

COMPILATION FROM SHANKAR IAS ENVIRONMENT

PART-II-BIODIVERSITY

CONTENTS

1. BIODIVERSITY
2. INDIAN BIODIVERSITY
3. ANIMAL DIVERSITY OF INDIA
4. PLANT DIVERSITY OF INDIA
5. MARINE ORGANISM
6. PROTECTED AREA NETWORK
7. GLOBAL INITIATIVE
8. CONSERVATION EFFORTS

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

(a) Genetic diversity:

- variation in genes within a particular species.
- It is the total number of genetic characteristics in the genetic makeup of a species.
- Genetic diversity allows species to adapt to changing environments.
- The genetic diversity gives us beautiful butterflies, roses, parakeets or coral in a myriad hues, shapes and sizes

(b) 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.(Imp)

(c) 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.
- Change in climatic conditions is accompanied by a change in vegetation as well.
- 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:

1. species richness, and
2. species evenness

(i) Species richness

- **It is the measure of number of species found in a community**

A) Alpha diversity-It refers to the diversity within a particular area or ecosystem, and is usually expressed by the number of species (i.e., species richness) in that ecosystem.

B) Beta diversity-It is a comparison of diversity between ecosystems, usually measured as the change in amount of species between the ecosystems.

C) Gamma diversity-It is a measure of the overall diversity for the different ecosystems within a region.

(ii) Species evenness

- It measures the proportion of species at a given site, e.g. low evenness indicates that a few species dominate the site.
- 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:

(a) 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

(b) Biological services:

- Food, Medicinal resources and pharmaceutical drugs
- Wood products, Ornamental plants
- Diversity in genes, species and ecosystems. Etc.

(c) 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 latter is more common as habitat destruction is inevitable fallout of development.
- 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
- Extinction- end of a species, which is inevitable when capacity to breed & recovery lost ;when they are no longer able to survive in changing environment or against superior competitor , finally marked by the death of last individual of that species.

Biodiversity conservation-

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

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.

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.
- Exploitation of living natural resources for monetary gain.
- 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

- Of the 34 globally identified biodiversity hotspots, India harbors two hotspots, i.e., Eastern Himalayas, Western Ghats and Sri Lanka.

INDIA REPRESENTS:

1. 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 are 1. nearctic realm ,2. palaearctic realm, 3. afrotropical realm, 4. indomalayan realm, 5. oceania realm 6. Australian realm, 7. Antarctic realm, 8. Neotropical realm

2. 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:**
 - 1) Tropical Humid Forests
 - 2) Tropical Dry or Deciduous Forests (including Monsoon Forests)
 - 3) Warm deserts and semi-deserts
 - 4) Coniferous forests and
 - 5) Alpine meadows.

3. Bio-geographic Zones-

- ✓ 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 northeastern India,
- 3) 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.
- ✓ 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 predominantly deciduous vegetation. 4.3 % of the country's landmass.
- ✓ Gangetic plain-Defined by the Ganges river system, these plains are relatively homogenous.
- ✓ North-east India- The plains and non-Himalayan hill ranges of northeastern 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; Lakshadweep islands are included in this with the percent area being negligible
- **India further divided into 25 biogeographic provinces.**

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

1. 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 autotrophic plants, as they can manufacture their own food.

2. Fungi:

- Non-green non differentiated plants characterized by total absence of chlorophyll are called Fungi.
- Moulds and mushrooms are the familiar examples of saprophytic fungi.
- The maximum diversity of fungi is in the Western Ghats followed by the eastern Himalaya and the western Himalaya.

3. Bacteria

- Non-chlorophyllous micro-organisms which lead saprophytic or parasitic existence.
- Many of them are pathogenic;
- Saprophytic bacteria are rather beneficial. They are soil borne and many of them are used in industries.

4. Lichens

- A peculiar combination of an alga and a fungus—the two live deriving mutual benefit.
- They are group of greyish green plants which grow on rocks, tree-trunks, dead wood, etc.
- The algae manufactures carbohydrate food which becomes available to the fungus, and the latter absorbs and retains water and -thus keeps the algal cells moist. So it is a nice example of symbiosis.

5. Bryophytes

- The plant body is differentiated into a small stem and simple leaves, but true roots are absent.
- They usually grow in moist places. E.g. Liverworts, mosses
- They are the second largest group of green plants in India distributed largely in Eastern Himalaya, North-eastern India, Western Himalaya and the Western Ghats.
- Mosses constitute the major component of Indian bryo flora followed by liverworts and hornworts

6. Pteridophytes

- Have well-differentiated plant bodies, consisting of roots, stems and leaves. Moreover, they possess vascular bundles.

7. Gymnosperms

- **Gymnosperms** (gymnos=naked, sperma=seed) are the naked-seeded plants.
- They have very simple flowers without accessory whorls and the microsporophylls (stamens) and megasporophylls (carpels) remain aggregated in cones.

8. Angiosperms:

- **Angiosperms** (angeion=a case) are the closed seeded plants. '
- These are the most highly developed plants which bear flowers having conspicuous accessory and essential whorls.
- Carpels have the ovary, style and stigma

Crop genetic diversity

- The national gene bank at National Bureau Of Plant Genetic Resources (NBPGR), Delhi is primarily responsible for conservation of unique accessions on long-term basis, as base collections for posterity, predominantly in the form of seeds

Livestock genetic diversity

- India ranks first in buffaloes, second in cattle and goats, third in sheep, fourth in ducks, fifth in chicken and sixth in camels in the world.

WILDLIFE OF INDIA (please read it with IUCN list)

(1) Himalayan foothills –

- **Flora:** Natural monsoon evergreen and semi-evergreen forests; dominant species are sal, silk-cotton trees, giant bamboos; tall grassy meadow with savannahs in tarai.
- **Fauna :** Includes big mammals of like elephant, sambar, swamp deer, cheetal, hog deer, barking deer, wild boar tiger, panther, wild dogs, hyena, black bear, sloth bear, porcupine, Great Indian one-horned rhinoceros, wild buffalo, gangetic gharial, golden langur.

(2) Western Himalayas (High altitude region)

- **Flora:** Natural monsoon evergreen and semi-evergreen forests; rhododendrons; dwarf hill bamboo and birch forests mixed with alpine pastures.
- **Fauna:** Wild ass, wild goats (thar, markhor, ibex) and sheep (Nayan, Marcopolo's sheep, bharal or blue sheep) ; antelopes (Chiru and Tibetan gazelle), deers (hangul of Kashmir stag and shou or Sikkim stag, musk deer); marmots and pikas or mouse hares; golden eagle, snow cocks, snow partridges; snow leopard, wolf, fox, cats, black and brown bears; birds like Himalayan monal pheasant, western trogon, Koklass, whitecrested khalij cheer pleasant; Griffon vultures, lammergeiers, choughs, ravens

(3) Eastern Himalayas-

- **Flora**-Oaks, magnolias, laurels and birches covered with moss and ferns; coniferous forests of pine, fir, yew and junipers with undergrowth of scrubby rhododendrons and dwarf bamboos; lichens, moses, orchids, and other epiphytes dominant (due to high humidity and high rainfall).
- **Fauna**- Red panda, hog badgers forest badgers, crestless porcupines, goat antelopes (Scrow, Goral, Takins).

(4)Peninsular India-

- It is home to tropical moist deciduous to tropical dry deciduous and scrub vegetation depending upon the variation in rainfall and humidity.
- **Flora:** Sal in north and east extensions (higher rainfall) and teak in southern plateau are dominant trees.

