

Unit-III:BIODIVERSITY AND ITS CONSERVATION

“Biodiversity refers to variety and variability of all living organisms in a ecosystem”.

1/10 billionth part of earth is occupied by living organisms of 50 million species which is restricted to 1 km thickness of soil. It is pleasure to see much diversity on this earth with little physical matter. The diversity is from tropical rain forests to deserts, high snow clad mountain peaks to deepest of ocean. They diverse in the form of size, colour, shape, forms, unique ecological relationship etc. If there would be little species, then the world looks dull.

In conventional of biological diversity (1992) biodiversity is defined as variability among living organisms including inter alia, terrestrial, aquatic eco system etc.

Levels of biodiversity: It may range from genus to species and they are categorised as follows: **a)**

Genetic diversity:

The diversity within the same species is due to difference in the gene level and this is known as genetic diversity.

Genes are the basic units of hereditary information. They carry genetic information from one generation to other. Different genetic combination with in a species leads to variety.

Eg: *Oryza sativa* is a rice species having thousands of varieties (which has different size, shape, colour, etc) **b)**

Species diversity:

This is the diversity seen between different species (or) within the population of species. It represents number of species and the predominance in a community.

There are two Species Measuring indices. They are: i)

Shannon-wiener index and ii) Simpson index.

The total number of species in the world would be 10-50 million (rough estimation given by Wilson in 1992) But only 1.5 million living and 3 lakh fossil species have been determined and given scientific names. It is fact that some species become extinct before knowing their names and uses.

Table 4.1. India's major biogeographic habitats

Sr. No.	Biogeographic zone	Biotic province	Total area (Sq. Km.)	Important flora and fauna
1.	Trans-Himalayan	Upper Regions	186200	<ul style="list-style-type: none"> Pine, Deodar Wild sheep, Yak, Tibetan ass, Snow Leopard, Marmot, Wolf, Black necked crane.
2.	Himalayan	North-West Himalayas	6900	<ul style="list-style-type: none"> Pine, Cork tree, Sal, Dhaak (Butea), Castor
		West Himalayas	720000	<ul style="list-style-type: none"> Wild bear, Sambar, Leopard, Sikkim Stag, Musk Deer
		Central Himalayas	123000	
		East Himalayas	83000	
3.	Desert	Kutch	45000	<ul style="list-style-type: none"> Acacia, Zizyphus, Khejri, Date palm.
		Thar	180000	<ul style="list-style-type: none"> Camel, Bastard, Wild ass, Desert cat, Fox, Rat
		Ladakh	NA	
4.	Semi-arid	Central India	107600	<ul style="list-style-type: none"> Acacia, Date palm, Peepal
		Gujarat-Rajwara	400400	<ul style="list-style-type: none"> Gir Lion, Tiger Sariska and Ranthambore (Tiger Reserves)
5.	Western Ghats	Malabar Coast	59700	<ul style="list-style-type: none"> Sheesham, Peepal, Tuna, Bahera
		Western Ghat Mountains	99300	<ul style="list-style-type: none"> Tortoise, Frog, Lizards, Snakes
6.	Deccan Peninsula	Deccan Plateau	378000	<ul style="list-style-type: none"> Acacia, Palaash, Tuna, Pine, Castor
		South-Central Plateau	341000	<ul style="list-style-type: none"> Sambar, Sloth bear, Tiger, Cheetal, Four-horned stag, Wild elephant, Wild buffalo
		Eastern Plateau	198000	
		Chhota Nagpur	217000	
		Central Highlands	287000	

c) Ecosystem diversity:

This is the diversity that shows variations in physical characters, ecological niches, trophic structures, food webs, nutrient cycles, etc. The physical factors are moisture, temperature, altitude, precipitation (rainfall & snow fall) etc. Of all the diversity, eco system diversity has great value which ended over millions of years. We can't replace it & if we destroy it, it disturbs the ecological balance and function.

Eg: Coniferous trees of boreal forests cannot do the function of tropical deciduous forest and vice versa.

Let us consider forest ecosystem to explain the eco system diversity. Due to variations in the physical factors etc different types of forest are evolved; viz, tropical rainforest, tropical deciduous forest, temperature deciduous forest, etc.

Major bio geographical regions of India:

Biogeography consists of phyto & zoogeography distribution of plants & animals respectively.

Due to variations in climate, topography, enormous varieties of flora and fauna are seen in India & which is rich in biodiversity and occupies 10th position among plant rich nation in the world.

