Quadrant II – Transcript and Related Materials

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Notes

ECOLOGICAL PYRAMIDS

Definition. An ecological pyramid is graphical representation of parameter like number or biomass or accumulated energy at different trophic levels in a food chain in an ecosystem.

Introduction:

The idea of ecological pyramids was developed by Charles Elton (1972), hence the ecological pyramids are also called Eltonian pyramids.

An ecological pyramid may be upright, (tapering towards the tip); Inverted (widens towards the tip); Spindle shaped (broader in the middle and narrow above and below).

Types of ecological pyramids:

On the basis of ecological parameters, ecological pyramids are of three types:

1) **Pyramid of Number**

2) **Pyramid of Biomass**

3) **Pyramid of Energy**

1) **Pyramid of Number**

It is the graphic representation showing the arrangement of number of individuals of different trophic levels in a food chain. It depicts the relationship between producer, herbivores (primary consumers) and carnivores (secondary, tertiary and quaternary consumers) at successive trophic levels in terms of their number.

The pyramid of number may be upright, spindle shape or inverted in different ecosystem.

In a predatory food chain e.g., food chain in a grassland ecosystem or pond ecosystem the pyramid of number is a straight pyramid. The number decreases in a food chain (from grasses to predatory birds in grassland ecosystem and from phytoplankton to large fish in pond ecosystem).

In grassland ecosystem the grasses (producers) are always more in number. This number shows a gradual decline towards the apex as the primary consumers like grass hopper, rabbit etc. are lesser in number than the grasses; the secondary consumers like snakes etc. are still lesser in number than the grass hopper, rabbit. Finally the tertiary consumers like hawk, owl, lion are least in number. Thus the pyramid becomes upright.

Similarly the pyramid of number in pond ecosystem is also upright. The producers, which are mainly phytoplanktons, such as algae, cyanobacteria etc. are maximum in number than the organisms present at the successive

trophic levels. There is gradual decrease in the number from producer to successive trophic levels thus, forming an upright pyramid.

In a forest ecosystem, the pyramid of number is spindle shape. The producers, which are large sized trees are lesser in number, the primary consumers (herbivores) such as fruit eating birds, elephant, deer's etc. are more in number than the producers. Then, there is gradual decrease in the number in the successive trophic levels of secondary consumers and tertiary consumers. Thus, the pyramid appears spindle shaped.

In a tree dominated ecosystem single large sized tree is attacked by numerous minute plant-eating insects which in turn are preyed upon by fewer spiders and carnivorous insects, these are further preyed upon by a lesser number of small sized birds, which are further preyed upon by only a few large sized birds.. Thus, resulting in spindle shaped pyramid.

However, in a **parasitic food chain like an Oak-tree**, pyramid of number is an inverted pyramid in which a single oak tree (producer) supports a large number of fruit eating birds which, in turn, support still large number of parasites like lice and bugs. Hyper-parasites like actinomycetes, bacteria, fungi etc. are the greatest in number and occupy the top of inverted pyramid of number.

This is due to the fact that a single plant may support the growth of many primary consumers and each primary consumer in turn may provide nutrition to several secondary consumers (parasites), which in turn may supports many tertiary consumers (hyper-parasites). Thus, there is gradual increase in the number of organisms from the producer level to the tertiary consumer level, making the pyramid an inverted one.

The pyramid of number vary in different communities with different types of food chain in the same environment. It does not give the true picture of the food chain and do not indicate the relative effects of the geometric food chain and size factor of the organisms.

(b) Pyramid of biomass.

Biomass: The total amount of dry weight of living organisms or organic matter in an ecosystem at any time is called biomass.

Definition: Pyramid of biomass represents the biomass present per unit area in different trophic levels (Standing crop).

Pyramid of biomass is a straight or upright pyramid in a terrestrial habitat which shows that biomass is maximum at producer level and there is gradual decrease in biomass from lower to higher trophic levels. It is found that about 10 to 20 % of the biomass is transferred to the next trophic level in a food chain.

However, in aquatic habitat (pond ecosystem), the pyramid of biomass is inverted as the biomass of producers (phytoplanktons) which are small organisms is least, and shows gradual increase in the biomass in the successive trophic levels towards the apex..

Pyramid of biomass are more fundamental, as they, instead of geometric factor, show the quantitative relationships of the standing crop

Pyramid of energy: It is a graphic representation of amount of energy trapped per unit time and area in different trophic levels of a food chain. The

unit of measurement of energy is kcal/m^2/year. Pyramid of energy is always upright because a given trophic level has a smaller energy content than the trophic level immediately below it. Every living organism carries on activity that release energy, this energy is lost as heat, therefore each higher consumer level obtained a smaller percentage of the original energy that was trapped by the producers.

According to second law of thermodynamics, there is gradual decrease in energy in successive trophic levels. It is so because at each transfer, about 90% of energy available at lower trophic level is used to overcome its entropy and to perform its metabolic activities and only 10% is available to next trophic level thus, the pyramid of energy is always upright. The law governing the retaining of only 10% of chemical energy at each trophic level is called 10 percent law and, was proposed by Lindermann (1942).

In pyramid of energy the number and weight of organisms at any trophic level depends not on the amount of fixed energy present at any one time in the level just below but rather on the rate at which the food is being produced, thus it gives the best picture of overall nature of the ecosystem.

Limitations of ecological pyramids

- Ecological pyramids do not take into account those species which belong to two or more trophic levels e.g. if a bird feeds on seeds, fruits, peas, etc. is said to be primary consumer., while it is said to be a secondary consumer when it eats insects and worms..
- They do not accommodate food web.
- Decomposers, though they play an important role in nutrient cycling are not taken into account in ecological pyramids.