

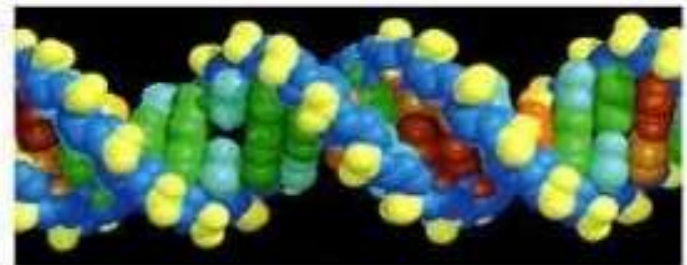
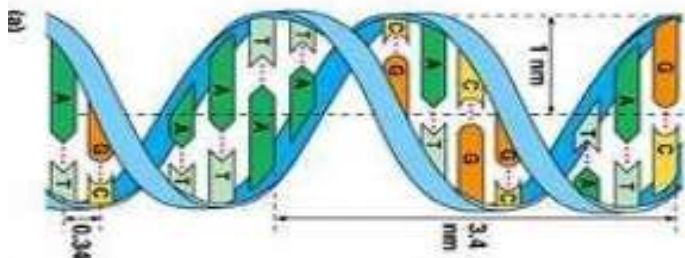
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- Biodiversity - the variety of life across all levels of ecological organization. Includes:
 - Genetic diversity - differences in DNA among individuals/species
 - Species diversity - # or variety of species in a given area
 - Ecosystem diversity - variety of ecosystems/habitats/communities

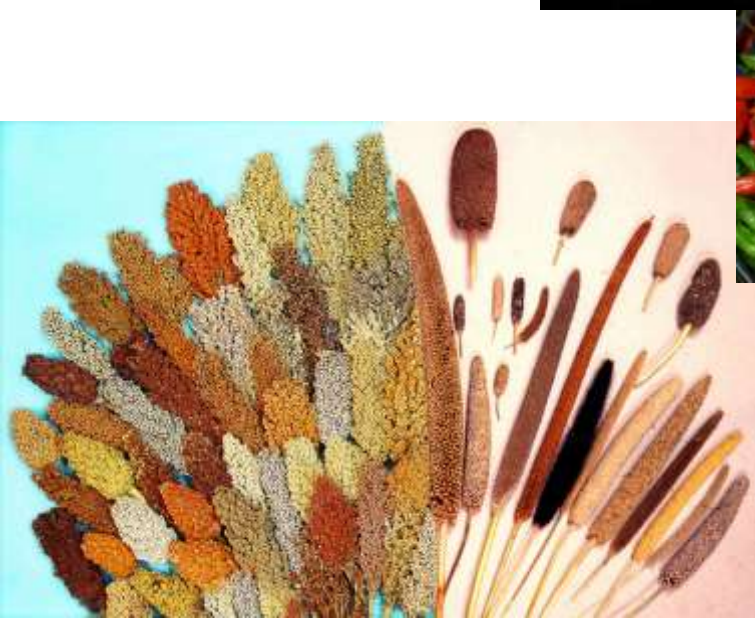


GENETIC DIVERSITY

- ▶ Each member of any animal or plant species differ widely from other individual in its genetics makeup, owing to the large number of combinations possible in genes that give every individual specific its characteristics.
- ▶ For example ,each human being is very different from all others.
- ▶ The diversity in wild species forms the 'gene pool'.
- ▶ Today, the variety of more productive, disease-resistant crops & to breed superior domestic animals .
- ▶ Modern biotechnology also manipulates genes to develop better types of medicines and a variety of industrial products.



- Populations with little genetic diversity have a reduced ability to withstand environmental change, therefore they can be more vulnerable to disease and may produce weak or defective offspring



Chihuahua



Beagle



SPECIES DIVERSITY

- ▶ The number of species of plants and animals that's are present in a region constitutes its species diversity.
- ▶ This diversity is seen both in nature ecosystem & in agriculture ecosystem.
- ▶ For example monkeys, dragonflies, and meadow beauties etc. are all different species.
- ▶ At present, conservation scientists have been able to identity & categorize about 1.8 million species on earth.
- ▶ Area that are rich in species diversity are called 'hotspots' of diversity; INDIA is among the world's 15 nations that are exceptionally rich in species diversity.

What is Biodiversity Hotspots

- Hotspots are areas that are extremely rich in species, have high endemism and are under constant threat due to human pressure.
- To qualify as a hotspot, a region must meet two strict criteria: it must contain at least 1,500 species of vascular plants as endemic and it has to have lost at least 70% of its original habitat.
- These are particularly rich in floral wealth and endemism, not only in flowering plants but also reptiles, amphibians, butterflies and mammals.

1. Himalaya
2. Indo-Burma
3. Western Ghats
4. Andaman and Nicobar Islands









ECOSYSTEM DIVERSITY

- ▶ Ecosystem diversity can be described for specific geographical region ,or a political entity such as country ,a state or a taluka.
- ▶ An ecosystem is referred to as 'natural' when it is relatively by human activities or 'modified' when it is changed to other types of uses ,such as farmland or urban areas.

- Biodiversity above the species level
- The number and variety of ecosystems within a given area
- Can be community types and habitats
- Ex. Seashore of rocky & sandy beaches; Ocean waters

Types of Ecosystem:

