

Chapter-2

ECOSYSTEM

Level of Organisation

ECOSYSTEM



COMMUNITY



POPULATION



ORGANISM



DEFINATION

- Term Ecosystem was introduced by A.G Tansley in 1935.
- Ecosystem is a part of nature which is composed of different communities of living individuals and the physical environment, both of these biotic and abiotic components interacting and exchanging material in between them.
- System resulting from the interaction of all living and non-living factors of the environment.

Types of Ecosystem

NATURAL ECOSYSTEM

- Which develop under natural conditions without human interference.

1. Terrestrial ecosystems
(grasslands, forests, desert ecosystems)

2. Aquatic ecosystem
(ocean, pond, lake)

ARTIFICIAL ECOSYSTEM

- Which are created and maintained by human beings.
- eg. A crop land, garden, aquarium, park

Characteristics of Ecosystem

- Specific Area
- Nutrient Cycling (cyclic)
- Flow of energy (unidirectional)
- Relationships

Components of Ecosystem

BIOTIC FACTORS

- the living parts of an ecosystem

ABIOTIC FACTORS

- the nonliving parts of an ecosystem

Abiotic components

Abiotic Component: The non living factor or the physical environment prevailing in an ecosystem forms abiotic components.

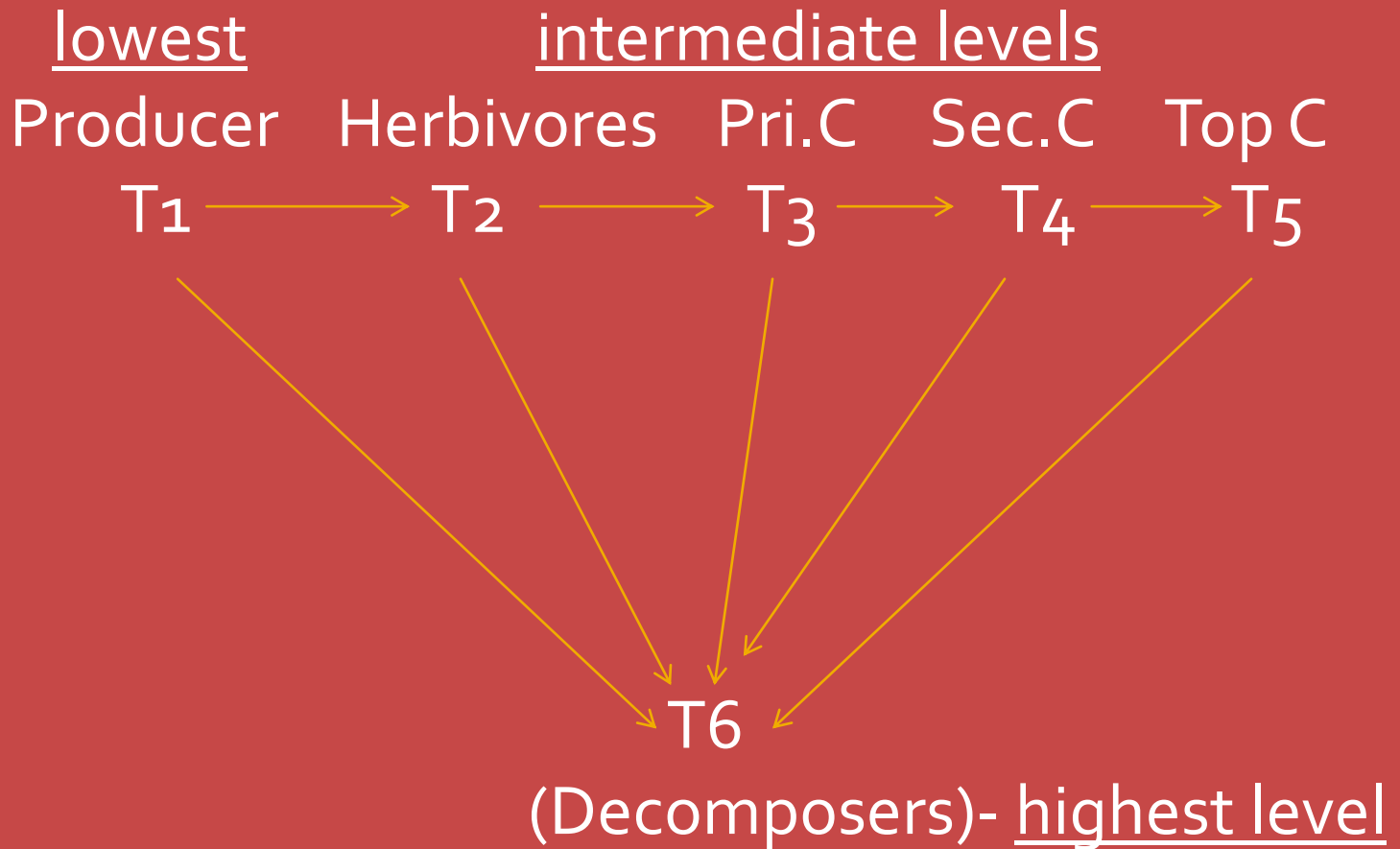
• **Abiotic component** are mainly of two types,
(a) Climatic factors It includes, rain, temperature, light, wind, humidity, etc.

(b) Edaphic factors (i.e. factors related to soil) :
It includes soil, pH, topography, minerals.

