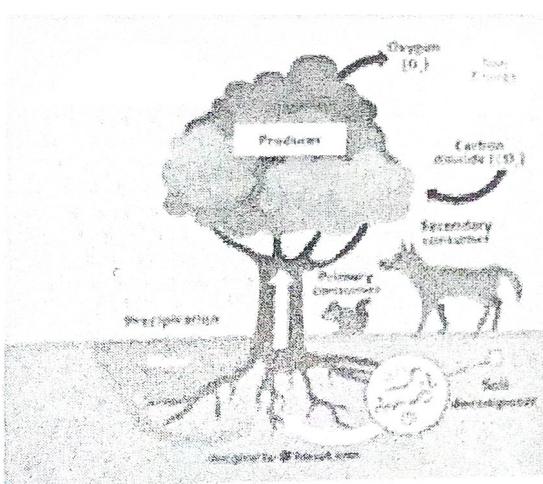


Environment and Ecology

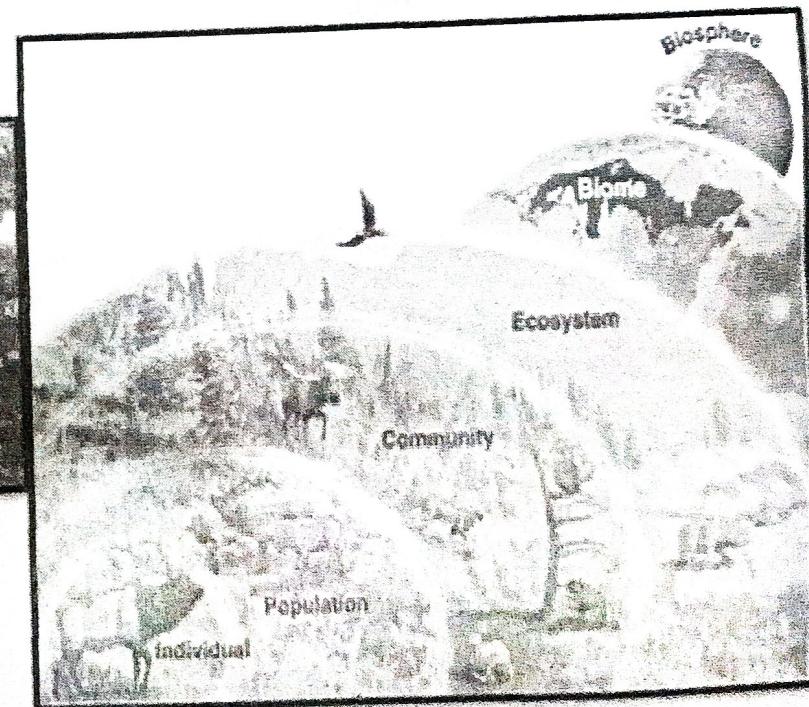
- Everything that surrounds or affects an organism during its life time is collectively known as its environment.
- The environment is defined as 'the sum total of living, non-living components
- **Ecology** is defined as a scientific study of the relationship of the living organisms with **each other** and with their **environment**.
- Thus in ecology we study both energy flow and mineral cycling.



Components of Environment	
Abiotic	Biotic
Energy	Green plants
Radiation	Non-green plants
Temperature & heat flow	Decomposers
Water	Parasites
Atmospheric gases and wind	Symbionts
Fire	Animals
Gravity	Man
Topography	
Soil	
Geologic substratum	