1. Forest ecosystem.



2. Grassland ecosystem.



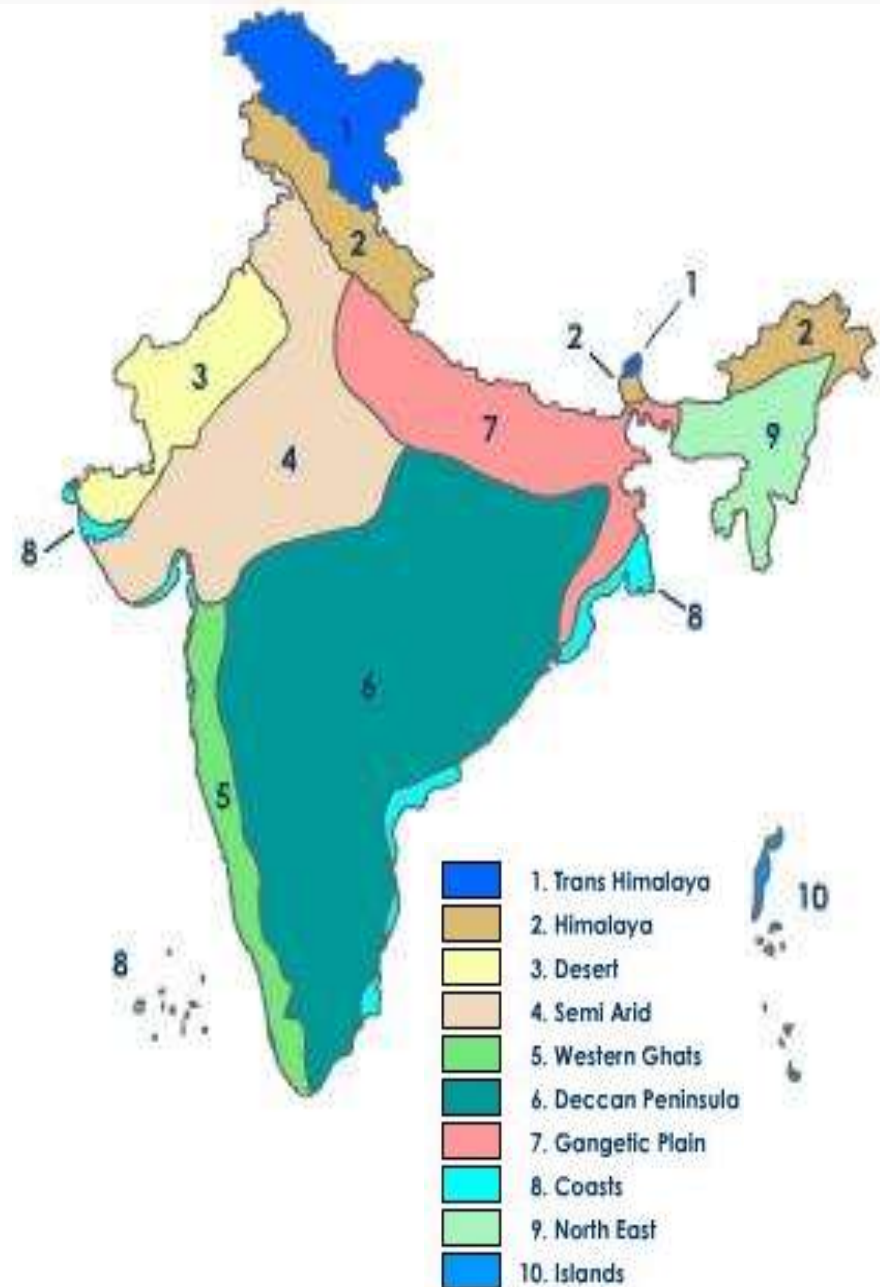
3. Desert ecosystem.

4. Aquatic ecosystem.



Biogeographic zones and provinces - INDIA

Trans Himalaya	1A: Himalaya - Ladakh Mountains 1B: Himalaya -Tibetan Plateau 1C: Trans - Himalaya Sikkim
The Himalaya	2A: Himalaya - North West Himalaya 2B: Himalaya - West Himalaya 2C: Himalaya - Central Himalaya 2D: Himalaya - East Himalaya
The Indian Desert	3A: Desert – Thar 3B: Desert – Katchchh
The Semi Arid	4A: Semi - Arid - Punjab Plains 4B: Semi - Arid - Gujarat Rajputana
The Western Ghats	5A: Western Ghats - Malabar Plains 5B: Western Ghats -Western Ghats Mountains
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
The Gangetic Plains	7A: Gangetic Plain - Upper Gangetic Plains 7B: Gangetic Plain - Lower Gangetic Plains
The Coasts	8A: Coasts - West Coast 8B: Coasts - East Coast 8C: Coasts – Lakshdweep
Northeast India	9A: North - East - Brahamputra Valley 9B: North - East – North East Hills
Islands	10A: Islands – Andamans 10B: Islands – Nicobars

