

# Ecology and Ecosystems

(1)

Ecology may be defined as the study of the relationship of various ~~eg~~ organisms to their surroundings.

Depending upon ~~whether~~ <sup>if</sup> the study is of a single organism with respect to its environment then it is called Autecology and if the study is for a group of organisms then it is called Synecology.

The structural and functional unit of Ecology is known as Ecosystem. It is the basic unit of Ecology. eg pond ecosystem, river ecosystem, forest ecosystem etc.

Components of an ecosystems.

- biotic (living) -
- abiotic (non living) - eg land, air, water.

Based on nutritional (trophic) status, Biotic components are further sub-divided into:

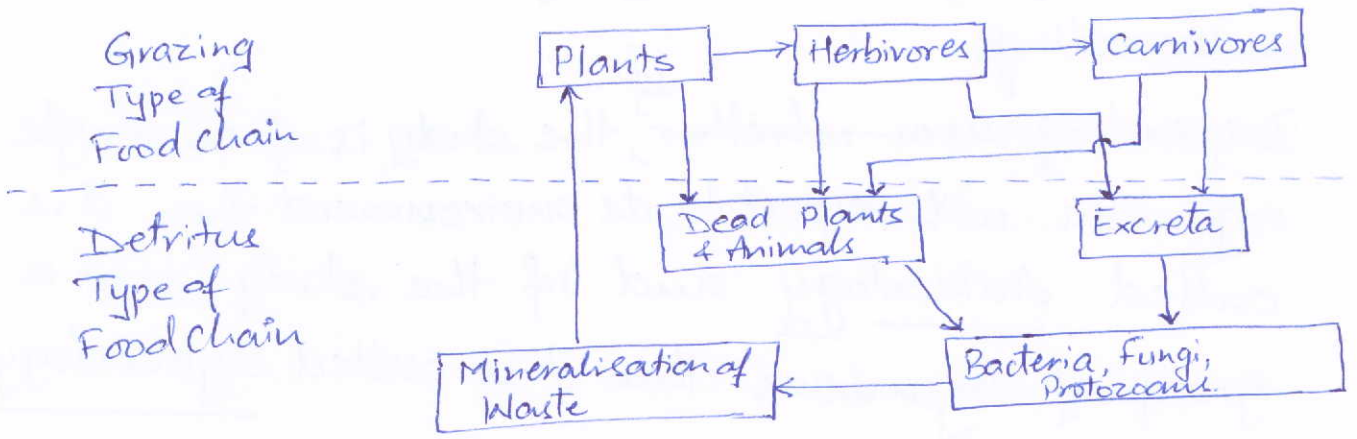
- Autotrophic ie self nourishing or producers eg plants
- Heterotrophic ie consumers. eg animals.

├ Herbivorous  
└ Carnivorous.

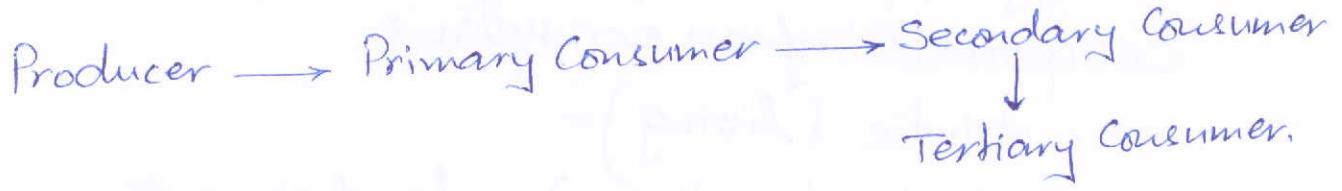
# Functions of an Ecosystem :

## + Food-chains and Food Webs :->

- Grazing
- Detritus



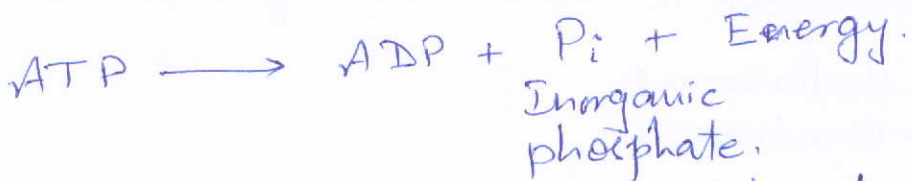
Food-chains are not so simple and straight forward, but a lot of inter-locking does take place. Such a food-chain is called a Food-web.



