ECOSYSTEM

Definition -

- The term “ecosystem” was proposed by British ecologist A. G. Tansley in 1935
- It is the system resulting from the integration of all the living and non-living factors of the environment.
- An ecosystem may, in its simplest form, be defined as a self-sustained community of plants and animals existing in its own environment.
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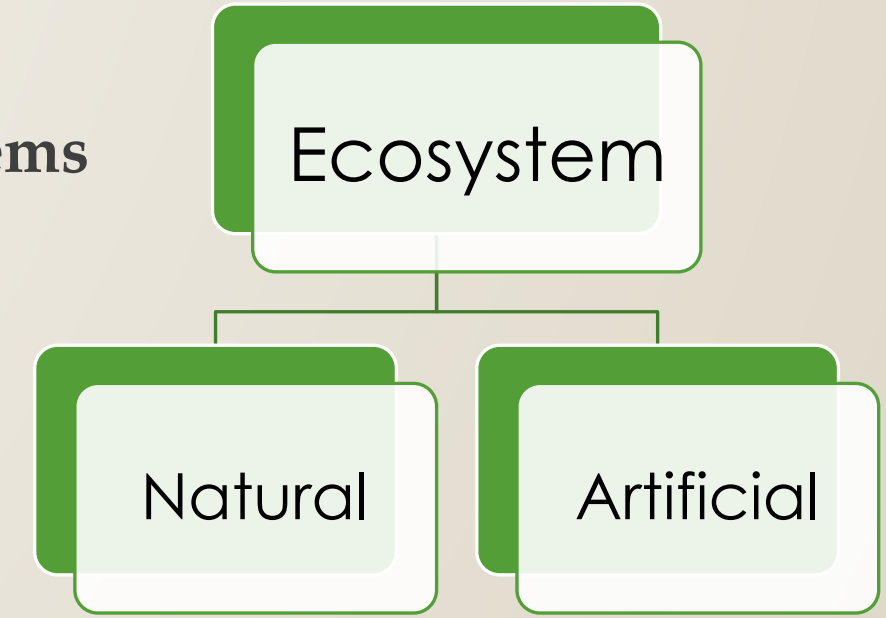
Types of ecosystem-

Different ecosystems develop differently depending on the influence of the abiotic components in an ecosystem on the organisms of that ecosystem. The classification is as follows:

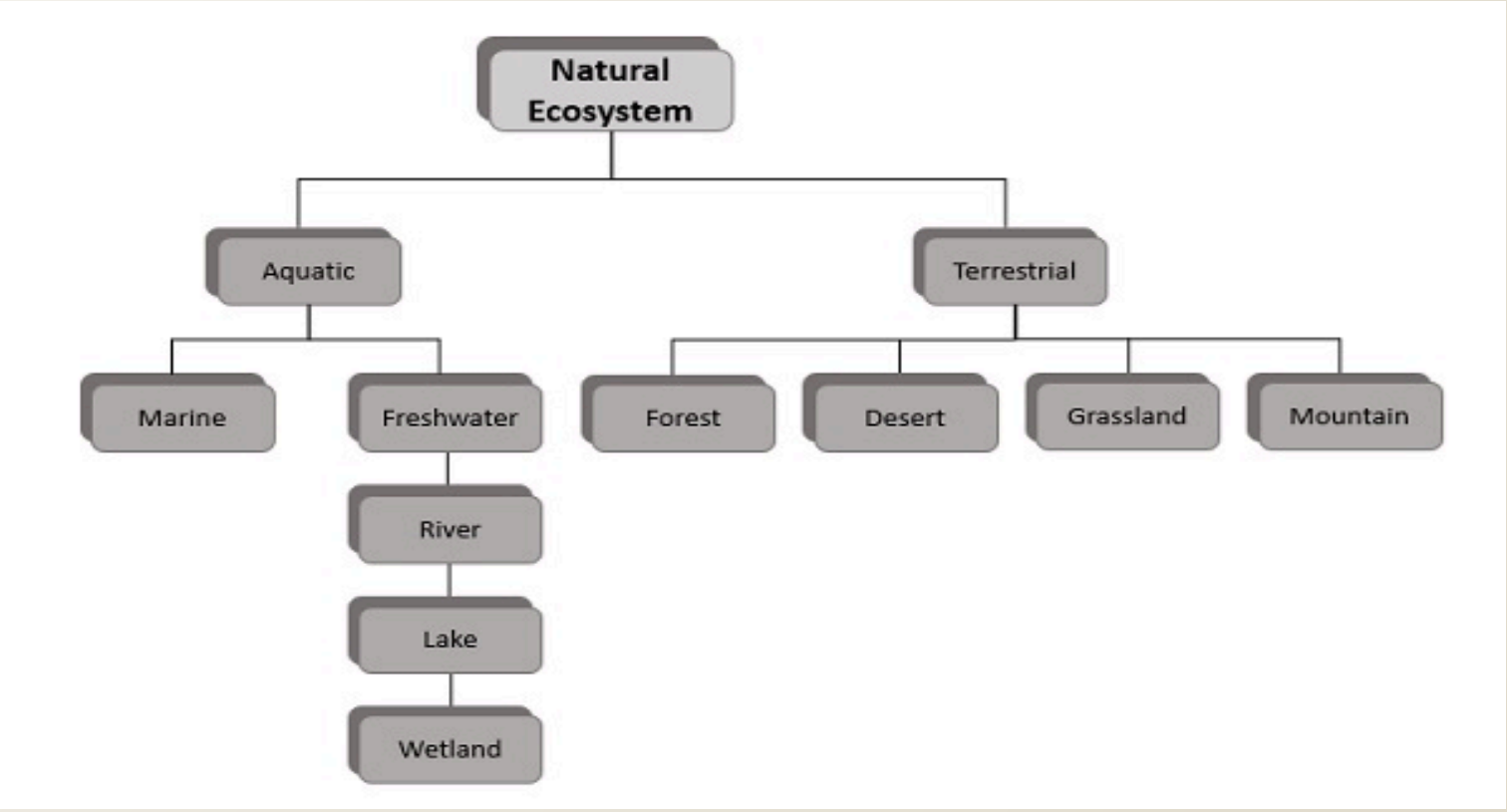
- **Natural Ecosystems**
- **Artificial Ecosystems or Engineered Ecosystems**