Biotic components

- **Biotic Components:** The living organisms include, plants, animals, and micro-organisms in an ecosystem forms biotic components.
- •Biotic Components are further classified into 3 main groups
 - A. •**Producers or Converters**
 - B. •**Consumers**
 - 1. Herbivores
 - 2. Carnivores
(Primary, Secondary, Top or Tertiary carnivores)
 - 1. Omnivores
 - C. •**Decomposers or Reducers**

Trophic Levels



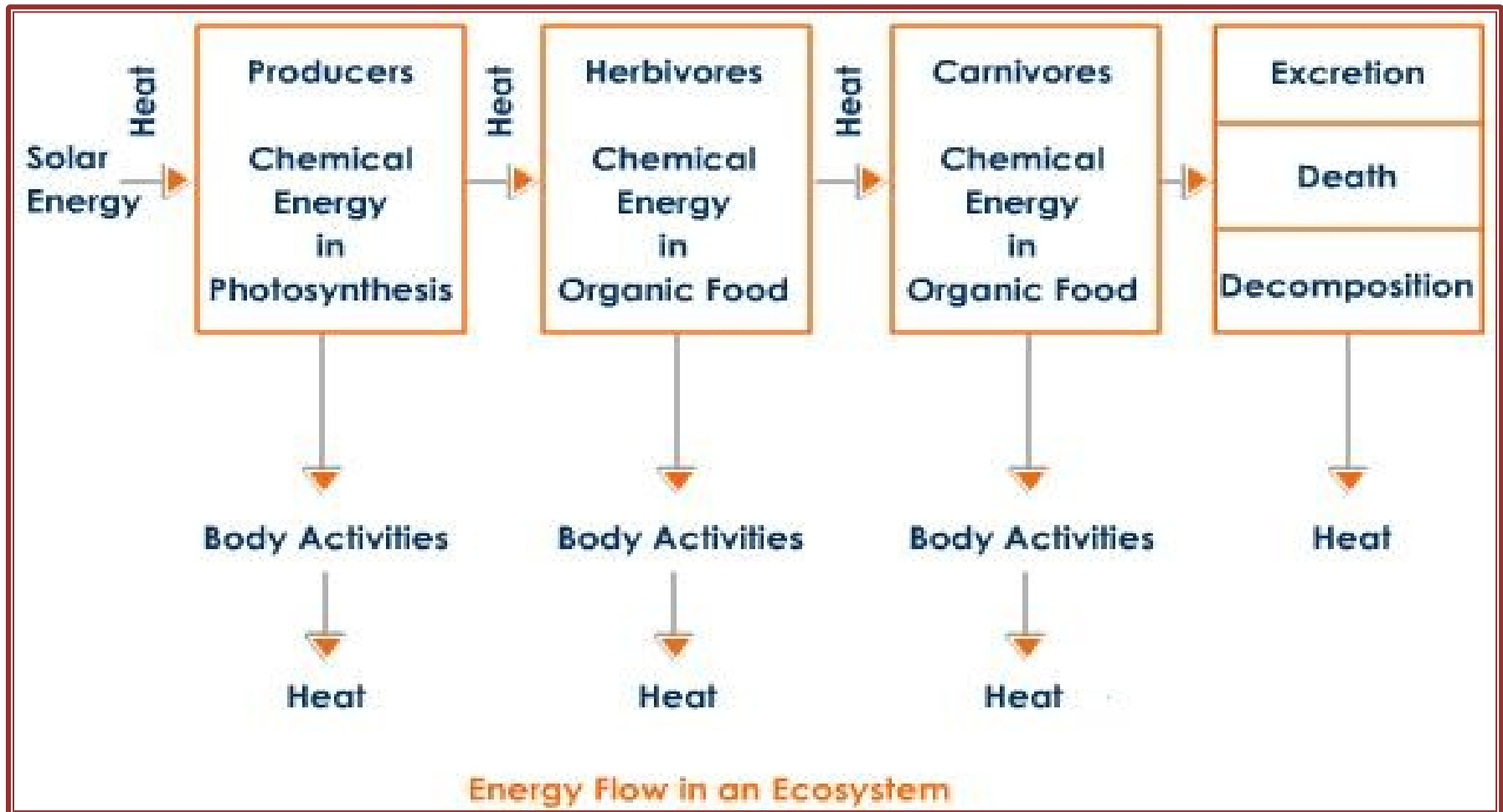
Trophic Levels

- Functional grouping of organisms based on the similar mode of nutrition.
- Producers T₁ lowest
- Herbivores T₂
- Carnivores T₃ or T₄
- Top carnivores T₄ or T₅
- Decomposers T₅ or T₆ highest

Single Channel Energy Flow Model

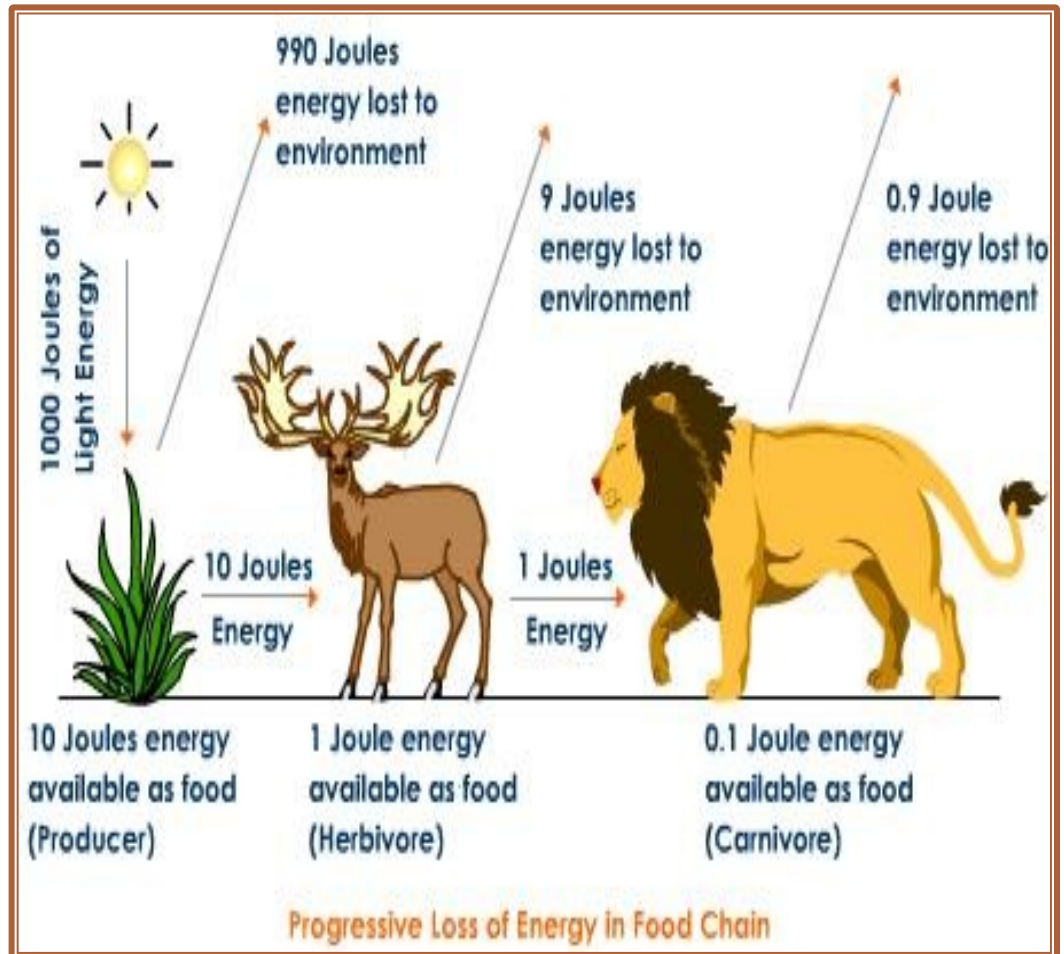
- The flow of energy takes place in a unidirectional manner through a single channel of producers to herbivores and carnivores. The energy captured by autotrophs does not revert back to solar input but passes to herbivores; and that which passes to herbivores does not go back to autotrophs but passes to consumers. Due to one way flow of energy, the entire system would collapse if primary source of energy were cut off. At each trophic level there occurs progressive decrease in energy which is mainly due to loss of energy as heat in metabolic reactions and also some of the energy is utilized at each trophic level

