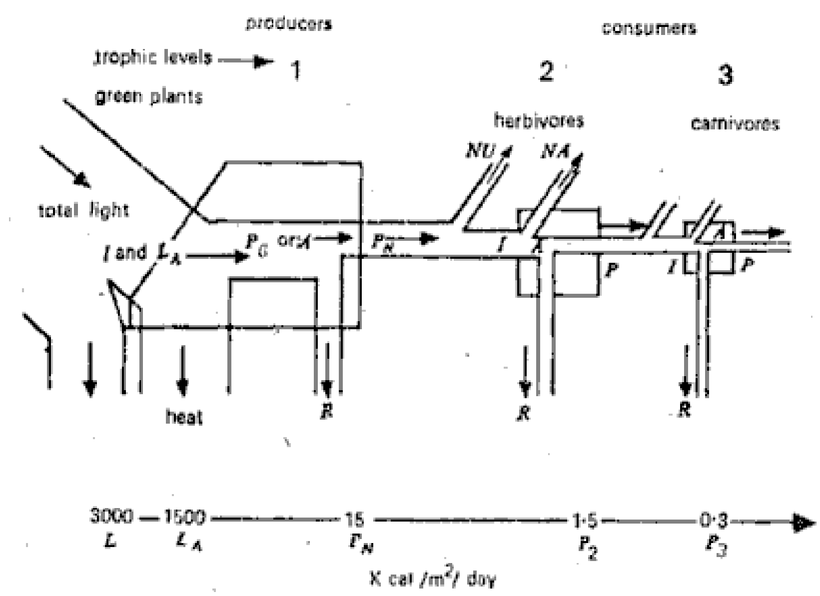


Fig. 3.13. A simplified energy flow diagram depicting three trophic levels (boxes numbered 1,2,3,) in a linear food chain.

In fig. 3.13 the ‘boxes’ represent the trophic levels and the ‘pipes’ depict the energy flow in and out of each level. Energy inflows balance outflows as required by the first law of thermodynamics, and energy transfer is accompanied by dispersion of energy into unavailable heat (i.e. respiration) as required by the second law. Fig. 3.13 presents a very simplified energy flow model of three trophic levels, from which it becomes evident that the energy flow is greatly reduced at each successive trophic level from producers to herbivores and then to carnivores. Thus at each transfer ofenergy from level to another, major part of energy is lost as heat or other form.

It is natural to argue that with a reduction in energy flow (shown as ‘pipes’ in the diagram) at each successive trophic level, there is also a corresponding decrease in standing crop or biomass (shown as ‘boxes’ in the and energy (Fig.3.13).

Y- shaped Energy Flowmodels

Fig. 3.12 and 3.13 describe simple, single-channel energy flow diagrams. Similar energy flow models for different kinds of ecosystems have been described by several authors. We have already considered these two kinds of food chains (i) the grazing food chain beginning with green plant base going to herbivores and then to carnivores, and (ii) the detritus food chain beginning with dead organic matter acted by microbes, then passing to detritivores and their consumers (predators). Fig. 3.19 presents one of the first published energy flow models as pioneered by Odum in 1956. There is shown a common boundary, and, in edition to light and heat flows, the import, export and storage of organic matter are also included. Decomposers are placed-in a separate box as a means of partially separating the grazing and detritus food chains. Decomposers are in fact a mixed group in terms of energy levels.

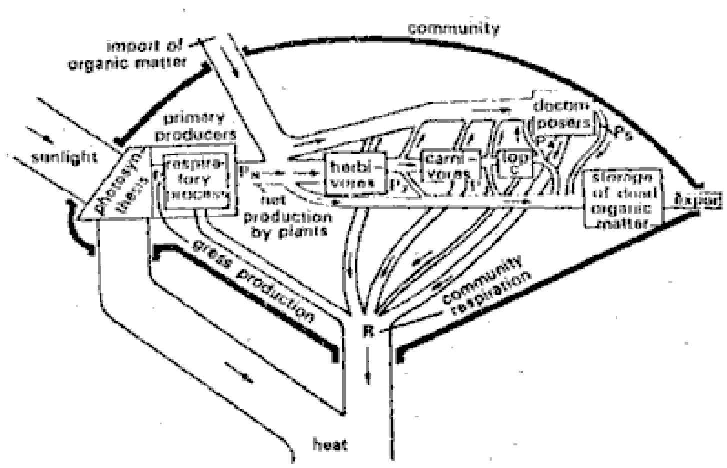


Fig. 3.14 The relationship between flow of energy through the grazing food chain and detritus pathway.

Fig. 3.14 shows two Y-shaped or 2-channel energy flow models. In each y–shaped model one arm represents the herbivore food chanin and the other, the decomposer (detritus) food chain.

