Biodiversity and its Conservation

•Biodiversity refers to the variety and variability among all groups of living organisms and the ecosystem complexes in which they occur.

•**Levels of Biodiversity**

•Units of biodiversity may range from the genetic level within a species to the biota in a specific region and may extend up to the great diversity found in different biomes.

•**Genetic Diversity:**

•It is the basic source of biodiversity.

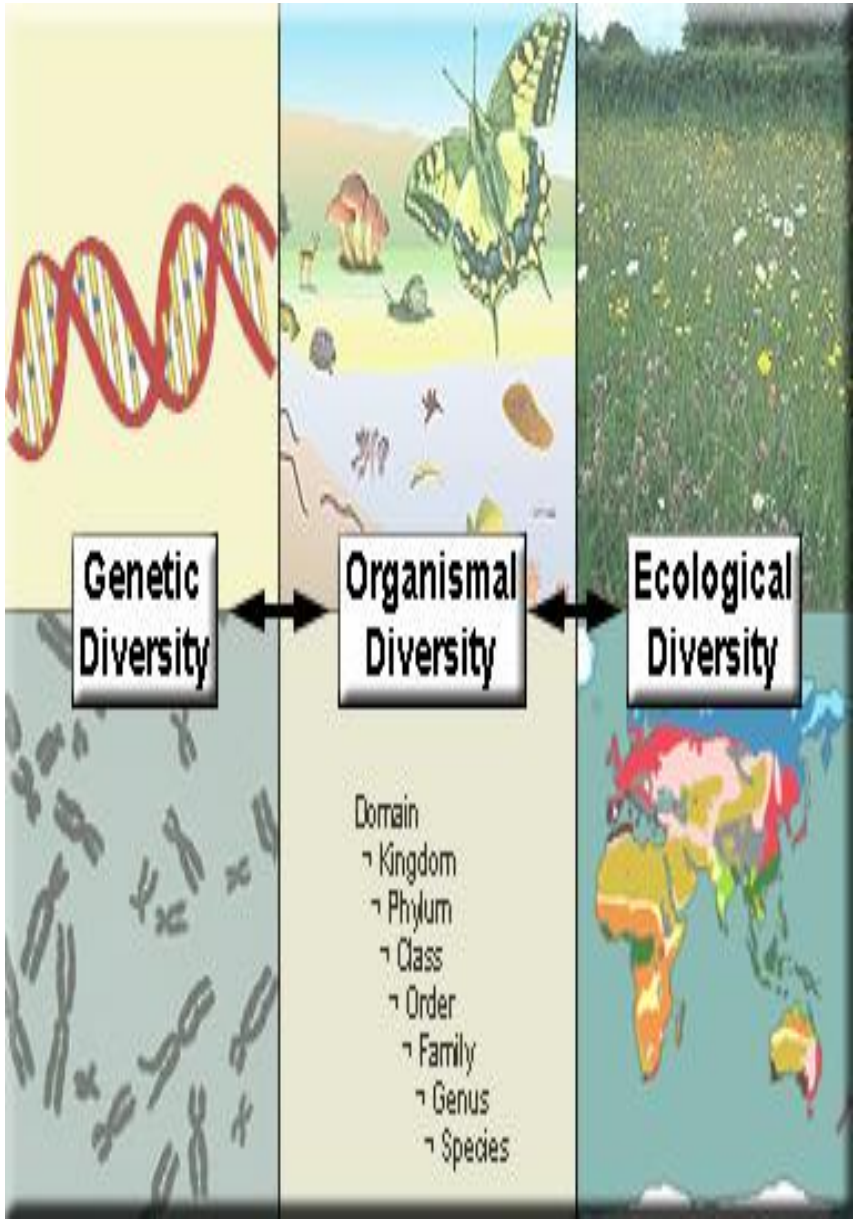
•The genes found in organisms can form enormous number of combinations each of which gives rise to some variability.

