FOOD WEBS

In nature simple food chain occur rarely. The same organism may operate in the ecosystem at more than one trophic level i.e. it may derive its food from more than one source. Even the same organism may be eaten by several organisms of a higher trophic level or an organism may feed upon several different organisms of lower trophic level. In this way individual food chains interconnect to form a complex network with several linkages and are known as food web. Thus food web is defined as—"**A network of food chains where different types of organisms are connected at different trophic levels, so that there are a number of options of eating and being eaten at each trophic level.**

Fig. (3.7) shows the interlinking of five food chains in a terrestrial food web.

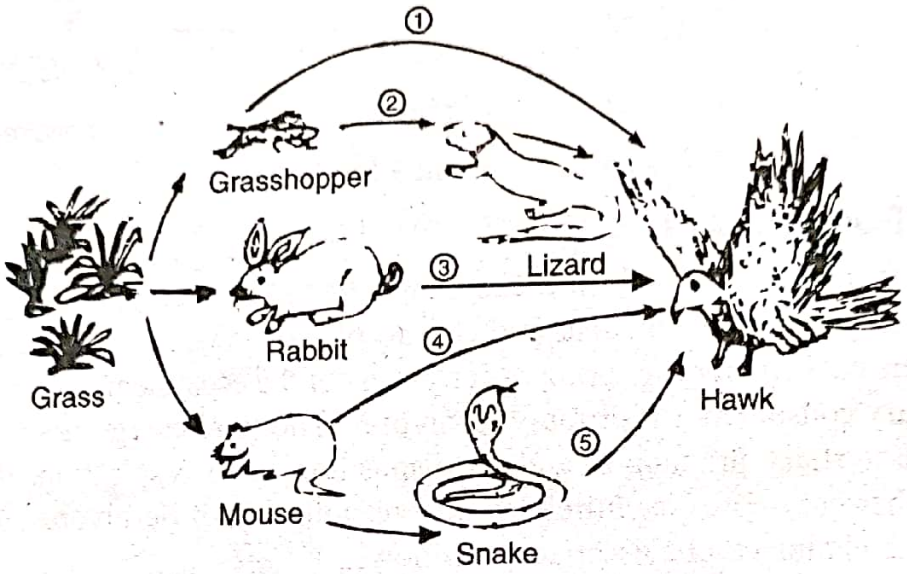


Fig. 3.7 A food web in a grassland ecosystem with five possible food chains.

The following five types of food chains are interconnected to form food web in this figure.

(1) Grass → Grasshopper → Predatory bird (Hawk)

(2) Grass → Grasshopper → Lizzard → Hawk.

(3) Grass → Rabbit → Hawk (or vulture or man)

(4) Grass → Mouse/Rat → Hawk

(5) Grass → Mouse/Rat → Snake → Hawk.

This shows, food chains in natural conditions never operate as isolated sequences but are interconnected with each other forming some sort of interlocking pattern (which is referred to as a food web).

ECOLOGICAL PYRAMIDS

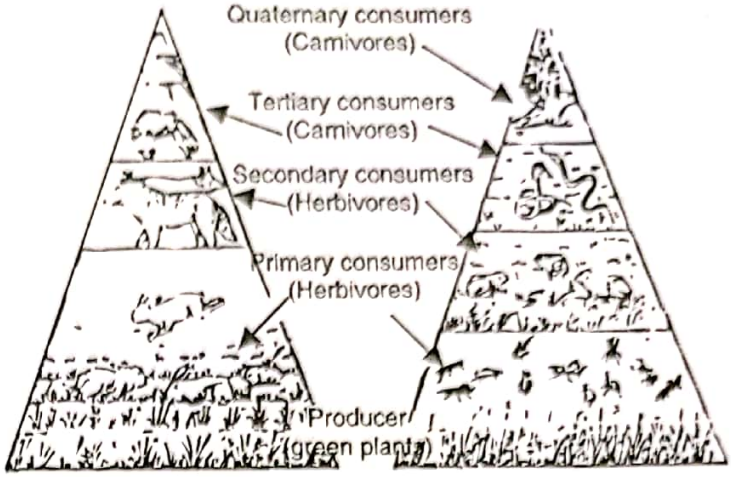
Charles Elton in 1927, noted that the animals at the base of the food chain are relatively abundant, while those at the end are relatively few in number i.e. there is progressively decrease in between the two extremes. Secondly, there is some sort of relationship between the numbers, biomass and energy content of the primary producers, consumers of the first and second orders and so on to top, Carnivores in any ecosystem. These relationships may be represented in diagrammatic (Graphic) ways and are referred to as **ecological pyramids or Eltonian Pyramids.**