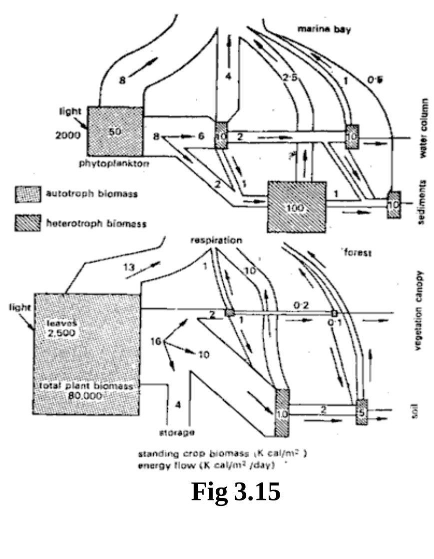


Fig 3.15

The two arms differ fundamentally in the way in which they can influence primary producers. In each model the grazing and detritus food chains are sharply separate.

A Y-shaped or 2-channel energy flow diagram that separates a grazing food chain (water column of vegetation canopy) from a detritus food chain (sediments and in soil). Estimates for standing crops (shaped boxes) and energy flows compare a hypothetical coastal marine ecosystem (upper diagram) with a hypothetical forest (lower diagram).

The important point in Y-shaped model is that two food chains are not isolated from each other. This Y-shaped model is more realistic and practical working model the single-channel model because, (1) it confirms to the basic stratified structure of ecosystems, (ii) it separates the grazing and detritus food chains (direct consumption of living plants and utilization of dead organic matter respectively) in both time and space, and (iii) that the microconsumers (absorptive bacteria, fungi) and the macroconsumers (phagotroghic animals) differ greatly in size-metabolism relations.

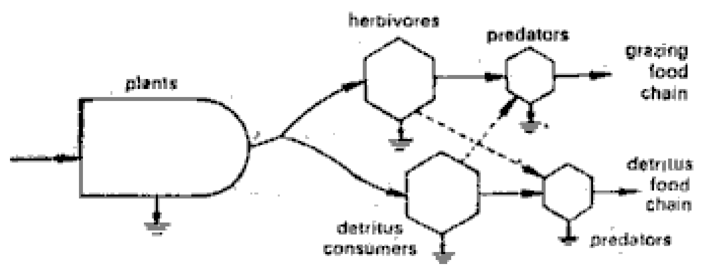
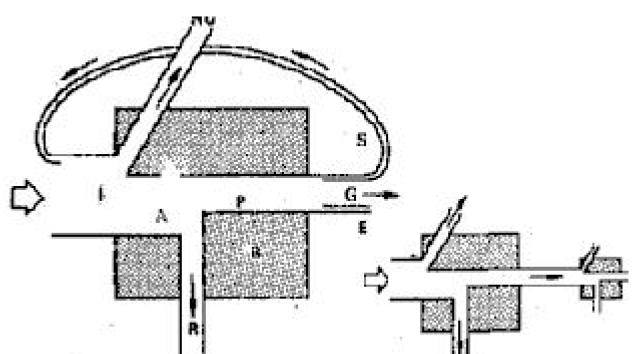


Fig. 3.16. The Y-shaped energy flow model showing linkage between the grazing and detritus food chains.



Components for a 'Universal' model of energy glow I=input or ingreated energy, NU= not used A=Assimalated energy, P=Production; R=respiration, B=biomass, G=growth S=stored energy E=Excreted energy

Fig. 3.17

Fig. 3.17 presents what might be called a universal model, one that is applicable to any living emponent, whether a plant, animal, micro-organism, or individual, population or a trophic group (Odum., 1968). Such a model may depict food chain as already shown in single and Y-shaped energy flow systems, or the bioenergetics of an entire ecosystem.

3.4 Food Chains and Food Web

The transfer of food energy from the producers, through a series of organisms (herbivores to carnivores to decomposers) with repeated eating and being eaten, is known as a food chain. Producers utilize the-radiant energy of sun which is transformed to chemical form, ATP during photosynthesis. Thus green plants occupy, in any food chain, the first trophic (nutritional) level - the producers level, and are called the primary producers. The energy, as stored in food matter manufactured by green plants, is then utilized by the plant eaters-the herbivores, which constitute the second trophie level - the primary consumers level, and are called the primary consumers (herbivores).

Herbivores in turn are eaten by the carnivores, which constitute the third trophic level-the secondary consumers level, and are called the secondary consumers (carnivores). These in turn may be eaten still by other carnivores at tertiary consumer level i.e. by the tertiary consumers (carnivores). Some organisms are omnivores eating the producers as well as the carnivores at their lower level in the food chain. In any food chain, energy flows from primary producers to primary consumers (herbivores), from primary consumers to secondary consumers (carnivores), and from secondary consumers to tertiary consumers (carnivores/omniovers) and so on. This simple chain of eating and being eaten away is known as food chain.

In nature, we generally distinguish two general types of food chains:

i. Grazing Food Chain

This type of food chain starts from the living green plants, goes to grazing herbivores (that feed on living plant materials with their predators), and on to carnivores (animal eaters). Ecosystems with such type of food chain are directly dependent on an in flux of solar radiation. This type of chain thus depends on autotrophic energy capture and the movement of this captured energy to herbivores. Most of the ecosystems in nature follow this type of food chain. From energy standpoint, these chains are very important. The phytoplanktons - zooplankons - fish sequence or the grasses-rabit-fox sequence are the examples of grazing food chain.

ii. Detritus Food Chain

This type of food chain goes from dead organic matter into microorganisms and then to organisms feeding on detritus (detritivores) and their predators. Such ecosystems are thus less dependent on direct solar energy. These depend chiefs' on the influx of organic matter produced in another system (Fig. 3.18a).