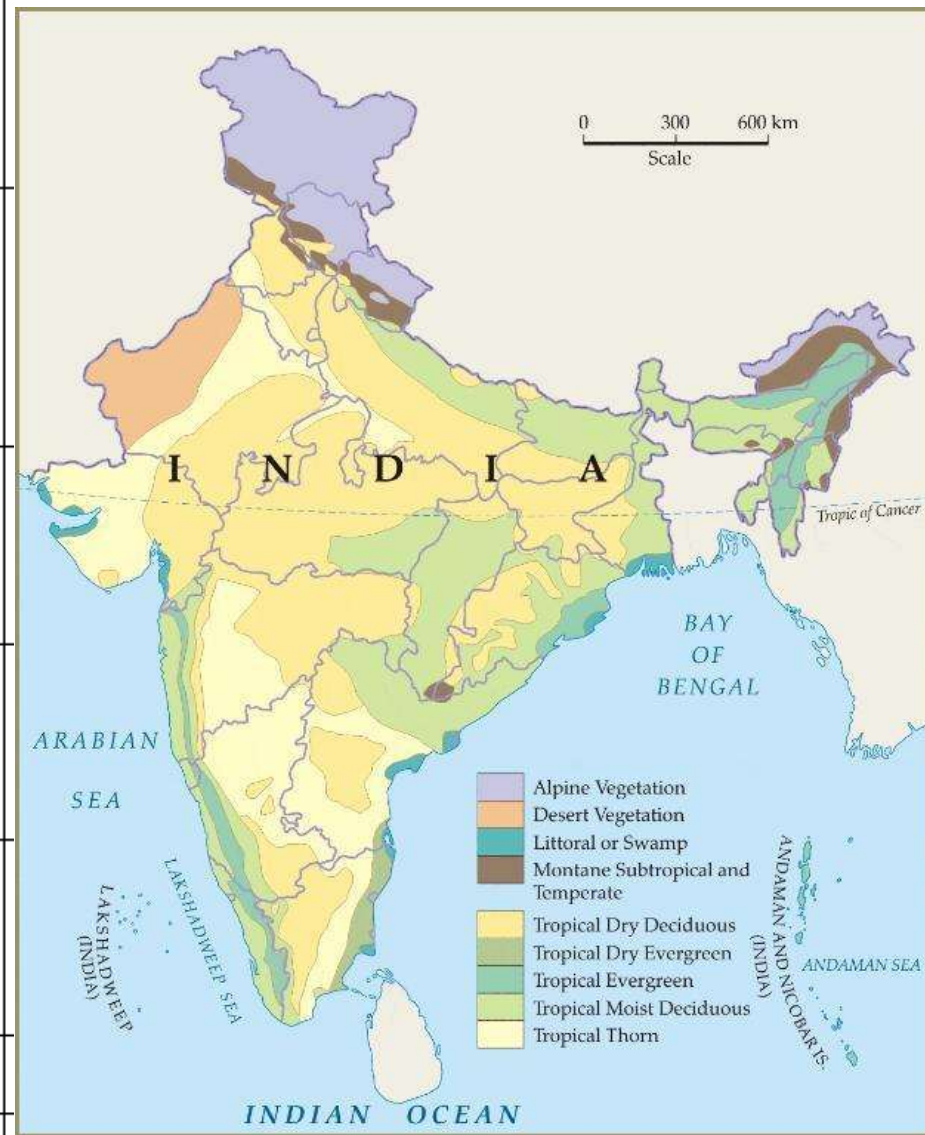


1. Classification of biogeographic zones are based on,
 - Geography
 - Climate
 - Pattern of vegetation
 - Animal communities (Mammals, birds, reptiles etc.)
2. Each biogeographic regions contains a variety of ecosystems such as forests, grasslands, lakes, rivers, wetlands, mountains and hills
3. Specific plant and animal species

Chauhan, B. S. (1 January 2008). *Environmental studies*. Firewall Media. pp. 107–111. ISBN 978-81-318-0328-8. Retrieved 27 October 2012.

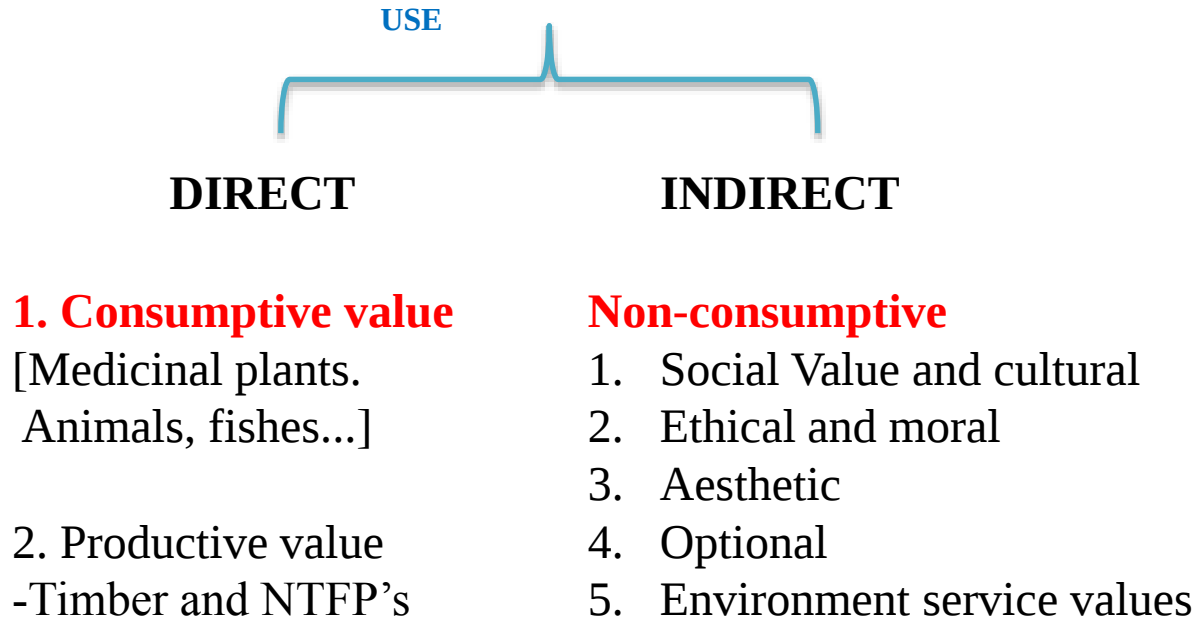
Forest Classification in India – Champion and Seth, 1968

Major Types	Minor Types
Moist Tropical Forest	Tropical Wet Evergreen Forest Tropical Semi-Evergreen Forest Tropical Moist Deciduous Forest Littoral and Swamp Forest
Dry Tropical Forest	Tropical Dry Deciduous Forest Tropical Thorn Forest Tropical Dry Evergreen Forest
Montane Subtropical Forest	Subtropical Broadleaved Hill Forest Subtropical Pine Forest Subtropical Dry Evergreen Forest
Montane Temperate Forest	Montane Wet Temperate Forest Himalayan Moist Temperate Forest Himalayan Dry Temperate Forest
Sub-Alpine Forest	Sub-alpine Forest
Alpine Scrub	Moist Alpine Scrub Dry Alpine Scrub



6 major and 16 minor

BIODIVERSITY VALUES



I. Direct values

- The direct value include food resources
-
- Plant resources:** grains, vegetables, fruits which are obtained
- Animal resources:** meat, fish, egg, milk and milk products.
- These also include **other values** like medicine, fuel, timber, fiber, wool, wax, resin, rubber, silk and decorative items.

The direct values are of two types (i) Consumptive use value and (ii) Productive use value.

1. Consumptive use value

These are the direct use values where the biodiversity products can be harvested and consumed directly.

Example: Food, fuel and drugs. These goods are consumed locally and do not account in national and international market.

(a) Food

- (i) **Plants:** The most **fundamental value** of biological resources particularly plants is providing **food**. Basically three crops i.e. **wheat** (*Triticum vulgare*), **maize** (*Zea mays-corn*) and **rice** (*Oryza sativa*) constitute more than two third of the food requirement all over the world.
- (ii) **Fish:** Through the development of aquaculture, techniques, fish and fish products have become the **largest source of protein** in the world.

