

For UPSC Civil Services and State PCS Exam

2021 NEW EDITION

ENVIRONMENT

SHANKAR IAS BOOK

**SUMMARY NOTES ENVIRONMENT SHANKAR BOOK
CHAPTER:- 1 TO 29
NOTES FOR 2021 & 2022**

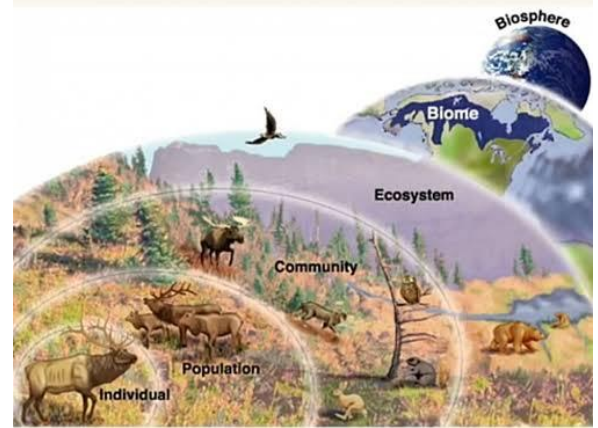
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CHAPTER: 1 - ECOLOGY

- Ecology is defined as a scientific study of the relationship of the living organisms with each other and with their environment.
- It deals with the ways in which organisms are moulded by their environment, how they make use of environmental resources including energy flow and mineral cycling.



The main levels of organisation of ecology are six and are as follows.

1. **Individual:** - Individual-Organism is an individual living being that has the ability to act or function independently.
2. **Population:** - Population-Population is a group of organisms usually of the same species, occupying a defined area during a specific time,
3. **Community:** - Communities in most instances are named after the dominant plant form (species). A community is not fixed or rigid; communities may be large or small.

- **Types of Community:** On the basis of size and degree of relative independence communities may be divided into two types-

- i. **Major Community:** - These are large-sized, well organized and relatively independent. They depend only on the sun's energy from outside and are independent of the inputs and outputs from adjacent Communities. E.g: tropical ever green forest in the North-East
- ii. **Minor Communities:** - These are dependent on neighbouring communities and are often called societies. They are secondary aggregations within a major community

HISTORY OF ECOLOGY

- The classical texts of the Vedic period such as the Vedas, the Samhitas, the Brahmanas the Aranyakas - Upanishads contain many references to ecological concepts
- The Indian treatise on medicine, the Caraka - Samhita and the surgical text Susruta - Samhita.
- Contain classification of animals on the basis of habit and habitat, land in terms of nature of soil, climate and vegetation; and description of plants typical to various localities.
- Caraka - Samhita contains information where air, land, water and seasons were indispensable for life and that polluted air and water were injurious for health.

ENVIRONMENT AND ITS COMPONENTS

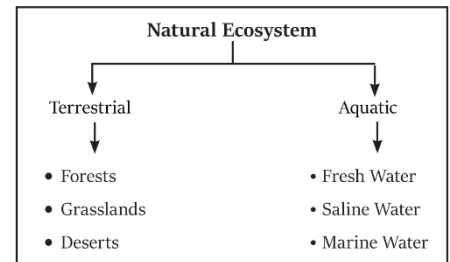
The environment is defined as 'the sum total of living, non-living components; influences and events, surrounding an organism.

Components of Environment	
Abiotic	Biotic
Energy	Green plants
Radiation	Non-green plants
Temperature & heat flow	Decomposers
Water	Parasites
Atmospheric gases and wind	Symbionts
Fire	Animals
Gravity	Man
Topography	
Soil	
Geologic substratum	

LEVELS OF ORGANISATIONS IN ECOLOGY

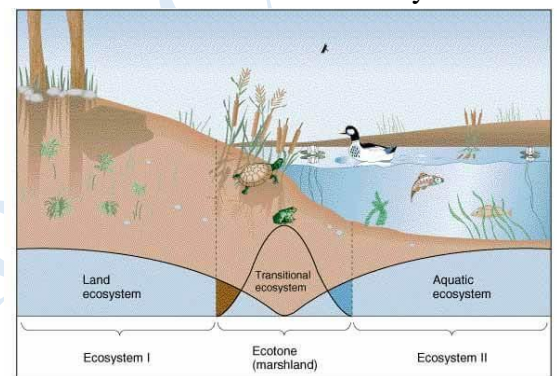
- on plants e.g. cow, rabbit.
- Secondary consumers feed on primary consumers e.g. wolves. Carnivores which feed on secondary consumers are called tertiary consumers e.g. lions which can eat wolves. Omnivores are organisms which consume both plants and animals e.g. man.
- **Micro consumers - Saprotrophs (decomposers or osmotrophs).**
- They are bacteria and fungi which obtain energy and nutrients by decomposing dead organic substances (detritus) of plant and animal origin.
- The products of decomposition such as inorganic nutrients which are released in the ecosystem are reused by producers and thus recycled.
- Earthworm and certain soil organisms (such as nematodes, and arthropods) are detritus feeders and help in the decomposition of organic matter and are called detritivores.

○ Classification of Eco-system



○ Ecotone

- Zone of junction between two or more diverse ecosystems. For e.g. the mangrove forests represent an ecotone between marine and terrestrial ecosystem.



ii. Characteristics of Ecotone

1. It may be very narrow or quite wide.
2. It has the conditions intermediate to the adjacent ecosystems. Hence it is a zone of tension.
3. It is linear as it shows progressive increase in species composition of one in coming community and a simultaneous decrease in species of the other outgoing adjoining community.
4. A well-developed ecotone contains some organisms

which are entirely different from that of the adjoining communities.

5. Sometimes the number of species and the population density of some of the species is much greater in this zone than either community. This is called edge effect for example the density of birds is greater in the mixed habitat of the ecotone between the forest and the desert.

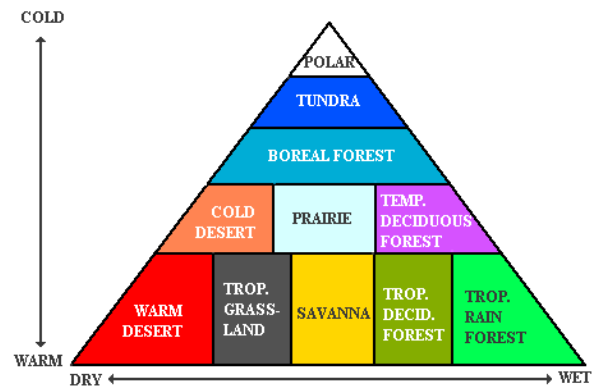
- **Niche**

- i. A description of all the biological, physical and chemical factors that a species needs to survive, stay healthy and reproduce.
- ii. NO two species have exact identical niches. Niche plays an important role in conservation of organisms.

- iii. **Types of Niche**

1. Habitat niche where it lives
2. Food niche - what it eats or decomposes & what species it competes with
3. Reproductive niche - how & when it reproduces.
4. Physical & chemical niche - temperature, land shape, land slope, humidity & other requirement.

5. BIOME

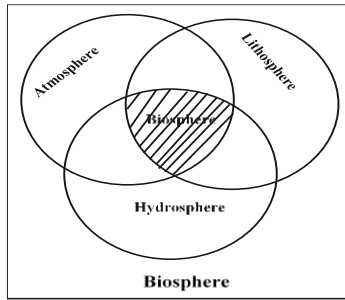


- The terrestrial part of the biosphere is divisible into enormous regions called biomes, which are characterized, by climate, vegetation, animal life and general soil type
- No two biomes are alike. The most important climatic factors are temperature and precipitation.
- **Aquatic Zones**
 - i. Aquatic systems are not called biomes; however they are divided into distinct life zone.
 - ii. The major differences between the various aquatic zones are due to salinity, levels of dissolved nutrients; water temperature, depth of sunlight penetration.

6. BIOSPHERE

- A part of the earth where life can exist represents a highly integrated and interacting zone comprising of atmosphere (air), hydrosphere (water) and lithosphere (land).
- Life in the biosphere is abundant between 200 metres (660 feet) below the surface of the Ocean and about 6,000 metres (20,000 feet) above sea level.

- Biosphere is Absent at extremes of the



North and South poles. Living organisms are not uniformly distributed throughout the biosphere.

S.No.	Name of Biome	Region	Flora and Fauna
1	Tundra	Northern and Southern most region of world adjoining the ice bound poles	Devoid of trees except stunted shrubs in the southern part of tundra biome, ground flora includes lichen, mosses and sedges. The typical animals are reindeer, arctic fox, polar bear, snowy owl, lemming, arctic hare, ptarmigan. Reptiles and amphibians are almost absent.
2	Taiga	Northern Europe, Asia and North America. Moderate temperature than tundra. Also known as boreal forest.	The dominating vegetation is coniferous evergreen mostly spruce, with some pine and firs. The fauna consists of birds, hawks, fur bearing carnivores, little mink, elks, puma, Siberian tiger, wolverine, wolves etc.
3	Temperate Deciduous Forest	Extends over Central and Southern Europe, Eastern North America, Western China, Japan, New Zealand etc. Moderate average temperature and abundant rainfall.	The flora includes trees like beech, oak, maple and cherry. Most animals are the familiar vertebrates and invertebrates. These are generally the most productive agricultural areas of the earth
4	Tropical rain forest	Tropical areas in the equatorial regions, which is abound with life. Temperature and rainfall high.	Tropical rainforest covers about 7% of the earth's surface & 40% of the world's plant and animal species. Multiple storey of broad-leaved evergreen tree species are in abundance. Most animals and epiphytic plants are concentrated in the canopy or tree top zones.
5	Savannah	Tropical region: Savannah is most extensive in Africa.	Grasses with scattered trees and fire resisting thorny shrubs. The fauna include a great diversity of grazers and browsers such as antelopes, buffaloes, zebras, elephants and rhinoceros; the carnivores include lion, cheetah, hyena; and mongoose, and many rodents.
6	Grassland	North America, Ukraine, etc. Temperate conditions with low rainfall.	Grasses dominate the vegetation. The fauna include large herbivores like bison, antelope, cattle, rodents, prairie dog, wolves, and a rich and diverse array of ground nesting bird.
7	Desert	Continental interiors with very low and sporadic rainfall with low humidity. The days are very hot but nights are cold.	The flora is drought resistance such as cactus, euphorbias, sagebrush. Fauna: Reptiles, Small Mammals and birds.

S.No	Aquatic ecosystem	Characteristics
1.	Fresh Water Ecosystem	Fresh water ecosystem are classified as lotic (moving water) or lentic (still or stagnant water). Lotic water system includes freshwater streams, springs, rivulets, creeks, brooks, and rivers. Lentic water bodies include pools, ponds, some swamps, bogs and lakes. They vary considerably in physical, chemical and biological characteristics.
2.	Marine Ecosystem	Nearly three - quarter of earth's surface is covered by ocean with an average depth of 3,750 m and with salinity 35 ppt, (parts per thousand), about 90 per cent of which is sodium chloride.
3.	Estuaries	Coastal bays, river mouths and tidal marshes form the estuaries. In estuaries, fresh water from rivers meet ocean water and the two are mixed by action of tides. Estuaries are highly productive as compared to the adjacent river or sea.
4.	Coral reef	
5.	Mangrove	

CHAPTER: 2 – FUNCTIONS OF AN ECOSYSTEM

ENERGY FLOW

- Energy is the basic force responsible for all metabolic activities. The flow of energy from producer to top consumers is called energy flow which is unidirectional.

