Sri SAI RAM ENGINEERING COLLEGE
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ENVIRONMENTAL SCIENCE AND ENGINEERING

UNIT NO 1

ENVIRONMENT, ECOSYSTEMS AND BIODIVERSITY

1.4 Biodiversity at global, national and local levels – mega-diversity hot-spots – threats to biodiversity endangered and endemic species of India

SCIENCE & HUMANITIES

4 QUALITY EDUCATION

GLOBAL BIODIVERSITY

Total number of living species in the world are about 20 million. But, of which only about 1.5 million species are found and given scientific names. Tropical deforestation alone is reducing the biodiversity by 0.5% every year.

1.4.1.Terrestrial biodiversity (or) Biomass

It is the largest ecological units present in different geographic areas and are named in different ways.

Examples Tropical rain forests, Savannas, desert, tundra,etc.,

1. Tropical rain forests

These are the earth's largest storehouse of biodiversity. They are inhabited by millions of species of plants, insects, birds, amphibians and mammals. About 50 to75% of global biodiversity lies in these tropical rain forests.

(a) Medicinal plants: More than 25% of the world's prescription drugs are extracted from plants growing in tropical forest.

Examples

(i) Of about 3000 plants identified by National Cancer Research Institute as source of cancer fighting chemicals, 70% is derived only from tropical rain forests.

(ii) Extracts from one of the creeping vines in the rainforests at cameroon have proved effective in the inhibition of replication of AIDS virus.

(b) Flowering plant: It has been estimated that nearly1,30,000 flowering plant species are found available. But, till now we know only 1-3% of these plant species.

Protection of tropical rain forest: Thus, it is essential to protect our tropical rainforests.

Examples

i. The Silent Valley in Kerala is the only place in India, where tropical rain forests available. In order to protect our only tropical rain forest biodiversity, Silent Valley Hydroelectric Project was abandoned.

ii. . **Temperate forests**

These have much less biodiversity. Globally, they have nearly,

(a) 1,70,000 flowering plants.

(b) 30,000 vertebrates.

(c) 2,50,000 other group of species

1.4.2. Marine diversity is much higher than terrestrial biodiversity, but it is less known and described.

Estuaries, coastal waters and oceans are biologically diverse but the diversity is very low. Sea is the cradle of every known phylum.

Out of 35 existing phyla of multicellular animals, 34 are marine.

Living species estimate (World Resource Institute, 1999)

Taxonomic group	Number
Protozoans (Single called animals)	31,000
Bacteria and Cyanobacteria	5,000
Algae	27,000
Fungi (Mushrooms)	45,000
Higher Plants	2,50,000
Jelly fish, Corals etc.	10,000

Taxonomic group	Number
Sponges	5,000
Flatworms, earthworms	36,000
Insects	7,50000
Snails, Slugs etc	70,000
Fish	22,000
Amphibians	4,000
Reptiles	5,000
Mammals	4,000
Birds	9,000
Total	1,400,000

1.4.3. BIODIVERSITY AT NATIONAL LEVEL (INDIA)

India is second largest nation containing 5% of world's biodiversity and 2% of the earth surface

Rank of India in biodiversity

It has been estimated that India gets.

1. 10th rank among the plant rich countries of the world.
2. 11th rank among the endemic species of higher vertebrates
3. 6th rank among the centers of diversity and origin of agricultural crops.

India is an agricultural country and its economic growth depends on the production of many crops.

Among several developing nations, India is considered as "mega - diversity" nation because it is rich in both fauna and flora. There is high demand for Indian species in abroad.

Medicinal value

More than 2000 medicinal plants are cultivated in India, which can cure many disease.

Examples

1. Tulsi and Neem is well known plant for its medicinal values.
2. Turmeric in India was proved to be an anticarcinogen, but Germanians patented this in their land.

Commercial value

1. Indian sandal wood has high commercial value, if it is sold in abroad.
2. Indian tobacco has high nicotine content, when compared to other tobacco.
3. Several species of non - wild edible mushrooms cultivated and exported to advanced countries.
4. The demand for ornamental plants, flowers and fruits are increasing from decade to decade.

5. More than 100 species of microorganisms were collected from Indian soils and cultured, developed and formulated in the abroad laboratories.

