

**UNIT – I**  
**ENVIRONMENT, ECOSYSTEM AND BIODIVERSITY**  
**DEFINITION, SCOPE AND IMPORTANCE**

**CHAPTER 1 ENVIRONMENT, SCOPE AND IMPORTANCE**

**1.1 Introduction:**

Environmental science is the study of nature and the facts about environment. Basically environment can be defined as “all the social, economical, physical & chemical factors that surrounds man” (or) “all abiotic and biotic components around man-all living and non-living things surrounds man”.

**1.2 Environment Components can be divided into biotic and abiotic components.**

According to ancient man the environment was the Panchaboodhas (i.e) air, water, land, sky and energy. The human were disciples of nature. They were able to protect themselves from harmful one and protect the others. But according to modern man the environment is only air land and water. Exploitation of various earth resources to satisfy the increasing needs of human population has resulted in 1) depletion of various resources of earth 2) pollution. Principles of environmental education:

- Examine the major environmental issues
- Discover the root cause
- Develop problem solving skills
- Promote co-operation in solving problems
- Emphasis active participation in prevention and solution to problems.

**1.3 Scope of environmental science:**

- Studying the interrelationship between the components of env.
- Carrying out impact analysis and env. Audit
- Preventing pollution from existing and new industries
- Stopping the use of biological and nuclear weapons
- Managing unpredictable disasters etc.

**1.4 Public awareness:**

Environmental Pollution or problems cannot be solved by mere laws. Public participation is an important aspect which serves the environmental Protection. Public awareness of environmental Is at infant stage 30-40% of public of developing country are aware of environmental. Problems but they do not bother about it.

- Ignorance and incomplete knowledge has lead to misconceptions

- Development and improvement in std. of living has lead to serious environmental disasters
- Debate on environmental Issues are treated as anti-developmental

### **1.5 Reasons for environmental Ignorance:**

Science, technology and economics failed to integrate the knowledge on environmental Aspects in curriculum the decision makers do not process environmental Angle of decision making consideration of economic growth, poverty eradication has lead to environmental Degradation only few developmental activities are made considering the environmental Aspects.

### **1.6 Need For Public Awareness:**

The United Nations Conference on Environment and Development held at Reo de Janeiro in 1992 (popularly known as “Earth Summit”) and world summit on sustainable development at Johannesburg in 2002, have highlighted the key issues of global environmental concern. They have attracted the attention of people. Any government at its own cannot achieve the goals of clear environment until the public participate in action. Public participation is possible only when the public is aware about the ecological and environmental issues. Eg. Ban- the littering of polythene.

### **1.7 Methods to propagate environmental Awareness:**

1. Among students through education – introducing environmental studies in the curriculum.
2. Among public through mass media- environmental programmms through TV, radio etc.
3. Among decision makers, planners, leaders etc.

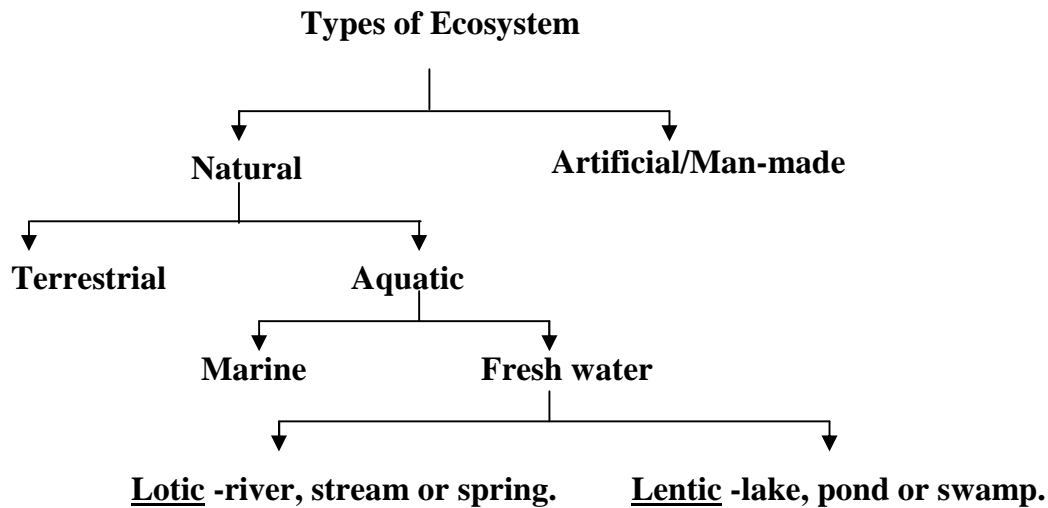
### **1.8 Role of NGOs**

1. Advise the government in interacting with ground level people
2. Organize public meetings to create environmental awareness Eg. Recent report of “centre for science and environment on permissible limits of pesticides in cola drinks. Public awareness is needed in the area
3. Study of natural resources-conservation and management
4. Ecology and biodiversity – conservation 3. environmental Pollution and prevention
5. Social issues related to development and environment
6. Human population and environment.

## CHAPTER 2

## ECOSYSTEMS AND BIODIVERSITY

**2.1 Ecosystem** -living things in a given area, non-living chemical and physical factors of their environment, linked together through nutrient cycle and energy flow



**2.2.1 Ecology** - Study of the distribution and abundance of organisms, the flows of energy and materials between abiotic and biotic components of ecosystems.

**2.2 Ecosystem Structure:** The living components of an ecosystem

- The roles of organisms in an ecosystem:
- Producer (autotrophy): make food; plants, algae
- Consumer (heterotrophy): eat other organisms
- Decomposer: eat dead organic matter; bacteria and fungi

### 2.2.1 Classes of Consumers

Herbivore – primary consumer – eats plants

Carnivores – secondary – meat eaters; eat herbivores

Tertiary – feed on carnivores

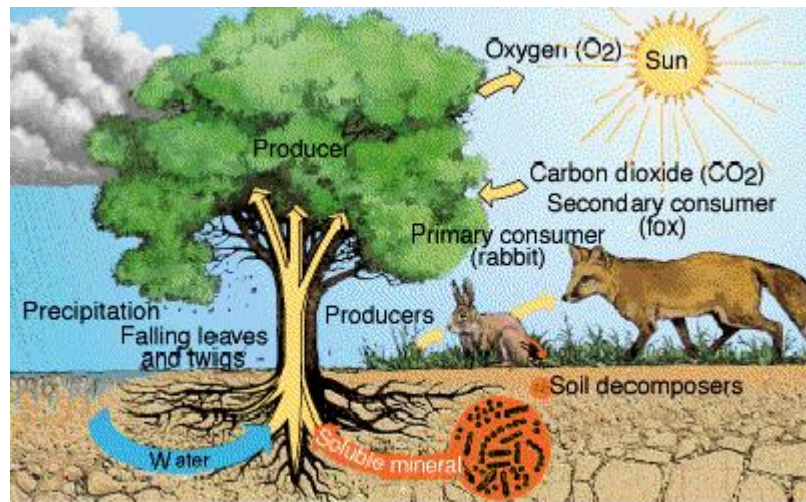
Omnivores – eat plants/animals.

### 2.2.2 Role of Organisms

**Scavengers** – feed on dead organisms (vultures, flies, crows, lobsters)

**Detritus feeders** – organisms that extract nutrients from fragments of dead organisms into more simple organic waste (termites, earthworms, crabs)

**Decomposers** – organisms that digest parts of the dead organisms into simplest chemicals (bacteria, fungi)



**Fig. 2.2.2 Role of organisms**

## **2.3 FOREST ECOSYSTEM (TERRESTRIAL ECOSYSTEM)**

### **2.3.1 Introduction**

- ❖ A forest is an area with a high density of trees.
- ❖ World's total land area is 13,076 million hectares - (Source: FAO; 1989)
- ❖ Of which total forests account for about 31% of the world's land area.
- ❖ In India, the forest cover is roughly 19% of the total land area.
- ❖ The forest ecosystems are of great concern from the environmental point of view.
- ❖ It provides numerous environmental services like;
  - Nutrient cycling,
  - Maintaining biodiversity
  - Providing wildlife habitat
  - Affecting rainfall patterns
  - Regulating stream flow
  - Storing water
  - Reducing flooding
  - Preventing soil erosion
  - Reclaiming degraded land & many more....
- ❖ Apart from environmental values, forest ecosystems have some traditional values as well.
- ❖ Examples are:
  - Fire Wood & Timber.
  - Fruits.
  - Gums.
  - Herbs & drugs.