Trophic Level Interaction

- Trophic level interaction deals with how the members of an ecosystem are connected based on nutritional needs.
- Energy flows through the trophic levels: from producers to subsequent Trophic levels.
- There is a loss of some energy in the form of unusable heat at each trophic level.

Trophic levels (Trophe = nourishment)		
I	Autotrophs	Green plants (producers)
II	Heterotrophs	Herbivore (primary consumers)
III	Heterotrophs	Carnivores (secondary consumers)
IV	Heterotrophs	Carnivore (tertiary consumers)
V	Heterotrophs	Top carnivores (Quarternary consumers)

The Trophic Level Interaction Involves Three Concepts Namely

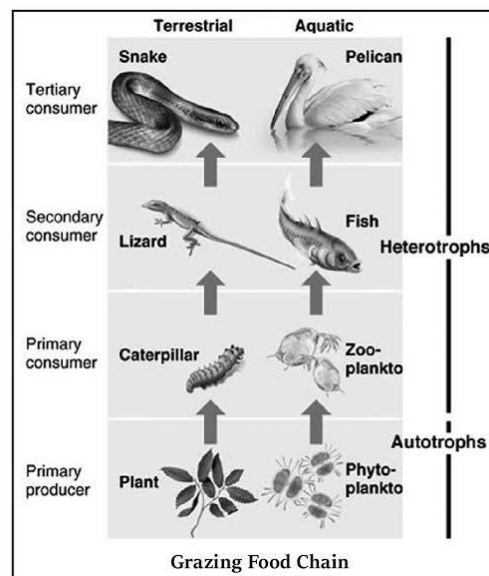
- Food Chain
- Food Web
- Ecological Pyramids

FOOD CHAIN

- ✓ A food chain starts with producers and ends with top carnivores. The sequence of eaten and being eaten, produces transfer of food energy and it is known as food chain.

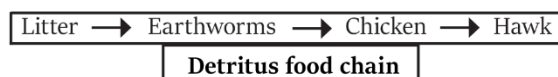
- **Grazing food chain**

- The consumers which start the food chain, utilising the plant or plant part as their food, constitute the grazing food chain. This food chain begins from green plants at the base and the primary consumer is herbivore



- For example, In terrestrial ecosystem, grass is eaten up by caterpillar, which is eaten by lizard and lizard is eaten by snake.
- In Aquatic ecosystem phytoplankton's (primary producers) is eaten by zoo planktons which is eaten by fishes and fishes are eaten by pelicans

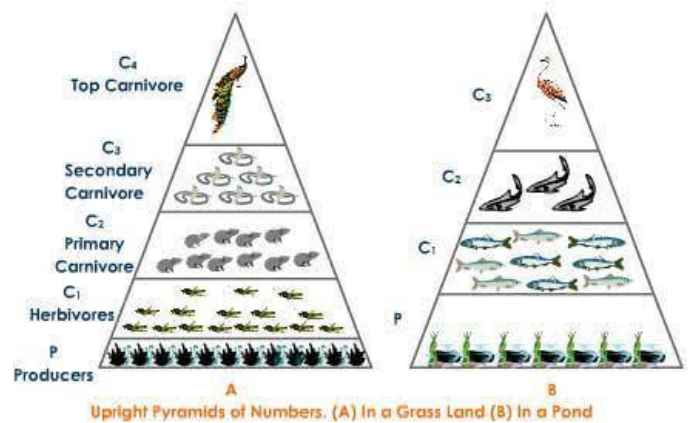
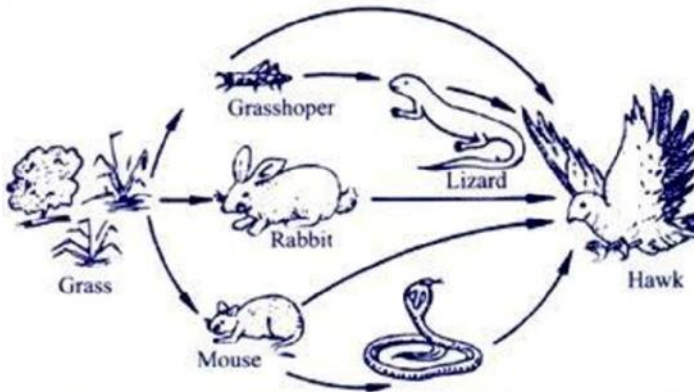
- **Detritus food chain**



- The food chain starts from dead organic matter of decaying animals and plant bodies to the micro-organisms and then to detritus feeding organism called detritivores or decomposer and to other predators. Litter - Earthworms - Chicken - Hawk
- The distinction between these two food chains is the source of energy for the first level consumers.

FOOD WEB

- A food web illustrates, all possible transfers of energy and nutrients among the organisms in an ecosystem, whereas a food chain traces only one pathway of the food.

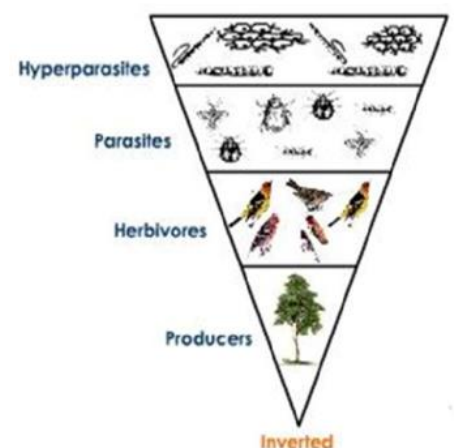


- In this pyramid, the number of individuals is decreased from lower level to higher trophic level.
- This type of pyramid can be seen in grassland ecosystem.

ECOLOGICAL PYRAMID

- The steps of trophic levels expressed in a diagrammatic way are referred as ecological pyramids.
- The food producer forms the base of the pyramid and the top carnivore forms the tip. Other consumer trophic levels are in between
- The pyramid consists of a number of horizontal bars depicting specific trophic levels which are arranged sequentially from primary producer level through herbivore, carnivore onwards.
- Length of each bar represents the total number of individuals at each trophic level in an ecosystem.
- **The ecological pyramids are of three categories**
- Pyramid of numbers,
- Pyramid of biomass, and
- Pyramid of energy or productivity
- **Pyramid of Numbers:** This deals with the relationship between the numbers of primary producers and consumers of different levels. Depending upon the size and biomass, the pyramid of numbers may not always be upright, and may even be completely inverted.
 - **Pyramid of numbers upright**

- **Pyramid of numbers – inverted**
- In this pyramid, the number of individuals is increased from lower level to higher trophic level. A count in a forest would have a small number of large producers, for e.g.
- Few numbers of big trees. This is because the tree (primary producer) being few in number and would represent the base of the pyramid and the dependent herbivores (Example - Birds) in the next higher trophic level and it is



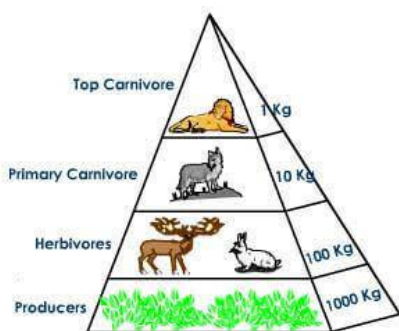
followed by parasites in the next trophic level. Hyper

parasites being at higher trophic level represents higher in number.

- A pyramid of numbers does not take into account the fact that the size of organisms being counted in each trophic level can vary the pyramid of number does not completely define the trophic structure for an ecosystem.

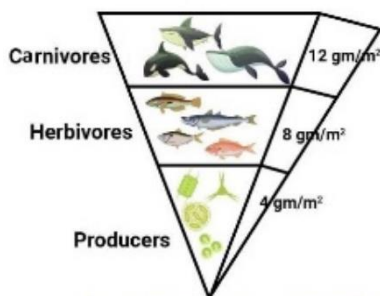
- **Pyramid of Biomass:** In this approach individuals in each trophic level are weighed instead of being counted. This gives us a pyramid of biomass, i.e., the total dry weight of all organisms at each trophic level at a particular time. Biomass is measured in g/m².

- Upward - Pyramid** For most ecosystems on land, the pyramid of biomass has a large base of primary



Upright Pyramid of biomass in a Terrestrial Ecosystem

- Inverted pyramid-** In contrast, in many aquatic



Inverted Pyramid in an Aquatic Ecosystem

ecosystems, the pyramid of biomass may assume an inverted form.

- **Pyramid of Energy** - To compare the functional roles of the trophic levels in an ecosystem, an energy Pyramid is most suitable. An energy pyramid, reflects the laws of thermodynamics, with conversion of solar energy to chemical energy and heat energy at each trophic level and with loss of energy being depicted at each transfer to another trophic level. Hence the pyramid is always upward, with a large energy base at the bottom.



POLLUTANTS AND TROPHIC LEVEL

Movement of these pollutants involves two main processes:

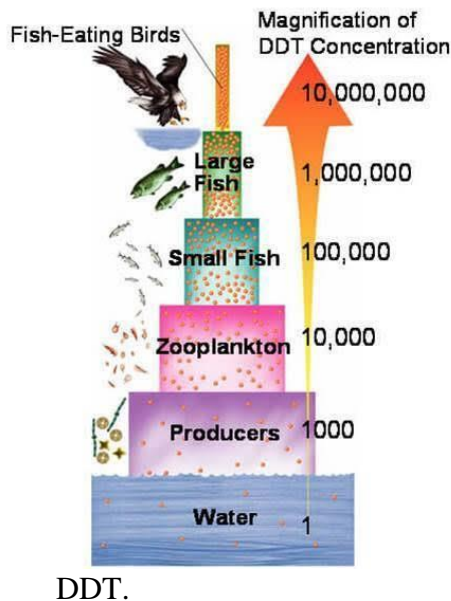
1. Bioaccumulation

- Refers to how pollutants enter a food chain. there is an increase in concentration of a pollutant from the environment to the first organism in a food chain.

2. Bio magnification

- Refers to the tendency of pollutants to concentrate as they move from one trophic level to the next.
- There is an increase in concentration of a pollutant from one link in a food chain to another
- In order for bio magnification to occur, the pollutant must be: long-lived, mobile, soluble in fats, biologically active.

- If a pollutant is not active biologically, it may bio magnify, but we really don't worry about it much, since it probably won't cause any problems Examples :



BIOTIC INTERACTION

The interaction between the organisms is fundamental for its survival and functioning of ecosystem as a whole.

Biotic Interaction			
S.No.	Type	Species 1	Species 2
1.	Mutualism	(+)	(+)
2.	Commensalism	(+)	(o)
3.	Amensalism	(-)	(o)
4.	Competition	(-)	(-)
5.	Predation	(+)	(-)
6.	Parasitism	(+)	(-)
(+) Benefited (-) Harmed			
(o) Neither Benefited nor harmed.			

Type of Biotic Interaction

Mutualism - both species benefit. Example: in pollination mutualisms, the pollinator gets food (pollen, nectar), and the plant has its pollen transferred to other flowers for cross-fertilization (reproduction).

