BIO - DIVERSITY AND ITS CONSERVATION

The 1992 UN Earth Summit defined Biodiversity as 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. This includes diversity within species, between species and ecosystems of a region.

Levels of biodiversity:

Edward Wilson popularized the term 'Biodiversity' to describe diversity at all levels of biological organization from populations to biomes. There are three levels of biodiversity – Genetic diversity, Species diversity and Community/Ecosystem diversity.

Genetic diversity refers to the differences in genetic make-up (number and types of genes) between distinct species and to the genetic variation within a single species; also covers genetic variation between distinct populations of the same species. Genetic diversity can be measured using a variety of molecular techniques. India has more than 50,000 genetic variants of Paddy and 1000 variants of Mango. Variation of genes of a species increases with diversity in size and habitat. It results in the formation of different races, varieties and subspecies. Rouwolfia vomitaria, a medicinal plant growing in different ranges of the Himalayas shows differences in the potency and concentration of the active ingredient reserpine due to genetic diversity. Genetic diversity helps in developing adaptations to changing environmental conditions.

Species diversity refers to the variety in number and richness of the species in any habitat. The number of species per unit area at a specific time is called species richness, which denotes the measure of species diversity. The Western Ghats have greater amphibian species diversity than the Eastern Ghats. The more the number of species in an area the more is the species richness. The three indices of diversity are - Alpha, Beta and Gamma diversity

Alpha diversity: It is measured by counting the number of taxa (usually species) within a particular area, community or ecosystem.

Beta diversity: It is species diversity between two adjacent ecosystems and is obtaining by comparing the number of species unique to each of the ecosystem.

Gamma diversity: It refers to the diversity of the habitats over the total landscape or geographical area.

Community/Ecosystem diversity: is the variety of habitats, biotic communities, and ecological processes in the biosphere. It is the diversity at ecosystem level due to diversity of niches, trophic levels and ecological processes like nutrient cycles, food webs, energy flow and several biotic interactions. India with its alpine meadows, rain forests, mangroves, coral reefs, grass lands and deserts has one of the greatest ecosystem diversity on earth.

Magnitude of biodiversity:

Biodiversity is often quantified as the number of species in a region at a given time. The current estimate of different species on earth is around 50-80 million. However, we really don't know the exact magnitude of our natural wealth. This is called the 'The Taxonomic impediment'. So far about 1.5 million species of microorganisms, animals and plants have been described. Each year about 10-15 thousand new species are identified and published worldwide, of which 75% are invertebrates. The number of undescribed species is undoubtedly much higher.

India is very rich in terms of biological diversity due to its unique bio-geographical location, diversified climatic conditions and enormous eco-diversity and geo-diversity. According to world biogeographic classification, India represents two of the major realms (The Palearctic and Indo-Malayan) and three biomes (Tropical humid forests, Tropical Dry/Deciduous forests and Warm Deserts/Semi deserts). With only about 2.4% of the world's total land surface, India is known to have over 8 % of the species of animals that the world holds and this percentage accounts for about 92,000 known species.

India is the seventh largest country in the world in terms of area. India has a variety of ecosystems, biomes with its varied habitats like, hills, valleys, plateaus, sea shores, mangroves, estuaries, glaciers, grasslands and river basins. It also reflects different kinds of climates, precipitation, temperature distribution, river flow and soil. India is one of the 17 mega biodiversity countries of the world and has ten biogeographic zones with characteristic habitat and biota.

Patterns of biodiversity distribution:

The distribution of plants and animals is not uniform around the world. Organisms require different sets of conditions for their optimum metabolism and growth. Within

this optimal range (habitat) a large number and type of organisms are likely to occur, grow and multiply. The habitat conditions are determined by their latitudes and altitudes.