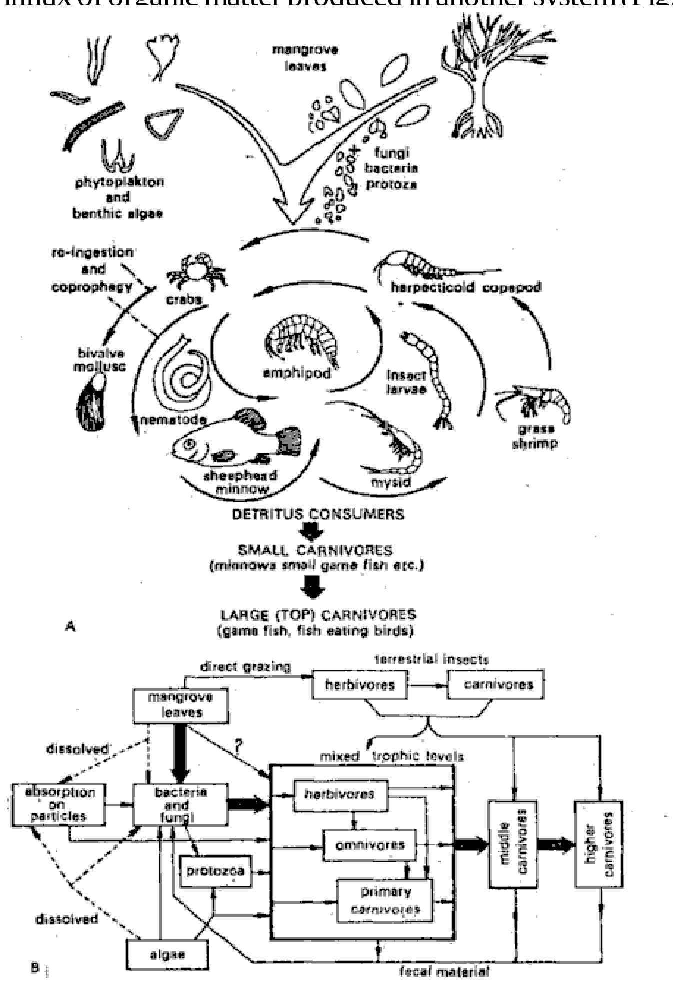


Fig. 3.18 A Detritus food chain

Based on mangroves leaves falling into shallow estuary waters. Leaf fragments acted on by the saprotrophs and colonized by algae are eaten and re-eaten (coprophagy) by a key group of small detritivores which in turn, provide the main food for game fish, herons, stroke and ibis. B-a "pictorial model" of the food chain "compartmental model".

In detritus chain, the detritus consumers, in contrast to grazing herbivores, are a mixed group in terms of trophic levels (Fig.3.23b). These include herbivores, omnivores, and primary carnivores. As a group, the detritus feeders obtain some of their energy directly from plant material, most of it secondarily from microorganisisms, and some tertiarily throguh carnivores (for example by eating protozoa or other small invertebrates that have fed on bacteria that have digested plant material). But under natural situations, a system must always be self sufficient. In fact this type of food chain (detritus type) is simply a sub-component of another ecosystem. And, the aboversaid two types of food chain in nature are indeed limited together belonging to the same ecosystem.

Food Web

However, 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. Under natural conditions, the linear arrangement of food chains, hardly occurs and these remain indeed interconnected with each other through different types of organisms at different trophic levels.

A similar food web in a pond, with different interlinked food chains is shown in Fig. 3.24. The food web are very important in maintaining the stability of an ecosystem in nature. For example, decrease in the population of rabbit would naturally cause an increase in the population of alternative herbivore, the mouse. This may decrease the population of the consumer (carnivore) that prefers to eat rabbit.

Thus alternative (substitutes) serve for maintenance of stability of the ecosystem, Moreover, a balanced ecosystem is essential for the survival of all living organisms of the system. For instance, had primary consumers (herbivores) not been in nature, the producers would have perished due to overcrowding and competition.

Similarly, the survival of primary consumers is linked with the secondary consumers (carnivores) and so on. Thus, each species of any ecosystem is indeed kept under some sort of a natural check so that the system may remain balanced.

The complexity of any food web depends upon the diversity of organisms in the system. It would accordingly depend upon two main points:

(i) Length of the food chain. Diversity in the organisms based upon their food habits would determine the length of food chain. More diverse the organisms in food habits, more longer would be food chain.

(ii) Alternatives at different points of consumers in the chain. More the alternatives, more would be the interlocking pattern. In deep oceans, seas etc. where we find a variety of organisms, the food webs are much complex.

