Definition of Biodiversity

biodiversity/biological diversity Species, genetic, and ecosystem diversity in an area, sometimes including associated abiotic components such as landscape features, drainage systems, and climate.

Biodiversity, also called **biological diversity**, the variety of life found in a place on Earth or, often, the total variety of life on Earth. A common measure of this variety, called species richness, is the count of species in an area. Colombia and Kenya, for example, each have more than 1,000 breeding species of birds, whereas the forests of Great Britain and of eastern North America are home to fewer than 200. A coral reef off northern Australia may have 500 species of fish, while the rocky shoreline of Japan may be home to only 100 species. Such numbers capture some of the differences between places—the tropics, for example, have more biodiversity than temperate regions—but raw species count is not the only measure of diversity. Furthermore, biodiversity encompasses the genetic variety within each species and the variety of ecosystems that species create.

Levels of biological diversity: genetic, species and ecosystem diversity

The living world is a complex combination of different levels of organisms. The key components of life are at one extreme and communities of species at the other extreme. The manifestations of all types of diversities are found at all these levels of organisms. Biodiversity is the shorter form of word biological diversity which means diversity in the biological world. Thus one can define biodiversity as the degree of variety in nature with regards to biological species.

Types of Biodiversity:

(a) Genetic diversity:

It is the variation of genes within the species. This results distinct population of one, even same species. It gives genetic variation within a population or varieties within one species. There are two reasons for differences between individual organisms. One is variation in the gene which all organisms possess which is passed from one to its offspring's.

The other is the influence of environment on each individual organism. The variation in the sequence of four base pairs in DNA chain forms the genetic variation in the organism. The recombination)

of genetic material during cell division makes it an imperative for genetic diversity within a species. Loss of genetic diversity within a species is called genetic erosion.

The whole area of agricultural productivity and development depend on genetic diversity. The plant as well as animal genetic resources play important role in the economy of a country. Genetic diversity is the whole basis for a sustainable life system in the earth.

Scientists in many parts of the world are trying to introduce genetically modified seeds in the agriculture sector for better yield as well as for the resistance of drought and flood situations. The local people or farmers are not showing any interest to preserve the natural way of genetic diversity.

(b) Species diversity:

This refers to the variety of species within a particular region. The number of species in a region is a measure for such diversity. The richness of species in a given region provides a yard stick for species diversity. Species diversity depends as much on the genetic diversity as on the environmental condition.

Colder regions support less than the warmer regions for species diversity. The good climate with good physical geography supports a better species diversity. Species richness is a term which is used to measure the biodiversity of a given site.

In addition to species richness, species endemism is a term used to measure biodiversity by way of assessing the magnitude of differences between species. In the taxonomic system similar species are grouped together in general, similar genera in families, families in orders and so on till in the level of kingdom. This process is a genuine attempt to find relationships between organisms. The higher taxa have thousands of species. Species that are very different from one another contributes more to overall biodiversity.

(c) Ecosystem diversity/ Ecological diversity:

This is the number of species in a community of organisms. Maintaining both types of diversity is fundamental to the functioning of ecosystems and hence to human welfare. India is one of the 12 centres of diversity and origin of several cultivated plants in the world. It is estimated that 15,000 species of plants occur in India. The flowering plants comprise 15,000 species of which several hundred (5000-7500) species are endemic to India. The region is also rich in fauna, containing about 65,000 species of animals.

Among these, more than 50,000 species of insects, 4,000 of molluscs. 6,500 of other invertebrates, 2,000 offish, 140 of amphibians, 420 of reptiles, 1,200 of birds and 340 of mammals are recorded from India. This richness in biological diversity is due to immense variety of climatic and altitudinal conditions coupled with varied ecological habitats.

These vary from the humid tropical Western Ghats to the hot desert of Rajasthan, from the cold desert of Ladakh and the icy mountains of Himalayas to the warm coasts of peninsular India including coastal region of Orissa. Gandhamardan Hills of Sambalpur is rich in biodiversity. The Indian tradition teaches us that all forms of life, human, animal and plants are so closely linked that disturbance in one gives rise to imbalance in the other. Our old scriptures tell lot about these things.

India as a mega-biodiversity nation

Geological events in the landmass of India have provided conditions for high levels of biological diversity. A split in the single giant continent around 70 million years ago, led to the formation of northern and southern continents, with India a part of Gondwanaland – the southern landmass, together with Africa, Australia and the Antarctic.

Later tectonic movements shifted India northward across the equator to join the Northern Eurasian continent. As the intervening shallow Tethis Sea closed down, plants and animals that had evolved both in Europe and in the Far East migrated into India before the Himalayas had formed.

A final influx came from Africa with Ethiopian species, which were adapted to the Savannas and semi-arid regions. Thus India's special geographical position between three distinctive centers of biological evolution and radiation of species is responsible for our rich and varied biodiversity.

Among the biologically rich nations, India stands among the top 10 or 15 countries for its great variety of plants and animals, many of which are not found elsewhere. India has 350 different mammals (rated eight highest in the world), 1,200 species of birds (eighth in the

world), and 453 species of reptiles (fifth in the world) and 45,000 plant species, of which most are angiosperms, (fifteenth in the world).

These include especially high species diversity of ferns (1022 species) and orchids (1082 species). India has 50,000 known species of insects, including 13,000 butterflies and moths. It is estimated that the number of unknown species could be several times higher. It is estimated that 18% of Indian plants are endemic to the country and found nowhere else in the world.

Among the plant species the flowering plants have a much higher degree of endemism, a third of these are not found elsewhere in the world. Among amphibians found in India, 62% are unique to this country.

Among lizards, of the 153 species recorded, 50% are endemic. High endemism has also been recorded for various groups of insects, marine worms, centipedes, mayflies and fresh water sponges.

The eastern Himalayas from a humid region having high monsoon rain fall milder temperature and less snowfall. The mighty mountains with their snow-pick and extremely rich forest exert a tremendous influence on the flora and fauna of the region.

Arunachal Pradesh is a land of mighty rocks and luxuriant forests, gentle streams and raging torrents. It presents a breath taking

spectacle of nature in her glory, beauty of gorges and galaxy of ethnics people make the area as one of the best in the world.

The mountain range in Sikkim, Arunachal Pradesh, Nagaland, Manipur, Tripura, Mizoram and the Darjling hills are symbol of celestial splendor where a good number of peaks rise well over 7000 m., the highest being the Kanchenjunga 8335 m which is very close to Mt. Everest, the world highest peak.

Biogeographic zones of India

India is a megadiverse country. With only 2.4 per cent of the total land area of the world, the known biological diversity of India contributes 8 per cent to the known global biological diversity. In terms of Biogeography, India has been divided into 10 biogeographic zones as shown in the below table:

India has been divided into **ten recognizable biogeographic zones** as follows:

Biogeographic Region	%*
Andaman & Nicobar Island	0.3
Coastal region	2.5
North East Region	5.2
Gangetic Plains	10.8
Deccan Plateau	42
Western Ghats	4
Semi Arid Region	16.6
Indian Desert Zone	6.6
Himalayan Zone	6.4
Transhimalayan Region	5.6
Total	100
*Of total geographic area	

1. **Trans-Himalayan Region**
2. **Himalayan Zone**
3. **Indian Desert Zone**
4. **Semi Arid Region**
5. **Western Ghats**
6. **Deccan Plateau**
7. **Gangetic Plain**
8. **North East Region**
9. **Coastal Region**
10. **Andaman and Nicobar Islands**

Trans-Himalayan Region

It constitutes 5.6 per cent of the total geographical area, includes the high altitude, cold and arid mountain areas of Ladakh, Jammu & Kashmir, North Sikkim, Lahaul and Spiti areas of Himachal Pradesh. This zone has sparse alpine steppe vegetation that harbours several endemic species and is a favourable habitat for the *biggest populations of wild sheep and goat in the world* and other rare fauna that *includes* ***Snow Leopard*** *and the migratory Blacknecked Crane (Grus nigricollis).* The cold dry desert of this zone represents an extremely fragile ecosystem.

Himalayan Zone

It constitutes 6.4 per cent of the total geographical area includes some of the highest peaks in the world. The Himalayan zone makes India one of the richest areas in terms of habitats and species.

The alpine and sub-alpine forests, grassy meadows and moist mixed deciduous forests provide diverse habitat for endangered species of bovids such as Bharal (*Pseudois nayaur*), Ibex (*Capra ibex*), Markhor (*Capra falconeri*), Himalayan Tahr (*Hemitragus jemlabicus*), and Takin (*Budoreas taxicolor*). Other rare and endangered species restricted to this zone include Hangul (*Cervus eldi eldi*) and Musk Deer (*Moschus moschiferus*) .

Indian Desert Zone

Indian Desert Zone, constituting 6.6 per cent of the total geographical area, includes the Thar and the Kutch deserts and has large expanses of grassland that supports several endangered species of mammals such as Wolf (*Canis lupus*), Caracal (*Felis caracal*), Desert Cat (*Felis libyca*) and birds of conservation interest viz., Houbara Bustard (*Chamydotis undulate*) and the Great Indian Bustard (*Ardeotis nigriceps*).

Semi Arid Region

Semi-arid Region, constituting 16.6 per cent of the total geographical area, is a transition zone between the desert and the dense forests of Western Ghats.

Peninsular India has two large regions, which are climatically semi-arid. *This semi-arid region also has several artificial and natural lakes and marshy lands.*

The *dominant grass and palatable shrub layer in this zone supports the highest wildlife biomass*. The cervid species of **Sambar** (*Cervus unicolor*) and **Chital** (*Axis axis*) are

restricted to the better wooded hills and moister valley areas respectively. The Lion (*Leo persica*), an endangered carnivore species (restricted to a small area in Gujarat), Caracal (*Felis caracal*), Jackal (*Canis aureus*) and Wolf (*Canis lupus*) are some of the endangered species that are characteristic of this region.

Western Ghats

Constitutes 4.0 per cent of the total geographical area. It is one of the major tropical evergreen forest regions in India and represents one of the two biodiversity 'hot spots'. Western Ghats are home to viable populations of most of the vertebrate species found in peninsular India, besides an endemic faunal element of its own.

Significant species endemic to this region include **Nilgiri Langur** *(Presbytis jobni),* **Lion Tailed Macaque** *(Macaca silenus),* **Grizzled Giant Squirrel** *(Ratufa macroura),* **Malabar Civet** *(Viverricula megaspila),* **Nilgiri Tahr** *(Hemitragus bylocrius)* **and Malabar Grey Hornbill** *(Ocycerous griseus).* The Travancore Tortoise *(Indotestudo forstem)* and Cane turtle *(Heosemys silvatica)* are two endangered taxa restricted to a small area in central Western Ghats.

Deccan Plateau

Deccan Plateu is India's largest biogeographic region making 42 per cent of the total geographical area. It's a semi-arid region that falls in the rain shadow area of the Western Ghats. This bio-geographic zone of peninsular India is by far the most extensive zone, covering India's finest forests, particularly in the States of Madhya Pradesh, Maharashtra and Odisha.

Majority of the forests are deciduous in nature but there are regions of greater biological diversity in the hill ranges. The zone comprising of deciduous forests, thorn forests and degraded scrubland support diverse wildlife species.

Species found in this region are **Chital** *(Axis axis),* **Sambar** *(Cervus unicolor),* **Nilgai** *(Boselapbus tragocamelus)* **and Chousingha** *(Tetracerus quadricornis)*, **Barking deer** (Muntiacus muntjak) and Gaur (Antilope cervicapra), Elephant (*Elephas maximus*) in Bihar-Orissa and Karnataka-Tamil Nadu belts, Wild Buffalo (*Bubalus bubalis*) in a small area at the junction of Orissa, Madhya Pradesh and Maharashtra and the hard ground Swamp Deer (*Cervus duvauceli*), now restricted to a single locality in Madhya Pradesh.

Gangetic Plain

Gangetoc plain constitutes around 10.8 per cent of the total geographical area. The Gangetic plain is topographically homogenous for hundreds of kilometers. The characterstic fauna of this region include Rhino (*Rhinoceros unicornis*), Elephant (*Elephas maximus*), Buffalo (*Bubalus bubalis*), Swamp Deer (*Cervus duvauceli*), Hog-Deer (*Axis porcinus*) and Hispid Hare (*Carprolagus bispidus*).

North East Region

North East Region constitutes 5.2 per cent of the total geographical area. This region represents the transition zone between the Indian, Indo-Malayan and Indo-Chinese bio-geographical regions as well as being a meeting point of the Himalayan mountains and peninsular India. The North-East is thus the biogeographical 'gateway' for much of India's fauna and flora and also a biodiversity hotspot (Eastern Himalaya). Many of the species contributing to this biological diversity are either restricted to the region itself, or to the smaller localized areas of the Khasi Hills.

Coastal Region

Coastal region constitutes 2.5 per cent of the total geographical area with sandy beaches, mangroves, mud flats, coral reefs and marine angiosperm pastures make them the wealth and health zones of India. The coastline from Gujarat to Sunderbans is estimated to be 5,423 km long. Atotal of 25 islets constitute the Lakshadweep, which are of coral origin, and have a typical reef lagoon system, rich in biodiversity. However, the densely populated Lakshadweep islands virtually have no natural vegetation.

Andaman and Nicobar Islands

This constitutes 0.3 per cent of the total geographical area are one of the three tropical moist evergreen forests zones in India. *The islands house an array of flora and fauna not found elsewhere.* These islands are centres of high endemism and contain some of India's finest evergreen forests and support a wide diversity of corals. In India, *endemic island biodiversity is found only in the Andaman and Nicobar Islands.* Some of the endemic fauna of Andaman & Nicobar islands include *Narcondam hornbill*, South Andaman krait etc.

Biodiversity Hotspots in India

Biodiversity is the collection of flora and fauna of a place. **Biodiversity Hotspot is a region which is a prime location for the existence of rich biodiversity but also faces the threat of destruction. It is a place which needs our immediate and constant attention to survive and thrive in the future as well.**

This idea of identifying hotspots was put forth by **Norman Myers in 1988**. By now, a **total of 35 biodiversity hotspots** have been identified out of which most of them lie in tropical forests. Almost **2.3% of the land surface of Earth** is represented by these hotspots. These also **comprise of around 50% of the world's most common plant species and 42% of terrestrial vertebrates prevalent**. Sadly, these biodiversity hotspots have been losing 86% of their habitats some of which are still on the verge of extinction due to serious threats posed by climate change and human intervention.

To be called a hotspot, a region has to be able to fulfil at least two criteria including:

1. It should comprise of at least 1500 species of vascular plants i.e. more than 0.5% of the world's total plants.

2. It should have lost greater than or equal to 70% of its original habitat.

India has always been on the list of the richest countries in the world for its biodiversity which can easily be seen in the demography of its land. Though biodiversity and demographic diversity are two completely different topics, the human population has been dependant on biodiversity since forever in numerous ways. Also, as a result of exponential growth in human population, their survival pressure too has increased tremendously on the biodiversity.

Rich Biodiversity of India

As it has been already mentioned, India is a country rich in biological diversity. It is situated in the Indomalaya ecozone.

In India, there are approximate-

-350 mammals which make up 7.6% of world species

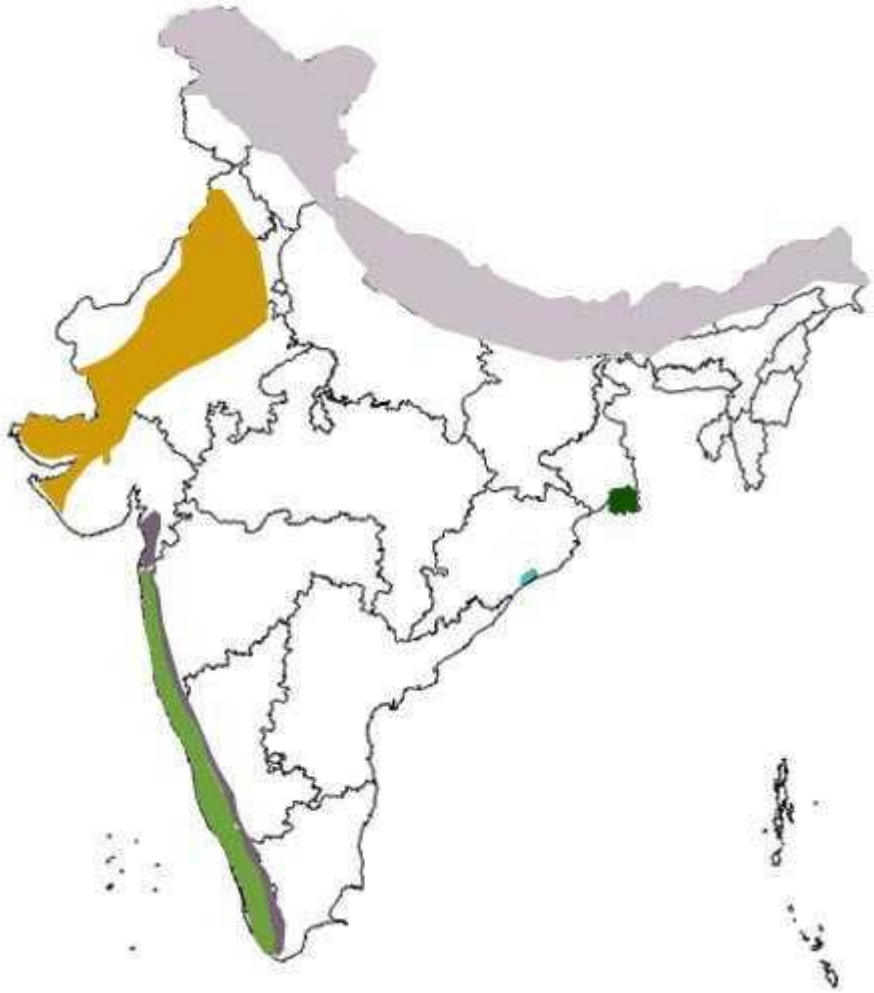
-1224 birds which make up 2.6% of the world species

-197 amphibians which make up 4.4% of the world species

-408 reptiles which make up 6.2% of the world species

-2546 fishes which make up 11.7% of the world species

-15000 flowering plants which make up 6% of the world species



History

India originally belonged to Gondwana from where many Indian species (descendants of taxa) originated. Due to the collision of Peninsular India with the Laurasian landmass, there was a mass exchange of species which took place. However, what caused most turmoil was the eruption of volcanoes and climate change 20 million years ago which led to the extinction of many Indian forms. After this, mammals were seen entering India through from Asia through the Himalayas as a result of which out of the Indian species, there were 12.6% mammals and 4.5% birds which were endemic and 45.8% reptiles as well as 55.8% amphibians.

Four Biodiversity Hotspots in India

Some of these biodiversity hotspots are present in India which includes:

1. The Western Ghats

These hills are present along the western edge of peninsular India. Since they are situated near the ocean, they are likely to receive a good amount of rainfall. Most of the deciduous, as well as rainforests, are present in this region. Around 77% of the amphibians and 62% of the reptiles found here cannot be spotted elsewhere in the world. Sri Lanka in South India is a country which is rich in species too. It is connected to India through a land bridge which has a width of nearly 140 km.

There are more than 6000 vascular plants here which belong to more than 2500 genus. 3000 plants out of these are endemic. Most of the spices found in the world such as black pepper and cardamom all are believed to have originated in the Western Ghats. Most of the species are however present in the Agasthyamalai Hills situated in extreme South. The region is also home to around 450 species of birds, 140 mammals, 260 reptiles and 175 amphibians. Such diversity is quite beautiful as well as rare but now lies on the verge of extinction. The vegetation in this region

was originally spread over 190,000 square kilometres but has reduced to 43,000 square kilometres today. Only 1.5% of the original forest is still prevalent in Sri Lanka.

2. The Himalayas

This region comprises of Bhutan, Northeast India, and Southern, Central and Eastern Nepal. These Himalayan Mountains are the highest in the world and abode to some of the highest peaks of the world including Mount Everest and K2. Some of the major rivers in the world originate from the Himalayas. The Himalayas comprise of more than 100 mountains beyond 7200 meters.