Single Channel Energy Flow Model



Ten percent law of Energy flow

- Given by Lindemann in 1942.
- According to the law, during the transfer of organic food from one trophic level to the next, only about ten percent of the organic matter is stored as flesh. The remaining is lost during transfer or broken down in respiration.



Food Chain

- It is a series of group of organisms called trophic levels in which there is repeated eating and eaten by so as to transmit the food energy.
- 2 types-
 1. **Grazing type food chain** (starts from green plants.
 2. **Detritus type food chain** (starts from dead organic matter)

Grazing type food chain

Type of Ecosystem	Producers	Herbivores	Primary Carnivores	Secondary Carnivores	Tertiary Carnivores
A. Grassland Ecosystem	1. Grasses	Insects	Frogs	Snakes	Predatory Birds
	2. Grasses	Rats and Mice	Snakes	Predatory Birds	
	3. Grasses	Rabbit	Fox	Wolf	Lion
B. Pond Ecosystem	Phytoplankton	Zooplanktons	Small Fishes	Large Fishes	Predatory Birds
C. Forest Ecosystem	Trees	Phytophagous Insects, Herbivore Mammals	Lizards Birds Foxes	Lions Tigers Etc.	

Food Web

- The interconnected, interlocking pattern of food chain is known as food web.
- •Under natural condition of the linear arrangement of food chain hardly occurs and they remain interconnected with each other through different types of organisms at different levels Such a interconnected and interlocking pattern of food chain is known as food web.
- It is a network of food chains which become interconnected at various trophic levels so as to form a number of feeding connections amongst different organisms of biotic community.

Ecological Pyramids

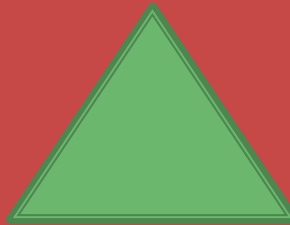
- First developed by ecologist Charles Elton in 1972.
- Also called as Eltonian Pyramids
- The relationship between the different trophic levels of a food chain in terms of no., biomass, and energy and expressed by means of graphical diagrams are called ecological pyramids

Structure of pyramids

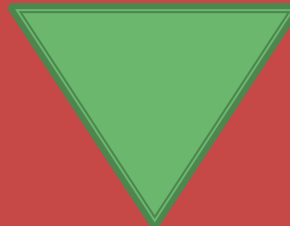
- Producers – forming base of pyramids.
- Consumers – forming intermediate tiers.
- Top Carnivores – forming top or apex of pyramids.