Latitudinal and altitudinal gradients:

Temperature, precipitation, distance from the equator (latitudinal gradient), altitude from sea level (altitudinal gradient) are some of the factors that determine biodiversity distribution patterns. The most important pattern of biodiversity is latitudinal gradient in diversity. This means that there is an increasing diversity from the poles to equator. Diversity increases as one moves towards the temperate zones and reaches the maximum at the tropics. Thus, tropics harbour more biodiversity than temperate or polar regions, especially between the latitudes of 23.5^0N and 23.5^0S (Tropic of Cancer to the Tropic of Capricorn). Harsh conditions exist in temperate areas during the cold seasons while very harsh conditions prevail for most of the year in Polar Regions.

Columbia located near the equator (0^0) has nearly 1400 species of birds while New York at 41^0N has 105 species and Greenland at 71^0N has 56 species. India, with much of its land area in the tropical latitudes, is home for more than 1200 species of birds. Thus it is evident that the latitude increases the species diversity.

Decrease in species diversity occurs as one ascends a high mountain due to drop in temperature (temperature decreases @ 6.5^0 C per Km above mean sea level)

The reasons for the richness of biodiversity in the Tropics are:

1. Warm tropical regions between the tropic of Cancer and Capricorn on either side of equator possess congenial habitats for living organisms.
2. Environmental conditions of the tropics are favourable not only for speciation but also for supporting both variety and number of organisms.
3. The temperatures vary between 25^0C to 35^0C, a range in which most metabolic activities of living organisms occur with ease and efficiency.
4. The average rainfall is often more than 200 mm per year.
5. Climate, seasons, temperature, humidity, photoperiods are more or less stable and encourage both variety and numbers.
6. Rich resource and nutrient availability.

Species - Area relationships:

German Naturalist and Geographer Alexander von Humboldt explored the wilderness of south American jungles and found that within a region the species richness increased with increasing area but upto a certain limit. The relationship between species richness and area for a wide variety of taxa (angiosperm plants, birds, bats, freshwater fishes) turned out to be the rectangular hyperbola. On a logarithmic scale.the relationship is a straight line described by the equation.

$$\log S = \log C + Z \log A$$

Where

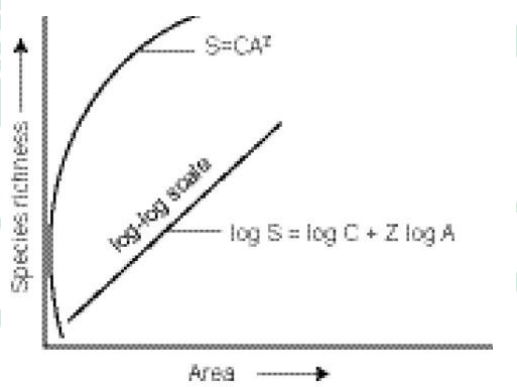
S = Species richness

A = Area

Z = Slope of the line (regression coefficient)

C = Y-intercept

Regression coefficient Z generally has a value of 0.1-0.2 regardless of taxonomic group or region. However, in case of the species – area relationship in very large areas like entire continents, the slope of the line appears to be much steeper (Z-value in the range of 0.6-1.2). For example, in case of the fruit eating (frugivorous) birds and mammals in the tropical forests of different continents, the slope is found to be a steeper line of 1.15.