Natural ecosystem-

An ecosystem that is developed under natural conditions is called a natural ecosystem. Natural ecosystems operate by themselves under natural conditions without interference by humans. Based upon particular kind of habitat, natural ecosystems may be classified as follows:

- **Terrestrial Ecosystems**
- **Aquatic Ecosystems**



Terrestrial Ecosystems-

- Ecosystems that are found on land are called terrestrial ecosystems.
- These are further subdivided in terms of physical conditions and their responses to biotic communities.
- Forest, grassland, desert etc. are types of terrestrial ecosystems.

Aquatic Ecosystems-

Ecosystems found in water are known as aquatic ecosystems. Tanks, oceans, rivers, lakes etc. are examples of aquatic ecosystems. Aquatic ecosystems are further divided as:

- **Freshwater ecosystems**
- **Marine ecosystems**

Freshwater ecosystems-

- Only 3% of the world's water is fresh; 99% of this fresh water is either frozen in glaciers or is ground water. The remainder is found in lakes, ponds, rivers etc. and forms freshwater ecosystems.
- On the basis of water movement and size, freshwater ecosystems may be classified into lotic or lentic ecosystem.

i. **Lotic ecosystem**: **(flowing water ecosystem)** water moves at a constant pace in a uniform direction.

ii. **Lentic ecosystem**: **(standing water ecosystem)** water remains in the same area for a longer duration.

Marine ecosystems-

- Marine water covers two-thirds of the surface of the earth.
- The water of such ecosystem is saline in nature.
- Oceans, seas etc. are examples of saline aquatic ecosystems.

Artificial Ecosystems or Engineered Ecosystems-

- Artificial ecosystems are maintained artificially by human beings.
- In these ecosystems natural balance is disturbed regularly.
- In artificial ecosystems, humans try to control the biological and physiological properties of the ecosystem.
- Aquariums, gardens, dams, crop-fields etc. are examples of such ecosystems.

The differences between natural and artificial ecosystems are given below:

Natural ecosystem

- Natural ecosystems are developed under natural conditions.
- In natural ecosystem, plants of one species are often scattered.
- Natural ecosystems usually have alternate sources of food available in case one fails.
- In natural ecosystems, inorganic nutrients are returned to the soil from which they were taken.
- Natural ecosystems have no distinct boundaries.

Artificial ecosystems

- Artificial ecosystems are created and manipulated by human activities.
- In artificial ecosystems, plants of the same species grow in close proximity.
- Artificial ecosystems usually contain fewer food choices.
- In artificial ecosystems, inorganic nutrients do not return to the soil but are carried away to other places.
- Artificial ecosystems have distinct boundaries.

STRUCTURE OF ECOSYSTEMS-

All types of natural and engineered ecosystems consist of two major components-

- **Biotic Components**
- **Abiotic Components**

Biotic Components-

- Biotic components include all the living organisms occurring in any natural habitat.
- These can be classified as producers, consumers or decomposers depending on how they obtain food.