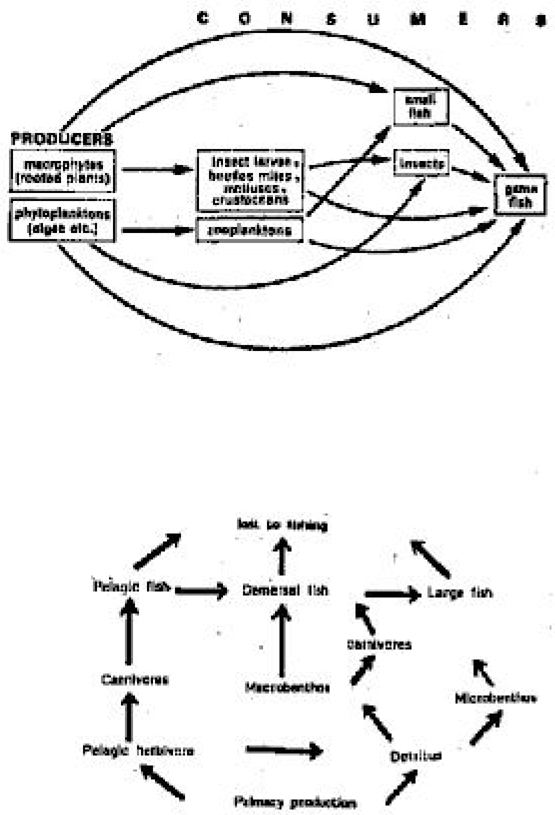


Fig. 3.9

3.5 Trophic levels of Ecological piramids

The producer organisms are autotrophs, largely phytoplankton and other green plants, that manufacture their food through photosynthetic activity utilizing the abiotic elements of the water. Other organism in the aquatic ecosystem, largely animals, are consumers which utilize the producers as their food. These organisms are phagotrophic heterotrophs, micro or macro consumers. Another category of heterotrophs is of those organisms, chiefly bacteria and fungi, which are decomposers (saprophytes) of dead organic matter, partly utilizing these as their food, and partly releasing simple products utilizable I as food by both autotrophs and consumer heterotrophs. Fish belongs to the category of phagotrophic hetetroph of the macro consumer type. In this set up, complex patterns of food relatinship occurs in which there are repated stages of one organism eating the other and in turn serving as the food for the third one and so on. Fish populations may be classified, thus, into several trophic levels, depending upon their position in this food chain.

There are some fish communities which occupy thesecond trophic level (the producers belong to the first trophic level). These are herbivores, eating green plants (the producers) and in which, the transfer of food energy from producers reaches fish in one step. Other fish communities belong to the third trophic level. These are carniovorous fish, eating herbivorous fish or other herbivorous animals like zooplankter (zooplankters belong to the third trophic level, since they eat insects and their larvae and other arthropods living on detritus (these themselves occupying the second trophic level alongside bacteria and fungi). Still other fish commuities occupy the fourth trophic level. These are predatory fish eating carnivorous fish or other carivorous animals. The trasfer of food energy from producers occurs thus in two or three steps in the third and the fourth trophic levels respectively. A relatively simple food chain operates in managed fish ponds but a complex one occurs in large lakes and other fresh water ecosystems. The picture is very complicated in trophic relations is still large and wild water bodies, especially in seas, where complicated food chains are referred to as food webs which infact represent several food chains interconnected into a whole

There are again fish communities which occupy multiple positions or mixed positions between different trophic levels. Such fishes consume a variety of food, both plants and animals. These are called omnivorous fishes and these cannot be naturally classified with any one particular trophie level.

Ecological Pyramids

Trophic structure i.e. the interaction of food chain and the size metabolism relationship between the linearly arranged various biotic components of an ecosystem is characteristic of each type of ecosystem. The trophic structure and function at successive trophic levels, i.e. producers herbivores carnivores, may be shown graphically by means of ecological pyramids where the first or producer level constitutes the base of the pyramid and the successive levels, the tiers making the apex.

Ecological pyramids are of three general types - (i) pyramid of numbers, showing the number of individual organisms at each level, (ii) pyramid of biomass, showing the total dry weight and other suitable measure of the total amount of living matter, and (iii) pyramid of energy, showing the rate of energy flow and or productivity at successive trophic levels. The pyramid 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.

i. Pyramids of Number

They show the relationship between producers, herbivores and carnivores at successive trophic levels in terms of their number. The pyramids of numbers in three different kinds of ecosystems are shown in Fig. 3.20 (A-C) In a grassland (Fig.3.20A) the producers, which are mainly grasses are always maximum in number. This number then shows a decrease towards apex, as the primary consumers (herbivores) like rabbits, mice etc. are lesser in number than the grasses; the secondary consumers, snakes and lizards are lesser in number than the rabbits and mice. Finally, the top (tertiary) consumers hawks or other birds, are least in number.