Shapes of Pyramids

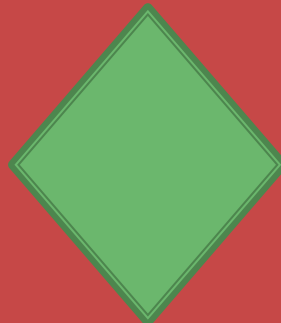
- 1. UPRIGHT-



- 2. INVERTED-



- 3. SPINDLE-



Types of Pyramids

- Pyramid of Number
- Pyramid of Biomass
- Pyramid of Energy

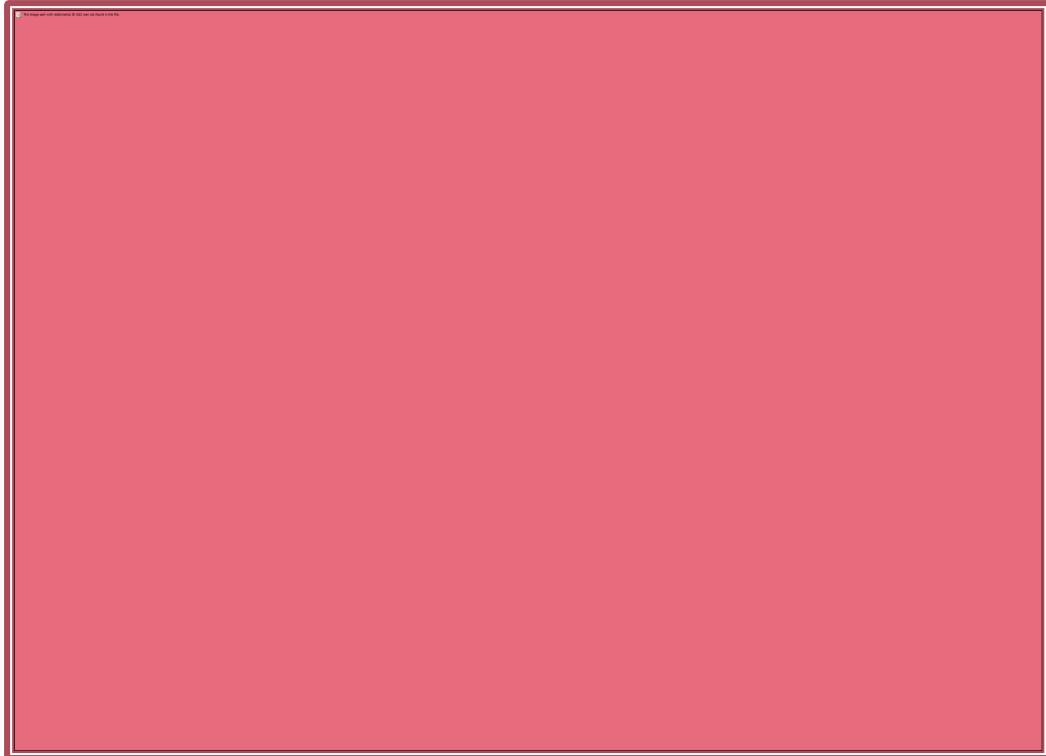
Pyramid of Number

They show the relationship between producers, herbivores, and carnivores at successive trophic levels in terms of their number.

GRASSLAND

- In case of grassland ecosystem the producers are mainly grasses and are always maximum in number. This number then shows a decrease towards apex as primary consumers like mice, rabbit are lesser in number than grasses, the secondary consumers like lizard, snake, are even lesser in number than the grasses, finally the top tertiary consumers like hawks are least in number. Thus the shape of pyramid is **UPRIGHT**.

DIAGRAM



Pyramid of Number

FOREST ECOSYSTEM

- In case of forest ecosystem the pyramids is inverted because the producers are mainly large trees, are lesser in numbers, the herbivores fruit eating birds are more in number than the producers, then there is gradual decrease in number of secondary consumers thus making pyramid upright again. So, the picture of forest ecosystem is SPINDLE shaped.

DIAGRAM



Pyramid of Biomass

The pyramid of biomass represents the relationship between different trophic levels in terms of biomass. Amount of living material present in an organism in terms of weight is called biomass.

GRASSLAND ECOSYSTEM

- The biomass of Producers are more than the herbivores and that of herbivores is more than the dependent carnivores. Top carnivores exhibit the minimum biomass. Therefore, Pyramid of biomass in grassland ecosystem is UPRIGHT.

POND ECOSYSTEM

- Pyramid of Biomass is INVERTED type. It is because the biomass denotes only the standing crop i.e. the living organism at any time. Biomass is high in case of long living organisms. In short living organisms it is less due to high death rate. So the biomass of Phytoplankton is less and gradually increases in progressive trophic levels.

Pyramid of energy

It is always UPRIGHT. Because the producers synthesize the food energy and have the maximum amount of energy. At every change in trophic level the amount of energy decreases due to loss in the form of heat or radiations. Pyramid of energy takes into consideration the actual amount of energy received, amount of energy utilized and amount of energy actually stored in the body.

Pyramid of energy

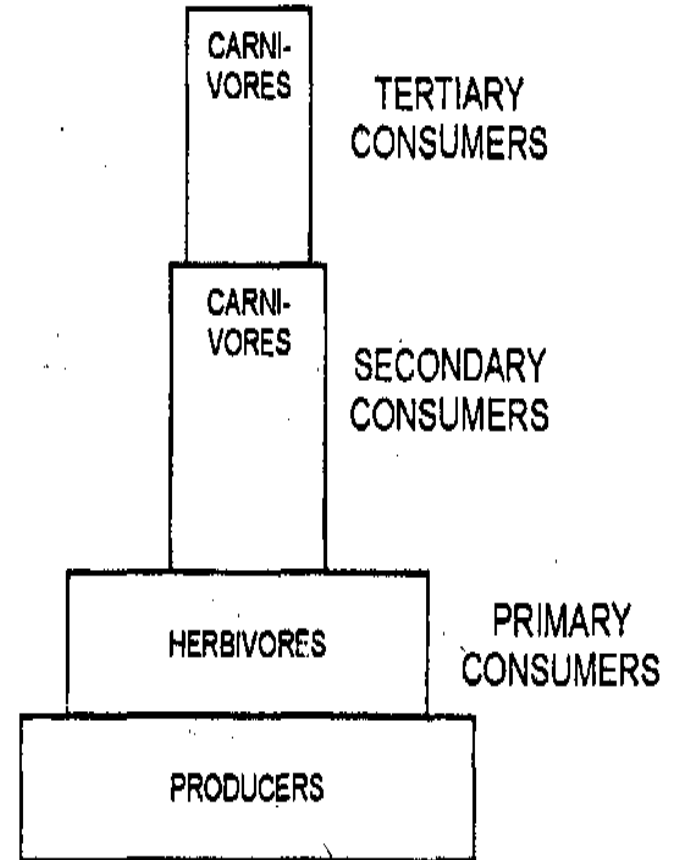


FIGURE 14.11. Pyramid of Energy.

Ecological Succession

- It is a long term directional process of natural development of different plant communities at the same site ,one after the another till the climax (last & stable) community develops which does not change further because it is in perfect harmony with the area.

OR

- An orderly process of changes in the community structure and function with time mediated through modifications in the physical environment and ultimately culminating in a stabilized ecosystem.

Ecological Succession

- PIONEER COMMUNITY- The first community which inhabit a bare area.
- CLIMAX COMMUNITY-The last & stable community.
- SERAL or TRANSITIONAL COMMUNITY-The intermediate community between.

Hydrosere- Succession beginning on watery habitats such as ponds, lakes etc.

Xerosere- Starts in dry habitats with little moisture.

TYPES OF SUCCESSION

- 1) Primary succession- the biotic community that occurs on a substratum devoid of earlier life. It takes place on a primary bare area which was not previously occupied by any type of vegetation.
- 1) Secondary succession- the biotic community that occurs in an area which have become bare due to destruction of previously existing biotic community by fire, drought, earthquake etc.

Mechanism of Succession

NUDATION



MIGRATION



ECESIS



AGGREGATION



COMPETITION



REACTION



STABILISATION

Mechanism of Succession

- **NUDATION:** Process of formation of bare area.
- **MIGRATION:** The seeds or spores of some organisms reach the bare area. Brought about by air, water, animals. the first arrivals on a bare area are called as pioneer colonisers.
- **ECESIS:** The successful establishment of a species after reaching to new area , with the prevailing conditions is called as ecesis.
- **AGGREGATION:** After ecesis the increase in the number of colonising individuals .
- **COMPETITION:** Due to different environmental conditions & they also compete for space & nutrition.
- **REACTION:** The mechanism of modification of the environment through the influence of living organisms on it, is called reaction.
- **STABLISATION:** After a long period some get stabilised to env condition & called as climax community.