There are almost 163 endangered species in this region including one-horned rhinoceros, wild Asian water buffalo and as many as 45 mammals, 50 birds, 12 amphibians, 17 reptiles, 3 invertebrate and 36 plant species. One such endangered species found here is the relict dragonfly whose only other species is found in Japan. Himalayan Newt is also present in this region. Coming to the fauna, there are 10,000 species of plants in the Himalayas a third of which are endemic and cannot be located anywhere else in the world. Some of the threatened ones include Cheer pheasant, Western Tragopan, Himalayan quail, Himalayan vulture, White-bellied heron and the like. Mammals too can be spotted here with over 300 species such as Asiatic wild dogs, sloth bears, snow leopard, black bear, blue sheep and wild water buffalo. Namadapha flying squirrel is, however, a mammal which is almost on the verge of extinction and therefore needs immediate attention.

3. Indo-Burma Region

This region consists of numerous countries including North-Eastern India (to the south of the Brahmaputra River), Myanmar, and China's Yunnan provinces southern part, Lao People's Democratic Republic, Vietnam, Cambodia, and Thailand. It is spread over a distance of 2 million square kilometres.

Although this region is quite rich in its biodiversity, it has been worsening over the past few decades. Six species of mammals have been discovered in this region recently including large-antlered muntjac, Annamite Muntjac, gray-shanked douc, leaf deer, saola and Annamite striped rabbit. Other species such as monkeys, langurs, and gibbons too can be found here with a population as less as a hundred. Freshwater turtle species found in the region are however endemic. 1300 species of birds too can be spotted here including the white-eared night-heron, Gray-crowned crocias, and orange necked Patridge most of which are endangered. Almost 13,500 plant species can be spotted in the region half of which are endemic and cannot be found in any other place in the world.

4. Sundaland

This region lies in South-East Asia and includes Thailand, Singapore, Indonesia, Brunei, and Malaysia. The Nicobar Islands represent India. These islands were declared as the world biosphere reserve in 2013 by the United Nations. These islands have a rich terrestrial as well as marine ecosystem including mangroves, seagrass beds, and coral reefs. Species such as dolphins, whales, turtles, crocodiles, fishes, prawns, lobsters and seashells comprise the marine biodiversity. In case the marine resources are over-used, it can pose a serious threat to biodiversity.

Major Reasons for Loss of Biodiversity in Hotspots

These include:

1. Destruction of habitats

2. Pollution and environmental degradation

3. Poachings

4. Climate Change

It is high time to step up and start taking measures to protect our natural biodiversity beforetime actually runs out.

Ecotourism

A way forward to stop the loss of Biodiversity Hotspots can be Ecotourism. Ecotourism involves visiting fragile, pristine, and relatively untouched natural areas, with the intention to support conservation efforts. One observes the flora and fauna in their natural environment and cause as little impact as possible. It is often done on a small scale and is a great alternative to the mainstream commercial tourism.

Endemic and endangered species of India

Endemic Species

"Endemic species is that ecological state of a species where a species is unique to a defined geographical location."

What is Endemic Species?

Endemic species are those that are found in just one region and nowhere else in the world. For example, kangaroos are originally endemic to Australia and are found nowhere else in the world. The cases where they have been spotted outside their natural habitat is due to humans introducing them when the animal was in captivity.

There are also other marsupials that are endemic only to Australia and its surrounding islands. The Tasmanian Tiger is one such animal that was endemic to Australia, Tasmania and New Guinea. But now, it is extinct.

One tends to adapt themselves to their surroundings, climate, habitat and other variations. After which it becomes difficult to uproot ourselves and settle elsewhere. All living species, human, plants, animals, and birds have a habit of making home and finding it difficult to leave when the time calls for it. The ones which do not leave the area become endemic to that region.

Endemic species are those which are only found in a given region or location and nowhere else in the world. So the region which the species is endemic to ends up being called the "endemic site", a "national endemic", a "geographical range endemic", or a political region endemic depending on the location.

But as we see endemic plants and animals are unique to a particular geographical region; they are incredibly unique and more vulnerable to extinction. As a result, special efforts are required to conserve them.

Endemic Species of India

A list of the endemic species of India is mentioned below:

Asiatic Lion, Gir Forest

Asiatic Lion is also known as the Indian Lion and can be only found in and around Gir Forest National Park of Gujarat. These are listed as endangered species. These are one of the five big cats found in India, the others being Indian Leopards and Bengal Tigers.

Kashmir Stag, Kashmir Valley

Also known as Hangul, Kashmir Stag is found in the dense forests of Dachigum National Park, Kasmir Valley and Chamba district, Himachal Pradesh.

Lion-Tailed Macaque, Western Ghats

It is the rarest and the most threatened and endangered primate species found only in the Western Ghats of Southern India.

Purple Frog, Western Ghats

The purple frog, also known as Pignose frog is only found in the rainforests of western ghats in India. It spends most of its life underground.

Sangai Deer, Loktak Lake

It is also known as Brow Antlered Deer exclusively found in Keibul Lamjao National Park of Manipur. This park is a marshy wetland located in the southern parts of Loktak lake.

Nilgiri Tahr, Nilgiri Hills

It is a wild sheep species, endangered and endemic to the Nilgiri Hills of Western Gats.

Other endemic species of India include:

- Pygmy Hog, Assam
- Bronzeback Vine Snake, Western Ghats
- Nilgiri Blue Robin, Nilgiri Hills
- Malabar Civet, Western Ghats
- Anaimalai Gliding Frog, Anaimalai Hills
- Namdapha Flying Squirrel, Arunachal Pradesh
- Indian Giant Squirrel
- Bonnet Macaque

Examples of Endemic species

There are several ways in which a species may come to be endemic to a particular area. A broadly distributed population may disappear from several habitats due to changes which have occurred in their natural habitat. The changes could be an influx of predators, human activities, and climate changes.

All other species that were widely distributed around the world starts to die out until the species becomes forcefully restrained to just one region.

For example, Endemic species, such as the tortoises of the Galápagos and the lemurs of Madagascar can be found small islands. Big islands also provide the same isolation but on a larger scale.

Antarctica Hawaii and Australia are all huge land masses where we can find a lot of endemic species. Kangaroos, koalas, and polar bears are all endemic to these places.

In the case of endemic plants, sometimes species become endemic due to habitat destruction as discussed above.

The Redwood Forest on the West Coast of the United States has become endemic as it is now almost entirely limited to California. While there was a time when Redwoods used to cover much of the United States but have been destroyed by logging and are now limited to a small conservation area.

Diseases, on the other hand, can also be endemic. An endemic disease may be geographically isolated or it may be isolated to a certain group. Malaria is an example of an endemic disease because it is mostly limited to small pockets of infection in Africa.

Endangered Species

International Union for Conservation of Nature (IUCN) enlisted some species as endangered species. **Endangered species** can be defined as those species whose life is under risk or threat. In other words, species which are about to be extinct. Many factors are responsible for this which may be natural or man-made. Endangered species, sooner or later enters the extinction phase. In order to prevent this, necessary actions have to be taken.

A species which was native to a region and its population strength reduced from 50 percent to 5 percent; such species are known are endangered species. **IUCN** categorized them and made a list called **red list** or **Red Data Book**. These documents consisting of a list of species are used as a guide for researchers to estimate the level of threat. There are separate books for both flora and fauna.

Factors Affecting Endangered Species

Different factors that risk the survival of animals and plants are hunting, loss of habitat, climate changes, diseases, pollution and other natural calamities. Species which have limited population strength are more likely to become endangered. Presently, the rate of extinction is also much faster than before; these are mainly the consequences of human activities like deforestation, industrialization etc.

Some of the endangered species are Greater Horseshoe Bat, Loggerhead turtle, Siberian tiger, White-tailed eagle and Bluefin tuna etc. As per current status, about one-fourth of all mammals are endangered. These not only affect the ecological values but also economical, legal and ethical values. Entire globe will lose its equilibrium since they are the sources of resources like food, shelter, medicines etc. The main objective of conservation is to protect biodiversity by restoring

habitat. Due to the awareness and importance of protection of wildlife, many agencies and NGOs were motivated for initiations. Government and non-government organizations (NGOs) have started certain projects to save wildlife. Other efforts include wildlife films, photos, documentaries, posters etc. to create awareness among the public.

Mammals

· Red panda (*Ailurus fulgens*)
· Sei whale (*Balaenoptera borealis*)
· Blue whale (*Balaenoptera musculus*)
· Fin whale (*Balaenoptera physalus*)
· Wild water buffalo (*Bubalus arnee*)
· Hispid hare (*Caprolagus hispidus*)
· Dhole (*Cuon alpinus*)
· Indian elephant (*Elephas maximus indicus*)
· Kolar leaf-nosed bat (*Hipposideros hypophyllus*)
· Lion-tailed macaque (*Macaca silenus*)
· White-bellied musk deer (*Moschus leucogaster*) · Servant mouse (*Mus famulus*)
· Mandelli's mouse-eared bat (*Myotis sicarius*) · Nilgiri tahr (*Nilgiritragus hylocrius*)
· Asiatic lion (*Panthera leo persica*)
· Bengal tiger (*Panthera tigris tigris*)
· Ganges river dolphin (*Platanista gangetica gangetica*) · Gee's golden langur (*Trachypithecus geei*) · Nicobar treeshrew (*Tupaia nicobarica*)
· Sangai (*Rucervus eldii eldii*)

(*yellow colored highlighted are important)

Fish

· Knifetooth sawfish (*Anoxypristis cuspidata*) · Asian arowana (*Scleropages formosus*)
· Red line torpedo barb (*Sahyadria denisonii*) · Golden mahaseer (*Tor putitora*)
· Deccan labeo (*Labeo potail*)

Birds

· Forest owlet (*Athene blewitti*)
· Steppe eagle (*Aquila nipalensis*)
· Great knot (*Calidris tenuirostris*)
· Masked finfoot (*Heliopais personatus*)
· Lesser florican (*Sypheotides indicus*)
· Manipur bush-quail (*Perdicula manipurensis*) · Greater adjutant (*Leptoptilos dubius*)
· White-bellied blue robin (*Myiomela albiventris*) · Nilgiri blue robin (*Myiomela major*)
· White-winged duck (*Asarcornis scutulata*) · White-headed duck (*Oxyura leucocephala*) · Green peafowl (*Pavo muticus*)
· Narcondam hornbill (*Rhyticero*)
· Nordmann's greenshank (*Tringa guttifer*) · Black-bellied tern (*Sterna acuticauda*)
· Black-chinned laughingthrush (*Trochalopteron jerdoni*) · Egyptian vulture (*Neophron percnopterus*)

Reptiles

· Perrotet's vine snake (*Ahaetulla perroteti*)
· Three-striped roofed turtle (*Batagur dhongoka*) · Green turtle (*Chelonia mydas*)
· Indian narrow-headed softshell turtle (*Chitra indica*) · Goan day gecko (*Cnemaspis goaensis*)
· Wyanad day gecko (*Cnemaspis wynadensis*)
· Keeled box turtle (*Cuora mouhotii*)
· Boulenger's dasia (*Dasia subcaerulea*)
· Poona skink (*Eurylepis poonaensis*)
· Inger's mabuya (*Eutropis clivicola*)
· Yellow-headed tortoise (*Indotestudo elongata*)
· Asian forest tortoise (*Manouria emys*)
· Indian kangaroo lizard (*Otocryptis beddomii*)
· Assam roofed turtle (*Pangshura sylhetensis*)

· Cantor's giant softshell turtle (*Pelochelys cantorii*) · Travancore Hills thorntail snake (*Platyplectrurus madurensis*) · Travancore earth snake (*Rhinophis travancoricus*) · Cochin forest cane turtle (*Vijayachelys silvatica*)

IUCN Red list criteria and categories

What is Red Data Book?

The Red Data Book is a public document which is created for recording endangered and rare species of plants, animals, fungi as well as some local subspecies which are present in a particular region.

The Red Data Book helps us in providing complete information for research, studies and also for monitoring the programs on rare and endangered species and their habits.

This book is mainly created to identify and protect those species which are on the verge of extinction.

Currently, the International Union for Conservation of Nature maintains the Red Data Book. IUCN is the world's most detailed inventory centre of the global conservation status of biological species. The **International Union for Conservation of Nature** (**IUCN**) was founded in 1964 with an aim to maintain a complete record of every species that ever lived.

The Red Data Book contains the complete list of threatened species. The main aim behind this documentation is to provide complete information for research and analysis of different species.

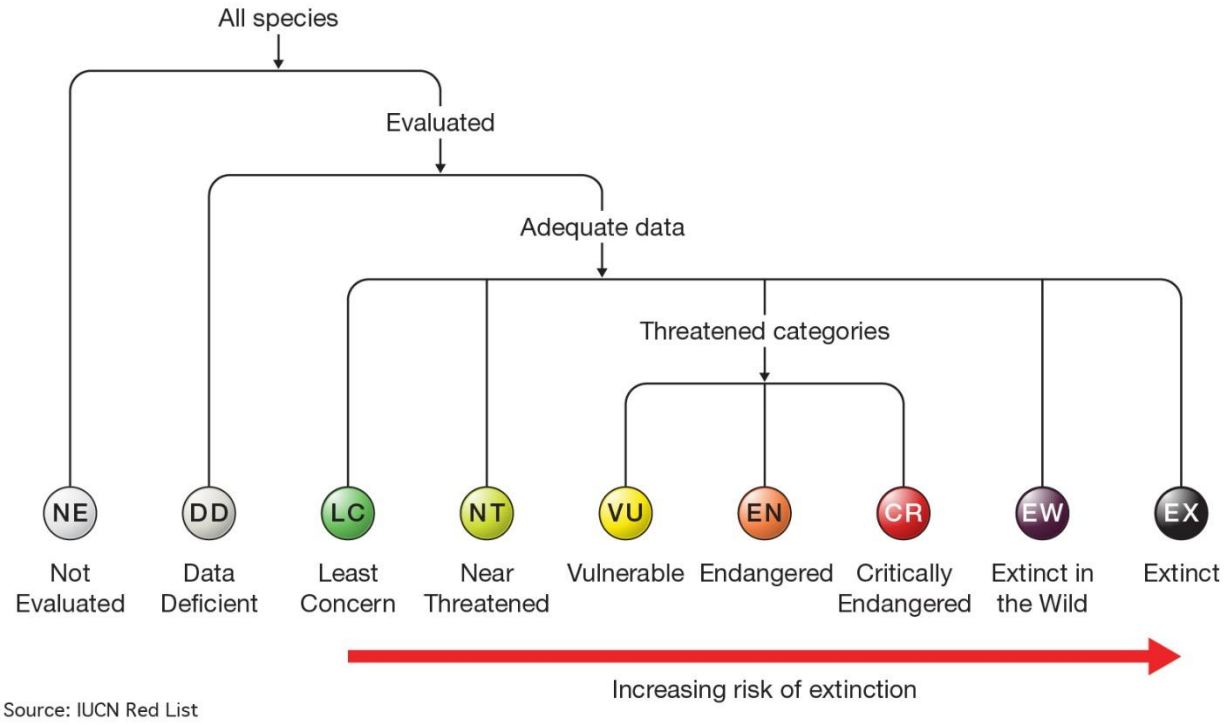
The Red Data Book contains colour-coded information sheets, which are arranged according to the extinction risk of many species and subspecies.

- Black represents species which are confirmed to be extinct.
- Red represents species that are endangered
- Amber for those species whose status is considered to be vulnerable
- White is assigned for species that are rare
- Green for species that were formerly endangered, but their numbers have started to recover
- Grey coloured for the species that are classified as vulnerable, endangered, or rare but sufficient information is not available to be properly classified.

In a nutshell, the Red Data Book indexes species as:

- Threatened
- Not threatened
- Unknown

Furthermore, The Red Data Book also has information as to why a species has become extinct along with the population trends and the extent of its range (distribution).



Advantages of the Red Data Book

- It helps in identifying all animals, birds and other species about their conservation status.
- It is used to evaluate the population of a particular species.
- The data available in this book can be used to evaluate the taxa at the global level.
- With the help of this book, we can estimate the risk of taxa becoming globally extinct.
- Provides a framework or guidelines for implementing protective measures for endangered species.

Disadvantages of the Red Data Book

- The information available in the Red Data Book is incomplete. Many species, both extinct and extant are not updated in this book.
- The source of the book's data has been speculated and has been mired in controversy.
- This book maintains the complete record of all animals, plants, other species but it has no information about the microbes.

EXTINCT (EX)

A taxon is Extinct when there is no reasonable doubt that the last individual has died. A taxon is presumed Extinct when exhaustive surveys in known and/or expected habitat, at appropriate times (diurnal, seasonal, annual), throughout its historic range have failed to record an individual. Surveys should be over a time frame appropriate to the taxon's life cycle and life form.

(Ex. Dodo, thylocine, passenger pigeon)

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. A taxon is presumed Extinct in the Wild when exhaustive surveys in known and/or expected habitat, at appropriate times (diurnal, seasonal, annual), throughout its historic range have failed to record an individual. Surveys should be over a time frame appropriate to the taxon's life cycle and life form.

(Ex. Red-tailed black shark, south china tiger)

CRITICALLY ENDANGERED (CR)

A taxon is Critically Endangered when the best available evidence indicates that it meets any of the criteria A to E for Critically Endangered (see Section V), and it is therefore considered to be facing an extremely high risk of extinction in the wild.

(EX. Pink-headed duck, one-horned rhino)

ENDANGERED (EN)

A taxon is Endangered when the best available evidence indicates that it meets any of the criteria A to E for Endangered (see Section V), and it is therefore considered to be facing a very high risk of extinction in the wild.

(Ex. Fauna-Pink pigeon, blue whale, yellowed-eyed penguin
Flora-Sarpagandha, brahmakamal, Malasian slipper orchid)

VULNERABLE (VU)

A taxon is Vulnerable when the best available evidence indicates that it meets any of the criteria A to E for Vulnerable (see Section V), and it is therefore considered to be facing a high risk of extinction in the wild.

(Ex. Cheetah, lion, musk deer, Indian bison)

NEAR THREATENED (NT)

A taxon is Near Threatened when it has been evaluated against the criteria but does not qualify for Critically Endangered, Endangered or Vulnerable now, but is close to qualifying for or is likely to qualify for a threatened category in the near future.

(Ex. Bald eagle, brown bear, sea otter)

LEAST CONCERN (LC)

A taxon is Least Concern when it has been evaluated against the

criteria and does not qualify for Critically Endangered, Endangered, Vulnerable or Near Threatened. Widespread and abundant taxa are included in this category.
(Ex. Brown rat, mountain quail and wood pigeon)

DATA DEFICIENT (DD)

A taxon is Data Deficient when there is inadequate information to make a direct, or indirect, assessment of its risk of extinction based on its distribution and/or population status. A taxon in this category may be well studied, and its biology well known, but appropriate data on abundance and/or distribution are lacking. Data Deficient is therefore not a category of threat. Listing of taxa in this category indicates that more information is required and acknowledges the possibility that future research will show that threatened classification is appropriate. It is important to make positive use of whatever data are available. In many cases great care should be exercised in choosing between DD and a threatened status. If the range of a taxon is suspected to be relatively circumscribed, and a considerable period of time has elapsed since the last record of the taxon, threatened status may well be justified.

NOT EVALUATED (NE)

A taxon is Not Evaluated when it is has not yet been evaluated against the criteria.

Value of biodiversity: Ecological, economic, social, ethical, aesthetic, and informational values of biodiversity with examples

Some of the major values of biodiversity are as follows: 1. Environmental Value 2. Social Value 3. Ecosystem Services 4. Economic Value 5. Consumptive use value 6. Productive Use Value 7. Ethical and Moral Value 8. Aesthetic Value.

Biodiversity is the most precious gift of nature mankind is blessed with. As all the organisms in an ecosystem are interlinked and interdependent, the value of biodiversity in the life of all the organisms including humans is enormous.

The role of biodiversity in providing ecosystem services is twofold.

Firstly, biodiversity is directly used as a source for food, fibre, fuel and other extractable resources. Secondly, biodiversity plays an important role in ecosystem processes providing the regulating, cultural and supporting services.

For example, vegetation cover protects the soil from erosion by binding soil particles and minimizing the effects of water runoff. Likewise, cultivation of crops is to a large extent dependent on the availability of pollinating insects.