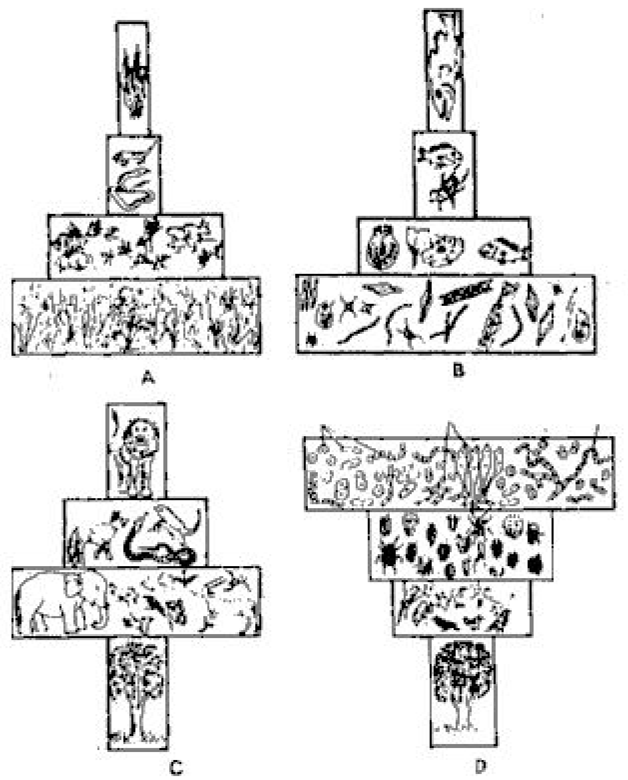


Fig 3.20

Thus, the pyramid becomes upright. Similarly in a pond ecosytem (Fig. 3.20B) the pyramid is upright. Here the producers, which are mainly the phyto-planktons as algae, bacteria etc. are maximum in number; the herbivores, which are smaller fish; rotifers etc. are lesser in number than the each other, water beetles etc. are lesser in number than the herbivores. Finally, the top (tertiary) consumers, the bigger fish are least in number. In a forest ecosystem (Fig. 3.20C), however, the pyramid of numbers is some what different in shape. The produces, which are mainly large-sized trees, are lesser in number, and form the base of the pyramid. The herbivores, which are the fruit-eating birds, elephants, deers etc. are more in number than the producers. Then there is a gradual decrease in the number of successive carnivores, thus making the pyramid again upright. However, in a parasitic food chain (Fig.3.20D) the pyramids are always inverted. This is due to the fact that a single plant may support the growth of many herbivores and each herbivore in turn may provide nutrition to several parasites, which support many hyperparasites. Thus, from the producer towards consumers, there is a reverse position, i.e. the number of organisms gradually shows an increase, making the pyramid inverted in shape.

Fig. 3.20. Pyramids of numbers (individuals per unit area) in different kinds of ecosystem/food chains. A - grassland ecosystem. B - pond ecosystem, C - forest ecosystem. In A-C parasitic microorganisms and soil animals are not included. D - parasitic food chain.

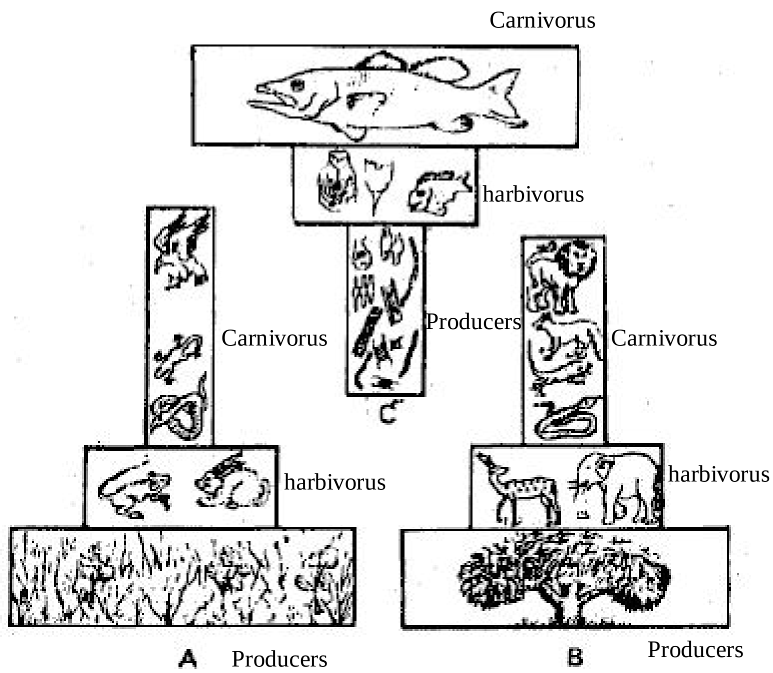
Actually the pyramid of numbers do not give a true picture of the food chain as they are not very functional. They do not indicate the relative effects of the 'geometric', 'food chain' and 'size' factors of the organisms. They generally vary with different communities with different types of food chains in the same environment. It becomes sometimes very difficult to represent the whole community on the same numerical scale (as in forests).