- ✓ West Ghats have evergreen vegetation (flora and fauna similar to evergreen rainforests of north eastern of India).
- ✓ In dry areas of Rajasthan and Aravalli hills, trees are scattered and thorny scrub species predominate. The forests give way to more open savannah habit.
- **Fauna** : Elephant, wild boar, deers (cheetal or axis deer), hog deer, swamp deer or barasingha, Sambar, muntjac or barking deer, antelopes (four-horned antelope, nilgai, blackbuck, chinkara gazelle), wild dog or dhole, tiger, leopard, cheetah, lion, wild pig, monkey, striped hyena, jackal, gaur

(5) Indian desert-

- **Flora**: Thorny trees with reduced leaves; cacti, other succulents are the main plants.
- **Fauna**: Animals are mostly burrowing ones. Among mammals rodents are the largest group. The Indian desert gerbils are mouse like, rodents, other animals are, wild ass, black buck, desert cat, caracal, red fox; reptiles (snakes, lizards and tortoise) well represented. Desert lizards include agamids, lacertids and geckos.
- Among birds the most discussed is Great Indian bustard.

(6) Tropical rain forest region

- Distributed in areas of western ghats and north east India.
- **Flora**: Extensive grass lands interspersed with densely forested gorges of evergreen vegetation known as sholas occur in the Nilgiris (an offshoot of Western ghats).
- ✓ The rain forests of the Westernghats have dense and lofty trees with much species-diversity. Mosses, ferns, epiphytes, orchids, lianas and vines, herbs, shrubs make diverse habitat.
- ✓ Ebony trees predominate in these forests. A variety of tropical orchids are found.
- ✓ Stratification in rain forests is very distinct-three horizontal layers are distinguished.
- **Fauna**-There are wild elephants, gaur and other larger animals. Most species are tree dwellers. The most prominent are hoolock gibbon (only ape found in India), golden langur, capped langur or leaf monkey, Assam macaque and the pig-tailed macaque, lion-tailed macaque, Nilgiri langur slender loris, bats, giant squirrel, civets, flying squirrels, Nilgiri mongoose, spiny mouse

(7) Andaman and Nicobar Islands

- ✓ **Flora**. These are home for tropical rain forests
- Among marine mammals there are dugong, false killer whale, dolphin. Among birds are rare one is Narcondum hornbill.
- Nicobar pigeon and megapode. There are also other birds like white-bellied sea-eagle, white-breasted swiftlet and several fruit pigeons

ANIMAL DIVERSITY OF INDIA

- **THE RED DATA BOOK**-issued by the International Union for Conservation of Nature (IUCN) located in Morges, Switzerland
- information for endangered mammals and birds are more extensive than for other groups of animals and plants, coverage is also given to less prominent organisms facing extinction.
- The pink pages in this publication include the critically endangered species.
- Green pages are used for those species that were formerly endangered, but have now recovered to a point where they are no longer threatened.
- **Extinct (EX)** - A taxon is Extinct when there is no reasonable doubt that the last individual has died.
- **Extinct in the Wild (EW)**-A taxon is Extinct in the Wild when it is known only to survive in cultivation, in captivity or as a naturalized population (or populations) well outside the past range.

Critically Endangered (CR)- criteria for Critically Endangered.(any1)

- reduction in population (**> 90% over the last 10 years**),
- population size (number less than 50 mature individuals),
- quantitative analysis showing the probability of extinction in wild in at least 50% in their 10 years) and
- it is therefore considered to be facing an extremely high risk of extinction in the wild

Endangered (EN)- criteria for Endangered.(any1)

- reduction in population size (**70% over the last 10 years**),
- population size estimated to number fewer than 250 mature individuals,
- quantitative analysis showing the probability of extinction in wild in at least 20% within 20 years and
- it is therefore considered to be facing a very high risk of extinction in the wild

Vulnerable (VU)- criteria

- reduction in population (**> 50% over the last 10 years**)
- population size estimated to number fewer than 10,000 mature individuals,
- Probability of extinction in wild is at least 10% within 100 years, and.
- It is therefore considered to be facing a high risk of extinction in the wild.

CRITICALLY ENDANGERED

MAMMALS-

1. **Pygmy Hog (Porcula salvania)- (in news nov 2014)** <http://www.thehindu.com/news/national/other-states/visitors-to-assam-zoo-can-soon-view-endangered-pygmy-hogs/article6584759.ece>
 - Is the world's smallest wild pig, with adults weighing only 8 kgs. This species constructs a nest throughout the year.
 - The grasslands where the pygmy hog resides are crucial for the survival of other endangered species such as Indian Rhinoceros, Swamp Deer, Wild Buffalo, Hispid Hare, Bengal Florican and Swamp Francolin.
 - In 1996, a captive-breeding programme of the species was initiated in Assam, and some hogs were reintroduced in Sonai Rupai area in 2009.
 - Habitat: Relatively undisturbed, tall 'terai' grasslands.
 - Distribution: Formerly, the species was more widely distributed along the southern Himalayan foothills but now is restricted to only a single remnant population in Manas Wildlife Sanctuary and its buffer reserves.
 - **Pygmy hog-sucking Louse** (Haematopinus oliveri), a parasite that feeds only on Pygmy Hogs will also fall in the same risk category of critically endangered as its survival is linked to that of the host species.
2. **Andaman White-toothed Shrew (Crocidura andamanensis), Jenkin's Andaman Spiny Shrew**
 - (Crocidura jenkinsi) and the Nicobar White-tailed Shrew (Crocidura nicobarica) Endemic to India.
 - They are usually active by twilight or in the night and have specialized habitat requirements.
 - Habitat: Leaf litter and rock crevices.
 - Distribution: The Andaman White-toothed Shrew is found on Mount Harriet in the South Andaman Islands.
 - The Jenkin's Andaman Spiny Shrew is found on Wright Myo and Mount Harriet in the South Andaman Islands.
3. **Kondana Rat (Millardia kondana) (in news)**
 - It is a nocturnal burrowing rodent that is found only in India.. It is sometimes known to build nests.
 - Habitat: Tropical and subtropical dry deciduous forests and tropical scrub.
 - Distribution: Known only from the small Sinhagarh Plateau (about one km²), near Pune in Maharashtra. Reported from an elevation of about 1,270 m above mean sea level.
 - <http://www.thehindu.com/news/national/half-of-mammals-face-habitat-loss-zoological-survey-of-india/article7283074.ece>
4. **The Large Rock Rat or Elvira Rat, (Cremnomys elvira)(in news)**
 - It is a medium sized, nocturnal and burrowing rodent. endemic to India.
 - Habitat: Tropical dry deciduous shrubland forest, seen in rocky areas.

- Habitat / distribution: Known only from Eastern Ghats of Tamil Nadu. Recorded from an elevation of about 600 m above mean sea level.

5. The Namdapha Flying Squirrel (*Biswamoyopterus biswasi*)

- It is a unique (the only one in its genus) flying squirrel that is restricted to a single valley in the Namdapha N.P. (or) W.L.S. in Arunachal Pradesh.
- Habitat: Tropical forest.

6. The Malabar Civet (*Viverra civettina*)(in news)

- It is, considered to be one of the world's rarest mammals.
- It is endemic to India and was first reported from Travancore, Kerala.
- Habitat / distribution: Western Ghats.

7. The Sumatran Rhinoceros (*Dicerorhinus sumatrensis*)(already extinct from india)

- It is the smallest and most endangered of the five rhinoceros species.
- It is now thought to be regionally extinct in India, though it once occurred in the foothills of the Himalayas and north-east India.

8. The Javan Rhinoceros (*Rhinoceros sondaicus*)

- is also believed to be extinct in India and only a small number survive in Java and Vietnam

9. Kashmir stag/ hangul (*Cervus elaphus hanglu*)

- It subspecies of Red Deer which is native to India.
- Habitat / distribution - in dense riverine forests, high valleys, and mountains of the. Kashmir valley and northern Chamba in Himachal Pradesh.
- State animal of J&k.