SUCCESSION IN A POND: Hydrosere

■ Stages

1. Plankton stage
2. Rooted submerged stage
3. Rooted floating stage
4. Reed swamp stage
5. Sedge meadow stage
6. Wood land stage
7. Forest stage



SUCCESSION IN A POND: Hydrosere

- **Plankton stage**: pioneer stage & spores of planktons reach to newly formed water body through air or animals. these planktons are autotrophic & called as phytoplankton & the population of these are balanced by zooplankton. Death & decomposition of phytoplankton mix with silt & form soft mud at the bottom of pond which favours the growth of next seral stage.
- **Submerged stage**: soft mud mixed with organic matter favours the growth of submerged plants they are rooted in mud & fill the water death & decay of submerged plants enrich the soil with humus & makes the area less fit for submerged plants & more suitable for next seral stage.
- **Floating stage**: the area is invaded by the species of floating leaved plants. these again make the water rich in minerals & organic matter rapid growth of floating stage further builds up bottom & make water shallower on the periphery.

SUCCESSION IN A POND: Hydrosere

- **Reed swamp stage**: the amphibious plants replace the floating plants in area & these build up shore by setting down sedimentary materials & humus. The substratum now changes to a marshy soil.
- **Marsh meadow stage**: the marshy shore of water body is invaded by some grasses & herbs & these again add more humus to the soil.
- **Woodland stage**: the periphery of these marsh stage is invaded by some shrubs which can tolerate sunlight & water logged conditions they cast shade & make surface dry by transpiration & lower the water table and some shade loving herbs grow under them.
- **Climax stage**: many trees which have shade loving seedlings grow there & result in large trees which in future result in development of forests that is called as climax community.

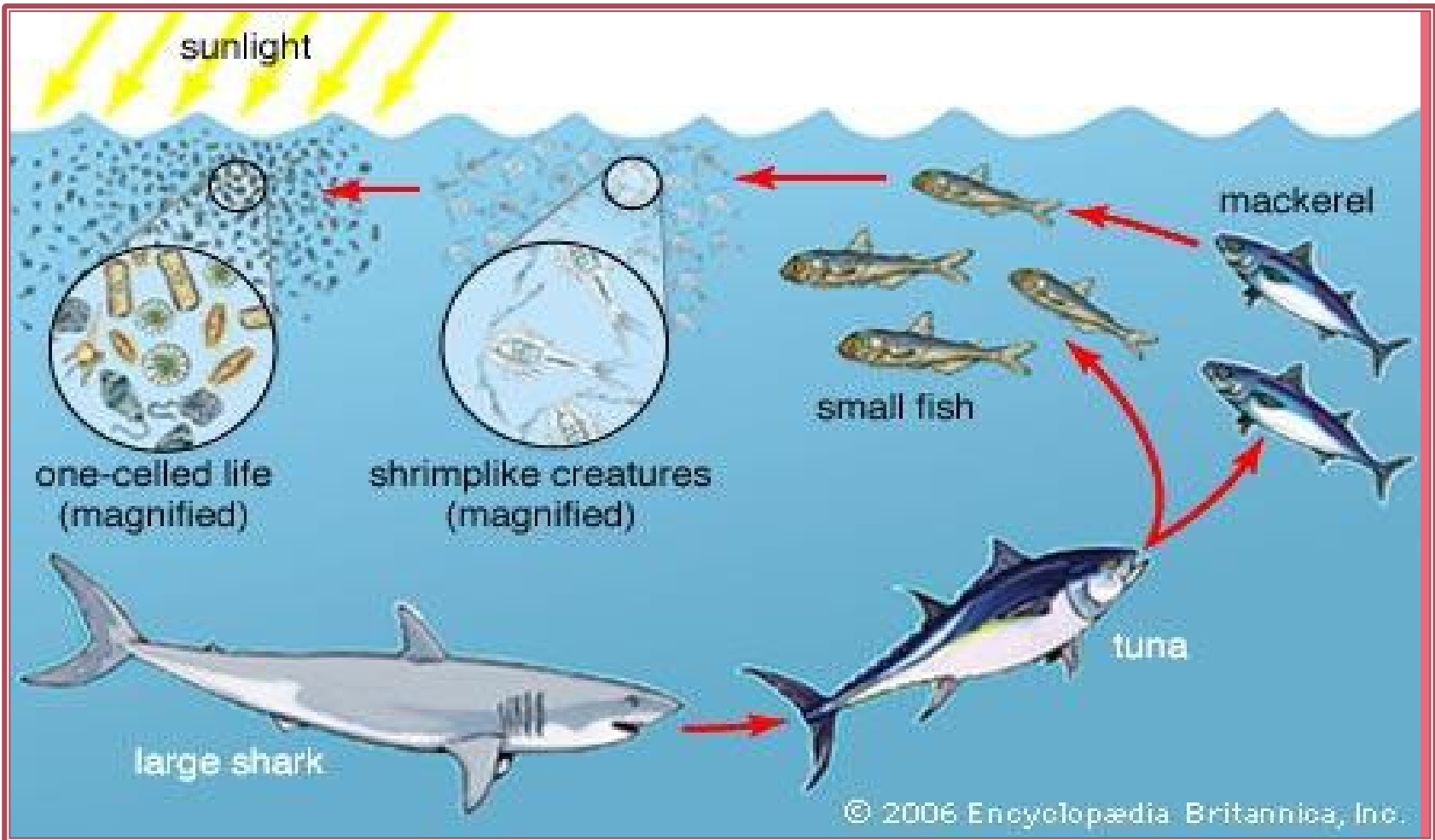
Major Ecosystems

- •Earth is a vast ecosystem it is however difficult to handle and thus for convenience we generally study it by making artificial subdivisions into units of smaller ecosystem. (eg. *Terrestrial ecosystem* as, forest ecosystem, desert ecosystem, grassland ecosystem, *manmade ecosystem* as cropland ecosystem, and *aquatic ecosystem* as freshwater, marine, etc.)
- •An ecosystem thus be separated from each other but it must be remembered that these units of ecosystem are linked with each other forming an integrated system.

