I) **Pyramid of Number**:

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

•In case of pond ecosystem the producers are mainly phytoplankton and are always maximum in number this number then shows a decrease towards apex as primary consumers are zooplanktons are lesser in number than phytoplankton, the secondary consumers are large fish are even lesser in number than the phytoplankton. Thus the shape of pyramid is upright. But in case of forest ecosystem the pyramids is always 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. Thus the pyramid of number does not give a true picture of the food chain and are not very functional.

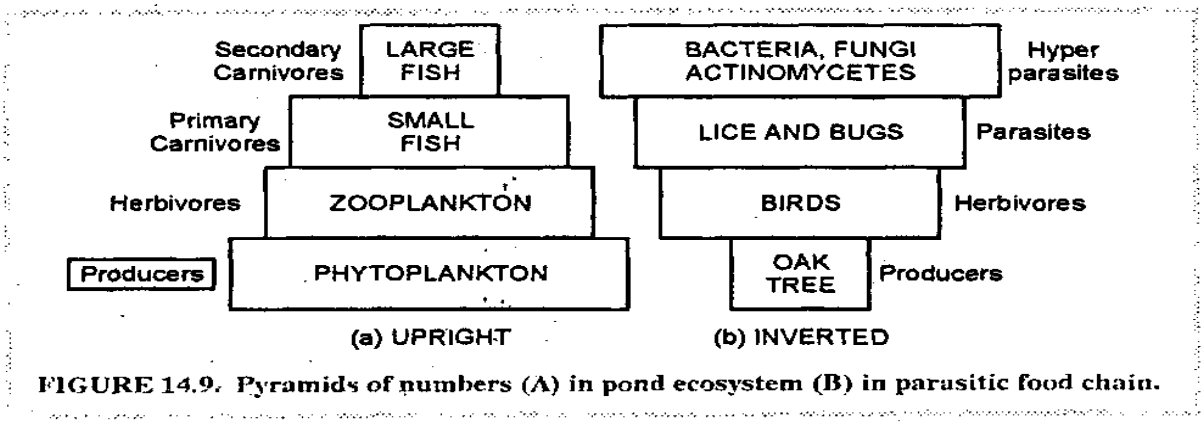


FIGURE 14.9. Pyramids of numbers (A) in pond ecosystem (B) in parasitic food chain.

II) **Pyramid of Biomass**:

•The pyramid of biomass represents the relationship between different tropic levels in terms of biomass. •There is generally gradual decrease in biomass of organisms at successive levels from the producers to the top carnivores. Thus pyramid of biomass is upright for grassland ecosystem.
•However in case of a pond as the producers are algae, are least in number and this value gradually shows an increase towards the apex of pyramid thus making the pyramid inverted in shape.

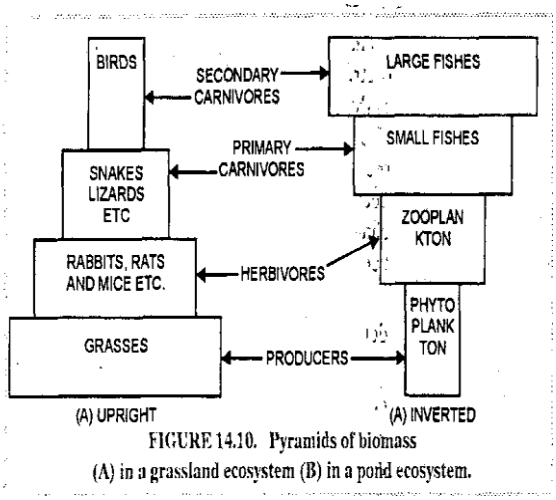
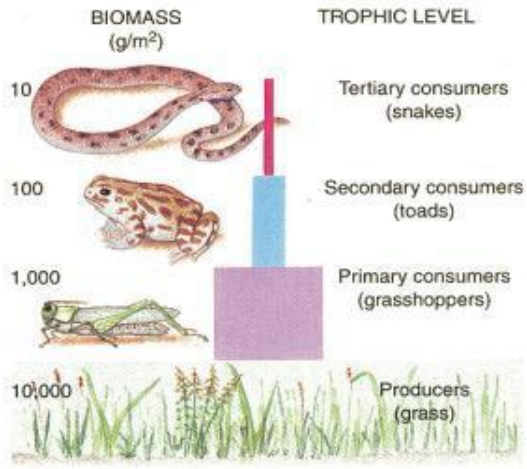