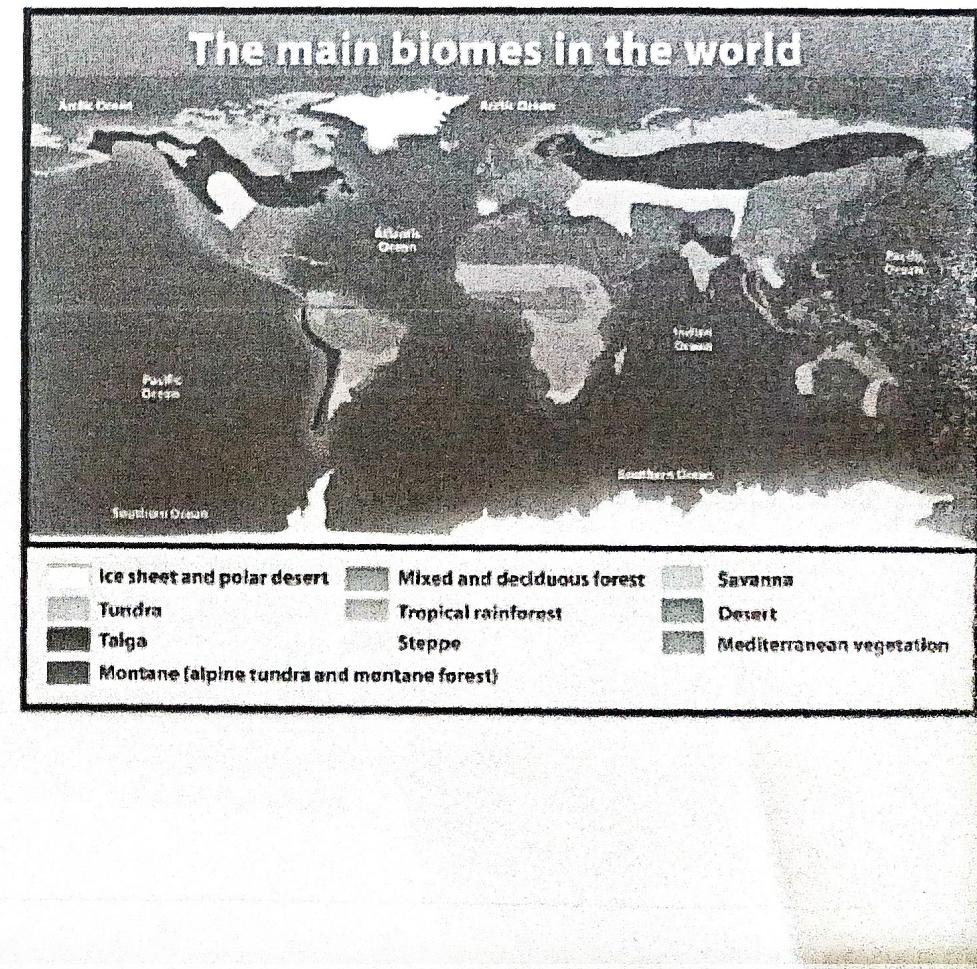
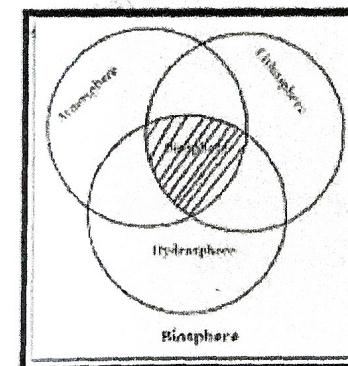
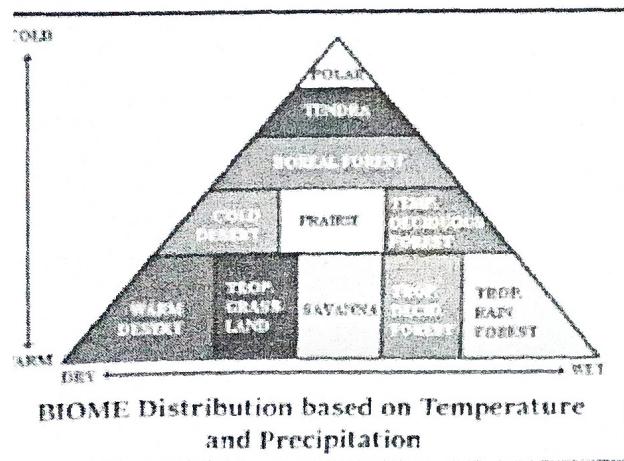
Levels of Organizations In Ecology

- **Individual:** Organism is an individual living being that has the ability to act or function independently.
- **Population:** is a group of organisms usually of the same species, occupying a defined area during a specific time.
- **Community:** Biotic components of a given place at a given time. In order to survive, individuals of any one species depend on individuals of different species with which they actively interact in several ways.
- **Ecosystem:** Both biotic and abiotic components of a given place at a given time are collectively referred to as an ecosystem.
An ecosystem is defined as a **structural and functional unit of biosphere** consisting of biotic and the abiotic components , both interacting and exchanging materials between them.