Ecological pyramids are of three general types —

1. Pyramid of numbers - (Based on number of organisms at each level.)
2. Pyramid of Biomass - (Based on biomass of organisms.)
3. Pyramid of energy - (Showing the rate of energy flow and/or productivity at successive trophic levels.

The pyramids of numbers and biomass may be upright or inverted depending upon the nature of the food chain in the particular ecosystem whereas pyramids of energy are always upright.

1. Pyramid of numbers. This deals with the relationship between the number of producers, herbivores and carnivores at successive trophic levels. At the base of such figure (pyramid) is always the number of primary producers and the subsequent structures on this base are represented by the number of consumers at successive levels. In figure 3.8 a grassland ecosystem, the producers which are mainly grasses are always many in number. This number then shows a decrease towards apex, as the primary consumers or herbivores like rabbits are less in number than the grasses. The secondary consumers are lesser in number than primary consumers. Finally the top consumers (tertiary) like hawks or other animals are least in number. Thus the pyramid becomes upright. In a pond ecosystem, the pyramid is also upright.

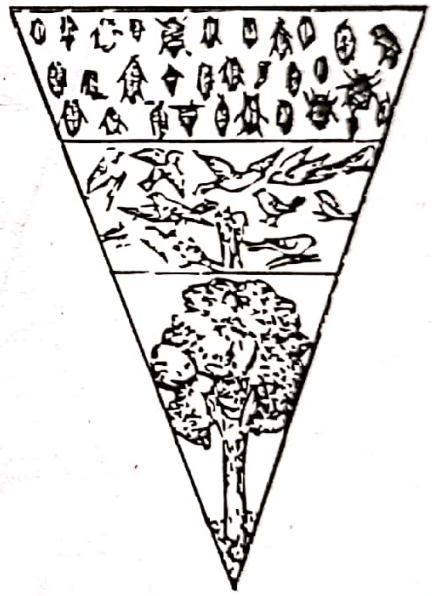


(Upright)

Fig. 3.8 Pyramids of Numbers

Here the producers which are mainly the phytoplanktons as algae, bacteria etc. are maximum in number, the herbivores which are smaller fish are lesser in number than producers. The secondary consumers are lesser in number than herbivores. Finally the top consumers (tertiary) are least in number.

In a forest ecosystem, however the pyramid is inverted, Fig. 3.9 illustrates an instance where the number of primary producers (a tree) is less than that of herbivore birds feeding upon the tree fruits. The number of parasites like bugs and lice living and feeding upon the birds body is still higher. Thus depending upon the size and biomass the pyramid of numbers may not be always pyramidal, it may even be completely inverted in shape.



(Inverted)

Fig.3.9 Pyramid of numbers

Odum (1971) has studied the grassland and forest ecosystems by collecting the data from USA and England respectively.

2. Pyramid of Biomass. Pyramids of biomass are comparatively more fundamental, as they instead of geometric factor, show the quantitative relationships. In order to explain the inverted nature of a pyramid of numbers, the idea of pyramid of biomass is given where the weight of primary producers forms the base. In figure 3.10 the ecosystem is shown where the pyramid of biomass is upright. The biomass of one tree is very high. The biomass of a number of birds feeding upon the tree is far less than that of the tree. Similarly, the biomass of even a very large number of parasite in and on the body of the birds is far less. Thus the pyramid of biomass, therefore, becomes upright. But there can be instances where the pyramid of biomass also get inverted as shown in figure 3.11. The biomass of phytoplanktons is quite negligible as compared to the small herbivores i.e. fish that feed on them. The biomass of large carnivores (Fish) feeding on small fishes is still higher. Harvery (1950) studied that in English Channel the biomass of primary producers is only 4 g/m^2 whereas that of the consumers is 21 g/m^2. This is the case in most aquatic bodies.