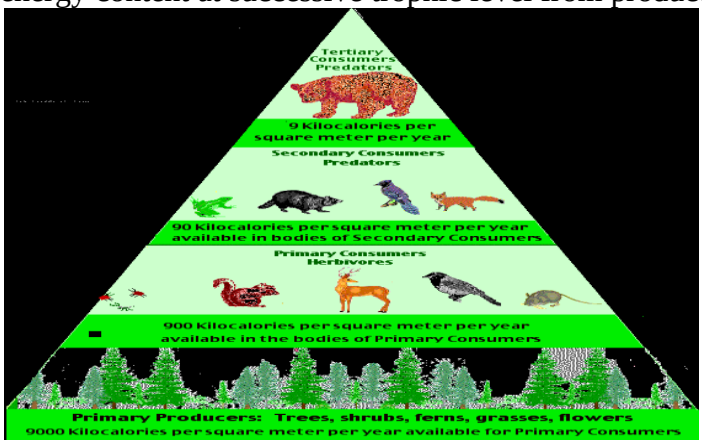
FIGURE 14.10. Pyramids of biomass
(A) in a grassland ecosystem (B) in a pond ecosystem.



III) **Pyramid of energy**:

•Of the 3 types of ecological pyramid the energy pyramid gives the best picture of overall nature of the ecosystem. In this type of pyramid the tropic level is decided depending upon the rate at which food is being produced.

•In shape it is always upright as in most of the cases there is always gradual decrease in the energy content at successive trophic level from producers to various consumers.



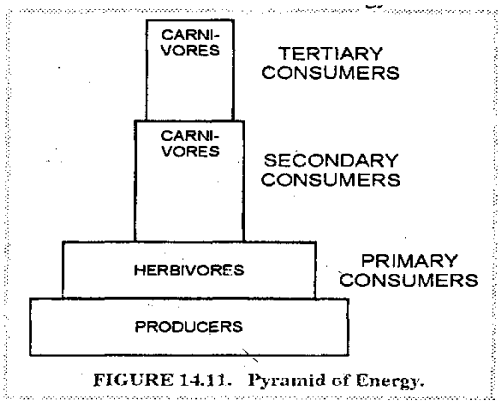


FIGURE 14.11. Pyramid of Energy.