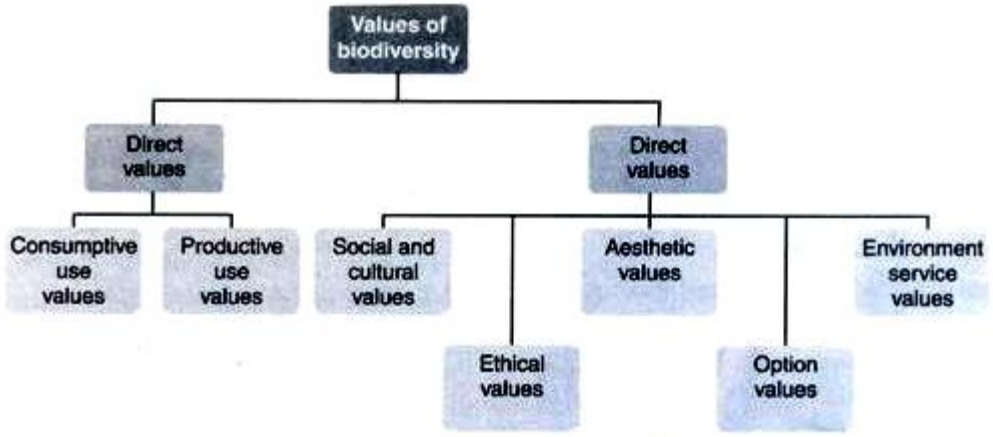
Biodiversity has a fundamental value to humans because we are so dependent on it for our cultural, economic, and environmental well-being. Elements of biodiversity can contribute to cultural identity, and

many ecosystem characteristics are frequently incorporated into cultural traditions.

Other facts of human well-being, such as health and economic and political security, can influence the value of biodiversity. Many arguments to increase efforts to conserve diversity often emphasize the value of the “un-mined riches” that has yet to be discovered.

These include potential sources of new foods, medicines, and energy which can further fuel economic activity, as well as a healthier population. Biodiversity has proven to hold enormous value when adapted for use in health, agricultural, or industrial applications.

In the field of medicine alone, approximately 50% of current prescription medicines are derived from or modelled on natural substances. The health and diversity of ecosystems can have a significant effect on the overall stability of nearby communities.



Values of Biodiversity

1. Environmental Value:

The environmental value of biodiversity can be found by examining each ecosystem process and identifying the ecosystem services that result. For instance, in wetlands the vegetation captures water- carried sediment and the soil organisms break down a range of nutrients and pollutants washed into the area.

These processes provide the ecosystem service of purifying water. Wetlands also act as spawning and nursery grounds for some fish and provide a refuge for animals in times of drought. Some ecosystem services are easy to overlook until the underlying process is impaired.

For instance, dry-land salinity has emerged as a problem following sustained clearance of deep rooted perennial plants over wide areas. Water tables have raised carrying dissolved salts which then concentrate in the soil. Forests regulate the amount of carbon dioxide in the air by releasing oxygen as a by-product during photosynthesis, and control rainfall and soil erosion.

2. Social Value:

The social value of biodiversity includes aesthetic, recreational, cultural and spiritual values. To this can be added health benefits resulting from recreational and other activities. While traditional societies which had a small population and required less resources had preserved their biodiversity as a life supporting resource, modern man has rapidly depleted it even to the extent of leading to the irrecoverable loss due to extinction of several species.

Thus apart from the local use or sale of products of biodiversity there is the social aspect in which more and more resources are used by affluent societies. The biodiversity has to a great extent been preserved by traditional societies that valued it as a resource and appreciated that its depletion would be a great loss to their society.

There can be marked differences in landscape and biodiversity preferences according to age, socioeconomic factors and cultural influences. The lifestyle of the ancient people was closely interwoven with their surroundings.

The life of the indigenous people in many parts of the world still revolves around the forests and environment, even in these modern times, many of them still live in the forests and meet their daily requirements from their surroundings.

The biodiversity in different parts of the world has been largely preserved by the traditional societies. Since the indigenous people always protect the forests for their own benefit. In ancient times, especially in India, the environment in totally i.e., flora, fauna, etc., were held in high esteem.

Trees like Peepal, Banyan and Tulsi are still worshipped. Ladies offering water to Tulsi daily is considered good and there are festivals when ladies tie sacred threads around Peepal and Banyan trees and pray for the welfare of their families.

3. Ecosystem Services:
These services also support human needs and activities such as intensely managed production ecosystems.

Ecosystem service includes:
a. The production of oxygen by land based plants and marine algae;

b. The maintenance of fresh water quality by vegetation slowing run off, trapping sediment and removing nutrients and by soil organisms breaking down pollutants;

c. The production and maintenance of fertile soil as a result of many interacting processes;

d. The provision of foods such as fish, pastures for cattle and sheep, timber, fire wood and harvested wildlife such as kangaroos and native cut flowers;

e. The provision of native species and genes used in industry research and development, for instance, in traditional breeding and biotechnology applications in agriculture, forestry, horticulture, mariculture, pharmacy, chemicals production and bioremediation;

f. Pollination of agricultural crops, forest trees and native flowering plants by native insects, birds and other creatures;

g. Pest control in agricultural land by beneficial native predators;

h. Flood mitigation by vegetation slowing run off and trapping sediment;

i. Breakdown of pollutants by micro-organisms in soil and aquatic ecosystems and sequestration of heavy metals in marine and fresh water sediments;

j. Greenhouse gas reduction by, for instance, sequestering atmospheric carbon in wood and marine calcium carbonate deposits;

k. Maintenance of habitats for native plants and animals; and

l. Maintenance of habitats that are attractive to humans for recreation, tourism and cultural activities and that has spiritual importance.

4. Economic Value:

The economic potential of biodiversity is immense in terms of food, fodder, medicinal, ethical and social values. Biodiversity forms the major resource for different industries, which govern the world economy.

The salient features regarding the economical potential of biodiversity are given below:

1. The major fuel sources of the world including wood and fossil fuels have their origin due to biodiversity.

2. It is the source of food for all animals and humans.

3. Many important chemicals have their origin from the diverse flora and fauna, used in various industries.

4. Diverse group of animals are used for medical research during the testing of new drugs.

5. Consumptive use value:

This is related to natural products that are used directly for food, fodder, timber, fuel wood etc. Humans use at least 40,000 species of plants and animals on a daily basis. Many people around the world still depend on wild species for most of their needs like food, shelter and clothing. The tribal people are completely dependent on the forests for their daily needs.

6. Productive Use Value:

This is assigned to products that are commercially harvested and marketed. Almost all the present date agricultural crops have originated from wild varieties. The biotechnologists continuously use the wild species of plants for developing new, better yielding and disease resistant varieties. Biodiversity represents the original stock from which new varieties are being developed.

7. Ethical and Moral Value:

It is based on the principle of 'live and let others live'. Ethical values related to biodiversity conservation are based on the importance of protecting all forms of life. All forms of life have the right to exist on earth. Man is only a small part of the Earth's great family of species.

Don't plants and animals have an equal right to live and exist on our planet which is like an inhabited spaceship? Morality and ethics teach us to preserve all forms of life and not to harm any organism unnecessarily.

Some people take pleasure in the hunting of animals. People also sometimes degrade and pollute the environment by their unethical actions. Through proper education and awareness, the people's conscience against such practices must be raised.

8. Aesthetic Value:

The beauty of our planet is because of biodiversity, which otherwise would have resembled other barren planets dotted around the universe. Biological diversity adds to the quality of life and provides some of the most beautiful aspects of our existence. Biodiversity is responsible for the beauty of a landscape.

People go far off places to enjoy the natural surroundings and wildlife. This type of tourism is referred to as eco-tourism, which has now become a major source of income in many countries. In many societies, the diversity of flora and fauna has become a part of the traditions and culture of the region and has added to the aesthetic values of the place.

Sacred groves and their importance with examples

SACRED GROVES

"Segment of landscape , containing vegetation , life forms and geographical features, delimited and protected by human societies under the belief that to keep them in a relatively undisturbed state is expression of an important relationship of humans with the divine or with nature."

(Hughes and Chandra,1998)

- Sacred Groves are conserved on the basis of Religion, faith and belief of the community.
- "Sacred Groves are small patches of forests/natural vegetation dedicated by local communities to ancestral spirit or deities and have traditional means of biodiversity."

(Singh *et al*., 2010, Basu,2000)

Origin of Sacred Groves

- Believed that shifting cultivation could be one of the reasons for creation of sacred groves.
- Sacred groves might have also originated as result of its utilitarian nature.
- A social institution or as a part of the taboo that evolved historically over several generation to provide a site for culturally crucial social interactions.

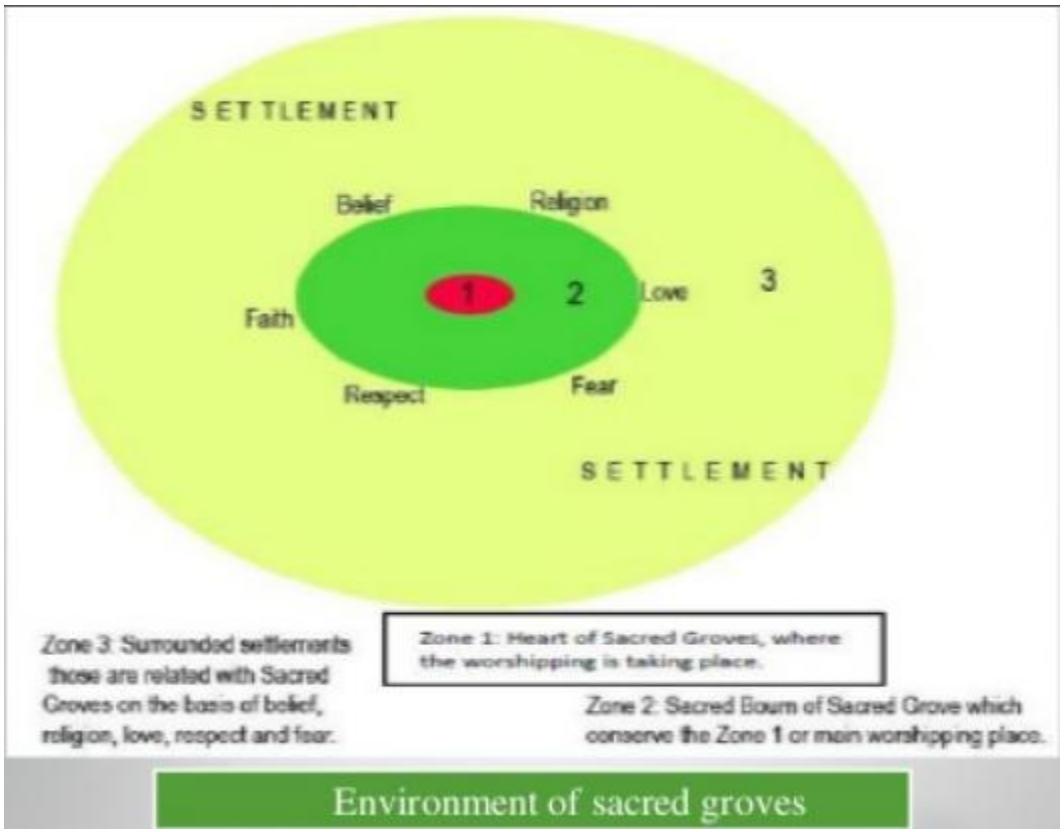
(Gadgil *et al*.,1976, Hazra 1980)

Environment of Sacred Groves

- "Sacred Groves represent an ancient Indian conservation tradition, protected by lot of Reverence and Respect, Fear and Sentiments."
- Sacred Grove are the Repositories of Rare and Endemic species.
- These provides inextricable link between present Society to the past in terms of Biodiversity, Culture, Religious, and Ethnic Heritage.



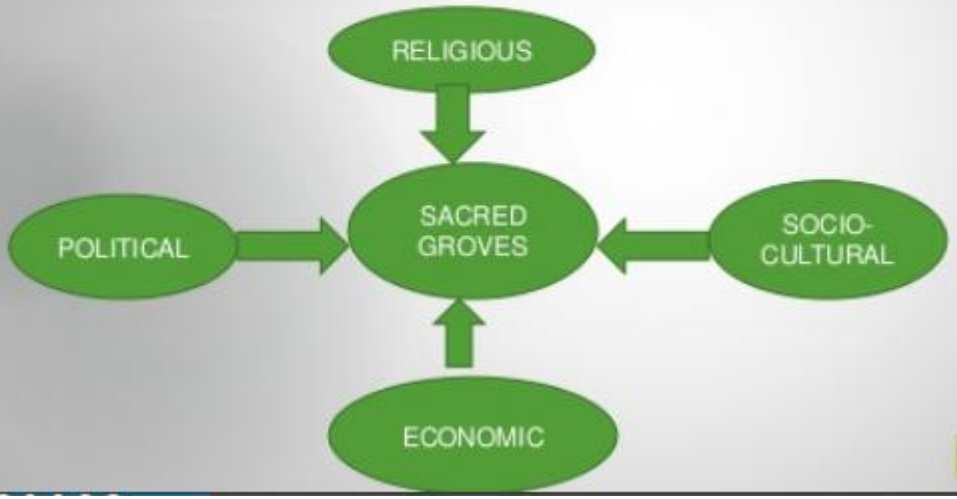
(Swain *et al*., 2008).



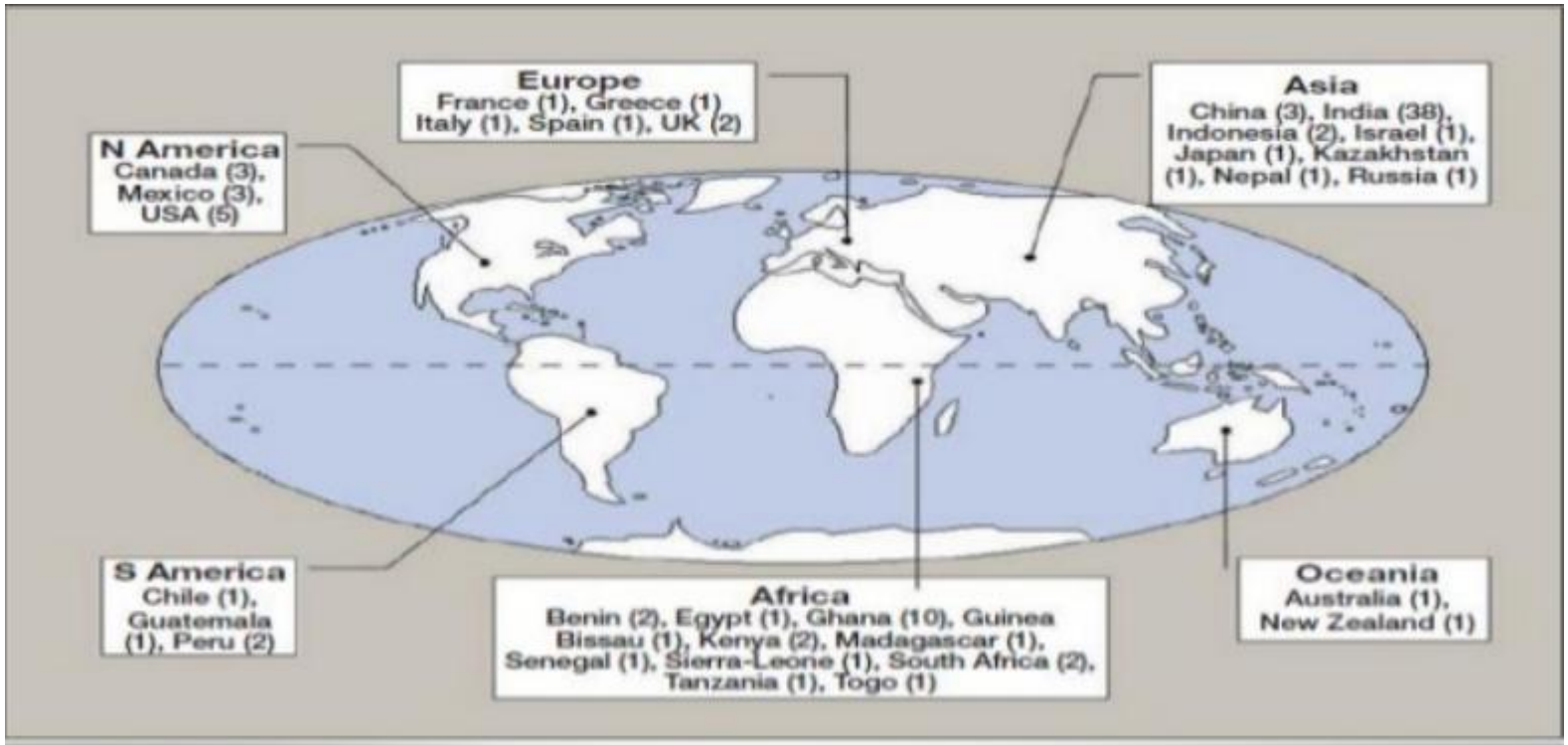
Environment of sacred groves

Interface between People and Sacred Groves

- In role of sacred groves in the lives of the people from four aspects: (i) religious; (ii) socio-cultural; (iii) economic, and (iv) political.



(Komal *et al*,. 2014)



DISTRIBUTION OF SACRED SITES IN THE WORLD

(Shonil A Bhagwat *et al*, 2006)

Distribution of Sacred grove indifferent states of India

States	Numerical scenario of Sacred Groves
Andhra Pradesh	750
Arunachal Pradesh	58
Assam	40
Chattrishgarh	600
Gujrat	29
Hariyana	248
Himachal Pradesh	5000
Jharkhand	21
Karnataka	1424 Sacred Groves across 5947 hac.
Kerala	2000 Sacred Groves across 500 hac.
Madhya Pradesh	21
Maharashtra	1600
Manipur	365
Meghalaya	79 Sacred Groves across 26326 hac.
Orissa	322 Sacred Groves across 30 hac.
Rajasthan	9 Sacred Groves across 241 hac.
Tamil nadu	448

C.P.R. Environmental Education Centre

least 13,720 SGs have been reported so far in India.

Shrinidhi and B. N. Sathish, *et al.,2008*

The total area of SGs in India as a whole, would be about 39,063 ha. 0.055% of the total Forest area of India.

(Lalitha K P, 2015)

Status of Sacred Groves in Tamil Nadu

- Tamil Nadu has two important institution namely *kovilkadu* and *sthalavriksha.*
- In all, 448 groves have been reported from 28 districts of the State.
- Flora account of 105 species belonging to 95 genera distributed among 44 families of flowering plants.

(ENVIS, 2015)

Status Of Sacred Groves In Karnataka

- Western Ghats of Karnataka has1424 SGs
- In Kodagu about 873 *devarakadus* spread over 10,865 acres were counted, registered and their boundaries were marked ,in 1873 by the forest department

Distribution of Sacred Groves in Kodagu District

- Out of the 1214 sacred groves in the district, The density of sacred groves is very high (i.e., one sacred grove for every 300 ha of land) and possibly the highest in the world.
- Kodagu District could be regarded as a "hotspot" of sacred grove tradition in the world

(Kushalappa *et al.*, 2001. Gokhale, 2000)

Status Of Sacred Groves In Kerala

- It is estimated that about 2000 area of 500 ha of forest area is under SGs (Prasad and Mohanan, 1995) contributing 0.05% of the total forest area of the state.

(Chandrashekara and Sankar, 1998).

Status Of Sacred Groves In Andhra Pradesh

- Documented sacred groves are 580.
- Over 400 sacred groves are conserving Medicinal plants
- Several groves can be found in the habitation area or economic zone and the common land of the village.

ENVIS, 2015

Ownership and Management of SGs

Under ownership three categories:

1. **SGs under the control of State forest departments.**
2. **SGs under the control of revenue and other government departments; and**
3. **Privately owned SGs.**

- Karnataka and Maharashtra states of sacred groves are under the control of the Revenue Department.