1. **Commensalism** - one species benefits, the other is unaffected. Example: cow dung provides food and shelter to dung beetles. The beetles have no effect on the cows

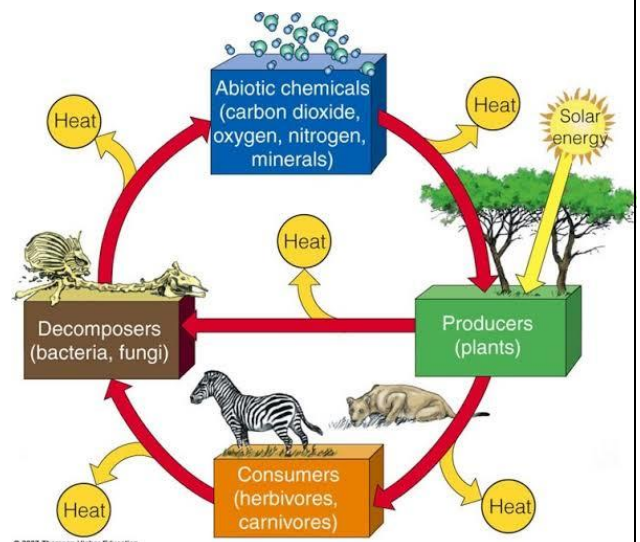
2. **Competition** - both species are harmed by the interaction. Example: if two species eat the same food, and there isn't enough for both. both may have access to less food than they would if alone. They both suffer a shortage of food
3. **Predation and parasitism** - one species benefits, the other is harmed. Example: predation-one fish kills and eats. Parasitism: tick gains benefit by sucking blood; host is harmed by losing blood
4. **Amensalism** - One species is harmed, the other is unaffected Eg-A large tree shades a small plant, retarding the growth of the small plant. The small plant has no effect on the large tree.
5. **Neutralism** - There is no net benefit or harm to either species. Perhaps in some interspecific interactions, the costs and benefits experienced by each partner are exactly the same so that they Sum to zero.

BIO-GEO-CHEMICAL CYCLE

The elements or mineral nutrients are always in circulation moving from non-living to living and then back to the non-living components of the ecosystem in a more or less circular fashion. This circular fashion is known as biogeochemical cycling (bio for living; geo for atmosphere).

1. Nutrient Cycling:

- The nutrient cycle is a concept that describes how nutrients move from the physical environment to the living organisms, and subsequently



recycled back to the physical environment.

- It is essential for life and it is the vital function of the ecology of any region. In any particular environment, to maintain its organism in a sustained manner, the nutrient cycle must be kept balanced and stable.

- **Types of Nutrient Cycle**

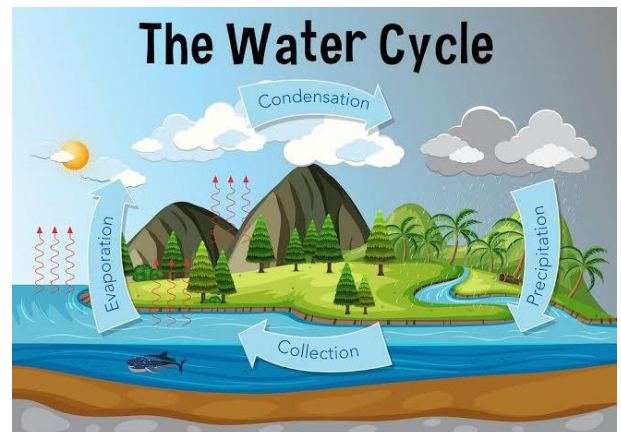
- Based on the replacement period a nutrient cycle** is referred to as Perfect or Imperfect cycle.
- A perfect nutrient cycle** is one in which nutrients are replaced as fast as they are utilised. Most gaseous cycles are generally considered as perfect cycles. In contrast sedimentary cycles are considered relatively imperfect, as some nutrients are lost from the cycle and get locked into sediments and so become unavailable for immediate cycling.
- Based on the nature of the reservoir**, there are two types of cycles namely Gaseous and sedimentary cycle
- Gaseous Cycle**- where the reservoir is the atmosphere or the hydrosphere, and
- Sedimentary Cycle**- where the reservoir is the earth's crust.

2. Gaseous Cycles –

a. Water Cycle (Hydrologic)

- The hydrologic cycle is the continuous circulation of water in the Earth-atmosphere system which is driven by solar energy.

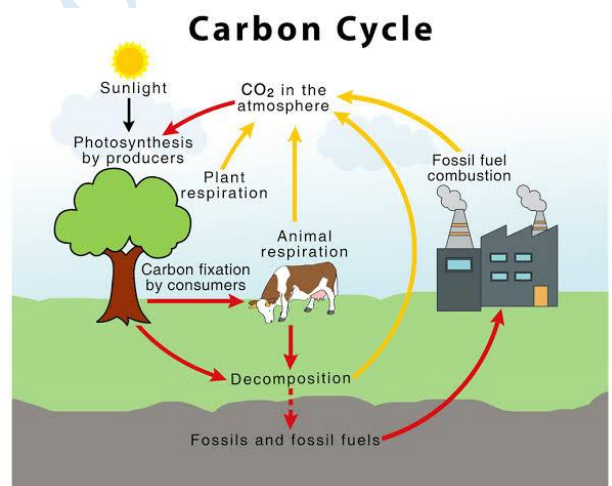
- Water moves from one reservoir to another by the processes of evaporation, transpiration, condensation, precipitation, deposition,



runoff, infiltration, and groundwater flow.

b. The Carbon Cycle

- Without carbon dioxide life



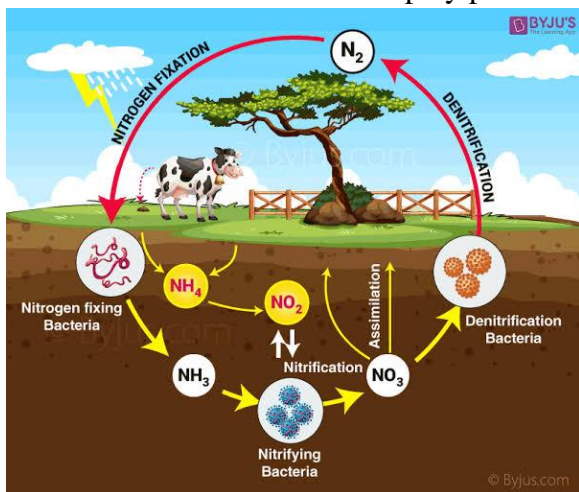
could not exist, because it is vital for the production of carbohydrates through photosynthesis by plants. It is the element that anchors all organic substances from coal and oil to DNA (deoxyribonucleic acid: the compound that carries genetic information).

- Carbon cycle involves a continuous exchange of carbon between the atmosphere and organisms. Carbon from the atmosphere moves to green

plants by the process of photosynthesis, and then to animals. By process of respiration and decomposition of dead organic matter it returns back to atmosphere.

c. The Nitrogen Cycle

- An essential constituent of protein and is a basic building block of all living tissue. It constitutes nearly 16% by weight of all the proteins.
- There is an inexhaustible supply of nitrogen in the atmosphere but the elemental form cannot be used directly by most of the living organism
- Needs to be 'fixed', that is, converted to ammonia, nitrites or nitrates, before it can be taken up by plants.



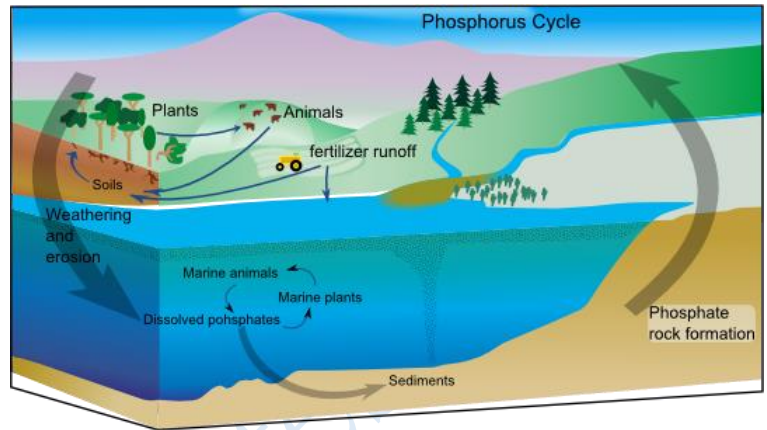
- Nitrogen fixation on earth is accomplished in three different ways:
 - By microorganisms (bacteria and blue-green algae)
 - By man using industrial processes (fertilizer factories) and
 - To a limited extent by atmospheric

phenomenon such as thunder and lighting

3. Sedimentary Cycle

- Phosphorus, calcium and magnesium circulate by means of the sedimentary cycle.

i. Phosphorus Cycle

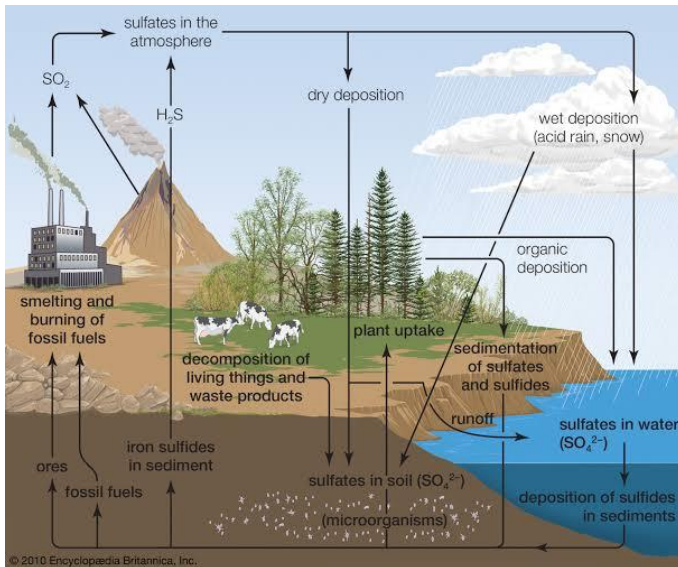


- Phosphorus plays a central role in aquatic ecosystems and water quality.
- Phosphorus occurs in large amounts as a mineral in phosphate rocks and enters the cycle from erosion and mining activities.
- This is the nutrient considered to be the main cause of excessive growth of rooted and free-floating microscopic plant in lakes.
- The main storage for phosphorus is in the earth's crust. On land phosphorus is usually found in the form of phosphates. By the process of weathering and erosion phosphates enter rivers and streams that transport them to the ocean.
- In the ocean once the phosphorus accumulates on continental shelves in the form of insoluble deposits after millions of years, the crustal plates rise from the sea floor

and expose the phosphates on land.

- After more time, weathering will release them from rock and the cycle's geochemical phase begins again.

ii. Sulphur Cycle



- The sulphur reservoir is in the soil and sediments where it is locked in organic coal, oil and peat) and inorganic deposits (pyrite rock and sulphur rock) in the form of sulphates, sulphides and organic sulphur.
- It is released by weathering of rocks, erosional runoff and decomposition of organic matter and is carried to terrestrial and aquatic ecosystems in salt solution
- The sulphur cycle is mostly sedimentary except two of its compounds hydrogen Sulphide (H_2S) and sulphur dioxide (SO_2) add a gaseous component to its normal Sedimentary cycle.
- Atmospheric sulphur dioxide is carried back to the earth after being dissolved in rainwater as weak sulphuric acid.
- Sulphur in the form of sulphates is take up by plants and incorporate through a

series of metabolic processes into sulphur bearing amino acid which is incorporated in the proteins of autotroph tissues. It then passes through the grazing food chain.