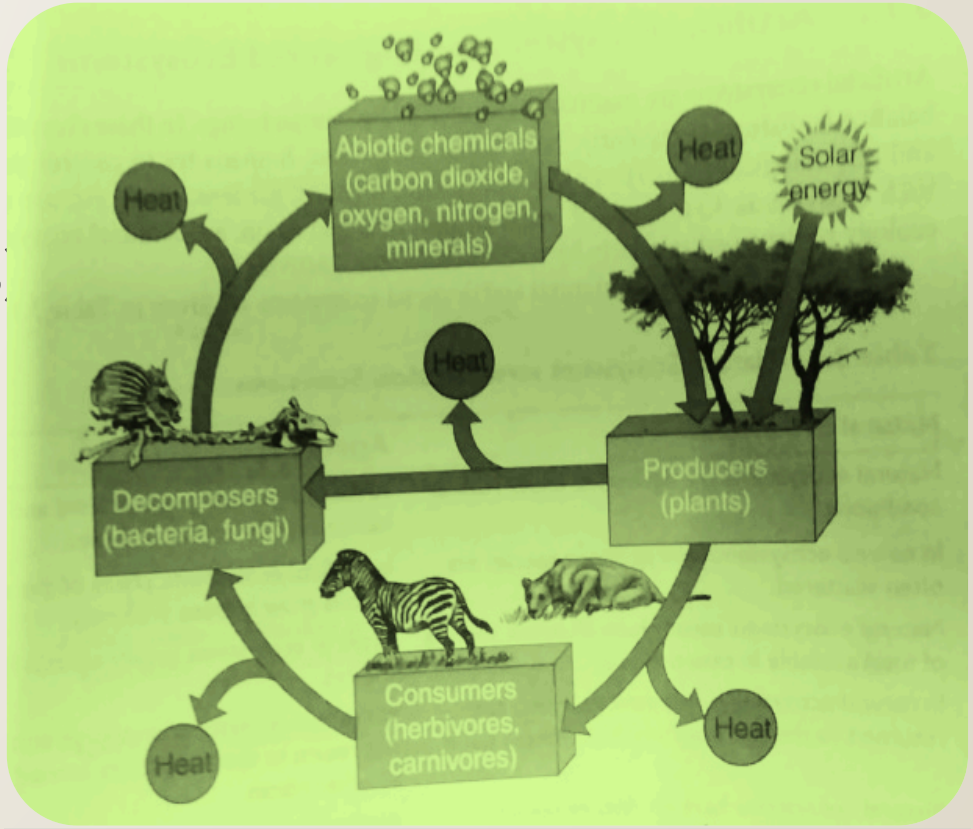
Producers (autotrophs or self-feeders)

- Autotrophic organisms, largely green plants on land and the small algae in aquatic ecosystems are able to produce their food from simple inorganic substances are called producers.

Consumers (heterotrophs or other feeders)-

Heterotrophic organisms, which cannot manufacture their own food and depend, directly or indirectly, on the producers for their food requirements are called consumers. Depending upon their food habits, consumers can be further classified into four types-

- **Herbivores (primary consumers)**
- **Carnivores (secondary consumers)**
- **Tertiary consumers**
- **Decomposers**



Herbivores (primary consumers)-

- They are plant eaters and feed directly on producers.
- They are also known as first order consumers or primary consumers.
- Deer, rabbit and cattle are few examples of primary consumers.

Carnivores (secondary consumers)-

- They are meat eaters and feed on herbivores.
- Examples of carnivores or secondary consumers include dog, fox, wolf etc

Tertiary consumers-

- They constitute the terminal end of predator or grazing food chain.
- These are carnivores which prey upon other carnivores but are not themselves eaten.
- Examples of tertiary consumers are lion, tiger etc.

Decomposers-

- Organisms that feed on dead and decaying matter and convert the organic materials into inorganic materials are called decomposers.
- They help in recycling nutrients in the biosphere; they return nutrients to the environment in forms that may be used again by the producers.
- Examples are bacteria, fungi etc

Abiotic Components-

The physical and chemical components of an ecosystem constitute its abiotic structure. Abiotic components as follows:

Physical Factors:

- Sunlight and shade,
- intensity of solar flux,
- length of day,
- average temperature,
- maximum and minimum temperatures,
- annual rainfall, wind,
- latitude and altitude,
- soil type, water availability and water

Chemical Factors:

- Availability of major essential nutrients such as carbon, nitrogen, phosphorus, potassium, hydrogen, oxygen, Sulphur, level of toxic substances,
- salts causing salinity, and various organic substances present in the soil
- or water largely

FOOD CHAIN-

- A food chain refers to the order of events in an ecosystem, where one living organism eats another organism, and later that organism is consumed by another larger organism.
- The flow of nutrients and energy from one organism to another at different trophic levels forms a food chain.