## 2.3.2 Structure and Function of Forest Ecosystem

### I. Biotic components

- ❖ The various biotic components, representatives from the three functional groups, of a forest ecosystem are:

#### 1) Producer Organisms

- ❖ In a forest, the producers are mainly trees.
- ❖ Trees are of different kinds depending upon the type of forest developed in that climate.
- ❖ Apart from trees, climbers, epiphytes, shrubs and ground vegetation.
- ❖ Dominant species of trees in major types of forest ecosystems are:
  - ❖ *Tectona grandis*, *Acer*, *Betula*, *Picea*, *Pine*, *Cedrus*.

#### 2) Consumers

- ❖ In a forest, consumers are of three main types;

##### a) Primary Consumers

- ❖ These are Herbivores which feed directly on producers.

Eg:

- ❖ Ants, Beetles, Bugs, spiders etc. feeding on tree leaves.
- ❖ Larger animals such as Elephants, Deer, giraffe etc. grazing on shoots and/or fruits of trees.

##### b) Secondary Consumers

- ❖ These are carnivores and feed on primary consumers.

Eg: Birds, Lizards, Frogs, Snakes and Foxes.

##### c) Tertiary Consumers

- ❖ These are secondary carnivores and feed on secondary consumers
  - ❖ These include top carnivores like Lion, Tiger.

#### 3) Decomposers

- ❖ These include wide variety of saprotrophic micro- organism like;
  - ❖ Bacteria (*Bacillus Sp.*, *Clostridium sp.*, *pseudomonas*).
  - ❖ Fungi (*Aspergillus sp.*, *Ganoderma sp.*, *Fusarium*).
  - ❖ Actinomycetes (*Streptomyces*).
- ❖ They attract the dead or decayed bodies of organisms & thus decomposition takes place.
- ❖ Therefore, nutrients are released for reuse.

### II. Abiotic components

- ❖ These include basic inorganic & organic compounds present in the soil & atmosphere.
- ❖ In addition dead organic debris is also found littered in forests.



**Producers: Different tree species**



**Consumers in a Forest Ecosystem**



**Decomposers in a Forest ecosystem**

**Fig.2.3 Forest Ecosystem**

## **2.4 GRASSLAND ECOSYSTEM (TERRESTRIAL ECOSYSTEM)**

### **2.4.1 Introduction**

- ❖ Grasslands (also called Greenswards) are areas where the vegetation is dominated by grasses and other herbaceous (non-woody) plants.
- ❖ Grasslands occupy about 24% of the earth's surface.
- ❖ Grasslands occur in regions too dry for forests and too moist for deserts
- ❖ The annual rainfall ranges between 25- 75 cm, Usually seasonal
- ❖ The principal grasslands include:
  - Prairies (Canada, USA),Pampas (South America),Steppes (Europe & Asia)  
Veldts (Africa)
- ❖ The highest abundance & greatest diversity of large mammals are found in these ecosystems.
- ❖ The dominant animal species include
  - ❖ Wild horses, asses & antelope of Eurasia,
  - ❖ Herds of Bison of America; and
  - ❖ The antelope & other large herbivores of Africa.

### **2.4.2 Structure and functions of Grassland Ecosystems**

#### **I. Biotic components**

##### **1) Producer Organisms**

- ❖ In grassland, producers are mainly grasses; though, a few herbs & shrubs also contribute to primary production of biomass.
- ❖ Some of the most common species of grasses are:
  - ❖ Brachiaria sp., Cynodon sp., Desmodium sp., Digitaria sp.

## 2) Consumers

- ❖ In a grassland, consumers are of three main types;

### a) Primary Consumers

- ❖ The primary consumers are herbivores feeding directly on grasses. These are grazing animals such as
  - ❖ Cows, Buffaloes, Sheep, Goats, Deer, Rabbits etc.
  - ❖ Besides them, numerous species of insects, termites, etc are also present.

### b) Secondary Consumers

- ❖ These are carnivores that feed on primary consumers (Herbivores)
- ❖ These include;-Frogs, Snakes, Lizards, Birds, Foxes, Jackals etc.

### c) Tertiary Consumers

- ❖ These include hawks etc. which feed on secondary consumers.

## 3) Decomposers

- ❖ These include wide variety of saprotrophic micro- organism like: Bacteria; Fungi; Actinomycetes
- ❖ They attract the dead or decayed bodies of organisms & thus decomposition takes place.
- ❖ Therefore, nutrients are released for reuse by producers.

## II. Abiotic components

- ❖ These include basic inorganic & organic compounds present in the soil & aerial environment.
- ❖ The essential elements like C, H, N, O, P, S etc. are supplied by water, nitrogen, nitrates, sulphates, phosphates present in soil & atmosphere.





**Producers: Different grass species**



**Consumers of Grassland ecosystem**



**Decomposers in a Grassland ecosystem**

**Fig.2.4 Grassland Ecosystem**

## **2.5 DESERT ECOSYSTEM**

### **2.5.1 Introduction**

- ❖ A desert is a landscape or region that receives almost no precipitation.
- ❖ Deserts are defined as areas with an average annual precipitation of less than 250 millimeters per year.
- ❖ It occupies about 17% of the earth's surface.
- ❖ Deserts are characterized by hot days & cold nights.
- ❖ The deserts of the world are mainly located in the South- western United States, Mexico, North America, Asia (Thar, Gobi, Tibet) & west Asia.
- ❖ Deserts are characterized by scanty flora & fauna.
- ❖ Soils of deserts often have abundant nutrients but little or no organic matter.

### **2.5.2 Structure and Functions of Desert Ecosystems**

#### **I. Biotic components**

##### **1) Producer Organisms**

- ❖ In a desert, producers are mainly shrubs/bushes; some grasses & a few trees.
- ❖ Dominant plant species include: Succulents (water - retaining plants adapted to arid climate or soil conditions) & hardy grasses.



❖ Besides some lower plants such as lichens & xerophytic mosses are also present.

## 2) Consumer Organisms

These include animals such as insects, reptiles which are capable of living in xeric conditions

❖ Besides some nocturnal rodents, birds & some mammalians like camel etc are also found.

## 3) Decomposers

Due to poor vegetation with very low amount of dead organic matter, decomposers are poor in desert ecosystem.

❖ The common decomposers are some bacteria & fungi, most of which are thermophilic.

## II. Abiotic components

Due to high temperature & very low rainfall, the organic substances are poorly present in the soil.



### Producers



### Consumers

Fig. 2.5 Forest Ecosystem

## 2.6 AQUATIC ECOSYSTEMS

### 2.6.1 Introduction

❖ Aquatic ecosystems deal with biotic community present in water bodies.

❖ In terrestrial ecosystem, carbon dioxide & oxygen are present in gaseous form whereas in aquatic ecosystem, these are available in dissolved state.

- ❖ Depending upon the quality and nature of water, the aquatic ecosystem are categorized into:
  - ❖ Freshwater Ecosystem and
  - ❖ Marine Ecosystem.