Levels of Organizations In Ecology

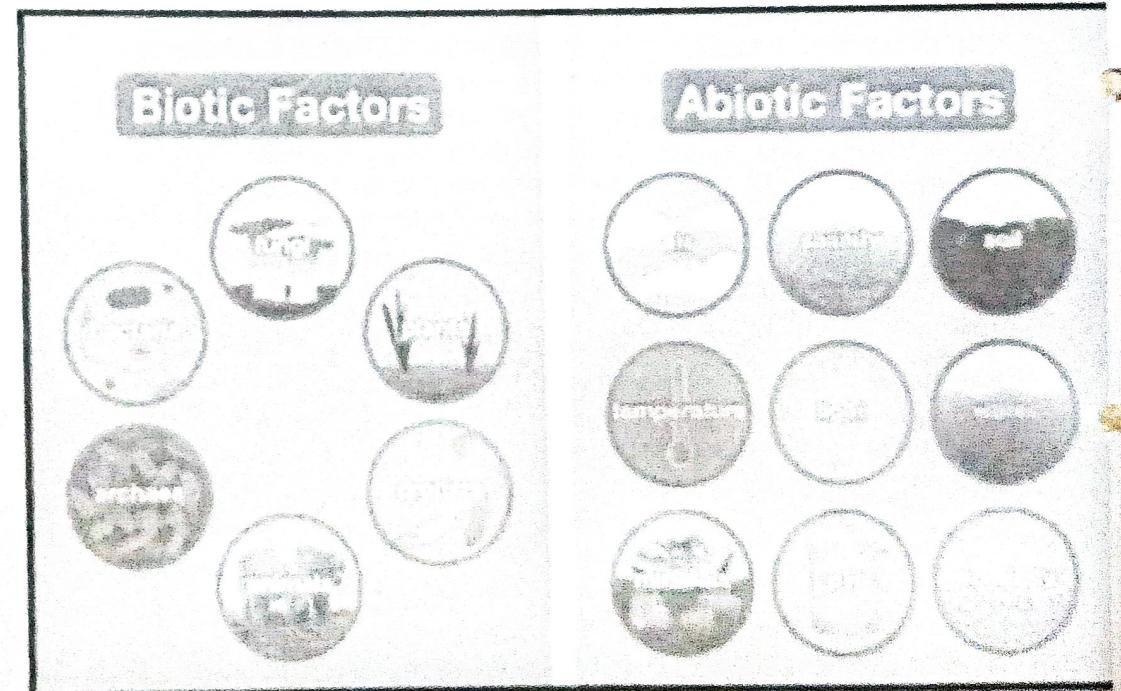
- **Biosphere:** Biosphere is a part of the earth where life can exist. Biosphere represents a highly integrated and interacting zone comprising of atmosphere (air), hydrosphere (water) and lithosphere (land). Life in the biosphere is abundant between 200 below the surface of the ocean and about 6,000 metres above sea level. Biosphere is absent at extremes of the **North and South poles**, the highest mountains and the deepest oceans, since existing hostile conditions there do not support life. Occasionally **spores** of fungi and **bacteria** do occur at great height beyond 8,000 metres, but they are not metabolically active, and hence represent only **dormant life**.
- **Biome:** The terrestrial part of the biosphere is divided into enormous regions called biomes, which are characterized, by similar climate, vegetation, animal life and general soil type.



Components of Ecosystem

Abiotic Component: inorganic and non-living parts:

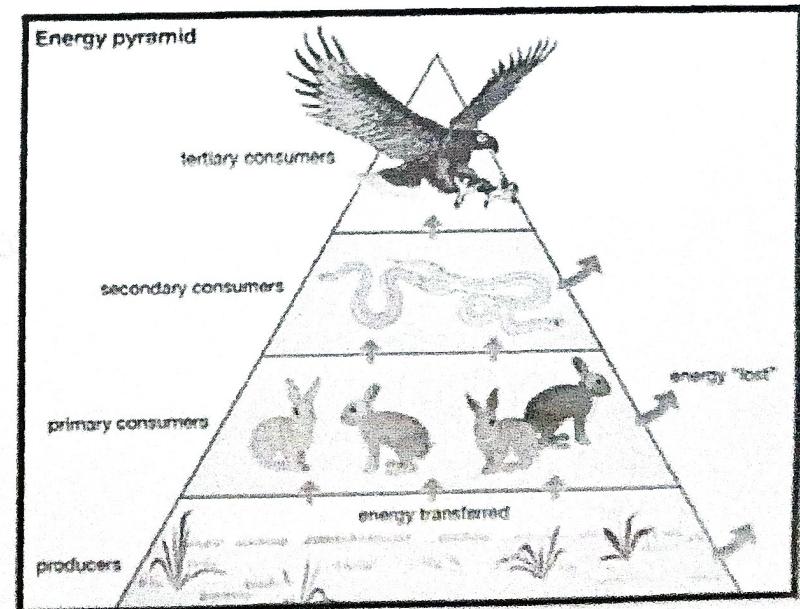
1. **Energy:** Energy from the sun is essential for maintenance of life. Solar energy at the base of food chain.
2. **Rainfall:** Majority of biochemical reactions take place in an aqueous medium. Water helps to regulate body temperature.
3. **Temperature:** Organisms can tolerate only a certain range of temperature and humidity.
4. **Gases:** Oxygen for respiration and Carbon-di-oxide for Photosynthesis.
5. **Soil:** Roots of plants pierce through the soil to absorb water and nutrients. Land is covered by soil and a wide variety of microbes, protozoa, fungi and small animals (invertebrates) thrive in it.
6. **Materials:** Organic compound such as proteins, carbohydrates, lipids, humic substances are formed from inorganic compound (Inorganic compound such as carbon dioxide, water, sulphur, nitrates, phosphates) on decomposition.