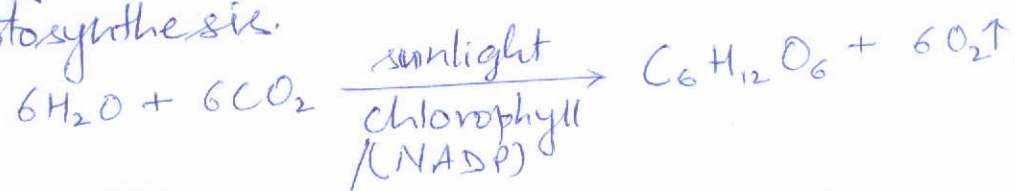
## + Transfer of Energy.

The living cells store potential energy in the form of high energy phosphate bonds in phosphate molecules.

ATP -> adenosine tri phosphate (most common).



Animals generate their ATP while plants use solar energy for their development through the process of photosynthesis.



# Biogeochemical Cycles

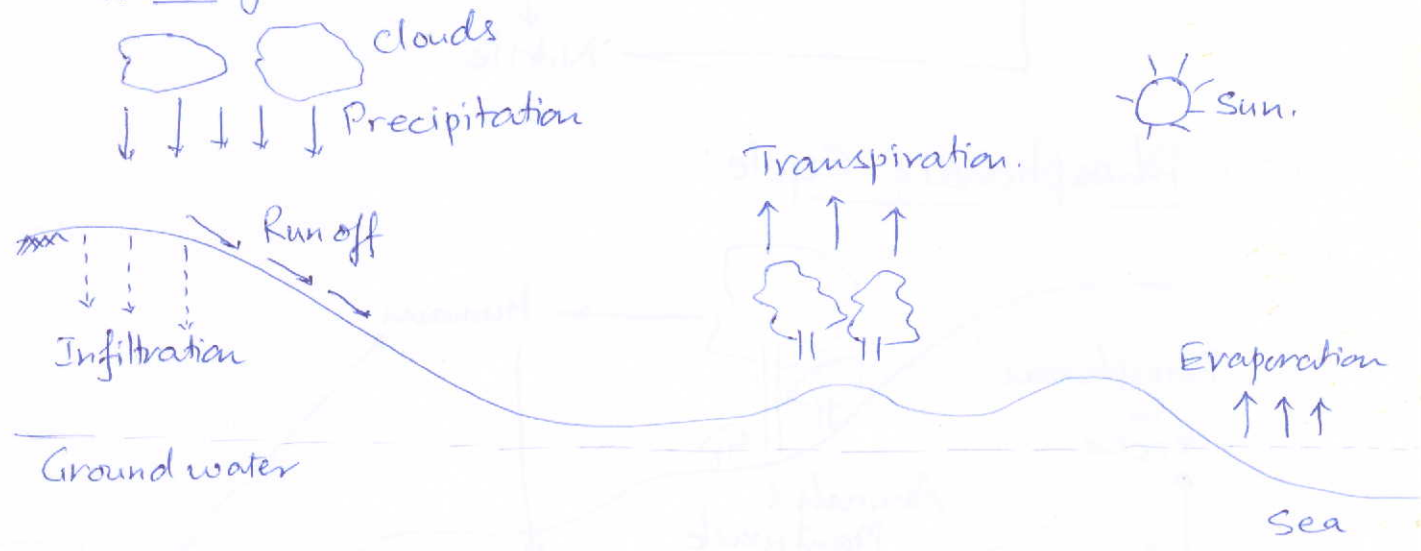
- Six major elements required by majority of living organisms are: Carbon, Hydrogen, Oxygen, Nitrogen, Phosphorus and Sulphur. Other important minerals are Calcium, ~~Phosph~~ Potassium and Magnesium.