Bio geographical classification of India:

It is very important to study the evolution, distribution and dispersal of plants & animals. The distribution of flora & fauna of our country has been grouped into 10 bio geographic zones. They are listed as follows: **Values of biodiversity:**

Due to biodiversity, there are different values. There will be benefits for a given organism in different ways whether it is small or large. Some species may produce invaluable drugs like medicines for cancer, AIDS, etc., the multiple values of biodiversity has been classified by Mc Neely et al in 1990. The different values are:



1) Consumptive use value:

This includes direct usage of products like fuel, food, drugs, fibre, pulp, wood, etc.

Food:

There are number of wild varieties of plants consumed by human & about 80,000 species have been reported as edible. About 90% of present food crops are cultivated from wild tropical plants. Eminent scientists develop hardy strains by using existing wild plants only, because they possess better tolerance & hardness. **Drugs and medicines:**

About 75% of world's population depends on extracts of plants for medicines. There are number of medicinal plants which are reported as:

DRUG	SPECIES NAME	USES
Isabgol	plantago (husk)	bowel disorder
Penicillin	penicillium (fungus)	antibiotic
Tetra cyclin	tetra cyclone (bacteria)	antibiotic
Quinine	cinchonatree (bark)	malaria
Digitalin	digitalis (foxglove)	cure for heart
Vinblastin & vincristine	catharanthus	anticancer action Fuels:

Since from olden ages, forest products are used for fuel. The fossil fuels like coal, petroleum, natural gas are the products of fossilised biodiversity. Fire wood comes under consumptive value because they are not marketed and used directly by local people.

2) Productive use value:

Based on product use these products are marketed & sold commercially.

- This includes animal products like elephant tusks, deer musk's, silk, sheep, wool, animals' fur, insect lac etc.
- Based on above products of biodiversity, industries are operated. **Eg:** paper, pulp, fly wood, silk, textile, leather, pear industries etc.
- Wild gene resources used for introducing desirable traits (character) in crops by scientists.

Some products of endangered species like fur, hide, horns, tusks, live specimen etc are banned for trading and marketing but still smuggling is done with exchange of millions of dollar every year in developing countries like Asia, Africa, Latin America etc. Countries like china and Hong Kong export cat & snake skins which is a booming business.

3) Social value: Based on socio – cultural use

It includes social life, customs, religion beliefs, psycho- spiritual aspects etc, of people.

- Many plants & its products are used for holy & sacred in our country. **Eg:** Tulsi, peepal, mango, lotus, bael, etc.

7.	Gangetic Plain	Upper Gangetic Plain Lower Gangetic Plain	206400 153000	<ul style="list-style-type: none"> Sal, Acacia, Jamun, Mango, Bael Black chinkara, Stag, Rhinoceros, Gazzel, Alligator, Turtle.
8.	North-East India	Brahmaputra Valley North-Eastern Hills	65200 106200	<ul style="list-style-type: none"> Bamboo, Sal, Jack fruit, Tuna Chestnut, Castor Elephant, Rhinoceros, Yak, Deer, Porcupine
9.	Islands	Andaman Islands Nicobar Islands Lakshadweep Islands	6397 1930 180	<ul style="list-style-type: none"> Bahera, Harar, Jack fruit, Cardamom, Coconut, Cloves Dolphin, Alligator, Molluscs
10.	Coasts	West Coast East Coast	6500 6500	<ul style="list-style-type: none"> Coconut, Banana, Cashew nut Dugong, Dolphin, Turtle, Alligator, Molluscs

Source: "Conserving our Biological Wealth", WWF for Nature-India and Zoological Survey of India.

- Similarly many animals has significant role in our psycho – spiritual aspects. **Eg:** cow, snake, bull, peacock, owl etc (vehicles of god & goddesses, which are vertebrates of chordate)
- The tribal people have their beliefs in social life, songs, dance and customs around wild life.

4) Ethical value: Based on ethics of existence

It involves issues like preservation of life based on the concept “live & let live”.

We should protect the precious biodiversity for future. Some species may not be helpful yet we have to protect it. We should feel sorry for the extinct species like Passenger pigeon, Dodo etc. There is no direct use from animals like kangaroo, zebra, giraffe, etc., yet we need to protect them for the existence of these species in nature. This is known as ethical value.



ig. 4.2 Zebra: The majestic animal has Existence or Ethical value.

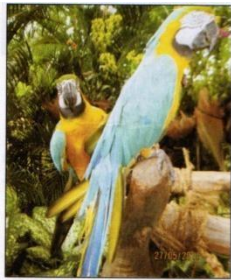


Fig. 4.3 The beautiful blue parrot possesses aesthetic value. (Pic. Aviary, Singapore)



Fig. 4.4 Jurong Park, Singapore with 600 bird species is an eco-tourism centre.

5) Aesthetic value: Based on aesthetics

This is the value which gives pleasure, peace of mind, excitement and feeling of appreciation.