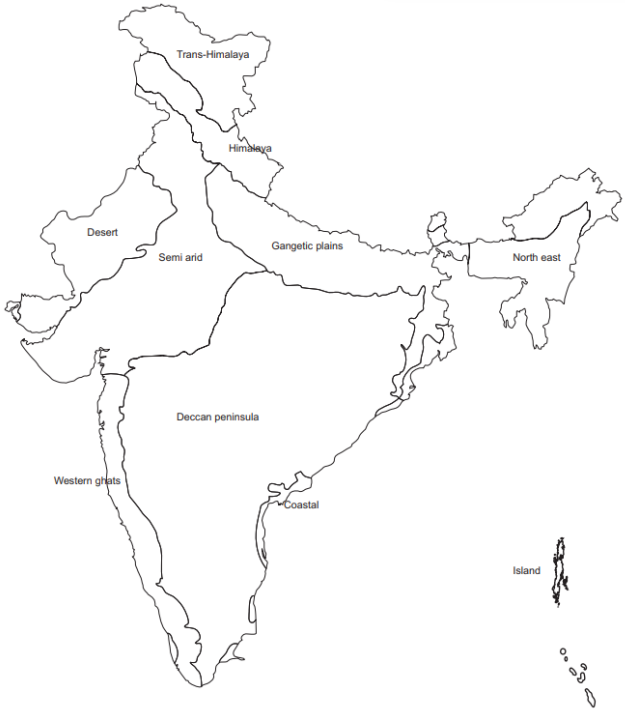
Importance of biodiversity – Global and India:

1. Continuity of nutrient cycles or biogeochemical cycles (N_2, C, H_2O, P, S cycles)
2. Soil formation, conditioning or maintenance of soil health (fertility) by soil microbial diversity along with the different trophic members
3. Increases ecosystem productivity and provide food resources

4. Act as water traps, filters, water flow regulators and water purifiers (forest cover and vegetation)
5. Climate stability (forests are essential for rainfall, temperature regulation, CO_2 absorption, which in turn regulate the density and type of vegetation)
6. Forest resource management and sustainable development
7. Maintaining balance between biotic components
8. Cleaning up of pollutants – microbes are the biggest degraders of molecules including many anthropogenic ones which are present in effluents, sewage, garbage and agro-chemicals
9. Ecological stability – the varieties and richness of species contribute to ecological stability and survival of species. Biodiverse regions are reservoirs of biological resources like food resources, gene pool, genetic resource, medicinal resources, bio-prospecting
10. To provide unique aesthetic value and hot spots for Ecotourism. Along with forest resources and wildlife it has commercial significance
11. An indicator of the health of the ecosystem. Endemism is a crucial indicator of richness.

Biogeographical regions of India:

As per the international 'biome' type of classification based upon climate, fauna and flora and the soil conditions, India can be divided into ten different biogeographic zones.



Trans Himalayan Region: An extension of the Tibetan plateau, high-altitude cold desert in Ladakh (J&K) and Lauhala Spiti (H.P) comprising 5.7% of the country's landmass. The mountains of this region have the richest wild sheep and goat community in the world, renowned for its quality wool and wool products. Other fauna include Chiru and Black-rocked Crane.

Himalayas: The entire mountain chain running from north-western to north-eastern India, comprising a diverse range of biotic provinces and biomes and covers 7.2% of the country's landmass. The common fauna of the Himalayan ranges, are the wild sheep, mountain goats, shrew, snow leopard and panda, many of which are endangered.

Indian Desert: The extremely arid area west of the Aravalli hill range, comprising both the salty desert of Gujarat and the sand desert of Rajasthan. It comprises 6.9% of the country's land-mass. Wild ass is endemic to this region. It is also the habitat for the Indian Bustard, camel, foxes and snakes, many of which are endangered.

Semi – Arid Zones: This zone is between the desert and the Deccan plateau, including the Aravalli hill range covering 15.6% of the country's landmass. Fauna found here are nilghai, blackbuck, four horned antelopes, sambar, chital and spotted deer which are herbivores along with predators like Asiatic lion, tiger, leopard and jackal.

Western Ghats: Western Ghats, are mountain ranges along the west coast of India, extending over almost 1,500km from Sat Pena in south Gujarat to the southernmost tip of Kerala. The annual rainfall is about 2000 mm. This zone has large populations of Nilgiri Langur, tiger, leopard, and Indian elephant.The grizzled squirrel and lion tailed macaque are endemic to this region.