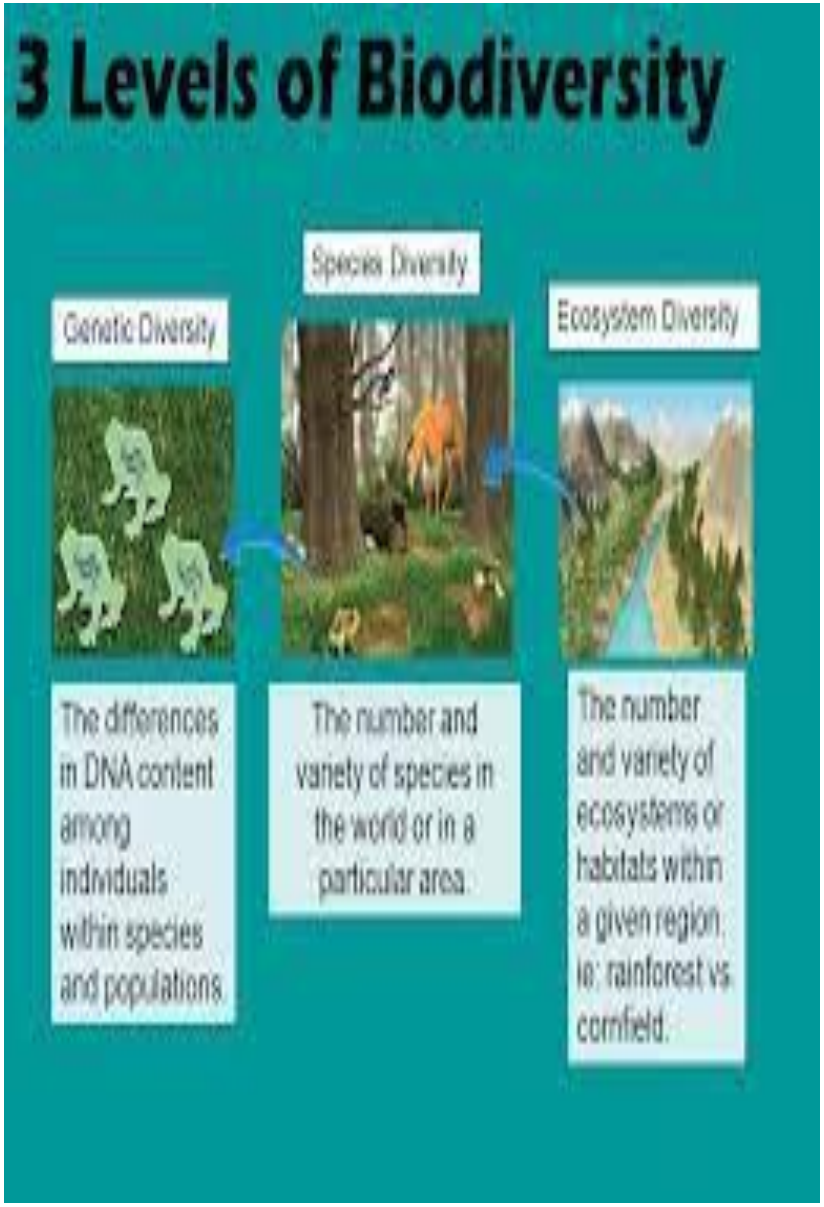
•Genes are the basic units of hereditary information transmitted from one generation to other.

•When the genes within the same species show different versions due to new combinations, it is called genetic variability.

•For example, all rice varieties belong to the species *Oryza sativa*, but there are thousand of wild and cultivated varieties of rice which show variations at the genetic level and differ in their colour, size, shape, aroma.