(b) Fuel:

Since ages forests have provided wood which is used as a fuel.

Moreover **fossil fuels** like coal, petroleum, natural gas are also product of biodiversity which are directly consumed by humans (Energy consumption).

(c) Drugs and medicines:

The **traditional medical** practice like ayurveda utilizes plants or their extracts directly. In **allopathy**, the pharmaceutical industry is much more dependent on natural products. Many drugs are derived from plants like

- (i) **Quinine:** The famous anti malaria drug is obtained from cinchona tree.
- (ii) **Penicillin:** A famous antibiotic is derived from penicillium, a fungus.
- (iii) **Tetracycline:** It is obtained from bacterium.
- (iv) Recently **vinblastin** and **vincristine**, two anti cancer drugs have been obtained from catharanthus plant which has anti cancer alkaloids.

2. Productive use values

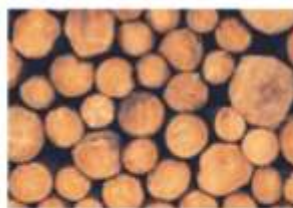
NTFP- These are the direct use values where the product is **commercially sold in national and international market**. Many industries are dependent upon these values.

Example- Textile, leather, silk, paper and pulp industry etc.

Although there is an international ban on trade of products from endangered species like tusks of elephants, wool from sheep, fur of many animals etc. These are traded in market and fetch a booming business.

Fuel, Timber, Fiber, Wool, Wax, Resin, Rubber

Bioprospecting : Development of new sources of **chemical compound, Genes, micro-organisms**, macro and other valuable products from nature



TREVORS FIREWOOD
Phone 0427 446 101

II. Indirect values

Biodiversity provides indirect benefits to human beings which support the **existence of biological life and other benefits which are difficult to quantify.**

These include social and cultural values, ethical values, aesthetic values, option values and environment service values.

1. Social and cultural value

Many plants and animals are considered holy and sacred in India and are worshipped

Like Tulsi, Peepal, Cassia fistula, cow, snake etc. *Gloriosa superba*

In **Indian society great cultural value** is given to forest and as such tiger, peacock and lotus are named as the national animal, bird and flower, respectively.

Sacred Grooves

2. Ethical: These values are related to conservation of biodiversity where ethical issue of 'all life forms must be preserved' is laid down. There is an existence value which is attached to each species because biodiversity is valuable for the **survival of human race**. Moreover all species have a **moral right to exist independent** of our need for them.

3. Aesthetic value: There is a great aesthetic value which is attached to biodiversity. Natural landscapes at undisturbed places are a delight to watch and also provide opportunities for recreational activities like **bird watching, photography** etc.

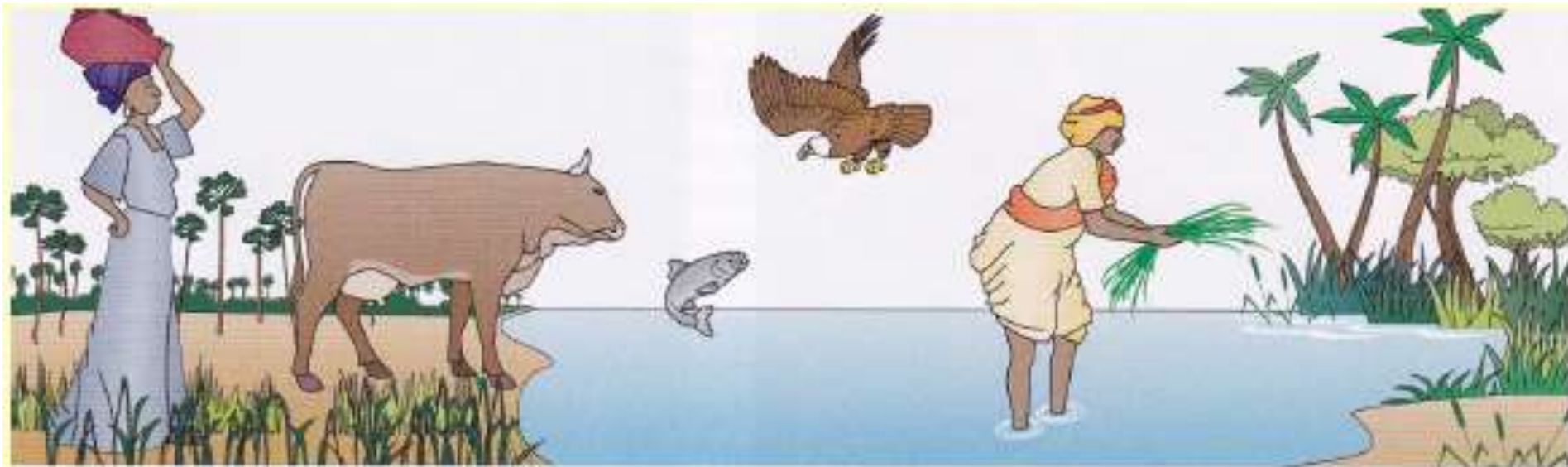
It promotes **eco-tourism** which further generates revenue by designing of **zoological, botanical gardens, national parks**, wild life conservation etc.