Deccan Peninsula: This covers much of the southern and south-central plateau with a predominantly deciduous vegetation and 4.3% of the country's landmass. It is known for deciduous forests, thorn forests and pockets of semi ever green forests. Fauna found here are Chital, Sambhar, Nilghai, elephant, sloth bear, black buck and barking deer. It is the catchment area of major Indian rivers like Godavari, Tapti, Narmada and Mahanadi.

Gangetic Plains: These plains are relatively homogenously defined by the Ganges river system and occupy about 11% of the country's landmass. This region is very fertile and extends up to the Himalayan foothills. Fauna includes rhinoceros, elephant, buffalo, swamp deer, hog-deer.

North-East India: The plains and non-Himalayan hill ranges of north eastern India are home to a wide variety of vegetation. With 5.2% of the country's landmass, this region represents the transition zone between the Indian, Indo-Malayan and Indo-Chinese bio-geographical regions and is the meeting point of the Himalayan Mountains and peninsular India. The North-East is thus the biogeographical 'Gateway' for much of India's fauna and flora and also biodiversity hotspot (Eastern Himalaya), which includes the Indian rhinoceros, leopard and golden langur.

Coastal Region: Coastal region of India with sandy beaches, mud flats, coral reefs, mangroves constitutes 2.5% of the total geographical area. The coastline from Gujarat to Sundarbans is estimated to be 5423km long. Apart from this a total of 25 islets constitute the Lakshadweep, which are of coral origin and have a typical reef lagoon system, rich in biodiversity. The fauna includes native crabs, turtles and tunas

Andaman and Nicobar Islands: The Andaman and Nicobar Islands in the Bay of Bengal have highly diverse set of biomes, constituting 0.3% of the total geographical area. They are centers of high endemism and contain some of India's finest evergreen

forests and support a wide diversity of corals. Fauna includes Narcondam hornbills of the Andamans and the South Andaman Krait.

Threats to biodiversity:

Causes of biodiversity loss:

1. Habitat loss, fragmentation and destruction (affects about 73% of all species)
2. Pollution and pollutants (smog, pesticides, herbicides, oil slicks, GHGs)
3. Climate change
4. Introduction of alien/exotic species
5. Over exploitation of resources (poaching, indiscriminate cutting of trees, over fishing, hunting, mining)
6. Intensive agriculture and aquacultural practices
7. Hybridization between native and non-native species and loss of native species
8. Natural disasters (Tsunami, forest fire, earth quake, volcanoes)
9. Industrialization, Urbanization, infrastructure development, Transport – Road and Shipping activity, communication towers, dam construction, unregulated tourism and monoculture are common area of specific threats
10. Co-extinction

Habitat Loss:

Development of human society is inevitable. Natural habitats are destroyed for the purpose of settlement, agriculture, mining, industries and construction of highways. As a result species are forced to adapt to the changes in the environment or move to other places. If not, they become victim to predation, starvation, disease and eventually die or results in human animal conflict.

Over population, urbanization, industrialization and agricultural advancements require additional land, water and raw materials every year. This is made possible only through fragmentation or destruction of natural habitats by filling wetlands, ploughing grasslands, cutting down trees, forest, desilting rivers, constructing transport ways, caving mountains, extracting, ores, changing the course of rivers and filling of seashore.

The most dramatic example of habitat loss comes from the tropical rainforests 14% of the earth's land surface once covered by these tropical forests, is not more than 6% now. The Amazon rainforest, a vast area, harbouring millions of species, also called "Lungs of

the planet"is destroyed and being replaced for agriculture and human settlements. 90% of New Zealand's wetlands have been destroyed and cleared for cultivating soya beans and raising grass for beef cattle. Kodaikanal and Nilgiri hills of Tamil Nadu have been destroyed rapidly for human occupancy. Loss of habitat results in annihilation of plants, microorganisms and forcing out animals from their habitats.

