Note –

- The main decomposers in ecosystem are bacteria and fungi.
- Decomposers play a significant role in **mineral cycle.** Decomposers are responsible for converting complex organic material of dead animals or plants into simpler organic matter through the process of decomposition and release mineral substances into the soil where these are reused by the producers. So that soil is considered as the best resource of minerals.
- In Bacteria and fungi, process of decomposition completely takes place outside the body. They release enzymes from their body on dead remains and decompose it into simpler organic substances and then absorb it so these are called as **osmotrophs (absorptive).**

SPECIAL POINT OF BIOTIC FACTOR

- **Nutrient Immobilisation -** In the process of decomposition, some nutrients get tied up with the biomass of microbes and become temporarily unavailable to other organisms. Such incorporation of nutrient in living microbes (bacteria & fungi) is called **nutrients immobilisation.**
- In aquatic system **whale** is secondary consumer. It is an example of **filter feeder** because it feeds on lankton.
- **Vulture** is a scavenger not predator because it never kills any animals. Vulture is also a decomposer. In Vulture, the break down of the food material takes place inside the body and then released into the soil in the form of waste material and minerals.
- **Plant parasites** are known as primary consumers while animals parasites (E. coli bacteria, Entamoeba histolitica, liver fluke, tapeworm) are known as secondary consumers.
- **All the insectivorous** plants play the double role i.e. producer as well as secondary consumer because they synthesise their own food through photosynthesis and they eat insects simultaneously.
- **Man and peacock** are omnivores.
- Organisms which use **milk** or curd are known as secondary consumer.

Note:

Inorganic materials (CO_2, H_2O, Light), autorophs (**Producer**) and **decomposers** are essential in ecosystem but, **macro consumers** are non essential.

Function of ecosystem :

There are two basis functions of ecosystem

(i) Biogeochemical cycle (mineral cycle)

(ii) Energy flow - The storage, expenditure, transformation of energy is based on two basic law of thermodynamics -

- Energy is neither created nor destroyed but only transformed from one state to another state.
- The law of entropy - The transfer of food energy form one to another organism leads to loss of energy as heat due to metabolic activity .

FOOD CHAIN

In ecosystem every organism depends on other organism for food material and all organism are (herbivores to carnivores) arranged in a series in which food energy is transferred through repeated eating and being eaten. It is called food chain. In food chain , energy flow is in the form of food.

In a food chain, food material or food energy transfer is from one trophic level to next trophic level.

Four trophic levels are present in the ecosystem, because level of energy decreases during the

flow of energy from one trophic to the another trophic level.

First tropic level	**[T_1]**	=	Producers
Second trophic level	**[T_2]**	=	Primary consumers
Third trophic Level	**[T_3]**	=	Secondary consumers
Fourth trophic level	**[T_4]**	=	Top consumers

Note -

1. There are **five trophic levels** found in highly complex ecosystem in which tertiary consumer is present in between the secondary consumers and top consumer. Then the fifth trophic level (T_5) is formed by the top consumer.
2. In food chain energy flow is **unidirectional** (producers to herbivores)
3. Shorter food chains will provide greater energy.
4. Generally the decomposers (Bacteria and Fungi) are not included in the food chain but when included then included as the last trophic level.

TYPE OF FOOD CHAINS

In nature three types of food chains are present

1. **Grazing food chains or Predatory food chain -** Most of food chain in nature are of this type. This food chain begins with **producers** (plants) and in successive order it goes from **small organism to big organism**

Aquatic ecosystem :

Producer	**Pri. consumer**	**Sec. consumer**	**Top consumer**
↑	↑	↑	↑
Phytoplankton	Zooplankton	Small fish	Large fish
↓	↓	↓	↓
T_1	**T_2**	**T_3**	**T_4**

Grass land ecosystem :

Producer	**Pri. consumer**	**Sec. consumer**	**Top consumer**
↑	↑	↑	↑
Grass	Rabbit	Fox	Lion
↓	↓	↓	↓
T_1	**T_2**	**T_3**	**T_4**

2. **Parasitic food chain -** This food chain also starts from **producers** but is successive order it goes four big **organism to the smaller organism.**

e.g.

Tree ecosystem -

Tree	Birds	Parasites
↓	↓	↓
T_1	**T_2**	**T_3**

Note : Both above food chains are directly dependent on **solar radiation** (as a primary source of energy) and have **rapid energy flow.**

3. **Detritus food chain or Saprophytic food chain -** This food chain begins with decomposition of dead organic matter by **decomposers** so it is also known as saprophytic food chain. In this food chain primary consumers are bacteria and fungi. The detritivores, in turn are eaten by secondary consumers which include insect larvae, nematodes etc.