### 2.6.2 Freshwater Ecosystems

- ❖ Freshwater ecosystems cover 0.8% of the Earth's surface and contain 0.009% of its total water.
- ❖ Freshwater ecosystems contain 41% of the world's known fish species.
- ❖ Aquatic ecosystems perform many important environmental functions. For example:
  - They recycle nutrients, purify water, attenuate floods, recharge ground water and provide habitats for wildlife.
  - Aquatic ecosystems are also used for human recreation, and are very important to the tourism industry, especially in coastal region.
- ❖ There are three basic types of freshwater ecosystems:
  - Lentic: slow-moving water, including Pools, Ponds, and Lakes.
  - Lotic: rapidly-moving water, for example Streams and Rivers.
  - Wetlands: areas where the soil is saturated with water or inundated for at least part of the time

### 2.6.3 Lakes & pond Ecosystem

- ❖ A pond is a place where living organisms not only live but interact with biotic & abiotic components.
- ❖ Ponds are often exposed to tremendous anthropogenic pressure which significantly affects the system.
- ❖ Lakes are usually big standing freshwater bodies.
- ❖ They have a shallow water zone called Littoral zone; an open water zone where effective penetration of solar light takes place, called limnetic zone and a deep water zone where light penetration is negligible, called Profoundal zone.

#### I. Biotic components

##### 1) Producer Organisms

- ❖ It includes submerged, free floating and amphibious macrophytes (like; Hydrilla, Utricularia, Wolfia, Azolla, Typha etc.) and minute floating and suspended lower phytoplanktons (like; Ulothrix, Spirogyra, Oedogonium etc.)

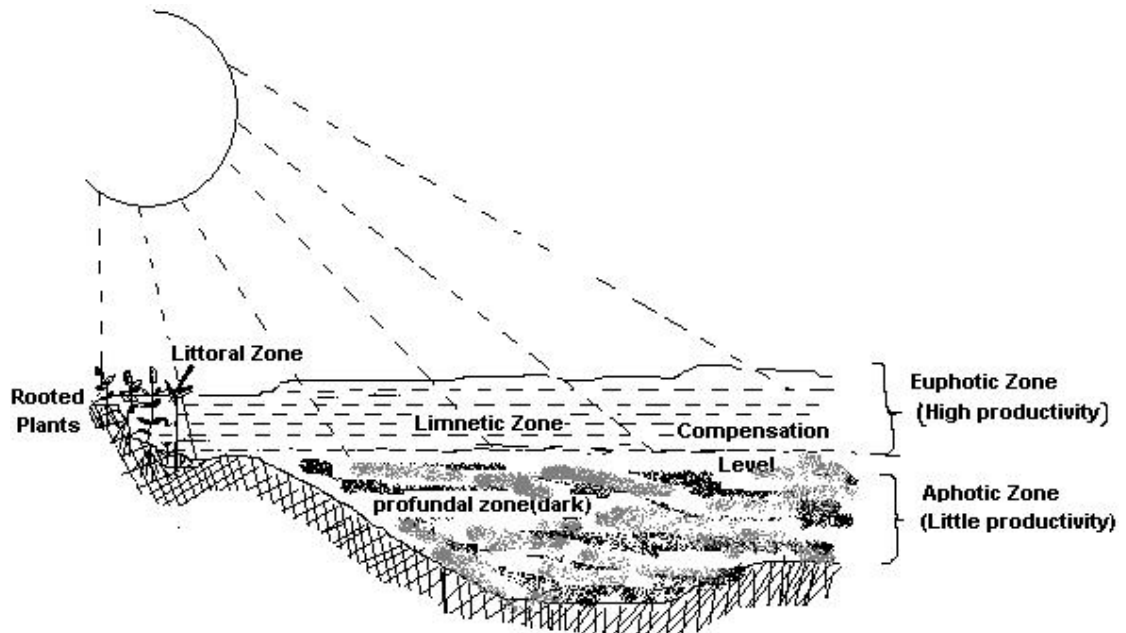
##### 2) Consumer Organisms

- a) Primary consumers: These are zooplanktons (ciliates, flagellates, other protozoan, small crustaceans) and benthos.
- b) Secondary consumers: These are carnivores like insects and fishes feeding on herbivores
- c) Tertiary consumers: These are the large fishes feeding on small fishes.

##### 3) Decomposers Micro – organisms like bacteria, fungi and actinomyctes.

#### II. Abiotic component

- ❖ These are the inorganic as well as organic substances present in the bottom soil or dissolved in water. In addition, to the minerals, some dead organic matter is also present.



**Fig.2.6.4 Zonation in a lake ecosystem**

## 2.6.4 Marine or Ocean Ecosystem

- ❖ Marine ecosystems are among the Earth's aquatic ecosystems. They include: Oceans, Estuaries and Lagoons, Mangroves and Coral reefs, the Deep sea and the Sea floor.
- ❖ These are the gigantic reservoirs of water covering approximately 71% of the Earth's surface (an area of some 361 million square kilometers).
- ❖ These ecosystems are different from freshwater ecosystem mainly because of its salty water.
- ❖ The salt concentration in an open sea is usually 3.5% (35 parts per thousand (ppt)). Dominant ions are sodium & chloride.
- ❖ Average temperature of Marine ecosystem is 2-3 degree centigrade, devoid of light.

### I. Biotic components

**1) Producers** It includes phytoplanktons (diatoms, dinoflagillates), large seaweeds (mainly algae like chlorophyceae, phaeophyceae & rhodophyceae; angiosperms like Ruppia, Zostera, posidonia ), and mangrove vegetation (like Rhizophora, Carapa etc.)

### 2) Consumers

- Primary consumers: These are herbivores and feed directly on producers (Crustaceans, Mollusks, fish etc.)
- Secondary consumers: These are carnivorous fishes (Herring, Sahd and Mackerel)
- Tertiary consumers: These are top carnivorous fishes (Cod, Haddock, etc.)

**3) Decomposers** These are micro – organisms like bacteria, fungi

### II. Abiotic components

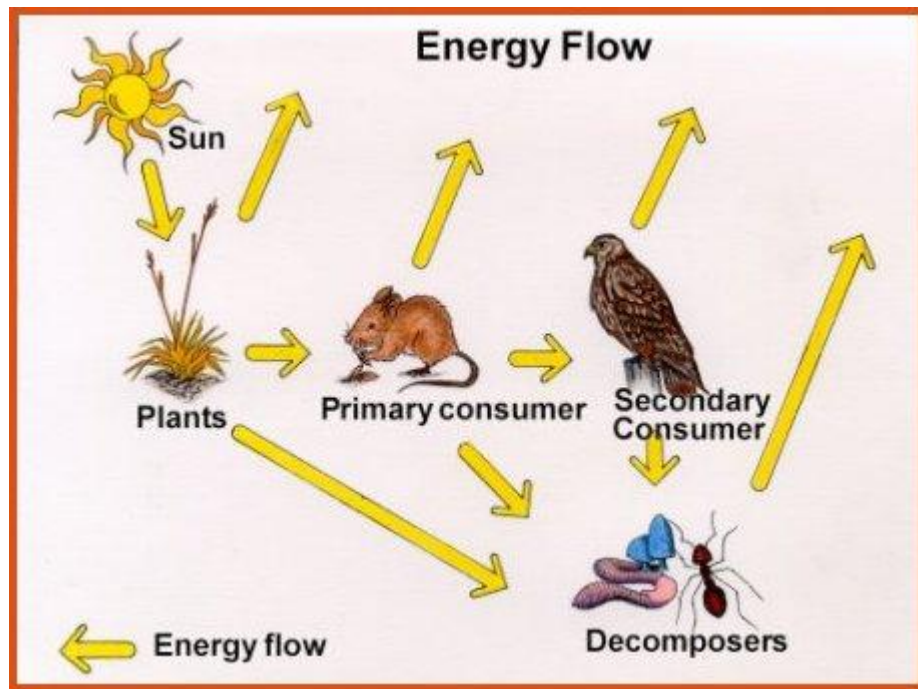
- ❖ High Na, Ca, Mg and K salt concentration, variable dissolved oxygen content, light & temperature make a unique physiochemical conditions in marine water.