Number of plant and animal species in India

Group	Number of species
Flowering plants	20,000
Insects	67,000
Fishes	1460
Birds	1200
Reptiles	420
Mammals	340
Domesticated animals plants	170

1.4.4 BIODIVERSITY AT LOCAL LEVEL (OR)MEASUREMENT OF BIODIVERSITY

Based on their spatial distribution, biodiversity at local level is categorized into four types.

(i) Point richness

It refers to the number of species that can be found at a single point in a given space.

(ii) Alpha richness

It refers to the number of species found in a small homogeneous area. It is strongly correlated with physical variables.

Example

There are 100 species of tunicates in arctic waters, 400 species in temperate waters and 600 in tropical seas. Thus, temperature is the most important factor affecting the richness of tunicates.

(iii)Beta richness

It refers to the rate of change in species composition across different habitats. It means that the number of species increases as more heterogeneous habitats are taken into consideration.

Example

The ant species found in local regions of north pole is merely 10. As we move towards the equator the number of species of ants is going on increasing as high as 2000 on the equational region.

(iv)Gamma Richness

It refers to the rate of change across a large landscape.

1.4.5. Biodiversity at Tamilnadu

The distribution of plants and animals among different districts of Tamil Nadu is uneven.

Examples

1. There are some dense forests in Salem district.
2. Western Ghats has 1500 species of plants, 50 speciesof mammals and 90 reptiles.
3. Birds of several species is coming to Vedanthangal from far off places.
4. The elephant sanctuaries at Anaimalai.
5. Tiger sanctuary at Mundanthurai.

1.4.6. MEGA – DIVERSITY

There are nearly 170 countries in the world and 12 of them contain 70% of our planet's biodiversity.

Mega diversity regions

Following 12countries, Australia,Brazil,China,Colombia,Ecuador,the United States,India,Indonesia,Madagascar,Mexico,Peru and democraticRepublic of the Congo regions are known as mega diversity regions.

These countries have the world's selected few rich floral land and faunal zones.

India as a Mega-Diversity Nation

India is one among the 12 mega-diversity countries in the world. It has 89,450 animal species accounting for 7.31% of the global faunal species and 47,000 plant species which accounts for 10.8% of the world floral species. The loss of biodiversity or endemism is about 33%.

Distribution of species in some groups of flora and fauna in India

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

Endemism (or) Endemic species

The species which are confined to a particular area are called endemic species. Our country has a rich endemic flora and fauna. About 33% of the flowering plants, 53% of fresh water fishes, 60% amphibians, 36% reptiles and 10% mammalian are endemic species.

1.Plant diversity

Nearly 5000 flowering plants and 166 crop plant species have their origin in India.

2.Marine diversity

More than 340 coral species of the world are found here. Several species of mangrove plants and seagrasses are also found in our country.

3.Agro-biodiversity

There are 167 crop species and wild relatives. India is considered to be the centre of origin of 30,000 to 50,000 varieties of rice, mango,turmeric, ginger, sugarcane, etc.

4.Animal biodiversity

There are 75,000 animal species including 5,000 insects. India is a home to about nearly 2,00,000 living organisms.

1.4.6. 'RED' Data book (or) Red list

Red book is a catalogue of taxa facing risk of extinction. The purpose of preparation of red list is to

1. provide awareness to the degree of threat to biodiversity.
2. provide global index on already decline of biodiversity.
3. identification of species at high risk of extinction.
4. help in conservation action.

5. information about international agreements.

India's biodiversity is threatened due to habitat destruction, degradation, fragmentation and over exploitation of resources.

According to 'RED' Data book 44 plant species are critically endangered, 54 endangered and 143 are vulnerable (exposed to damage).

India ranks 2nd interms of the number of threatened mammals and 6th among the countries with the most threatened birds.

Examples

1. Pitcher plant has become endemic in Eastern Himalayas.
2. Taxus wallichina has come under red dad category due to its over exploitation.

1.4.7. HOT-SPOTS OF BIODIVERSITY

The most remarkable and threatened areas, where many of them have been reduced to less than 10% of their original vegetation. These areas are called hotspots of biodiversity.

(or)

Hot spots are the geographic areas which possess high endemic species.

At global level, these are the areas of high conservation priority, if these species are lost, they can never be replaced (or) regenerated.