The inorganic compounds of major elements are known as Macro-nutrients. and compounds of minor elements are known as Micro-nutrients.

These chemical elements tend to circulate in the biosphere in characteristic paths. Such paths are known as Bio-geo-chemical cycles. Two types are :-

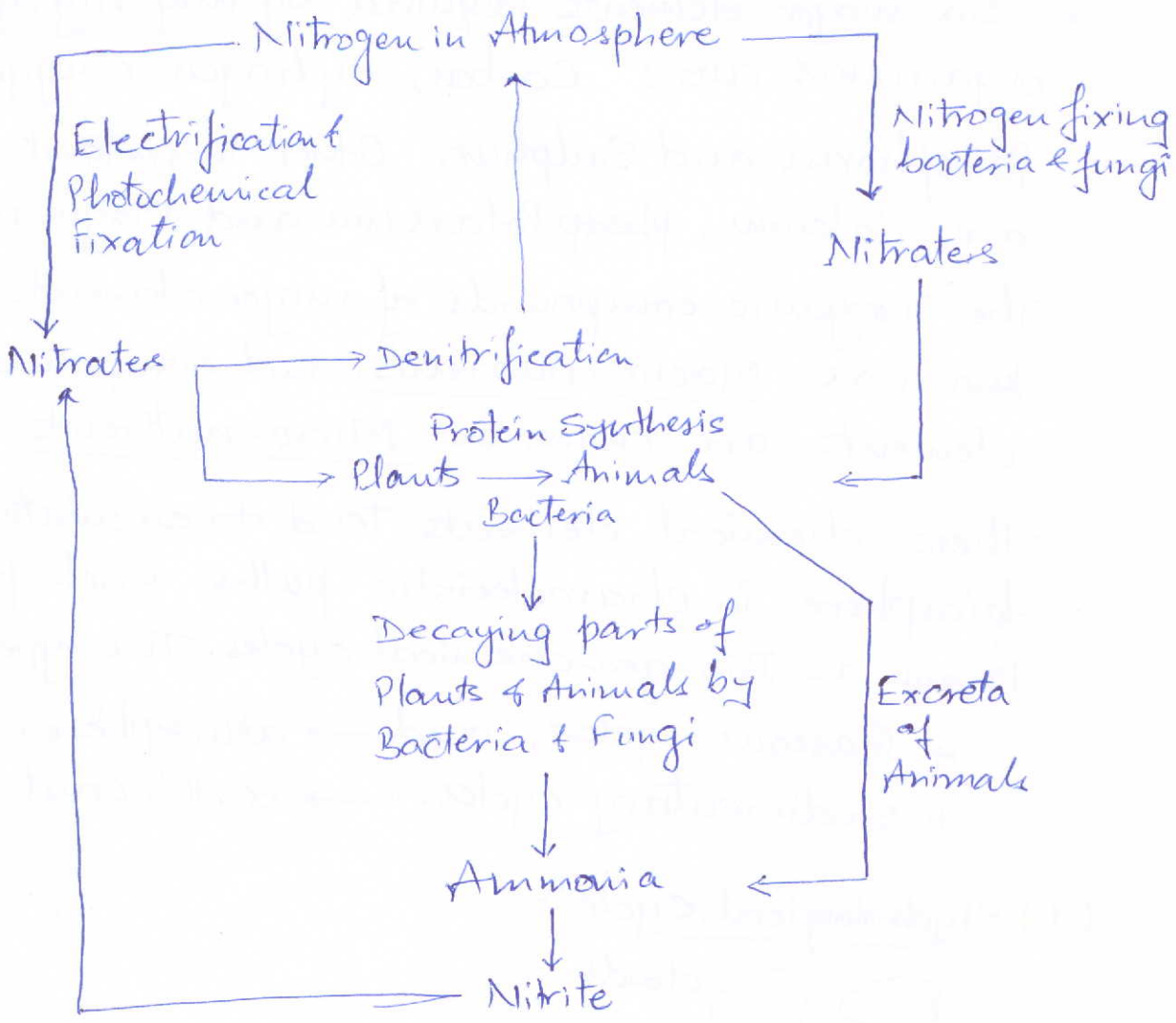
- + Gaseous cycles; and → atmosphere as reservoir.
- + Sedimentary cycles. → Earth's crust " " "

