

of consumers and so every other level of consumers get share of energy, but in decreasing order.

14.8 TROPHIC LEVELS IN ECOSYSTEM

We have already explained that the solar energy is harvested by green plants (producers) as chemical energy of the food molecules. This food energy passes on to all consumers in different steps till it is completely spent. The entire series of organisms through which food energy moves in an ecosystem by the processes of eating and being eaten is called **food chain** (Fig. 14.6) and each step of the food chain is called **trophic level** or **energy level**.

Each trophic level has certain mass of living substance called **standing crop**. The standing crop is measured as the mass of living organisms called **biomass**. It is the total amount or number of living things or of one kind of living thing, for example, unharvested crop in a farm, the fish in a pond, or organisms in an ecosystem in a particular area at any given time. It is measured in terms of fresh or dry weight. Dry weight is more reliable than fresh weight.

The **first trophic level** (T_1) in the food chain is constituted by green plants. The **second trophic level** (T_2) is constituted by the herbivores. The **third trophic level** (T_3) is constituted by carnivores, the **fourth-level** (T_4) by top carnivores (Fig. 14.7A). *So all organisms of one trophic level is bound up with organisms of another level through food chain.*

It is not true that food energy moves from green plants to the top carnivores in one linear food chain. Several food chains may operate in an ecosystem and the carnivores may be linked up to the producers through more than one interconnected food chains. All these food chains together create an intricate pattern called **food web**.

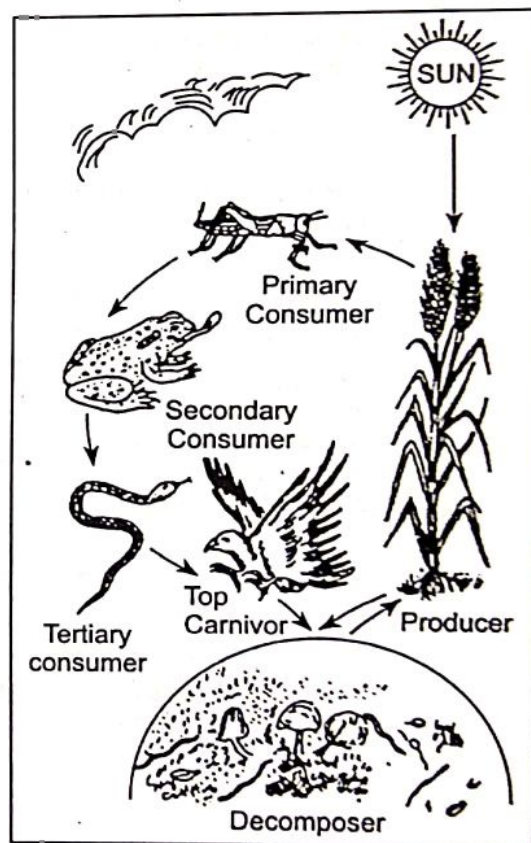


Fig. 14.6. A simple food-chain in an ecosystem

Grazing food chain and detritus food chain

Gazing food chain:

1. It always start from green plants and move to tertiary consumer level.
2. Green plants are the first type of organism to absorb solar energy from where the energy moves to different level of food chain.
3. They indirectly help in nutrient cycle.
4. Generally large organisms are involved in this type of food chain.

Detritus food chain:

1. It always starts from detrivores.
2. Bacteria, fungi are the first one.
3. They are directly involved in nutrient cycle.
4. Generally, small organism maintain this type of food chain.