Criteria for recognising hot spots

1.The richness of the endemic species is the primary criterion for recognising hot spots.

2.The hot spots should have a significant percentage of specialised species.

3.The site is under threat.

4.It should contain important gene pools of plants of potentially useful plants.

Reason for rich biodiversity in the tropics

Followings are the reasons for rich biodiversity in the tropics.

1. The tropics have a more stable climate.

2. Warm temperature and high humidity in the tropical areas provide favourable conditions.

3. No single species can dominate and thus there is an opportinity for many species to coexist.

4. Among plants, rate of out-crossing appear to be higher in tropics.

1.4.8.Area of hot spot

These hot spots covering less than 2% of the world's land are found to contain 50,000 endemic species. According to myersetal (2000), an area is designated as a hot spot when it contains atleast 0.5% of the endemic plant species.

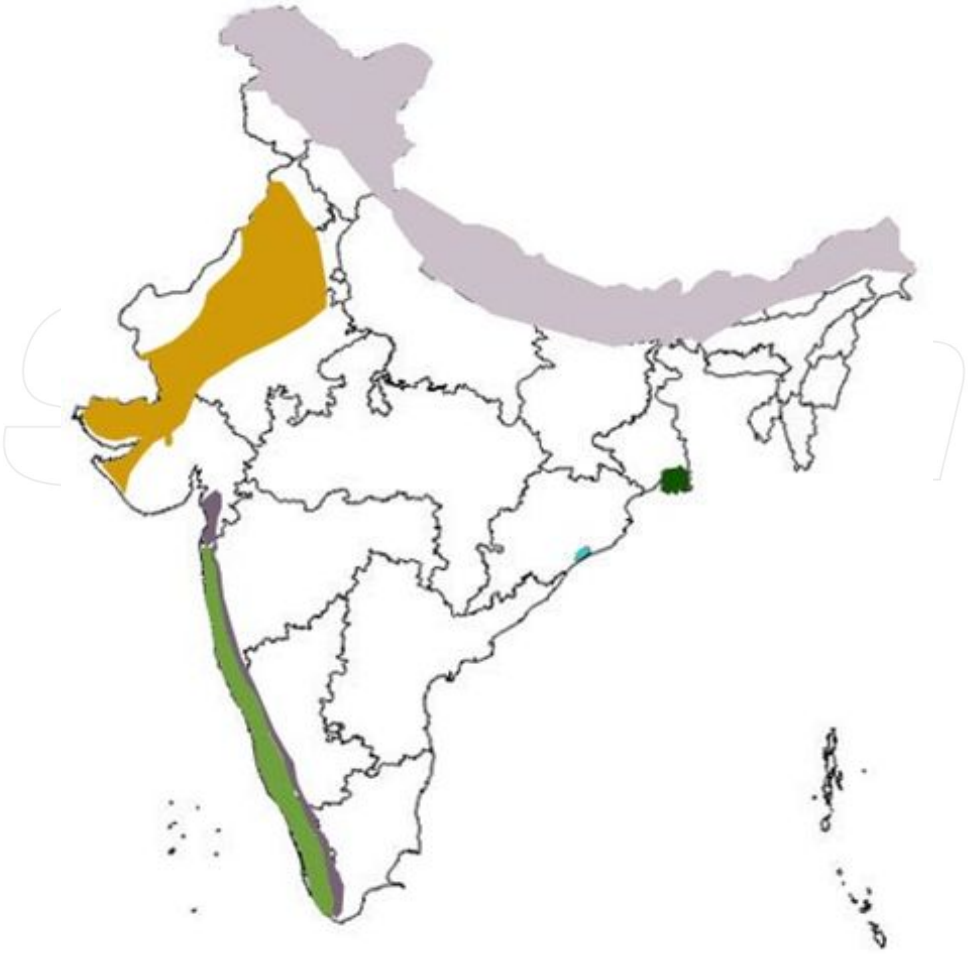
About 40% of terrestial plants and 25% of vertebrate species are endemic and are found in these hot spots. These are the areas of high diversity, endemism and are also threatened by many human activities.