Dead organic matter → bacteria fungi

Note :

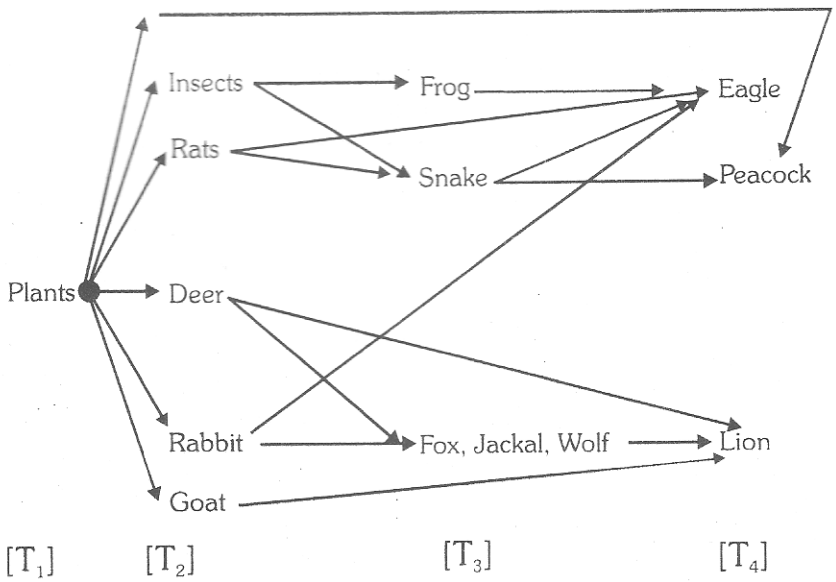
- In mangrove vegetation this food chain goes up to big organism.
  Dead mangroves leaves → Bacteria & fungi → Amphipds, molluscs, crabs nematodes → small fishes → fish eating birds.
- It detritus food chain **energy flow** is rather very slow yet magnitude of energy is great because vast no. of decomposers are involved.
- It does not depends on **light.**

- Ecosystem/food chain-
  In an aquatic ecosystem, CGF (Grazing Food Chain) is the major conduit (source) of energy flow. As against this, in a terrestrial ecosystem, a much larger energy flow through the detritus food chain than through the grazing food chain.
- In Sunder bans, Tigers feed on the fishes and crab in the absence of their natural prey.

FOOD WEB

In big ecosystem many food chains are interlinked together on different trophic levels to form food web. In food web transfer of food energy is unidirectional but from many different alternative path way. In food web members of particular trophic level obtain their food according to their choice and taste but that type of facility is not present in food chain. It means they have more than one option or alternative for getting food.

As much as food web is complex that ecosystem is more permanent or stable, such type of ecosystem is not destroyed naturally and continues for long time. This ecosystem is not affected by loss any organism of any particular trophic level. **Those ecosystems which have simple food web are not very stable** it means that they can be finished at any time, if there is a change in any particular trophic level.



Homeostasis -

Ecosystem is a dynamic system because continuous interaction is going on in between abiotic or biotic components so ecosystem is present in an equilibrium position. Ecosystem is also self maintainable and self regulatory system, it means an ecosystem maintains as balance in between different trophic levels. Each trophic level controls the other tropic level in an ecosystem. If any change take place in any trophic level of ecosystem, the other trophic levels of this ecosystem may react according to it. So ecosystem always remain in equilibrium. This feature of system is knows as **homeostatic.**

Cybernetics -

A science of self control as (homeostasis) is an ecosystem is called cybernetics.

PYRAMIDS OF ECOSYSTEM

Graphical representation of ecological parameters are different trophic level in ecosystem is called pyramids. These parameters are Number, Biomass and Energy. First of all, pyramid was formed by **Charls Elton;** So we called it Eltonian pyramids.

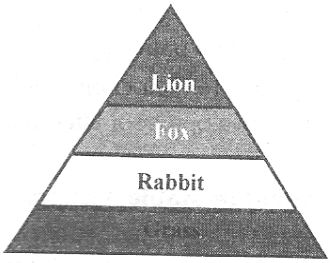
In pyramids basal, mid and top tiers show the parameter values for producer, herbivores and carnivores in the ecosystem

THESE PYRMAMID ARE OF THREE TYPES

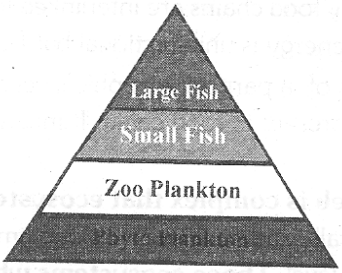
(1) Pyramids of number (2) Pyramids of energy (3) Pyramids of biomass

(1) Pyramids of number -

In this type of pyramids the number of individual organism in various trophic level is shown. These pyramids are mostly upright, because number of producers [T_1] is maximum m and No. of herbivores and carnivores decrease towards apex or at successive trophic levels, such as Grassland ecosystem and aquatic ecosystem.