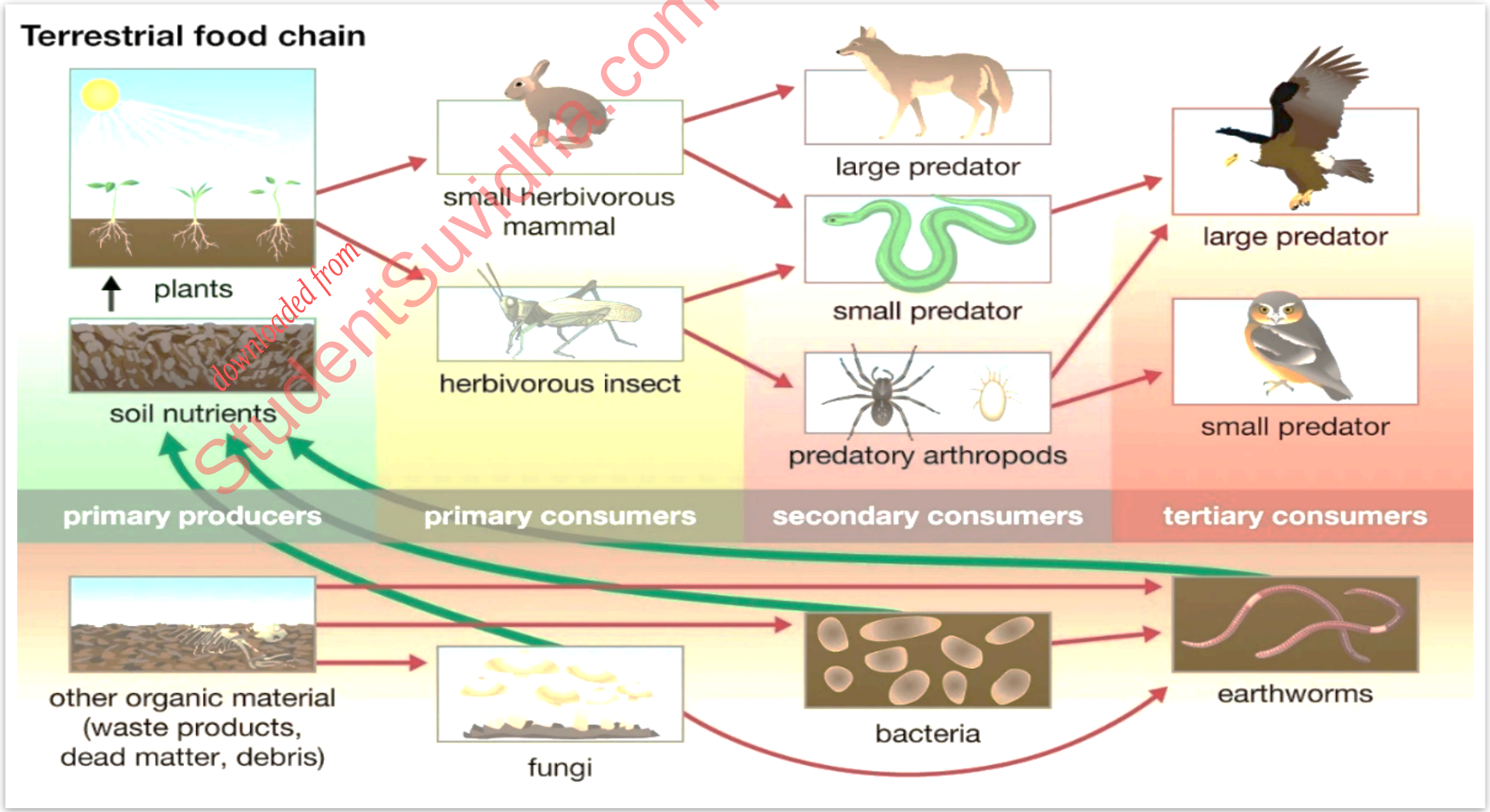


Fig. 1.1 A Food Chain

- Fig 1.1 shows a simple food chain. The number of steps of links in a food chain is restricted usually to four or five and each stage of transfer of food energy is known as a trophic level.
- Following are the parts of a typical food chain, starting from the producers:
  - At the base of the food chain lie the **primary producers**. The primary producers are autotrophs and are most often photosynthetic organisms such as plants, algae, or cyanobacteria.
  - The organisms that eat the primary producers are called **primary consumers**. Primary consumers are usually **herbivores**, plant-eaters, though they may be algae eaters or bacteria eaters.

- The organisms that eat the primary consumers are called **secondary consumers**. Secondary consumers are generally meat-eaters—**carnivores**.
- The organisms that eat the secondary consumers are called **tertiary consumers**. These are carnivore-eating carnivores, like eagles or big fish.
- Some food chains have additional levels, such as **quaternary consumers**—carnivores that eat tertiary consumers. Organisms at the very top of a food chain are called **apex consumers**.

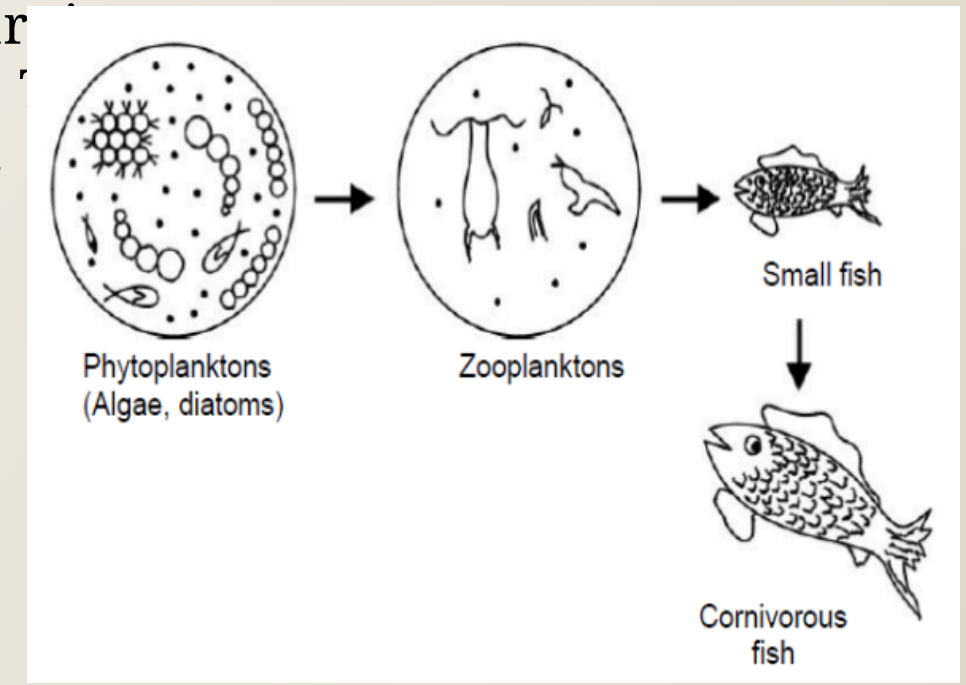
- Examples of theses levels can be seen in Fig 1.1.