- **Species Diversity:**
- This is the variability found within the population of a species or between different species of a community.
- It represents broadly the species richness and their abundance in a community.
- **Ecosystem Diversity:**
- This is the diversity of ecological complexity showing variations in ecological niches, trophic structure, food webs, nutrient cycling etc.
- The ecosystem also show variations with respect to physical parameters like moisture, temperature, altitude, precipitation etc.
- Thus there, occurs tremendous diversity within the ecosystems.
- The ecosystem diversity is of great value that must be kept intact.
- This diversity has developed over millions of years of evolution.
- This diversity, it would be disrupt the ecological balance .
- We cannot even replace the diversity of one ecosystem by that of another.


Genetic Diversity
Organismal Diversity
Ecological Diversity
Domain
Kingdom
Phylum
Class
Order
Family
Genus
Species


3 Levels of Biodiversity
Genetic Diversity
Species Diversity
Ecosystem Diversity
The differences in DNA content among individuals within species and populations.
The number and variety of species in the world or in a particular area.
The number and variety of ecosystems or habitats within a given region ie: rainforest vs. cornfield.

- **Biogeographical Classification of India:**
- India has different types of climate and topography in different parts of the country and these variations have induced enormous variability in flora and fauna.
- India has a rich heritage of biological diversity and occupies the tenth position among the plant rich nations of the world.
- It is very important to study the distribution, evolution, dispersal and environmental relationship of plants and animals in time and space.
- Biogeography comprising of phytogeography and zoogeography deals with these aspects of plants and animals.
- In order to gain insight about the distribution and environmental interactions of flora and fauna of our country, it has been classified into ten biogeographical zones .
- Each of these zones its own characteristic climate, soil, topography and biodiversity.

S.No	Bioiogeographic zone	Biotic Province	Important Flora and Fauna
1	Trans - Himalayan	Upper regions	Pine, Deodar, Wild sheep, Yalk, wolf, black necked crane, snow leropard
2	Himalayan	North, West, Central, East Himalayas	Pine, cork tree, wild bear, sambar deers, leopard, musk deer
3	Desert	Kutch, Thar, Ladakh	Acacia, Zizyphus, date palm, camel, wild ass, desert cat
4	Semi - arid	Central India, Gujarath	Acacia, date palm, peepal, tiger, gir lion, Sariska and Ranathambore tiger reserves.
5	Western Ghats	Malabar coast, western ghats	Sheesham, tuna, frog, lizards, snakes
6	Deccan Peninsula	Deccan Plateau, south central, eastern plateau, chhota nagpur central highlands	Acacia, pine, castor, sloth bear, tiger, cheetal, wild elephant.
7	Gangetic Plain	Upper gangetic and lower gangetic plain	Sal, Acacia, jamun, mango, Rhinoceros, gazzel, alligator, turtle
8	North – East India	Brahmaputra valley, North – Eastern Hills	Bamboo, sal, jack, elephant, Rhinoceros, deer, porcupine
9	Islands	Andaman Nicobar, Lakshadweep Islands	Jack fruit, cardamom, dolphin, alligator, molluscs
10	Coasts	West – East coasts	Coconut, banana, dolphin, turtle

VALUE OF BIODIVERSITY

•The value of biodiversity in terms of its commercial utility, ecological services, social, aesthetic value is enormous.

1. **Consumptive value:** These are direct use values where the biodiversity product can be harvested and consumed directly, e.g. food, drugs and fuel.

Food: A large number of wild plants are consumed by human beings as food.

- About 80,000 edible plant species have been reported from wild.
- About 90% of present day food crops have been domesticated from wild tropical plants.
- Wild relatives usually possess better tolerance and hardness.
- A large number of wild animals are also our sources of food.

Drugs and Medicines: About 75% of the world's population depends upon plants or plant extracts for medicines.

- The wonder drug used as an antibiotic is derived from a fungus called pencillium. Likewise, we get Tetracycline from a bacterium.
- Quinine, the cure for malaria is obtained from the bark of Cinchona tree, while Digitalis is obtained from Digitalis which is an effective cure for heart aliments.