No one wishes to visit barren lands but shows interest for site seeing zoo's, parks, etc, and also spends money for that case. This is known as aesthetic value and a type of tourism, known as eco-tourism. The willingness to pay concept on such eco-tourism gives us even a monetary estimate for aesthetic value of biodiversity. 12 billion dollars of revenue are generated / year.

6) Option values: Based on unknown utility that is to be explored

known at present and may be known in the future i.e., one day it may proved that it posses values. Thus option values of biodiversity states that any species may prove to be a miracle species someday. These bio diverse species are precious, gifted by nature. We should not lose it.

Eg: Many marine animals are believed to possess anti-cancer properties which are to be known in future.

NOTE: This option value also includes visiting of variety of flora & fauna specifically endemic (or) endangered species.

7) Eco system service: Based on values of various ecosystem services.

These include services provided by eco systems. Recently various eco system services has been recognised which includes soil erosion, prevention of floods, soil fertility maintenance, nutrients cycle, nitrogen fixation, hydrological cycle etc. ocean acts as sink for CO₂ (green house – global warming)

From the above categories it is clear that there is lot of values from biodiversity, its loss leads to huge economic, ecological and socio-cultural losses.

Some important values of biodiversity of some selected species:

Animals/Plants Species in Lifetime

Amount Gained Through Ecotourism / Year

Male lion (7 years)	\$ 515,000
Skin (if killed)	\$ 1000
Kenyon elephant	\$ 1 million
Mountain gorillas	\$ 4 million
Whale watching on herney bay	\$ 12 million
Great barrier keef (Australia)	\$ 2 billion
Typical tree	\$ 19, 62, 150 worth by

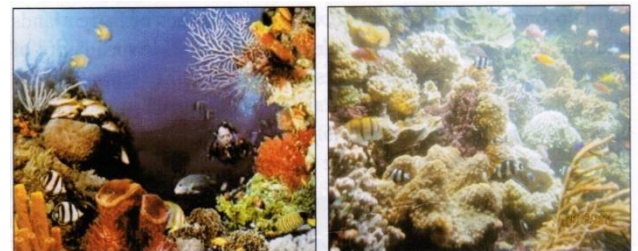


Fig. 4.5 Marine Biodiversity is enormous and marine species have great option value as future medicines and cures (Picture : Downtown Aquarium, Houston, Texas, USA)

Global biodiversity:

After earth summit in 1992 at Rio de Janeiro, we came to know that it is mandatory to know the scientific names of species which is still unknown to us. Roughly 15% of the species is known till date i.e., 1.5 million. But the tropical deforestation reduces 0.5% diversity every year. So, biodiversity mapping is an emerging task for conservation and utilization in a specific manner.

Terrestrial biodiversity of earth is known as biomes. These biomes are predominant over the land and named accordingly. **Eg:** Tropical rain forests, savannas, deserts, etc.

- The tropical rain forests consists of plants, birds, amphibians, insects, mammals & it is the largest store house of biodiversity. Many species are subjected to extinction when their homes are lost.
- About 50-80% of global diversity lies in these rainforests and there is 1, 25,000 flowering plants are estimated of which only 1-3 % are known.
- 1/4th of the present drugs are extracted from plants in tropical forests of which 3000 plants identified for anti cancer agents by national cancer research institute.
- Creeping vines extracts from tropical rain forests at Cameroon inhibited the replication of AIDS virus.
- Neem tree, which is popular in India and is now seen in western temperature countries also.
- Silent valley in Kerala is the only tropical rain forest in India (some hydro projects has been illustrated and abandoned due to loss of bio diversity)
- Temperate forests have comparatively less biodiversity but possess better documentation of species.
- Marine diversity is even much higher than terrestrial, but very little species are known. This includes oceans, seas, estuaries etc., and is the habitat of every known animal phylum.
- There are 35 phylum existing of which 34 are marine and 16 are exclusively marine.
- Globally, there are 1,70,000 flowering plants, 30,000 vertebrates & 2,50,000 species of other groups (on estimation)

NOTE: It is a tremendous task to specify the remaining species which may range from 8-100million.

Indian biodiversity:

Every country has its own biodiversity based on the climate conditions of which India is rich in bio diversity of flora and fauna.

- 6% of global species are found in India & total number of species is 1,50,000.

World rank of India

10th

Category
among plant rich countries.

11th

endemic of higher vertebrates.

6th

centres of diversity & origin of agricultural crops.

- India has 3 hot spots out of 34 in the world. India is one of 12- mega diversity countries in the world.

India – mega diversity nation:

As per ministry of environment and forests, government of India records (2000) possess.