## (1) Hydrological Cycle :-

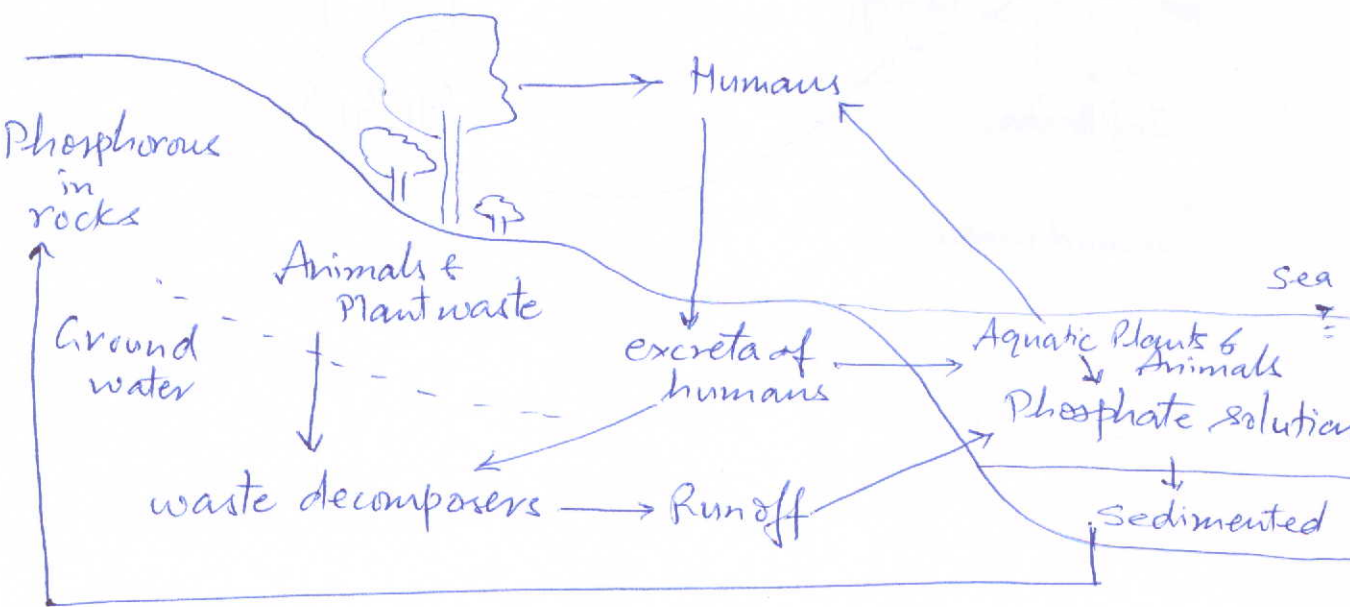




(2) The Nitrogen Cycle:



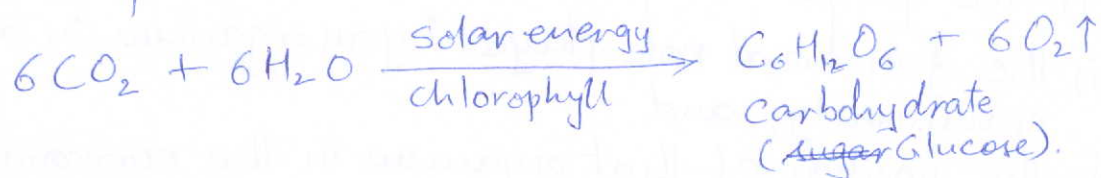
(3) Phosphorous Cycle:



## The Carbon Cycle :

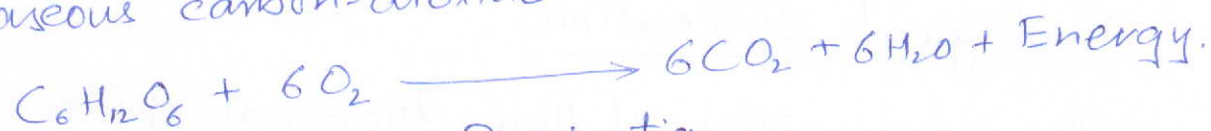
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The atmospheric air as carbon-dioxide gas ( $\text{CO}_2$ ) enters the biological world through the process of Photosynthesis. During photosynthesis, green plants use solar energy to combine  $\text{CO}_2$  and water to produce energy rich carbohydrates (sugar etc.) and in the process release oxygen, i.e.,



Three functions of green plants are:-

- (i) Complex organic compounds such as sugars, proteins, amino acids etc are produced from simple inorganic carbon-dioxide and water;
- (ii) the sunlight, captured and stored, provides the energy needed by the plants themselves or by the consumer of plants; and
- (iii) the process liberates oxygen, which is used by the living organisms for breathing and survival. i.e. it breaks down the organic carbon compounds into gaseous carbon-dioxide and water;



This is known as Respiration.

Residence Time :  $\rightarrow$  It is the time period for which a particular element/compound remains/stays in the system or cycle.

## Residence of Living Organisms in Ecosystems.

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Habitat — refers to the place where a particular organism lives.

Ecological Niche → The habitats with the following characteristics:

- (i) the physical space occupied by an organism
- (ii) the functional role played by an organism in a community, and
- (iii) the position of that organism in the environmental gradient (ie. salinity, temperature etc.).

• Species Richness and Species Diversity in a Community.

↳ the number of species present in a community.

• Homeostasis and stability of an Ecosystem.

The tendency of biological systems to resist change and remain in a state of steady equilibrium is called the Homeo-stasis.

• Ecological Succession.

The communities of living biological species are not permanently stable over time. They do change, involving replacement of one community with the other. This replacement of one community with the other is called the Ecological Succession. This is a continuous process, at least until a final stage, called Climax, is reached.



## (4) The Carbon Cycle:

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### Process of Biotic Succession

The succession of living organisms in a habitat can be divided into the following two types:-

- (i) Primary
- (ii) Secondary.

In primary succession, the living organisms establish themselves for the first time in that habitat. This first community of living organisms that develop ~~the~~ <sup>in a</sup> habitat is called the pioneer community.

The secondary succession,:- the habitat which was earlier occupied by a living community ~~has been~~ have disappeared due to some catastrophic event like flood, fire or volcanic eruption and now in the present times, new organisms start inhabiting that habitat.

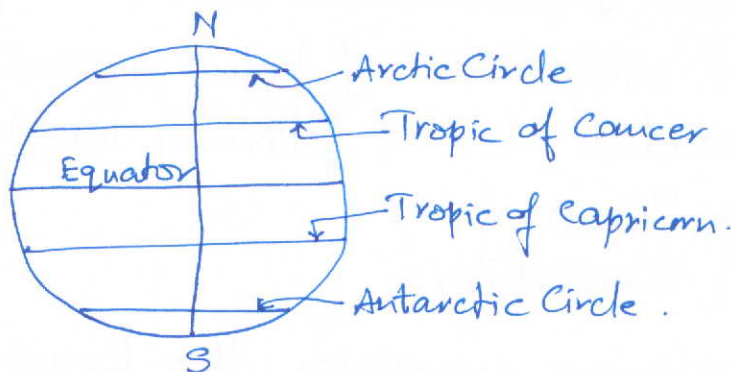
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### Major Ecosystems (Biomes) and their Biodiversity.