Components of Ecosystem

Biotic Component: Organic and Living parts:

- Primary Producers(Autotrophs) : Self nourishing, i.e. they prepare their own food. They synthesise carbohydrate from simple inorganic raw materials like carbon dioxide and water in the presence of sunlight by the process of photosynthesis for themselves, and supply indirectly to other non-producers. In terrestrial ecosystem, producers are basically **herbaceous** and **woody plants**, while in aquatic ecosystem producers are various species of **microscopic algae**.
- Consumers- Heterotrophs : other nourishing: Consumers are incapable of producing their own food (photosynthesis). They depend on organic food derived from plants, animals or both. Consumers can be divided into two broad groups namely **micro** and **macro consumers**.
 - Macro Consumers (phagotrophs) : Organisms which digest the food, i.e. ingestion is followed by digestion
 - Micro Consumers : Which obtain energy by decomposing the dead organic substances (detritus) of plant and animal origin. They are of following types **heterotrophs**
 - Saprotrophs (Digest then absorb) – release digestive juice on the dead plants and animals and convert them into its liquid form of nutrients and are taken as food. (Fungi-dead plant, bacteria- dead animal matter)
 - Osmotroph- absorbing organic matter in solution from its surroundings i.e. osmosis for nutrition (Most Bacteria and some fungi)
 - Detritivores (Ingest then digest)- feed on detritus, e.g. Earthworms



Chemotrophs: An organism that obtains energy mainly from carbon dioxide and from other inorganic chemicals through a process called chemosynthesis.

Trophic Levels

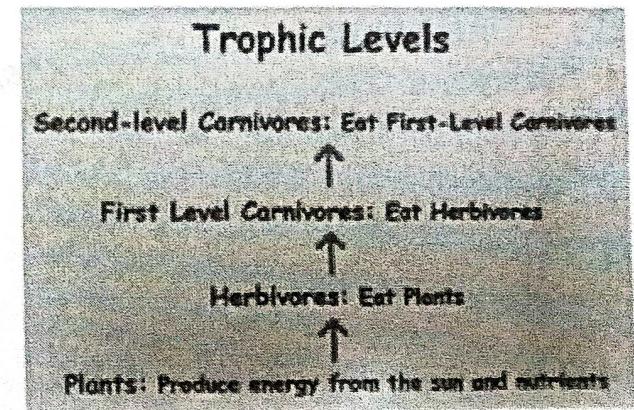
- **Troph** means to obtain food.
- A trophic level is the **representation of energy flow in an ecosystem**.
- The trophic level of an organism is the position it occupies in a food chain.
- Trophic level interaction deals with **how the members of an ecosystem are connected** based on nutritional needs

Energy flows through the trophic levels from producers to subsequent trophic levels is **unidirectional**.

Only 10% energy is transferred from one trophic level to another, 90% is lost in heat (**Lindeman's law**), hence there are usually not more than four-five trophic levels as further beyond hardly any energy is left.

