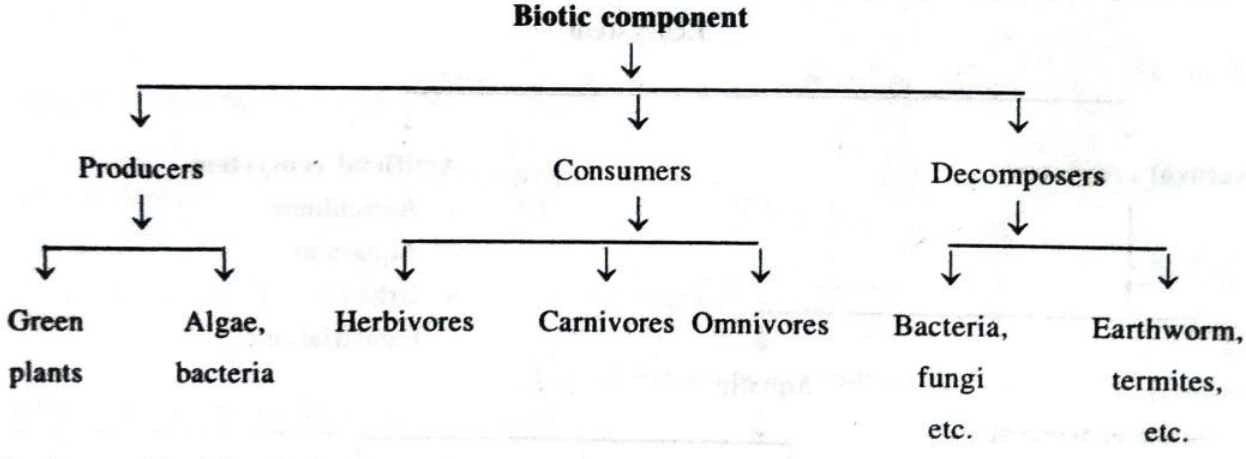
There are two basic structural components of ecosystem :

1. Biotic components (living)
2. Abiotic components (non–living)

1. Biotic components :

The living organisms including plants, animals and micro–organisms (bacteria and fungi) that are present in an ecosystem form the biotic component of the ecosystem.

On the basis of their role in the ecosystem the biotic components are further classified into :



(i) Producers (Autotrophs) :

The set of living organisms which are capable of producing the food on their own are known as **producers** or **autotrophs.**

e.g. green plants, algae.

Green plants and algae, directly utilize the sunlihgt energy to convert CO_2 and water to simplest carbohydrates called glucose and release oxygen as a by–product. This process is called **photosynthesis.**

Some bacteria are able to use the energy in some inorganic chemicals to form organic matter from CO_2 and water. This process is called **chemosynthesis.** Such organisms are also called producers.

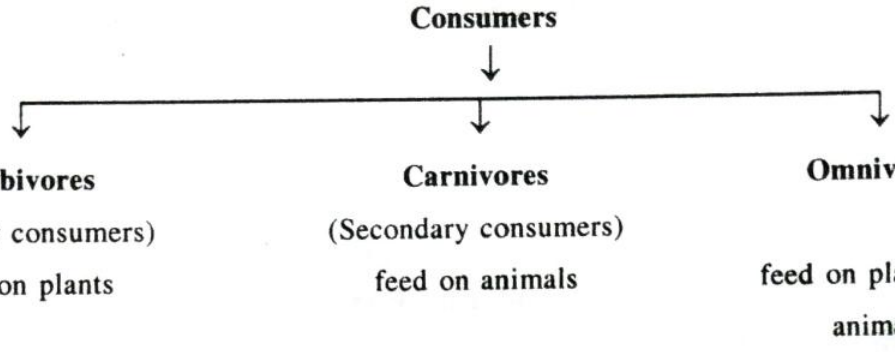
All other organisms in an ecosystem get the energy and nutrients they need by feeding on producers. Thus, producers are the building blocks of every ecosystem.

(ii) Consumers :

The set of living organisms feeding on producers are consumers.

They are also called **heterotrophs**. i.e. nourish on others.

The subgroups of consumers are :



Herbivores :

Herbivores are animals and other organisms that feed directly on plants.

e.g.
- cow
- dear
- goat
- grasshopper, etc.