Habitat fragmentation:

Habitat fragmentation is the process where a large, continuous area of habitat is both, reduced in area and divided into two or more fragments. Fragmentation of habitats like forest land into crop lands, orchard lands, plantations, urban areas, industrial estates, transport and transit systems has resulted in the destruction of complex interactions amongst species, (food chain and webs) destruction of species in the cleared regions, annihilation of species restricted to these habitats (endemic) and decreased biodiversity in the habitat fragments. Animals requiring large territories such as mammals and birds are severely affected. The elephant corridors and migratory routes are highly vulnerable. The dwindling of many well-known birds (sparrows) and animals can be attributed to this.

Over exploitation:

We depend on nature for our basic needs such as food and shelter. However, when the need becomes greed, it leads to over exploitation of natural resources. Excessive exploitation of a species, reduces the size of its population to such a level that it becomes vulnerable to extinction. Dodo, passenger pigeon and Steller's sea cow have become extinct in the last 200-300 years due to over exploitation by humans. Overfishing due to population pressure leads to many marine fish (populations) declining around the world.

Exotic species invasion:

Exotic species (non-native; alien) are organisms often introduced unintentionally or deliberately for commercial purpose, as biological control agents and other uses. They often become invasive and drive away the local species and is considered as the second major cause for extinction of species. Exotic species have proved harmful to both aquatic and terrestrial ecosystems.

Tilapia fish (Jilabi kendai) (Oreochromis mosambicus) introduced from east coast of South Africa in 1952 for its high productivity into Kerala's inland waters, became invasive, due to which the native species such as Puntius dubius and Labeo kontius face local extinction. Amazon sailfin catfish is responsible for destroying the fish population in the wetlands of Kolkata. The introduction of the Nile Perch, a predatory fish into Lake Victoria in East Africa led to the extinction of an ecologically unique assemblage of more than 200 nature species of cichlid fish in the lake.

African apple snail (Achatina fulica) is the most invasive among all alien fauna in India. This mollusc was first reported in the Andaman and Nicobar Islands. It is now found across the country and threatens the habitat of several native species. Moreover it is becoming a vicious pest in vegetable farms.

Exotic earthworms compete for food with native varieties and deplete their population in soil. Papaya Mealy Bug (Paracoccus marginatus) is native of Mexico and Central America, is believed to have destroyed huge crops of papaya in Assam, West Bengal and TamilNadu.

Global Climate changes:

Industrialization is a major contributor to climate change and a major threat to biodiversity. Energy drives our industries, which is provided by burning of fossil fuels. This increases the emission of CO_2, a GHG, leading to climate change. Due to large scale deforestation, the emitted CO_2 cannot be absorbed fully, and its concentration in the air increases. Climate change increases land and ocean temperature, changes precipitation patterns and raises the sea level. This inturn results in melting of glaciers, water inundation, less predictability of weather patterns, extreme weather conditions, outbreak of squalor diseases, migration of animals and loss of trees in forest. Thus, climate change is an imminent danger to the existing biodiversity.

Shifting or Jhum cultivation (Slash-and-burn agriculture):

In shifting cultivation, plots of natural tree vegetation are burnt away and the cleared patches are farmed for 2-3 seasons, after which their fertility reduces to a point where crop production is no longer profitable. The farmer then abandons this patch and cuts down a new patch of forest trees elsewhere for crop production.This system is practiced in north-eastern regions of India. When vast areas are cleared and burnt, it results in

loss of forest cover, pollution and discharge of CO_2 which in turn attributes to loss of habitat and climate change which has an impact on the faunal diversity of that regions.

Coextinctions:

Coextinction of a species is the loss of a species as a consequence of the extinction of another. (Eg., orchid bees and forest trees by cross pollination). Extinction of one will automatically cause extinction of the other. Another example for co-extinction is the connection between Calvaria tree and the extinct bird of Mauritius Island, the Dodo. The Calvaria tree is dependent on the Dodo bird for completion of its life cycle. The mutualistic association is that the tough horny endocarp of the seeds of Calvaria tree are made permeable by the actions of the large stones in bird's gizzard and digestive juices thereby facilitating easier germination. The extinction of the Dodo bird led to the imminent danger of the Calvaria tree coextinction.