ii. Pyramids of Biomass

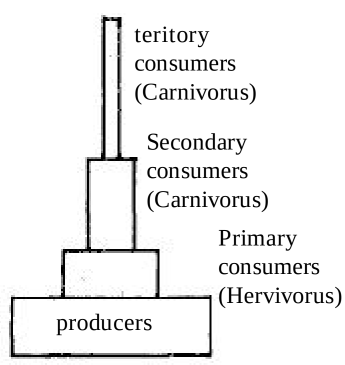
They are comparatively more fundamental, as they, instead of geometric factor, show the quantitative relationships of the standing crops. The pyramids of biomass in different types of ecosystem are shown in Figure 3.26 (A-C). In grassland and forest (Fig. 3.26 A.B), there is generally a gradual decrease in biomass of organisms at successive levels from the producers to the top carnivores. Thus pyramids are upright. However, in a pond (Fig. 3. 26C) as the producers are small organisms, their biomass is least, and this value gradually shows an increase towards the apex of the pyamid, thus making the pyramid inverted in shape.

iii. Pyramid of Energy

Of the three types of ecological pyramids, the energy pyramid give the best picture of overall nature of the ecosystem. Here, number and weight of organisms at any 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 food is being produced. In contrast with the pyramids of numbers and biomass, which are pictures of the standing situations (organisms present at any movement), the pyramid of energy (Fig. 3. 27) is a picture of the rates of passage of food mass through the food chain. In shape it is always upright, as in most of the cases there is always a gradual decrease in the energy content at successive trophic levels from the producers to various consumers.



(A-C) Pyramids of biomass (g. dry wt. per unit area) in different kinds of ecosystems. A-grassland, B-forest, C-Pond



Pyramid of energy (K cal per unit area within unit time, seasons or years) in any eco system)

Fig. 3.21

The species structure includes not only the number and kinds of species but also the diversity of species i.e. the relationship between species and number of individuals or biomass; and the dispersion (spatial arrangement) of individuals of each species present in the community.

3.6 Productivity of Ecosystem

The productivity of an ecosystem refers to the rate of production i.e. the amount of organic matter accumulated in any unit time. Productivity is of the following types:

Primary productivity

It is associated with the producers which are autotrophic, most of which are photosynthetic, and to a much lesser extent the chemosynthetic microorganisms. These are the green plants, higher macrophytes as well as lower forms, the phytoplanktons and some photosynthetic bacteria. Primary productivity is defined as "the rate at which radiant energy is stored by photosynthetic and chemosynthetic activity of producers." Primary productivity is further distinguished as:

(a) **Gross primary productivity**. It is the total rate of photosynthesis including the organic matter used up in respiration during the measurement period.

(b) **Net primary productivity**. It is the rate of storage of organic matter in plant tissues in excess of the respiratory utilization by plants during the measurement period.

Secondary productivity

It refers.to the consumers or heterotrophs. These are the rates of energy storage at consumers level. Since consumers only utilize food materials (already produced) in their respiration, simply converting the food matter to different tissues by an overall process, secondary productivity is not divided into 'gross' and 'net' amounts. to use the term assimilation rather than 'production' at this level the consumers level. Secondary productivity actually remains mobile (i.e. keeps on moving from one organism to another) and does not live in situ like the primary productivity.

Net productivity

It refers to the rate of storage of organic matter not used by the heterotrophs (consumers) i.e. equivalent to net primary production minus consumption by the heterotrophs during the unit period.

3.7 Limnology of Pond Ecosystem

Limnology is a branch of science, which deals with the study of freshwater ecosystems of all kinds ranging from lakes, reservoirs, streams, ponds, marshes, bogs, etc - physically, chemically and biologically. (Forel's Lelemane - 1888 to 1909-Fathwr of Limnology).

Limnological studies such as, physical, chemical and biological forms a part of limnology.

(i) Physical*:* Physiography, morphometry, bathymetry, temperature, turbidity, conductivity, water volume, water current etc. are covered in this area of study.

(ii) Chemical: Study of H^+ ion concentration dissolved oxygen, CO_2. alkalinity, No_3, PO_4, Silicate, Calcium hardness, chloride, ammonia in solution, H_2S and trace elements like B, Mn, Mg, Fe, Cu, etc.

(iii) Biology: Study of plankton (phyto, zoo, nanno plankton); nekton (fish, Insects, crustacea, annelids, molasses and other free swimming animals); Benthos (phyto benthos, zoo benthos); pedon (botton fauna or zoo benthos) and microorganism inform of dead organic matters (DOM, bottom mat etc.,)

Apart from these studies (Qualitative), quantitative production studies are also forms a partin limnology. It also comprises, the correlations between an organism or a community with other organisms and physico - chemical environment (climate and rainfall).

The food chains (in water) of fishes, plankton, pedon, other animals and macrophytes are all studied under limnology.

Limnology requires a multidisciplinary approach. Besides physical, chemical and biological studies, it also encampass some area of other disciplins, such as geology, geography, matereology, hydrology, statistics, biochemistry, bacteriology, geodesy and engineering.

i. Plankton

The plankton is nothing but a group heterogenous tiny piants and animals adopted to suspension in the sea and fresh waters.

Their intrinsic movements are essentially depends upon the mercy of water currents. The plankton occurs in all natural waters as well as in artificial impoundments like ponds, tanks, reservoirs, irrigation channels etc.