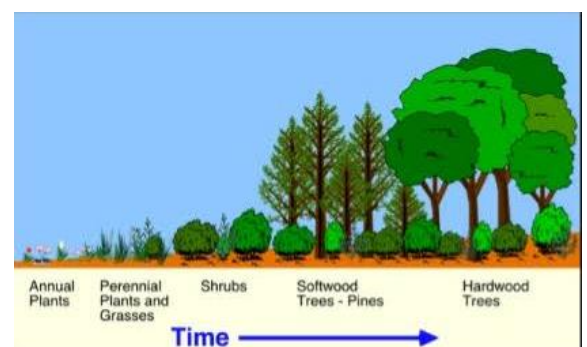
- Sulphur bound in living organism is carried back to the soil, to the bottom of ponds and lakes and seas through excretion and decomposition of dead organic material

ECOLOGICAL SUCCESSION

- A universal process of directional change in vegetation, on an ecological time scale. occurs when a series of communities replace one another due to large scale destruction either natural or manmade.
- Continues -one community replacing another community, until a stable, mature community develops the first plant to colonise an area is called the pioneer community. The final stage of succession is called the climax community. The stage leading to the climax community are called successional stages or seres.
- Characterised by the following: increased productivity, the shift of nutrients from' the reservoirs, increased diversity of organisms with increased niche development, and a gradual increase in the complexity of food webs.

○ Primary Succession

- In primary succession on a terrestrial site the new site



is first colonized by a few hardy pioneer species that are often microbes, lichens and mosses. The pioneers

CHAPTER: 3 - TERRESTRIAL ECOSYSTEMS

- The interrelations between organisms and environment on the land constitute "Terrestrial Ecology". The most important limiting factors of the terrestrial ecosystems are moisture and temperature.

Tundra

- The word tundra means a "barren land" since they are found where environment conditions are very severe. There are two types of tundra-arctic and alpine.
- **Distribution**
 - Arctic tundra extends as a continuous belt below the polar ice cap and above the tree line in the northern hemisphere. It occupies the northern fringe of Canada, Alaska, European Russia, Siberia and island group of Arctic Ocean.
 - On the south pole, tundra is very small since most of it is covered by ocean. Alpine tundra occurs at high mountains above the tree line. Since mountains are found at all latitudes therefore alpine tundra shows day and night temperature variations.
- **Flora and fauna**
 - Typical vegetation of arctic tundra is cotton grass, sedges, dwarf heath, willows, birches and lichens. Animals of tundra are reindeer, musk ox, arctic hare, caribous, lemmings and squirrel. Most of them have long.
 - They are protected from chillness by the presence of thick cuticle and epidermal hair. Mammals of the tundra region have large body size and small tail and ear to avoid the loss of heat from the surface. The body is covered with fur for insulation.

FOREST ECOSYSTEM

- Includes a complex assemblage of different kinds of biotic communities. Optimum conditions such as temperature and ground moisture are responsible for the establishment of forest communities
- Forests may be evergreen or deciduous. Distinguished on the basis of leaf into broad-leafed or needle leafed coniferous forests in the case of temperate areas. Classified into three major categories: coniferous forest, temperate forest and tropical forest.
 - **Coniferous forest (boreal forest)**
 - Cold regions with high rainfall, strong seasonal climates with long winters and short summers evergreen plant species such as spruce, fir and pine trees, etc and by animals such as the lynx, wolf, bear, red fox, porcupine, squirrel, and amphibians like Hyla, Rana, etc.
 - Boreal forest soils are characterized by thin podzols and are rather poor. Both because, the weathering of rocks proceeds slowly in cold environments and because the litter derived from conifer needle (leaf is decomposed very slowly and is not rich in nutrients.
 - These soils are acidic and are mineral deficient. This is due to movement of large amount of water through the soil, without a significant counter-upward movement of evaporation, essential soluble nutrients like calcium, nitrogen and potassium which are leached sometimes beyond the reach of roots.

Due to heavy rainfall and high humidity the timberline in this part is higher than that in the West. Rhododendron of many species covers the hills in these parts.

15. Moist Alpine scrub

- i. Moist alpine are found all along the Himalayas and on the higher hills near the Myanmar border. It has a low scrub, dense evergreen forest, consisting mainly of rhododendron and birch. Mosses and ferns cover the ground in patches. This region receives heavy snowfall.

16. Dry alpine scrub

- i. Dry alpine are found from about 3000 metres to about 4900 metres. Dwarf plants predominate, mainly the black juniper, the drooping juniper, honeysuckle, and willow.

Importance of Forest

1. Forests keep up the natural balance.
2. Forests purify the air
3. Forests provide micro climate
4. Forests indirectly play a role in precipitation
5. Forests prevent floods
6. Forests prevent soil erosion
7. Forests provide medicinal properties
8. Forests provide us fuel and timber
9. Forests provide raw materials for industries

DEFORESTATION

Indiscriminate felling of trees as a result of urbanization, industrialization, mining operations, and use of wood for domestic and other purposes, have caused heavy depletion of forests.

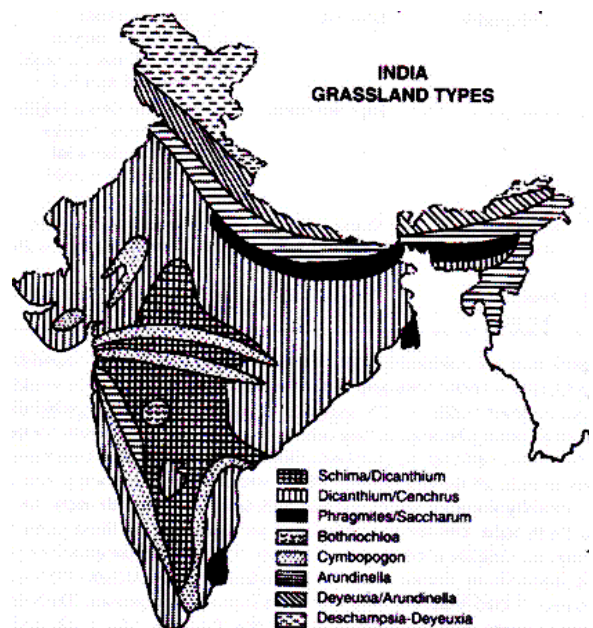
Causes of Deforestation



- Shifting cultivation
- development project
- Fuel Requirements
- Raw Material Requirements

GRASSLAND ECOSYSTEM

- Found where rainfall is about 25-75 cm per year, not enough to support a forest, but more than that of a true desert. Vegetation formations that are generally found in temperate climates.
- In India, they are found mainly in the high Himalayas. The rest of India's grasslands are mainly composed of steppes and savannas. Steppe formations occupy large



areas of sandy and saline soil; in western Rajasthan, where the climate is semi-arid,

- The major difference between steppes and savannas is that all the forage in the steppe is provided only during the brief wet season whereas in the savannas forage is

CHAPTER: 4 - AQUATIC ECOSYSTEM

Ecosystems consisting of water as the main habitat are known as aquatic ecosystems. Aquatic ecosystems are classified based on their salt content.

- **Fresh water ecosystems-** The salt content of fresh bodies is very low, always less than 5 ppt parts per thousand). E.g lakes, ponds, pools, springs, streams, and rivers
- **Marine ecosystems** - the water bodies containing salt concentration equal to or above that of sea water (i.e., 35 ppt or above). E.g shallow seas and open ocean
- **Brackish water ecosystems-** these water bodies have salt content in between 5 to 35 ppt. e.g. estuaries, salt marshes, mangrove swamps and forests.

AQUATIC ORGANISMS

- The aquatic organisms are classified on the basis of their one of occurrence and their ability to cross these zones. Can be classified on the basis of their life form or location into five groups
 - **Neuston**
 - These are unattached organisms which live at the air-water interface such as floating plants, etc.
 - Some organisms spend most of their lives on top of the air-water interface such as water, Striders, while others spend most of their time just beneath the air-water interface and obtain most of their food within the water. E.g., beetles and back-swimmers.
 - **Periphyton**
 - These are organisms which remain attached to stems and leaves of rooted plants or substances emerging above the bottom mud such as sessile algae and the associated group of animals

○ **Plankton**

- This group includes both microscopic plants like algae (phytoplankton) and animals like crustaceans and protozoans (zooplankton) found in all aquatic ecosystems, except certain swift moving waters
- The locomotory power of the planktons is limited so that their distribution is controlled, largely, by currents in the aquatic ecosystems.

○ **Nekton**

- This group contains animals which are swimmers.
- The nektons are relatively large and powerful as they have to overcome the water currents.

○ **Benthos**

- The benthic organisms are those found living in the bottom of the water mass.
- Practically every aquatic ecosystem contains well developed benthos

• **Factors Limiting the Productivity of Aquatic Habitats**

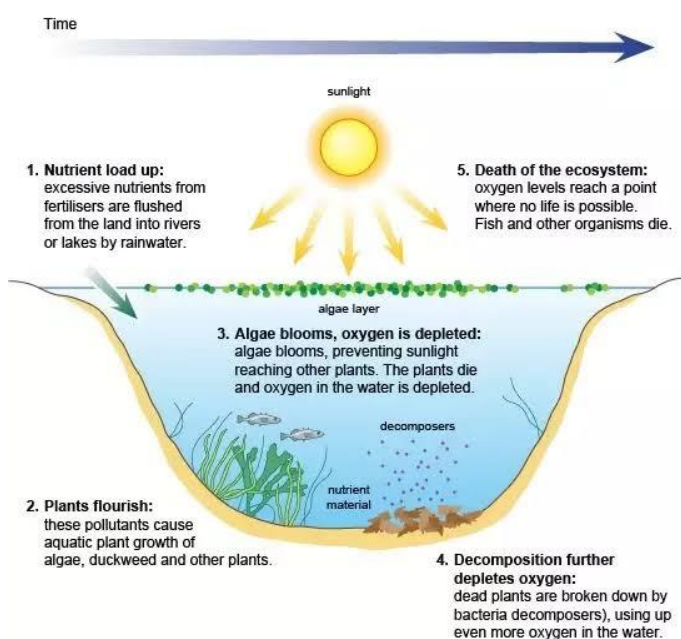
- Sunlight
- Photic zone
- Aphotic zone
- Dissolved oxygen
- Transparency
- Temperature

LAKE ECOLOGY

- Anybody of standing water, generally large enough in area and depth, irrespective of its hydrology, ecology, and other character is generally known as lake.

1. **Ageing of Lakes**

- It is primarily caused by the leaching of phosphate and nitrate containing fertilisers from agricultural lands into lakes or rivers.
- The growth of green algae which we see in the lake surface layer is the physical identification of an Eutrophication.
- Some algae and blue-green bacteria thrive on the excess ions and a population explosion covers almost entire surface layer is known as algal bloom. This growth is unsustainable, however.
- As Algal Bloom covers the surface layer, it restricts the penetration of sunlight. Diffusion of gas from atom.
- Oxygen is required by all respiring animals in the water and it is replenished by diffusion and photosynthesis of green plants.



Types

- **Natural**
 - Deposition of nutrients [such as depositional environments. When the nutrients flow into the system on temporal basics.
 - It Occurs over centuries, Eg. Seasonally inundated tropical flood plains
- **Manmade**
 - Occurs in decades
 - These inputs may come from untreated sewage discharges,

runoff of fertilizer from farm fields, golf

- courses, park , etc. & from animal wastes.
- Combustion of fossil fuel [produces gases – nitrogen oxides
- Growing urban population in the coastal areas

Effects

- Change in ecosystem
- Decreased biodiversity
- New species invasion
- Toxicity
- Mitigation

HARMFUL ALGAL BLOOMS

- Algae or phytoplankton are microscopic organisms that can be found naturally in coastal waters. They are major producers of oxygen and food for many of the animals that live in these waters.
- When environmental conditions are favorable for their development, these cells may multiply rapidly and form high numbers of cells and this is called an algal bloom.
- A bloom often results in a color change in the water. Algal blooms can be any color, but the most common ones are red or brown. These blooms are commonly referred to as red or brown tides.
- • Most algal blooms are not harmful but some produce

Why Red Tide is a misnomer?