- Terrestrial → land
- Aquatic → water

A biome is defined as a biotic community, characterised by the distinctiveness in the life forms of the important climax bio-species. Also, a group of smaller ecosystems, in which the primary producers have similar life forms, and the consumers have similar feeding habits, may be called a biome.

Due to large scale climatic variations on Earth, various types of terrestrial biomes have evolved.



The important terrestrial biomes are:

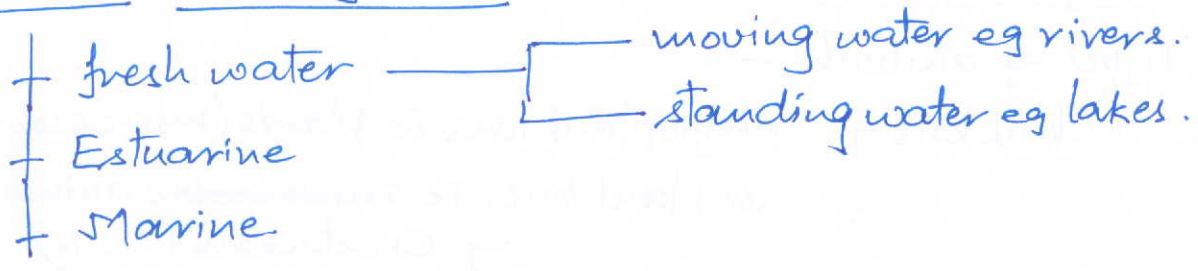
- (i) Tundra biome
- (ii) Taiga biome
- (iii) Grassland biome.
- (iv) Deciduous forest biome
- (v) Highlands Icy Alpine biome.
- (vi) Chapparral biome.
- (vii) Desert biome
- (viii) Savanna biome.
- (ix) Tropical Rain forest biome.

<u>Biome</u>	<u>Climate</u>	<u>Dominant Plants</u>	<u>Animals.</u>
1. Tundra	Extremely cold, dry; permanently frozen	Lichens, low shrubs, sedges.	Arctic foxes, polar bears, caribou, wolves, migratory birds.
2. Taiga a) Boreal forest b) Temperate coniferous	cold winters, short growing season. Cool, moist.	Coniferous evergreen trees chiefly, balsam, fir, jack pine, black & white spruce. Coniferous evergreen trees - redwood, cedar, hemlock, pine.	Bears, moose, wolves, ducks, loons. Bears, elk, mountain lions, wolves.
3. Deciduous forest	Cold winters, warm summer, moist	Broadleaf deciduous trees, eg, elm, maple, oak.	Deer, raccoons, squirrels, birds.
4. Grasslands	Temperate, subhumid	Grasses & other herbaceous plants.	chenu (deer), bears, yaks etc. Antelope, bison, buffaloes, wolves, coyotes.



<u>Biome</u>	<u>Climate</u>	<u>Dominant Plants</u>	<u>Animals</u>
Highlands Icy Alpine	Summers (10-15°C) winters below 0°C	small height plants, shrubs etc.	Cheru (deer), bears, yaks etc.
Chapparral	Rainy, mild winter, hot, dry summer; fires common.	Low shrubs, with small hard leaves, such as scrub oak & manzanita.	Coyotes, mule deer, many species of lizards.
Desert	Extremely dry	Cacti, and other fleshy plants, sparse grasses, small-leaved shrubs	Lizards, snakes, rodents, etc
Savanna	Long dry season.	Grasses and scattered clumps of trees, such as acacia & baobab trees.	Giraffes, zebras, jackals, lions.
Tropical rain forests	Warm, & wet all the year	Broadleaf evergreen trees, some palms & tree ferns, climbing vines	Bats, colorful birds, lizards, monkeys, snakes.