- Recently vinblastin and vincrystine, two anti cancer drugs, have been obtained from Catharanthus plant.
- A large number of marine animals are supposed to possess anti-cancer properties which are yet to be explored systematically.

Fuel: Our forests have been used since ages for fuel wood.

- The fossil fuels coal, petroleum and natural gas are also products of fossilized biodiversity.

2. **Productive use values:** these are the commercially usable values where the product is marketed and sold.

- These may include the animal products like tusks of elephants, musk from musk deer, silk from silk-worm, wool from sheep, fur of many animals, lac from lac insects.
- All of which are trades in the market.

•Many industries are dependent upon the productive use values of biodiversity. E.g. the paper and pulp industry, plywood industry, railway sleeper industry, textile industry, leather industry, pearl industry etc.

3. Social value: these are the values associated with the social life, customs, religion and psycho-spiritual aspects of the people.

•Many of the plants and animals are considered holy and sacred in our country.

4. Ethical value: it is also sometimes known as existence value.

•It involves ethical issues like " all life must be preserved"

•It is based on the concept of "Live and Let Live".

•If we want our human race to survive, then we must protect all biodiversity, because biodiversity is valuable.

5. Aesthetic value: great aesthetic value is attached to biodiversity.

•No one of us would like to visit vast stretches of barren lands with no signs of visible life.

•People from far and wide spend a lot of time and money to visit wilderness areas where they can enjoy the aesthetic value of biodiversity and this type of tourism is known as **eco-tourism**.

6. Option value: these values include the potentials of biodiversity that are presently unknown and need to be explored.

- Thus option value is the value of knowing that there are biological resources existing on this biosphere that may one day prove to be an effective option for something important in the future.

7. Ecosystem service value:

- It refers to the services provided by ecosystems like prevention of soil erosion, prevention of floods, maintenance of soil fertility, cycling of nutrients, fixation of nitrogen, cycling of water pollutant absorption and reduction of the threat of global warming etc.

Hotspots Biodiversity

- Areas which exhibit high species richness as well as high species endemism are termed as hot spots of biodiversity.
- Earlier 25 such hotspots of biodiversity were identified on a global level out of which two were present in India. Later additional 9 hotspots were added bringing the total to 34.
- These hotspots covering less than 2% of the world's land area are found to have about 50% of the terrestrial biodiversity.
- According to Myers et al. (2000) an area is designated as a hotspots when it contains at least 0.5% or 1500 species of the plant species as endemics and have lost at least 70% of its primary vegetation.
- About 40% of terrestrial plants and 25% of vertebrate species are endemic and found in these hotspots.
- After the tropical rain forests, the second highest number of endemic plant species are found in the Mediterranean.
- Broadly, the hotspots are in Western Amazon, Madagascar, North and East Borneo, North-Eastern Australia, West Africa and Brazilian Atlantic forests.

- These are the areas of high diversity, endemism and are also threatened by human activities.
- More than 1 billion most of whom are desperately poor people, live in these areas.
- Now three of these hotspots lie in India extending into neighbouring countries.
- Indo-Burma Hotspot (Nepal, Bhutan and India)
- **Western Ghats Hotspot** (Maharashtra, karnataka, Tamil Nadu and kerala): **In July 2012, the Western Ghats have been included in the World Heritage sites**
- The major centers of diversity are **Agastyamalai Hills and Silent Valley – the New Amambalam Reserve Basin**.
- **Eastern Himalayas Hotspot:** There are numerous deep and semi-isolated valleys in Sikkim which are extremely rich in endemic plant species, particularly Orchids.

Threats to Biodiversity

•Extinction or elimination of a species is a natural process of evolution.

•During evolution, species have died out and have been replaced by others.

•The process of extinction has become particularly fast in the recent years of human civilization.

•One of the estimates noted by ecologist, E.O. Wilson puts the figure of extinction at 10,000 species per year or 27 per day.