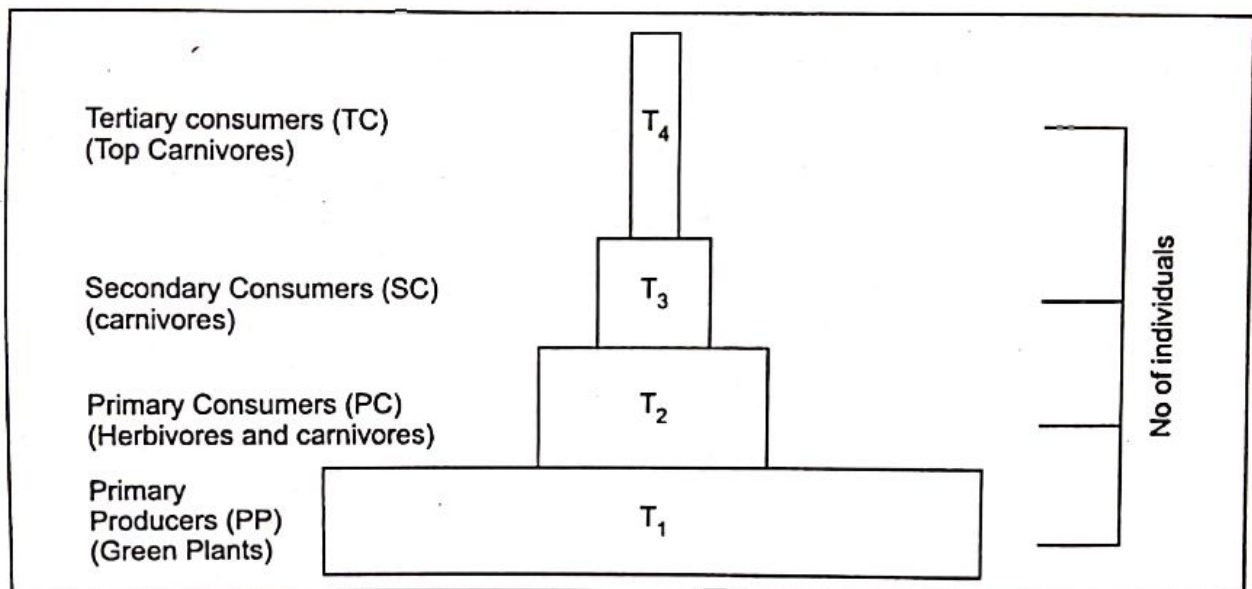


Fig. 14.7 (A). Trophic level in an ecosystem showing producer (P) and various consumers (C). T₁–T₄ represent various trophic levels.