Ocean Ecosystem

- •**Abiotic Components:** Dissolved oxygen, light, temperature, minerals.
- •**Biotic Components:**
 - •**Producers:** These are autotrophs and are also known Primary producers. They are mainly, some microscopic algae (phytoplanktons) besides them there are mainly, seaweeds, as brown and red algae also contribute to primary production.
 - •**Consumers:** They are all heterotrophic macro consumers
 - •**Primary Consumer:** The herbivores, that feed on producers are shrimps, Molluscs, fish, etc.
 - •**Secondary Consumers:** These are carnivores fish as Herring, Shad, Mackerel, feeding on herbivores.
 - •**Tertiary Consumers:** These includes, other carnivores fishes like, Halibut, Sea Turtle, Sharks etc.
 - •**Decomposers:** The microbes active in the decay of dead organic matter of producers, and animals are chiefly, bacteria and some fungi.

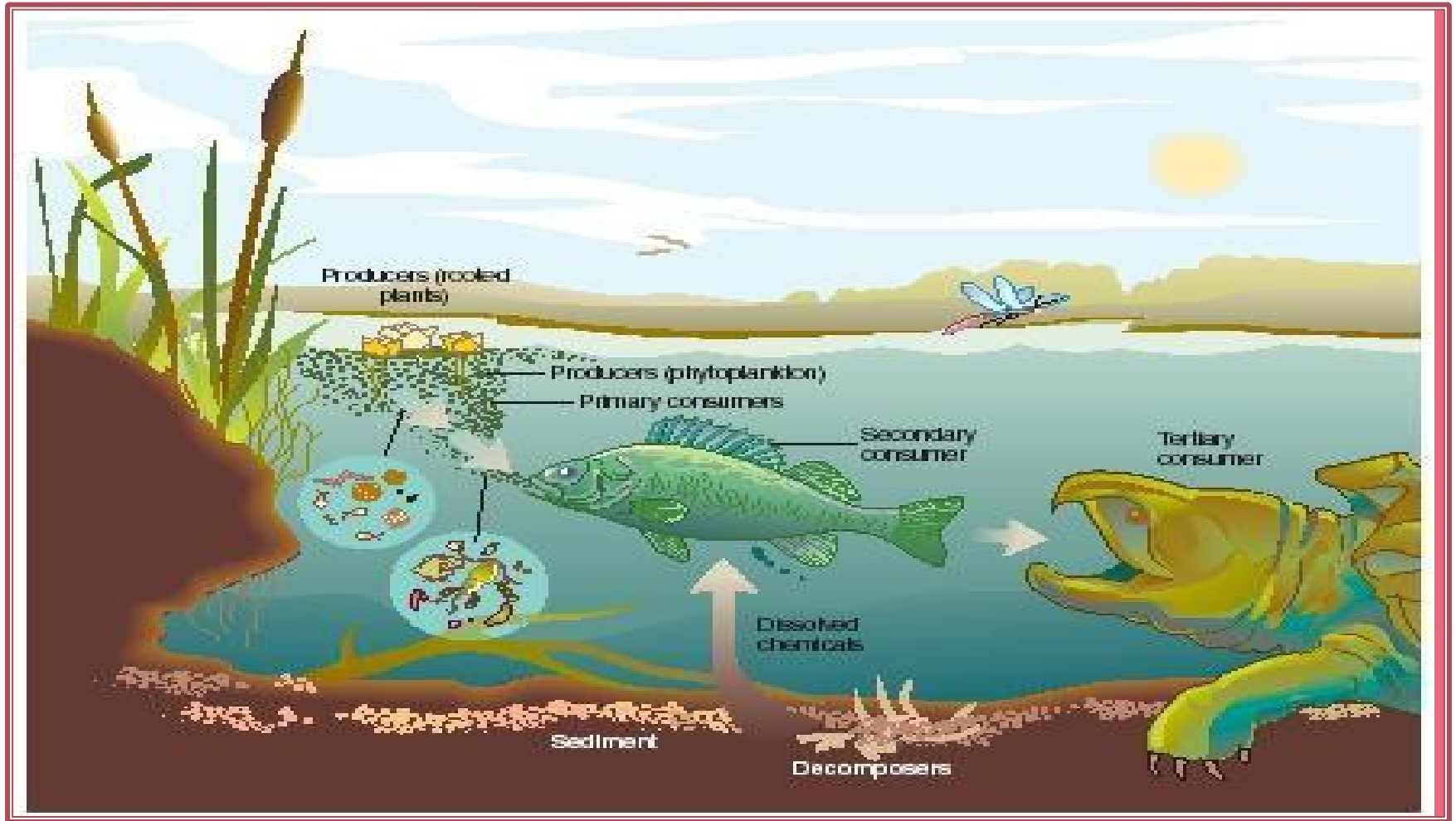
Ocean Ecosystem



Pond Ecosystem

- **Producers** are of following type
- •**Macrophytes**: these are large rooted plants, which include partly or completely submerged hydrophytes, eg Hydrilla, Trapa, Typha.
- •**Phytoplankton**: These are minute floating or submerged lower plants eg algae.
- •**Consumers**: They are heterotrophs which depends for their nutrition on the organic food manufactured by producers.
- •**Primary Consumers**:
 - – **Benthos**: These are animals associated with living plants ,detrivores and some other microorganisms
 - –**Zooplanktons**: These are chiefly rotifers, protozoans, they feed on phytoplankton
- •**Secondary Consumers**: They are the Carnivores which feed on herbivores, these are chiefly insect and fish, most insects & water beetles, they feed on zooplanktons.
- •**Tertiary Consumers**: These are some large fish as game fish, turtles, which feed on small fish and thus become tertiary consumers.
- •**Decomposers**: They are also known as micro-consumers. They decompose dead organic matter of both producers and animal to simple form. Thus they play an important role in the return of minerals again to the pond ecosystem, they are chiefly bacteria, & fungi.