The trophic level interaction involves three concepts namely

- 1) Food Chain
- 2) Food Web
- 3) Ecological Pyramids

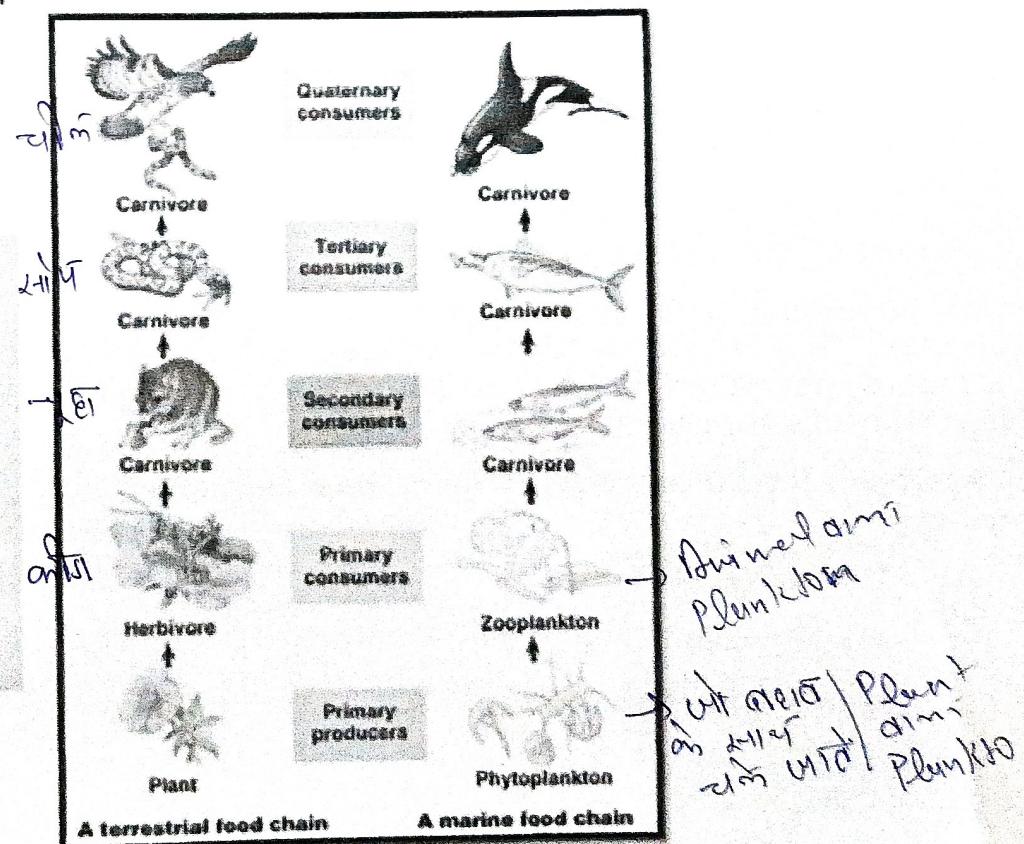


Food Chain

- A sequence of organisms that feed on one another form a food chain. A food chain starts with producers and ends with top carnivores. (Chittend)
- The trophic level of an organism is the position it occupies in a food chain.
- Types of Food Chains:
 - 1) Grazing food chain (Chittend)
 - 2) Detritus food chain (Chittend)

Phytoplankton are the primary producers in the oceans. They include:

1. Diatoms (unicellular algae)
2. Coccolithophores (unicellular, eukaryotic protist)
3. Cyanobacteria (Bluegreen algae)—
Synechococcus, Prochlorococcus, Nostoc, spirogyra etc.
4. Dinoflagellates (flagellated protists).

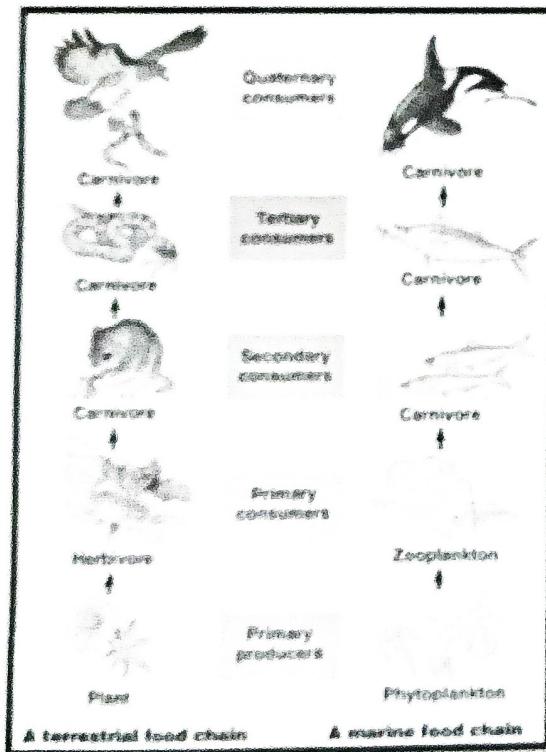




Types of Food Chain

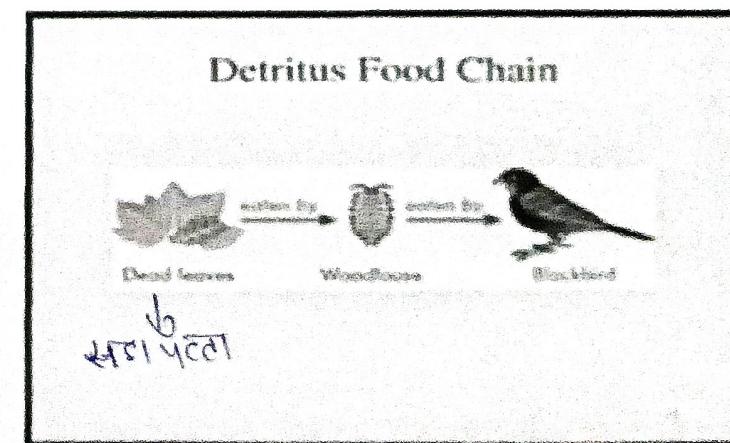
Grazing Food Chain

- Food chain starts from the plant or plant part utilized by consumer as their food, constitute the grazing food chain.