•Let us consider some of the major causes and issues related to threats to biodiversity.

1. **Loss of Habitat**

- Destruction and loss of natural habitat is the single largest cause of biodiversity loss.
- Billions of hectares of forests and grasslands have been cleared over the past 10,000 years for conversion into agriculture lands, pastures and development projects or settlement areas.

- These natural forests and grasslands are natural homes of thousands of species which perished due to loss of their natural habitat.
- There are many wild life species like bears and large cats that require large territories to subsist.
- They get badly threatened as they breed only in the interiors of the forest due to habitat fragmentation.
- There has been a rapid disappearance of tropical forests in our country and Marine biodiversity is also under serious threat due to human intervention.

2. Poaching

- Illegal trade of wildlife products by killing, prohibited, endangered animals i.e. poaching is another threat to wildlife.
- Despite international ban on trade in products from endangered species, smuggling of wildlife items like furs, hides, horns, tusks, live specimens and herbal products worth millions of dollars per year continues.

- The developing nations like Asia, Latin America and Africa are the richest source of biodiversity and have enormous wealth of wildlife.
- The rich countries in Europe, North America and some affluent countries in Asia like Japan, Taiwan and Hong Kong are the major importers of the wildlife products.
- The trading of such wildlife products is highly profit making for the poachers who just hunt these prohibited wildlife and smuggle it to other countries mediated through mafia.

3. Man-Wild life Conflicts

- Some time we come across conflicting situations when wildlife starts causing immense damage and danger to man and under such conditions it becomes very difficult for the forest department to pacify the affected villagers and gain local support for wildlife conservation.
- Instances of man-animal conflicts keep on coming to limelight from several states in our country.

1. In Sambalpur, Odisha 195 humans were killed in the last 5 years by elephants. In retaliation the villagers killed 98 elephants and badly injured 30 elephants

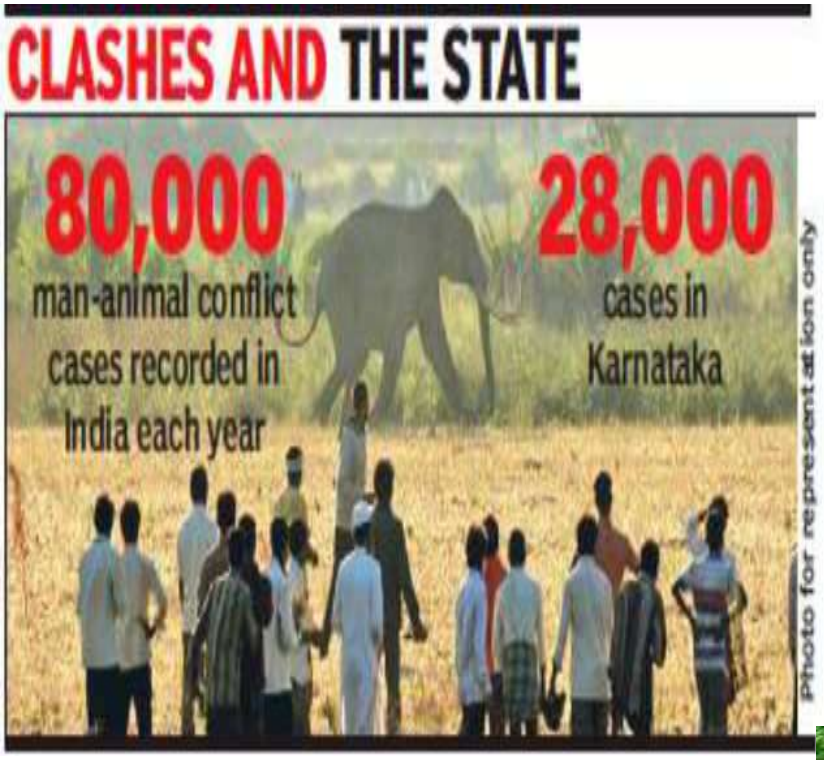
- Several instances of killing of elephants in the border regions of Kote-Chamarajanagar belt in Mysore have been reported recently.
- The man-elephant conflict in this region has arisen because of the massive damage done by the elephants to the framer's cotton and sugarcane crops.
- In early 2004, a man-eating tiger was reported to kill 16 Nepalese people and one 4 years old child inside the Royal Chitwan National park.
- In June, 2004 two men were killed by leopards in Powai, Mumbai. A total of 14 persons were killed during 19 attacks in January 2004 by the leopards from the Sanjay Gandhi National Park, Mumbai which has created panic among the local residents.