Plants species (flora) – 47,000

Animal species (fauna)- 81,000

Endemism:

Species restricted to particular area are known as endemic species & India shows good number of endemic species. About 62% of amphibians & 50% of lizards are endemic to India of which Western Ghats possess maximum.

Table 4.2. Living species estimates
(World Resource Institute, 1999)

Taxonomic group	Number
Bacteria and Cyanobacteria	5,000
Protozoans (Single celled animals)	31,000
Algae	27,000
Fungi (Molds, Mushrooms)	45,000
Higher Plants	2,50,000
Sponges	5,000
Jelly fish, Corals etc.	10,000
Flatworms, roundworms, earthworms	36,000
Snails, Clams, Slugs etc.	70,000
Insects	7,50,000
Mites, Ticks, Croaks, Shrimps	1,20,000
Fish and Sharks	22,000
Amphibians	4,000
Reptiles	5,000
Birds	9,000
Mammals	4,000
Total	1,400,000

Table 4.3. Distribution of species in some major groups of flora and fauna in India

Group-wise species distribution			
Plants	Number	Animals	Number
Bacteria	850	Lower groups	9979
Fungi	23,000	Mollusca	5042
Algae	2500	Arthropoda	57,525
Bryophytes	2564	Pisces (Fishes)	2546
Pteridophytes	1022	Amphibia	428
Gymnosperms	64	Reptiles	1228
Angiosperms	15,000	Birds	204
		Mammals	372

Source: MoEF (GoI), 2000

Centre of origin: More number of species is originated from India. Nearly 5000 species of flowering plants of which 166 of crop varieties & 320 species of wild varieties. India is quite rich in terms of agricultural diversity.

Marine diversity:

Along 7500 km coastline of our country, there exists more species of mangroves, estuaries, coral reefs. More than 340 species of corals are found here. This marine diversity is rich in molluscs, crustaceans (crabs), poly cheats etc. A large number of species in India is to be explored still, in connection with many wet lands coral reefs, mangroves have to be studied in detail.

Indian forests cover 64.01 million hectares & rich in biodiversity due diverse climate across trans-Himalayan, North West, West, Central and Eastern Himalayas, Western Ghats, Coasts, Deserts, Gangetic Plains, Deccan Plateau, Andaman Nicobar, Lakshadweep island etc.

Hot spots of biodiversity:

They areas which posses endemic species and more rich species are termed as hot spots of biodiversity & introduced by Myers (1988). Earlier 25 hot spots were identified of which two belongs to India and at present 34 are there and in India 3.

- Inspite of 2% of world land area, hot spots cover 50% of terrestrial biodiversity. According to Myer et al, an area is determined as hot spot when it contains at least 0.5% (or) 1500 species of plants as endemics.
- About 40% of terrestrial plants & 25% of vertebrates are endemic to these hot spots.
- Next to tropical rain forests, the endemics are seen more in Mediterranean basin.
- These are characterised by high diversity, endemism but threatened by human activities because 1/6th of world's population live in these areas. In connection of this it has to be protected.
- The hot spot are situated in Western Amazon, Madagascar, North and East Borneo, North Eastern Australia, Brazilian Atlantic forests and many more listed in the table.

Table 4.4. Global Hot spots of biodiversity

Hot spots	Plant species	Endemic plants	% of Global plants	Vertebrate species	Endemic vertebrates	% of Global vertebrates
1. Tropical Andes	45000	20000	6.7	3389	1567	5.7
2. Mesoamerican Forests	24000	5000	1.7	2859	1159	4.2
3. Caribbean	12000	7000	2.3	1518	779	2.9
4. Brazil's Atlantic Forest	20000	8000	2.7	1361	567	2.1
5. Choc/Darien of Panama Western Ecuador	9000	2250	0.8	1625	418	1.5
6. Brazil's Cerrado	10000	4400	1.5	1268	117	0.4
7. Central Chile	3429	1605	0.5	335	61	0.2
8. California Floristic Province	4426	2125	0.7	584	71	0.3
9. Madagascar	12000	9704	3.2	987	771	2.8
10. Eastern Arc and Coastal Forest of Tanzania/Kenya	4000	1500	0.5	1019	121	0.4
11. Western African Forests	9000	2250	0.8	1320	270	1.0
12. Cape Floristic Province	8200	5682	1.9	562	53	0.2
13. Succulent Karoo	4849	1940	0.6	472	45	0.2
14. Mediterranean Basin	25000	13000	4.3	770	235	0.9

(Cont.)