2.1.4 CLASSIFICATION OF ECOSYSTEMS

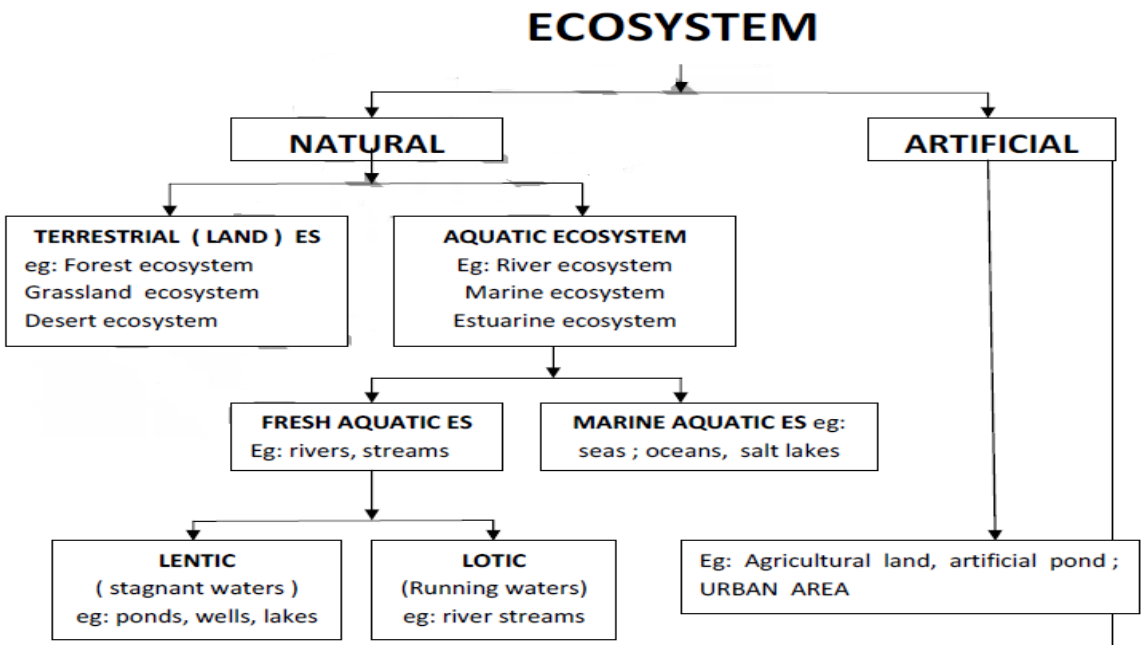
Due to the abiotic factors, different ecosystems develop in different ways. These factors and their interaction between each other and with biotic components have resulted in formation of different types of ecosystems as explained below.

Ecosystem may be natural or artificial.

Artificial Ecosystem: These are maintained or created artificially by man. The man tries to control biotic community as well as physico-chemical environment.

Eg: Artificial pond, urban area development.

Natural Ecosystem: It consists of Terrestrial and Aquatic Ecosystems which are maintained naturally.



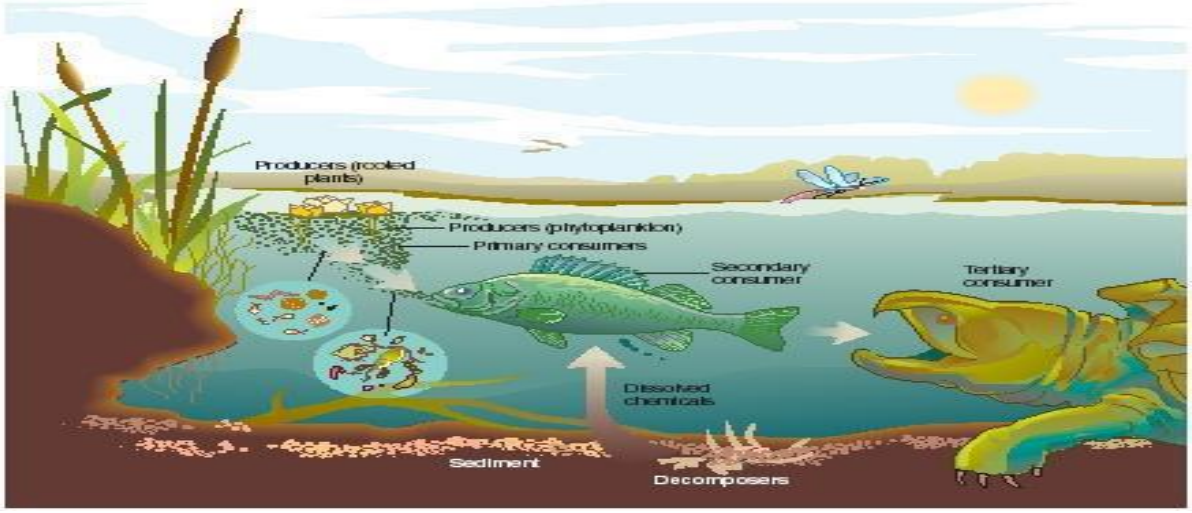
Different types of ecosystem of biosphere artificially categorized as follows:

I) Natural Ecosystems: These ecosystems operate by themselves under natural conditions without any major interference by man. Based upon the particular kind of habitat, these are further divided as: •Terrestrial as forest, grassland, desert etc.
•Aquatic which may be further distinguished as
•Freshwater which may be lotic (running water as springs, stream, river) or lentic (standing water as
lake, pond, pools, ditch, swamps, etc.)
•Marine Ecosystems: as an ocean or shallow ones like sea or estuary etc.
II) Artificial Ecosystems: These are maintained by man where, by addition of energy & planned manipulations natural balance is disturbed regularly.
For eg : croplands like maize, wheat, rice-fields etc., where man tries to control the biotic community as well as physico-chemical environment are artificial ecosystems

Pond Ecosystem: A Pond as a whole serves a good example of freshwater ecosystem
•**Abiotic Components**: The chief components are heat, light, pH of water, CO_2, oxygen, calcium, nitrogen, phosphates, etc.
•**Biotic Components**: The various organization that constitute the biotic component are as follows,
•**Producers:** These are green plants, and some photosynthetic bacteria. The producer fix radiant energy and convert it into organic substances as carbohydrates, protein etc

•**Macrophytes:** these are large rooted plants, which include partly or completely submerged hydrophytes, eg Hydrilla, Trapha, Typha.
•**Phytoplankton:** These are minute floating or submerged lower plants eg algae.
•**Consumers:** They are heterotrophs which depend 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.



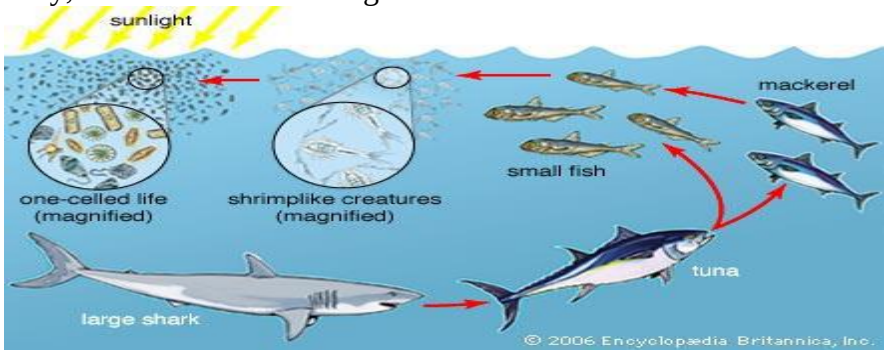
Ocean Ecosystem

are more stable than pond ecosystem, they occupy 70 % of the earth surface.

•**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 (phyto-planlanktons) 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, COD, Halibut, Sea Turtle, Sharks etc.

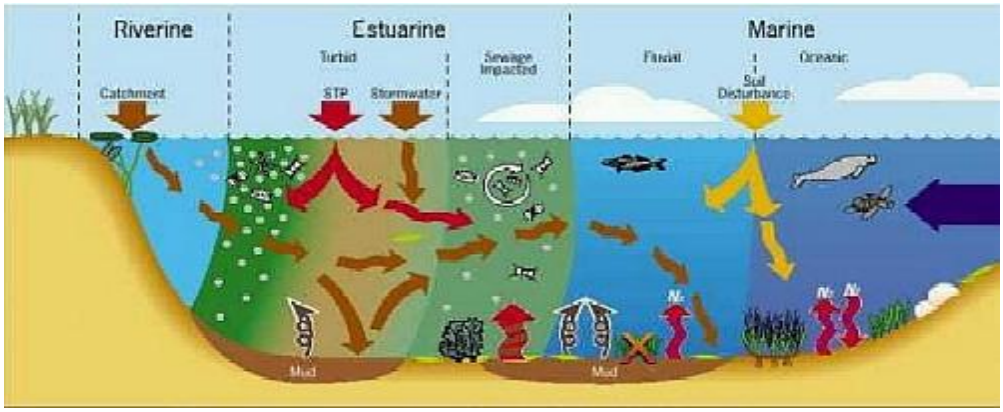
•**Decomposers:** The microbes active in the decay of dead organic matter of producers, and animals are chiefly, bacteria and some fungi.