Pond Ecosystem

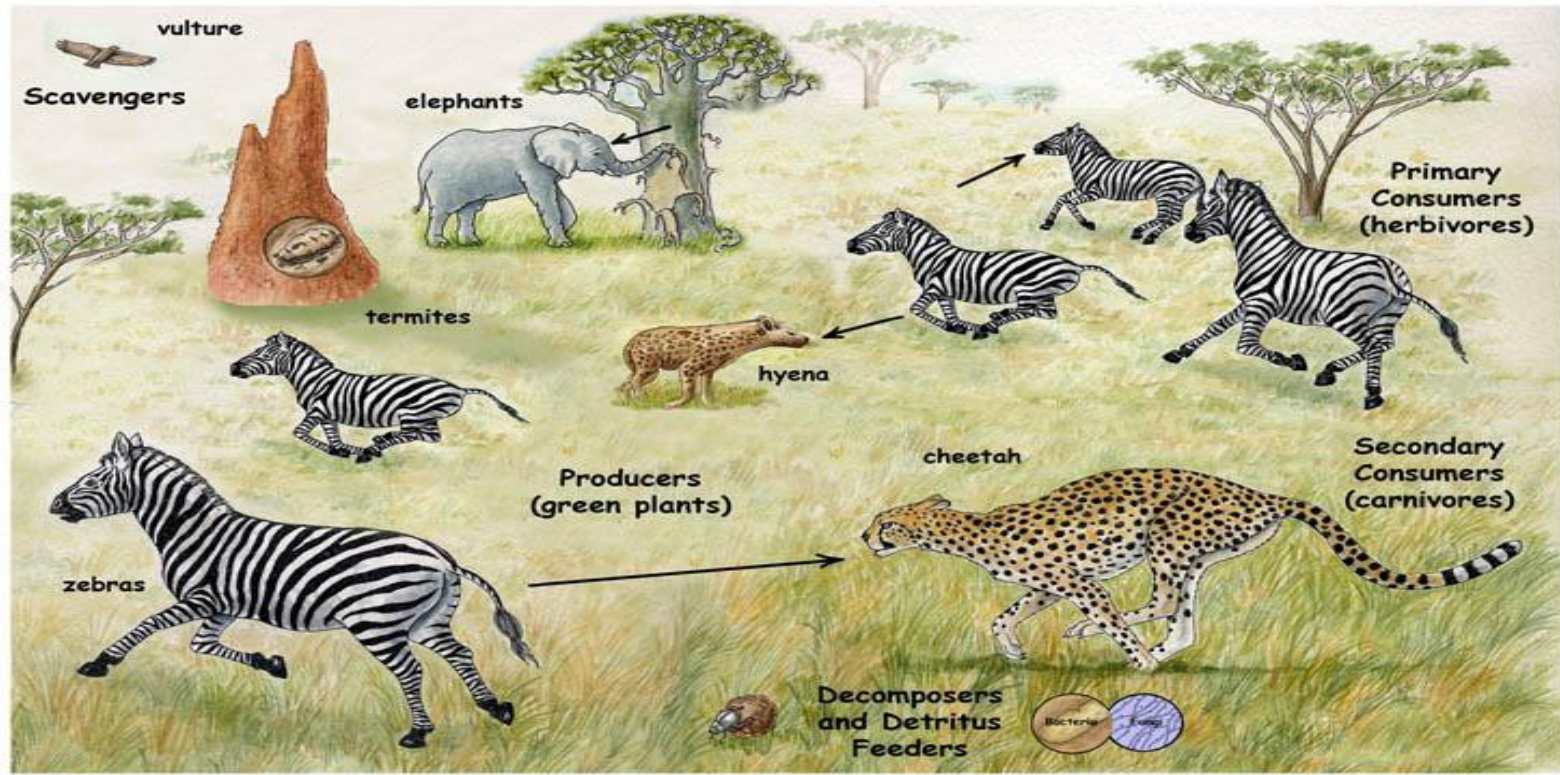


Land Ecosystem

- **•Grassland Ecosystem:** Grassland occupy comparatively fewer area roughly 19 % of the earth's surface.
- **•Abiotic Components:** These are nutrients present in soil, and aerial environment, thus the elements like, phosphates, sulphates, water, carbon dioxide, present in soil and in air. Moreover some trace elements are also present.
- **•Biotic Components:**
 - Producers: They are mainly grasses as species of Cynadon, Desmodium, besides them a few shrubs also contribute some primary production.
- **•Consumers:**
 - **•Primary Consumers:** The herbivores feeding on grasses are grazing animals, as cows, goats, rabbit, etc. besides them there are some insects as termites, millipedes that feed on grasses.
 - **•Secondary Consumers:** These are carnivores feeding on herbivores these include, animals like, fox, jackals, snakes, frogs, birds.
 - **•Tertiary Consumers:** Some times hawks, vultures, feeding on secondary consumer, thus occupy tertiary consumers.
- **•Decomposers:** The microbes active in the decay of dead organic matter of different form are fungi and some bacteria.