(Kalam,1996 and Roy Burman,1996

Classification of sacred groves

1. **Traditional Sacred Groves** : It is the place where the village deity resides, who is represented by an elementary symbol.
2. **Temple Groves** : Here a grove is created around a temple and conserved.
3. **Groves around the burial or cremation ground**



(Pandey *et al.*, 2002)

CLASSIFICATION OF SACRED GROVES

The groves in the Western Ghats broadly fall under two categories.

1. **The smaller groves are entirely protected**: no tree felling or other biomass extraction may be allowed.
2. **larger groves function as resource forests:** offering both livelihood sustenance and ecological security.

(Chandran and Gadgil, 1993).

BROAD CLASSIFICATION OF SACRED GROVES

- Based on Number of Sacred Trees
- Based on Nature of Human Interference
- Based on Structural Frame/ Land-use/Religion

(Tiwari *et al.*, 1998),

BASED ON NUMBER OF SACRED TREES:

1. **Single tree based Sacred Groves :** where one Sacred Tree covers an area in large and numerous secondary trees or vegetation's are grown under the shade of primary Sacred Tree.

2. Multi trees based Sacred Groves : where no primary Sacred Tree is found but the Grove is worshipped total.

BASED ON NATURE OF HUMAN INTERFERENCES

1. **Totally free from human interferences:** For example, Pirtala in Sahara, Kalitala (WB)

2. Partly affected by human interferences: SGs are nourished being a Sacred Grove but the sacred zone has been bounded by wall.

ECOLOGICAL SIGNIFICANCE

- Conservation of Biodiversity
- Recharge of aquifers
- Soil conservation and fertility.
- Climate regions regulation of the local hydrology.
- Maintenance of the nutrients cycles.
- Provide aesthetic scenic beauty to the landscape
- Functioning of the ecosystem by their unique ability like keystone species or functional groups
- Avoids deforestation and degradation of forest cover.

(M. Thandavamoorthy, 2010)

Biological significance of Sacred Groves

- They are composed of several floras with medicinal, rare, endemic, threatened, timber and fuel wood yielding plants.
- Ethno botanically, these areas remain unexplored and no comprehensive account of local tradition is available.
- Their plant wealth and conservation potential were impressive enough to acknowledge as 'mini biosphere reserves.

DIVERSITY IN GROVES

Birds	475 species
Mammals	100 species
Reptiles	156 varieties
Amphibians	91 species
Fish	196 species
Butterflies	150 species

LARGEST IN STATE

Iringole Kavu
LOCATION: Perumbavoor
AREA: 20 hectares



(M. Thandavamoorthy, 2010)
THE HINDU, April, 2016

Socio-cultural Importance:

a) **Religious**

b) **Cultural values**

c) **Health** for human kind

d) **Economic** value

e) **Psychological** : Moral support and guidance of local people.

f) **Educational** : Ideal sites for teaching and research.

(AMPILI BHARAT KUMAR, IFS)

Governance of sacred groves

- A people-declared-managed sacred groves policy.
- **Section 36C in The Wild Life Protection Act, 1972**(Declaration and management of community reserve.)
- 2002 an amendment was brought in Wildlife Protection Act, 1972 WLPA to include Sacred Groves under the act.
- C.P.R Environmental Education Centre Conservation of Ecological Heritage and Sacred sites of India.
- On the international level, organizations such as the International Union for the Conservation of Nature (IUCN) and UNESCO have created guidelines for management of sacred sites.

(WILDLIFE PROTECTION ACT 1972)

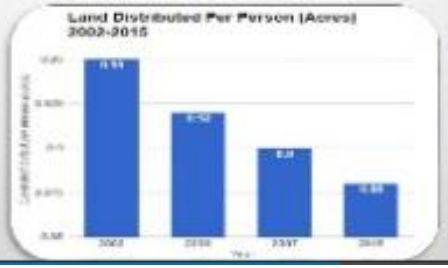
THREATS

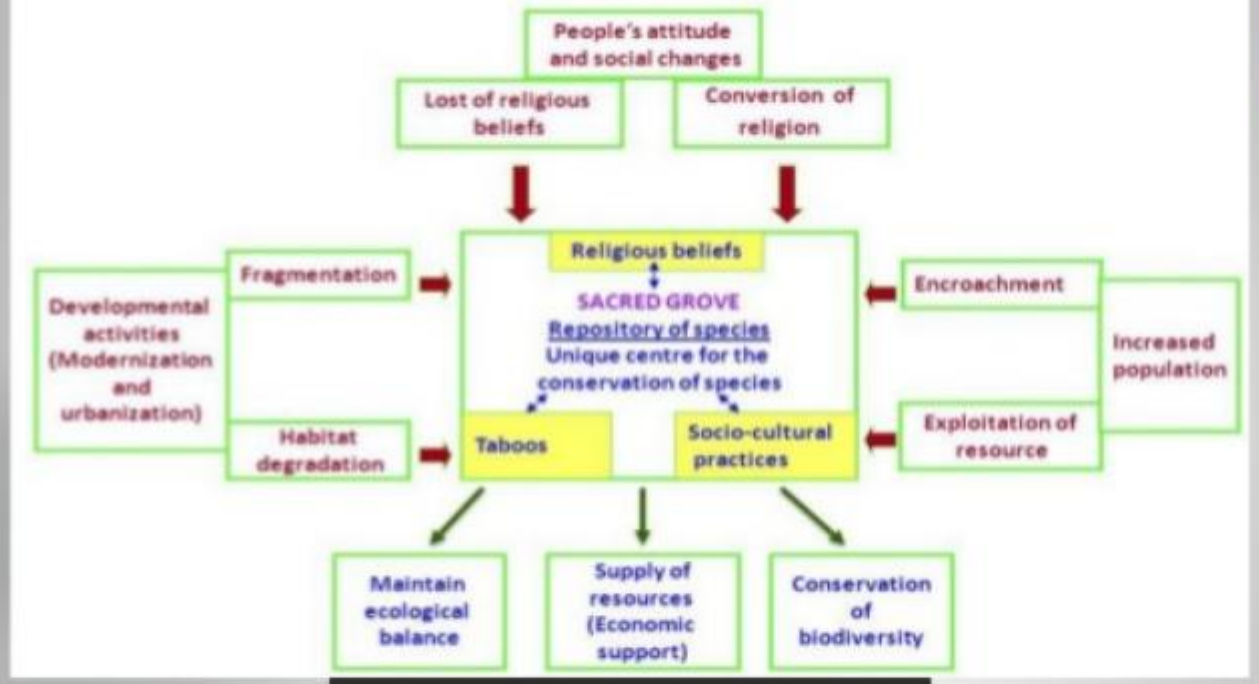
Primary Threats causing degradation of sacred groves

- Commercial forestry
- Raise in international demand for Medicinal plants.
- Rapid urbanization and developmental interventions.
- Development projects.
- Effects of Invasive alien species
- Pilgrimage and tourism:
- Removal of biomass and grazing.
- Encroachment
- Over-exploitation of resources
- Natural Calamities

Secondary threats causing degradation of sacred groves

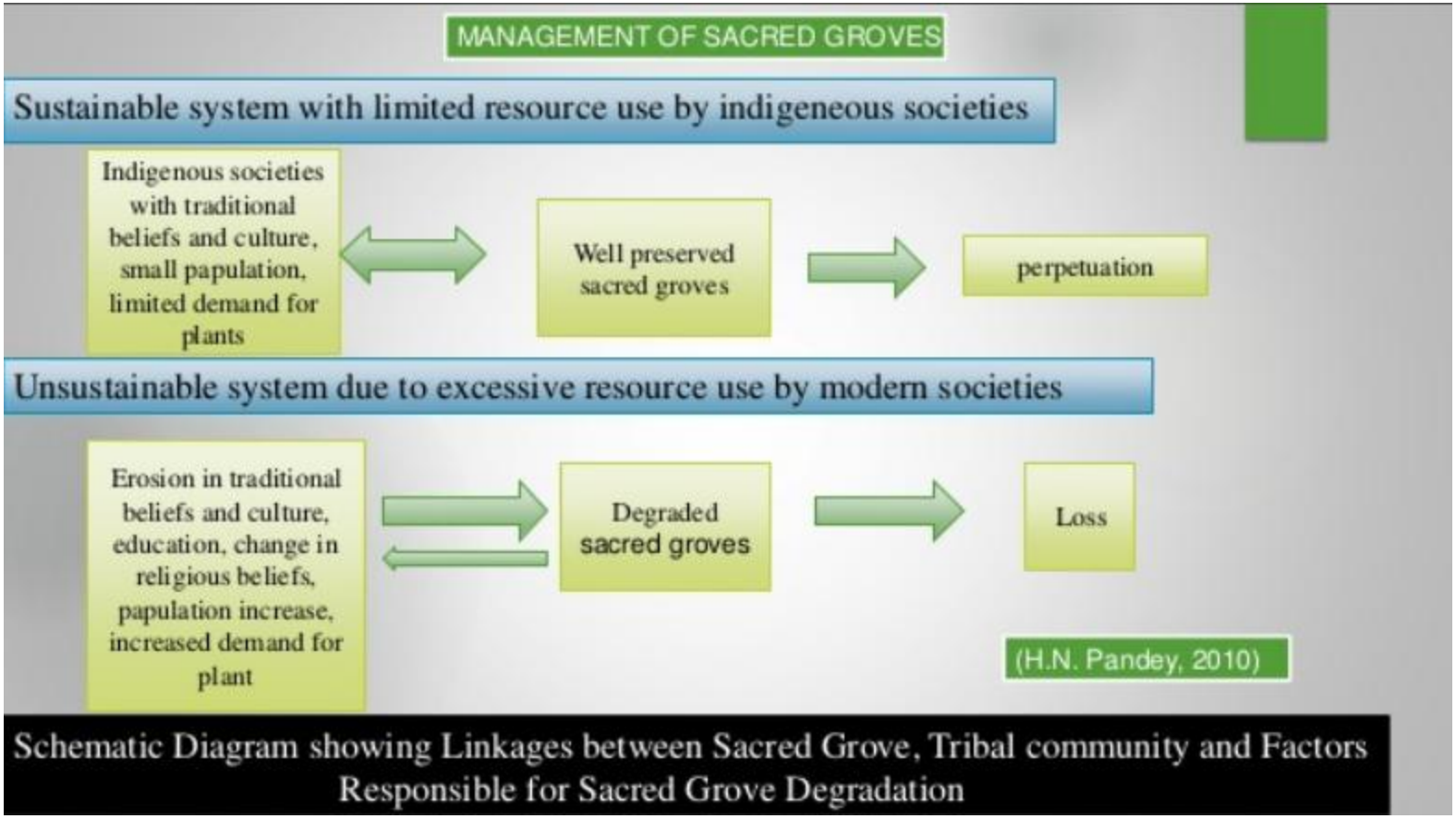
- Shift in belief system
- Transformation of religions
- Sanskritisation
- Modernization and market forces
- Fragmentation and perforation
- Land reforms (Kerala)





Threats and sustainability of Sacred Groves

(Khumbongmaym, *et al.*,2004)



Schematic Diagram showing Linkages between Sacred Grove, Tribal community and Factors Responsible for Sacred Grove Degradation

Management and conservation

Measures to check degradation and for conservation:

- The faith in sacredness should connect with ecological knowledge.
- Declare sacred groves as Heritage sites and provide Financial support for management
- Re survey of Sacred Groves and recover the encroached areas.
- Conservation of intact groves and restoration of degraded ones.
- Awareness should be organized for the local people.
- A buffer zone between sacred groves and the surrounding to check anthropogenic disturbances

(Jayarajan, 2004)

Conservation of Biological Resources

- The endemic and threatened plant species should be Conserve.
- Conserve medicinal plants diversity.
- Add SGs to protected area network to ensure the protection of habitats.
- Convert the traditional belief into an effective conservational strategy.
- The scientific basis and conservational values.
- Reduce anthropogenic pressure on the sacred grove
- Ecological studies of threatened species.



- 5) Development of nursery technique for the indigenous and native species.
- 6)Efforts should be made to utilize the traditional knowledge in the regenerating those native species.
- 7) There is need to highlight the ecological services rendered by sacred groves.

Y.Chattterjee,2007,

Opportunities

- In Karnataka, Maharashtra, Rajasthan, West Bengal, Chhattisgarh and Jharkhand states established new groves.
- In Kerala new partnerships have been developed among the grove trustees, NGOs and local people to protect the forest.
- In Madhya Pradesh, Forest Department, in collaboration with local people, has fenced sacred groves.

THE WORLD BANK
IBRD • IDA

Opportunities

- International agencies like UNESCO, the World Bank and Ford Foundation have included SGs in their agenda.
- the Indira Gandhi Rashtriya Manav Sangrahalaya (IGRMS) Bhopal Established 200-acre campus for **replicas of SGs.**

UNESCO
United Nations Educational, Scientific and Cultural Organization

FORDFOUNDATION
Working with Visionaries on the Frontlines of Social Change Worldwid

Governmental approaches for Conservation

1) An inventory of SG's OF Country.

2) Mapping of the nature and extent of vegetation cover.

3) Government of India should develop a Strong policy document on SG's.

4) Departments should aware of the ecological functions performed by SG's and motivate them to protect it.

Institutional approaches to conservation

At National Level Indira Gandhi Manav Sangrahalaya, Bhopal - protection and conservation of sacred groves Some of the initiatives and activities undertaken by IGMS are as follows:

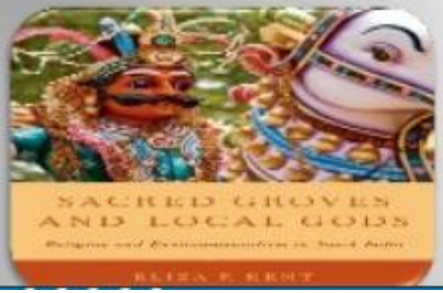
1) Replicas of sacred groves of Arunachal Pradesh, Chhattisgarh, Kerala, Maharashtra, Manipur, Meghalaya, Rajasthan, Tamil Nadu, and west Bengal were created at Bhopal.

2) Indoor exhibitions were organized using Photograph, Maps and Charts etc,

3) Travelling exhibitions

4) Sacred Groves festivals.

5) Publication of literature on sacred groves.



(Malhotra *et al.*, 2007).

NGO's Approaches to Conservation

Applied Environmental Research Foundation (AERF)

- Ecological restoration of 12 sacred groves covering an area of 37 ha.
- Build compound walls for 3 sacred groves to avoid grazing and encroachment.
- 3 new nurseries for Rare and endangered Fauna.
- Papulations of 3 red listed tree species secured with in 12 Sacred Groves and re-introduced in 6 new sites.
- 120 new sacred groves are surveyed and prioritized.
- FRLHT- Kalakkad Mundanthrai Tiger Reserve: Medicinal plants
- ATREE

www.aerfindia.org

Woody species diversity of two sacred groves in Pudukottai, Tamil Nadu.

- A total of 20 species belonging to 19 genera and 12 families were recorded from these groves. The areas of the groves are 6.8 ha in Keeranur and 2.9 ha in Sittakkadu.
- The number of woody species was 13 in Keeranur and 9 in Sittakkadu.

M.P. Ramanujam *et al*,.2004

Sacred Forest of Kunjapuri Siddhapeeth, Uttarakhand

- A total of 239 plant species belonging to 78 families and 207 genera were collected from the study area.
- Out of these, 9 species are considered threatened and 3 species vulnerable.
- Presently, the health of this sacred forest is deteriorating under constant anthropogenic pressures.

(Megha Rawat *et al*., 2011)

Plant Diversity In The Sacred Groves Of Madeour, Karaikal Region, Pondicherry

- The study recorded 84 species belonging to 80 genera, 44 families, including 21trees, 9 shrubs, 11 climbers, 43herbs.
- Mostly present in medicinal value plants. The most dominant species *Adhatoda zeylanica.* Euphorbiaceae is the most dominant families.

(K.Tholkappiyavathi *et al*2014)

Floristic composition and practices on the selected sacred groves of Rajapalayam, Virudhunagar District, Tamil Nadu

- selected 13 sacred groves observed, around 67 plant species are identified which are belonging to 35 family with 62 genera.
- Among 67 plant species, 48% are trees, 22% are herbs, 15% are shrubs, 12% are Climbers and 3% are undershrubs.

T. Francis Xavier *et al 2013*

CONCLUSION

- It has been observed that several medicinal plants that are not to be found in the forest are abundant in the sacred groves.
- Further, rare, endangered, threatened and endemic species are often concentrated in sacred groves.
- The sacredness, religious beliefs and taboos play a significant role in promoting sustainable utilization and conservation of flora and fauna of the region.
- However, with the passage of time, considerable changes have taken place in the extent of the sacred groves, in their vegetation structure, peoples' perception towards them to conserve these **"Biodiversity Hotspots"**

Threats to biodiversity: Habitat loss, degradation, and fragmentation; Poaching of wildlife


Biodiversity and threats to it

Threats to biodiversity

-**Habitat destruction** - Important to protect habitat in order to protect biodiversity within it. Huge pressure from the World's rapidly increasing population.

- **Global climate change** - Change in a biotic elements of ecosystems leading to biotic change.

- **Habitat fragmentation –** From human activity. Reduces ability of habitat to support species.

- **Pollution** - Introduction of pollutants such as nutrient overloading with nitrate fertilizer as well as more immediately harmful chemicals.

- **Over-exploitation** - This includes the illegal wildlife trade as well as overfishing, logging of tropical hardwoods etc.

- **Alien species** - Introduced by humans to regions where there are no natural predators.

- **Disease** - Reduction in habitat causing high population densities, encourages spread of diseases.


NOWHERE TO HIDE
GULP!
HABITAT LOSS
Habitat loss
Game Birds
WEATHER


Adrian Dorst

Habitat loss:-

Habitat loss can be described when an animal loses their home. Every animal in the animal kingdom has a niche, a their in their animal community and without their habitat they no longer have a niche.

Reasons of habitat loss by humans:

~ agriculture, farming
~ harvesting natural resources for personal use
~ for industrial and urbanization development

Habitat destruction is currently ranked as the primary causes of species extinction world wide...!!!

Example :

The impact upon china's panda, ones found across the nation. Now it's only found in fragmented and isolated regions in the south west of the country as a result of wide spread deforestation in the 20th century.

There are natural causes too..

Habitat destruction through natural processes such as volcanism, fire and climate change is well documented in the fossil record. One study shows that fragmentation of tropical rainforest in euro 3000 million years ago lead to a great loss of amphibian diversity.