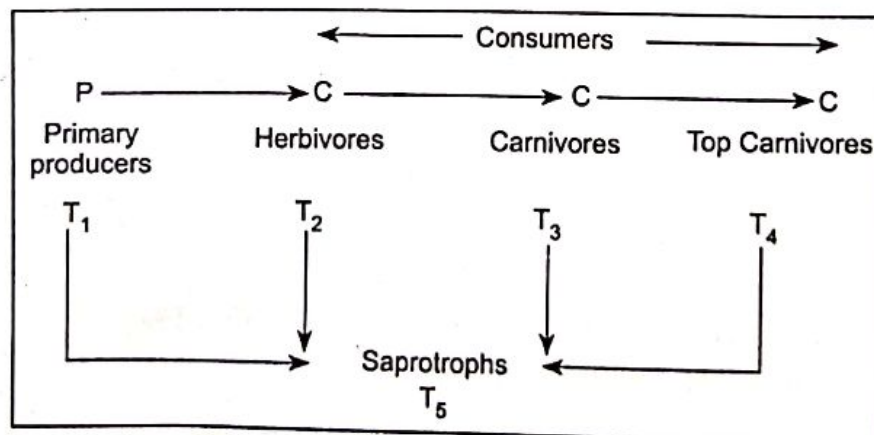


Fig. 14.7. (B) Diagrammatic representation of a food chain

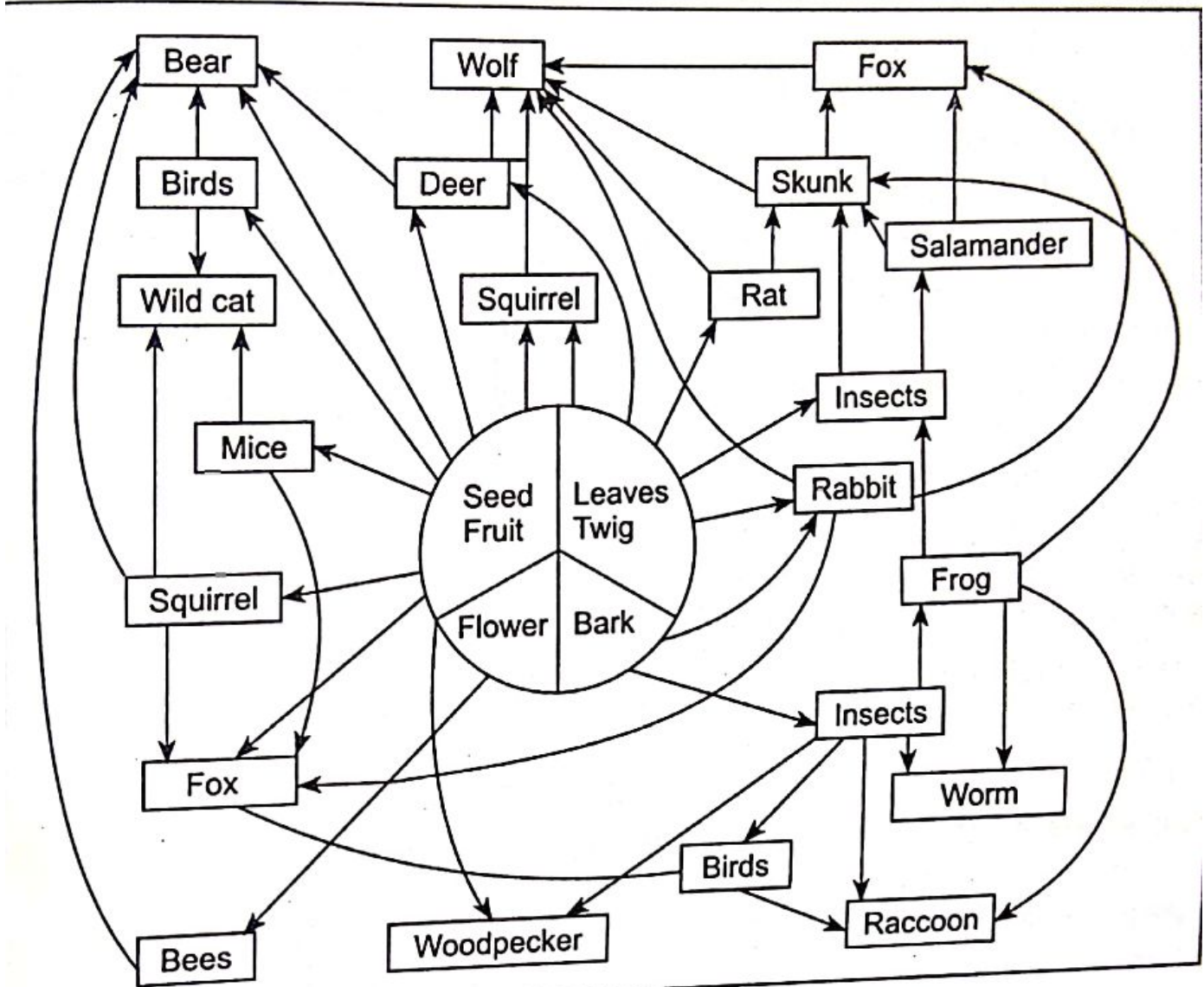


Fig. 14.8. Food web

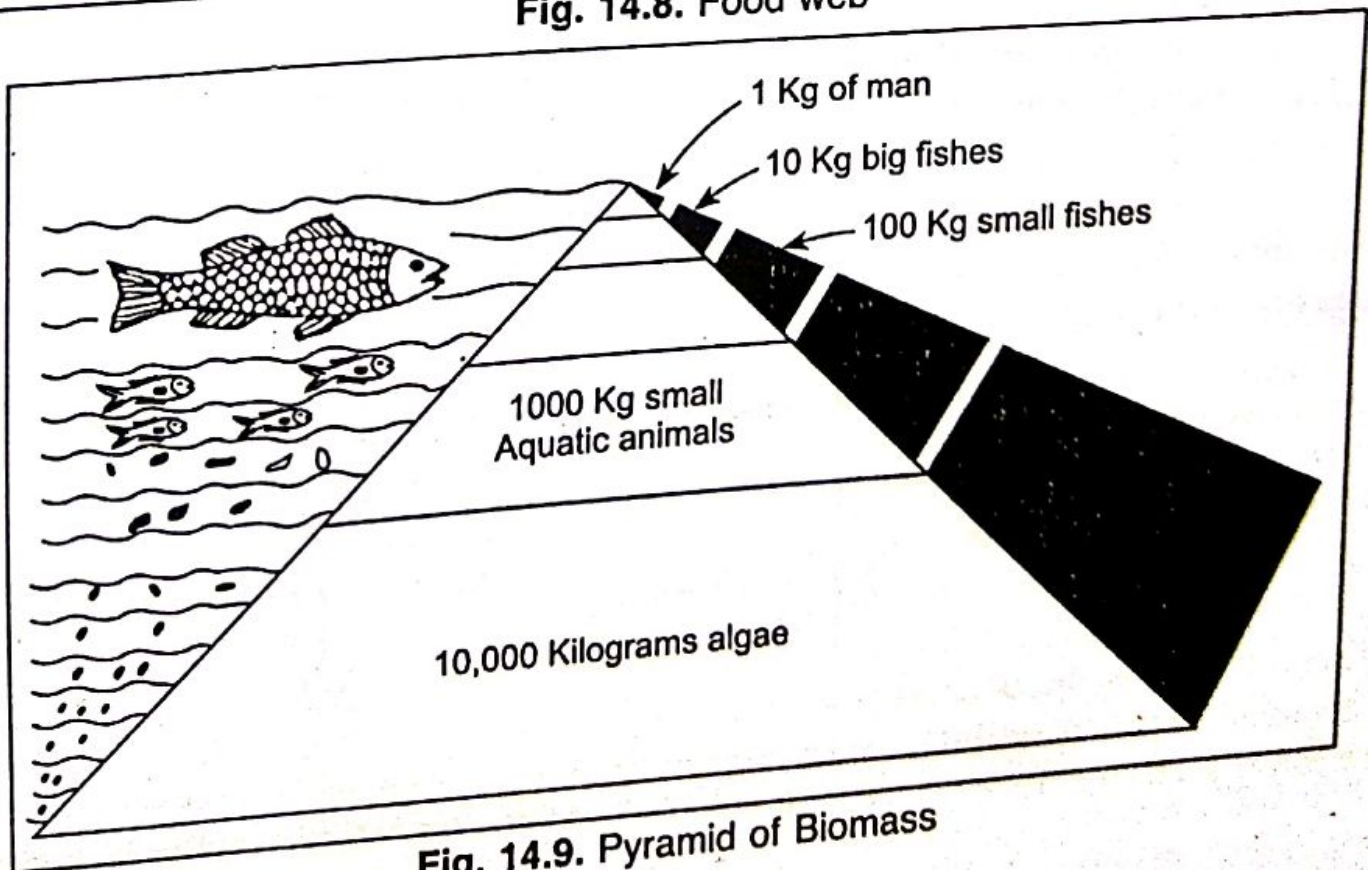


Fig. 14.9. Pyramid of Biomass

14.9. FOOD CHAIN AND ECOLOGICAL PYRAMIDS

In an ecosystem food chain is extended to several levels starting from producers to top carnivores. Each such level is interconnected with the other in a definite pattern forming trophic levels of the ecosystem. Organisms of one level depend upon the organisms of their lower level for food. The number of organisms of a trophic level and their vigour depend upon the availability of energy (food) in the organisms of their lower trophic level and also their own efficiency to convert this into potential energy in their body. This interrelationship between the successive food levels may be expressed in terms of number of individuals, biomass, energy flow etc. in graphical form called ecological pyramids.