- “Red Tide” is a common name for such a phenomenon where certain phytoplankton species contain pigments and “bloom” such that the human eye perceives the water to be discolored.
- The term “red tide” is thus a misnomer because blooms are not always red, they are not associated with tides, they are usually not harmful, and some species can be harmful or dangerous at low cell concentrations that do not discolor the water.

- The mangroves of Bhitarkanika (Orissa), which is the second largest in the Indian sub continent, harbour high concentration of typical mangrove species and high genetic diversity.



Role of mangroves

- Mangroves moderate monsoonal tidal floods and reduce inundation of coastal lowlands.
- It prevents coastal soil erosion.
- It protects coastal lands from tsunami, hurricanes and floods.
- Mangroves enhance natural recycling of nutrients.
- Mangrove supports numerous flora, avifauna and wild life.
- Provide a safe and favorable environment for breeding, spawning, rearing of several fishes.
- It protects coastal inland from adverse climatic elements.

Threat

- They are destroyed for conversion of area for agricultural purpose, fuel, fodder and, salinization, mining, oil spills, aquacultural (shrimp farming), use of chemical pesticides & fertilizers, industrial purposes.

Mangroves for the Future

- Partnership based initiative promoting investment in a coastal ecosystem for sustainable development.

CORAL REEFS

- Coral is actually a living animal. Coral has a symbiotic relationship (each gives something to the other and gets something back in return) With 'zooxanthellae' microscopic algae which live on coral [i.e. instead of living on the sea floor, the algae lives up on the coral which is closer to the ocean surface and so that the algae gets lots of light.
- The tissues of corals themselves are actually not the beautiful colours of the coral reef, but are instead clear (white). The corals receive their coloration from the zooxanthellae living within their tissues.
- There are two types of corals: hard corals and soft corals, such as sea fans and gorgonians, only the builders of coral reefs are tiny animals called polyps.
- As these polyps thrive, grow, then found in tropical and sub-tropical water, there are also deep-water corals in colder hard corals build reefs. die, they leave their limestone (calcium carbonate) skeletons behind. The limestone is colonized by new



polyps.

Features

- They occur in shallow tropical areas where the sea water is clean, clear and warm.
- The coral reef cover in Indian waters is roughly estimated upto 19,000 sq. Km.
- Coral reefs are one of the most productive and complex coastal ecosystems with high biological diversity.

- The high productivity is owing to the combination of its own primary production and support from its surrounding habitat.
- The corals are generally slow growing colonies of animals while zooxanthellae are fast growing plants.

Classification and their location

- The fringing reefs are contiguous with the shore and they are the most common - by occurring reef form, found in Andamans.
- Patch reefs are isolated and discontinuous patches, lying shoreward of offshore reef structures as seen in the Palk bay, Gulf of Mannar and Gulf of Katchchh.
- Barrier reefs are linear offshore reef structures that run parallel to coastlines and arise from submerged shelf platforms. The water body between the reef and the shore is termed as lagoon. Barrier reefs are seen in Nicobar and Lakshadweep.

Functions of Coral Reefs

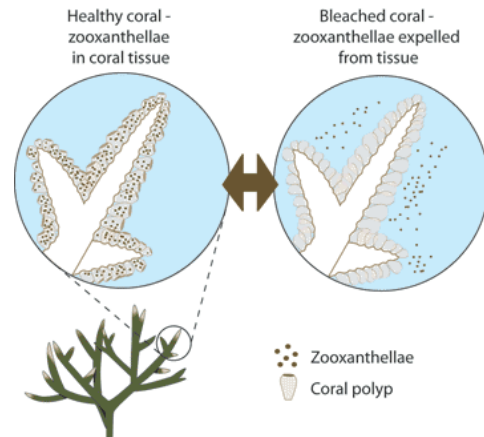
- Coral reefs are natural protective barriers against erosion and storm surge.
- The coral animals are highly adapted for capturing plankton from the water, thereby capturing nutrients
- Largest biogenic calcium carbonate producer
- They provide substrate for mangroves
- Coral reefs provide habitat for a large variety of animals and plants including avifauna.

Threat

- Natural causes may be due to the outbreak of reef destroying mechanisms, "bleaching" and depletion of essential symbiotants.
- Anthrogenic causes – may be due to chemical pollution (pesticides, cosmetics, etc), industrial pollution, mechanical damage, nutrient loading or sediment loading, Dredging, shipping, tourism, mining or collection, thermal pollution, intensive fishing, etc.

Coral Bleaching

- Bleaching, or the paling of coral colour occurs; when
 - the densities of zooxanthellae decline and
 - the concentration of photosynthetic pigments within the zooxanthellae fall



Ecological causes of coral bleaching

- Temperature (Major Cause)
- Sub aerial Exposure
- Fresh Water Dilution
- Inorganic Nutrients
- Xenobiotics

GOVERNMENT MEASURES TO PROTECT MANGROVE FOREST AND CORAL REEFS (OR COASTAL ECOSYSTEM)

- Coastal Ocean Monitoring and Prediction System (COMAPS)
- Land Ocean Interactions in the Coastal Zone (LOICZ)
- Integrated Coastal and Marine Area Management (ICMAM)
- Institutions for Coastal Management
- Society of Integrated Coastal Management (SICOM)
- Beach Environment & Aesthetics Management Service.

GANGA ACTION PLAN

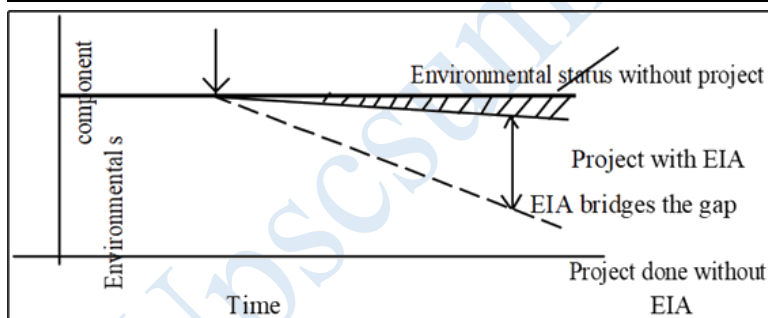
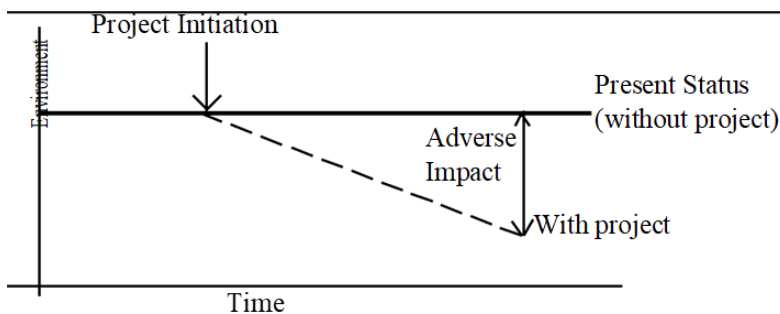
- The Ganga Action Plan was launched on 14th January 1986 with the main objective of pollution abatement, to improve water quality by interception, diversion and treatment of domestic sewage and toxic and industrial chemical wastes present,

CHAPTER: 8 - ENVIRONMENTAL IMPACT ASSESSMENT

- Environmental Protection and Sustainable Development has been the cornerstones of the policies and procedures governing the industrial and other developmental activities in India.

The Need for EIA

- Every anthropogenic activity has some impact on the environment. More often it is harmful to the Environment than benign. However, mankind as it is developed today cannot live without taking up these activities for his food, security and other needs.
- Consequently, there is a need to harmonise developmental activities with the environmental Concerns. It is desirable to ensure that the Development options under consideration are sustainable.



Environmental impact assessment (EIA)

- Environmental impact assessment (EIA) is one of the tools available with the planners to achieve the goal of harmonising development activities with the environmental concerns.
- EIA integrates the environmental concerns in the developmental activities right at the time of initiating for preparing the feasibility report. In doing so it can enable the integration of environmental concerns and mitigation measures in project

development. EIA can often prevent future liabilities or expensive alterations in project design.

INDIAN POLICIES REQUIRING EIA

- The environmental impact assessment in India was started in 1976-77 when the Planning Commission asked the then Department of Science and Technology to examine the river-valley projects from environmental angle. This was subsequently extended to cover those projects, which required approval of the Public Investment Board. These were administrative decisions, and lacked the legislative support. The Government of India enacted the Environment (Protection) Act on 1986.
- To achieve the objectives of the Act, one of the decisions that were taken is to make environmental impact assessment statutory.

THE EIA CYCLE AND PROCEDURES

The EIA process in India is made up of the following phases:

- Screening
- Scoping
- Baseline data collection
- Impact prediction
- Assessment of alternatives, delineation of mitigation
- Public hearing
- Environment Management Plan
- Decision making
- Monitoring the clearance conditions

Salient Features of 2006 Amendment

- Environment Impact Assessment Notification of 2006 has decentralised the environmental clearance projects by categorizing the developmental projects in two categories, i.e.,
- Category A and Category B. 'Category A' projects are appraised at national level by Impact Assessment Agency (IAA) and the Expert Appraisal Committee (EAC) and

CHAPTER: 9 - BIODIVERSITY

- The variability among living organisms from all sources, including terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are a part; Includes diversity within species, between species and of ecosystems.

Levels of Biodiversity

- Biodiversity is considered to exist at three levels: genetics, species, and ecosystems
- **Genetic diversity**
 - Variation in genes within a particular species.
 - It is the total number of genetic characteristics in the genetic makeup of a species.
 - The genetic diversity gives us beautiful butterflies, roses, parakeets or coral in a myriad hues, shapes and sizes
- **Species diversity:**
 - It refers to the variety of living organisms on earth.
 - Species differ from one another, markedly in their genetic makeup, do not inter-breed in nature.
 - It is the ratio of one species population over total number of organisms across all species in the given biome.
 - Zero' would be infinite diversity, and 'one' represents only one species present.
- **Ecosystem/ Community diversity:**
 - This refers to the different types of habitats. A habitat is the cumulative factor of the climate, vegetation and geography of a region. Thus, the variety or diversity of species in the ecosystem is influenced by the nature of the ecosystem

Biodiversity is measured by two major components:

- **Species richness** - It is the measure of number of species found in a community
 - **Alpha diversity** - It refers to the diversity within a particular area or ecosystem, and is usually expressed by the number of species (1.e., species richness) in that ecosystem
 - **Beta diversity** - It is a comparison of diversity between ecosystems, usually measured as the change in amount of species between the ecosystems.
 - **Gamma diversity** - It is a measure of the overall diversity for the different ecosystems Within a region
- **Species evenness**
 - It measures the proportion of species at a given site, e.g. low evenness indicates that a few species dominate the site.

Biodiversity and Food Web

- The building blocks of plants, animals and humans are identical, and are made of the four elements - carbon, oxygen, nitrogen and hydrogen
- The chain that links consumers to producers is called the food chain or web of life.

Services provided by Biodiversity:

- **Ecosystem services:**
 - Protection of water resources, Soils formation and protection, Nutrient storage and recycling
 - Pollution breakdown and absorption Contribution to climate stability Maintenance of ecosystems
 - Recovery from unpredictable events
- **Biological services:**
 - Food, Medicinal resources and pharmaceutical drugs

- Wood products, Ornamental plants
Diversity in genes, species and ecosystems. Etc.

- **Social services:**

- Research, education and monitoring
- Recreation and tourism Cultural values

Causes for Biodiversity Loss

- Loss of biodiversity occurs when either a particular species is destroyed or the habitat essential for its survival is damaged.
- The extinction of species takes place when they are exploited for economic gain or hunted as sport or for food. Extinction of species may also occur due to environmental reasons like ecological substitutions, biological factors and pathological causes which can be caused either by nature or man.