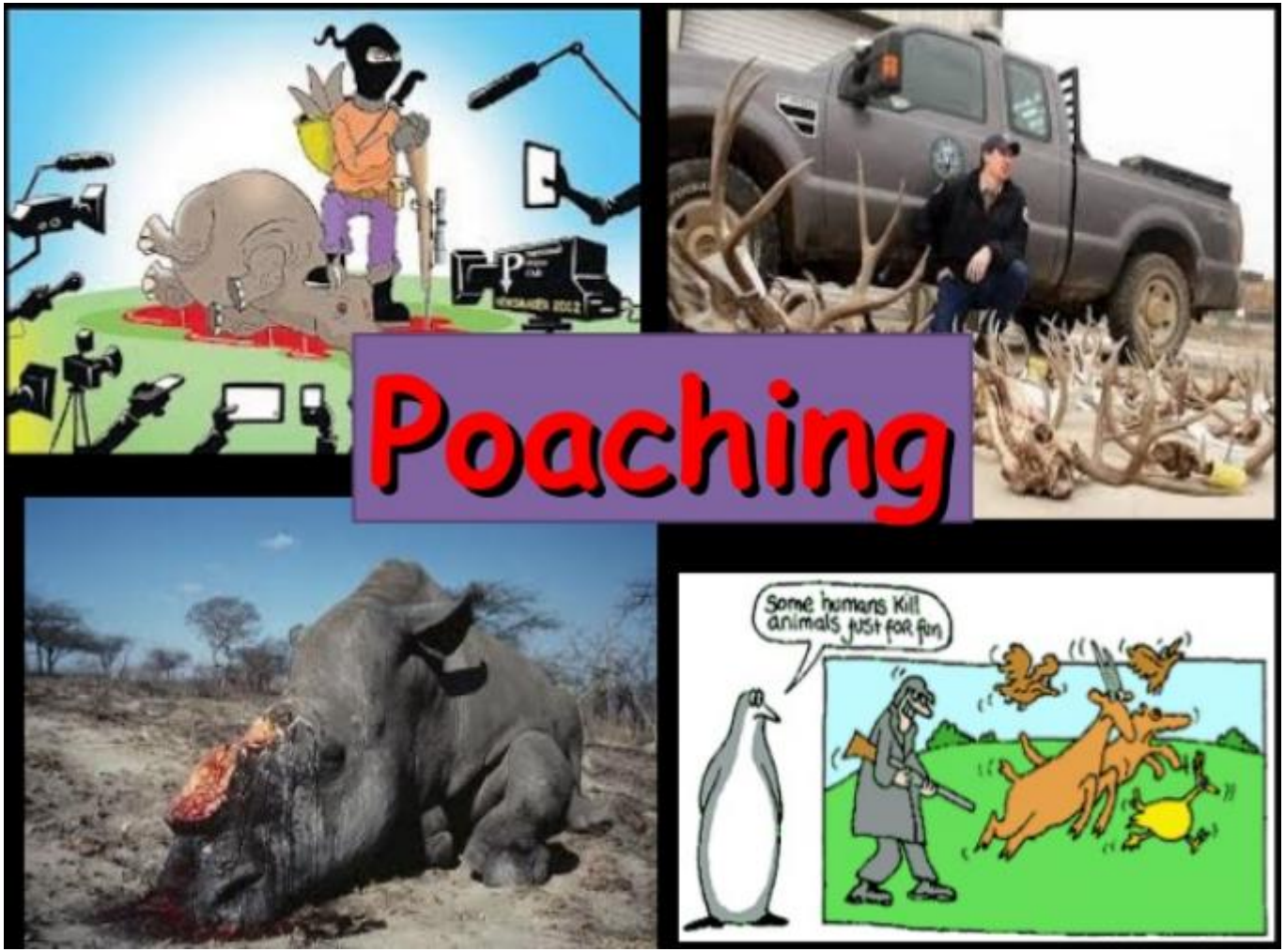
Solutions on for this..

~ Protecting remaining intact section of natural habitat.

~ Reduce human population and expansion of urbanisation and industries.

~ Educating the public about the importance of natural habitat and bio diversity.

~Solutions to habitat loss can include planting trees, planting home gardens so as to reduce need for man to need large lands for agricultural farms which lead to habitat loss.


Poaching
Some humans kill animals just for fun

Poaching:-

Poaching is the hunting and harvesting taking of wild plants or animals, such as through hunting, harvesting, fishing, or trapping.

History of poaching

~ Millions of years ago, in the Stone Age

~Followed through the ages, to even the tribal natives

~but it was during the Late Middle Ages that poaching became a punishable offense

Why Poaching is done???

~ Poaching is done for large profits gained by the illegal sale or trade of animal parts, meat and pelts.

~ Exists because there is a demand for these products, caused by a lack of education or disregard for the law amongst the
buyers

~ Many cultures believe that certain animal parts have medicinal value.

Poaching is not limited to animals its also for plants too……!

Three of the most often poached species in the park are galax, black cohosh, and ginseng.

GALAX

BLACK COHOSH

GINSENG

How does poaching affect the environment?

~Poaching or illegal hunting causes animals endangered of being extinct. If more animals becomes extinct there's a **disruption in the food chain**, and that will cause major problems in our ecosystem, resulting eventually in new adaptations of animals, and or species beyond human control.

~Poaching results in animals being hunted too soon for them to have time to reproduce and repopulate.

Man-wildlife conflicts

Human-wildlife conflict refers to the interaction between wild animals and humans, and the resultant negative impact on people, animals, resources, and habitats. It occurs when growing human populations overlap with established wildlife territory, creating competition for space and resources. Conflict takes many forms including but not limited to: loss of life or injury to humans and wild animals, depredation of livestock, and degradation of habitat. Human-wildlife conflict is a global issue present in urban and rural landscapes alike.

What are the causes of man-animal conflict?

- Habitat fragmentation and shrinking of habitats
- Increased disturbance due to collection of fuel wood, fodder, Non-timber forest products (NTFPs), water etc. from the forests has also increased the incidences of man-animal conflict
- people have to go deeper and deeper, year by year for fetching firewood
- Decreased prey base

What is the impact of man wildlife conflict?

1. Injury or loss of human lives or animals
2. Crop damage , livestock depredation
3. Damage to human property and destruction of habitat

What can be done to reduce this conflict?

1. Capacity building of forest guards
2. Increased vigilance and protection of identified locations using hi-tech surveillance tools like sensors for knowing Animal movements – Eg. Buxa forest
3. Construction of highways/railways bypassing wildlife rich areas like Trans-Canada Highway bypassed Banff National park
4. Expansion of protected reserves : in-situ and ex-situ habitat conservation measures will help in securing animals their survival and reduced conflict with humans
5. Safe animal zones creation: re-locating of animal habitats away from residential and commercial centres will serve to minimize animal-man conflict for illegal and self-interested motives
6. Community based rehabilitation measures: making community responsible for resolution of animal-man conflict will aid in decentralized approach of governance for wildlife preservation. For ex it is done Keibul Lamjao National Park, Kaziranga national park, Sundarbans etc;
7. Partnering with WWF which provide tailor made solutions to man wildlife conflict with community and species in consideration
8. Adequate compensation after rehabilitation – Baiga tribe in Kanha tiger reserve were relocated without proper compensation

Biological invasion with emphasis on Indian biodiversity

What is Biodiversity

Biodiversity means the variety of life on Earth.

It is measured as the variety within species—or genetic diversity—the variety between species, and the variety of ecosystems.

Importance of Biodiversity

- Diversity is the key to ensuring the continuance of life on earth
- Evolved through millions of years of evolution
- Higher the diversity = greater stability !!
- Provides Invaluable Ecosystem services

It is the essence of life on earth

Ecosystem services

- Oxygen and water
- Detoxification and decomposition of wastes
- Conserve soils and their fertility
- Pollination of flowers & Dispersal of seeds
- Protection from the ultraviolet rays
- Maintenance of biodiversity
- Moderation of weather extremes and their impacts
- Provision of aesthetic beauty and intellectual and spiritual stimulation for the human spirit

Biodiversity Global

- No. of total species - ????
- estimated total at about 5 million - 30 million
- The number of described species 1.4 million;
- It has taken 3.5 billion years for this biodiversity to evolve,
- We are rapidly destroying it.

India - Biodiversity

- 8.1% of all biodiversity in 2.4% of worlds area
- Origin of 30,000 cultivated Plants
- 6,33,000 km2 of forest cover (~19% of the land)
- 4.5% of area of India is protected
- 84 National Parks and 447 WLS
- 12 BRs and 23 Tiger Reserves
- High endemicity (5150 species (33%) of plants are endemic)

India – biodiversity

- 45,000 plant species (15,000 flowering plants)
- 75,000 species of animals, including
  - 50,000 insects
  - 4,000 molluscs,
  - 2000 fish,
  - 420 reptiles,
  - 140 amphibians,
  - 1200 birds and
  - 340 mammals

Medicinal plants

- India has 2,500 medicinal plants
- Of these, 2000 to 2,300 species are used in traditional medicines
- Only around 150 species are used commercially (Tulsi, Neem Turmeric, etc.)

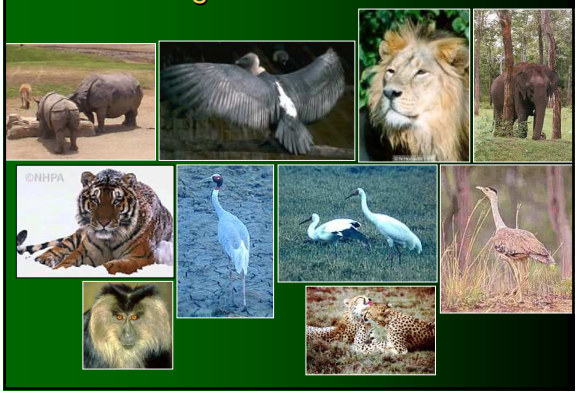
Every single day ….

- **We are losing**
  - 300 km2 of rainforest, (1 acre / second)
  - 40 to 100 species

Already lost 1 million species,

- Natural rate of extinction - 1species/ year,
- The present rate is 1species/hour (10,000 times higher)

Endangered Indian Wildlife



Why to Conserve ?

- Every one has a right to live on this planet
- Every species has its own role to play in the ecosystem
- Values of many sp. (and even the species itself) are still unknown !
- Every single species is an integral part of the vast chain of life

No chain is stronger than its weakest link !

Biodiversity -threats

- Habitat Degradation

  All Natural habitats are under threat from human activities

  Over-exploitation, deforestation, reclamation, Pollution

- Biological Invasion

  Biological invasion by alien species is another major threat to native species and ecosystems

  as alien species flourish at the cost of local species

Alien Species (exotic/ introduced)

- **Alien species are those that occur outside their natural range**.
- **Alien species those threaten the existence of native plants and animals or other aspects of biodiversity are termed alien invasive species.**
- **Alien invasive species occur in all groups of plants and animals.**

As competitors, predators, pathogens and parasites, they have invaded almost every type of native ecosystem, and caused hundreds of extinctions.

How they get introduced

Deliberately

imported ornamental species, Lantana, Eichhornia

Introduced pests and pathogens for biological control

(some agents attack non target species, and it is very difficult to remove the exotic species once it is established).

Unintentionally /accidentally

trade and international transport

Parthenium with wheat from US

Introduced species

Lantana camara, native of South America

invaded **protected forests**, fallow land

Parthenium hysterophorus, native of America

Road sides, follow land, agricultural land

Eichhornia crassipes native of America, terror of Bengal

an aquatic weed, lakes, rivers, has chocked the canal system of Bhakra


Lantana camara


Chromolaena odorata


Chromolaena odorata

Introduced species: **Rabbits of Australia**

Rabbits of Australia caused havoc in Australian economy

24 rabbits were introduced for hunting (from Europe)

Successful colonization

•Can thrive in variety of climatic conditions

•Reproduce fast

•No natural enemy in new habitat (no Foxes)

Rabbits were competing for pasture for sheep and cattle

Poison, fences, gun nothing worked.

Virus myxomatosis was introduced to kill them

10 to 20 % survived. Several became resistant. Number is up again.

Introduced species

Similar case in India: Spotted Deer, introduced in the Andaman Nicobar island by Britishers

Number has proliferated, no predator except crocodiles

There large number is affecting forest regeneration as they overexploit certain plant species

The little fire ant, Native to South America, (*Wasmannia auropunctata*) was acciden-tally introduced throughout the tropics.

This tiny but highly invasive ant, forms vast super colonies. Some super-colonies are so large that they cover the territory of an entire country

Introduced species

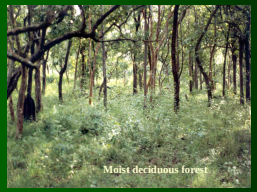
•The predatory brown tree snake, introduced in cargo from the Admiralty Islands, has eliminated ten of the eleven native bird species from the forests of Guam.

•North American gray squirrels are driving native red squirrels to extinction in Great Britain and Italy by foraging for nuts more efficiently than the native species.

Impact on native species

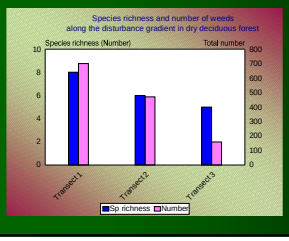
A research study conducted in Nilgiri Biosphere Reserve revealed that

in invasive weed infested areas, species richness and density of native species were severely affected.



Human disturbance and weed invasion

During the similar study it was also noticed that invasion of exotic species was comparatively more in disturbed areas than undisturbed areas



Seeds get carried away along with people

Exotic weeds prefer open spaces

Addressing the problem globally

Internationally, the Rio Convention of Biological Diversity (1992) recognized the threat and called for action to limit it.

A Global Invasive Species Program, formed by the United Nations and other international organizations, is beginning to answer this call with a series of programs designed to deal with particular sorts of introduced species.

IUCN has identified the problem of alien invasive species as one of its major global initiatives and recently finalised the *IUCN Guidelines for the Prevention of Biodiversity Loss Caused by Alien Invasive Species*.

Addressing the problem: Locally

Forest Management

- **Integrated management strategy :**
  - **Mechanical**
  - **Biological**
  - **Chemical**
- **Early detection and prevention of new invasive species**
- **to curb human disturbance**

MASS EXTINCTION CRISIS

Our planet now faces a global extinction crisis never witnessed by humankind. Scientists predict that more than 1 million species are on track for extinction in the coming decades.

But there's still time to halt this crisis — and we need your help. By taking part in our Saving Life on Earth campaign, you can help build a coast-to-coast network to ensure the United States is a leader in saving the world's biodiversity.

Why Is This So Important?

Each time species goes extinct, the world around us unravels a bit. The consequences are profound, not just in those places and for those species but for all of us. These are tangible consequential losses, such as crop pollination and water purification, but also spiritual and cultural ones.

Although often obscured by the noise and rush of modern life, people retain deep emotional connections to the wild world. Wildlife and plants have inspired our histories, mythologies, languages and how we view the world. The presence of wildlife brings joy and enriches us all — and each extinction makes our home a lonelier and colder place for us and future generations.

The current extinction crisis is entirely of our own making. More than a century of habitat destruction, pollution, the spread of invasive species, overharvest from the wild, climate change, population growth and other human activities have pushed nature to the brink. Addressing the extinction crisis will require leadership — especially from the United States — alongside bold, courageous, far-reaching initiatives that attack this emergency at its root.

Every Taxon **Is in Trouble**

AMPHIBIANS

No group of animals has a higher rate of endangerment than amphibians. Scientists estimate that a third or more of all the roughly 6,300 known species of amphibians are at risk of extinction. The current amphibian extinction rate may range from 25,039 to 45,474 times the background extinction rate.

Frogs, toads, and salamanders are disappearing because of habitat loss, water and air pollution, climate change, ultraviolet light exposure, introduced exotic species, and disease. Because of their sensitivity to environmental changes, vanishing amphibians should be viewed as the canary in the global coal mine, signaling subtle yet radical ecosystem changes that could ultimately claim many other species, including humans.

BIRDS

Birds occur in nearly every habitat on the planet and are often the most visible and familiar wildlife to people across the globe. As such, they provide an important bellwether for tracking changes to the biosphere. Declining bird populations across most to all habitats confirm that profound changes are occurring on our planet in response to human activities.

A 2009 report on the state of birds in the United States found that 251 (31 percent) of the 800 species in the country are of conservation concern. Globally, BirdLife International estimates that 12 percent of known 9,865 bird species are now considered threatened, with 192 species, or 2 percent, facing an “extremely high risk” of extinction

in the wild — two more species than in 2008. Habitat loss and degradation have caused most of the bird declines, but the impacts of invasive species and capture by collectors play a big role, too.

FISH

Increasing demand for water, the damming of rivers throughout the world, the dumping and accumulation of various pollutants, and invasive species make aquatic ecosystems some of the most threatened on the planet; thus, it's not surprising that there are many fish species that are endangered in both freshwater and marine habitats.

The American Fisheries Society identified 700 species of freshwater or anadromous fish in North America as being imperiled, amounting to 39 percent of all such fish on the continent. In North American marine waters, at least 82 fish species are imperiled. Across the globe, 1,851 species of fish — 21 percent of all fish species evaluated — were deemed at risk of extinction by the IUCN in 2010, including more than a third of sharks and rays.

INVERTEBRATES

Invertebrates, from butterflies to mollusks to earthworms to corals, are vastly diverse — and though no one knows just how many invertebrate species exist, they're estimated to account for about 97 percent of the total species of animals on Earth. Of the 1.3 million known invertebrate species, the IUCN has evaluated about 9,526 species, with about 30 percent of the species evaluated at risk of extinction. Freshwater invertebrates are severely threatened by water pollution, groundwater withdrawal, and water projects, while a large number of invertebrates of notable scientific significance have become either endangered or extinct due to

deforestation, especially because of the rapid destruction of tropical rainforests. In the ocean, reef-building corals are declining at an alarming rate: 2008's first-ever comprehensive global assessment of these animals revealed that a third of reef-building corals are threatened.

MAMMALS

Perhaps one of the most striking elements of the present extinction crisis is the fact that the majority of our closest relatives — the primates — are severely endangered. About 90 percent of primates — the group that contains monkeys, lemurs, lorids, galagos, tarsiers, and apes (as well as humans) — live in tropical forests, which are fast disappearing. The IUCN estimates that almost 50 percent of the world's primate species are at risk of extinction. Overall, the IUCN estimates that half the globe's 5,491 known mammals are declining in population and a fifth are clearly at risk of disappearing forever with no less than 1,131 mammals across the globe classified as endangered, threatened, or vulnerable. In addition to primates, marine mammals — including several species of whales, dolphins, and porpoises — are among those mammals slipping most quickly toward extinction.

PLANTS

Through photosynthesis, plants provide the oxygen we breathe and the food we eat and are thus the foundation of most life on Earth. They're also the source of a majority of medicines in use today. Of the more than 300,000 known species of plants, the IUCN has evaluated only 12,914 species, finding that about 68 percent of evaluated plant species are threatened with extinction.

Unlike animals, plants can't readily move as their habitat is destroyed, making them particularly vulnerable to extinction. Indeed, one study found that habitat destruction

leads to an “extinction debt,” whereby plants that appear dominant will disappear over time because they aren't able to disperse to new habitat patches. Global warming is likely to substantially exacerbate this problem. Already, scientists say, warming temperatures are causing quick and dramatic changes in the range and distribution of plants around the world. With plants making up the backbone of ecosystems and the base of the food chain, that's very bad news for *all* species, which depend on plants for food, shelter, and survival.

REPTILES

Globally, 21 percent of the total evaluated reptiles in the world are deemed endangered or vulnerable to extinction by the IUCN — 594 species — while in the United States, 32 reptile species are at risk, about 9 percent of the total. Island reptile species have been dealt the hardest blow, with at least 28 island reptiles having died out since 1600. But scientists say that island-style extinctions are creeping onto the mainlands because human activities fragment continental habitats, creating “virtual islands” as they isolate species from one another, preventing interbreeding and hindering populations' health. The main threats to reptiles are habitat destruction and the invasion of nonnative species, which prey on reptiles and compete with them for habitat and food.

Biodiversity conservation strategies: in-situ and ex-situ methods of conservation

Conservation of biodiversity and genetic resources helps protect, maintain and recover endangered animal and plant species. There are mainly two strategies for the conservation of wildlife: In-situ conservation and Ex-situ conservation. Although, both the strategies aim to maintain and recover endangered species, they are different from each other. Let us see how they differ from each other!

In-situ Conservation:

In-situ conservation, which is also known as "on-site conservation", refers to the conservation of wild species in their natural habitats and environment. It aims to conserve the natural habitats of the living creatures and maintain and recover wild species, especially the endangered species. The national parks, wildlife sanctuaries and biosphere reserve are some of the examples of in-situ conservation. This method of conservation allows animals flourish in their natural habitat and food chain and offers more mobility to the animals. It is suitable for the conservation of animals that are found in abundance.

Ex-situ Conservation:

Ex-situ conservation, which is also known as off-site conservation, refers to the conservation of endangered species in the artificial or man-made habitats that imitate their natural habitats, e.g. zoo, aquarium, botanical garden etc. It offers less mobility to the animals as it is smaller in area than the area of in-situ conservation. This method of conservation is suitable for the animals which are not found in abundance.

It provides protection to animals against predators, unfavourable climatic conditions and other hostile factors. Furthermore, proper food and care is provided under good supervision.