The table below shows the Global hotspots of biodiversity

Hotspots	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. 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	4426	2125	0.7	584	71	2.8
9. Madagascar	12000	9704	3.2	987	771	2.8
10. Eastern Arc and Coastal Forest of Kenya	4000	1500	0.5	1019	121	0.4
11. Western African Forests	9000	2250	0.8	1320	270	1.0

Hotspots	Plant Species	Endemic Plants	% of Global Plants	Vertebrate Species	Endemic Verte brates	% of Global Vertebrates
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
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 Eastern Himalayas	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

1.4.9. HOT SPOT OF BIODERVERSITY IN INDIA



Myers etal recognized 25 hot spots in the world as shown in table 3.8. Two of which are found in India. (Table below)

Biodiversity hot spots in India

1.	Eastern Himalayas	Indo - Burma region.
2.	Western Ghats	Sri Lanka region.

Eastern Himalayas

Geographically these area comprises Nepal, Bhutan and neighboring states of Northern India. There are 35,000 plant species found in the Himalayas, of which 30% are endemic.

The Eastern Himalayas are also rich in wild plants of economic values.

Examples Rice, banana, citrus, ginger, chilli, jute and sugarcane.

Western ghats

The area comprises Maharastra, Karnataka, Tamilnadu and Kerela. Nearly 1500 endemic, dicotyledone plant species are found from Western ghats. 62% amphibians and 50% lizards are endemic in western Ghats.

It is reported that only 6.8% of the original forests are existing today while the rest has been deforested or degraded.

Some common plants: Ternstroemia Japonica,Rhododendron and Hypericum.

Some common animals: Blue bird, lizard, hawk.

1.4.10. THREATS TO BIODIVERSITY

Any disturbance in an natural ecosystem tend to reduce its biodiversity.

The waste generated due to increase in human population and industrialisation, spoils the environment and leads to more diversity in biological species.

Any change in the system leads to a major imbalance and threatens the normal ecological cycle.

CAUSES FOR LOSS OF BIODIVERSITY (OR) VARIOUS THREATS TO INDIAN BIODIVERSITY

Habitat loss

The loss of populations of interbreeding organisms is caused by habitat loss. Habitat loss threatened a wide range of animals and plants.

Factors influencing Habitat Loss

1. **Deforestation**: The loss of habitat is mainly caused bydeforestation activities. Forests and grasslands have been cleared for conversion into agricultural lands, or settlement areas or developmental project.

The forest and grasslands are the natural homes of thousands of species, which disintegrate due to loss of their natural habitat.

2. **Destruction of wetlands**: The wetlands, estuaries and mangroves are destroyed due to draining, filling and pollution, which causes huge biodiversity loss.

3. **Habitat fragmentation:** Sometimes the habitat is divided into small and scattered patches. This phenomenon is known as habitat fragmentation. Due to this many wild animals and songbirds are vanishing.

4. **Raw material:** For the production of hybrid seeds, the wild plants are used as raw materials. As a result, many plant species become extinct.

5. **Production of drugs**: Many pharmaceutical companiescollect wild plant for the production of drugs. Therefore several medicinal plant species are on the verge of extinction.

6. **Illegal trade:** Illegal trade on wild life also reduces the bio-diversity and leads to habitat loss.

7. **Developmental activities**: Construction of massive dams in the forest areas, discharge industrial effluents which kill the birds and other aquatic organisms.

Poaching (over harvesting) of wildlife

Poaching means killing of animals (or) commercial hunting. It leads to loss of animal biodiversity.

1. **Subsistence poaching:** Killing animals to provide enoughfood for their survival is called subsistence poaching.

2. Commercial poaching: Hunting and killing animals to sell their products is called commercial poaching.

Factors Influencing Poaching

1. **Human population**: Increased human population in our country has led to pressure on forest resources, whichultimately causes degradation of wildlife habitats.

2. **Commercial activities**: Though international ban ontrading the products of endangered species, smuggling of wildlife products continues. Since the trading of such wildlife products is highly profit, poaching makes the poachers to just hunt these prohibital wildlife and smuggle it to other countries.

Wild life products: Furs, horns, tasks, live specimens, herbal products.

Wealth of wildlife: The developing nations in Asia, LatinAmerica and Africa have richest source of biodiversity.

Importers of wild life: The rich countries in Europe and North America, Japan, Taiwan, Hong Kong are the major importers of wildlife products (or) wildlife itself.