Biodiversity conservation-

- Conservation of biological diversity leads to conservation of essential ecological diversity to preserve the continuity of food chains.

Modes of Conservation

1. **Ex-situ conservation:** Conserving biodiversity outside the areas where they naturally occur is known as ex- situ conservation. For example, the gangetic

gharial has been reintroduced in the rivers of Uttar Pradesh, Madhya Pradesh and Rajasthan where it had become extinct.

2. **In-Situ Conservation:** Conserving the animals and plants in their natural habitats is known as in-situ conservation. The established natural habitats are: National parks, Sanctuaries, Biosphere reserves and Reserved forests, Protected forests, Nature reserves

Constraints in biodiversity conservation:

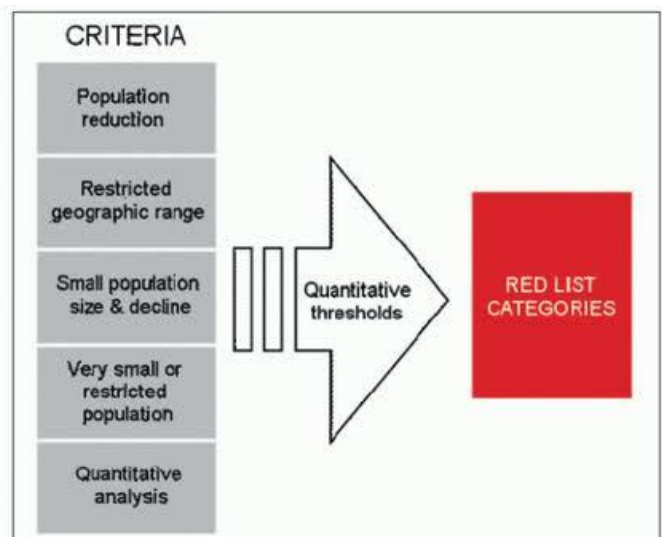
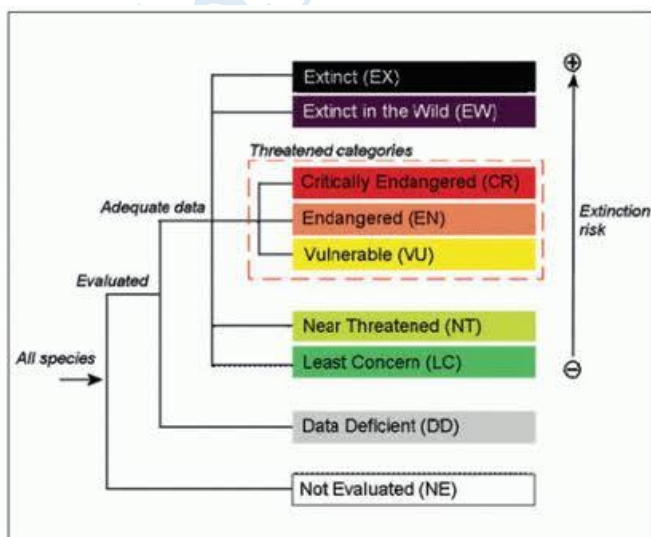
- Low priority for conservation of living natural resources.
- Values and knowledge about the species and ecosystem inadequately known.
- Unplanned urbanization and uncontrolled industrialization.

Botanical garden

- Botanical garden refers to the scientifically planned collection of living trees, shrubs, herbs, climbers and other plants from various parts of the globe.

ZOO

- An establishment, whether stationary or mobile, where captive animals are kept for exhibition, to the public and includes a circus and rescue centers but does not include an establishment of a licensed dealer in captive animals – CZA.

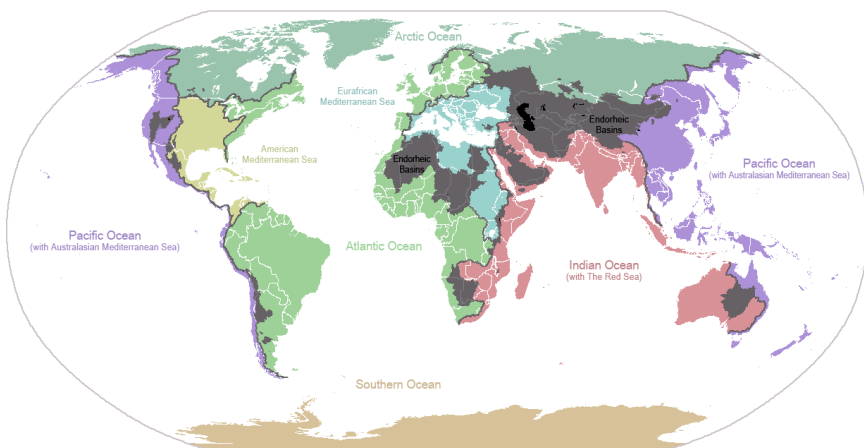


CHAPTER: 10 - INDIAN BIODIVERSITY DIVERSE LANDSCAPE

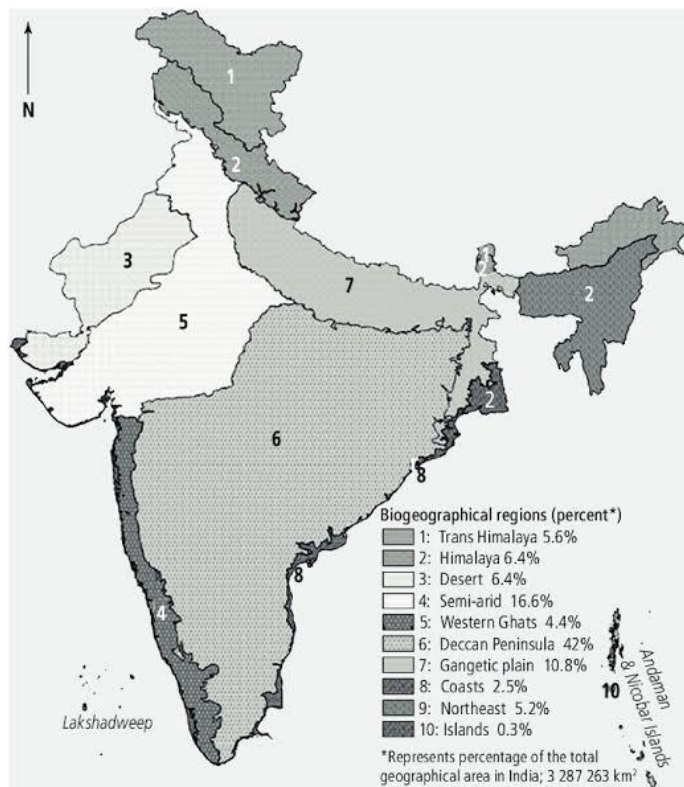
- India is recognised as one of the mega-diverse countries, rich in biodiversity and associated traditional knowledge. With just 2.4% of the land area, India accounts for nearly 7% of the recorded species even while supporting almost 18% of human population.
- In terms of species richness, India ranks seventh in mammals, ninth in birds and fifth in reptiles.
- The varied Edaphic, Climatic and Topographic conditions have resulted in a wide range of ecosystems and habitats such as forests, grasslands, wetlands, coastal and marine ecosystems, and deserts in India with greater biodiversity.

INDIA REPRESENTS

- **Two Realms**
 - Biogeographic realms are large spatial regions within which ecosystems share a broadly similar biota. Realm is a continent or sub-continent sized area with unifying features of geography and fauna & flora.
 - the Himalayan region represented by Palearctic Realm and
 - the rest of the sub-continent represented by Malayan Realm.
 - In world eight terrestrial biogeographic realms are typically recognized. They
- **Biomes of India**
 - The term biome means the main groups of plants and animals living in areas of certain climate patterns.
 - **The five biomes of India are:**
 - Tropical Humid Forests
 - Tropical Dry or Deciduous Forests (including Monsoon Forests)
 - Warm deserts and semi-deserts
 - Coniferous forests and
 - Alpine meadows.
- **Bio-geographic Zones:** There are 10 biogeographic zones which are distinguished clearly in India. They are as follows:
 - **Trans-Himalayas** - An extension of the Tibetan plateau, harboring high-altitude cold desert in Laddakh (J&K) and Lahaul Spiti (H.P) comprising 5.7 % of the country's landmass. East to west parallel to Himalayas
 - **Himalayas** - The entire mountain chain running from north-western to north-eastern India,
 - **Desert** - The extremely arid area west of the Aravalli hill range, comprising both the salty desert of Gujarat and the sand desert of Rajasthan. 6.9% of the country's landmass
 - **Semi-arid** - The zone between the desert and the Deccan plateau, including the Aravalli hill range 15.6 % of the country's landmass.



are



Western Ghats - The hill ranges and plains running along the western coastline, south of the Tapti river,

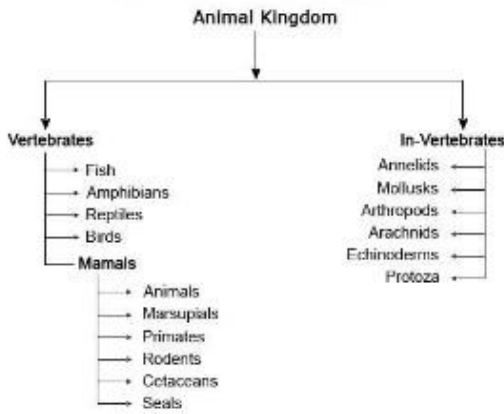
- **Deccan peninsula-** The largest of the zones, covering much of the southern and south-Central plateau with pre-dominantly deciduous vegetation. 4.3 % of the country's landmass.
- **Gangtic plain-** Defined by the Ganges river system, these plains are relatively homogenous.
- **North-east India-** The plains and non-Himalayan hill ranges of northeaster India, with a wide variation of vegetation. 5.2% of the country's landmass.
- **Islands-** The Andaman and Nicobar Islands in the Bay of Bengal, with a highly diverse set of biomes.
- **Coasts-** A large coastline distributed both to the west and east, with distinct differences between the two; India further divided into 25 biogeographic provinces.

• Bio-geographic Province

- Bio-geographic Province is a Eco systematic or biotic subdivision of realms. India is divided into 25 bio geographic zones.
- Biogeographic classification of India was done by Rodgers and Panwar (1988), describing 10 biogeographic zones in India, further divided into 25 biogeographic provinces.
- The classification was done using various factors such as altitude, moisture, topography, rainfall, etc. Biogeographic zones were used as a basis for planning wildlife protected areas in India.