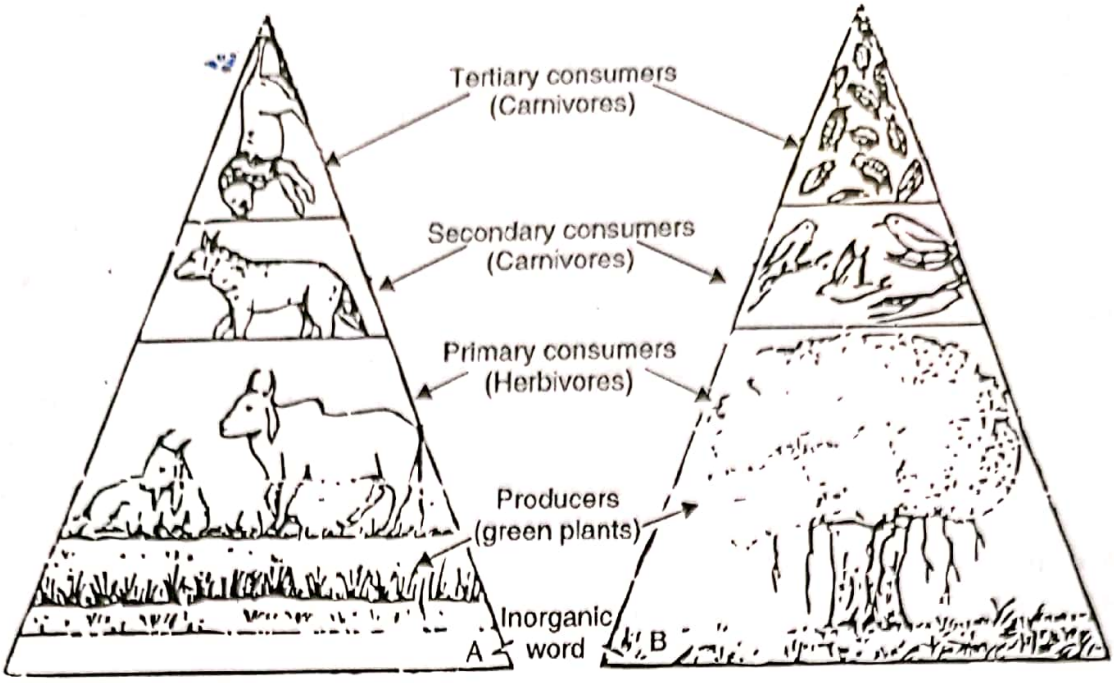


Fig. 3.10 Pyramids of Biomass

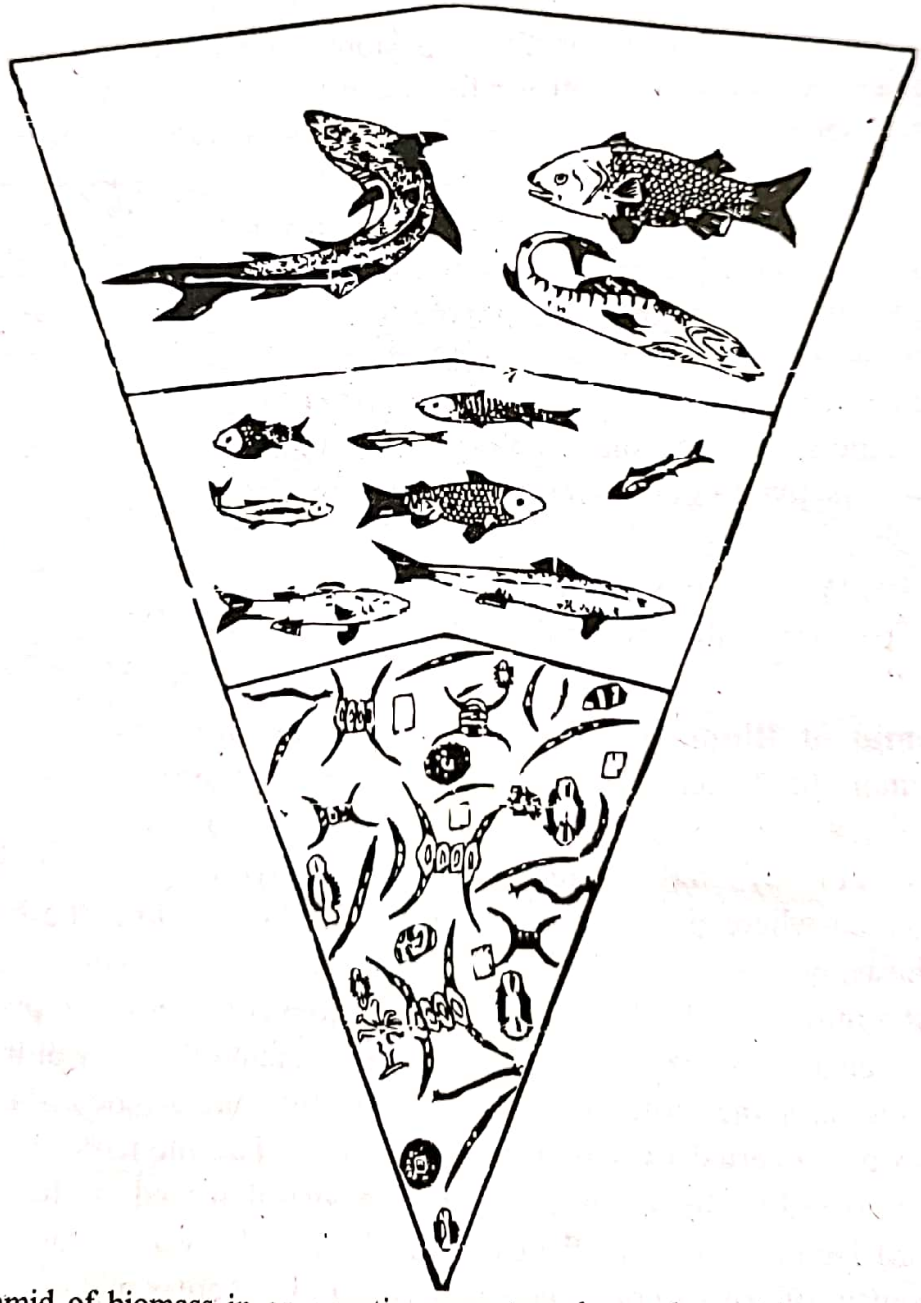


Fig. 3.11 Inverted pyramid of biomass in an aquatic ecosystem due to lower biomass of phytoplanktons than of consumers in unit volume of water at any one time.

3. Pyramid of energy

Of the three types of ecological pyramids, the energy pyramid give the best picture of overall nature of the ecosystem. As against the pyramids of numbers and biomass the shape of the pyramid of energy is always upright, because in this the time factor is always taken in to account. The pyramid of energy represent the total quantity of energy utilized by different trophic level organisms of an ecosystem per unit area over a set period of time. The base upon which the pyramid of energy is constructed is the quantity of organisms produced per unit time or the rate at which food material passes through the food chain. Energy pyramids are always slopping (upright) because less energy is transferred from each level than was paid into it. In figure 3.12 organisms of the terrestrial and an aquatic ecosystems are shown. The quantity of the energy trapped by green plants in an area over a period is highest compared to that of organisms of other trophic levels and therefore the base of the pyramid