AQUATIC ECOSYSTEMS.



Freshwater Ecosystems.

The scientific study of the ecosystem of fresh water is called Limnology.

- Moving water ecosystem (lotic water habitats)
  - fast
  - slow.
- Standing water ecosystem (lentic water habitats).

Moving Water Ecosystem: Nutrients present is less as compared to standing water ecosystem i.e. lakes. The calcium content (represents hardness of water) may vary from 9 mg/l (soft waters) to about 26 mg/l (hard water). It is essential for metabolic activity of biotic systems & if more than 12 mg/l, animals like molluscs are present in abundance.

Standing Water Ecosystem:-

Estuarine Ecosystems:

An estuary is defined as that outfall reach of a river in which the back water of an ocean during high tides comes in contact with river current. It is a transition zone between fresh water river and salt water oceans.

Marine Ecosystems.

Types of animals:-

- Planktons — phytoplanktons i.e. plants (microscopic)
- — zooplanktons. i.e. ~~microscopic~~ animals. eg. Crustaceans (70%)
- Molluscs

Wetland Systems:

Transitional area between terrestrial and aquatic ecosystems. It is an area of land where water level remains near or above the surface of the ground for almost all the year round.

Types:-

- bogs
- marshes
- swamps.



Bogs are the wet spongy areas of land.

Marshes are flat treeless land areas covered with water.

Swamps are the areas of muddy watery land covered by trees and bushes. There are three types of swamps i.e.,

- (i) deep water swamps
- (ii) shallow water swamps
- (iii) mangrove swamps. → salt water

(1.) Deep water swamps





# BIODIVERSITY & Its

## CONSERVATION

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Biological diversity or Biodiversity is defined as the variability among the living organisms from all the sources including interalia, Terrestrial, marine and other aquatic ecosystems and ecological complexes of which they are the part; and this includes the diversity within the species, between the species, and of the ecosystems.

### Levels or Components of Biodiversity.

Three types or levels of biodiversity :-

- (i) genetic.
- (ii) species or organisomal.
- (iii) ecosystem or ecological.

Each of these three components of biodiversity has its own hierarchical level. All the components are, in fact, intimately inter-linked, and actions at any one level have impacts on other level of the hierarchy.

Species is the basic unit of classification, and is generally defined as a group of similar organisms that interbreed or share a common lineage or descent.

The genetic biodiversity occurs amongst the same species due to enormous number of combinations, which can be formed by the genes found in that species. The genes are the basic units of heredity information, transmitted from one generation to another.

The species diversity or organismal diversity: is variability among the different species of organisms of a community. It broadly represents the species richness and their abundance in a community.

The ecosystem or ecological diversity: - the variations in ecological niches, food chains and food webs, nutrient cycling etc, provided by the different ecosystems.

Importance & Value of Biodiversity:

Biodiversity, besides its intrinsic value of maintaining an ecological balance, provides us goods and services, having high economic value.

The economic value of biodiversity may usually be divided into the following two categories:

- (i) Productive use value; and
- (ii) Consumptive use value.

In addition to economic values, biodiversity uses may be classified as: social & cultural value, aesthetic & recreational, scientific & educative, ethical & religious, potential & option values.

(1) Productive Use Value: → value assigned to the products that are commercially harvested for sale in formal markets eg Fish, timber, crops etc.

(2) Consumptive Use Value: → value placed on natural products that are consumed directly, without entering the normal channels of trade eg. fuel wood, foods, drugs, fibres etc.



## Global Biodiversity.

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The distribution and magnitude of the biodiversity existing today over the entire Earth is a product of over 3 to 5 billion years of its evolution, involving, speciation, migration, extinction, and more recently - human influence.

At present only about 1.8 million (18 lakh) species are known and have been documented but it is estimated that about 8 to 100 million are present.