They are also called **Primary consumers** or **first order consumers.**

Carnivores :

The animals which feed on the herbivores are called **carnivores.**

Birds that feed on insects are carnivores.

Hawks that feed on birds are also carnivores.

Other examples are fox, snakes.

Carnivores are also called **secondary consumers** or second order consumers.

Tertiary consumers :

They are basically large carnivores because they feed on secondary consumers.

They are third order consumers.

e.g. lion, tiger, etc.

Omnivores :

The animals that feed both on plants and animals are called **omnivores.**

e.g. men, frog

Omnivores are also called **opportunistic feeders** (survive by eating what is available).

They are the top level carnivores.

(i) Decomposers (Reducers) :

Decomposers are microorganisms which breakdown dead organic material of producers and consumers to simple organic substances and by–products to get their food.

Decomposers convert complex organic matter into simpler one with reduction in volume of material, so they are also called reducers.

e.g. • bacteria
• fungi

Generally bacteria attacks on animal tissues while fungi attacks on plant tissues.

Scavengers (detritivores) are animals which feed on dead bodies of other organisms.

They are also called **saprotrophs.**

e.g. • earthworms
• termites

Predetors and Parasites :

In any relationship in which one organism feed on other, the organisms that does the feeding is called the **predator,** and the organism that is fed on is called the **Prey.**

Parasites are organisms – either plants or animals that become intimately associated with their **'Prey'** and feed on it over an extended period of time, without killing it but sometimes weakening it. The plant or animal that is fed upon is called the **host.** Various worms, protozoa, insects and even mammals and plants are examples of parasites. Parasite may live inside or outside their hosts.

2. Abiotic components :

All the non–living components of ecosystem are called abiotic components. They play an important role in maintaining the balance in the ecosystem. They are classified as under :

Abiotic components

Inorganic substances	**Organic substances**	**Climatic factors**	**Edaphic factors**
• Carbon dioxide	• Carbohydrates	• Rain	• Soil
• Water	• Proteins	• Temperature	• pH
• Dissolved oxygen	• Lipids	• Light	• Minerals
• Nitrogen	• Fats	• Wind	• Topography
• Inorganic salts– phosphates, nitrates, sulphates		• Air	
		• Humidity	

1.5 FACTORS AFFECTING ECOSYSTEM (CHANGE IN ECOSYSTEM) :

Two main components of ecosystem are biotic components and abiotic components. These two components affect the ecosystem.

The other factors affecting ecosystem are :

(a) **Natural factors :**

1. Physical factors
2. Climatic factors
3. Biological factors

1. Physical factors :

Land, air, water are the physical factors.

2. Climatic factors :

Sunlight, change in temperature, moisture in atmosphere, wind, etc. are the climatic factors.

3. Biological factors :

If population of certain species increase abnormally in the ecosystem, it creates imbalance in the ecosystem. e.g. abnormal increase in the population of insects.

(b) **Human related factors :**

The indiscriminate and over use of natural resoures by people creates imbalance in the ecosystem. For example,

- Due to deforestation, the ecosystem of forest changes. There is decrease in the population of harbivores and carnivores.
- In agriculture farmland, due to use of pesticides and insecticides many insects die causing imbalance in the ecosystem.
- In the sixtieth century in USA, farmers started using DDT as insecticide, resulting in destruction of many birds.
- Due to forest fire, many species die and there is reduction in forest cover. e.g. Fire in California forest of USA, fire in Australian forest.
- Due to construction of a large dam, the down stream area of dam is starved of water and many species die.
- For treatment of animals, the medicine named 'diclofenac' was used. The death of vultures is mainly due to eating of such dead animals.

1.6 ENERGY FLOW IN ECOSYSTEM :

Sun is the primary source of energy for every ecosystem. In the process of photosynthesis, green plants take energy from sunlight to convert carbon dioxide into glucose to get energy. This energy transfers from one tropic level to another, i.e. from producers to top carnivores.

Flow of energy in ecosystem is governed by two basic laws of thermodynamics :

1. Energy can neither be created nor destroyed but can be transferred from one state to another.
2. Each transfer of energy causes loss of energy within the ecosystem from one level to another.

Energy flows through the ecosystem in the form of carbon – carbon bonds. When respiration occurs, the carbon–carbon bonds are broken and the carbon is combined with oxygen to form carbon dioxide. This process releases energy, which is either used by the organism (to move its muscles, digest food, excrete wastes, think etc.) or the energy may be lost as heat.