BIRDS

10. The Jerdon's Courser (*Rhinoptilus bitorquatus*)

- It is a flagship species for the extremely threatened scrub jungle.
- The species was considered to be extinct until it was rediscovered in 1986 and the area of rediscovery was subsequently declared as the Sri Lankamaleswara Wildlife Sanctuary.
- Distribution: Jerdon's Courser is endemic to Andhra Pradesh.(northern part of ap)

11. The Forest Owlet (*Heteroglaux blewitti*)

- Had been lost for more than a century. After 113 long years, the owl was rediscovered in 1997 and reappeared on the list of Indian birds.
- Habitat: Dry deciduous forest.
- Habitat / distribution: South Madhya Pradesh, in north-west Maharashtra and north-central Maharashtra.

12. The White-bellied Heron (*Ardea insignis*)

- Extremely rare bird found in five or six sites in Assam and Arunachal Pradesh, one or two sites in Bhutan, and a few in Myanmar.
- Habitat: Rivers with sand or gravel bars or inland lakes.

13. The Bengal Florican (*Houbaropsis bengalensis*)

- A rare bustard species that is very well known for its mating dance. Among the tall- grasslands, secretive males advertise their territories by springing from the ground and flitting to and fro in the air.
- Habitat: Grasslands occasionally interspersed with scrublands.
- Distribution: Native to only 3 countries in the world - Cambodia, India and Nepal. In India, it occurs in 3 states, namely Uttar Pradesh, Assam and Arunachal Pradesh.

14. The Himalayan Quail (*Ophrysia superciliosa*)

- It is presumed to be extinct since no reliable records of sightings of this species exist after 1876. Intensive surveys are required as this species is hard to detect due to its reluctance to fly and its preference for dense grass habitats. Possible sighting of this species was reported in Nainital in 2003.

- Habitat: Tall grass and scrub on steep hillsides.
- Distribution: Western Himalayas.

15. Pink- headed Duck (*Rhodonessa caryophyllacea*)

- It has not been conclusively recorded in India since 1949. Males have a deep pink head and neck from which the bird derives its name.
- Habitat: Overgrown still-water pools, marshes and swamps in lowland forests and tall grasslands.
- Distribution: Recorded in India, Bangladesh and Myanmar. Maximum records are from north-east India.

16. Sociable Lapwing (*Vanellus gregarius*)

- It is a winter migrant to India. This species has suffered a sudden and rapid population decline due to which it has been listed as critically endangered
- Distribution: central Asia, Asia Minor, Russia, Egypt,, India, Pakistan. In India, habitat / distribution is restricted to the north and north-west of the country.

17. Spoon Billed Sandpiper (*Eurynorhynchos pygmeus*)

- It requires highly specialized breeding habitat, a constraint that has always kept its population scarce.
- India is home to some of the last existing wintering grounds of this species.
- Habitat: Coastal areas with sparse vegetation. No breeding records further inland than 7 km from the seashore.
- Distribution: Has been recorded in West Bengal, Orissa, Kerala and Tamil Nadu.

18. Siberian Crane (*Grus leucogeranus*)

- It is a large, strikingly majestic migratory bird that breeds and winters in wetlands. They are
- known to winter at Keoladeo National Park, Rajasthan. However the last documented sighting of the bird was in 2002.
- Habitat: Wetland areas.
- Located distribution: Keoladeo National Park in Rajasthan.

REPTILES

19. Gharial (*Gavialis gangeticus*)

- It is the most uniquely evolved crocodilian in the world, a specialized, river-dwelling, fisheater.
- Habitat: Clean rivers with sand banks.
- Distribution: Only viable population in the National Chambal Sanctuary, spread across three states of Uttar Pradesh, Rajasthan and Madhya Pradesh in India.
- Small non-breeding populations exist in Son, Gandak, Hoogly and Ghagra rivers.
- Now extinct in Myanmar, Pakistan, Bhutan and Bangladesh.

20. Hawksbill Turtle (*Eretmochelys imbricata*)

- It is a heavily exploited species. The species is migratory in nature and nesting occurs in about 70 countries across the world. Maturation is slow and is estimated between 25 — 40 years.
- Habitat: Nesting occurs on insular, sandy beaches.
- Distribution: In India they are found in the Andaman and Nicobar Islands, the coast of Tamil Nadu and Orissa.

21. Leatherback Turtle (*Dermochelys coriacea*)

- It is the largest of the living sea turtles, weighing as much as 900 kg.
- Adult leatherback turtles are excellent swimmers. They swim an average of 45-65 km a day, travel, Jellyfish is their primary food.
- the population spikes of leatherback coincide with abundance of jellyfish, making them Important top-predators in marine environments.
- Habitat: Tropical and subtropical oceans.

- Distribution: Found in tropical and temperate waters of the Atlantic, Pacific, and into Indian Oceans.

22. Four-toed River Terrapin or River Terrapin (Batagur baska) (a type Turtle)

- The omnivorous diet of the river terrapin and other terrapin species makes them an essential part of the efficient clean-up systems of aquatic habitats.
- Habitat: Freshwater rivers and lakes.
- Distribution: Bangladesh, Cambodia, India, Indonesia and Malaysia.

23. Red-crowned Roofed Turtle or the Bengal Roof Turtle (Batagur kachuga)

- mainly restricted to the Ganga basin. Males have a bright red coloration during the breeding season.
- Habitat: Deep, flowing rivers but with terrestrial nest sites.
- Distribution: Found in India, Bangladesh and Nepal. In India it resides basically in the watershed of the Ganga.

24. Sispara day gecko (Cnemaspis sisparensis)

- It is a large gecko which dwells usually in forests, it is largely insectivorous and nocturnal.
- Habitat / distribution: Endemic to Western Ghats, and found in Sispara, Nilgiris, Kavalai near Cochin.

FISH

25. The Pondicherry Shark (Carcharhinus hemiodon)

- It is a marine fish that occurs or occurred inshore on continental and insular shelves.
- This is a very rare and little-known species.
- Habitat / distribution: Indian Ocean— from Gulf of Oman to Pakistan, India and possibly Sri Lanka.
- In scattered localities spanning India to New Guinea. Also been recorded at the mouth of the Hooghly river.

26. The Ganges Shark (Glyphis gangeticus)

- It is a uniquely adapted fish-eating shark that occurs in the turbid waters of the Ganga river and the Bay of Bengal. The small eyes suggest that it is adapted to living in turbid water, while the slender teeth of the species suggests that it is primarily a fish-eater.
- Habitat / distribution: It occurs in India and possibly in Pakistan. The Ganga river system and Hooghly river mouth are its known habitats.

27. The Knife-tooth Sawfish (Anoxypristes cuspidata)

- It has a long narrow snout with blade-like teeth and a shark-like body. It spends most of its time near the bottom of the sea,
- It is found in shallow coastal waters and estuaries.
- Habitat / distribution: Widespread in western part of the Indo-Pacific region, including Red Sea.

28. Large-tooth Sawfish (Pristis micro don)

- They are heavy-bodied sawfish with a short but massive saw, and grow up to 3 m. in length.
- It is seen seasonally and very occasionally caught along with the Bull Sharks and the Green Sawfish.
- Habitat / distribution and habitat : Western part of the Indo-Pacific (East Africa to New Guinea, Philippines and Vietnam to Australia).
- In India, it is known to enter the Mahanadi river, up to 64 km inland, and also is very common in the estuaries of the Ganga and Brahmaputra.

29. Long-comb Sawfish or Narrow-snout Sawfish (Pristis zijsron)

- ✓ It grows up to 4.3m in length and are heavily exploited by humans.
- ✓ This species was reported as frequently found in shallow water.
- ✓ It inhabits muddy bottoms and also enters estuaries. Its presence has been recorded in inshore marine waters, and it goes down to depths of at least 40 m.