Hot spots	Plant species	Endemic plants	% of Global plants	Vertebrate species	Endemic vertebrates	% of Global vertebrates
15. Caucasus	6300	1600	0.5	632	59	0.2
16. Sundaland	25000	15000	5.0	1800	701	2.6
17. Wallacea	10000	1500	0.5	1142	529	1.9
18. Philippines	7620	5832	1.9	1093	518	1.9
19. Indo-Burma	13500	7000	2.3	2185	528	1.9
20. South-Central China	12000	3500	1.2	1141	178	0.7
21. Western Ghats-Sri Lanka	4780	2180	0.7	1073	355	1.3
22. South-western Australia	5469	4331	1.4	456	100	0.4
23. New Caledonia	3332	2551	0.9	190	84	0.3
24. New Zealand	2300	1865	0.6	217	136	0.5
25. Polynesia/Micronesia	6557	3334	1.1	342	223	0.8
Total	—	133,149	44.4	—	9645	35.3

Source: Myers, N. et al., 2000. Biodiversity Hot spots for Conservation Priorities. *Nature* 403 : 853-858.

Recently additional nine hot spots have been added, one of which lies in India. These nine hot spots are as follows:

26. The Madrean-Pine-Oak Woodlands	29. The Horn of Africa	32. Eastern Himalaya
27. Maputaland-Pondoland-Albany	30. The Irano-Anatolian	33. Japan
28. The Eastern Afromontane	31. The Mountains of Central Asia	34. East Melanesian Islands

Hot spots in India:

In India there are three hot spots but extending into the neighbouring countries namely Indo- Burma Region, Eastern Himalaya and Western Ghats-Srilanka region. The Indian hot spots are rich in floral endemics and also reptiles, amphibians, swadow, tailed butterflies, etc.

1. Indo- Burma hot spot:

It covers with an area of 2 million KM² of tropical East Asia of Ganges – Brahmaputra low lands. It covers Indo- Chinese sub region.

- This hot spot covers lower Mekong catchment, Eastern Bangladesh, North Easter India, south of Brahmaputra river, Myanmar, part of southern & western China, Cambodia, Vietnam, Thailand, small part of peninsular Malaysia and several off shore islands.
- In this hot spot distinct weather conditions are seen with wide diversity of ecosystems (which includes wet green, dry green, deciduous, mundane forest, shrub lands, wood lands, swamps, mangroves and grass lands.
- Fauna includes 6 large mammal species, Antlered muntjac, the Annamite muntjac, grey – Shankled douc, the Annamite striped rabbit, the leaf deer and Saola.
- The endemic species includes turtles, which is likely to be extinct due to habitat loss.



Fig. 4.7 Grey shanked Langur from Indo-Burma Hot-spot.

- This hot spot also holds 1,300 birds which includes white-eared night-heron, the grey crowned crocias, orange-necked partridge, which are threatened for extinction.

Western Ghats hot spot:

It covers an area of 17,000 KM² along Maharashtra, Karnataka, Tamil Nadu and Kerala. In 2011, it is included.

- It has 40% of endemics of flora and about 62% amphibian, 50% lizards are endemics to this region.
- 20% of forests are ever green with 500m elevation and some are semi-ever green with 500-1500 altitude.
- Centres of this spot are Agastyamalai Hills and silent valley-the new Amambalam reserve basin.



Fig. 4.8 Western Ghats have a large number of endemic frog species. (Source: <http://www.frogindia.org>)

Eastern Himalayas hot spot:

It covers an area of 7298 KM² of Sikkim, Eastern Himalayas and dwindled about 1/3rd of its original cover.

- In this hot spot, there numerous deep and semi- isolated valleys in which there are endemic species and rich in biodiversity.
- There are about 4250 plant species of 60% are endemic. Certain species like *Sapria himalayana*, a parasitic angiosperm sighted twice in last 70 years.
- This hot spot is considered as centre for organic evolution and cradle of flowering plants. Out of global flora 30% are endemic to India and in Himalayas there are 35,000.

Inspite of endemism, some species are common to hot spots in India. The common flora includes *Ternstroemia japonica*, *Rhododendron*, *Hypercium* and fauna includes laughing Thrush, fairy Blue bird, Lizard, Hawk etc.

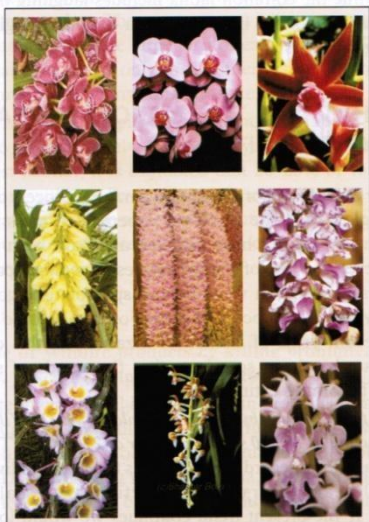


Fig. 4.9 Beautiful endemic orchids of Sikkim (Eastern Himalayan Hot spot)

Threats to biodiversity:

During course of evolution, some species get vanished i.e., extinction and may be replaced by others. This evolution is a slow process, but the process of extinction become fast due to human impact. An estimate by a famous ecologist E. O. Wilson states that 10,000 species/year and 27/day are subjected to extinction, which is a serious threat to biodiversity. Earlier the rate of extinction is slow but for the last 150 years, the rate is dramatically increased and if this continues we would lose 1/3rd to 2/3rd of current bio diversity by the middle of 21st century.