The dark arrows represent the flow of energy. Note that all energy comes from the sun will be converted to heat, which is lost to space. Only 10% of energy available in food is incorporated into biomass, the remaining 90% is lost.

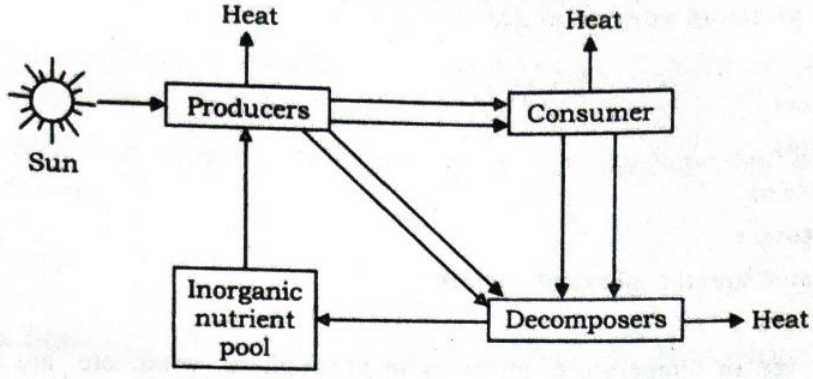


Fig. 1.1 (A) Energy and Nutrient flow in ecosystem

Energy does not recycle.

The other components shown in the diagram are the inorganic nutrients flow. They do not contain carbon–carbon bonds as they are inorganic. These inorganic nutrients include the phosphorus in your teeth, bones and cellular membrnes, the nitrogen in your amino acids (building blocks of proteins) and the iron in your blood. The movement of the inorganic nutrients is represented by open arrows. Note that producers (autotrophs) obtain these inorganic nutrients from the inorganic nutrient pool (soil or water surrounding the plants or algae). These inorganic nutrients are passed from organism to organism as one organism is consumed by another. Ultimately, all organisms die and become detritus, food for the decomposers. At this stage the last of the energy is extracted (and lost as heat) and the organic nutrients are returned to the soil or water to be taken up again. The organic nutrients are recycled, the energy is not.

Salient features of energy flow in ecosystem are :

1. The sun is the ultimate source of energy.
2. Fate of energy is to be lost as heat lastly.
3. Energy and nutrients are passed from organism to organism through the food chain as one organism eats another.
4. Decomposers remove the lost energy from the remains of organisms.
5. Inorganic nutrients are cycled, but energy is not.

In food chain the flow of energy is as under :

Sunlight (source of energy)

↓

Vegetation (Producers) – Green vegetation convert solar energy into food by photosynthesis process.

↓

Primary consumers (Herbivores) – Animals and other organisus that feed directly on plants. e.g. cow, goat, dear, etc.

↓

Secondary consumers (Carnivores) – They feed on the harbivores. e.g. snake eats rat, frog eats insects.

↓

Big carnivores – They feed on small carnivores and herbivores e.g. lion, tiger, etc.

↓

Decomposers – They are microorganisms which breakdown dead organic material to simple organic substances. e.g. bacteria, fungi

1.7 FOOD CHAIN :

The transfer of food energy from the producers through a series of organisms (herbivores, carnivores and decomposers) with repeated eating and being eaten is known as **food chain.**

In the ecosystem green plants contain chlorophyll with the help of which they convert solar energy to food which is being taken by different heterotrophs (consumers). Heterotrophs cannot produce food for themselves. The food which is produce by autotrophs (producers) is eaten by herbivores (cows, goats, rabbits, etc.) which are eaten by small carnivores which in turn become food for bigger carnivores and the process continues. Ultimately after the life cycle, the dead organism is decomposed by decomposers like bacteria and fungi, as shown in Fig. 1.1.