Land Ecosystem

Grassland Food Web



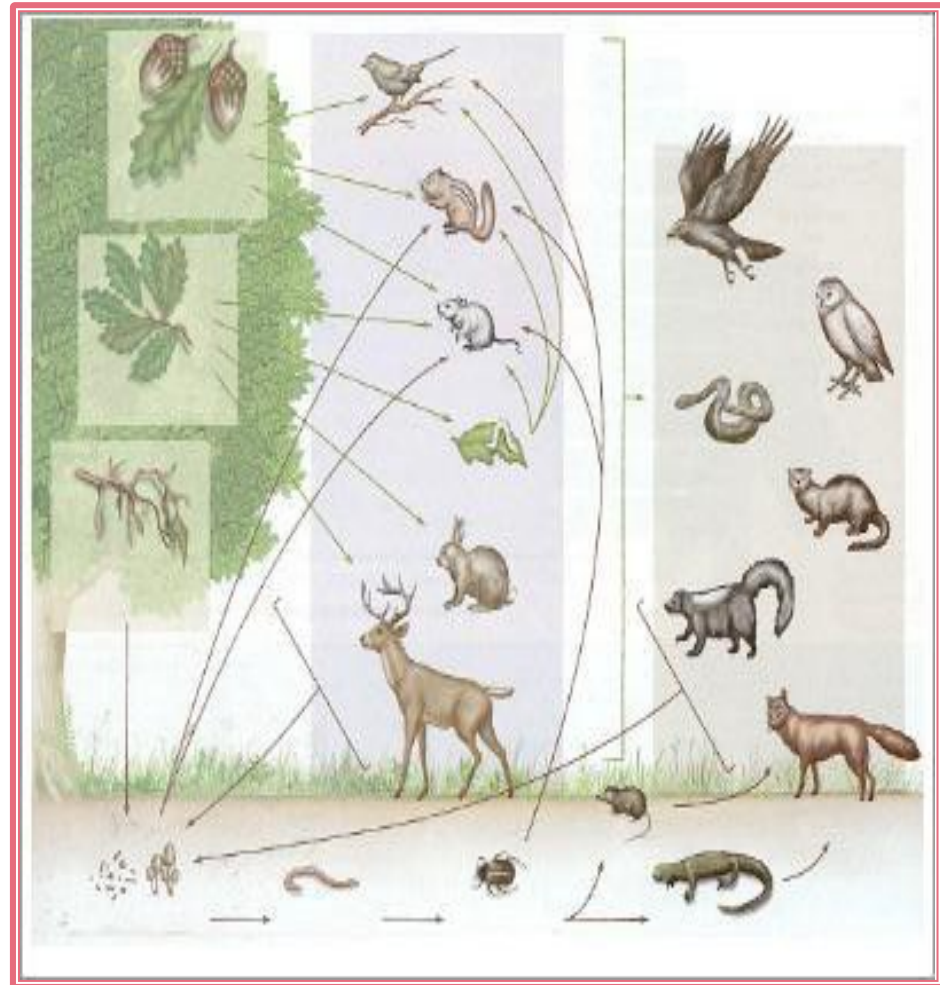
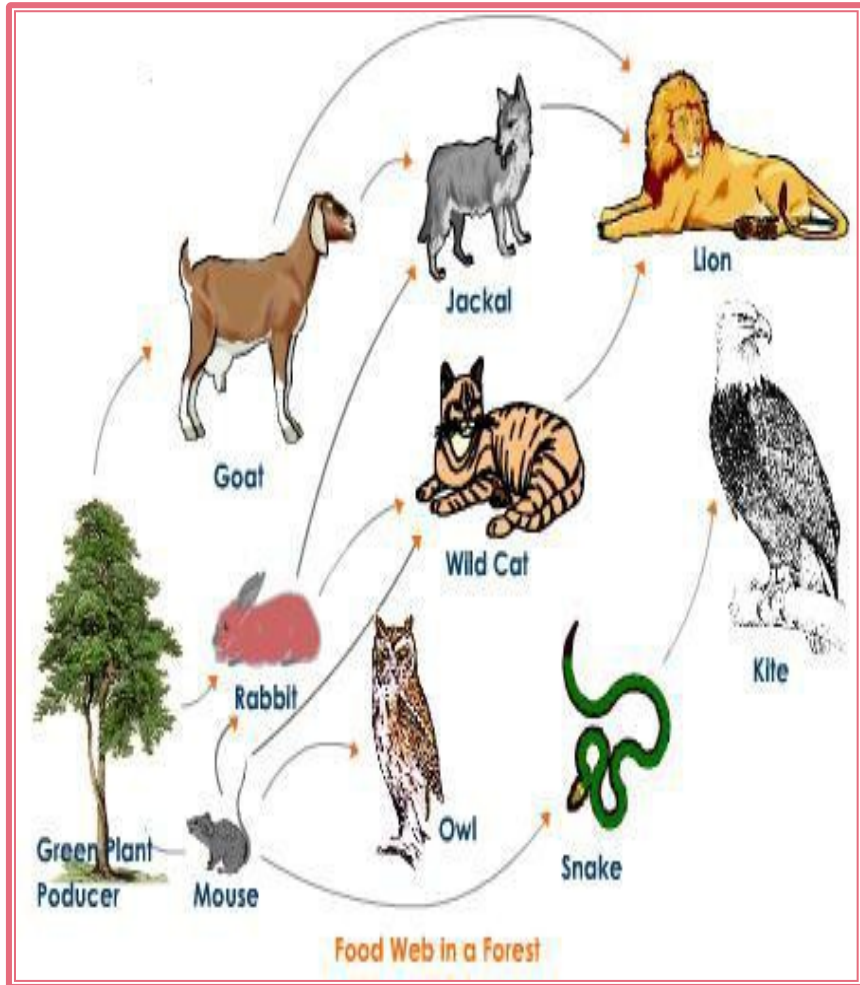
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Forest Ecosystem

- •Forest Occupy roughly 40 % of the land. The different components of forest ecosystem are as follows:
- •**Abiotic Components:** These are organic & inorganic substances present in the soil and atmosphere. In addition to minerals present in forest we find the dead organic debris, moreover light conditions are different due to complex stratification in the plants.
- •**Biotic Components:** •Producers These are mainly trees that show much species and greater degree of stratification. Besides trees there are also present shrubs, and ground vegetation.
- •**Consumers:** Primary Consumers: These are herbivores that include animals feeding on tree leaves, ants, beetles, grass hoppers, etc., and large elephants, dears, squirrels, etc.
- •**Secondary Consumers:** These are carnivores, like snakes, birds, lizards, fox, etc. feeding on herbivores.
- •**Tertiary consumers:** These are top carnivores like lion tiger, etc. that eat carnivores of secondary level.
- •**Decomposers:** These are wide variety of micro organisms including, fungi, bacteria.

Forest Ecosystem



Desert Ecosystem

- •Desert occupy 17 % of land.
- •**Abiotic components** include, light, temperature, minerals.
- •**Biotic Components:**
- •**Producers** : These are shrubs, especially bushes, some grasses, and few trees. •E.g. Cacti, Xerophytes, mosses
- •**Consumers:** The most common animals are reptiles, and insects, there are some rodents, and birds, and above all ship of desert camels, feed on tender plants.
- •**Decomposers:** These are very few as due to poor vegetation the amount of dead organic matter is less. They are some fungi and bacteria.

Desert Ecosystem