Causes of man-animal conflicts:

1. Dwindling habitats
2. Man-eating tendency
3. Scarcity of food
4. Electric wiring
5. Lack of corridors
6. Inadequate compensation

Remedial measures to Curb the Conflict

- Tiger Conservation Project has made provisions for making available vehicles, tranquillizer guns, binoculars and radio sets etc. to tactfully deal with any imminent danger.
- Adequate crop compensation and cattle compensation scheme must be started, along with substantial cash compensation for loss of human life.
- Solar powered fencing should be provided along with electric current proof trenches to prevent the animals from straying into fields.
- Cropping pattern should be changed near the forest borders and adequate fodder, fruit and water should be made available for the elephants within forest zones.
- Wildlife corridors should be provided for mass migration of big animals during unfavorable periods.


CLASHES AND THE STATE
80,000
man-animal conflict cases recorded in India each year
28,000
cases in Karnataka
Photo for representation only

CONSERVATION OF BIODIVERSITY

- The enormous value of biodiversity due to their genetic, commercial, medical, aesthetic and ecological importance emphasizes the need to conserve biodiversity.
- Gradually we are coming to realize that wildlife is not just **'game to be hunted'** rather it is a **'gift of nature'** to be nurtured and enjoyed.
- A number of measures are now being taken the world over to conserve biodiversity including plants and wildlife.
- There are two approaches of biodiversity conservation:
- **In situ conservation (within habitat) :** this is achieved by protection of wild flora and fauna in nature itself. E.g. Biosphere reserves, National parks, Sanctuaries, Reserve Forests etc.
- **Ex situ conservation (outside habitats):** This is done by establishment of gene banks, seed banks, zoos, Botanical gardens etc.

- **In situ conservation:** At present we have 18 major Biosphere reserves, 104 National parks, 543 wildlife Sanctuaries and 120 Botanical gardens in our country covering 4% of the geographical area.
- The **Biosphere Reserves** conserve some representative ecosystems as a whole for long-term in situ conservation.
- In India we have Nanda Devi (U.P), Nokrek (Meghalaya), Manas (Assam), Sunderbans (W.B), Nilgiri (karnataka, kerala, tamil nadu).
- Within the Biosphere reserve one or more National parks. For example, Nilgiri Biosphere reserve has two National parks viz. Bandipur and Nagrhole National park.
- A **National park** is an area dedicated for the conservation of wildlife along with its environment.
- It is also meant for enjoyment through tourism but without impairing the environment.
- Grazing of domestic animals, all private rights and forestry activities are prohibited within a National park.
- Each National park aims at conservation specifically of some particular species of wildlife along with others.

- Some major National parks in our country.

S.No	Name of the National Park and State	Important wildlife
1	Kaziranga, Assam	One-horned Rhino
2	Gir National Park, Gujarat	Indian Lion
3	Dachigam, J&K	Hangul
4	Bandipur, Karnataka	Elephant
5	Kanha, MP	Tiger
6	Corbett, Uttarakhand	Tiger
7	Ranathambore, Rajasthan	Tiger

- Wildlife sanctuaries are also protected areas where killing, hunting, shooting or capturing of wildlife is prohibited except under the control of highest authority.
- However, private ownership rights are permissible and forestry operations are also permitted to an extent that they do not affect the wildlife adversely.