- ✓ Habitat / distribution and habitat: Indo-Pacific region including Australia, Cambodia, China, India, Indonesia and Malaysia.

SPIDERS

- 30. Rameshwaram Ornamental or Rameshwaram Parachute Spider (Poecilotheria hanumavilasumica)**
- It was recently described in 2004, and is only found in India.
 - It can give a nasty bite which usually is not fatal.
 - The species is semi-social, which means they live partly in groups.
 - Habitat: Arboreal and tend to live in hiding.
 - Distribution: Endemic to India. Spread along the coastal savannah, tropical lowland rain forests and montane forests upto an altitude of 2000 m above mean sea level.

31. Gooty Tarantula, Metallic Tarantula or Peacock Tarantula (Poecilotheria metallica)

- Steel blue in colour with patches of intense orange-yellow, black and white.
- It was first found in Gooty (Ooty/Udagamandalam) in south India in a burn pile during railway construction.
- it has been in great demand in the illegal pet trade.
- Habitat: Wooded mountain area.
- Distribution: Endemic to South India

ENDANGERED

MAMMALS

1. Wild ass/ khur (Equus hemionus khur)

- Once extended from western India, southern Pakistan, Afghanistan, and south-eastern Iran, Today, its last refuge lies in the Indian Wild Ass Sanctuary, Little Rann of Kutch.
- Threat -Diseases- in 1958-1960, surra disease, caused by Trypanosoma evansi and transmitted by flies,

2. Dhole/ Asiatic wild dog or Indian wild dog (Cuon alpinus)

3. Eld's deer/ thamin or brow-antlered deer (Panolia eldii)

- deer indigenous to Southeast Asia
- Found in the Keibul Lamjao National Park (KLN), Manipur.

4. Himalayan Brown/ red Bear (Ursus arctos isabellinus).

- India's largest animals in the Himalayas, omnivores. Himalayan Brown Bears exhibit sexual dimorphism.
- Distribution - Nepal, Pakistan, and Northern India.

5. Golden langur (Trachypithecus geei)

- Primate, is an Old World monkey
- Distribution - small region of western Assam and in the neighboring foothills of the Black Mountains of Bhutan.

6- Himalayan wolf

- Habitat / distribution - trans-Himalayan region of Himachal Pradesh, Jammu and Kashmir in northern India.

7. Himalayan / White-bellied Musk Deer

- ✓ Habitat / distribution - Kashmir, Kumaon and Sikkim.
- ✓ Musk deer lack antlers, but they possess a pair of enlarged canines that grow continuously.
- ✓ Deer musk is a substance with a persistent odor obtained from a gland of the male musk deer (Only males produce the musk).

- ✓ The substance has been used as a perfume fixative, incense material, and medicine.

8. Hispid hare/ Assam rabbit (*Caprolagus hispidus*)

- ✓ Habitat / distribution - southern foothills of the central Himalayas. Status - endangered.
- ✓ The habitat of hispid hares is highly fragmented due to increasing agriculture, flood control, and human development.

9. Hog deer

- ✓ Habitat / distribution - northern india.
- ✓ Name - The hog deer runs through the forests with its head hung low (hog-like manner) so that it duck under obstacles instead of leaping over them like most other deer do.

10. Lion-tailed macaque/ wandero (*Macaca silenus*)

- Endemic to the Western Ghats.
- Avoid human presence and they do not live, feed or travel, through plantations.
- Habitat: Lion-tailed macaques live in southwest India in pockets of evergreen forests, called sholas, in the Western Ghats range. Today, they only live in mountain forests in three Indian states: Karnataka, Kerala, and Tamil Nadu.
- Captive breeding - Arignar Anna Zoological Park, Chennai and in Mysore Zoo.

11- Markhor (*Capra falconeri*)

- Exhibit sexual dimorphism national animal of Pakistan.
- Habitat / distribution-mountains of central Asia.
- In India - some parts of Jammu and Kashmir . Status - endangered
- Threat - hunting (both for meat and for its twisted horns),

12- Nilgiri langur/ Nilgiri leaf monkey (*Trachypithecus johnii*)

- Habitat / distribution - hilly areas of western ghats in Tamilnadu and Kerala. Tropical wet evergreen, semi-evergreen and riparian forests.

13- Nilgiri tahr

- The Nilgiri tahr is the largest of the three tahr species, inhabit montane grasslands of western ghats.
- It is the state animal of Tamil nadu.
- Shrub forest (stunted evergreen forests) are typically avoided by tahr.

14. Great Indian one horn Rhinoceros

- Habitat: Found only in the tall grasslands and forests in the foothills of the Himalayas.
- National Parks: Kaziranga National Park, Pabitora Wildlife Sanctuary, Manas National Park, Assam

15- Wild Ass

- Habitat: Flat grassland covered expanse known as berts (islands where coarse grasses sprout up during the monsoon).
- National Parks: Little Rann Of Kutch, Gujarat

VULNERABLE MAMMALS

1. Chiru / Tibetan Antelope

- Habitat : Tibet cold desert
- Threat : The chiru is threatened by hunting for its fine wool which is used to make the shahtoosh scarves, meat, magnificent horns.

2. Himalayan tahr

- habitat — Himalayas
- tahr have many characters in common with true goats, but lack a beard and have several other unique features.

3. Black buck

- ✓ Habitat — Grass land
- ✓ Black buck show sexual dimorphism.

4. Gaur

- ✓ The gaur (*Bos gaurus*), also called Indian bison, is a large bovine native to South Asia and Southeast Asia.
- ✓ The domesticated form of the gaur, *Bos frontalis*, is called gayal or mithun

5. Four-horned antelope, Chousingha

- The four-horned antelope must drink water regularly in order to survive

6. Takin

- Mountainous regions in the Himalayan Mountains and western China

7. Nilgiri marten

- Endemic to the Western Ghats.
- inhabits areas that are far from human disturbance Semi-arboreal lifestyle. Martens are Carnivorous animal.
- Only species of marten considered vulnerable to extinction.
- Only species of marten found in southern India

8. Red Panda

- ✓ endemic to the temperate forests of the Himalayas,
- ✓ Diet - omnivorous (mainly on bamboo).
- ✓ Habitat / distribution — Sikkim and assam, northern arunachal Pradesh.

9. Marbled cat (*Pardofelis marmorata*)

- Habitat / distribution - from northern India and Nepal, through south-eastern Asia to Borneo and Sumatra
- In india - Sikkim, Darjeeling, moist tropical forest.
- Arboreal in nature

10. Barasingha or swamp deer (*Rucervus duvaucelii*)

- Habitat / distribution- isolated localities in northern and central India, and southwestern Nepal.

11. Indian wolf

- Habitat / distribution - range extends from south of the Himalayas

12. Oriental small-clawed otter/ Asian small-clawed otter (*Aonyx cinerea*)

- ✓ Otter - any of 13 living species of semiaquatic mammals which feed on fish and shellfish, and also other invertebrates, amphibians, birds and small mammals.
- ✓ It is a smallest otter species in the world,
- ✓ It lives in mangrove swamps and freshwater wetlands.

13. Clouded leopard (*Neofelis nebulosa*)

- Habitat / distribution - Himalayan foothills through mainland Southeast Asia into China,
- They occur in northern West Bengal, Sikkim, Arunachal Pradesh, Manipur, Meghalaya, Mizoram, Nagaland and Tripura.

14. Asian black bear/ moon bear or white- chested bear (*Ursus thibetanus*)

- medium-sized species of bear, largely adapted for arboreal life,
- Habitat / distribution - seen across much of the Himalayas, Korea, northeastern China, the Russian far east and the Honshu and Shikoku islands of Japan.

Herbivorous Marine Mammals

- include dugong and manatees and they inhabit swamps, rivers, estuaries, marine wetlands, and coastal marine waters.