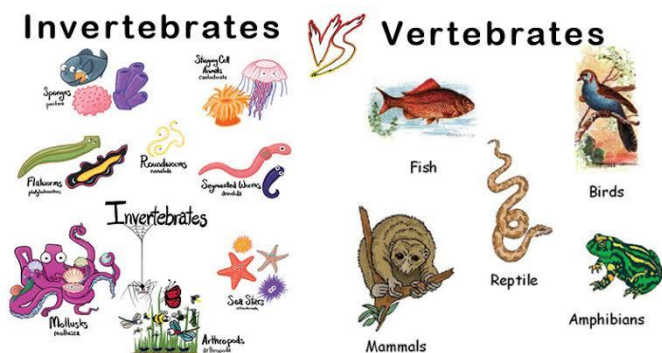
S.No.	Biogeographic Zones (10 nos)	Biogeographic Provinces (25 nos)
1.	Trans Himalaya	1A:Himalaya -Ladakh Mountains 1B: Himalaya -Tibetan Plateau 1C: Trans - Himalaya Sikkim
2.	The Himalaya	2A:Himalaya - North West Himalaya 2B: Himalaya - West Himalaya 2C: Himalaya - Central Himalaya 2D:Himalaya - East Himalaya
3.	The Indian Desert	3A: Desert – Thar 3B: Desert – Katchchh
4.	The Semi Arid	4A: Semi - Arid - Punjab Plains 4B: Semi - Arid - Gujarat Rajputana
5.	The Western Ghats	5A:Western Ghats - Malabar Plains 5B:Western Ghats -Western Ghats Mountains
6.	The Deccan Peninsula	6A: Deccan Peninsular - Central Highlands 6B: Deccan Peninsular - Chotta Nagpur 6C: Deccan Peninsular - Eastern Highlands 6D: Deccan Peninsular - Central Plateau 6E: Deccan Peninsular - Deccan South
7.	The Gangetic Plains	7A:Gangetic Plain - Upper Gangetic Plains 7B:Gangetic Plain - Lower Gangetic Plains
8.	The Coasts	8A: Coasts - West Coast 8B: Coasts - East Coast 8C: Coasts – Lakshdweep
9.	Northeast India	9A:North - East - Braham-putra Valley 9B: North - East – North East Hills
10.	Islands	10A: Islands – Andamans 10B: Islands – Nicobars

CLASSIFICATION OF ANIMALS



Vertebrates

- Vertebrates are animals with backbones and spinal columns. Vertebrates are the most advanced organisms on Earth.
- Although vertebrates represent only a very small percentage of all animals, their size and mobility-often allow them to dominate their environment. Fishes, Amphibians, Reptiles, Ayes, Mammals.



Invertebrates

- Do not have backbones.
- More than 98% animal species in the world are invertebrates. don't have an internal skeleton made of bone.
- Many invertebrates have a fluid-filled, hydrostatic skeleton, like the jelly fish or worm. Others have a hard-outer shell, like insects and crustaceans.
- **Annelids**
 - Have bodies that are divided into Segments.
 - Very well-developed internal organs.
 - Found almost anywhere in the world. don't have any limbs. E.g- earthworms, leeches, roundworms.

• Mollusks

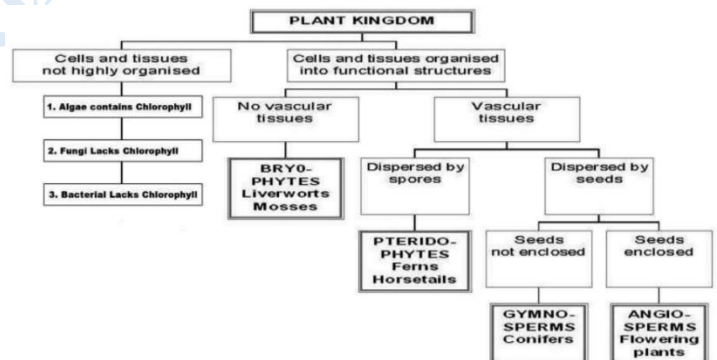
- Have a soft, skin-like organ covered with a hard outside shell.
- Some mollusks live on land, such as the snail and slug.
- Other mollusks live in water, such as the oyster, mussel, clam, squid and octopus.

• Echinoderms

- Are marine animals.
- Most echinoderms have arms or spines that radiate from the center of their body. Common echinoderms include the sea star, sea urchin, sand dollar and sea cucumber.
- Protozoa, Arthropods, Crustaceans, Insects, Arachnids are the other Invertebrates.

FLORAL DIVERSITY

In terms of plant diversity, India ranks tenth in the world and fourth in Asia. India represents nearly 11% of the world's known floral diversity.



1. Important floral groups found in India are described below:

○ Algae

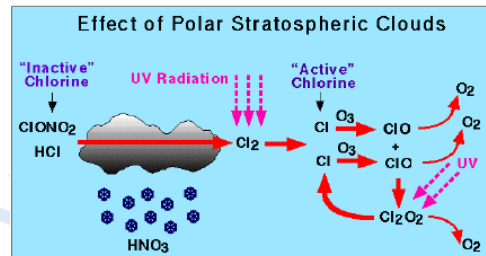
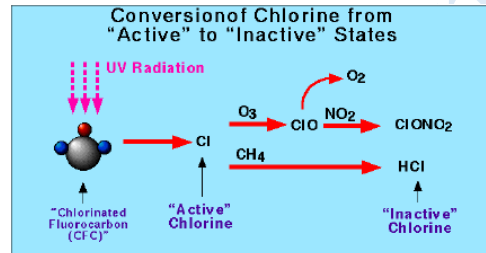
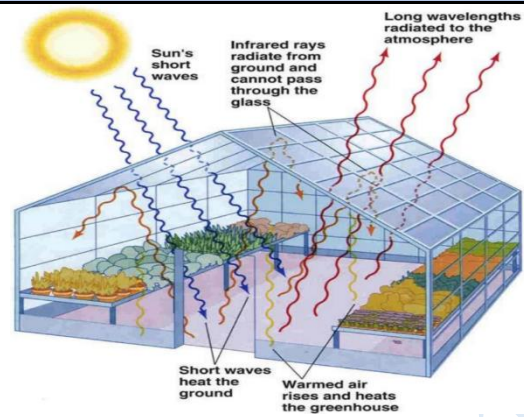
- The green non differentiated plants (non - differentiated into organs like root, stem and leaf.) possessing chlorophyll is known as Algae.
- The fresh-water algae are generally green or blue-green in colour, whereas the marine ones are red or brown. These are

CHAPTER: 17 - CLIMATE CHANGE

- “Climate change” means a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods.
- However, when today people talk about ‘climate change’, they mean the changes in climate over the last 100 years which is caused predominantly by human activity.

GLOBAL WARMING

- “Global warming is an average increase in the temperature of the atmosphere near the Earth’s surface and in the troposphere, which can contribute to changes in global climate patterns.
- Global warming can occur from a variety of causes, both natural and human induced. In common usage, “global warming” often refers to the warming that can occur as a result of increased emissions of greenhouse gases from human activities.”



Global Warming - Impacts

- Rise in Sea level
- Changes in rainfall patterns.
- Melting of the ice caps.
- Melting of glaciers.
- Spread of disease (like malaria, etc).
- Bleaching of Coral Reefs.
- Loss of Plankton due to warming of seas.

GREENHOUSE EFFECT

- The greenhouse effect is a naturally occurring phenomenon that blankets the earth lower atmosphere and warms it maintaining the temperature suitable for living things to survive.
- Water vapour and greenhouse gases warms the Earth.

Incoming Energy

- The Sun emits energy that is transmitted to Earth.
- Because the Sun is very hot, the energy is emitted in high-energy short wavelengths that penetrate the Earth's atmosphere.

Absorption

- About 30% of the Sun's energy is reflected directly back into space by the atmosphere, clouds, and surface of the Earth. The rest of the Sun's energy is absorbed into the Earth's system (70%)

Emission

- The Earth re-emits energy back into the atmosphere. Because the Earth is cooler than the Sun, the energy is emitted in the form of infrared radiation, at wavelengths longer than the incoming solar energy.

Role of Greenhouse Gases

CHAPTER: 19 - OZONE DEPLETION

- It is found in two different layers of the atmosphere. Ozone in the troposphere is "bad" because it dirties the air and helps to form smog, which is not good to breathe.
- Ozone in the stratosphere is "good" because it protects life on Earth by absorbing some of the sun's harmful Ultra Violet (UV) rays decrease in the concentration of ozone in a particular region of the atmosphere of ozone hole
- The best example of such an ozone hole is the atmosphere over the Antarctic which has only about 50 percent of the ozone that originally occurred there.

OZONE DEPLETION

- Ozone is a natural gas; it is an allotrope of oxygen consisting of three atoms of oxygen bound together in a non-linear fashion. The chemical symbol of ozone is O₃.
- It is found in two different layers of the atmosphere. Ozone in the troposphere is "bad" because it dirties the air and helps to form smog, which is not good to breathe. Ozone in the stratosphere is "good" because it protects life on Earth by absorbing some of the sun's harmful Ultra Violet
- (UV) rays.
- The ozone layer is very important because the configuration of the ozone molecule and its chemical properties are such that ozone efficiently absorbs ultraviolet light, thus acting like a sun-screen.
- The UV rays cause direct damage to the genetic material or DNA of animal and plant cells. Exposure of mammals to UV light has been shown to act on the immune system, thereby making the body more susceptible to diseases.

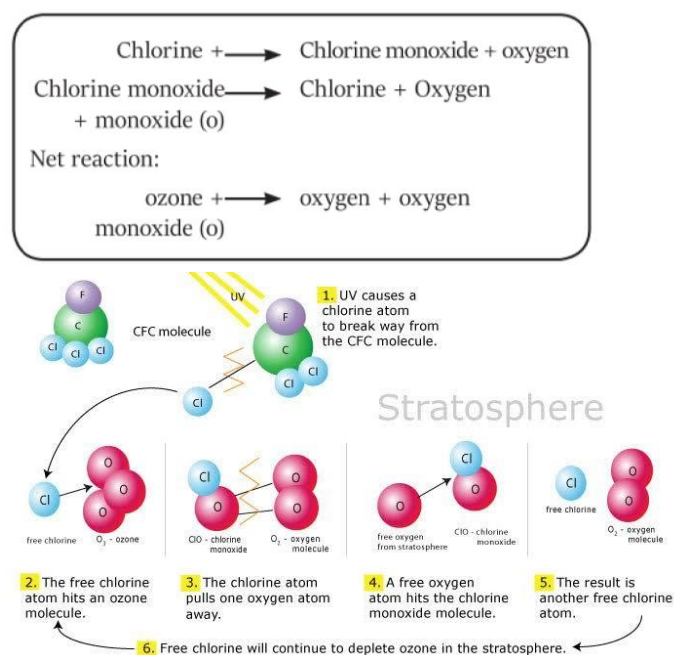
Sources

Chlorofluorocarbons (CFCs):

- CFCs molecules are made up of chlorine, fluorine and carbon. They are used as refrigerants (66%): Propellants in aerosol sprays, foaming agents in plastic manufacturing (30%), fire extinguishing agents, solvents for cleaning electronic and metallic components, for freezing foods etc
- CFCs has a wide and varied application due to its properties like non-corrosiveness, non-inflammability, low toxicity and chemical stability, etc. the residence time of CFCs in the atmosphere estimated to be between 40 and 150 years

The chemical reaction

- The molecules of CFCs when exposed to UV radiation break up, thus freeing chlorine atoms. A free chlorine atom reacts with an ozone molecule to form chlorine monoxide (ClO).
- The molecules of chlorine monoxide further combine with an atom of oxygen. This reaction results in the formation of an oxygen molecule (O₂) and reformation of the free chlorine atom (Cl).

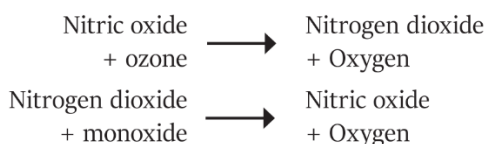


Nitrogen Oxides:

- The sources of nitrogen oxides are mainly explosions of thermonuclear weapons, industrial emissions and agricultural fertilizers.

- The chemical reaction**

- Nitric oxide (NO) catalytically destroys ozone.