Pollution:

Pollutants and pollution are a major cause for biodiversity loss. Excessive use of fertilisers, pesticides and heavy metals have polluted the land, ground and surface water bodies. There is a tendency of pesticide biomagnification which results in high concentrations at higher trophic levels which has resulted in drastic decline in the population of fish eating birds and falcons. Run off from fertilizer rich fields causes nutrient enrichment of water bodies leading to eutrophication. Mercury, arsenic, cadmium, chromium poisoning has led to depletion of biotic resources in vulnerable ecosystems. Death of vulture population is attributed to the veterinary medicine Diclofenac, which is responsible for the thinning of the egg shells.

Intensive agriculture:

Spread of agriculture is sometimes at the cost of wetlands, grasslands and forests. Intensive agriculture is based on a few high yielding varieties. As a result, there is reduction in the genetic diversity. It also increases vulnerability of the crop plants to sudden attack by pathogens and pests. There are only few varieties of traditional paddy strains today due to use to hybrid varieties in Tamil Nadu.

Forestry:

There is a tendency to grow economically important and viable trees like Teak, Sandal, Oak, Sal in forests resulting in loss of other forest trees.

Natural threats:

These include spontaneous jungle fires, tree fall, land slide, defoliation by insects or locust attack.

Hotspots:

Hotspots are areas characterized with high concentration of endemic species experiencing unusual rapid rate of habitat modification loss. Norman Myers defined hot spots as "regions that harbour a great diversity of endemic species and at the same time, have been significantly impacted and altered by human activities."

A hotspot is a region that supports at least 1500 endemic vascular plant species (0.5% of the global total) has lost more than 70% of its original vegetation. There are 35 biodiversity hotspots in the world. India is home to four biodiversity hotspots (as per ENVIS). They are

1. Himalaya (the entire Indian Himalayan region)
2. Western Ghats
3. Indo-Burma: includes entire North-eastern India, except Assam and Andaman group of Islands (and Myanmar, Thailand, Vietnam, Laos, Cambodia and Southern China)
4. Sundalands: includes Nicobar group of Islands (and Indonesia, Malaysia, Singapore, Brunei, Philippines)

Endangered organisms:

A species that has been categorized as very likely to become extinct is an endangered species. Endangered (EN), as categorized by the International Union for Conservation of Nature (IUCN) Red List, is the second most severe conservation status for wild populations in the IUCN's scheme after Critically Endangered (CR).

In 1998 there were1102 animal and 1197 plant species in the IUCN Red List. In 2012, the list features 3079 animal and 2655 plant species as endangered (EN) worldwide.

Extinction:

Species is considered extinct when none of its members are alive anywhere in the world. If individuals of a species remain alive only in captivity or other human controlled conditions, the species is said to be extinct in the wild.

There are three types of Extinctions:

1. Natural extinction is a slow process of replacement of existing species with better adapted species due to changes in environmental conditions, evolutionary changes, predators and diseases. A small population can get extinct sooner than the large population due to inbreeding depression (less adaptivity and variation).
2. Mass extinction: The earth has experienced quite a few mass extinctions due to environmental catastrophes. A mass extinction occurred about 225 million years ago during the Permian, where 90% of shallow water marine invertebrates disappeared.
3. Anthropogenic extinctions these are abetted by human activities like hunting, habitat destruction, over exploitation, urbanization and industrialization. Some examples of extinctions are Dodo of Mauritius and Steller's sea cow of Russia. Amphibians seem to be at higher risk of extinction because of habitat destruction.