Types of Food Chain-

There are two types of food chains, namely the detritus food chain and the grazing food chain –

1. **Grazing food chain**: This food chain starts with green plants (primary producers) and goes to herbivores and on to car

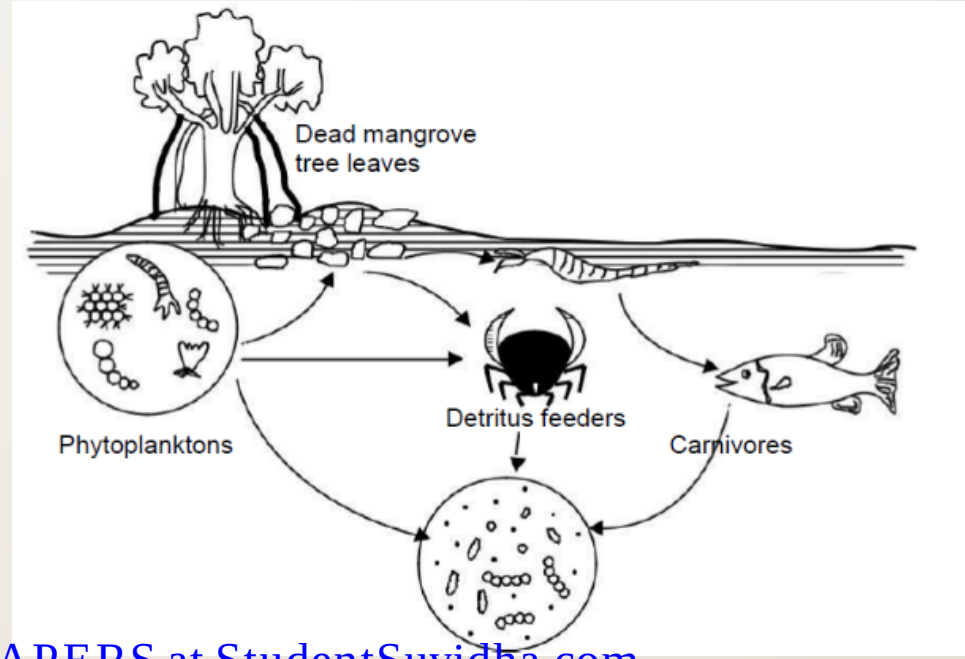
- Phytoplankton's → Zooplanktons → Small fish →
- Phytoplankton's → Zooplanktons → Fish → Man.
- Grass → Rabbit → Fox → Tiger.



2. **Detritus food chain**: It starts with dead organic matter which the detritivores and decomposers consume. Partially decomposed dead organic matter and even the decomposers are consumed by detritivores and their predators.

- Leaves or dead plants → Soil mites → Insects → Birds.
- Dead organic matter → Bacteria → Insects.
- Dead leaves → Algae → Fish → Man.

 An example of the detritus food chain is seen in a Mangrove (estuary)