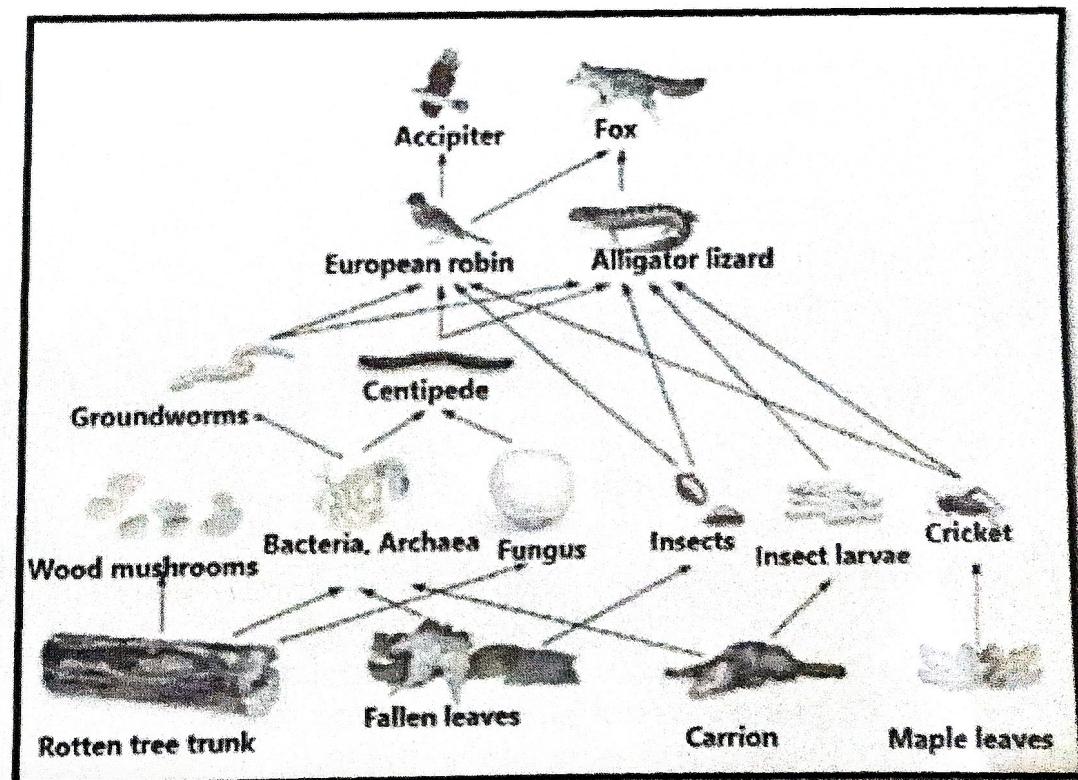
Detritus Food Chain

- This type of food chain starts from organic matter of dead and decaying animals and plant bodies.



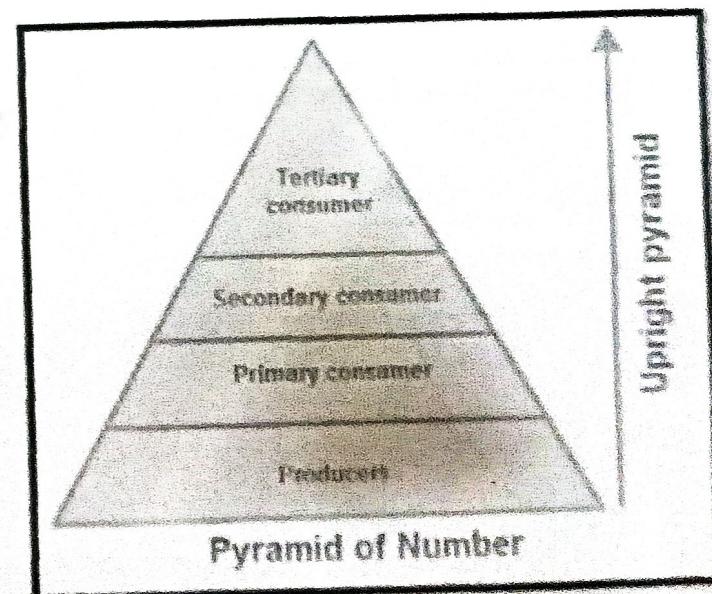
Food Web

- Multiple interlinked food chains make a food web.
- Food web represents all the possible paths of energy flow in an ecosystem.
- If any of the intermediate food chains is removed, the succeeding links of the chain will be affected largely.
- The food web provides more than one alternative for food to most of the organisms in an ecosystem and therefore increases their chance of survival.