S.No	Name of Sanctuaries	State	Major Wildlife
1	Ghana Bird Sanctuary	Rajasthan	300 species of birds
2	Hazaribagh Sanctuary	Bihar	Tiger, Leopard
3	Sultanpur Bird Sanctuary	Haryana	Migratory Birds
4	Nal Sarovar Bird Sanctuary	Gujarat	Water Birds
5	Mudamalai wildife Sanctuary	Tamil Nadu	Tiger, Elephant, Leopard
6	Jaldapara Wildlife Sanctuary	West Bengal	Rhinoceros, elephant, Tiger
7	Wild Ass Sanctuary	Gujarat	Wild ass, wolf, nilgai

- **Ex Situ Conservation:** This type of conservation is mainly done for conservation of crop varieties, the wild relatives of crops and all the local varieties with the main objective of conserving the total genetic variability of the crop species for future crop improvement or afforestation programmes.
- In India, we have the following important gene bank/seed bank facilities.
- **National Bureau of Plant Genetic Resources (NBPGR):** is located in Delhi.
- Here agricultural and horticultural crops and their wild relatives are preserved by **cryo-preservation** of seeds, pollen etc. by using liquid nitrogen at a temperature as low as -196^{o}C.
- **National Bureau of Animal Genetic Resources (NBAGR):** located at Karnal, Haryana.
- It preserves the semen of domesticated Bovine animals.
- **National Facility for Plant Tissue Culture Repository (NFPTCR) :**
- For the development of a facility of conservation of varieties of crop plants/trees by tissue culture.
- This facility has been created under NBPGR

- **Endangered Species of India:**
- The **International Union for Conservation of Nature and Natural Resources (IUCN)** publishes the **Red Data Book** which includes the list of endangered species of plants and animals.
- The red data symbolizes the warning signal for those species which are endangered and if not protected are likely to become extinct in near future.
- In India, nearly 450 plant species have been identified in the categories of endangered, threatened or rare.
- Existence of about 150 mammals and 150 species of birds is estimated to be threatened while an unknown number of species of insects are endangered.
- However, a few species of endangered reptiles, birds, mammals and plants are given below:
- **Reptiles:** Gharial, green sea turtle, tortoise, python,
- **Birds:** Great Indian Bustard, Siberian white crane
- **Carnivorous Mammals:** Indian wolf, red fox, sloth bear, red panda

- **Primates:** Nilgiri langur, capped monkey, golden monkey, lion-tailed macaque
- Plants: A large number of species of orchids, rhododendrons, medicinal plants like Rauvolfia serpentina, the sandal wood tree Santalum, Cycas beddonei etc.
- The Zoological Survey of India reported that cheetah, pink headed duck and mountain quail have already become extinct in India.
- A species is said to be **extinct** when it is not seen in the wild for 50 years at a stretch. E.g. Dodo, passenger pigeon.
- A species is said to be **endangered** when its number has been reduced to a critical level or whose habitats, have been drastically reduced and if such a species is not protected and conserved, it is in immediate danger of extinction.
- A species is said to be **vulnerable** category if its population is facing continuous decline due to overexploitation or habitat destruction. Such a species is still abundant, but under a serious threat.
- Species which are not endangered or vulnerable at present, but are at a risk are categorized as **rare** species.

- **Endemic Species of India:** India has two biodiversity hotspots and thus possesses a large number of endemic species.
- Out of about 47,000 species of plants in our country 7000 are endemic.
- Thus, Indian subcontinent has about 62% endemic flora, restricted mainly to Himalayas, Khasi Hills and Western Ghats.
- A large number out of a total 81,000 species of animals in our country is endemic.
- The Western Ghats are particularly rich in amphibians and reptiles .
- Different species of monitor lizards (varanus) reticulated python and Indian Salamander and Viviparous toad are some important endemic species of our country.