1. Pyramid of Energy. It has been discussed earlier that the pattern of energy-flow in ecosystem follows the first and the second law of thermodynamics. Therefore, commencing from the primary producers, at each step some energy is lost. The result is that the energy content gradually decreases at every step upward. This is evident from

the Figure 14.7A.

2. Pyramid of Biomass. The figure 14.9 indicates that all the biomass available from algae cannot be converted to net potential biomass by the smaller aquatic animals. Only 10 per cent has been conserved in them. Similarly, in the next higher level the smaller fishes can conserve only 10 per cent of the biomass available to them. In this way the biomass content steps down forming an upright pyramid.

3. Pyramid of Number. The Figure 14.10 also indicates that the number of individuals at each trophic level decreases forming an upright pyramid. The number of consumers at each level decreases because the energy conservation rate of each level decreases and also because it is

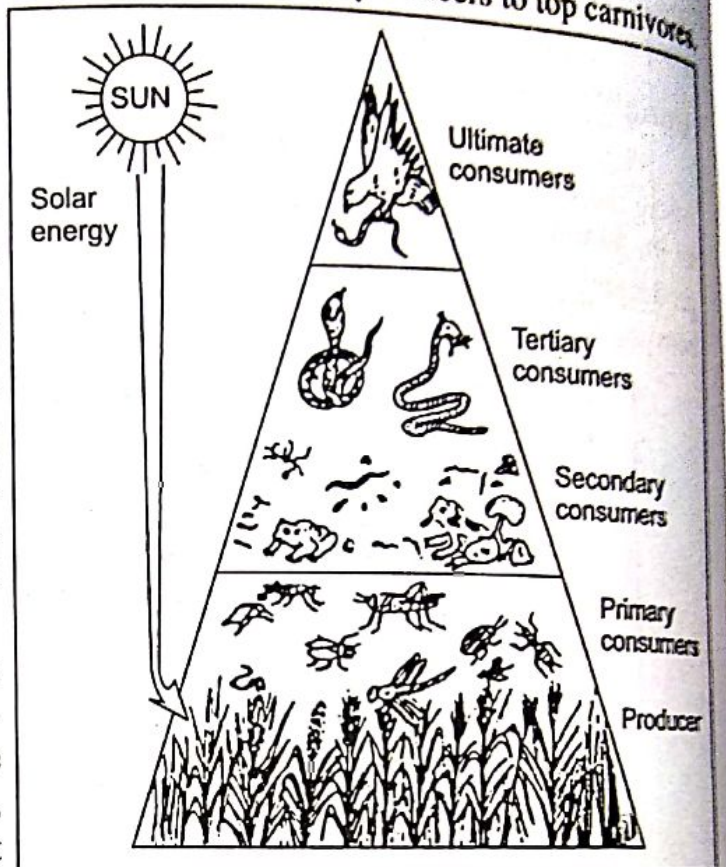


Fig. 14.10. Pyramid of number and energy in a crop field ecosystem

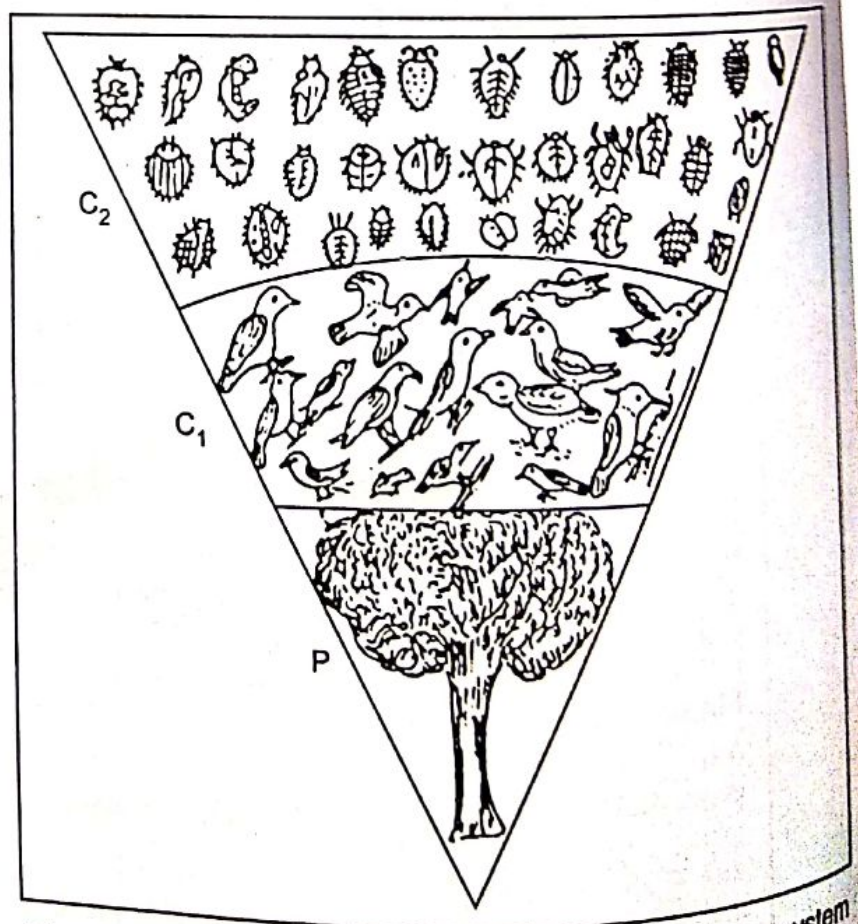


Fig. 14.11. Inverted pyramid of number in a tree ecosystem

necessary in nature to maintain the balance. For the above reason the size of the consumers is always larger than producers. Also the size of the secondary consumers is larger than primary consumers.

Upright pyramid and inverted pyramid of biomass

There are two types of biomass pyramids: upright and inverted. An upright pyramid is one where the combined weight of producers is larger than the combined weight of consumers (Fig. 14.9). An example is a forest ecosystem. An inverted pyramid is one where the combined weight of producers is smaller than the combined weight of consumers (Fig. 14.11). An example is an aquatic ecosystem.