1. Dugorig

- (Dugong dugon) also called as sea cow.
- Status - vulnerable.

2. Manatees- Habitat / distribution - Caribbean Sea, Gulf of Mexico, the Amazon Basin, and West Africa

- Threat - coastal development, red tide, hunting.

FEW EXCEPTIONS

Egg Laying Mammals

- The unique feature of monotremes, a sub division of mammal, is that monotremes lay eggs rather than giving birth to their young.
 - There are only five living Monotreme/ egg laying Mammals species: they are –
 - the duck-billed platypus and four species of spiny anteaters (also known as echidna).
 - All of them are found only in Australia and New Guinea.
1. **Echidnas are also known as spiny ant eaters.**
 - Habitat / distribution - Australia and New Guinea
 - In echidnas, the egg is carried in a pouch on the female's belly until the young hatches, at which point the barely-developed young must find a mammary gland and latch onto it for nourishment.
 2. **Platypus is a semi-aquatic mammal.**
 - Habitat / distribution - endemic to eastern Australia, including Tasmania.
 - In the platypus, the female retires to a burrow in the bank of a river or pond. The burrow is lined with dry vegetation, and there the eggs are laid.
 - The male platypus has venom strong enough to can kill a small dog, or cause excruciating pain among humans.

Marsupials

- the group of mammals commonly thought of as pouched mammals (like the wallaby and kangaroo).
- have placenta but it is very short-lived and does not make as much of a contribution to fetal nourishment.
- They give birth very early and the young animal, essentially a helpless embryo, climbs from the mother's birth canal to the nipples.
- They have short gestation time. due to having a yolk-type placenta inthe mother marsupial.
- Extinct - Marsupial - quagga, the marsupial wolf .
- Placental mammals all bear live young, which are nourished before birth in the mother's uterus through a specialized embryonic organ attached to the uterus wall, the placenta.
- Placental mammals nourish the developing embryo using the mother's blood supply, allowing longer gestation times. List of Marsupials

Phalangers

OpoSsum

Kola

Tasmanian devils

Kangaroo	Mursupial Mole (4 foot)
Wallaby	Bandi coot
Wombats	Tasmanian Wolf /Tiger Dasyure

Flying squirrel

- Flying squirrels are mammals too, but they don't really fly.
- They jump from high in a trees glide through the air like a kite.

PLANT DIVERSITY OF INDIA

PLANT CLASSIFICATION

- **Herb** is defined as a plant whose stem is always green and tender with height of not more than 1 meter.
- **Shrub** is defined as a woody perennial plant differing from a perennial herb in its persistent, and woody stem. It differs from a tree in its long stature and its habit of branching from the base. Not more than 6 meters in height.
- **Tree** is defined as a large woody perennial plant having a single well defined stem with more or less definite crown.
- **Parasites**- An organism that draws a part or whole of its nourishment from another living organism(not from soil). They grow on some living plant called host and penetrate their sucking roots, called haustoria, into the host plants. -
- **Epiphytes** - plant growing on the host plant but not nourished by the host plant. They only take the help of the host plant in getting access to light. Their roots perform two functions. While changing roots establish the plant on the branches of the host plant, aerial roots draw moisture from the air. Eg. Vanda - Climbers

EFFECT OF ABIOTIC COMPONENTS ON PLANTS

- Intensity of light on growth of plants
- Extremely high intensity favours root growth than shoot growth which results in increased transpiration, short stem, smaller thicker leaves, low intensity of light retards growth, flowering and fruiting.
- Out of 7 colours in the visible part of spectrum, only red and blue are effective in photosynthesis.
Plant grown in blue light are small, red light results in elongation of cells results in etiolated plants.

Effect of frost on plants

- Killing of young plants - frost chills the soil resulting in freezing the soil moisture. The plants growing in such soil, get exposed to direct sun light in the morning, they are killed due to increased transpiration when their roots are unable to supply moisture. This is the main reason for innumerable death of sal seedlings.
- Death of plants due to damage to cells - As a result of frost, water in the intercellular spaces of the plant gets frozen into ice which withdraws water from the interior of the cells. This results in increasing concentration of salts and dehydration of cells. Thus coagulation and precipitation of the cell colloid results in death of plant.
- Leads to Formation of canker.

Effect of temperature on plants

- Excessive high temperature results in death of plant due to coagulation of protoplasmic proteins.

INSECTIVOROUS PLANTS

- These plants are specialised in trapping insects and are popularly known as insectivorous plants.

- Insectivorous plants can broadly be divided into active and passive types based on their method of trapping their prey.
- The active ones can close their leaf traps the moment insects land on them.
- The passive plants have a 'pitfall' mechanism, having some kind of jar or pitcher-like structure into which the insect slips and falls, to eventually be digested.

Why do they hunt despite having normal roots and photosynthetic leaves?

- These plants are usually associated with rain-washed, nutrient-poor soils, or wet and acidic areas that are ill-drained.
- wetlands are acidic due to anaerobic conditions, which cause partial decomposition of organic matter releasing acidic compounds into the surroundings.
- most microorganisms necessary for complete decomposition of organic matter cannot survive in such poorly oxygenated conditions.
- Normal plants find it difficult to survive in such nutrient poor habitats.
- The hunter plants are successful in such places because they supplement their photosynthetic food production by trapping insects and digesting their nitrogen rich bodies.

The Indian Hunters

Insectivorous plants of India belong mainly to three families:

1. Droseraceae (3 species),
- 2 Nepenthaceae (1 species)and
3. Lentibulariaceae (36 species)

1. Family: Droseraceae:

- This includes 4 genera of which 2, namely Drosera and Aldrovanda, occur in India

2. Family Nepenthaceae:

- It consists of a single genus Nepenthes having about 70 species distributed throughout the tropical Old World. The members of the family are commonly known as 'pitcher plants' because their leaves bear jar-like structures.
- Distribution - It is confined to the high rainfall hills and plateaus of north-eastern region, at altitudes ranging from 1.00 —1500 m, particularly in Garo, Khasi and Jaintia hills of Meghalaya

3-Family: Lentibulariaceae:

- It have 4 genera, of which Utricularia and Pinguicula, occur in India

Medicinal properties

- Drosera are capable of curdling milk, its bruised leaves are applied on blisters, used for dyeing silk.
- Nepenthes in local medicine to treat cholera patients, the liquid inside the pitcher is useful for urinary troubles, it is also used as eye drops.
- Utricularia is useful against cough, for dressing of wounds, as a remedy for urinary disease.
- In India, species like Drosera peltata, Aldrovanda vesiculosa and Nepenthes khasiana have been -included in the Red Data Book as endangered plants

INVASIVE ALIEN SPECIES

- Alien species that threaten native plants and animals or other aspects of biodiversity are called alien invasive species

Effects

- Loss of Biodiversity
- Decline of Native Species (Endemics).
- Habitat Loss
- Introduced pathogens reduce crop and stock yields
- Degradation of marine and freshwater ecosystems
- This biological invasion constitutes the greatest threat to biodiversity

SOME INVASIVE ALIEN FLORA OF INDIA

1. Needle Bush

- Nativity: Trop. South

- Distribution in India: A shrub or small tree.

2. Black Wattle

- Nativity: South East Australia
- Distribution in India: Western Ghats
- Remarks: Introduced for afforestation in Western Ghats. Regenerates rapidly after fire and forms dense thickets. It is distributed in forests and grazing lands in high altitude areas.

3. Goat weed

- Nativity: Trop. America
- Distribution in India: Throughout
- Remarks: Aggressive colonizer. Troublesome weed in gardens, cultivated fields and forestS

MEDICINAL PLANTS

1. Beddomes Cycad / Perita I Konciaitha –

- Eastern Peninsular India.
- Uses : The male cones of the plant are used by local herbalists as a cure for rheumatoid arthritis and muscle pains.
- Fire resistant property is also there.