Based on the above information some of the key differences between in-situ and ex-situ conservation are as follows:

In-situ Conservation	Ex-situ Conservation
It means onsite conservation.	It means offsite conservation.
It is the conservation of wild species in their natural habitats in order to maintain and recover endangered species.	It is conservation of species in the man-made habitats that imitate the natural habitats of species.
It is more dynamic as it involves natural habitats of organisms.	It its less dynamic as it involves man-made habitats.
It provides protection to endangered species against predators.	It provides protection against all hostile factors.
It is suitable for animals that are found in abundance.	It is suitable for animals that are not found in abundance.
It is not suitable in the event of a rapid decline in the number of a species due to environmental, genetic or any other factor.	It is an ideal option in case of rapid decline in the number of a species due to environmental or any other reason.
Wildlife and livestock conservation involve in-situ conservation.	It can be used to conserve crops and their wild relatives.
Examples include national parks, wildlife sanctuaries, biospheres reserve etc.	Examples include zoo, aquarium and botanical garden.
It involves designation, management and monitoring of the target species in their natural habitat.	It involves sampling, storage and transfer of target species from their natural habitats to man-made habitats.
It helps maintain the ongoing process of evolution and adaptation within the natural environment of the species.	It separates the animals form the ongoing process of evolution and adaptations within their natural environment.

National Parks, Wildlife Sanctuaries, and Biosphere reserves

Wildlife Sanctuary and National Park both are protected natural habitats. They are created to protect the nature and wildlife by conserving the ecosystem. Though, both aim to conserve the natural habitats including a wide range of animals and birds, they are not similar. Let us see how they differ from each other!

Wildlife Sanctuary:

Wildlife Sanctuary is a natural protected habitat created to conserve or protect the wildlife including the rare and endangered species of birds and animals like Black Buck, Indian Wild Ass, and Musk Deer etc. It not only protects animals but also provides favourable living conditions to the birds, animals, insects etc. A wildlife sanctuary can be owned by a government or a organization that aims to protect birds and animal species.

A very limited human activity is allowed in a wildlife sanctuary, the hunting of animals is completely prohibited also the trees cannot be cut down for agriculture or any other purpose. It does not have any clearly marked boundaries to restrict the people from entering into the sanctuary. People can roam inside a wildlife sanctuary related to their research, educational or recreational purposes. The international Union for Conservation of Nature (IUCN), and its World Commission on Protected Areas has defined wildlife sanctuary as its Category IV type of protected areas.

National Park:

National parks are protected natural areas owned and maintained by the national government. They usually have beautiful countryside, wildlife, and cultural heritage. They are created to protect the entire ecosystem, e.g. flora, fauna, landscape etc. A national park is a highly restricted area. It has clearly marked boundaries and human activities are strictly prohibited. The international Union for Conservation of Nature (IUCN), and its World Commission on Protected Areas has defined national park as its Category II type of protected areas.

There are many national parks in the world. The first national park in the world "Yellowstone National Park" was established in 1872 in the United States. Jim Corbett National Park is the first national park of India, located in Uttarakhand, established in 1936. Today, there are more than 160 national parks in India, some of which are as follows:

- Kanha National Park
- Ranthombore National Park
- Sunderban National Park

- Kaziranga National Park
- Gir Forest National Park
- Valmiki National Park
- Bandipur National Park
- Blackbuck National Park

Based on the above information, some of the key differences between wildlife sanctuary and national park are as follows:

Wildlife Sanctuary	National Park
It is a natural protected habitat which provides protection and favourable living conditions to wildlife including the rare or endangered species of plants, animals, insects etc.	It is an area of land protected by the national government to conserve its entire ecosystem like its natural beauty along with the wildlife.
It mainly provides protection to birds, animals, insects, reptiles and other organisms.	It protects the entire ecosystem of the land plants, animals, landscapes, historic objects etc.
It is not a highly restricted area, limited human activities are allowed.	It is a highly restricted area, human activities are not allowed.
It does not have visible or marked boundaries.	It has clearly marked boundaries.
It can be owned by government or a private organization.	It is owned by the government only.
It is an IUCN category IV protected area.	It is an IUCN category II protected area.

We must make every effort to preserve, conserve and manage biodiversity. Protected areas, from large wilderness reserves to small sites for particular species, and reserves for controlled uses. The wildlife sanctuary, biosphere reserves and national park are designated places for protecting the wild plants, animals and natural habitats.

Living organisms exist almost everywhere from mountain peaks to the ocean depths; from deserts to the rainforests. We must make every effort to preserve, conserve and manage biodiversity. Protected areas, from large wilderness reserves to small sites for particular species, and reserves for controlled uses. The wildlife sanctuary, biosphere reserves and national park are designated places for protecting the wild plants, animals and natural habitats.

It is a consecrated place where sacred species are kept. It is not open for general public, unlike zoo. In other words, we say, it tries not to allow any activity that would place the animals in an unduly stressful situation. India has 543 wildlife sanctuaries.

Characteristics of Wildlife Sanctuary

1. It is natural area which is reserve by a governmental or private agency for the protection of particular species.

2. Area is designated for the protection of wild animals.

3. Only animals are conserved, Could be private property also, outside activities allowed

4. It came under the category called "**Protected Areas**". The Protected Areas are declared under **Wildlife (Protection) Act, 1972**.
5. International Union for Conservation of Nature (IUCN) has defined its Category IV type of protected areas

National Park

It is a home to many species of birds and animals which is established by central and state government for the conservation.

Characteristics of National Park

1. Reserve area of land, owned by the government.

2. Area is protected from human exploitation, industrialization and pollution.

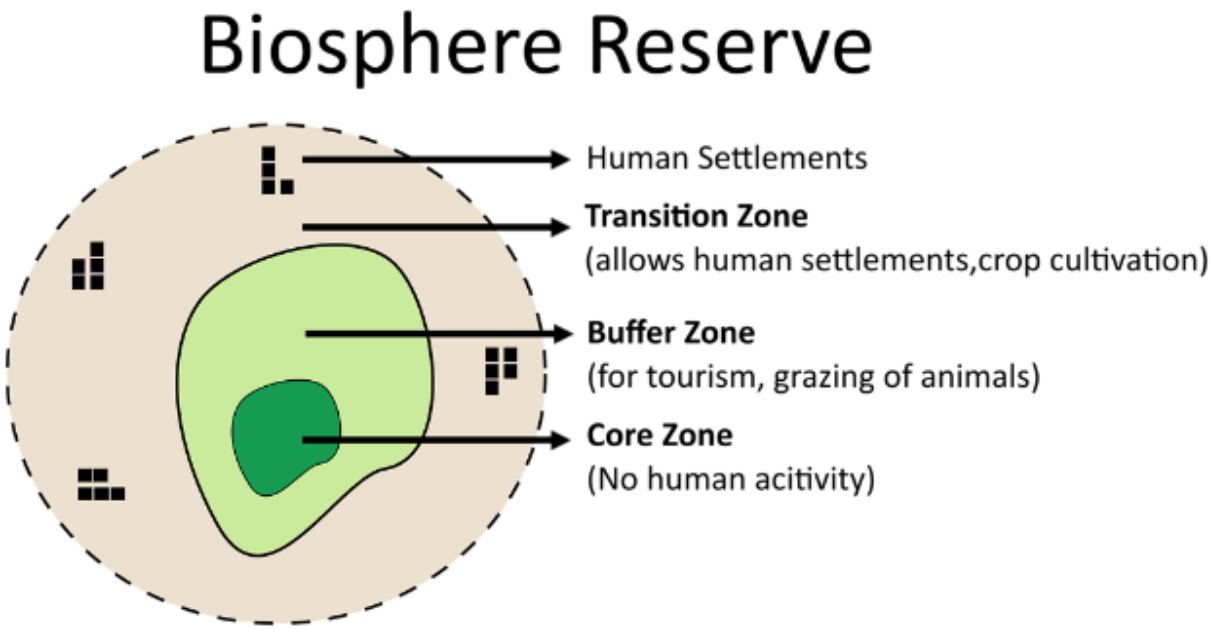
3. No cutting, Grazing allowed, Outside Species Allowed

4. It came under the category called "**Protected Areas**". The Protected Areas are declared under **Wildlife (Protection) Act, 1972**.
5. Conservation of 'wild nature' for posterity and as a symbol of national pride.

6. **International Union for Conservation of Nature (IUCN)**, and its **World Commission on Protected Areas**, has defined its Category II type of protected areas.

Biosphere Reserves

The International Co-ordinating Council (ICC) of UNESCO designated of 'Biosphere reserve' for natural areas from November, 1971. There are 18 Biosphere Reserves in India.



Characteristics of Biosphere Reserve

1. Notified areas which cover a larger area of land which may cover multiple National Parks, Sanctuaries and reserves as well.

2. Areas are meant for conservation of biodiversity of a specific area.

3. Three areas: **Core, Buffer & Marginal**. No outside Species allowed Conservation & research purpose.
4. It is internationally recognized within the framework of **UNESCO's Man and Biosphere (MAB) programme** and nominated by national governments.
5. The Ministry of Environment and Forest provides financial assistance to the respective State governments for conservation of landscape and biological diversity and cultural heritage.

Conservation of biodiversity is an essential part of the environment. By conservation, we do not mean preservation, but conservation means the utilization of natural sources in such a way that they are not allowed to destroy. The maintenance of species and ecosystems is a keystone sustainable development. Conservation of biodiversity includes all human efforts to preserve wildlife and plants from extinction as well as wise management of wildlife, plants and their environment.

Wildlife Sanctuary	National Park	Biosphere Reserve
They are established for the protection of only wildlife (wild animals)	It protects plants, animals, historical objects and entire ecosystem (flora and fauna and non living things)	It protects entire biodiversity (Biodiversity is variety of plants and animals living in area). It is also used for economic development of tribals living in area
Boundaries are not fixed	Boundaries are fixed as per law of government	Boundaries are fixed
There are less restrictions and human activity is allowed **Example** Grazing by their livestock, collecting medicinal plants, firewood, However hunting and capturing animals is prohibited	Human Activities are not at all allowed Cutting of trees is not allowed	There are more restrictions and human activity is not allowed in core zone However, it may be allowed in outermost zone and buffer zone
They may be owned by government or privately owned	They are owned by the government only	They are owned by the government
They are of small area	They are also of small area	They are also of comparatively large area
Examples Sanjay Gandhi Wildlife Sanctuary Asola Bhatti Wildlife Sanctuary	**Examples** Corbett National Park Sunderban National Park	**Examples** Pachmarhi Biosphere Reserve Sunderbans National Reserve

Wildlife Sanctuaries in India

Andaman and Nicobar Islands	Great Nicobar
Andhra Pradesh	1. Nagarjuna Sagar Srisailam 2. Eturnagaram 3. Kolleru 4. Pulicat
Arunachal Pradesh	Pakui-bameri
Assam	Garampani
Bihar	Gautam Buddha (Gaya)
Himachal Pradesh	1. Gobind Sagar 2. Shikari Devi (Mandi)
Jharkhand	1. Palamau 2. Hazaribagh
Karnataka	1. Bhadra 2. Dandeli 3. Ranganathittu
Kerala	1. Waynad 2. Nayyar
Madhya Pradesh	1. Bori-Satpura 2. Pachmarhi 3. National Chambal
Goa	Bhagwan Mahaveer
Maharashtra	1. Kanheri 2. Melghat
Mizoram	Dampa
Odisha	1. Satkasia 2. Nandan Kanan (Bhubaneshwar) 3. Chandka 4. Chilika Lake
Punjab	Abohar
Rajasthan	1. Mount Abu 2. Tal Chhappar
Tamil Nadu	1. Vedanthangal 2. Point Calimere 3. Mundanthurai
Uttar Pradesh	Chandraprabha (Varanasi)

West Bengal	1. Mahanadi 2. Joldapara 3. Sajanakhali

National Parks in India

Andaman and Nicobar lslands	1. Campbell 2. Galathea 3. Mahatma Gandhi Marine 4. Middle Button Island 5. Mount Harriet 6. North Button Island 7. Rani Jhansi Marine 8. Saddle Peak 9. South Button Island
Andhra Pradesh	1. Kasu Brahmananda Reddy 2. Mahaveer Harina Vanasthal 3. Mrugavani 4. Sri Venkataeswara
Arunachal Pradesh	1. Mouling 2. Namdapha
Assam	1. Dibru-Saikhowa 2. Kaziranga 3. Manas 4. Nameri 5. Orang
Bihar	Valmikinagar
Chhattisgarh	1. Indravati 2. Kangerghati 3. Sanjay
Goa	Mollen
Gujarat	1. Bansda 2. Gir 3. Marine (Gulf of Kachchh) 4. Blackbuck
Haryana	Sultanpur
Himachal Pradesh	1. Great Himalayan 2. Pin Valley

Jammu and Kashmir	1. City Forest (Salim Ali) 2. Dachigam 3. Hemis 4. Kistwar
Jharkhand	Betla
Karnataka	1. Anshi 2. Bandipur 3. Bannerghatta 4. Kudremukh 5. Nagarahole
Kerala	1. Eravikulam 2. Periyar 3. Silent Valley
Madhya Pradesh	1. Bandhavagarh 2. Fossil 3. Kanha 4. Madhav 5. Panna 6. Pench (Priyadarshini) 7. Sanjay 8. Satpur 9. Van Vihar
Manipur	Keibul-Lamjao
Maharashtra	1. Gugamal 2. Nawegaon 3. Pench 4. Sanjay Gandhi (Borivilli) 5. Tadoba
Meghalaya	1. Balphakram 2. Nokrek Ridge
Mizoram	1. Murlen 2. Phawngpui Blue Mountain
Nagaland	Intanki
Odisha	1. Bhitarkanika 2. Similipal
Rajasthan	1. Desert 2. Keoladeo Ghana 3. Ranthambore 4. Sariska
Sikkim	Khangchendzonga (Kanchenjunga)

Tamil Nadu	1. Guindy 2. Gulf of Mannar Marine 3. Indira Gandhi (Annamalai) 4. Mudumalai 5. Mukurthi
Uttarakhand	1. Corbett 2. Gangotri 3. Gobind 4. Nanda Devi 5. Rajaji 6. Valley of Flowers (Phoolon ki Ghati)
Uttar Pradesh	Dudhwa
West Bengal	1. Buxa 2. Gorumara 3. Neora Valley 4. Singhlila 5. Sunderbans

Bird Sanctuaries in India

Name of Bird Sanctuaries	Location
Ghana Bird Sanctuary (Keoladeo)	Bharatpur (Rajasthan)
Ranganathittu Bird Sanctuary	Mysore (Karnataka) ,
Vedanthangal Bird Sanctuary	Chingleput (Tamil Nadu)
Nalapati Bird Sanctuary	Nellore (Andhra Pradesh)
Dr. Salim Ali Bird Sanctuary	Chorao (Goa)
Dr. Salim Ali Bird Sanctuary	Thattekkad (Kerala)
Kumarakom Bird Sanctuary	Kottayam (Kerala)
Nal Sarovar Bird Sanctuary	Sanand (Gujarat)
Khijadiya Bird Sanctuary	Jamnagar (Gujarat)
Bankapura Peacock Sanctuary	Karnataka
Chintamoni Kar Bird Sanctuary	Narendrapur (24 Paragana, West Bengal)
Kanwar Bird Sanctuary	Begusarai (Bihar)
Bakhira Bird Sanctuary	Khalilabad (Uttar Pradesh)
Chilika Bird Sanctuary	Odisha

List of Biosphere Reserves in India

Name of Biosphere Reserves	Location
Achankamar-Amarkantak	Covers parts of Anupur and Dindori districts of Madhya Pradesh and parts Bilaspur districts of Chhattisgarh.
Agasthyamalai	Neyyyar, Peppara and Shendurney Wildlife Sanctuaries and their adjoining areas in Kerala.
Cold Desert	Pin Valley National Park and surroundings; Chandratal and Sarchu & Kibber Wildlife in Himachal Pradesh.
Dehang- Debang	Part of Siang and Dibang Valley in Arunachal Pradesh.
Dibru- Saikhowa	Part of Dibrugarh and Tinsukia Districts (Assam)
Great Nicobar	Southern most islands of Andaman & Nicobar.
Gulf of Mannar	Indian part of Gulf of Mannar between India and Srilanka (Tamil Nadu)
Kachchh	Part of Katchchh, Rajkot, Surendra Nagar and Patan Civil Districts of Gujarat State.
Khang Chendzonga	Parts of Khang Chenzonga hills and Sikkim.
Manas	Part of Kokrajhar, Bongaigaon, Barpeta, Nalbari, Kamprup and Daran districts (Assam)
Nanda Devi	Part of Chamoli, Pithoragarh and Bageshwar districts (Uttarakhand)
Nilgiri	Part Wayanad, Nagarhole, Bandipur and Madumalai, Nilambur, Silent Valley and Siruvani hills (Tamil Nadu, Kerala, and Karnataka)
Nokrek	Part of Garo Hills (Meghalya)
Seshachalam Hills	Covering parts of Chittor and Kadapa districts of Andhra Pradesh
Simlipal	Part of Mayurbhanj district (Orissa)
Sunderban	Part of delta of Ganges and Brahamaputra river system (West bengal)

Keystone, Flagship, Umbrella, and Indicator species, Species reintroduction and translocation

Keystone species enrich ecosystem function in a unique and significant manner through their activities, and the effect is disproportionate to their numerical abundance (Paine 1980, Terborgh 1988, Mills et al. 1993). Their removal initiates changes in ecosystem structure and often a loss of diversity. Examples of animals that significantly regulate ecosystem processes include beaver (*Castor canadensis*) (Naiman et al. 1988), large carnivores (Terborgh 1988), and prairie dogs (*Cynomys* spp.) (Miller et al. 1994). Because of the pronounced effect keystone species have on the integrity of an ecosystem, making them a target of management efforts provides an excellent opportunity to maintain or restore ecosystem processes through actions directed at a single species (Miller et al. 1994).

Flagship species are charismatic creatures—such as giant pandas (*Ailuropoda melanoleuca*) or sea turtles—that have wide appeal and thus draw attention to a conservation objective. They are the foundation of public relations and education campaigns, and the outreach built around flagships may be critical to building popular support for a protected area (Noss and Cooperrider 1994, Meffe and Carroll 1997).

Umbrella species generally cover large areas in their daily or seasonal movements (Frankel and Soulé 1981). Protecting enough habitat to assure a viable population of these organisms benefits many other species more restricted in their range. Large mammalian carnivores are often proposed as umbrellas because they are wide-ranging and ecological generalists, but large herbivores and raptors can also fill this role (Noss and Cooperrider 1994, Noss et al. 1996, Meffe and Carroll 1997).

Indicator species are tightly linked to specific biological elements, processes, or qualities; are sensitive to ecological changes; and are useful in monitoring habitat quality. Ideally, they would provide an early warning system and act as a surrogate for the integrity of the ecosystem they inhabit. Examples of indicator species include spotted owls (*Strix occidentalis*) for old-growth forests (Verner et al. 1992) and river otters (*Lutra* spp.) for rivers systems (Sánchez 1992). The choice of indicator species depends on the desired goals; they can represent an element as narrow as stream temperature or as broad as wilderness quality. When choosing indicator species it is important that the relationship between the species and the predicted effect is crystal clear.

Species translocation

Translocation: the capture and transfer of feral animals from one part of their natural range to another, with minimal time spent in captivity. Translocation may be used to reduce overcrowding in existing protected areas, to remove animals from areas of doomed habitat to more secure sites, and/or to repopulate protected areas with low densities of the species in question. It may be necessary to maintain translocated animals in captivity for short periods between transfers.

Introduction: the release of animals into a habitat in which they have never occurred naturally. Introductions usually involve wild-caught individuals, but may sometimes be attempted with captive-born animals. We use the term introduction for both long-range transfers to completely new habitats (e.g. Indian Rhesus macaques *Macaca mulatta* to Cayo Santiago, Puerto Rico (Carpenter, 1942)) and for short-range transfers to previously uninhabited portions of a natural range (e.g. Common squirrel monkeys *Saimiri sciureus* to Santa Sofia Island in the Rio Amazonas (Mittermeier *et al.*, 1977)). Introductions may be intentional or inadvertent.

Species reintroduction

Reintroduction: the release of either wild-caught or captive-born animals into an area in which they have either declined or disappeared as a result of human pressures (e.g. overhunting) or from natural causes (e.g. epidemics). A reintroduction project can involve translocation of wild-caught individuals from other areas of natural habitat, it can involve release of naive, captive-born animals, or it can be attempted with equally naive, wild-caught animals captured as either infants or young juveniles and raised in captivity. In the last two cases, a reintroduction project with primates would almost certainly also have to involve rehabilitation. It is assumed that reintroduction projects will be conducted only in areas where the natural habitat has not been severely altered and where adequate protective measures are in effect.