**Fig.2.6.5 Ocean Ecosystem**

## **2.7 ENERGY FLOW IN ECOSYSTEM**

- ❖ All organisms must obtain a supply of energy and nutrients from their environment in order to survive.
- ❖ The transformations of energy in an ecosystem begin first with the input of energy from the sun.
- ❖ Because, it is the first step in the production of energy for living things, it is called “Primary production”.
- ❖ Photosynthesis -- Chemical reaction where green plants use water & carbon dioxide to store the sun’s energy in glucose.
- ❖ ENERGY is stored in glucose.
- ❖ Glucose is stored as starch in plants
- ❖ The majority of autotrophs are photoautotrophs that harness the energy of the sun and pass some of this energy onto consumers through feeding pathways.
- ❖ The energy contained within producers and consumers is ultimately passed to the decomposers that are responsible for the constant recycling of nutrients.
- ❖ Thus, there is a one-way flow of energy through the biotic community and a cycling of nutrients between the biotic and abiotic components of the ecosystem
- ❖ Energy flow cannot occur in reverse direction.
- ❖ Starts from autotrophs (the producer level, i.e., first trophic level) to Heterotrophs including plant eaters or Herbivores (second trophic level) and so on.
- ❖ The amount of energy decreases with successive trophic levels.
- ❖ Only About 1% of energy from the sun is used by green plants & rest remains unutilized.
- ❖ Similarly, there is loss of energy in each trophic level.
- ❖ The transfer of food energy between the organisms in an ecosystem can be tracked by constructing food chains, food webs, pyramids of numbers, biomass and energy and energy flow diagrams.

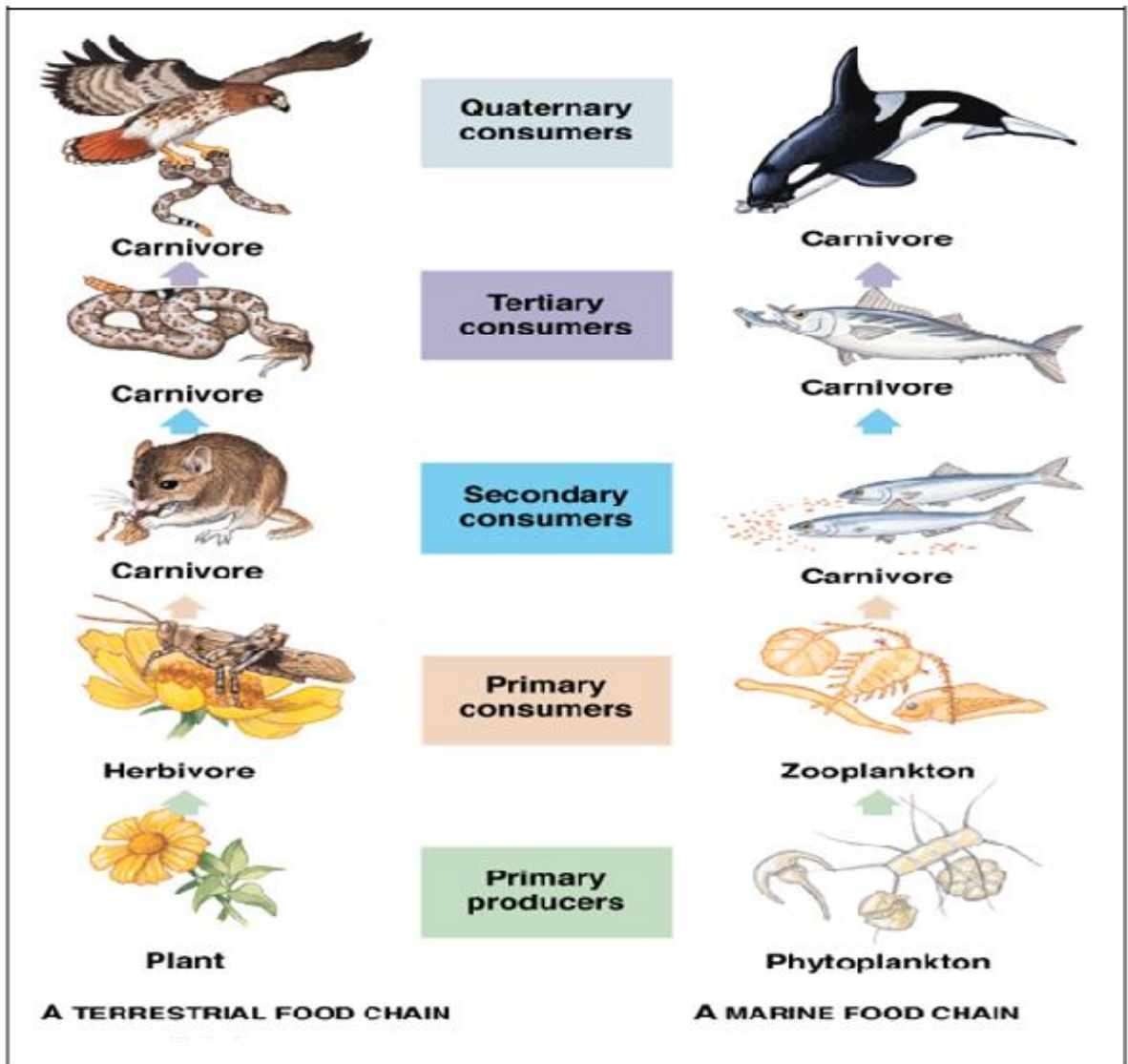


**Fig.2.7 Energy Flow**

## **2.8 FOOD CHAIN**

- ❖ A food chain may be defined as, “the transfer of energy and nutrients through a series of organisms with repeated process of eating and being eaten”.
- ❖ In an ecosystem, all the organisms are linked together with one another by food relationship.
- ❖ Each organism living or dead is potential food for some other organism.





**Fig.2.8 Food Chain**

## 2.9 FOOD WEB

- ❖ Under natural conditions, the linear arrangement of food chains hardly occurs & these remains connected interconnected with each other through different types of organisms.
- ❖ Interlocking pattern of several interlinked food chains is termed as FOOD WEB.