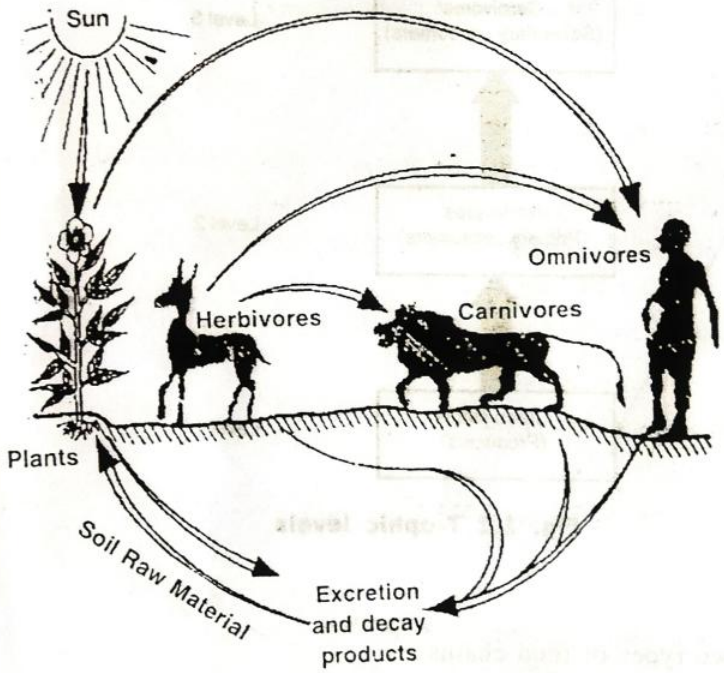


Fig. 1.1 Food chain of terrestrial ecosystem

Trophic Levels :

In a food chain, food energy passes from one group of organisms to other groups of organisms at different levels. These feeding levels of organisms are called **trophic levels.**

The food chain consists of four trophic levels.

Trophic level–1 :

The green plants are producers and form trophic level–1.

Trophic level–2 :

Herbivores are primary consumers and form trophic level–2.

e.g. cow, goat, deer, rabbit, etc.

Trophic level–3 :

Small carnivores are secondary consumers and form trophic level–3.

e.g. foxes, snakes, etc.

Trophic level–4 :

Big carnivores are tertiary consumers and form trophic level–4.

e.g. wolfs, hawks, tiger, lion etc.