Significance of Food Chain-

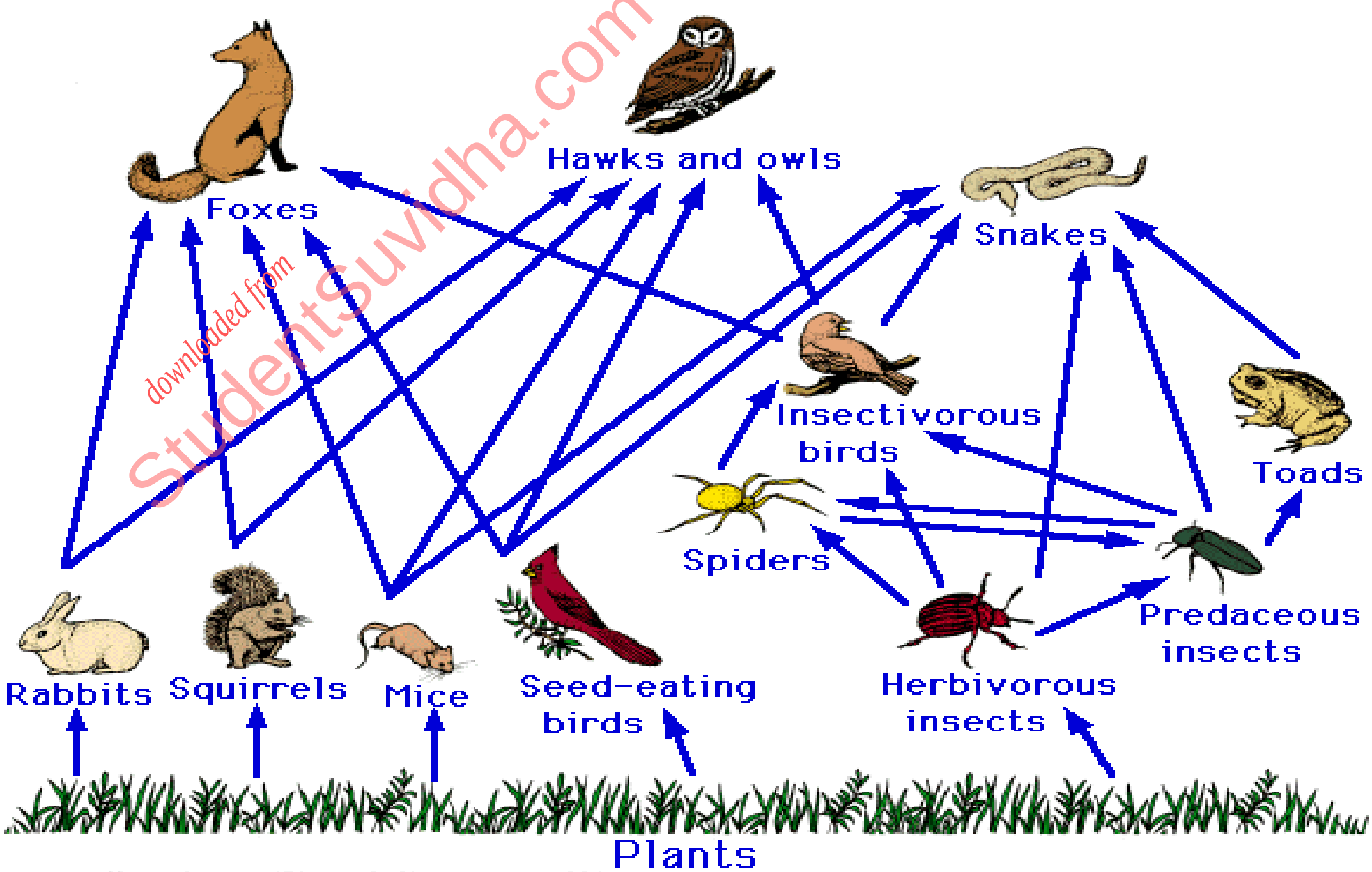
- Food chains are important for maintaining and regulating the population size of different animals and, thus, are instrumental in maintenance of ecological balance.

Biomagnification or Biological Magnification:

- Food chains show a unique property of accumulation of certain chemicals.
- There are several pesticides, heavy metals, and other chemicals which are non-biodegradable in nature and are not decomposed by micro-organisms.
- They keep on passing from one trophic level to another and, at each successive trophic level, their concentration keeps on increasing.
- This phenomenon is known as biomagnification or biological magnification.

FOOD WEB:

- Food chains in ecosystems are rarely found to operate as isolated linear sequences.
- Rather, they are found to be interconnected and usually form a complex network with several linkages and are known as food webs.
- Thus, “food web is 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.”



- Food web open several pathways for the flow of food energy.
- It also allows an organism to obtain its food from two or more types of organisms of the lower trophic level.
- Therefore, it can be said that food web helps in maintaining the stability of the ecosystem. More complex food webs bring stability to the ecosystem as they provide alternative trophic levels.

ECOLOGICAL PYRAMIDS:

- Ecological pyramids were first studied by a British ecologist Charles Eltan (1927).
- An Ecological Pyramid is a graphical representation consisting various trophic levels with producers forming the base and top occupy the carnivores.
- In an ecological pyramid the huge number of tiny individuals form at the base and a few large individuals occupy the top / apex .
- This formation is known as ecological pyramid. Hence, all producers (micro & macro plants) belong to the I trophic level; all primary consumers belong to II trophic level and organisms feeding on these consumers belong to the III trophic level and so on.