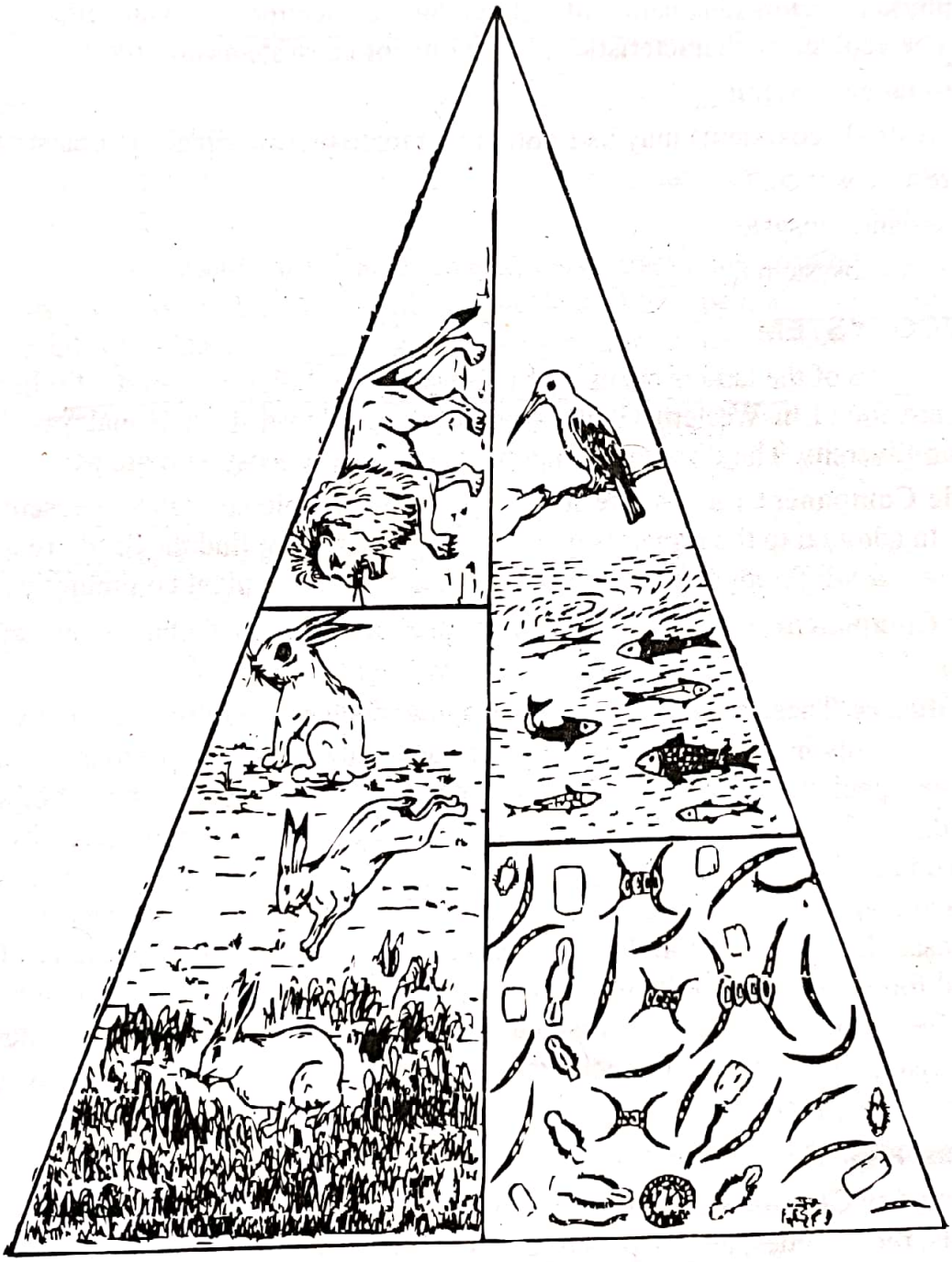


Fig. 3.12 Pyramids of energy in grassland and aquatic ecosystems. The cumulative energy contents utilized by primary producers is always higher as compared to energy utilization by successive trophic levels, over a period of time in a given area.

is broad. The population of phytoplanktons in aquatic ecosystem also complete their life cycle and sets of new generation in every few hours or days. The cumulative energy content of these generations of phytoplanktons trap in course of a year is certainly much more than that of only a few generations of herbivore fishes in the corresponding time and space. The energy content of top carnivores (utilized in one year) is the least. Therefore, the pyramid of energy is upright. The ratio of the amount of energy absorbed and the amount of energy which would be retained in biomass is known as ecological efficiency.