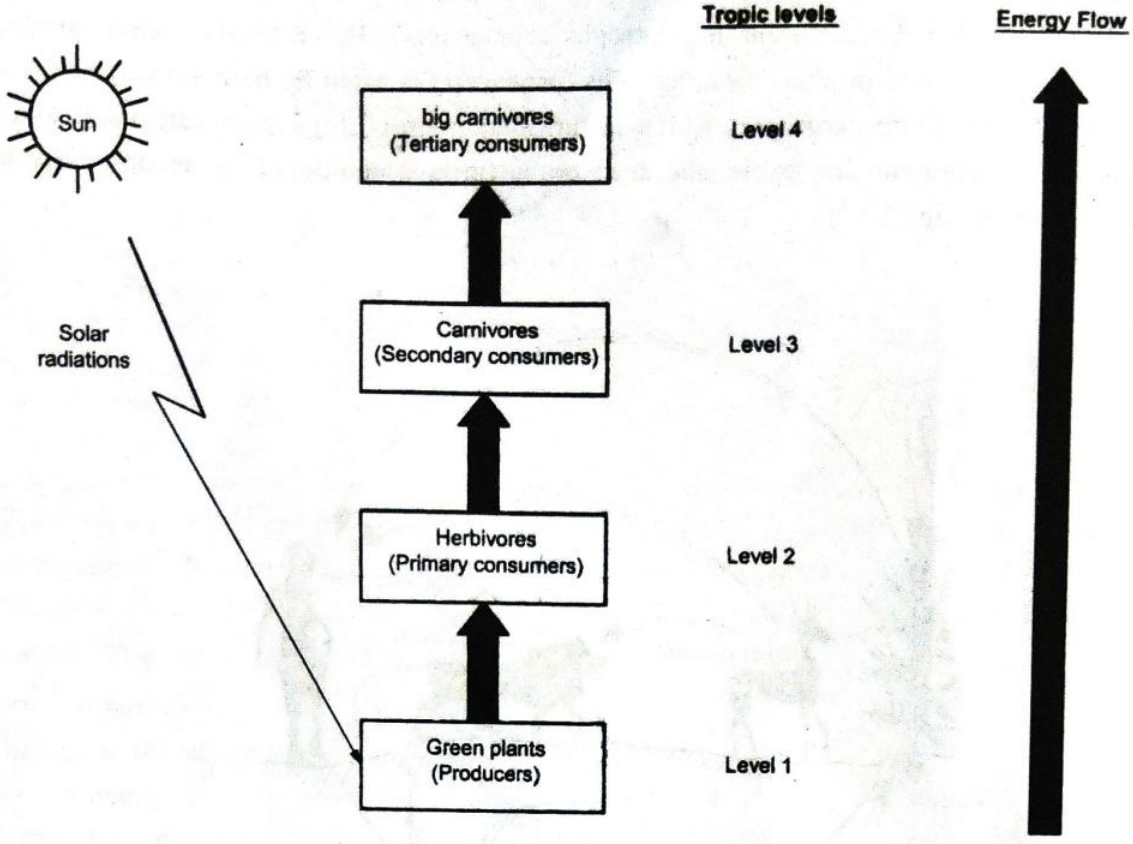


Fig. 1.2 Trophic levels

Types of food–chain :

All ecosystems possess two types of food chains :

(i) Grazing food chain

(ii) Detritus food chain

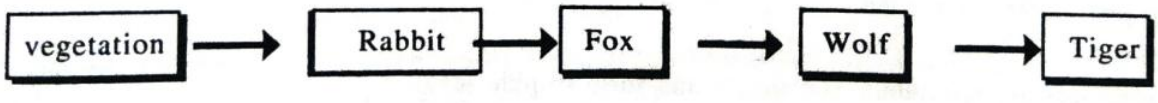
(i) Grazing food chain :

It starts from green plants (producers) and passes through herbivores to carnivores. It is again divided into two parts :

(a) Terrestrial food chain :

A food chain showing interconnections of living organisms in terrestrial ecosystem is called terrestrial food chain.

Example–1 :

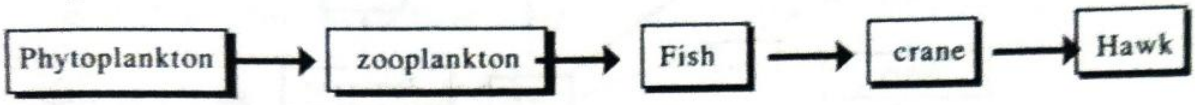


Example–2 :

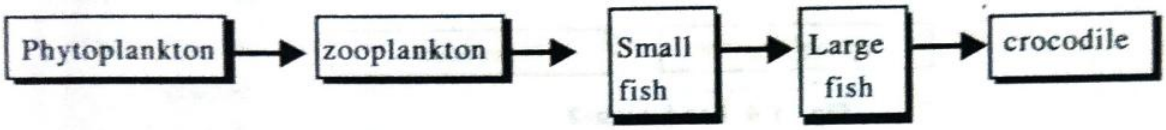
(b) Aquatic food chain :

A food chain showing interconnections of living organisms in aquatic ecosystem is called aquatic food chain.

Example–1 :



Example–2 :



1.8 FOOD WEB :

In the ecosystem, a number of food chains operate simultaneously. These food chains are inter–linked with one–another to form a food web. Thus, a food web is a complex network of interconnected food chains, where different types of organisms are interconnected at different trophic levels.

For, example,

a plant may be food for any herbivore or carnivore such as human beings. A herbivore again becomes food for carnivore–1 or is directly eaten by the top carnivore. For example, a mouse feeding on food grains become food for a snake which is eaten by a hawk. The mouse can be directly eaten by a hawk. In this way, the interrelated complex food chain forms a food web. A food web constitutes a number of alternate paths for energy flow and provides a greater stability to the ecosystem.