Examples

1. Male gorilla: In Rwanda and Zaire, it is hunted for its body parts, head and hands.
2. Blue morpho butterfly: In Brazil, it is poached for making attractive trays and other objects.
3. Snowy large egret: In U.S, it is poached for its white plumes, so as to keep it in ladies hats.
4. Blubber: It is used to prepare lamp oils and lubricating oils.
5. Baleen: It is used to prepare combs and other similar articles.
6. Elephant feet: It is used to make Ash trays.

7. Elephant: It is killed for ivory.

8. Bengal tigers: Its fur sell is more than $1,00,000 in the foreign market.

9. Bush meat: It is an important source of protein for many local people in west and central Africa.

10. Dynamite fishing: It is “high - tech fishing”, which have exhausted the ocean marine life.

11. Seahorses, Star turtles: These valuable species are also illegally sold into the foreign market for want of money.

Remedy measures

1. Illegal hunting and trade of animals and animal products should be stopped immediately.

2.We should not purchase fur coat, purse or bag or items made of crocodile skin or python skin.

3.Bio-diversity laws should be strengthened.

Man - wildlife conflicts

Man - wildlife conflicts arise, when wildlife starts causing immense damage and danger to the man.

Under such condition it is very difficult for the forest department to compromise the affected villagers and to gain the villagers support for wildlife conservation.

Examples for man - wildlife conflicts

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

2.In the border of Kote - Chamarajanagar, Mysore,several elephants was killed because of the massive damage done by the elephants to the farmer's cotton and sugarcane crops.

3.The agonized villagers sometimes hide explosives in The sugarcane fields, which explode when the elephants enter into their fields.

4. It has been reported that a man - eating tiger killed 16 Nepalese people and one 4 - years old child inside the Royal Chitwan National Park, kathmandu. Now the park has became a zone of terror for the locals.

5. Very recently, two men were killed by leopards in Powai, Mumbai.

6. A total of 14 persons were killed during 19 attacks by the leopards in Sanjay Gandhi National Park,Mumbai.

Factors influencing (or causes) man - animal conflicts

1.Shrinking of forest cover compels wildlife to move outside the forest and attack the fields and humans.

2.Human encroachment into the forest area induces a conflict between man and the wildlife.

3.Injured animals have a tendency to attack man. Usually the female wildlife attacks the human if she feels that her newborn cubs are in danger.

4.Earlier, forest departments used to cultivate sugarcane paddy, coconut trees, in the sanctuaries. When the favourite food of elephants (i.e., bamboo leaves) were not available, they feed them to the elephants. But, now due to lack of such practices the wild animals move out of the forest for searching

5.Often the villagers put electric wiring around their crop fields. The elephants get injured, suffer in pain and start violence.

6.The cash compensation paid by the government for the damage caused by the wild animals, is not enough. Therefore the agonized farmers gets revengeful and kill the wild animal. **Example** : A farmer, in Mysore, gets a compensation of Rs.400/- per quintal, but the market price is Rs.2400/- per quintal.

7.Garbage near human settlements or food crops nearforest areas attracts wild animals.

Remedial measures (or) Conservation of biodiversity

1. Adequate crop and cattle compensation schemes must be started.
2. Solar powered fencing must be provided along with electric current proof trenches to prevent the animals from entering into the fields.
3. Cropping pattern should be changed near the forest borders.
4. Adequate food, and water should be made available for the wild animals within forest zones.
5. The development and constructional work in and around forest region must be stopped.

ENDANGERED AND ENDEMIC SPECIES OF INDIA

According to International Union of conservation of Nature and Natural Resources (IUCN) the species are classified into various types.

1.**Extinct species**: A species is said to be extinct, when it is no longer found in the world.

2.**Endangered species**: A species is said to be endangered, when its number has been reduced to a critical level. Unless it is protected and conserved, it is in immediate danger of extinction.

3.**Vulnerable species**: A species is said to be vulnerable when its population is facing continuous decline due to habitat destruction or over exploitation. Such a species is still abundant.

4.**Rare species:** A species is said to be rare, when it is localized within restricted area (or) they are thinly scattered over a more extensive area. Such species are not endangered or vulnerable.

ENDANGERED SPECIES OF INDIA

A species is said to be endangered, when its number has been reduced to a critical level. Unless it is protected and conserved, it is in immediate danger of extinction.