International Union for Conservation of Nature (IUCN):

The International Union for Conservation of Nature (IUCN) is an organization working in the field of nature conservation and sustainable use of natural resources. It was established in 1948 and located at Gland VD, Switzerland. It is involved in data gathering and analysis research, field projects and education on conservation, sustainable development and biodiversity. IUCN's mission is to influence, encourage and assist societies throughout the world to conserve nature and to ensure that any use of natural resources is equitable and ecologically sustainable. It influences governments and industries through partnerships by providing information and advice. The organization collects, compiles and publishes the IUCN red list of threatened species and their conservation status in the world. It plays a vital role in the implementation of several international conventions on nature conservation and biodiversity.

Red Data Book:

Red Data book or Red list is a catalogue of taxa facing risk of extinction. IUCN – International Union of Conservation of Nature and Natural Resources, which is renamed as WCU – World Conservation Union (Morges Switzerland) maintains the Red Data book. The concept of Red list was mooted in 1963. The purpose of preparation of Red List are:

1. To create awareness on the degree of threat to biodiversity
2. Identification and documentation of species at high risk of extinction
3. Provide global index on declining biodiversity
4. Preparing conservation priorities and help in conservation of action
5. Information on international agreements on conservation of biological diversity

Red list has eight categories of species

i) Extinct
ii) Extinct in wild
iii) Critically Endangered
iv) Endangered
v) Vulnerable
vi) Lower risk
vii) Data deficiency
viii) Not evaluated.

Biodiversity and its conservation:

1. Identify and protect all threatened species
2. Identify and conserve in protected areas the wild relatives of all the economically important organisms
3. Identify and protect critical habitats for feeding, breeding, nursing, resting of each species
4. Resting, feeding and breeding places of the organisms should be identified and protected
5. Air, water and soil should be conserved on priority basis
6. Wildlife Protection Act should be implemented

There are two aspects of conservation strategies.

(a) In-situ conservation
(b) Ex-situ conservation

In-situ Conservation (Conservation in the natural habitat):

This is the conservation of genetic resources through their protection within a natural or manmade ecosystem in which they occur. It is conservation and protection of the whole ecosystem and its biodiversity at all levels in order to protect the threatened species.

National Parks (NP):

It is a natural habitat that is notified by the state government to be constituted as a National Park due to its ecological, faunal, floral, geomorphological, or zoological association of importance. No human activity is permitted inside the national park except the activities permitted by the Chief Wildlife Warden of the state under the conditions given in CHAPTER IV, of the Wildlife Protection Act (WPA) 1972.

There are 104 existing national parks in India covering an area of 40,501 km^2, which is 1.23% of the geographical area of the country (National Wildlife Database, Aug. 2018). National Park is an area which is strictly reserved for the betterment of wildlife and biodiversity and where activities like development, forestry, poaching, hunting, grazing and cultivation are not permitted. They are large areas of scenic and national beauty maintained for scientific educational and recreational use. They are not used for commercial extraction of resources. Kaziranga National park is a protected area for the one Horned Rhinoceros in Assam.

Wild Life Sanctuaries (WLS):

Any area other than the area comprised with any reserve forest or the territorial waters can be notified by the State Government to constitute as a sanctuary if such area is of adequate ecological, faunal, floral, geomorphological, natural or zoological significance. This is for the purpose of protecting, endangered factual species. Some restricted human activities are allowed inside the Sanctuary area details of which are given in CHAPTER IV, of the Wildlife Protection Act (WPA) 1972. Ecoturism is permitted, as long as animal life is undistrubed.

There are 544 existing wildlife sanctuaries in India covering an area of 118,918 km^2, which is 3.62 % of the geographical area of the country (National Wildlife Database, 2017).

Sanctuaries are tracts of land where wild animals and fauna can take refuge without being hunted or poached. Other activities like collection of forest products, regulated harvesting of timber, and private ownership of land are permitted. Periyar wild life sanctuary in Kerala is famous for the Indian Tiger and Asiatic Elephant.