2. Blue vanda / Autumn Ladies Tresses Orchid

- Distribution : Assam, Arunachal Pradesh, Manipur, Meghalaya, Nagaland.
- Vanda is one of the few botanical orchids with blue flowers a property much appreciated for producing interspecific and intergeneric hybrids.

3. Kuth / Kustha / Pooshkarmoola / Uplet

- Distribution : Kashmir, Himachal Pradesh
- Uses : It is used as an anti-inflammatory drug

4. Ladies Slipper Orchid

- Uses : These types of orchids are mainly used as collector's items And treat anxiety insomnia

5. Red vanda

- Distribution : Manipur, Assam, Andhra Pradesh
- Uses : As a whole orchids are collected to satisfy an ever demanding market of orchid fanciers, especially in Europe, North America and Asia

6. Sarpagandha

- Distribution : Sub Himalayan tract from Punjab eastwards to Nepal, Sikkim, Assam, Eastern & Western Ghats, parts of Central India & in the Andamans.
- Uses : It is used for treating various central nervous system disorders.

MARINE ORGANISMS

- 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 major inorganic nutrients required by phytoplankton for growth and reproduction are nitrogen and phosphorus.
- Marine phytoplankton are not uniformly distributed throughout the oceans of the world.
- The highest concentrations are found at high latitudes, with the exception of bivalve areas on the continental shelves, While the tropics and subtropics.
- Phytoplankton are the foundation of the aquatic food web, the primary producers
- Phytoplankton are responsible for most of the transfer of carbon dioxide from the atmosphere to the ocean. Carbon dioxide is consumed during photosynthesis, and the carbon is incorporated in the phytoplankton, just as carbon is stored in the wood and leaves of a tree.

ZOO PLANKTON

- Play vital role in food web of the food chain, nutrient recycling, and in transfer of organic matter from primary producers to secondary consumers like fishes.

SEA-GRASS

- Specialized angiosperms (marine flowering plants) that resemble grass in appearance.
- They produce flowers; have strap-like or oval leaves and a root system.
- They grow in shallow coastal waters with sandy or muddy bottoms & require comparatively calm areas.
- They are the only group of higher plants adapted to life in the salt water.
- Major Sea grass meadows in India occur along the south east coast of Tamil Nadu and in the lagoons of a few Lakshadweep Islands.
- few grass beds around Andaman and Nicobar islands.

SEAWEEDS

- are (thalloid plants) macroscopic algae, which mean they have no differentiation of true tissues such as roots, stems and leaves.
- have leaf-like appendages.
- grow in, shallow coastal waters wherever sizable substrata is available.

Uses of seaweeds

- Seaweeds are important as food for humans, feed for animals, and fertilizer for plants.
- Seaweeds are used as a drug for goiter treatment, intestinal and stomach disorders.
- Products like agar-agar and alginates, iodine which are of commercial value, are extracted from seaweeds.
- By the biodegradation of seaweeds methane like, economically important' gases can be produced in large quantities.
- potential indicators of pollution in coastal ecosystem, particularly heavy metal pollution due to their ability to bind and accumulate metals strongly.
- Rotting seaweed is a potent source of hydrogen sulfide, a highly toxic gas

PROTECTED AREA NETWORK

PROTECTED AREAS (PA)

- The adoption of a National Policy for Wildlife Conservation in 1970 and the enactment of the Wildlife (Protection) Act in 1972 lead to a significant growth in the protected areas - 669 Protected Areas including 102 National Parks, 515 Wildlife Sanctuaries, 49 Conservation Reserves and 4 Community Reserves

WILD LIFE SANCTUARY (WLS)

- The Wild Life (Protection) Act of 1972 provided for the declaration of certain areas by the State Government as wildlife sanctuaries if the area was thought to be of adequate ecological, geomorphological and natural significance.
- There are over 500 wildlife sanctuaries in the country, of Which Tiger Reserves are governed by Project Tiger.
- The Central Government may also declare a sanctuary under certain conditions

National Park (NP)

- The Wild Life (Protection) Act (WPA) of 1972 provided for the declaration of National Parks by the State Government are declared in areas that are considered to be of adequate ecological, geomorphological and natural significance although within the law,
- the difference in conservation value of a National Park from that of a sanctuary is not specified in the WPA 1972

Difference between the two

- National Parks enjoy a greater degree of protection than sanctuaries.
- Certain activities which are regulated in sanctuaries, such as grazing of livestock, are prohibited in National Parks.

- Wildlife sanctuary can be created for a particular species (for e.g. grizzled giant squirrel w.l.s in srivalliputhur) whereas the national park is not primarily focused on a particular species.

CONSERVATION RESERVE AND COMMUNITY RESERVES

- outcome of Amendments to the Wild life protection act in 2003
- It provides for a flexible system wherein the wildlife conservation is achieved without compromising the community needs.

Conservation Reserves

- It is an area owned by the State Government adjacent to National Parks and sanctuaries for protecting the landscape, seascape and habitat of fauna and flora. It is managed through a Conservation Reserve Management Committee
- State Government may, after having consultations with the local communities; declare any area owned by the Government-as conservation reserve.
- Tiruppadaimarathur conservation reserve in Tirunelveli, tamilnadu is the first conservation reserve established in the Country.

Community Reserve

- State Govt may notify any community land or private land as a Community Reserve, provided that the members of that community or concerned are agreeable to offer such area for protecting the fauna and flora, as well as their traditions, cultures and practices.
- The declaration of such an area is aimed at improving 'the socio-economic conditions of the living in such areas as well as conserving The Reserve is managed through a Reserve Management Committee
- No change in the land use pattern shall be made within the Community Reserve, except in accordance with a resolution passed by the management Committee and approval of same by the State Government

COASTAL PROTECTED AREAS

- It aims to protect and conserve the natural marine ecosystems in their pristine condition
- Marine Protected Area (MPA), as "any area of intertidal or sub tidal terrain, together with its overlaying water and Associated flora, fauna, historical and cultural features, which has been reserved by law or other effective means to protect part or all of the enclosed environment" - IUCN.
- The MPAs in marine environment in India, are primarily classified. into following three categories:
- Category-I: This covers National Parks and Sanctuaries and having entire areas in intertidal/sub-tidal or mangroves, coral reefs, creeks, seagrass beds, algal beds, estuaries, lagoons.
- Category-II: This includes Islands, which have major parts in marine ecosystem and some part in terrestrial ecosystem.
- Category-III: This includes sandy beaches beyond intertidal line but occasionally interacting with the seawater.
- Category-MB: This includes ever green or semi ever green forests of Islands

SACRED GROVES OF INDIA

- Sacred groves comprise of patches of forests or natural vegetation - from a few trees to forests of several acres - that are usually dedicated to local folk deities.
- In India, sacred groves are found all over the country and abundantly along the western ghats in the states of Kerala and Karnataka

THE MAN AND BIOSPHERE

- The Man and the Biosphere (MAB) Programme is an Intergovernmental Scientific Programme aiming to set a scientific basis for the improvement of the relationships between people and their environment globally.
- Launched in the early 1970s, it proposes an interdisciplinary research agenda and capacity building that target the ecological, social and economic dimensions of biodiversity loss and the reduction of this loss.
- identify and assess the changes in the biosphere resulting from human and natural activities and the effects of these changes on humans and the environment, in particular in the context of climate change;
- study and compare the dynamic interrelationships between natural/near- natural ecosystems and socio-economic processes
- promote the exchange and transfer of knowledge on environmental problems and solutions, and to foster environmental education for sustainable development.

- ensure basic human welfare and a livable environment in the context of rapid urbanization and energy consumption as drivers of environmental change.