4. Option values: These values include the unexplored or unknown potentials of biodiversity.

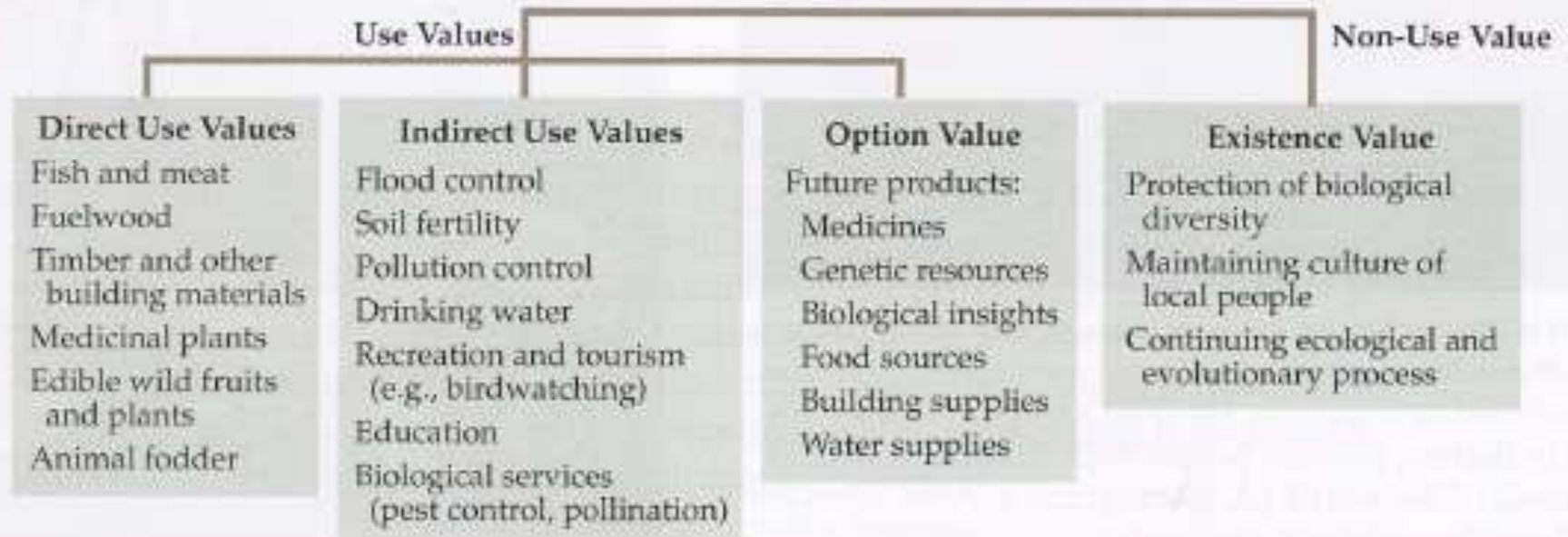
5. Environment service values

The most important benefit of biodiversity is maintenance of environment services which includes

- (i) Carbon dioxide fixation through photosynthesis.
- (ii) Maintaining of essential nutrients by **carbon** (C), **oxygen** (O), **Nitrogen** (N), **Sulphur** (S), **Phosphorus** (P) cycles.
- (iii) Maintaining water cycle and recharging of ground water.
- (iv) Soil formation and protection from erosion.
- (v) Regulating climate by recycling moisture into the atmosphere.
- (vi) Detoxification and decomposition of waste



Total Economic Value of a Tropical Wetland Ecosystem



THREATS TO BIODIVERSITY

- ▶ Habitat destruction.
- ▶ Introduced and invasive species.
- ▶ Genetic pollution.
- ▶ Overexploitation.
- ▶ Hybridization and food security.
- ▶ Climate change.
- ▶ Human overpopulation.



THREATS TO BIODIVERSITY

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graph TD; A[THREATS TO BIODIVERSITY] --> B[Anthropogenic effects]; A --> C[Climate change]; B --> D["✓ Over exploitation<br/>✓ Encroachment<br/>✓ Deforestation<br/>✓ Invasive species"]; C --> E["✓ Decline in habitat<br/>✓ Fragmentation<br/>✓ Extinction of species"];
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Anthropogenic effects

- ✓ Over exploitation
- ✓ Encroachment
- ✓ Deforestation
- ✓ Invasive species

Climate change

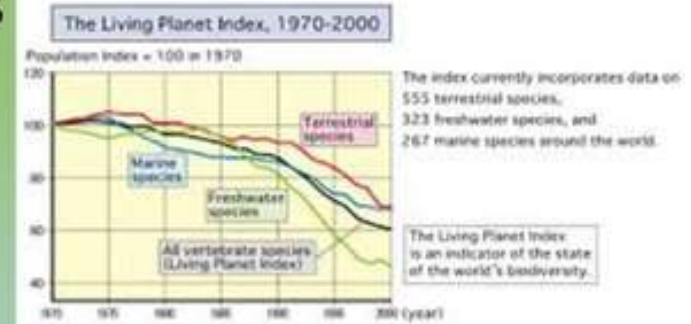
- ✓ Decline in habitat
- ✓ Fragmentation
- ✓ Extinction of species

Goals of Convention on Biological Diversity (CBD) 29 december1993

- ✓ Conservation of biological biodiversity
- ✓ Sustainable use of its components and
- ✓ Fair and equitable sharing of benefits arising from genetic resources

Living Planet Index

- Living Planet Index – developed by scientists at the World Wildlife Fund (WWF) and the United Nations Environment Programme (UNEP) to track species decline
- It summarizes population trends for a set number of terrestrial, freshwater, and marine species
- Closely monitored and provides reliable data
- Between 1970 and 2010, the Living Planet Index fell by 52%.



WILDLIFE POPULATION DECLINE BETWEEN 1970 AND 2010



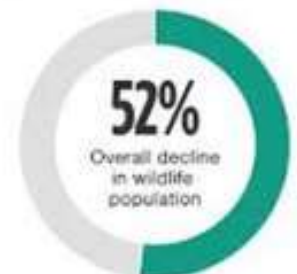
76%
Freshwater species



39%
Terrestrial species



39%
Marine species



THREATS TO BIODIVERSITY

▶ Habitat destruction:

- ❑ Habitat destruction has played a key role in extinctions ,especially related to tropical forest destruction.
- ❑ Deforestation and increased road-building in the Amazon Rainforest are a significant concern because of increased human encroachment upon wild areas, increased resource extraction and further threats to biodiversity.

▶ Introduced and invasive species:

- ❑ Barriers such as large rivers, seas, oceans, mountains and deserts encourage diversity by enabling independent evolution on either side of the barrier, via the process of allopatric speciation.
- ❑ The exotic organisms may be predators, parasites, or may simply outcompete indigenous species for nutrients, water and light.

THREATS TO BIODIVERSITY

► Genetic pollution :

- ☐ Genetic pollution leads to homogenization or replacement of local genomes as a result of either a numerical and/or fitness advantage of an introduced species.
- ☐ Hybridization and introgression are side-effects of introduction and invasion.
- ☐ The abundant species can interbreed with the rare species, swamping its gene pool.
- ☐ Some degree of gene flow is normal adaptation, and not all gene and genotype constellations can be preserved.