Estuarine Ecosystem

•An estuary is a partially enclosed body of water along the coast where fresh water from river and streams meet and mix with salt water from oceans. These Ecosystems are considered as most

fertile ecosystem. •**Abiotic Components**: Nutrients such as phosphorus and nitrogen, temperature, light, salinity, pH. •This ecosystem experience wide daily and seasonal fluctuations in temperature and Salinity level because of variation in freshwater in flow. •**Biotic Components:** •**Producers: Phyplanktons**- these micro-organisms manufacture food by photosynthesis and absorb nutrients such as phosphorous and nitrogen, besides them, mangroves, sea grass, weeds, and salt marshes. •**Consumers: Primary consumers**, Zooplanktons that feed on Phytoplankton, besides them some small microorganisms that feed on producers. •**Secondary Consumer:** Include worms, shellfish, small fish, feeding on Zooplanktons •**Tertiary Consumer:** Fishes, turtles, crabs, starfishes feeding on secondary consumers. •**Decomposers:** Fungi & Bacteria are the chief microbes active in decay of dead organic matter.



River Ecosystem

•As Compared with lentic freshwater (Ponds & lakes), lotic waters such as streams, and river have been less studied. However, the various components of an riverine and stream ecosystem can be arranged as follows. •**Producers:** The chief producers that remain permanently attached to a firm substratum are green algae as Cladophora, and aquatic mosses. •**Consumers:** The consumers show certain features as permanent attachment to firm substrata, presence of hooks & suckers, sticky undersurface, streamline bodies, flattened bodies.. Thus a variety of animal are found, which are fresh spongy and caddis-fly larvae, snails, flat worms etc. •**Decomposers:** Various bacteria and fungi like actinomycetes are present which acts as decompose

2.2 BIODIVERSITY

The word biodiversity is a combination of two words: “biological and diversity” and refers to the variety of life on the Earth. **Biodiversity** is the degree of variation of life forms within a given species, ecosystem, biome, or an entire planet. Biodiversity is a measure of the health of ecosystems.
The term biological diversity was used first by wildlife scientist and conservationist Raymond F. Dasmann in the 1968.
The term's contracted form biodiversity may have been coined by W.G. Rosen in 1985

Biodiversity is usually considered at three different levels:
The following are different types of biodiversity

1. Genetic diversity: variety in the genetic makeup among individuals within a species
2. Species diversity: variety among the species or distinct types of living organisms found in different habitats of the planet
3. Ecosystem or ecological diversity: variety of forests, deserts, grasslands, streams, lakes, oceans, coral reefs, wetlands and other biological communities
4. Functional diversity: biological and chemical processes of functions such as energy flow an matter cycling needed for the survival of species and biological communities

1. Genetic Diversity: Genetic diversity is the "raw material" that permits species to adjust to a changing world whether these changes are due to natural factors or are caused by human factors. It refers to the variation at the level of individual genes and provides a mechanism for populations to adapt to their ever-changing environment.
Eg: Human beings

2. Species Diversity: Species diversity refers to the different types of living organisms on Earth. This includes the many types of birds, insects, plants, bacteria, fungi, mammals, and more. Many differing species often live together in communities depending on each other to provide their needs.
A species can be defined as a group or population of similar organisms that reproduce by interbreeding within the group. Members of a species do not normally reproduce with members of any other species. Members of a specific species possess common characteristics that distinguish them from other species and this remains constant regardless of geographic location.

3. Ecosystem Diversity: Ecological diversity or ecosystem diversity is the variety of biological communities, such as forests, deserts, grasslands and streams that interact with one another and with their physical and chemical (nonliving) environments. It relates to the different forms of life which are present in any one particular area or site, in more precise terms, it concerns the different species of a particular genus which are present in an ecological community.