Out of ~~the~~ all the Terrestrial ecosystems, the tropical rain forests provide the maximum biodiversity; say about 50 to 80% of the total biodiversity provided by all types of biomes together.

National Cancer Research Institute has identified 3000 plants that have cancer fighting chemicals, 70% of them come from tropical rain forests.

World - Heritage Convention, an International agreement, has been executed in an attempt to protect and support biologically rich areas. In India 5 natural heritage sites are Manas wild life sanctuary, Kaziranga National Park in Assam, Keoladeo National Park in Bharatpur Rajasthan, Nanda Devi National Park in Himalayas in Uttaranchal and Sunderbans in West Bengal.

India has also signed 'The Convention on International Trade in Endangered Species (CITES)'; which is intended to reduce the utilization of endangered plants and animals by controlling trade in their products and also trade in pets.

# Status of Indian Biodiversity

Twelve (12) countries of the world have been identified to be bio-rich & they are: Mexico, Columbia, Madagascar, Ecuador, Cameroon, Peru, Brazil, Zaire, China, Malaysia, Indonesia and India.

India has a rich biodiversity. It has :-

- 372 species of mammals — 8<sup>th</sup> highest
- 1228 species of birds — 9<sup>th</sup> "
- 428 species of reptiles — 5<sup>th</sup> "
- 204 " of amphibians — 15<sup>th</sup> "
- 47000 species of plants.

It is further estimated that about 18% of Indian plants are endemic i.e they are found anywhere else in the world.

## Hotspots of Biodiversity.

Biological hotspots are the areas that are unusually rich in biological species, most of which are endemic (i.e not found elsewhere.), ~~and~~ and are under a  $\frac{1}{2}$  constant threat of being over-exploited. Plant diversity is the biological basis for hotspot ~~destination~~ designation. To qualify as a hotspot, a region must support atleast 1500 (i.e  $\frac{1}{2}$  % of global total plant species) endemic plant species. Additionally, the region must have lost more than 70% of its original habitat.

~~May~~ Myers in 1988 introduced the term hotspot. 25 hotspots has been identified and two of these are in India extending into neighbouring countries.



These <sup>25</sup> hotspots cover less than about 1.5% of the world's land area, but they contain about 50% of the terrestrial biodiversity.

About 44% of all the terrestrial plant species and 35% of all the terrestrial invertebrate species of the world are endemic and found in these 25 hotspots.

Threats to Biodiversity:-

Impacts of Loss of Biodiversity:-

The loss of biodiversity causes great financial loss along with causing environmental imbalances, and overall deterioration of the environment. Besides, the immediate and evident economic losses, the entire future potential is lost.

Factors Causing Loss of Biodiversity.

The primary reason for extinction of biological species is the loss of their habitation, caused by large scale deforestation and filling up of the wetlands. The major causes are:-

(i) Loss of Habitat →

Due to urbanisation, or extension of agriculture or for developing pasture lands, the biological species are getting destroyed as they mostly reside in the forests or in the wetlands. The maximum loss of biodiversity is caused by the destruction of tropical forests, which harbour maximum biodiversity.

Wetlands have been destroyed due to dumping of waste as they are considered as wastelands.



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Sometimes, the habitats of biological species have been fragmented by human activities, thereby threatening the existence of wild animals like elephants, bears, lions and leopards that require large territories to subsist. — Habitat fragmentation.

Marine biodiversity is also under a serious threat due to large scale destruction of fragile breeding and feeding grounds of our oceanic fishes and other organisms.

The other causes are expansion of agriculture & urbanisation.

(ii) Poaching

(iii) Man-Wildlife Conflicts.

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### Conservation of Biodiversity.

There are two approaches:-

(i) In-situ conservation, and

(ii) Ex-situ " "

The in-situ conservation is achieved by preserving the biological life within their natural habitats by protecting those habitats.

The ex-situ conservation is achieved by preserving wild life through their preservation outside their natural habitats in zoos and botanical gardens, and through preserving their genes in gene banks.