Major causes and issue for the threats to biodiversity:

1) Loss of habitat: (place in which they live)

This is the major cause in which billions of hectares of forests and grasslands have been cleared over the past 10,000 years for different human activities like agriculture, pastures, settlements, projects etc. Due to this, thousands of species homes were lost and gets perished. Wetlands are damaged which rich in biodiversity are including mangroves and estuaries and the reason for this are draining, filling and pollution.

This habitat loss takes place in step wise such that it is divided into small patches known as habitat fragmentation. Some of the species like bears & cats survive only in the interior of the forests but due to fragmentation they are relocated or vanishing. Some of the singing birds are also subjected to this phenomenon. With current late of disappearance of forests (0.6% per year), 20-25% of global flora would be lost within a few years. Marine diversity is also under serious threat due to fragile breeding and feeding ground by human.

2) Poaching:

It is defined as killing of prohibited endangered species for the purpose of trading, which is an illegal activity.

Inspite of ban at international level for the endangered species like furs, hides, horns, tusks, live specimen, herbal products, etc, the smuggling are done which in approximately million dollars per year. The developing

countries like in Asia, Latin America and Africa are rich source of biodiversity. But rich countries in Europe & North America, some part of Asia (Japan, Taiwan, Hong Kong) shows interest in importing wild life & its products.

This wild life trade is high profit making which is accompanied by mafia.

Product	Rate
Elephant's tusks	\$100/kg
Leopard fur coat	\$1,00,000 (in Japan)
Hyacinth macaw (from Brazil)	\$10,000

Note: For the purpose of particular animal, near the 50 animals were killed.

Remedied measures:

- We should not show interest in case of endangered species.
- Do not purchase fur coat, purse (or) bag made of crocodile (or) python skin.

Human wild life conflicts:

From the earlier discussion it is clear that we have to preserve and protect the wild life but at times wildlife is danger to man, in relation to this forest officers also in critical situation to help affected people & preserve wild life.

Some of the importance's are –(India)

- 195 human were killed by elephants and in turn 98 elephants were killed and 30 severely injured in last five years in Sambalpur, Odisha.
- In the border of kote-Chamaraja Nagar belt (Mysore) many elephants were killed in relation to the damage done by it to the farmers of cotton & sugarcane.
- In Royal Chitwan National Park (240 km from Kathmandu), a man–earlier tiger killed 16 Nepalese and a 4 year child (2004).
- Some people were killed by leopard, viz., 2 men in Powai (Mumbai) & 14 persons (leopards from Sanjay Gandhi National Park) in Mumbai (2004).
- Some more conflicts are reported from border of Corbett, Dhudwa, Palamar & Ranthambole National Parks.

Causes of Man-animal conflicts:

1) Dwindling habitats:

Due to shrinking of forests by human activities, ultimately animals attack the humans. **Ex:** tigers, elephants, rhinos, bears etc.

2) Man eating tendency:

Usually weak, ill & injured animals train to attack human and also in preventing human attack to infants of it. "Tiger once taste the human flesh then it does not touch any other animal and this is called man eating tiger". Many tigers were killed in tracing the man-eating ones, because it is difficult.

3) Scarcity of food:

In earlier days, forests department used to cultivate paddy, sugarcane etc. within the sanctuaries as the food is not available for them. But now days the cropping is not done such that animals like elephants invades into the people area for food. In an average 2 quintals of green fodder & 150 litres of water is required for an elephant for one day. If this amount is not available, then it is said to be under starvation.

4) Electric wiring:

Farmer places, electric fencing over the crop fields due to which animals like elephants are subjected to electric shock and injured.

5) Hack of corridor:

Earlier day's wild life for the purpose of migration uses the foot path. But now days these are occupied by human for settlements and so they are attacked (or) being attacked.

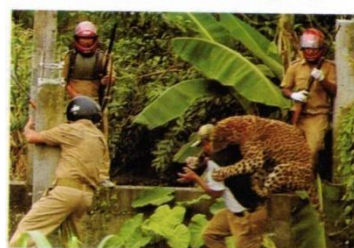


Fig. 4.10 A Leopard attacks a forest guard on the outskirts of Siliguri: A case of man-wildlife conflict.