Depending upon the ability to carry out the photosynthetic activity, planktons are classified into

(i) Phytoplankton (plant plankters) and

(ii) Zooplankton (animal plankters)

Planktons are having an immense value as a food and play an important role in the disposal of sewage and in natural purification of polluted waters. But some plankton form a harmful bloom that may cause a high mortality among the aquatic organisms and pose a serious hazard in the water supply for domestic and industrial use.

The fish culture practices attaining a greater importance in the field of aquaculture throughout the world as well as in India. For an efficient fish culture, the fish seed should be properly feed with sufficient natural food organisms. These small microscopic organisms are nothing but the 'Planktons'. As far as freshwater fish ponds concerned, the planktons comprises both the phytoplankton as well as Zooplankton.

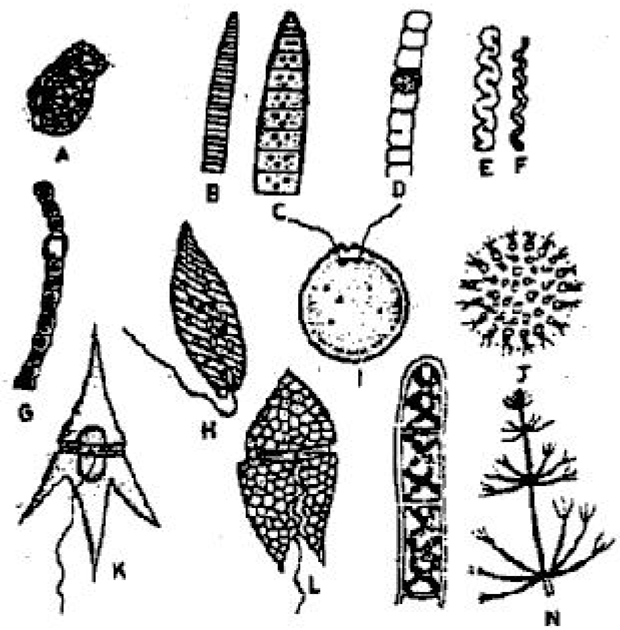
ii. Phytoplankton

The phytoplanktons mainly consists of the groups of Chlorophyceae, Bacillariophyceae, Eugleninaceae, and Myxophyceae and some extent a few Dinophyceae. Some of the common phytoplanktons found in lakes and ponds of India is listed in the Table 13.1.

Table 3.2: Common phytolanktons in lakes and ponds of India

Class	Characteristics	Common forms
Cyanophceae (blue green algae)	Absence of distinct and organized chloroplast, with a diffuse blue-green pigment. Some have chains of cells termed as trichomes. Some have heterocysts which are capable of nitrogen	Microcystis aeruginosa Microcystis aeruginosa Spirulina sp. Oscillatoria sp. Nostoc sp. Anabaena sp. Schizothrix sp.
Xanthophyceae	Similar to green alage but is distinguisted by the lack of strch reaction. Presence of several discordal chloroplasts per cell.	Vaucheria sp.

Euglenophyceae	Mostly unicellular flagellates. Presence of a naked chloroplast. Noramlly with two flagella arising from a pronounced depression or pit near the cell apex. Presence of a conspicusous red stigma.	Euglena sp.
Dinophyceae	Cells with two flagllae lying partially within two deep furrows. One furrow giriding the cell, the other At right angles towards one apex. Chloroplast discodial.	Gymnodinium sp. Ceratium sp.
Bacillariophuyceae (diatoms)	Cell walls consist of two halves which are identical in shape and fit neartly. Held in position by intercalary bands. Silicified walls known as frustules. May be ciruclar with radial symmetry or boat-shapped with bilateral symmetry. Presence of a slit-like raphe which secretes mucilage.	Melosira sp Meridionsp. Diatoma sp. Asterionella sp. Fragilaria sp. Synedra sp. Rhociosphenia sp Stauroneis sp. Navicula sp. Nitzschia sp.
Chlorophyceae	Large well-defined group of algae which are motile in their vegetative state. Cholroplast pale to deep grass-green. Unicellular, Colonial of filamentous. Normally with 1-2 parietal axile chloroplast, occasionally with many chloroplast	Chlamydomonas sp. Pandorina sp. Edudorina sp. Volvox sp. Scenedesmus sp. Hydrodictyon sp. Ulothrix sp. or Oedogonium sp. Spirogyra sp. Zygnema sp. Pediastrum sp. Euostrum sp.



Phytoplankton

(a) Microcystis (b & c) Oscillatoria (d) Anabaena

(e & f) Spirulina (g) Nostoc (h) Euglena

(i) Chlomydomanas (j) Volvox (k) Spirogyra (i) Nitella

Fig 3.22

iii. Zooplankton

Animals, which are carried along by the moving waters are known as 'Plankton'. The planktonic animals are virtually at the mercy of the currents and generally drift about passively. Zooplankton consists mostly of invertebrates and larvae and immature stages of both invertebrates as well as vertebrates.