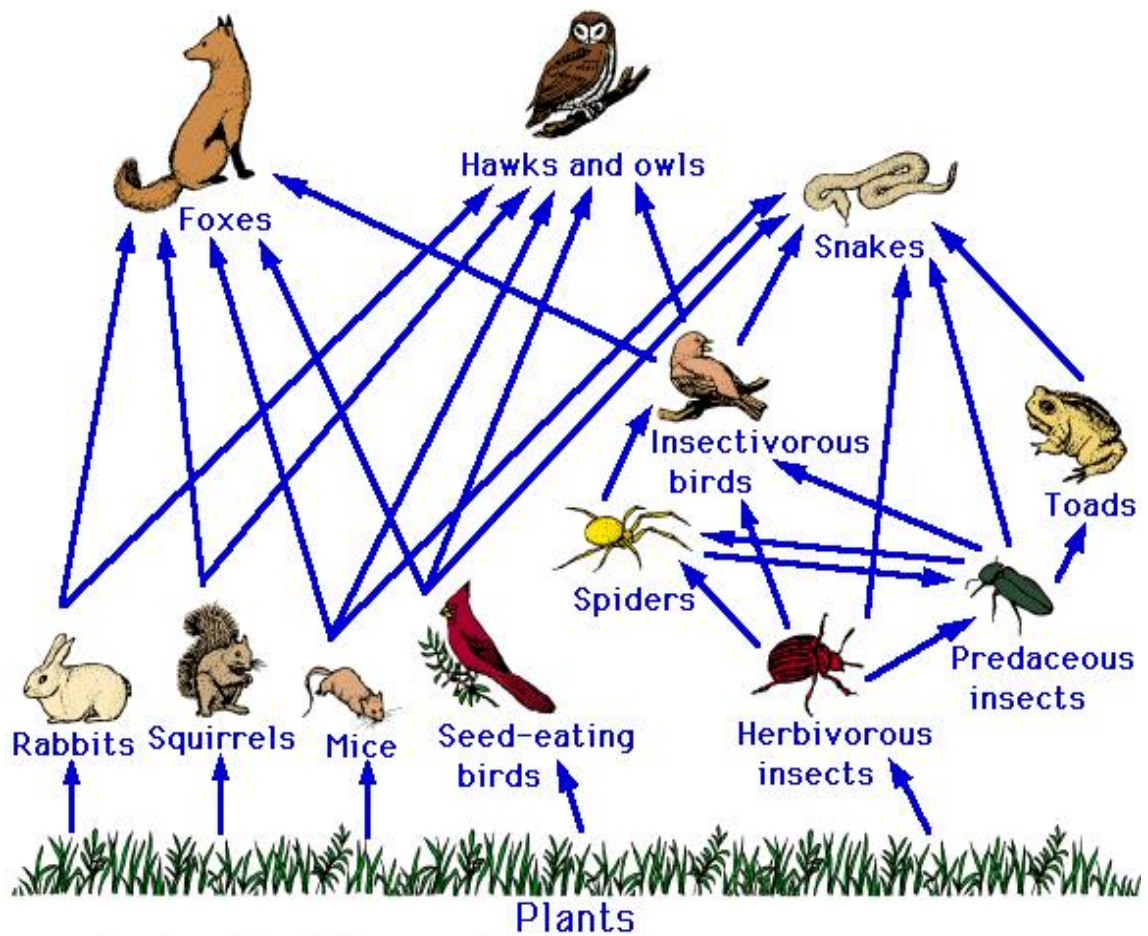


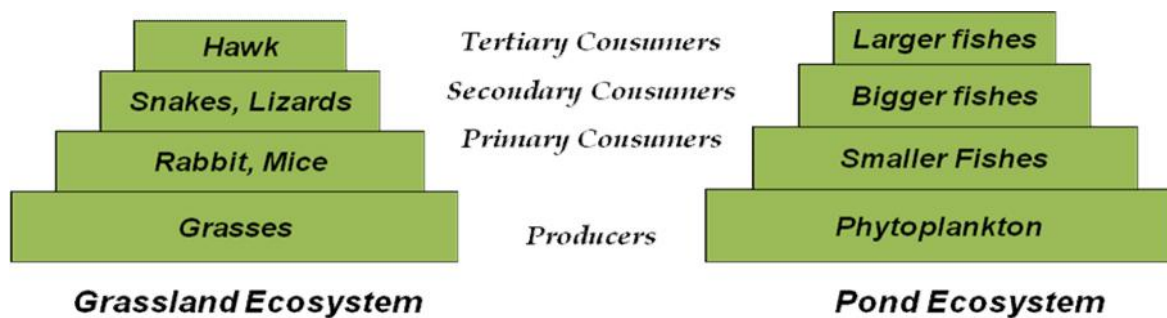
Fig.2.9 Food web in grassland ecosystem

## 2.10 ECOLOGICAL PYRAMIDS

- ❖ An "Ecological pyramid" is a graphical representation that shows the relative amounts of energy or matter contained within each trophic level in a food chain or food web.
- ❖ An ecological pyramid shows the relationship between consumers and producers at different trophic levels in an ecosystem
- ❖ There are three ecological pyramids recognized by ecologists:

### 2.10.1 Pyramid of Numbers

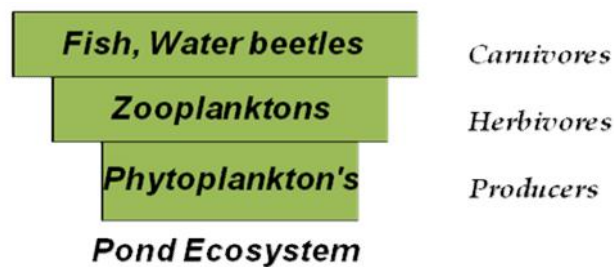
- ✓ Shows the relative number of individual organisms at each trophic level.



### 2.10.2 Pyramid of Biomass

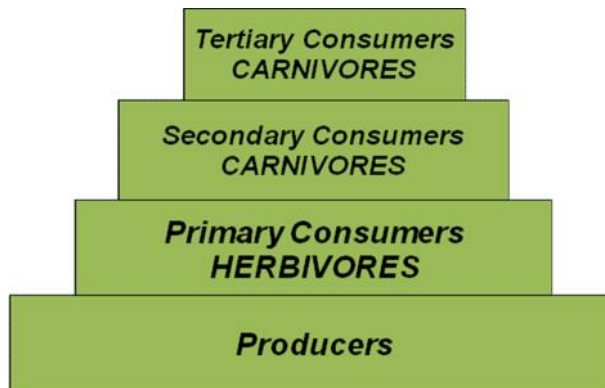


- ❖ A pyramid of biomass represents the total dry mass (in grams per square meter of area) of all the organisms in each trophic level at a particular time.



### 2.10.3 Pyramid of Energy

- ❖ A pyramid of biomass represents the rate of energy flow and/or productivity at successive trophic levels. The pyramids of energy are always upright.



## 2.11 NUTRIENT CYCLES

- ❖ Nutrient cycles involve storage and transfer of nutrients through different components of the ecosystem, so that the nutrients are repeatedly used.
- ❖ The cyclic movements of chemical elements of the biosphere between the organisms and environment are referred as “**BIOGEOCHEMICAL CYCLES**”

Gaseous cycle: Those elements in which the reservoir is the air or the oceans (via evaporation). Gaseous cycles include those of Carbon, Nitrogen, Oxygen, Carbon, and Water.

Sedimentary cycle: Those elements which are received from the Earth’s crust. Sedimentary cycles include those of iron, calcium, phosphorus, and other more earth bound elements.

### 2.11.1 NITROGEN CYCLE

- ❖ Nitrogen is crucial for all organisms
  - ❖ Nucleic acids

- ❖ Proteins
- ❖ Chlorophyll
- ❖ Nitrogen- 78% in Atmosphere
- ❖ N<sub>2</sub> is very stable and must be broken apart by organisms, combined with other atoms into a usable form.
- ❖ Nitrogen cycle completes in 5 steps:

### **1) Nitrogen Fixation**

Conversion of N<sub>2</sub> → NH<sub>3</sub>

- ❖ Combustion, volcanic action, Lightning, Industrial processes (making fertilizer). Bacteria (Azotobacter, Clostridium, Nostoc etc.)

### **2) Nitrification**

Conversion of NH<sub>3</sub> → NO<sub>3</sub>

Soil bacteria convert in a two step process.

### **3) Assimilation**

Roots absorb NH<sub>3</sub>, NH<sub>4</sub>, or NO<sub>3</sub> and incorporate them into nucleic acids and protein.