Rehabilitation: the process of training naive animals to live in their natural habitat. The rehabilitants may be either captive-born individuals never exposed to natural surroundings, or wild-born animals captured as infants or young juveniles and raised in captivity. In both cases, young animals have usually been deprived of important learning processes and have often become imprinted on humans as well. Rehabilitation is an important feature of reintroduction projects involving intelligent animals such as primates in which learning plays a major role in infant development; it is less significant or even unnecessary for animals in which instinctive behaviour patterns predominate (e.g. crocodilians).

Case study: Project Tiger

Status of Conservation of Tigers

According to data released by the **National Tiger Conservation Authority (NTCA),** poaching and electrocution were behind tiger deaths reported in the country.

Key highlights

- Around 40% of India's estimated 2,226 tigers (2014 census) lives outside the core areas of tiger habitats. These tigers are vulnerable to poaching and come into conflict with humans.
- The data shows a rise in tiger vulnerability with higher number of deaths reported in 2016 in comparison with previous years. According to the data, Madhya Pradesh (148) witnessed the highest number of deaths followed by Maharashtra (107), Karnataka (100) and Uttarakhand (82).
- Poaching cases for illegal wildlife trade is however less but death from electrocution (mostly through fences) has been a major concern from 2016 onwards.
- While 295 tigers died natural deaths (45% of the total), 36 were killed in road or rail accidents.
- Conflict outside sanctuaries, national parks and bio reserves in several places is likely to increase further in the coming years.

Tiger Census in India

- Every 4 years the National Tiger Conservation Authority (NTCA) conducts a tiger census across India.
- The first was conducted in 2006, followed by 2010 and in 2014.
- The Census (2014) had reported 2,226 tigers in the country, up from 1,706 in 2010.
- The fourth tiger census (All India Tiger Estimation 2018-19) estimated to be released in May 2019.

Importance of Fourth Tiger Census 2018

- This 2018 tiger census uses more technology including a mobile app named **"MSTrIPES"** for the very first time to store information of the counting.
- Another **primary focus of the tiger census 2018 is to cover the northeast India that was not included in the previous census**.
- For the very first time three neighbouring countries **Bhutan, Nepal** and **Bangladesh** are helping in **counting the number of tigers all across India,** especially in the region with mutual borders.

Note: M-STrIPES *(Monitoring System for Tigers - Intensive Protection and Ecological Status)* is an app based monitoring system, launched across Indian tiger reserves by the NTCA in 2010. The system would enable field managers to assist intensity and spatial coverage of patrols in a geographic information system (GIS) domain.

Project Tiger and National Tiger Conservation Authority (NTCA)

- **Project Tiger was launched in 1973** with 9 tiger reserves for conserving our national animal, the tiger. Currently, the **Project Tiger coverage has increased to 50,** spread out in 18 tiger range states.

Aim and objectives of Project Tiger

1. To maintain a viable population of tigers in their natural habitats and save them from extinction to preserve its scientific, economic, ecological and cultural value.
2. To ensure conservation of other endangered species, and harmonise the rights of tribal people with conservation of wildlife in the tiger reserves and areas around it.

- The tiger reserves are constituted on a **core/buffer strategy**. The **core areas have the legal status of a national park or a sanctuary, whereas the buffer or peripheral areas are a mix of forest and non-forest land, managed as a multiple use area**.
- It is an ongoing **Centrally Sponsored Scheme of the Ministry of Environment, Forests and Climate Change providing central assistance to the tiger States** for tiger conservation in designated tiger reserves.
- The **National Tiger Conservation Authority (NTCA) is a statutory body** of the Ministry, with an overarching supervisory/coordination role, performing functions as provided in the **Wildlife (Protection) Act, 1972**.
- The NTCA was launched in 2005, following the recommendations of the Tiger Task Force. It was given statutory status by 2006 amendment of **Wildlife (Protection) Act, 1972**.

Buffer Area

- Buffer area is the **area peripheral to the critical tiger habitat or core area** providing supplementary habitat for dispersing tigers, besides offering scope for co-existence of human activity.
- The limits of the buffer/ peripheral areas are determined on the basis of scientific and objective criteria in consultation with the Gram Sabha and an Expert Committee constituted for the purpose.

Ex-situ and In-situ conservation methods

- **Ex situ conservation** is the conservation and maintenance of samples of living organisms **outside their natural habitat**. Maintenance of Gene Banks, Seed Banks etc. comes under this method of conservation.
- **In situ conservation** is conservation of species **in their natural habitats**. Maintenance of natural habitats in the form of wildlife sanctuaries, national parks etc. comes under this method of conservation.

Project Tiger Reserves of India

Project Tiger Reserve	Location
Nagarjunsagar-Srisailam Kawal	Andhra Pradesh
Namdapha Pakhui/Pakke	Arunachal Pradesh
Kaziranga Manas Nameri	Assam
Valmiki Nagar	Bihar
Achanakmar Indravati Udanti and Sitanadi	Chhattisgarh
Palamau	Jharkhand
Bandipur Bhadra Dandeli-Anshi Nagarhole B.R Hills	Karnataka
Parambikulam Periyar	Kerala
Bandhavgarh Kanha Panna Pench Sanjay Dubri Satpura	Madhya Pradesh
Melghat Pench ShahyadriTabola-Andhari	Maharashtra
Dampa	Mizoram
Satkosia Simplipal	Orissa
Mukunda Hills Sariska Ranthambore	Rajasthan

Annamalai Kalakad-Mundathurai Mudumalai Sathyamangalam	Tamil Nadu
Katerniaghat Extension Dudhwa	Uttar Pradesh
Corbett	Uttarakhand
Buxa Sunderban	West Bengal

Case study: Project Elephant

Project Elephant- Conservation strategy for Elephant

- Project elephant is a centrally sponsored scheme launched in February 1992. The scheme helps and assists in the management and protection of elephants to the States having free-ranging populations of wild elephants, in order to ensure the survival of elephant population in the wild and protection of elephant habitat and elephant corridor.
- Project elephant is mainly implemented in 16 States / UTs, which includes Andhra Pradesh, Arunachal Pradesh, Assam, Jharkhand, Kerala, Nagaland, Meghalaya, Karnataka, Tamil Nadu, Uttar Pradesh, Orissa, Uttaranchal West Bengal Maharashtra and Chhattisgarh.
- The union government provides financial and technical assistance to the states to achieve the goals of this project. Help is also provided for the purpose of the census, training of field officials and to ensure the mitigation and prevention of human-elephant conflict.
- There are around 32 elephant Reserves in India notified by the state governments. The first elephant reserve was the Singhbhum elephant Reserve of Jharkhand.

Objectives of project elephant

- Protection of elephants, their habitats and elephant corridors.
- Mitigation and prevention of man-elephant conflict.
- To ensure the Welfare of domesticated elephants.

The aim of this project

- To ensure the protection of elephants from hunters and poachers, and prevent illegal trade of ivory. It also includes the strategy to prevent unnatural causes of death of elephants in India.
- To develop and promote scientific and planned management strategies for the conservation of elephants.
- To mitigate and prevent the increasing conflict between humans and elephants in elephant habitats. It also aims to reduce and remove the pressure of human and domestic livestock grazing and other activities in important elephant habitat.
- To ensure ecological restoration of the natural elephant habitats and their migratory routes.
- To promote scientific research on issues related to conservation of elephants and promotion of public awareness and education on these issues.
- To ensure the proper health care and breeding of domesticated elephants. To facilitate veterinary care and Eco-development for the elephants.

Elephant corridors in India

- Elephant corridor is the narrow strips of forested lands which connects larger elephant habitats with significant elephant populations. It acts as a conduit for the movement of elephants between the elephant habitat. It is necessary to enhance species survival and birth rate of the elephant population in the wild.
- There are around 88 elephant corridors in India out of which 20 are in South India, 12 in North Western India, 14 in North West Bengal, 20 in Central India and 22 in North Eastern India. About 77.3% of these corridors are regularly used by the elephants. One-third of these corridors are of high ecological priority and other two third are of medium priority.
- These elephant habitats are facing threats due to their fragmentation. This problem is severe in areas of Northern West Bengal followed by North Western India, North Eastern India and Central India. This fragmentation was least in South India.
- 65% of elephant corridor in South India fall under protected areas or reserved forests. But only 10% of elephant corridors in Central area are completely under forest area, while 90% of them are jointly under forest, agriculture and settlements. Overall, only 24% of elephant corridors in India are under complete forest cover.

Major threats to elephant corridors

- Problems such as elephant habitat loss which is leading to fragmentation and destruction primarily due to developmental activities such as the construction of roads, railways, buildings, holiday resorts and electric fencing etc.
- Mining activities such as coal mining and iron ore mining have been described as single biggest threats to elephant corridor in Central India. States like Jharkhand, Chhattisgarh and Orissa are mineral rich but also have the highest number of elephant corridors which is leading to elephant man conflict.
- As elephants require extensive grazing ground for food, lack of such grazing grounds can force elephants to search for food elsewhere. Most of the elephant reserves unable to accommodate all the elephants, which results in man-elephant conflict due to the destruction of crops by elephants.

Mitigation strategies

- Fusion of elephant corridors with the nearby protected areas and reserved forest wherever possible. In other areas, to provide protection to the elephant corridors, there is a need for the declaration of ecologically sensitive areas or conservation reserves.
- Securing the elephant corridors would require awareness generation and sensitizing the local population to promote voluntary relocation outside the conflict zones. This would prevent the problem of further fragmentation of continuous forest habitats from encroachment by human beings. It would also provide refuge for other wild animals such as tiger, Sambar, crocodile, bird species etc.
- During the process of securing the elephant corridor, there is a need to monitor the animal movements along with habitat restoration as per the requirements.

Elephant as the national heritage animal of India

- The elephant has been declared as the national heritage animal by the government of India in 2010 after the recommendations of the standing committee on national board for wildlife. This was to ensure sufficient protection for elephants before it's numbered fall to panic levels as it had happened in case of tigers.
- A proposed National elephant conservation authority (NECA) on the lines with NTCA has been proposed to be constituted by amending the Wildlife Protection Act 1972.

Monitoring of illegal killing of elephants (MIKE) programme

- MIKE program was started in South Asia and in 2003 after the conference of parties a resolution of CITES. It aims to provide information which is required by the elephant range countries to make proper management and enforcement decisions and to promote institutional capacity in those States for long-term protection and management of their elephant populations.

Main objectives of MIKE programme

1. To measure the levels and trends in the illegal poaching of elephants. To ensure changes in the trends for protection of elephant population.
2. To determine the factors which are responsible for such changes, and to assess in particular about the impact of decisions of the conference of parties to CITES responsible for such changes.
3. Under this programme, data are collected on a monthly basis from all the sites in specified MIKE patrol form and it is submitted to the sub-regional support office for South Asia programme located in Delhi.

Hathi Mere Sathi

- Ministry of environment and forests (MOEF) in partnership with Wildlife Trust of India (WTI) has launched a campaign called Hathi Mere Sathi. The campaign aims to improve the conservation, protection and welfare of elephants in India. It was launched at Elephant- 8 ministerial meeting which was held in Delhi on 24th may 2011.
- The countries who are the part of the Elephant-8 ministerial meeting are Botswana, Kenya, Srilanka, Republic of Congo, Indonesia, Tanzania, Thailand and India.
- The Hathi Mere Sathi campaign aims at increasing public awareness and developing friendship and companionship between local population and elephants.

The campaign mascot Gaju

- The campaign Mascot Gaju focuses on various groups which include local people near elephant habitats, youth, policymakers and others. The scheme envisions to set up elephant centres all over the country in the elephant landscapes. It aims to spread awareness about the plight of elephants and promote people's participation in addressing these issues.

- The campaign plans to ensure capacity building of law enforcement agencies at the ground level to enhance protection of elephants, and to advocate for the policies in favour of elephants.
- The elephant task force (ETF) which was constituted by the Ministry of Environment and Forest has recommended the campaign to Take Gajah (the elephant) to the Prajah (the people) in order to increase public awareness and their participation in the conservation and welfare of elephants.
- India has around 25000 - 29000 elephants in the wild. However, the tuskers (male) in India are as threatened as the Tigers as there are only around 1200 tusker elephants left in India.
- The Asian elephants are threatened by the habitat degradation, man-elephant conflict and poaching for the Ivory. This problem is more intense in India which has around 50% of the total population of world's Asian elephants.

Elephant - 8 ministerial meeting

- The Elephant- 8 ministerial meeting has the representation of all three species of elephants i.e. Asian elephant (Elephas maximus), African Bush elephant (Loxodonta africana), African forest elephant (Loxodonta cyclotis). The ministerial meeting has the participation of policymakers, wildlife conservationists, scientists, historians, experts from art and culture from the participating countries.
- The discussions in the ministerial meeting cover several issues under three basics themes which include science and conservation, management and conservation, and the cultural and ethical perspectives of conservation.
- The E-8 countries have agreed to take necessary steps for the protection and conservation of elephants. They have also decided to actively pursue a common agenda in order to ensure the long-term welfare, protection and survival of all the species of elephants in all the elephant range countries.
- The ministerial meeting has called all the E-8 countries for cooperation under the umbrella of elephant 50:50 forum. Elephant 50:50 forum is the shared vision of 50 countries to promote conservation, protection, management and welfare of elephants and their habitats in the next 50 years.

Project elephant along the India Bangladesh border in Assam

- The India Bangladesh border in Assam is being completely fenced to prevent an illegal influx of migrants. However, this has created a problem for the movement of elephants who frequently travel through the borders of India and Bangladesh. Therefore in order to allow free movement of elephants, jumbo-sized gates would be constructed along the borders which have been the part of elephant corridors for several hundred years.
- These gates would be manned by the security forces guarding the borders. The forest department personnel would keep track of the movement of elephants and they would inform the border guards to open the gates for the herds to cross the border safely. There is a proposal of surveillance mechanism to keep track of the suspicious movements through these corridors.
- The elephants need a large Habitat for their survival and therefore they have been migrating in the neighbouring forests of Bangladesh from Assam and Meghalaya. Any obstruction on the seasonal migration routes of elephants has often lead to man-animal conflict leading to loss of lives and damages to crops and property.

- There are around 5000 elephants in Assam and another 1800 in Meghalaya. There are 6 elephant corridors along the India Bangladesh border in these northeastern states. The efforts of Wildlife Trust of India to restore the traditional migratory routes of elephants have been blocked by construction of boundary fences. Construction of Jumbo gates is seen as a solution to this problem. However, these gates should be long enough with sufficient cover for elephants to cross through them.
- Elephants use entire forest along the borders for their movement, but once they know about a safe route to pass through, then they are smart enough to use these gates as their corridors.

Elephant reserve in India

S.No	Zone	State	Elephant Reserve
1	North-Western Landscape	Uttarakhand	Shivalik Elephant Reserve
2	North-Western Landscape	Uttar Pradesh	Uttar Pradesh Elephant Reserve
3	East-Central Landscape	West Bengal	Mayurjharna Elephant Reserve
4	East-Central Landscape	Jharkhand	Singhbhum Elephant Reserve
5	East-Central Landscape	Orissa	Mayurbhanj Elephant Reserve
6	East-Central Landscape	Orissa	Mahanadi Elephant Reserve
7	East-Central Landscape	Orissa	Sambalpur Elephant Reserve
8	East-Central Landscape	Orissa	Baitami Elephant Reserve

S.No	Zone	State	Elephant Reserve
9	East-Central Landscape	Orissa	South Orissa Elephant Reserve
10	East-Central Landscape	Chhattisgarh	Lemru Elephant Reserve
11	East-Central Landscape	Chhattisgarh	Badalkhol Tamor Pingla Elephant Reserve
12	Kameng- Sonitpur Landscape	Arunachal Pradesh	Kameng Elephant Reserve
13	Kameng- Sonitpur Landscape	Assam	Sonitpur Elephant Reserve
14	Eastern-South Bank Landscape	Assam	Dihing-Patkai Elephant Reserve
15	Eastern-South Bank Landscape	Arunachal Pradesh	South Arunachal Elephant Reserve
16	Kaziranga-Karbi Anglong-Intanki Landscape	Assam	Kaziranga-Karbi Anglong Elephant Reserve
17	Kaziranga-Karbi Anglong-Intanki Landscape	Assam	Kaziranga-Karbi Anglong Elephant Reserve
18	Kaziranga-Karbi Anglong-Intanki Landscape	Nagaland	Intanki Elephant Reserve
19	North Bengal- Greater Manas Landscape	Assam	Chirang-Ripu Elephant Reserve

S.No	Zone	State	Elephant Reserve
20	North Bengal- Greater Manas Landscape	West Bengal	Eastern Dooars Elephant Reserve
21	Meghalaya Landscape	Meghalaya	Garo Hills Elephant Reserve
22	Meghalaya Landscape	Meghalaya	Khasi-hills Elephant Reserve
23	Brahmagiri- Nilgiri-Eastern Ghats Landscape	Karnataka	Mysore Elephant Reserve
24	Brahmagiri- Nilgiri-Eastern Ghats Landscape	Kerala	Wayanad Elephant Reserve
25	Brahmagiri- Nilgiri-Eastern Ghats Landscape	Tamil Nadu	Nilgiri Elephant Reserve
26	Brahmagiri- Nilgiri-Eastern Ghats Landscape	Andhra	Rayala Elephant Reserve
27	Brahmagiri- Nilgiri-Eastern Ghats Landscape	Kerala	Nilambur Elephant Reserve
28	Brahmagiri- Nilgiri-Eastern Ghats Landscape	Tamil Nadu	Coimbatore Elephant Reserve
29	Anamalai- Nelliampathy- High Range Landscape	Tamil Nadu	Anamalai Elephant Reserve
30	Anamalai- Nelliampathy- High Range Landscape	Kerala	Anamudi Elephant Reserve

S.No	Zone	State	Elephant Reserve
31	Periyar- Agasthyamalai Landscape	Kerala	Periyar Elephant Reserve
32	Periyar- Agasthyamalai Landscape		Srivilliputhur Elephant Reserve

Case study: Vulture breeding program

In the 1990s, a decrease in the number of vultures was **noted by Vibhu Prakash of the Bombay Natural History Society**, who had monitored vulture populations at **Keoladeo National Park**. As the decline accelerated, the international scientific community looked for a reason. There were many difficulties to be overcome because vultures could not legally be killed for scientific study in India and freshly dead animals had become extremely rare, a situation exacerbated by the extremely hot weather in India where temperatures before the monsoon routinely exceed 40 °C (104 °F). Andrew Cunningham of the **Zoological Society of London** found that the usual suspects of **pesticide poisoning,** industrial pollutants or bacteria did not show anything abnormal in the vultures he could examine and suspected a new type of toxin exposure.

The cause discovered by **Dr. Lindsay Oaks and his team at The Peregrine Fund** in **2003** to be **diclofenac**. Diclofenac is a common anti-inflammatory drug administered to livestock and is used to treat the symptoms of inflammation, fevers and/or pain associated with disease or wounds. It was widely used in **India beginning in the 1990s**. The drug is fatal to vultures, however, and a vulture is exposed to a mortal dose of diclofenac if it eats from the carcass of an animal that has been treated with diclofenac recently. A simulation model demonstrated that if only 1% of carcasses were contaminated by diclofenac, Indian vulture populations would fall by between 60% and 90% annually, and a study of carcasses showed that about 10% were contaminated.

Captive-breeding programmes for several species of Indian vulture have been started. The vultures are long lived and slow in breeding, so the programmes are expected to take decades. Vultures reach breeding age at about five years old. It is hoped that captive-bred birds will be released to the wild when the environment is clear of diclofenac.

In early 2014 the *Saving Asia's Vultures from Extinction* (Save) programme announced that it expects to start releasing captive-bred birds into the wild by 2016.

Two captive Himalayan griffons were released in June, 2016 from **Jatayu Conservation Breeding Centre, Pinjore** as part of Asia's first vulture re-introduction program.

VULTURE CONSERVATION AND BREEDING CENTRES (VCBC)

Starting with just a few vultures, the total number of vultures in the Vulture Conservation and Breeding Centres (VCBCs) have increased to more than 700.