BIOSPHERE RESERVE (BR)

- The International coordinating council (ICC) of UNESCO, November, 1971, introduced the designation 'Biosphere Reserve' for natural areas.
- Biosphere Reserve (BR) is an international designation by UNESCO for representative parts of natural and cultural landscape's extending over large area of terrestrial or coastal/marine ecosystems or a combination thereof.
- BRs are special environments for both people and the nature and are living examples of how human beings and nature can co-exist while respecting each other's needs
- Biosphere reserves are sites established by countries and recognized under UNESCO's Man and the Biosphere (MAB) Programme.

Biosphere Reserves: an Indian approach

1. National Biosphere Reserve Programme.
 - initiated in 1986.

Objectives

- ✓ To conserve the diversity integrity of plants and animals within natural ecosystems;
- ✓ To safeguard genetic diversity of species on which their continuing evolution depend
- ✓ To provide areas for multi-faceted research and monitoring;
- ✓ To provide facilities for education and training;
- ✓ To ensure sustainable use of natural resources through most appropriate technology for improvement of economic well-being of the local people.

BIODIVERSITY HOT SPOTS

- ✓ Biodiversity hot spot concept was put forth by Norman Myers in 1988
- ✓ To qualify as a hot spot, a region must meet two strict criteria:
 - a. Species endemism - it must contain at least 1,500 species of vascular plants (> 0.5% of the world's total) as endemics, and
 - b. Degree of threat - it has to have lost at least 70% of its original habitat.

Indian Biodiversity Hot Spots

1. The Eastern Himalayas
2. Indo- Burma and
3. The western Ghats & Sri Lanka

Eastern Himalayas Hot Spot:

- the region encompassing Bhutan, northeastern India, and southern, central, and eastern Nepal.
- The region is geologically young and shows high altitudinal variation.
- has nearly 163 globally threatened species (both flora and fauna) including the One horned- Rhinoceros , the Wild Asian Water buffalo.
- a plant species Ermania Himalayensis was found at an altitude of 6300 meters in northwestern Himalayas.
- A few threatened endemic bird species such as the Himalaya Quail, Cheer pheasant, Western tragopan are found here, along with some of Asia's largest and most endangered birds such as the Himalayan vulture and White-bellied heron.
- Endemic Mammals like the Golden langur, The Himalayan tahr, the pygmy hog, Langurs, Asiatic wild dogs, sloth bears, Gaurs, Muntjac, Sambar, Snow leopard, Mack bear, Blue sheep, Takin, the gangetic dolphin, wild water buffalo, swamp deer call the Himalayan ranged their home.

Western Ghats and Sri Lanka:

- Western Ghats, also known as the "Sahyadri Hills" encompasses the mountain forests in the South western parts of India and highlands of southwestern Sri Lanka.
- The important populations include Asian elephant, Nilgiri tahr, Indian tigers, lion tailed macaque, Giant squirrel; etc.

WORLD HERITAGE SITES

- The sites are designated as having outstanding universal value under the Convention concerning the Protection of the World Cultural and Natural "Heritage".
- Until the end of 2004, there were six criteria for cultural heritage and four criteria for natural heritage. In 2005 this was modified so that there is only one set of ten criteria. Nominated sites must be of "outstanding universal value" and meet at least one of the ten criteria.
- The United Nations proclaimed May 22 as The International Day for Biological Diversity (IDB) to increase understanding and awareness of biodiversity issues.

CONSERVATION EFFORTS

PROJECT TIGER

- Project Tiger centrally sponsored scheme was launched in 1973 with the following objectives:
- To ensure maintenance of available population of Tigers in India for scientific, economic, aesthetic, cultural and ecological value
- To preserve, for all times, the areas of such biological importance as a national heritage for the benefit, education and enjoyment of the people

Aim

- Conservation of the endangered species and harmonizing the rights of tribal people living in and around tiger reserves.

Tiger Reserve

- Tiger reserves are areas that are notified for the protection of the tiger and its prey, and are governed by Project Tiger which was launched in the country in 1973.
- Initially 9 tiger reserves were covered under the project, and has currently increased to 42, falling in 17 States (tiger reserve States)

PROJECT ELEPHANT

- Project Elephant was launched in February, 1992 as centrally sponsored scheme to assist states having free ranging populations of wild elephants and to ensure long term survival of identified viable populations of elephants in their natural habitats.
- Implemented in 13 States / LITs, viz., Andhra Pradesh, Arunachal Pradesh, Assam, Jharkhand, Karnataka, Kerala, Meghalaya, Nagaland, Orissa, Tamil Nadu, Uttarakhand, Uttar Pradesh and West Bengal. Small support is also being given to Maharashtra and Chhattisgarh.
- (A3JK2MNOTU2wb.)

Objectives

- To protect elephants, their habitat & corridors
- To address issues of man-animal conflict
- Welfare of domesticated elephants

Monitoring of Illegal Killing of Elephants (MIKE) Programme

- Mandated by COP resolution of CITES, MIKE program started in South Asia in the year 2003 with following purpose —
- To provide information needed for elephant range States to make appropriate management and enforcement decisions, and to build institutional capacity within the range States for the long-term management of their elephant populations.

Main objectives

1. to measure levels and trends in the illegal hunting of elephants;
2. to determine changes in these trends over time;

3. to determine the factors causing or associated, with such changes, and to try and assess in particular to what extent observed trends are a result of any decisions taken by the Conference of the Parties to CITE.

Haathi Mere Saathi

- Haathi Mere Saathi is a campaign launched by the Ministry of environment and forest (MoEF) in partnership with the wildlife trust of India.
- To improve conservation and welfare prospects of the elephant - India's National Heritage Animal.
- The campaign was launched at the "Elephant- 8" Ministerial meeting held in Delhi on 24th May 2011
- The E-8 countries comprise of India, Botswana, the Republic of Congo, Indonesia, Kenya, Srilanka, Tanzania, and Thailand (I2T2BCKS)

The campaign mascot 'Gaju'.

- The campaign focuses on various target audience groups including locals near elephant habitats, youth, policy makers, among others.
- It envisions setting up of Gajah (the elephant) centres in elephant landscapes across the country to spread awareness on their plight and invoke people's participation in addressing the threats to them
- Tiger, faces threat of extinction, whereas the elephant faces threat of attrition
- elephant particularly the tuskers (male), in India is as threatened as the tiger. There are just about 1200 tuskers left in the country.

The E-8 ministerial meeting represented regions with all 3 species of elephants,

1. Elephas maximus (Asian elephant)
2. Loxodonta africana (African Bush Elephant)
3. Loxodonta cyclotis (African Forest Elephant)

E-50:50 forum

- the umbrella of elephant-50:50 forum. It is the shared vision of 50 states to promote conservation, management and welfare of elephants in the next 50 years.
- E-50:50 forum The E-8 countries decided to hold the 1st International Congress of E-50:50 forum in early

2013 at New Delhi, India

- for adopting a common global vision on conservation, management and welfare of elephants across all range countries.

VULTURE

India has nine species of vultures in the wild. They are the

1. Oriental White-backed Vulture (*Gyps bengalensis*),
2. Slender billed Vulture (*Gyps tenuirostris*),
3. Long billed Vulture (*Gyps indicus*),
4. Egyptian Vulture (*Neophron percnopterus*),
5. Red Headed Vulture (*Sarcogyps calvus*),
6. Indian Griffon Vulture (*Gyps fulvus*),
7. Himalayan Griffon (*Gyps himalayensis*),
8. Cinereous Vulture (*Aegypius monachus*)
9. Bearded Vulture or Lammergeier (*Gypaetus barbatus*).

- Decline of vulture populations in India was first recorded at the Keoladeo Ghana National Park, Rajasthan
- Red-headed vulture or king vulture, Slender billed Vulture and Long billed Vulture are listed as critically endangered.