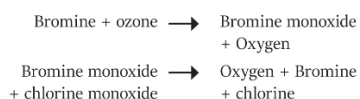


- The escape of N₂O**

- Nitrous oxide (N₂O) is released from soil through denitrification of nitrates under anaerobic conditions and nitrification of ammonia under aerobic conditions. This N₂O can gradually reach the middle of the stratosphere, where it is photolytically destroyed to yield nitric oxide which in turn destroys ozone.

- Other substances:**

- Bromine containing compounds called halons and HBFCs, i.e. hydrobromo fluorocarbons [both used in fire extinguishers and methyl bromide (a widely used pesticide)].
- Each bromine atom destroys hundred times of more ozone molecules than what a chlorine atom does.

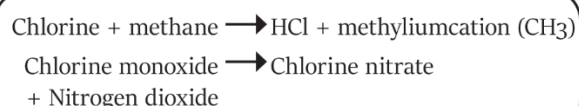


Role of polar stratospheric clouds in ozone depletion.

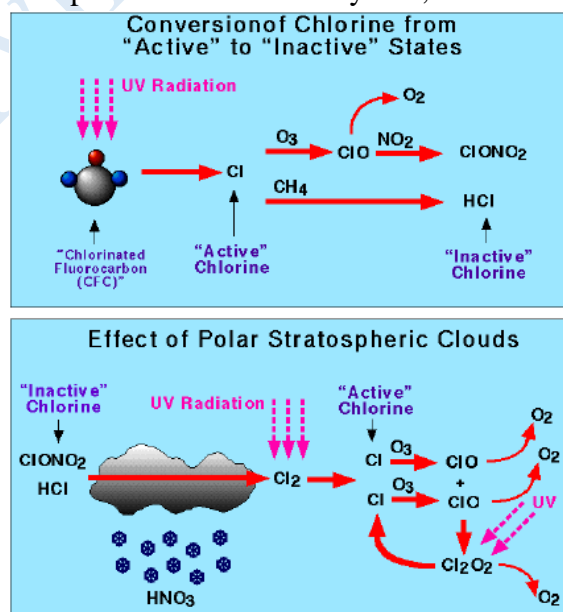
- There are three types of stratospheric clouds. They are:
 - Nacreous clouds extend from 10 to 100km in length and several kilometres in thickness. They are also called 'mother-of-pearl' clouds due to their glow with a seashell like iridescence.

- The second type of clouds contain nitric acid instead of pure water.
- The third type of clouds have the same chemical composition as nacreous clouds, but form at a slower rate, which results in a larger cloud with no iridescence.

- The chlorine released by the breakdown of CFCs exists initially as pure chlorine or as chlorine monoxide (active chlorine instable) but these two forms react further to form compounds Chlorine nitrate and HCL that are stable (inactive chlorine).



The stable compounds HCL and CLONO₂ are reservoirs of chlorine, and therefore for chlorine to take part in reactions of any sort, it has to be freed.



Why is the ozone hole predominant at the Antarctic?

- The Antarctic stratosphere is much colder. The low temperature enables the formation of Polar stratospheric Clouds (PSCs), below 20 km
- The vortex is a ring of rapidly circulating air that confines the ozone depletion in the Antarctic region. The longevity of the Antarctic vortex is another factor,

PREVIOUS YEAR QUESTION PAPERS

2011 QUESTION PAPER

1. Consider the following statements: Correct

1. Biodiversity is normally greater in the lower latitudes as compared to the higher latitudes.
2. Along the mountain gradients, biodiversity is normally greater in the lower altitudes as compared to the higher altitudes.

Ans. Both 1 and 2

2. Three of the following criteria have contributed to the recognition of Western Ghats – Sri Lanka and Indo-Burma regions as hotspots of biodiversity: - **Species richness, Endemism, Threat perception.**

3. Biodiversity forms the basis for human existence in the following ways:

- Soil formation
- Prevention of soil erosion
- Recycling of waste
- Pollination of crops

4. Which one of the following is not a site for in-situ method of conservation of flora: - **Botanical Garden**

5. Among the following States, which one has the most suitable climatic conditions for the cultivation of a large variety of orchids with minimum cost of production, and can develop an export-oriented industry in this field: -

Arunachal Pradesh

6. A sandy and saline area is the natural habitat of an Indian animal species. The animal has no predators in that area but its existence is threatened due to the destruction of its habitat. Which one of the following could be that animal: - **Indian wild ass**

7. The “Red Data Books” published by the International Union for Conservation of Nature and Natural Resources (IUCN) contain lists of: - **Threatened plant and animal species.**

8. In the context of eco-system productivity, marine upwelling zones are important as they increase the marine productivity by bringing the: - **Nutrients to the surface.**

9. The 2004 Tsunami made people realize that mangroves can serve as a reliable safety hedge against coastal calamities. How do mangroves function as a safety hedge: - **The mangroves**

trees do not get uprooted by storms and tides because of their extensive roots.

10. There is a concern over the increase in harmful algal blooms in the seawaters of India. What could be the causative factors for this phenomenon?

- Discharge of nutrients from the estuaries.
- Run-off from the land during the monsoon.
- Upwelling in the seas.

11. The Himalayan Range is very rich in species diversity. Which one among the following is the most appropriate reason for this phenomenon: - **It is a confluence of different bio geographical zones.**

12. If a tropical rain forest is removed, it does not regenerate quickly as compared to a tropical deciduous forest. This is because: - **the soil of rain forest is deficient in nutrients**

13. When the bark of a tree is removed in a circular fashion all around near its base, it generally dries up and dies because: - **Water from soil cannot rise to aerial parts.**

14. Which of the above add carbon dioxide to the carbon cycle on Earth?

- Respiration
- Decay of organic matter
- Volcanic action

15. Which of the above is/are the emission / emissions from coal combustion at thermal power plants?

- Carbon dioxide
- Oxides of Nitrogen
- Oxides of Sulphur

16. The formation of ozone hole in the Antarctic region has been a cause of concern. What could be the reason for the formation of this hole: - **Presence of prominent polar front and stratospheric clouds; and inflow of chloro fluorocarbons**

17. Regarding “carbon credits”, which one of the following statements is not correct: - **Carbon credits are traded at a price fixed from time to time by the United Nations Environment Programme.**

18. Which of the above Acts have relevance to / bearing on the biodiversity conservation in the country

APPENDIX

RAMSAR WETLANDS SITES IN

Sl. No.	Name of Site	State Location	Date Declaration	Area (in Sq. km.)
1	Asan Conservation Reserve	Uttarakhand	21.7.2020	4.444
2	Asthmudi Wetland	Kerala	19.8.2002	614
3	Beas Conservation Reserve	Punjab	26.9.2019	64.289
4	Bhitarkanika Mangroves	Orissa	19.8.2002	650
5	Bhoj Wetlands	Madhya Pradesh	19.8.2002	32.01
6	Chandertal Wetland	Himachal Pradesh	8.11.2005	0.49
7	Chilka Lake	Orissa	1.10.1981	1165
8	Deepor Beel	Assam	19.8.2002	40
9	East Kolkata Wetlands	West Bengal	19.8.2002	125
10	Hariker Lake	Punjab	23.3.1990	41
11	Hokera Wetland	Jammu and Kashmir	8.11.2005	13.75
12	Kabartal Wetland	Bihar	21.07.2020	26.20
13	Kanjli Lake	Punjab	22.1.2002	1.83
14	Keoladeo Ghana NP	Rajasthan	1.10.1981	28.73
15	Keshopur-Miani Community Reserve	Punjab	26.9.2019	3.439
16	Kolleru Lake	Andhra Pradesh	19.8.2002	901
17	Loktak Lake	Manipur	23.3.1990	266
18	Lonar Lake	Maharashtra	22.7.2020	4.27
19	Nalsarovar Bird Sanctuary	Gujarat	24.09.2012	120
20	Nandur Madhameshwar	Maharashtra	21.6.2019	14.37
21	Nangal Wildlife Sanctuary	Punjab	26.9.2019	1.16
22	Nawabganj Bird Sanctuary	Uttar Pradesh	19.9.2019	2.246
23	Parvati Agra Bird Sanctuary	Uttar Pradesh	2.12.2019	7.22
24	Point Calimere Wildlife and Bird Sanctuary	Tamil Nadu	19.8.2002	385
25	Pong Dam Lake	Himachal Pradesh	19.8.2002	156.62
26	Renuka Wetland	Himachal Pradesh	8.11.2005	0.2
27	Ropar Lake	Punjab	22.1.2002	13.65
28	Rudrasagar Lake	Tripura	8.11.2005	2.4
29	Saman Bird Sanctuary	Uttar Pradesh	2.12.2019	52.63
30	Samaspur Bird Sanctuary	Uttar Pradesh	3.10.2019	79.94
31	Sambhar Lake	Rajasthan	23.3.1990	240
32	Sandi Bird Sanctuary	Uttar Pradesh	26.9.2019	30.85
33	Sarsai Nawar Jheel	Uttar Pradesh	19.9.2019	16.13
34	Sasthamkotta Lake	Kerala	19.8.2002	3.73
35	Sunderbans Wetland	West Bengal	30.1.2019	4230
36	Surinsar-Mansar Lakes	Jammu and Kashmir	8.11.2005	3.5
37	Sur Sarovar	Uttar Pradesh	21.8.2020	4.31
38	Tso Kar Wetland Complex	Ladakh	17.11.2020	95.77
39	Tsomoriri Lake	Jammu and Kashmir	19.8.2002	120
40	Upper Ganga River (Brijghat to Narora Stretch)	Uttar Pradesh	8.11.2005	265.9
41	Vembanad Kol Wetland	Kerala	19.8.2002	1512.5
42	Wular Lake	Jammu & Kashmir	23.3.1990	189

Sl. No.	Name of Tiger Reserve	State	Area of the core critical tiger habitat (In Sq. Kms.)	Area of the buffer / peripheral (In Sq. Kms.)	Total area(In Sq.Kms.)
1	Nagarjunsagar Srisaillam (part)*	Andhra Pradesh	2595.72*	700.59*	3296.31*
2	Namdapha	Arunachal Pradesh	1807.82	245	2052.82
3	Kamlang Tiger Reserve	Arunachal Pradesh	671	112	783
4	Pakke	Arunachal Pradesh	683.45	515	1198.45
5	Manas	Assam	840.04	2310.88	3150.92
6	Nameri	Assam	200	144	344
7	Orang Tiger Reserve	Assam	79.28	413.18	492.46
8	Kaziranga	Assam	625.58	548	1173.58
9	Valmiki	Bihar	598.45	300.93	899.38
10	Udanti-Sitanadi	Chattisgarh	851.09	991.45	1842.54
11	Achanakmar	Chattisgarh	626.195	287.822	914.017
12	Indravati	Chhattisgarh	1258.37	1540.7	2799.07
13	Palamau	Jharkhand	414.08	715.85	1129.93
14	Bandipur	Karnataka	872.24	584.06	1456.3
15	Bhadra	Karnataka	492.46	571.83	1064.29
16	Dandeli-Anshi	Karnataka	814.884	282.63	1097.514
17	Nagarahole	Karnataka	643.35	562.41	1205.76
18	Billigiri Ranganatha Temple	Karnataka	359.1	215.72	574.82
19	Periyar	Kerala	881	44	925
20	Parambikulam	Kerala	390.89	252.772	643.662
21	Kanha	Madhya Pradesh	917.43	1134.361	2051.791
22	Pench	Madhya Pradesh	411.33	768.30225	1179.63225
23	Bandhavgarh	Madhya Pradesh	716.903	820.03509	1598.1
24	Panna	Madhya Pradesh	576.13	1021.97**	1578.55
25	Satpura	Madhya Pradesh	1339.264	794.04397	2133.30797

INDIA TIGER RESERVE OF INDIA