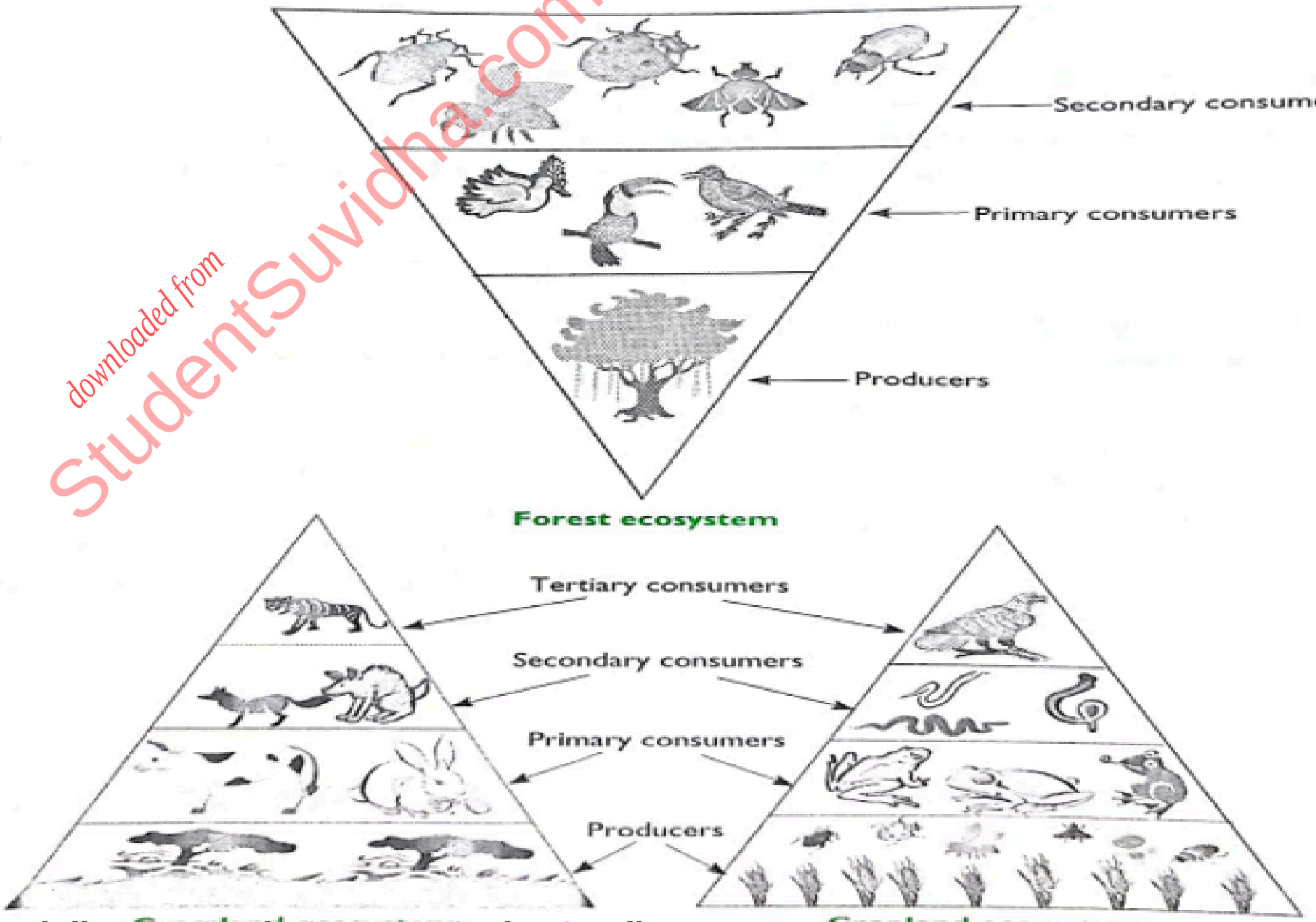
The ecological pyramids are of three types. They are:

- 1. The pyramid of Numbers (showing population).
- 2. The pyramid of Biomass (showing total mass of organisms).
- 3. The pyramid of energy (showing energy flow).

Pyramid of Number:

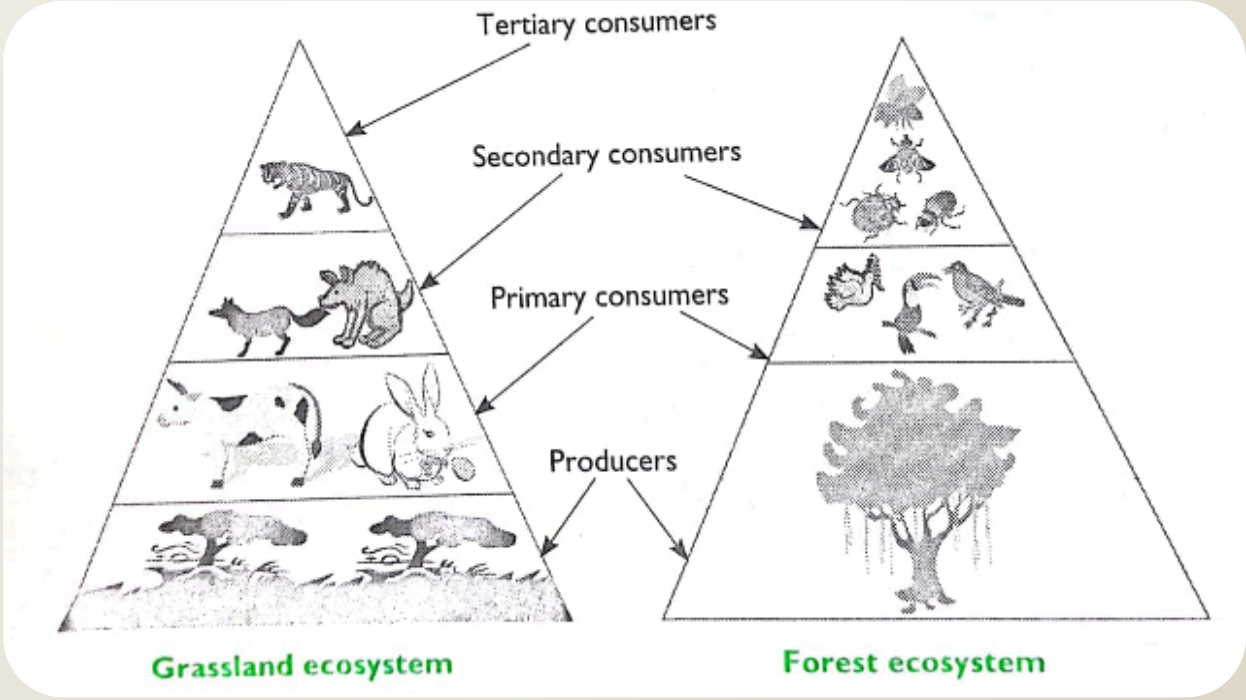
- It shows the relationships among the producers, herbivores and carnivores at successive trophic levels in terms of their number.
- Mostly the pyramid of number is straight (or) upright with number of individuals in successive higher trophic levels goes on decreasing from base to apex.
- The maximum number of individuals occurs at the producers 'level'.
- They support a small number of herbivores. The herbivores, in turn, support a fewer number of primary carnivores and so on….. Top carnivores are very few in number.