- Populations of Egyptian vultures and White- backed Vulture have also undergone decline in India and are now classified as Endangered.(Egypt people are white)
- decline in population was due to the drug diclofenac
- Meloxicam - An Alternative-Meloxicam is a second generation NSAID and rated better than Diclofenac for the treatment of livestock, with reduced risk of side effects, and is also approved for human use in more than 70 countries. Meloxicam is licensed as a veterinary drug in India, Europe and USA.

Vulture Safety Zones

- Aim of developing VSZs is to establish targeted awareness activities surrounding .150 km radius of vultures' colonies so that no diclofenac or the veterinary toxic drugs are found in cattle carcasses, the main food of vultures(to provide safe food).

Zones

1. The zone between Uttarkhand to Nepal, which spans from Corbett to Katriya Ghat, a Tarai belt, covering 30,000 square kilometers will be earmarked as Vulture Safe zone. Slender-billed vulture and white-backed vulture are Found hi this area, which is marshy grassland, savannas and forests.
2. Similarly, a belt between Dibrugarh in Assam to North Lakhimpur in Arunachal Pradesh will also be conserved as a vulture safe zone where slender-billed and white-backed species of vultures are found.
3. The third zone would be in central India, covering Chhattisgarh, where white-hacked and long-billed vultures are found

ONE HORN RHINO

Indian Rhino Vision 2020

- ✓ Indian rhino vision 2020 implemented by the department of environment and forests, Assam with The Bodo autonomous council as a active partner.
- ✓ The program will be supported by WWF - India; WWF areas (Asian rhino and elephant action strategy) programme, the international rhino foundation (IRF), save the rhino's campaign of zoological institutions worldwide.
- ✓ The vision of this program is to increase the total rhino foundation in Assam from about 2000 to 3000 by theyear2020 and to ensure that these rhinos are distributed over at least 7 protected areas. (PA) to provide long term viability of the one-horned rhino population.
- ✓ Translocations are the backbone of the IRV 2020 program
- ✓ The goal set was, to populate the potential rhino habitat areas identified viz. Manas NP, Dibru Saikhowa WLS, Laokhowa - Bura Chapor WLS with a viable population of rhino through translocations from Kaziranga NP and Pobitora WLS.

PROJECT SNOW LEOPARD

SNOW LEOPARD:

- ✓ The mystical apex predator
- ✓ The snow leopard is a globally endangered species. Merely 7,500 are estimated to be surviving over two million square kilometers in the Himalaya and Central Asian mountains, where they are facing tremendous human pressures.
- ✓ India is perhaps home to 10% of the global population in less than 5% of its global range,
- ✓ having a substantial proportion of its global population.
- ✓ Distribution in India — in Indian Himalayas, high altitude areas located above the forests.
- ✓ in the five Himalayan states of Jammu & Kashmir, Himachal Pradesh, Uttarakhand , Sikkim and Arunachal Pradesh.
- ✓ Most snow leopard occurring in China, followed by Mongolia and India
- ✓ Jan 2009 - The Project Snow Leopard is an Indian initiative for strengthening wildlife conservation in the Himalayan high altitudes.

Goal:

- To safeguard and conserve India's unique natural heritage of high altitude wildlife populations and their habitats by promoting conservation through participatory policies and actions
- The high altitudes of India (> 3000 m. to 130,000 km², including the Himalaya and Trans-Himalaya biogeographic zones) support a unique wildlife assemblage of global conservation importance.
- This includes highly endangered populations of species such as the snow leopard, two species of bears, wolf, red panda, mountain ungulates such as the wild yak, chiru, Tibetan gazelle, Tibetan argali, Ladakh urial, two species of musk deer, the hangul, three species of goral, serow, and takin, etc. High altitude lakes and bogs provide breeding grounds for a variety of fauna including the black-necked crane, barheaded Geese, brahminy ducks, and brown-headed gulls, etc.
- In 2003, the Convention on International Trade in Endangered Species (CITES) expanded the scope of the CITES Tiger Enforcement Task Force to include all Asian big cat species including the snow leopard.

SEA TURTLE PROJECT

- A significant proportion of world's Olive Ridley Turtle population migrates every winter to Indian coastal waters for nesting mainly at eastern coast.
- conservation of olive ridley turtles and other endangered marine turtles, Ministry of Environment & Forests initiated the Sea Turtle Conservation Project in collaboration of UNDP in November, 1999 with Wildlife Institute of India, Dehradun as the Implementing Agency
- Implemented in 10 coastal States of the country with special emphasis in State of Orissa.
- One of the important achievements have been demonstration of use of Satellite Telemetry to locate the migratory route of Olive Ridley Turtles in the sea and sensitizing the fishermen and State Government for the use of Turtle Exclusion Device (TED) in fishing trawlers to check turtle mortality in fishing net

INDIAN CROCODILE CONSERVATION PROJECT

- The Indian Crocodile Conservation Project has pulled back the once threatened crocodilians from the brink of extinction and place them on a good path of recovery.
- The Project has not just produced a large number of crocodiles, but has contributed towards conservation in a number of related fields as well.
- Central Crocodile Breeding and Management Training Institute, Hyderabad

PROJECT HANGUL

- The Kashmir stag (*Cervus affinis hanglu*) also called Hangul is a subspecies of Central Asian Red Deer native to northern India.
- It is the state animal of Jammu & Kashmir
- This deer lives in groups of two to 18 individuals in dense riverine forests, high valleys, and mountains of the Kashmir valley and northern Chamba in Himachal Pradesh.
- In Kashmir, it's found in Dachigam National Park at elevations of 3,035 meters.
- They were threatened, due to habitat destruction, over-grazing by domestic livestock and poaching.
- Captive breeding of lion tailed macaque in Arignar Anna Zoological Park, Chennai and in Mysore Zoo.

GANGES DOLPHIN

- The Ministry of Environment and Forests notified the Ganges River Dolphin as the National Aquatic Animal
- The River Dolphin inhabits the Ganges-Brahmaputra-Meghna and Karnaphuli-Sangu river systems of Nepal, India, and Bangladesh
- They are listed in Schedule I of the Wildlife Protection Act (1972).
- The Ganges Dolphin is among the four "obligate" freshwater dolphins found in the world - the other three are the 'baiji' found in the Yangtze River (China), the 'bhulan' of the Indus (Pakistan) and the 'boto' of the Amazon River (Latin America).
- The Chinese River Dolphin was declared functionally extinct by a team of international scientists in 2006.

SCHEDULE LIST-WPA, 1972

- WPA 1972 consists of 6 schedule lists, which give varying degrees of protection.
- Poaching, smuggling and illegal trade of animals listed Schedule 1 to schedule 4 are prohibited.
- Animals listed in schedule 1 and part II of schedule 2 have absolute protection - offences under these are prescribed the highest penalties.
- Examples of animals listed in schedule 1 are lion tailed macaque, rhinoceros, great Indian bustard, narcondam hornbill, nicobar megapode, black buck, etc.
- Examples of animals listed in schedule 2 are rhesus macaque, dhole, Bengal porcupine, king cobra, flying squirrel, himalyan brown bear.
- Animals listed in schedule 3 and schedule 4 are also protected, but the penalties are lower compared to schedule 1 and part 2 of schedule
- Examples of animals listed in schedule 3 are hyaena, hogdeer, nilgai, goral, sponges, barking deer, etc
- Examples of animals listed in schedule 4 are mangooses, vultures, etc.
- Animals listed in schedule 5 are called "vermin" which can be hunted.
- Mice, rat, 'common crow" and flying fox (fruit eating bats) are the list of animals (only 4 nos) in schedule 5.
- Cultivation, Collection, extraction, trade, etc. of Plants and its derivatives listed in schedule 6 are prohibited.
- Red Vanda, bite Vanda, kuth, pitcher plant, beddomes cycad and ladies slipper orchid are the list of plants listed in schedule 6.