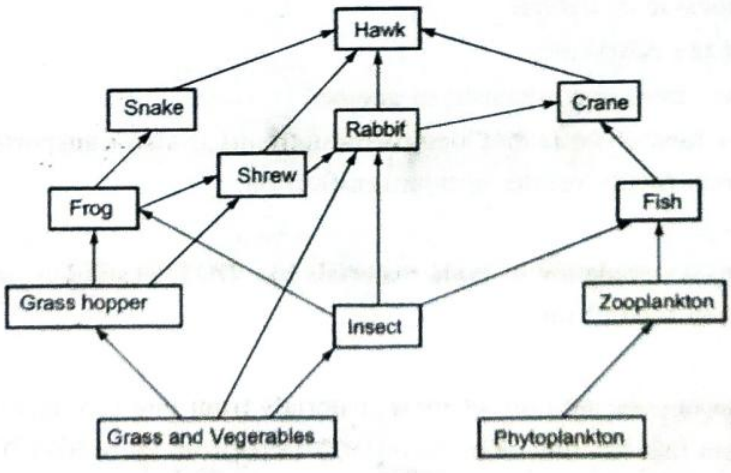


Fig. 1.3 Food web-1

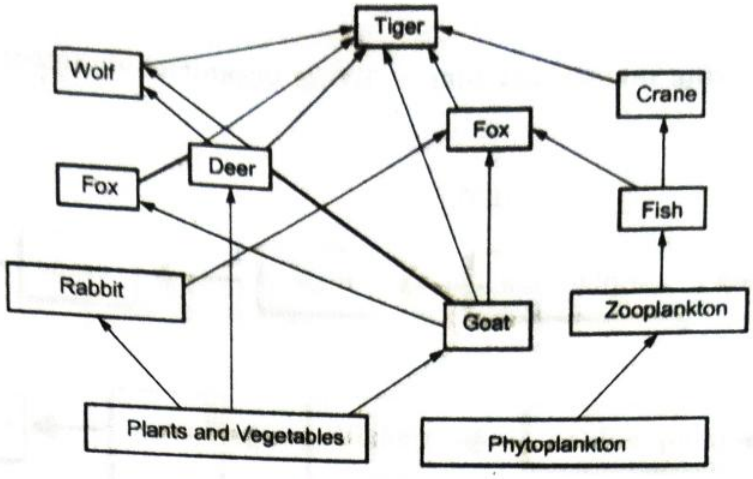


Fig. 1.4 Food web-2

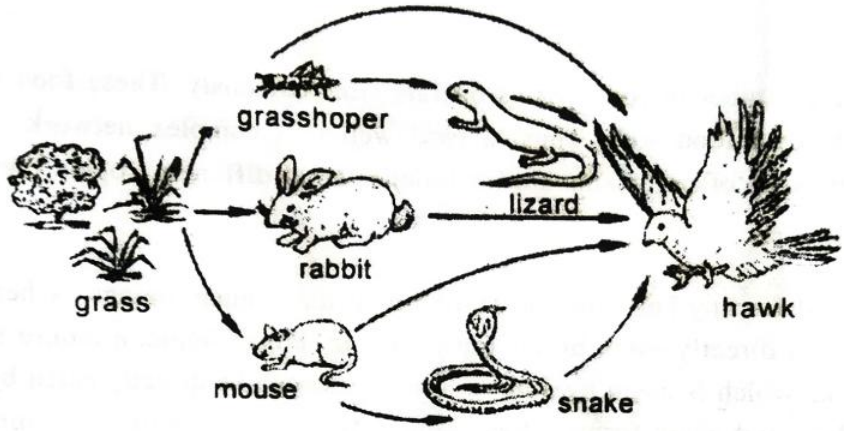


Fig. 1.5 Food web in a grass land ecosystem

- **Significance of food chain and food web :**

The food chain in the ecosystem helps to maintain :

(i) The biodiversity of nature.

(ii) The feeding relationship of nature.

(iii) Flow of energy of the ecosystem.

(iv) Passage of nutrients from one organism to another.

The only drawback of a food chain is that along with nutrients it also transports toxic substances from one organism to another which finally results in biomagnification.

Bioaccumulation :

Bioaccumulation means, accumulation of toxic materials like DDT, pesticides, heavy metals, etc. in the organisms at the bottom of the food chain.

Biomagnification :

It is defined as increase in concentration of toxic materials from one link in a food chain to another.

A little fish eats plankton that has tiny amounts of DDT in it (from the water). That little fish eats a lot of plankton in its life and the DDT accumulates in its body. A bigger fish eats a lot of those little fish over its life, accumulating the DDT in each of those little fish within its body. Thus big fish has the maximum concentration of DDT which is called the biomagnification of DDT.

1.9 ELTONIAN PYRAMID (ECOLOGICAL PYRAMID) :

An **ecological pyramid** is a graphical representation of variations in ecological parameters like number of organisms, biomass of organisms and energy with different tropic levels.

In ecological pyramid, producers form the base of pyramid and top carnivores exist at the top of pyramid. There is more than 90% loss in energy, numbers and biomass at each trophic level.