► Overexploitation:

- ☐ Overexploitation occurs when a resource is consumed at an unsustainable rate.
- ☐ The overkill hypothesis, a pattern of large animal extinctions connected with human migration patterns, can be used explain why mega faunal extinctions can occur within a relatively short time period.



THREATS TO BIODIVERSITY

► Hybridization and food security:

- ❑ In agriculture and animal husbandry, the Green Revolution popularized the use of conventional hybridization to increase yield.
- ❑ Local governments and industry have been pushing hybridization.
- ❑ Genetic erosion coupled with genetic pollution may be destroying unique genotypes, thereby creating a hidden crisis which could result in a severe threat to our food security.

► Climate change:

- ❑ Global warming is also considered to be a major potential threat to global biodiversity in the future.
- ❑ Increasing atmospheric carbon dioxide certainly affects plant morphology and is acidifying oceans, and temperature affects species ranges, phenology, and weather, but the major impacts that have been predicted are still just potential impacts.



LEGAL STATUS

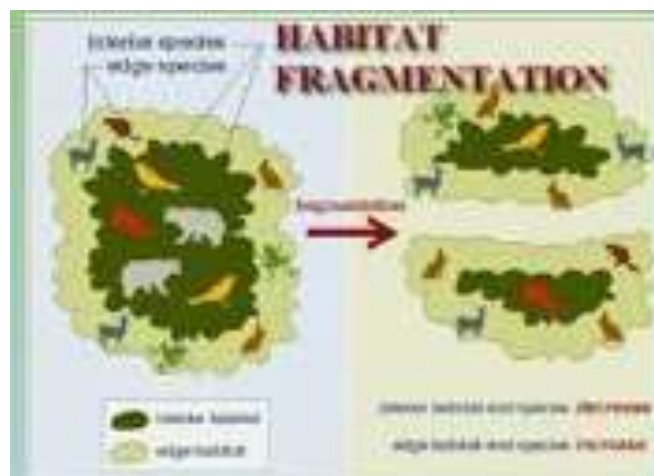
► International level:

- ☐ United Nations Convention on Biological Diversity (1992) and Cartagena Protocol on Biosafety;
- ☐ Convention on International Trade in Endangered Species (CITES);
- ☐ Ramsar Convention (Wetlands);
- ☐ Bonn Convention on Migratory Species;
- ☐ World Heritage Convention (indirectly by protecting biodiversity habitats)
- ☐ Regional Conventions such as the Apia Convention
- ☐ Bilateral agreements such as the Japan-Australia Migratory Bird Agreement.

Causes of Biodiversity Loss

- Complex & difficult to determine
- 4 Primary Causes of population decline:
 - Habitat change and loss
 - Invasive species
 - Pollution
 - Overharvesting
- Many scientists think global climate change will become a greater factor in the future





7.3 Protecting Biodiversity

- Endangered Species Act (ESA) – 1973 – U. S. law that forbids the gov't & private citizens from harming listed endangered & threatened species or their habitats, forbids trade in products made from species that are on the list, and it requires the U.S. Fish and Wildlife Service to maintain the official list of endangered and threatened organisms and to develop recovery plans for each protected species.
- The goal of the law is to prevent extinctions by protecting at-risk species from natural and artificial threats.



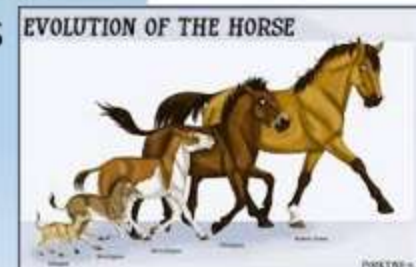
CITES

- 1975 Convention on International Trade in Endangered Species of Wild Fauna & Flora
- CITES protects endangered species by banning international transport of their body parts
- Effective when enforced by the 175 member nations
- Treaties are agreements under international laws that rely on enforcement
- Worldwide ban on ivory helped save the elephants from poaching as there was no market left



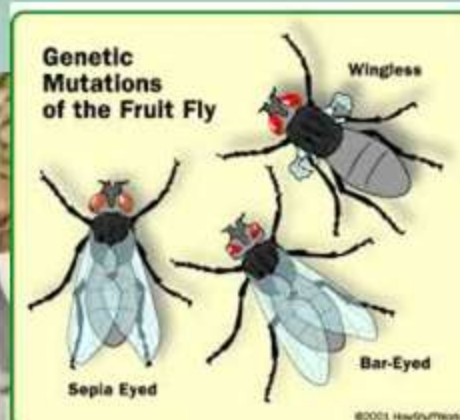
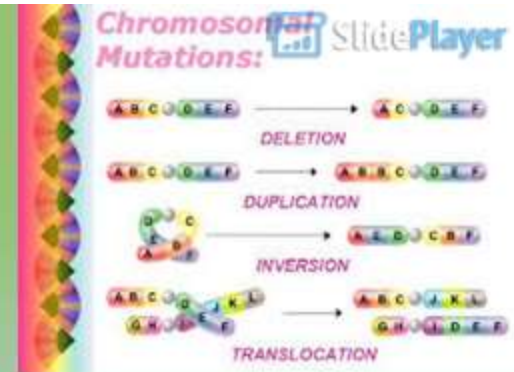
Evolution

- Biological evolution occurs through mutations, migrations, genetic drift, and natural selection
- Evolution means “change over time.”
 - Biological evolution – a change in a population’s gene pool over time
- Gene pool – includes all genes present in a population
- Gene – sequence of DNA that codes for a particular trait
- Any change to a population over generations, in terms of traits expressed, indicates biological evolution has occurred
- There are four primary mechanisms for evolution:
Mutation, Migration, Genetic Drift, Natural Selection