Ex:- In grassland as well as cropland ecosystems, the number of producers is higher than the number of carnivores. Hence, the pyramid is upright. However, in case of forest ecosystems, the pyramid is inverted because the number of primary consumers in forests is higher than the number of producers.



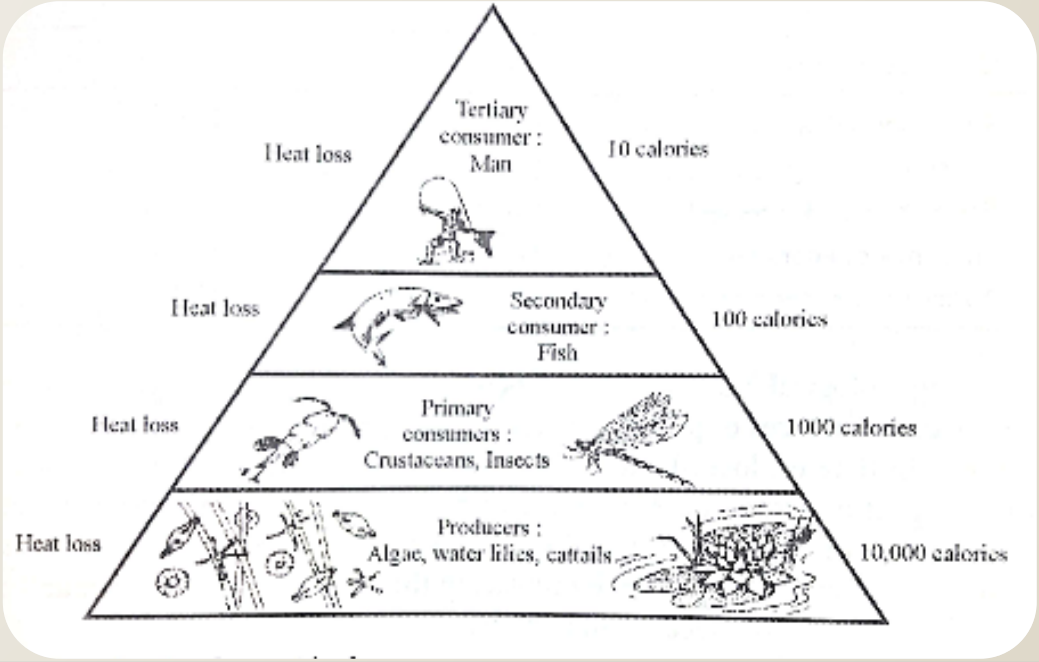
Pyramid of Biomass:

The amount of organic matter present in environment is called biomass. In pyramids of biomass, the relationship between different trophic levels is mentioned in terms of weight of organisms. The pyramid may be upright for grassland ecosystem and inverted for pond ecosystem.



Pyramid of energy:

The amount of energy trapped per unit time and area at different trophic levels of a food chain with producers forming the base and the top carnivores at the apex is called pyramid of energy



BALANCED ECOSYSTEM

- The ecosystem is a dynamic system, where a lot of event occurs, like plants eaten by animals, which in turn are eaten by other animals.
- Water and nutrients flow in and out of the system and the weather changes.
- However, despite all these events the ecosystem persists and recovers from minor disturbances due to homeostasis.
- Homeostasis: - All systems in order to operate smoothly need to maintain their existing constant condition. This capacity of a system to self-regulate or self-maintain itself is called homeostasis.

Factors of balanced ecosystems:

- In a balanced ecosystem, the community of living (biotic) organisms interacts with non-living (abiotic) features in the environment.
- Abiotic features of ecosystems include precipitation, temperature, landscape, sunlight, soil, water chemistry, and moisture.
- The types of biotic factors in a balanced ecosystem include primary producers such as plants, primary consumers such as herbivores, secondary consumers such as carnivores, consumers such as omnivores that consume both plants and animals, and detritivores that eat decaying organic matter.
- Biotic factors rely upon abiotic factors to survive.
- Plants require a certain temperature, moisture, and soil chemistry to thrive. Animals rely on those plants for their food.
- Anything affecting any factor of an ecosystem can throw it off balance and force organisms to adapt or die off.

Importance of ecological balance:

- Ecological balance ensures the stability of the organisms and environment.
- It creates a conducive environment for organism multiplication and thriving.
- It enhances a stable environment that is free from ecological imbalances such as flood, hunger caused by drought, windstorms that may wipe out everything, and over hunting of the predators.