2.2.1 VALUES OF BIODIVERSITY

The value of biodiversity (in terms of its commercial utility, ecological services, social and aesthetic values) is enormous. There are several ways that biodiversity and its various forms are Valuable to humans. The biodiversity value may be classified as follows:

1. CONSUMPTIVE VALUE: Biodiversity is an essential requirement for the maintenance of global food supply. The main sources of human food include animals, fish and plant produces.
A large number of plants are consumed by human beings as food. A few animal species are consumed by people which come from cattle, pigs, sheep, goats, buffaloes, chickens, ducks, geese and turkey species.
Fish: Many fresh water fish can be grown in ponds. Israel and China already get about half of their fish from aqua culture.
Drugs & medicines: About 75% of the world's population depends upon plants or plant extracts for medicines. The drug Penicillin used as an antibiotic is derived from a fungus called **Penicillium.** Likewise, Tetracycline from bacteria which is used to cure malaria is obtained from the bark of cinchona tree. .
Fuel: The fossil fuels like coal, petroleum products and natural gas are the products of biodiversity.

2. PRODUCTIVE VALUE: Some of the organisms are commercially usable where the product is marketed and sold. The animal products like tusks of elephants; musk from deer; silk from silkworm; wool from sheep or goats; fur of many animals etc all of which are traded in the market.

Eg: Calabar bean was tradionally used as a poison in West Africa.

Daisy plants were first used as a lice remedy in the Middle East and this led to the Discovery of Pyrethrum. Mosquito coils made from Pyrethrum are sold in the market.

The bacterium Bacillus thuringiensis produces toxic proteins that kill certain insects.

3. SOCIAL VALUE: These are the values associated with the social life, religion and spiritual aspects of the people. Many of the plants are considered to be sacred in our country like Tulasi, Mango leaves, Banana leaves . The leaves, fruits, flowers of some of the plants are used in worship. Many animals like cow, snake, bull, peacock also have significant place in spiritual and thus hold special importance. Thus, biodiversity has distinct social value, attached with different societies.

4. ETHICAL VALUE: The ethical value means that human beings may or may not use a certain species but knowing the very fact that this species exists in nature gives pleasure.

For eg: A peculiar species of Pigeon, grey / white bird with short legs is no more on this earth. Similarly, Dodo species is also no more. Human beings are not deriving anything direct from Kangaroo, giraffe but strongly feel that these species should exist in nature.

5. AESTHETIC VALUE: Every one of us would like to visit vast stretches of lands to enjoy the visible life. People from farther areas, spend a lot of time and money to visit wild life areas where they can enjoy the aesthetic value of biodiversity and this type of tourism is known as eco tourism.

Eco-tourism is estimated to generate 12 billion dollars of revenue annually that roughly gives the aesthetic value of biodiversity.

A study of the impact of environment on the psyche was undertaken by Kaplan and Kaplan (1989) in which they found that being near nature relieved working stresses while people who worked in closed environment or human made structures experienced much more job stresses and illnesses.

2.2.2 BIODIVERSITY AT GLOBAL, NATIONAL AND LOCAL LEVEL

The enormous diversity of life forms in the biosphere has evolved essentially through the process of trial and error during course of organic evolution. The changes in character of living organism which confer some advantage to the species are retained.

The changes in climatic conditions are reflected in the distribution of living organism and the pattern of biodiversity on our planet. The number of species present per unit area decreases as we move from mild tropics to the tundra's.

The Indian region (8° to 30° N and 60° to 97.5°) with total area of 329 million hectares is very rich in biodiversity. It is estimated that about 4500 species of plants occur in this country. The position of Indian sub-continent at the confluence of there biogeography reels is also an important contributing factor and explain the preserve of African, European, Sind, Japanese and Indo-Malayan elements in the flora and fauna in India. It is the sum total of such remarkable