Fig. 4.11 A dead elephant in Mysore Nanjangud-Gundhupet belt: A result of Man-wildlife conflict.

6) Inadequate compensation:

The compensation paid to the farmer by the government is insufficient (400 instead of 2400/quintal) and so they kill the wild animals for compensation.

Remedial measures:

1) Tiger conservation project (TCP):

In this relation some specialised vehicles are made. In addition to this tranquilizers guns, binoculars, radio sets, etc, are provided to deal tigers. In the month of April & May there is provision for hunting wild animals in Odisha. In this issue the prey (food) for tigers are reduced and they will be in search of it. To rectify this WWF-TCP is developed in the name of Akhand shikar.

2) Cropping pattern:

Adequate fodder, fruits, water should be left out for the animals such that it does not attack. For this, we should do cropping sufficiently inside the forest.

3) Solar power fencing: Solar power fencing is provided such that animals are not subjective to shocks.

4) Wild life corridor:

Corridors should be provided for the migration of animals. About 300 KM² area is required for elephants (as a corridor for migration)

5) Adequate crop compensation: Cash and cattle compensation should satisfy the farmer for the loss.

Endangered and Endemic species:

“If species number is reduced below critical level i.e., drastically reduced and if not protected then it is subjected to extinction, the species is known as endangered species”. **Eg:** Great Indian Bustard (less than 500 species)

“A species which is abundant but faces continuous decline due to over exploitation, then it is said to be vulnerable”. If the factors are not checked, they will become endangered. **Eg:** Andaman Hor Shoe Bat (endemic to India).

“The species which does not belongs to either endangered (or) vulnerable but it is at a risk known as rare species”. **Eg:** Ganges shark (its oil is valuable)

“A species is said to be extinct when it is not seen in the wild life for 50 years of period”. **Eg:** Dodo (Passenger Pigeon), in India (cheetah, pink headed dusk & mountain avail)

The international union for conservation of nature and natural resources (IUCN) published a „RED DATA book“ which consists of the list of endangered and extinct species of flora and fauna. Red data signal is the warning symbol that if they are not protected, they will be extinct.

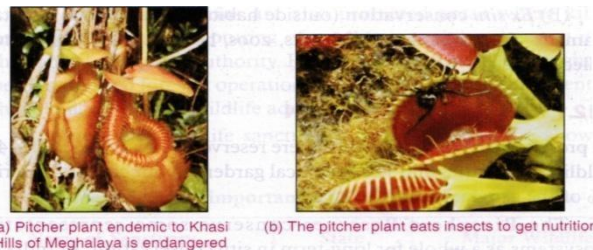




Fig. 4.12 Some important extinct and endangered Indian species of animals and birds.



(c) Toothbrush orchid endemic to Sikkim is endangered.
Fig. 4.13 Some endangered Indian Plant species.



(a) Pitcher plant endemic to Khasi Hills of Meghalaya is endangered. (b) The pitcher plant eats insects to get nutrition



It is difficult to give complete endangered flora and fauna of our country. Nearly 150 mammals, 150 birds and 450 plants species are identified as endangered in India of which 132 species of flora and fauna are identified as critically endangered (source: Red list of 2012, earth summit) Some of the endangered reptiles, birds, mammals and plants are listed below:

NAME OF THE CLASS/CATEGORY

Reptiles

Aves (birds)

Indian horn bill, Siberian white crane.

Mammals

leopard, striped hyena, Indian lion, golden cat, desert cat, dugong.

Primates

langur, capped monkey, golden monkey.

Plants

NAME OF THE SPECIES

Gharial, green sea turtle, tortoise, python.

great Indian bustard, peacock, pelican, great

Indian wolf, red fox, sloth bear, red panda, tiger,

Hoolock, gibbon, lion-tailed macaque, nilgiri

Orchids, rhododendrons, rauvolfia serpentina
santalum, cycas beddomei, pitcher plant

Endemic species in India:

In India there is 62% of endemic flora. The three hot spots of India consist of 7000 endemics out of 47000 species of endemic. The endemic are seen in Eastern Himalayas, khasi hills, Ganges- Brahmaputra low lands, Western Ghats etc.

Fig: *Sapria himalayana*, *Uraria lurida*, *Nepenthes khasiana*, *Pedicularis perroter* etc.

Out of 81,000 endemics of fauna, major portion are endemic to India of which Western Ghats cover 62% of amphibians and 50% lizards (reptiles)

Fig: *Varanus* (monitor lizards), python, Indian salamander, nectophryne etc.

Conservation of bio diversity: It can be conserved by 1. Protection.