The planktonic community exhibits considerably variety as it is composed of every group from protozoa to chordata. However, coelenterats, and crustaceans predominates. Siphanophorans, ctenophorans and chaetognathans among invertebrates and Larvacea among chordates are exclusively planktonic forms. Planktonic animals must necessasily have the capacity to remain afloat,.

iv. Classification

The Zooplankton may be classified according to their habitat and depth of distribution, size and duration of planktonic life, *Depending upon the basis of depth of distribution*, they are classified as

(i) Pleuston	- Living at surface of the water
(ii)Neustdn	- Living in the upper most few to tens of millimeters of the surface micro layer
(iii) Epipelagic plankton	- Living between 0 and 30Gm.
	Upper epiplankton - from 0 - l50m.
	Lower epiplankton - from 150 - 300m.
(iv) Mesopelagic plankton	- Living between 300 - 1000m.
(v) Bathy pelagic plankton	-Living between 1000 - 3000m.
(vi) Abyssopelagic plankton	- Living between 3000 - 4000m.
(vii) Epibenthic plankton	- Living at the bottom, i.e, demersal plankton.

2. Depending upon the size, the zooplanktons areclassified as

(i) Nanozooplankton	- <20mm
(ii) Microzooplankton	- 20 - 200 mm
(iii) Mesozoop(ankton	- 200 mm - 2 mm
(iv) Macrozooplankton	- 2 - 20 mm
(v) Megalozooplankton	- > 20 mm

Among the.unicellular organisms of the plankton, there are a few, which are neither plants nor animals. Flagellates are of this type and are classified as 'Protophyta'. These protophyta includes the members such as plants, animals (or) of both.

The zooplanktonic forms shows a great variability ranging from protozoans to chordates. Several members of the class Sarcodina are planktonic among the protozoans. Even the chordates, specially of protoehordates are also represented as planktons.

The zooplankons, protozoans (Diffiugia, Arcella and many ciliates), rotifers (Keratella, Polyarthra, Pedalia etc), crustaceans (Cladocerans Daphnia, Meriodaphnia, Monia and copepods, Cyclops, Diaptomus and Crustacean larvae and other Zooplanktons were discussed briefly, and some of the more common zooplanktons found in lakes and India (Table 3.2. and Fig. 3.29).

Table 3.3 Common zooplanktons in lakes in India.

A. Protozoa	*Difflugia pyriformes, Trachelomonas sp. Euglypha acanthophora, Chilomonas sp. Placoysta sp., Amoeba proteus Didinium nasututn, Arcella discoides Paramecium caudatum, Arcella gibbosa*
B. Porifera	*Spongilla lacustris*
C. Coelenterata	*Hydra virdis, Pelmatohydra oligactis, Hydra vulgaris*
D, Rotifera	*Philodina sp., Hexarthra mirum. Filinia terminalis, Filinia longiseta Asplanchna sp., Branchionus calcyflorus, Brachionus forficula, Polyarthra sp. Keratella tropica, Keratella procurva Epiphanes sp.*
E.Arthropoda	
Anostraca	*Strepiocephalus sp.*
Cladocera	*Daphnia carinata, Daphia lumholtzi Moina sp., Ceriodaphnia sp., simocephalus sp.*
Ostracoda	*Cypris sp., Stenocypris sp., Heterocypris sp. Centrocypris sp.*
Copepoda	*Mesacyclops sp., Diaptoinus sp., Neodiaptomus sp. Heliodiaptomus sp. Rhinediaptomus sp.*

Fig. 3.23 Common Zooplãnkters found in freshwaters
(1) Amoeba (2) Hydra (3) Asplanchna (4) Branchionus (5) filima (6) eiphanes (7) Keratella (8) triarthra (9) Diaptomus (10) Mesocyclops (11) Daphnia.

v. .Nekton

The nekton consists of actively swimming organisms, including a diverse group of insects and fishes (fig.3.30). Most of these insects can spend their time on the water surface and frequently dive inside the water for feeding. These are voracious feeders, feeding on plant oozes *(corixa)*, Insects and crustaceans (*Nepa: Ranatra: Hydrophiues):* eggs, fry and fingerlings of fishes *(Lethocerus, Belostoma, Diphonychus)*.

While going under water, Notonecta usually enter the water with a store of air under wing covers, or beneath the abdomen. The hydrofhge hairs and body surface cause the surface film to form a more (or) less complete envelope about the body, there by enclosing an air space. The surface film acts as a diffusion membrane through which gases pass from the air space to the water and vice-versa.

Table-3.4: Common nektons in lakes of India.

A.	**Insects**		
	Order	Hemiptera	
		Family Notonectidae	*Nownecta sp.*
		Family Nepidae	*Nepa sp.*
			Ranatra sp.
		Family Belostomidae	*Lethocerus sp.*
			Belostoma sp.
			Diplonuychus sp.
		Family Corixidae	*Corixa sp.*
	Order	Coleoptcra	
		Family Dytiscidae	*Cybister sp.*
			Laccophilus sp.
			Dytiscus sp.
		Family Hydrophilidae	*Hydrophilus sp.*
			Dineutes sp.
B.	**Fishes**		
	Order	Cypriniformcs	
		Family Cyprinidae	*Catla catla*
			Labeo rohita
			Cirrhina mrigala
			Labeo calbasu
			Labeo bata
			Labeo fimbniatus