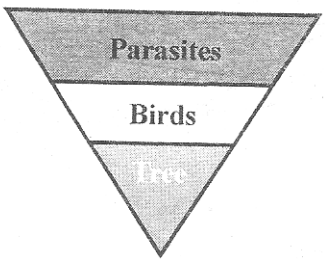


Grass land Ecosystem



Aquatic Ecosystem

But in a tree ecosystem the pyramid of number is inverted. This is called parasitic ecosystem because birds (herbivores) depends on the tree (producer) and parasites (consumer) depends on birds, therefore with increase in the no. of trophic levels, the number of the organisms increases sequentially.



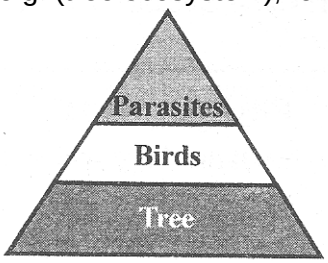
Tree Ecosystem

Note

- Maximum number of producers are present in aquatic ecosystem. **The number of organisms at any trophic level depends upon the availability of organism which are used as food** on lower lever so availability of food is main factor.• Pyramid of number shows **biotic potential** of a ecosystem. The number of members of any particular species in favourable conditions is called their biotic potential. When the numbers of the members of any species increases then it is called population explosion. Because of this existence of the species comes in danger. Human population is also near this condition at present

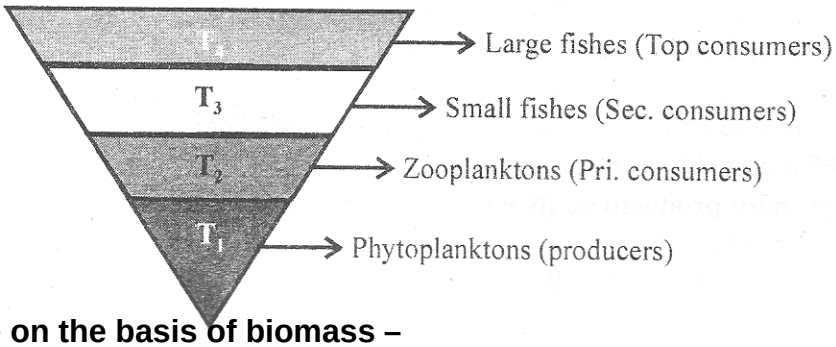
(2) Pyramid of Biomass -

Pyramids of biomass represent the total amount of biomass of each trophic level of ecosystem, mostly these pyramids are also upright (erect) e.g. (tree ecosystem), forest ecosystem.

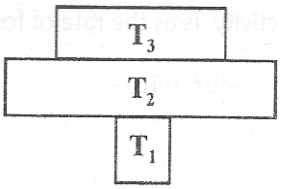


Pyramid of biomass in Tree ecosystem

Pyramids of biomass in aquatic ecosystem is inverted because it producers are micro-organism and their biomass is very less.



Note : Pyramid of lake on the basis of biomass –



Some Special point related to biomass :

(i) Standing crop - Total amount of **living organic matter** present in particular area in particular time in an ecosystem is known as standing crop. It may be expressed in terms of number or weight per unit area.
Biomass is the standing crop expressed in terms of weight (i.e. organisms mass). Biomass is measured
by **bomb calorimeter.**

(ii) Standing quality or Standing state - Total amount of **inorganic substance** such as P, S, N, H present in particular area at a particular time in an ecosystem is known as standing state.

Note: The pyramids of biomass show the **standing crop** of ecosystem.

(3) Pyramids of energy -

It represents amount of energy at different trophic levels, energy pyramids are always upright or erect because there is a gradual decrease in energy at successive ve trophic levels. According to the **10% law of Lindeman.** the 90% part of obtained energy of each organisms is utilized in their various metabolic activities and heat and only 10% energy is transferred to the next trophic level. So 90% energy is lost at each trophic level, therefore **top consumer like lion etc. are ecologically weakest** but physically they are strong.

Note : Pyramids of energy represent the productivity of ecosystem as well as transfer of production in ecosystem.