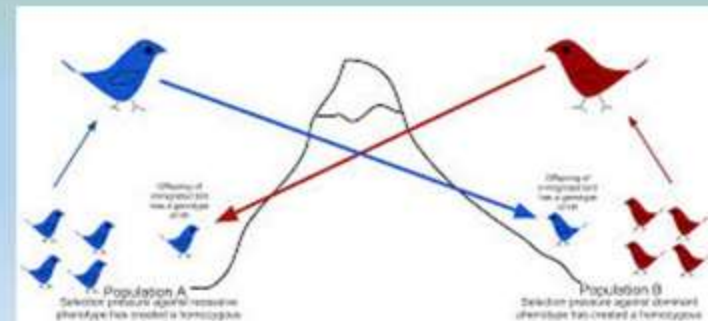
Mutations

- A mutation is a change in DNA
- Mutations give rise to genetic variation among individuals
- If a mutation occurs in a sperm or egg cell, it will be passed on to the next generation, and over many generations evolution will occur



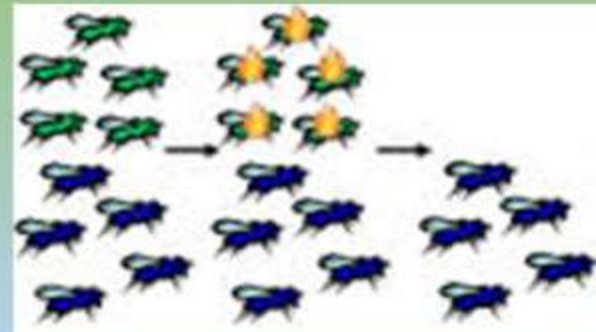
Migration

- Immigration into or Emigration out of a population could cause a change in the proportion of that trait in the population
- Over generations, evolution occurs because of this *gene flow*.



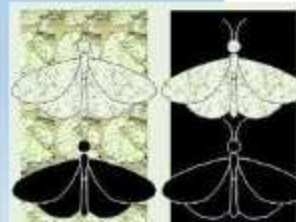
Genetic Drift

- Genetic Drift - biological evolution that occurs by chance
- Sometimes an unusual event, like a natural disaster or run-in with a fishing net, kills or somehow separates all but a few individuals from a population
- The next generation would have a different gene pool from the original population just by chance



Natural Selection

- Process by which traits that improve an organism's chances for survival & reproduction are passed on more frequently to future generations than those that do not
- Ex. – if striped fish were more attractive to mates, or better able to avoid predation than solid fish, their genes would be passed on to the next generation, and over time evolution would occur



Biodiversity Hotspots of the World



BENEFITS OF BIODIVERSITY

Consumptive value:

- Food/Drink
- Fuel
- Medicine
- Better crop varieties
- Industrial Material

Non-Consumptive Value:

- Recreation
- Education and Research
- Traditional value

Ecological services:

- Balance of nature
- Biological productivity
- Regulation of climate
- Degradation of waste
- Cleaning of air and water
- Cycling of nutrients
- Control of potential pest and disease causing species
- Detoxification of soil and sediments
- Stabilization of land against erosion
- Carbon sequestration and global climate change
- Maintenance of Soil fertility

THREATS TO BIODIVERSITY

Natural causes:

- Narrow geographical area
- Low population
- Low breeding rate
- Natural disasters



Anthropogenic causes:

- Habitat modification
- Overexploitation of selected species
- Innovation by exotic species



- Pollution
- Hunting
- Global warming and climate change
- Agriculture
- Domino effect



RECENT ISSUES ON BIODIVERSITY

- Some 75 per cent of the genetic diversity of crop plants been lost in the past century.
- Some scientists estimate that as many as 3 species per hour are going extinct and 20,000 extinctions occur each year.
- Roughly one-third of the world's coral reef systems have been destroyed or highly degraded.
- About 24 per cent of mammals and 12 per cent of bird species are currently considered to be globally threatened.
- More than 50 per cent of the world's wetlands have been drained, and populations of inland water and wetland species have declined by 50per cent between 1970 and 1999.

CONSERVATION OF BIODIVERSITY

- Biodiversity inventories
- Conserving Biodiversity in protected Habitats-
 - *In situ* conservation
 - *Ex situ* conservation
- Seed Bank, Gene Bank, Pollen Bank, DNA Bank