Ecological Pyramids

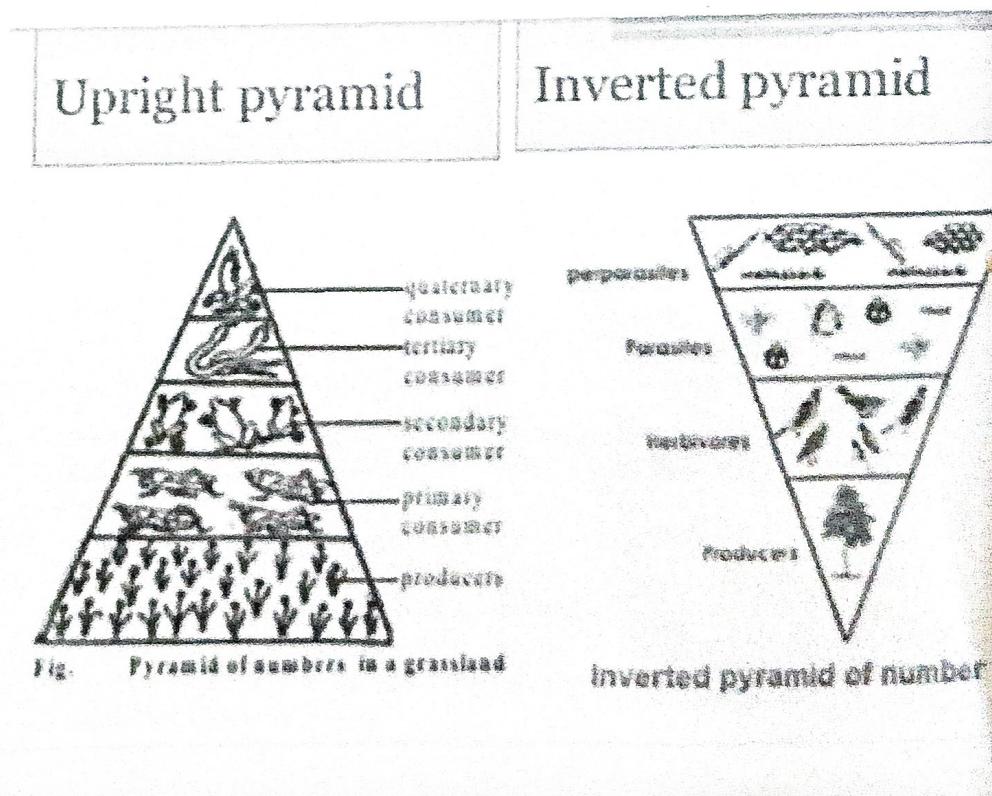
- The diagrammatic expression of trophic levels is called as an ecological pyramid
- The pyramid consists of a number of horizontal bars depicting specific trophic levels. The length of each bar represents the total number of individuals or biomass or energy at each trophic level in an ecosystem, depending upon the type of ecological pyramid.
- The food **producer forms the base of the pyramid** and the top carnivore forms the tip. Other consumer trophic levels are in between.
- Ecological Pyramids are of following three types:
 1. Pyramid of Numbers
 2. Pyramid of Biomass
 3. Pyramid of Energy