Some information :
The respiration cost most increases along successive higher trophic levels normally on an average respiration of **producers** consume about **20%** of its gross productivity. **Herbivores** consume about **30%** and **60%** consumes by **carnivores** in respiration.

PRODUCTIVITY

There are two type of productivity present

(i) Primary productivity -
Primary production is defined as the amount of biomass or organic matter produced per unit area over a time period by plants during photosynthesis. It is expressed in terms of weight (g^{-2}) or energy (Kcl m^{-2}). The rate of biomass production is called productivity. It is expressed in terms of g^{-2} yr^{-1} or (Kcal m^{-2}) to compare the productivity of different ecosystem. It can be divided into GPP and NPP.

Its again divides in two type

(a) Gross primary productivity (G.P.P.) - It is the total amount of energy fixed (organic food) in an ecosystem (in producers) in unit time is called G.P.P. including the organic matter use up in respiration
during the measurement period. It is also known as total (gross) photosynthesis. A considerable amount of GPP is utilized by plants in respiration.

(b) Net primary productivity (N.P.P.)- It is the amount of stored organic matter in plant tissue after respiratory utilization

NPP = GPP - R (R = Respiration + Metabolic activities)
or
GPP = NPP + R

- NPP is the available biomass for the consumption to heterotrophs.

(ii) Secondary productivity - Sec. productivity is as the rate of formation of new organic matter by consumers.

(iii) Net community productivity of Net productivity -
The rate of storage of organic matter not used by the heterotrophs

NCP = N.P.P. -HR (HR - Energy used by Heterotrophs or consumers)

Some informations related to productivity –

(1) Primary productivity depends on the plant species inhabiting a particular area. It also depends on a variety environemntal factors availability of nutrients and photosynthetic capacity of plants. Therefore it varies in different type of ecosystem. The annual net primary productivity of the whole biosphere is approximately 170 billion tons (dry weight) of the organic matter, productivity of the ocean are only 55 billion tons.

(2) In per unit area maximum productivity found in **tropical rain forest.**

(3) In water, least productive ecosystem is very deep lakes and highly productive ecosystem is coral reef.

(4) Nitrogen is the limiting factor in ocean and phosphorus is the limiting factor in lake productivity.

(5) In land - Tropical rain forest i.e. 5 kg/msq/year. - Lowest productivity is of Desert , tundra.

(6) Most productive Agro-ecosystem is Sugar cane and rice ecosystem - 3-4 kg./msq/year.

Some information :

(i) Ecological efficiency - The percentage of energy transferred from one trophic to the next is called ecological efficiency or food chain efficiency.

$$\text{E.E.} = \frac{\text{Energy in biomass production at a prophic level}}{\text{Energy in biomass production at previous trophic level}} \times 100$$

(ii) Assimilation efficiency - It is the proportion of consumed energy that is assimilated.

$$\text{A.E.} = \frac{\text{Food emergy assimilated}}{\text{Food energy ingested}} \times 100$$

(iii) Net production efficiency -

$$\text{N.P.E.} = \frac{\text{Net pri productivity}}{\text{G.P.P.}} \times 100$$

(iv) Photosynthetic efficiency -

$$\text{P.E.} = \frac{\text{G.P.P.}}{\text{Incident total solar radiation}} \times 100$$

ABIOTIC ENVIRONMENTAL FACTORS OF ECOSYSTEM

(A) Light **(B) Temperature** **(C) Soil** **(D) Other**

LIGHT

It is a complex physical environmental factor. Light is measured by **luxmeter or photometer.** It is a electromagnetic spectrum.

Solar Constant- Solar radiation before entering the atmosphere carried energy at a constant rate i.e., 2 cal cm^{-2} min^{-1} known as the solar constant.

In solar radiation wavelength (λ) so light or visible spectrum is 0.4 to 0.7 μm (400 - 700 nm) it is also called **photosynthetically active radiation (PAR).**

The U.V. radiation distinguished in

U.V.C. $\rightarrow$ (0.100 to 0.280 μm)
U.V.-B $\rightarrow$ (0.280 to 0.320 μm)
U.V.-A $\rightarrow$ (0.320 to 0.400 μm)

Albido value –

The ability of a surface to reflect the incoming radiation is called albido value (AV) it is **80%** for fresh snow, **20-30%** for sand, **5-10%** for the forest

Out of the total sun light only 1-5% is utilized in photosynthesis. Only 2-10% of PAR is utilized by plant in photosynthesis

Effect of light –

Photokinesis - Regulation of speed of locomotion due to light is called **photokinesis** e.g. larvae of mussel crab move faster if light intensity increases.