In India 450 plant species have been identified as endangered species. About 100 mammals and 150 birds are estimated to be endangered species. But India's biodiversity is threatened due to habitat destruction, degradation and over exploitation of resources.

Number of threatened species of India.

Group of Threatened species	Number of Threatened species
Plants	250
Birds	70
Mammals	86
Reptiles	25
Amphibians	3
Fishes	3
Molluscs	2
Insects	50

Important endangered Species

A few species of endangered reptiles, mammals, birds and plants are given below.

1.	Reptiles	Tortoise, green sea turtle, gharial, python
2.	Birds	Peacock, siberian white crane, pelican, Indian bustard.
3.	Mammals	Indian wolf, red fox, sloth bear, tiger, Indian lion, golden cat, desert cat.
4.	Primates	Hoolock gibbon, lion-tailed macaque, capped monkey, golden monkey.
5.	Plants	A large number of medicinal plants (like rauvol fia serpentina), sandal wood tree (like santalum, cycas bed donei).

RED - data book:

RED - data book contains the list of endangered species of plants and animals. The RED – data gives the warning signal for those species which are endangered and if not protected they become extinct in near future.

Factors affecting Endangered species

1.**Pollution:** Humans dispose their waste products on nature. So, the land, river, and air get polluted severely. These pollutants enter our environment and travel through the food chain and accumulate in the tissues of the living things, finally it leads to death.

2.**Over - exploitation**: Over - exploitation of the natural resources and poaching of wild animals also leads to extinct of wild animals.

3.**Climate change:** Climate change is brought about by the accumulation of greenhouse gases in the atmosphere.

Climate change threatens organisms and ecosystems, which cannot accommodate the change of environmental conditions.

Remedial measures

International treaties on Endangered Species (ITES)

Several international treaties and conventions help to protect endangered wild species. One of the most reaching treaty is, “Convention on International Trade in Endangered Species 1975” (CITES). This treaty is now signed by 160 countries.

1.This treaty lists some 900 species that cannot be commercially traded as live specimens or wildlife products, because they are in danger of extinction.

2.The treaty also restricts international trade of 2900 other species, because they are endangered.

Drawbacks of this treaty

1.The bad news of this treaty is that the effect of this treaty is limited because enforcement is difficult and convicted violators often pay only small fines.

2.Also, member countries can exempt themselves from protecting any listed species.

ENDEMIC SPECIES

The species, which are found only in a particular region are known as endemic species. In India of 47,000 species 7000 plants are endemic. Nearly 62% of our endemic species are found available in Himalayas and Western Ghats.

1.Fauna

Animals present in a particular region or period.

Examples

Sapria himalayana, Ovaria lurida, Nepenthes khasiana, Pedicularis Parroter, etc.,

Out of 81,000 species of animals in our country a large number is endemic. The Western Ghats are particularly rich in (a) amphibians (frogs, toads, etc.,) and (b) reptiles (lizards, crocodiles, etc.,). About 62% amphibians and 50% lizards are endemic to Western Ghats.

2.Flora

Plants present in a particular region or period.

It also refers to friendly bacteria which helps to protect the human body against invasion by pathogens.

Examples

Monitor lizards (varanus), reticulated python, Indian salamander and viviparous toad (Nectophhryne)

Endemic species in India

The following species are considered as endemic in India.

Endemic species of plants

Group	No. of Species
Pteridophyta	200
Angiosperms	4950

Endemic species of animals

Group	No. of Species
Land	878
Freshwater	89
Insecta	16214
Amphibia	110
Reptilia	214
Aves	69
Nannakua	38

Factors affecting endemic species

There are number of factors, which affect amphibians (frogs) at various points in their life cycle.

Habitat loss and fragmentation, because of the draining and filling of inland wetlands.

Pollution also play an important role.

Examples

1.Frog eggs, tadpoles and adults are very sensitive to many pollutants especially pesticides.

2. Overhunting of frog legs in Asia and France.

3. Populations of same can also be reduced by introduction of non-active predators and competitors (like fish) and disease producing organism.

VIDEO LINK

1. **HOT SPOT**

   https://youtu.be/WmV8TRY25VQ

2. **ENDANGERED AND ENDEMIC SPECIES**

   https://youtu.be/RBdLF0JIvW8

THANK YOU