zoo



Gene Bank



Tiger, Bandhavgarh National Park

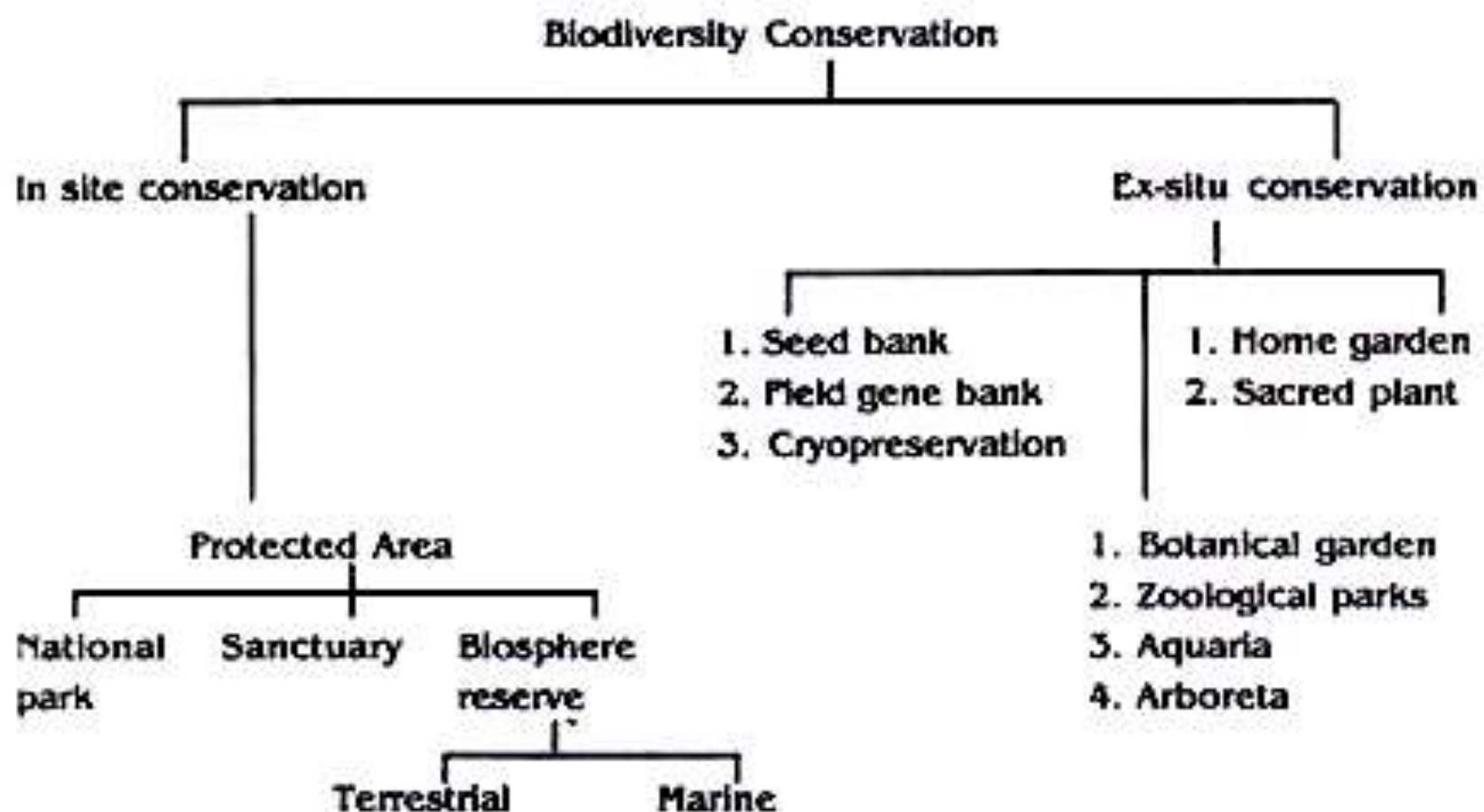
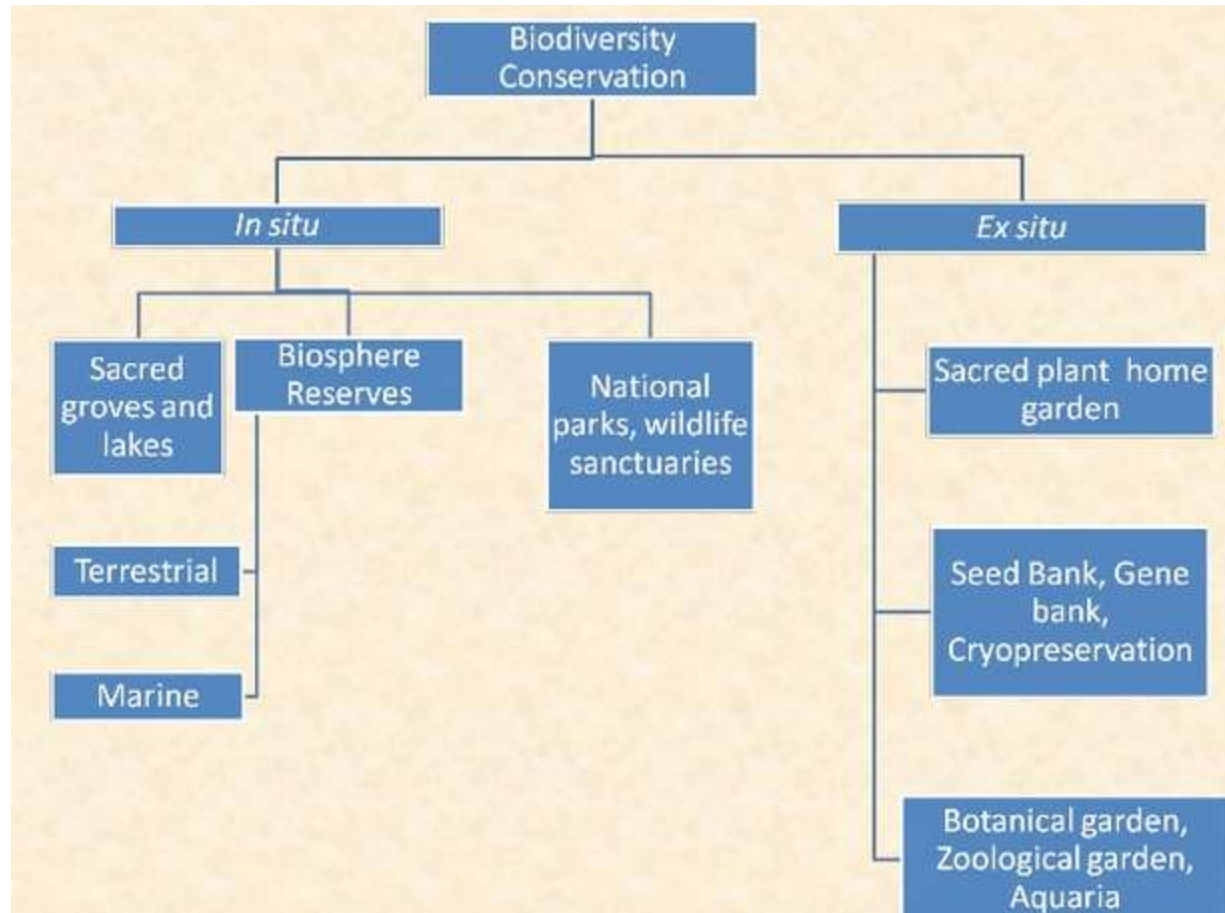


FIG. 5.1 : SCHEME SHOWING BIODIVERSITY CONSERVATION MANAGEMENT SYSTEMS.



Vocabulary Terms to Define (26)

- Biodiversity
- Ecosystem diversity
- Genetic diversity
- Species diversity
- Taxonomical key
- Adaptation
- Artificial selection
- Evolution
- Extirpation
- Genetic drift
- Mutation
- Biodiversity hotspot
- Gene pool
- Natural selection
- Speciation
- Variation
- Endangered species
- Endangered Species Act
- Endemic
- Extinction
- Captive breeding
- Habitat fragmentation
- Invasive species
- Species Survival Plan
- Poaching
- Threatened species

BIODIVERSITY IN INDIA

Categories	No. of Indian Species	% of Indian species Evaluated	Species Threatened In India
Mammals	386	59	41%
Birds	1219	—	7%
Reptiles	495	73	46%
Amphibians	207	79	57%
Freshwater Fish	700	46	70%

Source- Based on Kumar et.al 2000