### **4) Ammonification**

Amino acids and nucleotides are broken down into waste products NH<sub>3</sub> or NH<sub>4</sub>

### **5) Denitrification**

The reduction of NO<sub>3</sub> to N<sub>2</sub>. Denitrifying bacteria return some of the nitrogen to the atmosphere

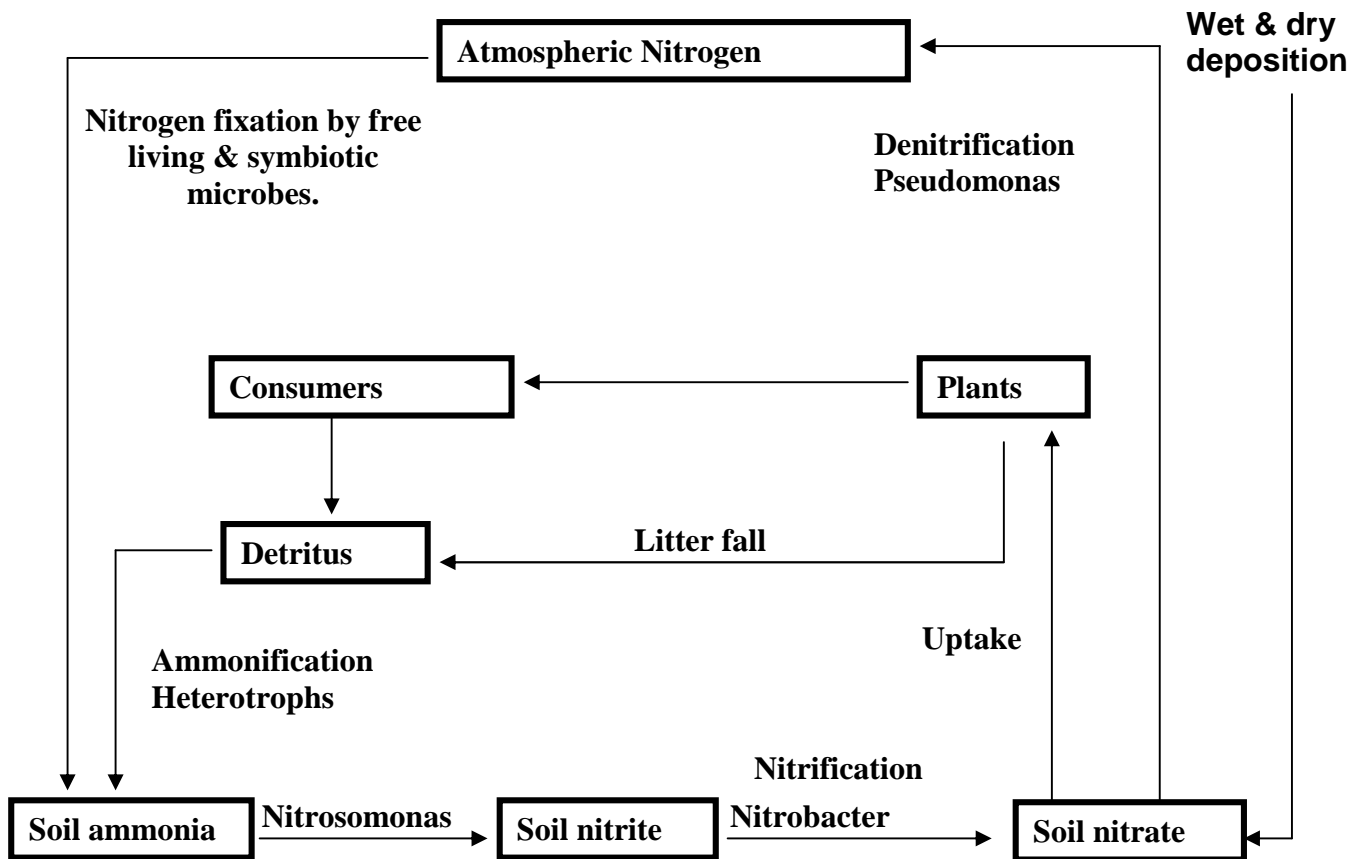
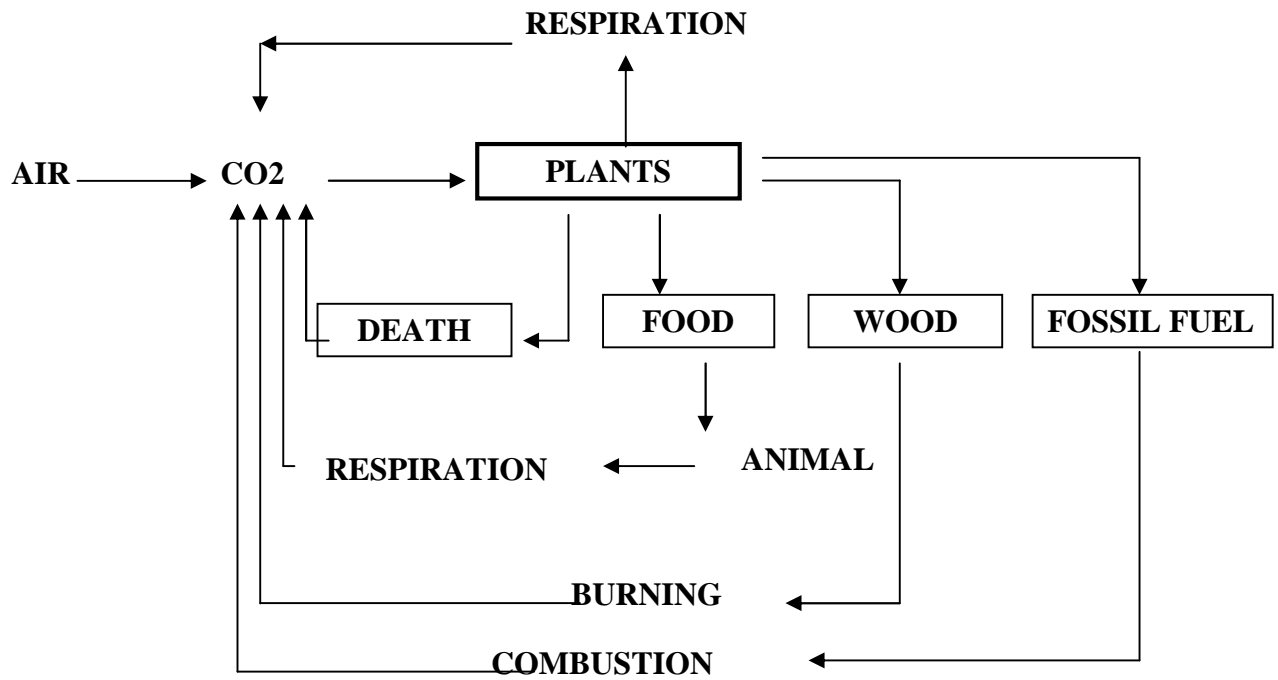


Fig.2.11.1 Nitrogen Cycle

## 2.11.2 CARBON CYCLE

- ❖ Carbon enters plants, etc., as  $\text{CO}_2$ 
  - Bacteria process carbon in a fashion that allows it to be recycled.
  - Obtain energy from the molecules, and convert carbohydrates to carbon dioxide as a result of respiration.
- ❖ Photosynthesis removes carbon from the abiotic environment (fixes carbon into organic molecules)
- ❖ Carbon moves through food chain through consumption of one organisms by another
- ❖ Cellular respiration, combustion, and erosion of limestone return carbon to the atmosphere, water and abiotic environment.