2. Creating awareness

Bio diversity has to be conserved for the different reasons like genetic value, commercial, medicinal, aesthetic, ecological and optional values.

Now a day's people realised hunting is not a game for enjoyment instead they think that diversity is gift of god and we need to enjoy the pleasure of it. Many measures are taken for its conservation. There are two approaches:

1. In situ conservation (with in habitat)
2. Ex situ conservation (out-side habitat)

1. In situ conservation: This is achieved by the protection of wild flora & fauna in nature itself.

Eg: Biosphere reserves, National parks, Sanctuaries, Reserve forests etc.

At present we have 7 major bio reserves, 80 national parks, 420 wild life sanctuaries and 120 botanical gardens in our country covering 4% of the geographic area.

The biosphere reserves conserve some representation eco system for long time period. In India there are many biosphere reserves, they are Nanda Devi (UP), Nokrek (Meghalaya), Manas (Assam), Sunderbans (West Bengal), Gulf of Mannar (Tamil Nadu), Nilgiri (Tamil Nadu, Karnataka, Kerala), Great Nicobars and Similipal (Odisha) Within the biosphere reserves there may be some National parks.

Eg: Nilgiri biosphere reserves has two national parks (Bandipur and Nagarhole)

A national park is a dedicated area for conservation of wild life. In addition to this it gives aesthetic value (tourism). National park conserves a particular species of wild life. Here domestic animal grazing & other forests activities are prohibited. Some natural parts of our country are listed below:

Table 4.5. Some important national parks in India

Name of National Park	State	Important Wildlife
Kaziranga	Assam	One-horned Rhino
Gir National Park	Gujarat	Indian Lion
Dachigam	J & K	Hangul
Bandipur	Karnataka	Elephant
Periyar	Kerala	Elephant, Tiger
Kanha	M.P.	Tiger
Corbett	Uttarakhand	Tiger
Dudwa	U.P.	Tiger
Ranthambore	Rajasthan	Tiger
Sariska	Rajasthan	Tiger

Table 4.6. Some important wildlife sanctuaries in India

Name of Sanctuary	State	Major Wildlife
Ghana Bird Sanctuary	Rajasthan	300 species of birds (including migratory)
Hazaribagh Sanctuary	Bihar	Tiger, Leopard
Sultanpur Bird Sanctuary	Haryana	Migratory birds
Nal Sarovar Bird Sanctuary	Gujarat	Water birds
Abohar Wildlife Sanctuary	Punjab	Black buck
Mudamalai Wildlife Sanctuary	Tamil Nadu	Tiger, Elephant, Leopard
Vedanthangal Bird Sanctuary	Tamil Nadu	Water birds
Jaldapara Wildlife Sanctuary	W. Bengal	Rhinoceros, Elephant, Tiger
Wild Ass Sanctuary	Gujarat	Wild ass, wolf, nilgai, chinkara

Wild life sanctuaries are the protected areas where killing, hunting, shooting (or) capturing of wild life is prohibited. However private ownership rights are given such that it should not affect the wild life. Some of the wild life sanctuaries are listed above.

There are many botanical gardens in India of which one of the major botanical garden is situated in Ooty (Tamil Nadu). For plants there is one gene sanctuary for citrus species (lemon, orange, etc.) & one for pitcher plant (insect eating plant) in North East India.

For the protection of animals, there are different projects.

Eg: project tiger, Gir lion project, Crocodile breeding project, Project elephant, Snow leopard project etc.

2. Ex-situ conservation:

This is achieved by establishment of gene banks, seed banks, zoos, botanical gardens, culture collection etc.

The main objective is to maintain genetic information (genes) of crop varieties and wild life species for future improvement. In India, the following important gene bank/seed banks are listed: **a) National Bureau of Plant Genetic Resources (NBPGR):**

This is in New Delhi, where agriculture and horizontal crops including wild varieties are preserved by cryo-preservation of seeds, pollen grains etc, by using liquid N₂ (at -196 °C)

Eg: Rice, pearls, millets, brassica, turnip, radish, tomato, onion, carrot, chilli, tobacco, poppy, etc, gene pool can be maintained by using liquid N₂ successfully. **ii) National Bureau of Animal Genetic Resources (NBAGR):**

This is Karnal, Haryana & maintains the semen of domesticated bovine animals. **iii)**

National Facility for Plant Tissue Culture Repository (NFPTCR):

In this bank tissue cultures of crops & plants are maintained for the development. Now this facility is within NBPGR.

The G-15 countries have also resolved to set up a network of gene banks to facilitate the conservation of various varieties of aromatic and medicinal plants for which India is the networking coordinator country.

All THE BEST Dr. Dayalan V M

E KEERTHIGA

G MUNI HEMALATHA

P BABITHA