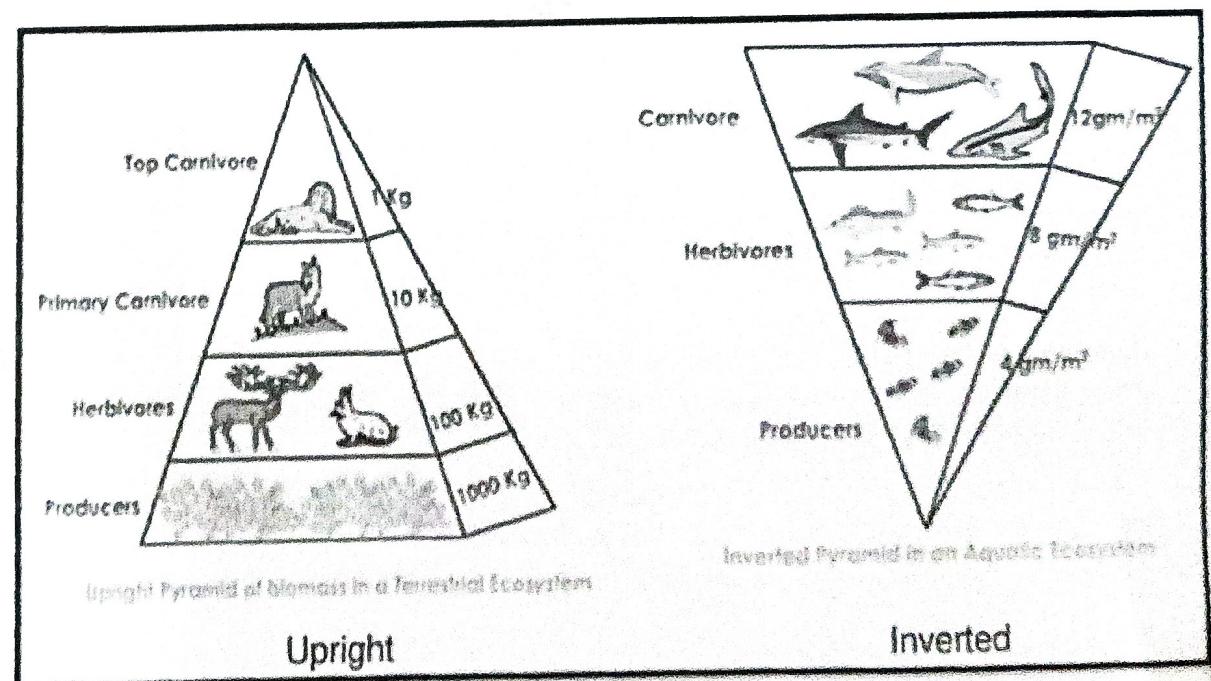
Pyramid of Numbers

- Pyramid of numbers represents the total number of individuals of different species (population) at each trophic level.
- Depending upon the size, the pyramid of numbers may not always be upright, and may even be completely inverted.
- It is very difficult to count all the organisms, in a pyramid of numbers and so the pyramid of number does not completely define the trophic structure for an ecosystem.



Pyramid of Biomass

- Pyramid of biomass is usually determined by collecting all organisms occupying each trophic level separately and measuring their **dry weight**.
- Each trophic level has a certain mass of living material at a particular time called the standing crop.
- This overcomes the size difference problem because all kinds of organisms at a trophic level are weighed.
- In **Aquatic Ecosystem** Pyramid of biomass may be **inverted** as producers are tiny phytoplankton that grows and reproduces rapidly while consumer biomass at any instant exceeds the producer biomass and the pyramid assumes an inverted shape.



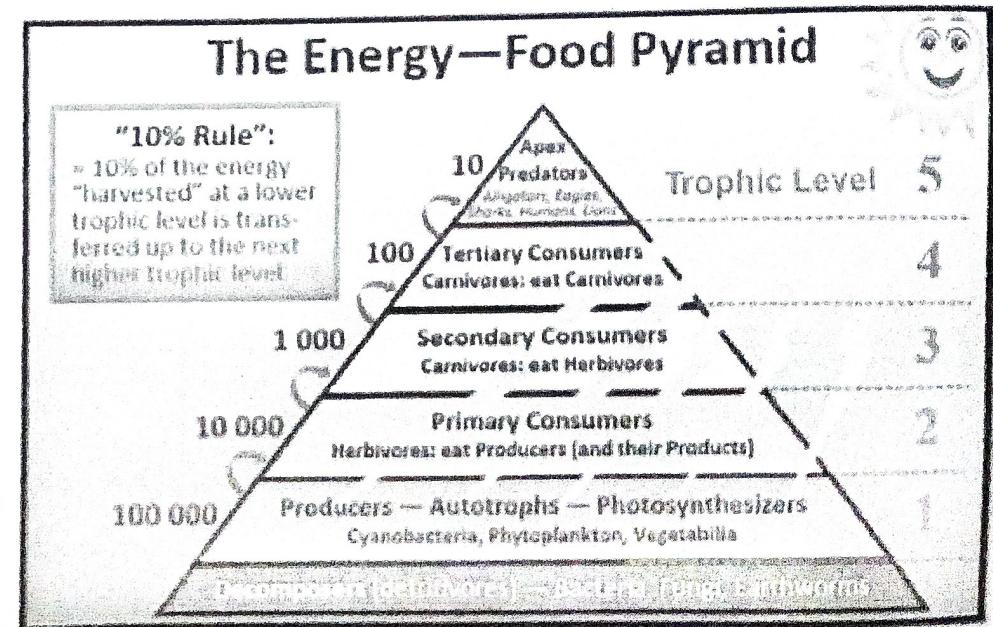


Pyramid of Energy

- An energy pyramid represents the amount of energy at each trophic level and loss of energy at each transfer to another trophic level. Hence the pyramid is always upward, with a large energy base at the bottom.

Limitations of the Ecological Pyramid

- More than one species may occupy multiple trophic levels as in case of the **food web**. Thus, this system does not take into account food webs.
- The **saprophytes** are not considered in any of the pyramids even though they form an important part of the various ecosystem.
- These pyramids do not deliver any concept in relation to **variations in season and climate**.



The decreases at each subsequent trophic level (10% rule) is due to two reasons:

- At each trophic, a part of the available energy is lost in respiration or used up in metabolism.
- A part of the energy is lost at each transformation.