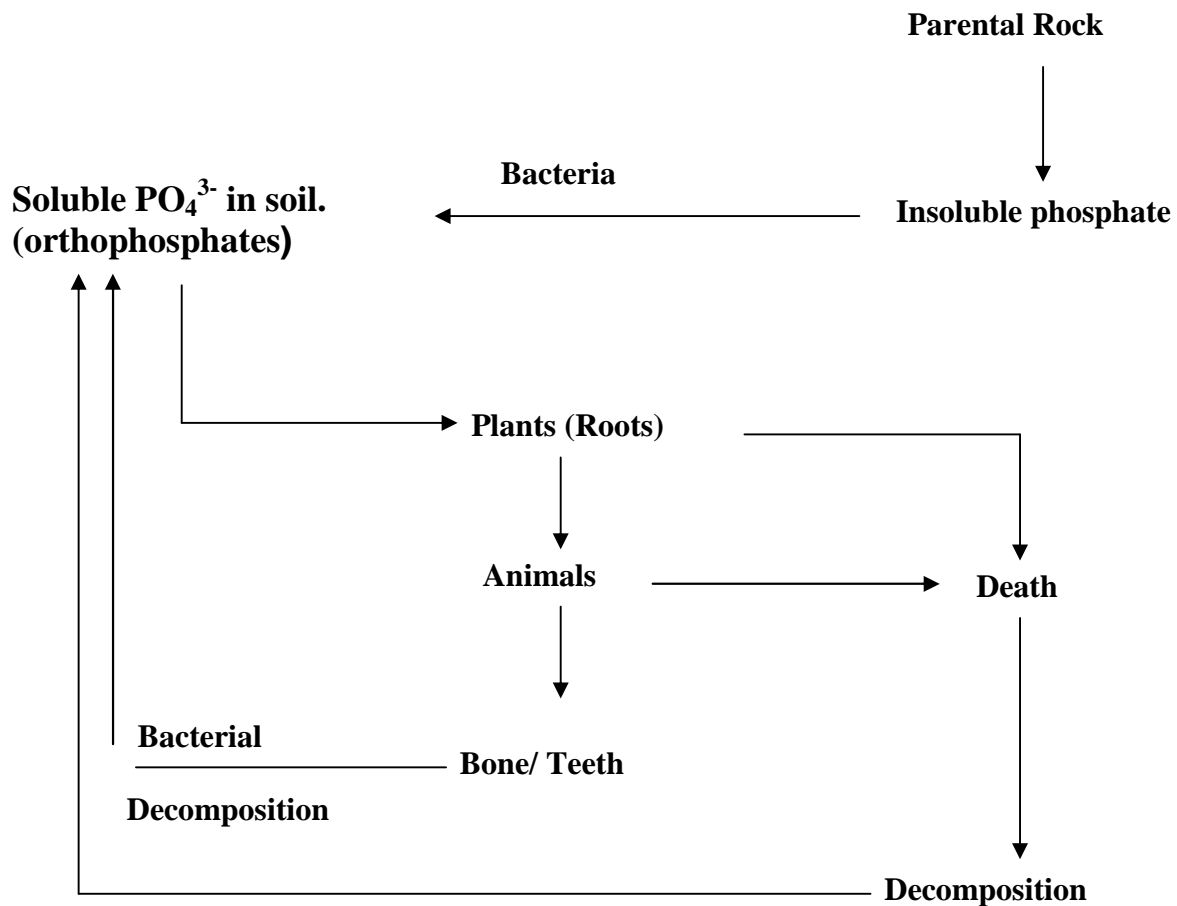


**Fig.2.11.2 Carbon Cycle**

The source of atmospheric carbon dioxide is variable but only plants can utilize atmospheric carbon directly

### 2.11.3 PHOSPHOROUS CYCLE

- ❖ The only cycle that does not have a gaseous state
- ❖ Inorganic phosphate  $\text{PO}_4^{3-}$  is released from rocks and sediments through the action of erosion.
- ❖ Soil  $\text{PO}_4^{3-}$  is absorbed by plants and incorporated into nucleic acids, phospholipids and ATP.
- ❖ Animals obtain most of their  $\text{PO}_4^{3-}$  by consumption of other animals and from water.
- ❖  $\text{PO}_4^{3-}$  is released to the soil again by decomposers.
- Dissolved  $\text{PO}_4^{3-}$  gets absorbed by algae and aquatic plants
- Decomposers break down waste and returns  $\text{PO}_4^{3-}$  to sediments on the seabed.
- Some returns to terrestrial environment through geologic processes and via seabirds. Guano



**Fig.2.11.3 Phosphorus Cycle**

## 2.12 ECOLOGICAL SUCCESSION

- ❖ Ecological succession is defined as, “A change in the community in which new populations of organisms gradually replace existing ones”.
- ❖ There are two types of ecological succession:

### 1) Primary Succession

- ❖ Occurs where there is no soil, e.g. after a volcanic eruption or a glacial retreat.
- ❖ “Pioneer organisms”
- ❖ Simple plants first – no or shallow roots.
- ❖ Gradual influx of more complicated and larger plants as the habitat changes
- ❖ Unfavorable for life at first.
- ❖ Ends with a “climax community” – ecosystem stays constant, provided there are no changes in abiotic influences.

### 2) Secondary Succession

- ❖ Community development in the areas that were previously occupied by a other community.
- ❖ Occurs after a disturbance. E.g., loss of trees after disease, Fire or wind, deforestation etc.
- ❖ Conditions are favorable for as soil and nutrients are already present.
- ❖ More rapid than primary succession.

## Primary Succession Vs Secondary Succession

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Primary	Secondary
➤ No soil.	➤ Soil already exists.
➤ Pioneer species.	➤ Seeds have suitable soil conditions.
➤ Weathering & decomposition	➤ Occurs much faster.
➤ Humus and sand increase over time.	➤ Climax community.
➤ End = Climax community.	

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### 2.13 BIODIVERSITY

- ❖ Biodiversity is the variety and differences among living organisms from all sources, including terrestrial, marine, and other aquatic ecosystems and the ecological complexes of which they are a part.
- ❖ It is virtually synonymous with “Life on earth”.
- ❖ Biologists most often define "biological diversity" or "biodiversity" as the "totality of genes, species, and ecosystems of a region".
- ❖ The biodiversity found on Earth today consists of many millions of distinct biological species, which is the product of nearly 3.5 billion years of evolution.

#### 2.13.1 Levels of Biodiversity

##### 1) Genetic diversity

- ❖ It is a level of biodiversity that refers to the total number of genetic characteristics in the genetic makeup of a species.
- ❖ It is distinguished from genetic variability, which describes the tendency of genetic characteristics to vary.

##### 2) Species diversity

- ❖ It refers to the variety of species within a region.
- ❖ Species diversity is an index that incorporates the number of species in an area and also their relative abundance.
- ❖ It is generally a much more useful value than species richness.

##### 3) Community and Ecosystem diversity

- ❖ Ecosystem diversity refers to the diversity of a place at the level of ecosystems. This has 3 perspective:
- ❖ Alpha Diversity: Within community diversity. Alpha diversity refers to the diversity of organisms sharing the same Community/Habitat.
- ❖ Beta Diversity: Between community diversity. It refers to the diversity of organisms sharing two habitats.
- ❖ Gamma Diversity: Diversity of the habitat over the total landscape or geographical area is called gamma diversity.

### 2.13.2 Values of Biodiversity

Food: About 80,000 edible plants and about 90% of present day food crops have been domesticated from wild.

Drugs & Medicines: About 75% of world's population depends on plants or plant extracts.

Fuel: Forests have been used since ages for fuel wood. Fossil fuels are also products of Biodiversity.

Social Value: Many of the plants like Tulsi, Lotus, Peepal etc are considered holy and sacred.

- ❖ About 2.1 million species have been identified till date, while many more species are believed to exist.
- ❖ According to UNEP estimate, approximately 9.0 – 52 million of species exist on Earth
- ❖ India's position is 10th in the world & 4th in Asia in terms of Plant diversity.

### 2.14 HOT- SPOTS OF BIODIVERSITY

- ❖ A biodiversity hotspot is a biogeographic region with a significant reservoir of biodiversity that is threatened with destruction.
- ❖ An area is designated as a hot spot when it contains at least 0.5% of plant species as endemic.
- ❖ There are 25 such hot spots of biodiversity on a global level, out of which two are present in India.
- ❖ These are: Indo- Burma (earlier The Eastern Himalayas) ,The western Ghats & Sri Lanka..
- ❖ These hot spots covering less than 2% of the world's land area are found to have about 50% of the terrestrial biodiversity.

#### 2.14.1 Criteria for determining hot-spots

- ❖ No. of Endemic Species i.e. the species which are found no where else.
- ❖ Degree of threat, which is measured in terms of Habitat loss.