Biosphere Reserve (BR):

Biosphere Reserve (BR) is an international designation by UNESCO for representative parts of natural and cultural landscapes extending over large area of terrestrial or

coastal/ marine ecosystems or a combination thereof. BRs are designated to deal with the conservation of biodiversity, economic and social development and maintenance of associated cultural values. Biosphere Reserves are thus special environments for both people and nature and are living examples of how human beings and nature can co-exist while respecting each other's needs. The Biosphere Reserve Programme is guided by UNESCO's Man and Biosphere (MAB) programme, as India is a signatory to the landscape approach supported by MAB programme. The scheme called Biosphere Reserve was implemented by the Government of India in 1986. There are 18 Biosphere Reserves in the country. Agasthyamalai (Karnataka - Tamil Nadu - Kerala), Nilgiri (Tamil Nadu - Kerala), Gulf of Mannar (Tamil Nadu) are the BRs notified in Tamil Nadu.

Sacred Groves:

A sacred grove or sacred woods are any grove of trees that are of special religious importance to a particular culture. Sacred groves feature in various cultures throughout the world.

Ex-Situ Conservation:

It is conservation of selected rare plants/animals in places outside their natural homes. It includes offsite collections and gene banks.

Offsite Collections:

They are live collections of wild and domesticated species in Botanical gardens, Zoological parks, Wildlife safari parks, Arborata (gardens with trees and shrubs). The organisms are well maintained for captive breeding programmes. As a result, many animals which have become extinct in the world continue to be maintained in Zoological Parks. As the number increases in captive breeding, the individuals are selectively released in the wild. In this way the Indian crocodile and gangetic dolphin have been saved from extinction.

Gene Banks:

Gene banks are a type of biorepository which preserve genetic materials. Seeds of different genetic strains of commercially important plants can be stored in long periods in seed banks, gametes of threatened species can be preserved in viable and fertile condition for long periods using cryopreservation techniques.

Role of WWF and CITES WWF:

World Wild Fund for Nature (WWF) is an international non-governmental charitable trust founded in 1961, with headquarters at Gland, Vaud, Switzerland. It aims at wildness preservation and the reduction of human impact on the environment. It was formerly named the World Wildlife Fund. The living planet report is being published every two years by WWF since 1998.

The vision of WWF is to conserve nature and reduce the most pressing threats to the diversity of life on Earth by conserving the world's most ecologically important regions, protect and restore species and their habitats, strengthen local communities' ability to conserve the natural resources they depend upon and to ensure that the value of nature is reflected in decision made by individuals, communities, governments and businesses.

CITES:

The Convention on International Trade in Endangered Species (CITES) of wild fauna and flora, also known as the Washington Convention, is a multilateral treaty to protect endangered plants and animals. It was drafted from a resolution adopted from a meeting of members of the IUCN in 1963 and opened for signature in 1973. It came into force during July 1975.

It aims to ensure that international trade in specimens of wild animals and plants should not be a threat to the survival of the species in the wild. It accords varying degrees of protection to more than 35,0000 species of animals and plants.

Biodiversity Act (BDA):

The Convention on Biological Diversity (CBD) is a United Nations initiative to protect Biodiversity and encourage the sustainable use of natural resources. The convention was held in 1992 at the 'Earth Summit' in Brazil. India is a signatory of the CBD. The Biological Diversity Act, 2002 is an Act of the Parliament of India for preservation of biological diversity in India, and provides mechanism for equitable sharing of benefits arising out of the use of traditional biological resources and knowledge. The Act was enacted to meet the obligations under Convention on Biological Diversity (CBD), to which India is a party.

The National Biodiversity Authority (NBA) was established by the Central Government in 2003 to implement India's Biological Diversity Act (2002). The NBA is a Statutory

Body and it performs facilitative, regulatory and advisory functions for the Government of India on issues of conservation, sustainable use of biological resources and fair and equitable sharing of benefits arising out of the use of biological resources. The Headquarters of the NBA is situated in Chennai.