FOOD CHAIN

Food chain involves the entire series of organisms through which food energy moves in an ecosystem by the process of eating and being eaten. A food chain involves producers, different levels of consumers and ultimately decomposers. Food chain moves in one way only. In such unidirectional move the organisms of upper trophic level depend upon the organisms of the lower trophic level for food.

FOOD WEB

In nature several food chains are found to operate simultaneously and therefore consumers may take part in more than one food chain, thus becoming connecting link of several food chains. All these interconnecting food chains are together called food web.

ECOLOGICAL PYRAMIDS

Ecological pyramid is a graphic representation of either the number of individuals involved or the amount of total biomass formed or the amount of energy conserved in different trophic level. The number of individuals or the biomass or the energy content of the successive upper trophic levels become lower and lower showing pyramidal shape of arrangement of various trophic levels.

Pyramid of number indicates the number of individuals in each trophic level progressively decrease forming upward pyramid. The decrease in number is due to availability of less and less energy in upper levels.

Pyramid of biomass indicates the fresh or dry weight of total individuals at each trophic level which progressively decreases forming an upward pyramid.

Pyramid of energy indicates the availability of energy from food at successive trophic level which gradually decreases due to its use and consequent loss at successive trophic level forming an upward pyramidal shape in the arrangement of trophic levels.

Pyramids are not always upright. If the individuals of successive trophic level are larger in size and less in number the pyramid is upright, but if reverse the pyramid is inverted.