In 1927, scientist Charles Elton observed that the number of animals present at the top of the trophic level is much less compared to the number of animals present at the base of the food chain. He plotted his findings on a graph to get a pyramid like structure.

He called this pyramid the Eltonian Pyramid.

There are three types of ecological pyramids :

1. Pyramid of numbers
2. Pyramid of biomass
3. Pyramid of energy

1. Pyramid of Numbers :

The pyramid of numbers show the numbers of organisms at each tropic level in a food chain. Producers (plants) remain at the base with maximum numbers followed by herbivores which eat plants in the next level. Top carnivores are very few in numbers like lion and tigers, form the top of the pyramid.

The width of bars represents the numbers.

Depending on the nature of the food chain in the present ecosystem the pyramid of numbers may be upright or inverted.

For example, in a grassland ecosystem, the producers are large number of tiny grasses. At the next tropic level the primary consumers (herbivores like rabbits and grasshoppers) are less, the secondary consumers (carnivores like snakes and lizards) that are lesser and finally the top carnivores, in this case hawks, which are the least in number. So the pyramid is upright in this case as shown in Fig. 1.6.

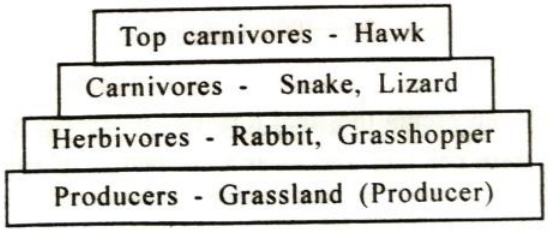


Fig. 1.6 Pyramid of Numbers (Grassland)

On the other hand, in case of a parasitic food chain the pyramid of numbers are always inverted. This is because a single plant support a large number of herbivores. These, in turn support a large number of parasites.

2. Pyramid of biomass :

The amount of organic matter present in any organism at particular environment is called its **biomass**. It is measured in kg/m^2.

The pyramid of biomass is based on the total biomass (dry matter) present at each trophic level of a food chain. In this concept, the individual in each trophic level is weighed instead of being counted. Thus,

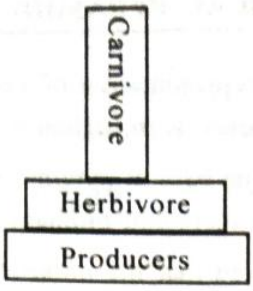


Fig. 1.7 Pyramid of biomass (Forest or grassland ecosystem)

in a pyramid of biomass, the total weight of each tropic level is represented. The pyramid of biomass may be upright or inverted.

For most of the ecosystems on land (forest or grassland ecosystem) the biomass of producers is large and it gradually decreases with each successive trophic resulting in an upright pyramid as shown in Fig. 1.7.

In the case of a pond or aquatic ecosystem, the producers are tiny phytoplanktons which grow and reproduce rapidly. These phytoplanktons are consumed as fast as they reproduce. In this case, the biomass of the consumer at any instant is more than the biomass of producers. Thus, in this case the pyramid of biomass is inverted.

- **Biome :**

Biome is a large region of land (terrestrial) portion characterized by species adapted to it. It is the land portion of the biosphere. It has smaller flora, fauna and microorganisms. The species of biome are adapted to its very conditions of water, heat and soil.

e.g. – Polar bears thrive in the arctic

– Cactus plants have thick skin to help preserve water in the hot desert.

Examples of biomes are,

- grasslands
- deserts
- tropical rainforest
- tundra, etc.

3. Pyramid of energy :

- The pyramid of energy represents the total quantity of energy utilized by different trophic level organisms of an ecosystem per unit area over a set period of time (per square metre per year).

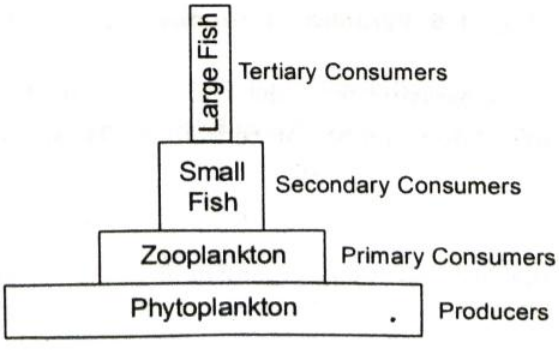


Fig. 1.8 Pyramid of energy