#### E.g. Indo- Burma (Eastern Himalayas) Hotspot

- ❖ The hotspot includes all of Cambodia, Vietnam & Laos, and nearly the entire areas of Thailand, Myanmar & Bhutan as well as part of Nepal, far eastern India and extreme southern China.
- ❖ In addition, it covers several offshore Islands including Mainan Islands in the south China Sea and Andaman & Nicobar Islands in Indian Ocean.
- ❖ Indo-Burma is one of the most threatened biodiversity hotspots, due to the rate of resource exploitation and habitat loss.

#### E.g. Western Ghats and Sri Lanka

- ❖ Western Ghats and Sri Lanka, also known as the "Sahyadri Hills" encompasses the montane forests in the southwestern parts of India and on the neighboring Islands of Sri Lanka.
- ❖ The entire extent of hotspot was originally about 1,82,500 square kms, but due to tremendous population pressure, now only 12,445 square Km or 6.8% is in pristine condition.
- ❖ The important populations include Asian elephant, Indian tigers and the endangered lion tailed macaque.

### 2.15 THREATS TO BIODIVERSITY



- ❖ Extinction is a natural event and, from a geological perspective, routine.
- ❖ In last century, human impact has been so severe that thousands of species and varieties are becoming extinct annually.
- ❖ Some of the main causes are:
- ❖ Habitat loss, degradation, fragmentation.
- ❖ Habitat loss & degradation are major causes of species extinction, affecting 89% of all threatened birds, 83% of mammals & 91% of all threatened plants assessed globally (IUCN, 2000)
- ❖ The main causes of habitat are agriculture activities, Mining, development of human settlement, industry etc.
- ❖ According to ICUN, UNEP report, more than 50% of wildlife habitat has been destroyed in 49 out of 61 old world tropical countries.

## **2.16 POACHING OF WILDLIFE**

- ❖ Poaching is another threat that has emerged in recent decades as one of the primary reason for decline in number of species.
- ❖ Wildlife is sold and traded in many countries for live specimens, folk medicines, furs, Skin, and other products such as Ivory, horns etc amounting to millions of dollars.

## **2.17 MAN – WILDLIFE CONFLICTS**

- ❖ The conflict between man and wildlife started with the evolution of man, but intensity increased due to the activities of modern man
- ❖ Due to the lack of stable food and disruption of movement, wild animals came out of forest area and attack the agricultural field and humans and in turn got killed by the humans.

### **2.17.1 Introduction of Exotic species**

- ❖ Organisms introduced into habitats where they are not native are termed as exotics.
- ❖ They can be thought of as Biological Pollutants and are considered to be among the most damaging agents of habitat alteration and degradation the world.

### **2.17.2 Climate change**

A changing global climate threatens species and ecosystems.

- ❖ The distribution of species (biogeography) is largely determined by climate.
- ❖ Climate change may simply shift these distributions but, for a number of reasons, plants and animals may not be able to adjust.

## **2.18 ENDANGERED SPECIES**

- ❖ According to The International Union of Conservation of Nature and Natural Resources (IUCN), the species that considered in imminent danger of extinction and whose survival is unlikely, if factors causing their decline continue to operate.
- ❖ Out of about 47,000 species of plants in our country, 7000 are endemic
- ❖ India contains 172 species of animals considered globally threatened by IUCN, or 2.9% of the world's total number of threatened species.
- ❖ These include 53 species of mammals, 69 birds, 23 reptiles and 3 amphibians

- ❖ As many as 3,000- 4,000 higher plants may be under high degree of threat in India
- ❖ Thus Indian subcontinent has about 62% endemic flora, restricted mainly to Himalayas, Khasi Hills & Western Ghats.
- ❖ *Sapria himalayana*, *Uvaria lurida*, *Napenthes khasians* etc. are some endemic flora of our country.
- ❖ A large number out of a total of 81,000 species of animals in our country is endemic. About 62% amphibians and 50% lizards are endemic to western Ghats.
- ❖ Golden monkey, Nilgiri Langur, Indian Wolf, Red Fox, Himalayan Brown Bear, Great Indian One Horned Rhinoceros, White Winged Wood Duck, Black Necked Crane, Indian Pea Fowl, Gharial, Indian egg eating Snake, Indian Salamander etc. are some examples of endemic animal species of India.

## 2.19 CONSERVATION OF BIODIVERSITY

- ❖ The convention on Biological Diversity held in June, 1992 stressed the need of the conservation of Biodiversity for sustainable development and perpetuation of human beings on earth.
- ❖ Conservation is defined as “ the management of human use of the biosphere so that it may yield the greatest sustainable benefit to the present generation while maintaining its potential to meet the needs and aspirations of the future generations”.
- ❖ The two basic approaches to wildlife conservation in protected habitats are:
  - 1) In- situ conservation
  - 2) Ex- situ conservation.

### 2.19.1 In- situ conservation

- ❖ It simply means conservation of species in its natural ecosystem or even in man made ecosystems.
- ❖ This strategy emphasizes protection of total ecosystem through a network of “protected area”.
- ❖ Protected Areas: an area of land and/or sea specially dedicated to the protection and maintenance of biological diversity and managed through legal effective means.
- ❖ There are different categories of protected areas which are managed with different objectives. These include; Biosphere reserves, National parks, Wild Life Sanctuaries etc.
- ❖ At present we have 11 major biosphere reserves, 80 National parks, 420 wildlife sanctuaries in our country covering 4% of the geographic area.
- ❖ The JIM CORBETT National Park was 1st national park established in India.

What is Difference among Biosphere reserves, National parks, Wild Life Sanctuaries ?

Examples of Biosphere reserves of India:

1. Nilgiri- 5,520 sq.km
2. Nanda Devi- 5,860.69 sq. km
3. Manas – 2837 sq. km
4. Gulf of Mannar – 10,500 sq. km
5. Great Nicobar – 885 sq. km
6. Panchmarhi – 4,926.28 Sq Km

Examples of some National park in India

1. Kaziranga- Assam, Gir National Park- Gujarat, Periyar – Kerala, Sariska – Rajasthan

Examples of some Wild Life Sanctuaries of India:

1. Ghana Bird sanctuaries
2. Hazaribagh sanctuaries
3. Abohar wild life sanctuaries
4. Jaldapara wild life sanctuaries
5. Mudamalai wild life sanctuaries

### 2.19.2 Ex- situ conservation

- ❖ It is defined as “the conservation of component of biological diversity (Sample of genetic diversity, particularly of endangered species) outside their natural habitats”.
- ❖ It involves maintenance and breeding of endangered plant and animal species under partially or wholly controlled conditions. E.g. Zoos, Botanical Gardens, Aquaria, Nurseries, DNA bank, Seed bank, Gene bank etc.
- ❖ There are more than 1500 Botanical gardens in the world containing more than 80,000 species.
- ❖ There are more than 800 zoos around the world with about 3,000 species of mammals, birds, reptiles and amphibians.

#### Review questions:

1. Define Environmental science.  
Environmental science is the study of the environment, its biotic and abiotic components and their interrelationships.
2. What are the important components of environment?  
Abiotic or non-living components Biotic or living component Energy component
3. What are the processes involved in hydrological cycle?  
Continuous evaporation, transpiration, precipitation of surface run off and ground water
4. Define biogeochemical cycle. Give example.  
The continuous circulation of all the essential elements and compounds required for life, from the environment to the organism and back to the environment.e.g., carbon cycle.
5. What are the functions of lithosphere? It is a home for human beings and wild lives.  
It is a store house minerals and organic matters
6. Mention the various types of public participation.
  - Pressure group      ▪ Watch dog
  - Advisory council    ▪ Enforcing the environmental laws
7. Explain biosphere?  
The part of lithosphere, hydrosphere and atmosphere in which living organisms live and interact with one another is called biosphere.