Background:

- The population of the vultures in the country declined sharply from 40 million in the 80s to a few thousand by 2009.
- The major reason behind the vulture population getting nearly wiped out was the drug **Diclofenac**, found in the carcass of cattle the vultures fed on. The drug, whose veterinary use was banned in 2008, was commonly administered to cattle to treat inflammation.

Vulture Conservation And Breeding Centres (VCBC):

- To study the cause of deaths of vultures, a Vulture Care Centre (VCC) was set up at Pinjore, Haryana in 2004. At present there are nine Vulture Conservation and Breeding Centres (VCBC) in India, of which three are directly administered by Bombay Natural History Society (BNHS).

- The objective of the VCBCs is not only to look after the vultures and breed them in captivity, but also to release them into the wild.

- The total number of vultures in these VCBCs is now more than 700. The three endangered species of vultures bred in the VCBC are the **White-backed, Long-billed and the Slender-billed vulture.**

Jatayu Conservation Breeding Centre, Pinjore

The Vulture Conservation Breeding Centre (VCBC) is a joint project of the Haryana Forest Department and the Bombay Natural History Society (BNHS). It is a collaborative initiative to save the three species of vultures, the White-backed, Long-billed and Slender-billed, from looming extinction.

The VCBC, earlier known as Vulture Care Centre (VCC), was established in September 2001 with the UK Government's 'Darwin Initiative for the Survival of Species' fund, to investigate the dramatic declines in India's Gyps species of vultures.

Subsequent to the release of the South Asia Vulture Recovery Plan in February 2004, the VCC was adapted and upgraded to being the first VCBC, in line with a key recommendation of the Recovery Plan to set up a conservation breeding programme for the three critically endangered species of vultures. The centre sprawls over 5 acres of Haryana Forest Department's land at village Jodhpur. The Jatayu Conservation Breeding Centre (JCBC) is a joint project of the Haryana Forest Department and the Bombay Natural History Society (BNHS).It is a collaborative initiative to save the three species of vultures, the White-backed, Long-billed and Slender-billed, from looming extinction. The centre is located at village Jodhpur on the edge of the Bir Shikargaha Wildlife Sanctuary which is about 8 km off the National Highway-22 from Pinjore on Mallah Road. The centre is spread on a 5 acre land of Haryana Forest Department.

Long-billed vulture

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At present the centre houses a total 160 Vultures which includes 63 White-backed Vultures, 74 Long-billed Vultures, 21 Slender-billed Vultures and 2 Himalayan Griffons. This is the largest collection of the three critically endangered Gyps species of vulture at one place anywhere in the world.

White-backed vulture

A planned conservation breeding programme was initiated with the financial assistance from the Central Zoo Authority, Darwin Initiative for the Survival of Species of the Government of U.K., the Royal Society for the Protection of Birds (RSPB) and technical support of the Zoological Society of London and International Centre for Birds of Prey, U.K. The Centre is the first centre of its kind in Asia and is poised to make major contributions in the conservation of

these critically endangered species. It was designated as the Coordinating Zoo for Vulture Conservation in India by the Central Zoo Authority.

Diclofenac implicated as the main cause of vulture decline

The centre played an important role in confirming that diclofenac, a non-steroidal anti-inflammatory drug, given to cattle to treat pain and inflammation, was the main cause of vulture mortality and population crash in vultures. The diclofenac was extracted from the tissue samples of vulture carcasses which were collected from different parts of the country and its presence was estimated in collaboration with Aberdeen University, UK. It was found that 75% of the vulture carcasses collected from various parts of the country had "Visceral Gout". This happens when there is kidney failure and the uric acid crystals get deposited on the visceral organs. It was established that all the vultures which had died of visceral gout had diclofenac residues in their tissues. This strong correlation established that at least 75% of the vulture population had died of diclofenac poisoning and this was the major cause of decline. The diclofenac as the major cause of vulture mortality was first established in 2003-04 by The Peregrine Fund, a U. S. based NGO, working in Pakistan. Vultures are exposed to diclofenac when they feed from carcasses of livestock that have died within a few

days of treatment and contain residues of the drug. The concentration of diclofenac, as low as 0.22 mg/gm of body weight, was found to be lethal to vultures.

Ban on the veterinary use of Diclofenac in India

The centre played a crucial role in getting the veterinary use of diclofenac banned in the country. This became possible because of the efforts taken by the then Hon'ble Forest Minister, Ms. Kiran Choudhry. She met the Prime Minister and the Chairperson of the ruling United Progressive Alliance and effectively convinced them to ban the veterinary use of diclofenac as it was responsible for the crash in vulture populations. The Drug Controller General of India instructed vide his letter dated 11 May 2006, to all the state drug controllers to withdraw the licences granted to manufacture diclofenac formulations for veterinary use. The final gazette notification was issued in August 2008. The BNHS advocacy programme worked tirelessly behind the scene to make this happen.

Case study: Vulture breeding program

In the 1990s, a decrease in the number of vultures was **noted by Vibhu Prakash of the Bombay Natural History Society**, who had monitored vulture populations at **Keoladeo National Park**. As the decline accelerated, the international scientific community looked for a reason. There were many difficulties to be overcome because vultures could not legally be killed for scientific study in India and freshly dead animals had become extremely rare, a situation exacerbated by the extremely hot weather in India where temperatures before the monsoon routinely exceed 40 °C (104 °F). Andrew Cunningham of the **Zoological Society of London** found that the usual suspects of **pesticide poisoning,** industrial pollutants or bacteria did not show anything abnormal in the vultures he could examine and suspected a new type of toxin exposure.

The cause discovered by **Dr. Lindsay Oaks and his team at The Peregrine Fund** in **2003** to be **diclofenac**. Diclofenac is a common anti-inflammatory drug administered to livestock and is used to treat the symptoms of inflammation, fevers and/or pain associated with disease or wounds. It was widely used in **India beginning in the 1990s**. The drug is fatal to vultures, however, and a vulture is exposed to a mortal dose of diclofenac if it eats from the carcass of an animal that has been treated with diclofenac recently. A simulation model demonstrated that if only 1% of carcasses were contaminated by diclofenac, Indian vulture populations would fall by between 60% and 90% annually, and a study of carcasses showed that about 10% were contaminated.

Captive-breeding programmes for several species of Indian vulture have been started. The vultures are long lived and slow in breeding, so the programmes are expected to take decades. Vultures reach breeding age at about five years old. It is hoped that captive-bred birds will be released to the wild when the environment is clear of diclofenac.

In early 2014 the *Saving Asia's Vultures from Extinction* (Save) programme announced that it expects to start releasing captive-bred birds into the wild by 2016.

Two captive Himalayan griffons were released in June, 2016 from **Jatayu Conservation Breeding Centre, Pinjore** as part of Asia's first vulture re-introduction program.

VULTURE CONSERVATION AND BREEDING CENTRES (VCBC)

Starting with just a few vultures, the total number of vultures in the Vulture Conservation and Breeding Centres (VCBCs) have increased to more than 700.

Background:

- The population of the vultures in the country declined sharply from 40 million in the 80s to a few thousand by 2009.
- The major reason behind the vulture population getting nearly wiped out was the drug **Diclofenac**, found in the carcass of cattle the vultures fed on. The drug, whose veterinary use was banned in 2008, was commonly administered to cattle to treat inflammation.

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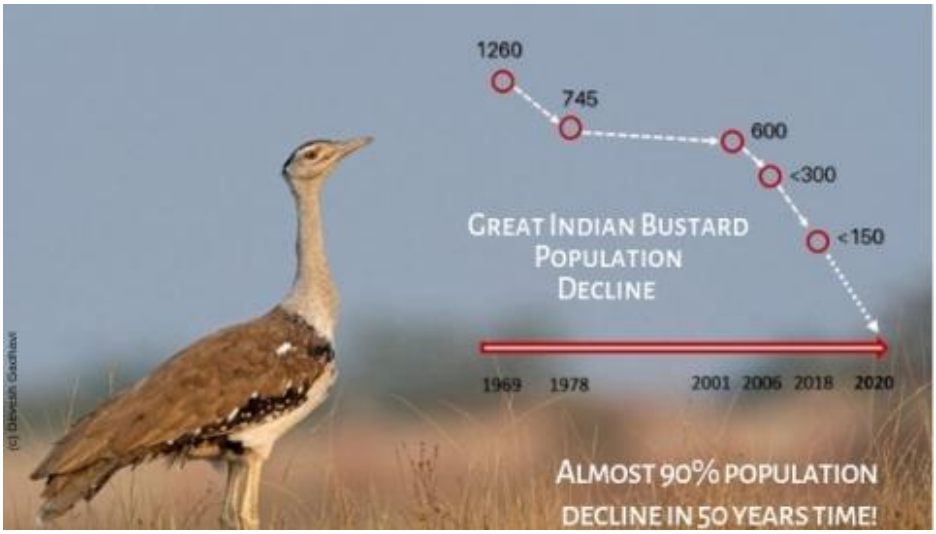
Case study: Project Great Indian Bustard



Since June last year, nine GIB eggs collected from the Desert National Park in Jaisalmer where a conservation centre has been set up, have hatched, and the chicks are reported to be doing well.

Great Indian Bustard

- The Great Indian Bustard, one of the heaviest flying birds, can weigh up to 15 kg and grow up to one metre in height.
- It is considered the flagship grassland species, representing the health of the grassland ecology.
- For long, conservationists have been demanding to secure this population, warning that the bird might get extinct in the coming decades.
- It would become the first mega species to disappear from India after Cheetah in recent times.
- Till 1980s, about 1,500-2,000 Great Indian Bustards were spread throughout the western half of India, spanning eleven states.
- However, with rampant hunting and declining grasslands, their population dwindled.
- In July 2011, the bird was categorised as “critically endangered” by the International Union for Conservation of Nature (IUCN).

Various threats to GIBs

I. General threats to GIB

- Habitat loss & fragmentation, change of land use pattern, desertification, ill-thought plantation of exotic & invasive species in grassland ecosystems are some of the generic causes.
- Neglect of state institutions due to classification of ‘grasslands’ as ‘wastelands’, conversion of grasslands to agriculture lands due to increasing irrigation potential and decline of nature/GIB-friendly agrarian practices, are all commonly and correctly blamed for the steady decline in India’s GIB population.

II. Role of Noise Pollution

- Noise pollution affects the mating and courtship practices of the GIB.
- The male GIB inflates his ‘gular’ pouch (near the neck) which almost touches the ground, in order to produce a large booming sound which reverberates across the grassland.
- The male GIB does this to attract GIB females and to inform them of his exact location in the vast expanse of the grassland.
- Thus, the sound of the male GIB should be loud enough to transcend the walls of the sanctuary and be audible to female GIBs in the fields nearby.
- The noise generated by human activities, whether be it by vehicles, tractors, music during processions, firecrackers, may interfere with the GIB’s mating call and drown it out.

III. Other threats

- The rate of reproduction amongst GIBs is very low; the female GIB lays only one egg per year.
- This solitary egg is under threat from natural predators of the grasslands such as jackals, hyenas or foxes or invasive species such as crows or feral dogs.
- In such a scenario, every opportunity the GIBs lose to mate pushes the species closer to extinction.

Protection Measures

- Birdlife International uplisted this species from Endangered to Critically Endangered (2011)
- Protection under CITES Appendix I
- Protection under Schedule I Wildlife (Protection) Amendment Act 2002
- Project Great Indian Bustard (Rajasthan): aims at identifying and fencing off bustard breeding grounds in existing protected areas as well as provide secure breeding enclosures in areas outside protected areas.

Rajasthan announces Project Great Indian Bustard

Rajasthan, home to one of the last remaining populations of the Great Indian Bustard, has charted out a plan to recover the population of the critically endangered bird. On June 5, the state announced Rs 12 crore-Project Great Indian Bustard, which is to be initiated from this year.

Till 1980s, about 1,500-2,000 Great Indian Bustards were spread throughout the western half of India, spanning eleven states. However, with rampant hunting and declining grasslands, their population dwindled. In July 2011, the bird was categorised as “critically endangered” by the International Union for Conservation of Nature (IUCN).

Alarmed by this, the Union Ministry of Environment and Forests (MoEF) prepared a species recovery programme for the Great Indian Bustard, the Lesser Florican and the Bengal Florican, three of the four bustard species found in India, in January last year. All the three birds have been endemic to the grasslands of India and are on the brink of extinction. The fourth one, Houbara, is a migratory species. While the recovery programme for bustards came after much delay, its progress since then has been even poorer. According to sources in MoEF, the final version of the guidelines for the recovery programme is yet to be printed and has to be communicated to the states.

Conservationists fear the delay in government action could cost dear for the bird. A campaign was initiated last month by several conservationists, urging the chief minister of Rajasthan to initiate actions to protect the bird. “The Rajasthan population

of birds is very crucial for recovery programme. In other states, most of the populations are restricted below 10. It is difficult to lead a recovery programme with limited population. The bird is a slow breeder and the success rate of breeding is very less," says Ramki Sreenivasan of non-profit Conservation India that led the campaign under which more than 1000 people have written to the Rajasthan chief minister.

On World Environment Day, Rajasthan forest department, finally announced its own Project Great Indian Bustard. The bird also happens to be the state bird of Rajasthan. "We plan to spend about Rs 4.5 crore this year on constituting enclosures and securing inviolate areas to ensure successful breeding of birds in the Desert National Park. A good number of birds are also found outside protected areas in Ajmer and Jaisalmer districts. In the coming years, we will spend close to Rs 8 crore at the breeding sites of bustards outside the protected areas," says P S Somashekhar, chief conservator of forests (wildlife), Rajasthan. Prerna Bindra, standing committee member of the National Board of Wildlife, has also reportedly raised the issue of conserving the last remaining population of the Great Indian Bustard in the standing committee meeting on June 6.

Case study: Crocodile conservation

As a result of concern for the future of the Indian gharial (*Gavialis gangeticus*) crocodile, the Government of India sought assistance from UNDP in carrying out a status survey. An FAO report (1974) noted that the gharial was on the verge of extinction, that the saltwater crocodile (*Crocodylus porosus*) was extremely rare and that the Indian mugger (*Crocodylus palustris*) although a depleted species was not threatened with extinction in the foreseeable future.

After accepting the report, the Government sought UN assistance in initiating a project for the conservation and management of all three species. It accepted the suggested procedure of rapid multiplication of the populations by collection of eggs laid in the wild for captive incubation, raising of the resultant young, and restocking of specially selected sanctuaries with juveniles of 1.20-m length - at which age they are free from predation other than by man. Protection under the project, quite apart from releases of captive-reared stock, is resulting in the gharial making a comeback. By March 1979, there were increases of 200 animals restored to the wild. The wild population is expected to exceed 1000 animals of more than 2-m length by early 1981, after which the number can be expected to double rapidly. The project has also carried out a well-coordinated programme of research on other Indian crocodiles. The Government of India, FAO and UNDP have laid stress on training.

The Central Crocodile Breeding and Management Training Institute, located in Hyderabad, took in its first trainees in December 1978.

The available habitat for all three crocodile species has become greatly reduced as a result of a wide range of development activities. What is important for the future is not merely the total number of crocodiles, but to ensure that they are distributed among national parks and sanctuaries in different parts of the country, something that has not been possible, for instance, with the great Indian rhinoceros or the Indian lion. The real problem - the necessity of retaining large sanctuary areas free from all types of human interference, including pollution - lies in the future. Relentless pressure will continue to be applied to India's forests, and hence to its sanctuaries.

The Indian crocodile project has been a major success story in the Asian wildlife scene. No country has done more than India to conserve its crocodiles and nowhere has the effort met with such marked success. The initiation of the project has coincided with (and perhaps to some extent has also been instrumental in creating) a wave of interest in wildlife and its conservation in India.

Summary:

- The Indian Crocodile Conservation Project is one of the most successful conservation initiatives in the world.

- It has pulled back the once threatened crocodilians from the brink of extinction and placed them on a good path of recovery.
- The broad objectives of activities under crocodile project were
    - to protect the remaining population of crocodilians in their natural habitat by creating sanctuaries;
    - to rebuild natural population quickly through `grow and release' or `rear and release' technique
    - to promote captive breeding;
    - to take-up research to improve management; and
    - to involve the local people in the project intimately.

Eg.

CAPTIVE BREEDING OF CROCODILES AT NANDANKANAN

Captive breeding units on all the three crocodilian species have been established at Nandankanan Zoo. Muggers bred at Nandankanan Zoo have also been released in Satkosia Gorge. Although Gharials have failed in establishing in Satkosia Gorge, Muggers have settled down well in this stretch of Mahanadi River. As per survey carried in January to March 2004 there are 64 Muggers in Mahanadi system and 83 Muggers in the rivers in Similipal.

PROJECT SITES IN Odisha

During 1976, survey of (i) salt-water crocodiles and (ii) Gharial crocodiles was conducted in the river system of Bhitarkanika area and in the Mahanadi, respectively. The number of salt-water crocodiles in Bhitarkanika area was estimated to be 95, including 34 adults. The number of Gharials in Mahanadi was estimated to be 8, including 4 adults. No detailed survey was, however, conducted for Mugger crocodiles at that time, although the species occurred at several places in the State. The one breeding population of Mugger known at that time was in the Balimela Dam in Koraput district.

The Crocodile Project started with the objective of building the population to a stage when incidence of sighting could be 5 to 6 crocodiles per KM length of water. The Project sought to make up the natural losses by death and predation through rear and release operation. This involved collection of eggs from the nests as soon as these were laid, incubation and hatching of these eggs in hatcheries under regulated conditions of temperature and humidity, rearing the young juveniles, marking and release of the young crocodiles into Nature in protected areas, and assessment of the degree of success in restocking any protected area with crocodiles released from the hatcheries. To accomplish these tasks, 3 separate research units were established at Tikarpara, Dangmal and Ramatirtha for the Gharial, Salt Water Crocodile and the Mugger, respectively. At the Nandankanan Biological Park, captive breeding plans for all three species were pursued.

SILENT VALLEY

Structure

Silent Valley Movement in Kerala was against the construction of a hydroelectric dam on the river Kunthipuzha under the Kudremukh project.

11.1 INTRODUCTION

"If the misery of our poor be caused not by the laws of nature, but by our institutions, great is our sin."

[**Charles Darwin**]

The mainstream development models implemented particularly in the Third World have had devastating effects on the ecology and environment of these countries to the extent of endangering the very existence of life forms on the planet earth. The basic problem with the development models prescribed and implemented is the unscrupulous exploitation of nature for short term economic gains of a few powerful individuals. The totalising imperatives of this new wave of development destroyed the forests and ultimately destabilised the 'blue planet'. In the post-war period there was a strong faith in the development models proposed by the west. Most of the developing countries followed these dominant models without raising any question. In India, the large dams were viewed as the "icons of development". Most often, the beneficiaries of these development models in India were the big farmers and the industrialists. Under these circumstances the traditional communities were totally marginalised and they were 'silenced' in the name of "nation building" and "development". In the process, they were evacuated from their homeland without any proper rehabilitation or compensation from the government. The most victimised among these sections are the *adivasis* and other deprived sections.

Large scale deforestation had taken place in the name of development in different parts of India. The destruction of the forests and the building up of huge dams resulted in the drying up of many water abundant rivers, other water bodies and ultimately deprived the local communities of their livelihood.

The growing awareness among the *adivasis* and such excluded sections led to the emergence of large scale protest movements against the concerted efforts of the privileged sections of the society to conquer the forests in the name of development. The movement for protecting 'soil and water' has contributed to the contemporary discourse on development politics. There are assertions from the deprived sections against the well thought out designs of exploitation in the name of development and modernisation. People joined together cutting across parochial social and formal political divisions in the society

to protect their right to livelihood. The civil society has become more active in environmental protection movements and gained acceptance beyond the formal political format. The strong feeling is that major political parties failed to address these types of issues. The need of the time is the active participation of the people in the forest conservation programmes and activities.

In this context we are discussing here the success story of an environmental protection movement in the Silent Valley in the Palghat district of Kerala against the proposed Hydro electric project during the late 1980s. The movement was locally initiated with the strong support from the civil society and later on it was taken up by the Kerala Sastra Sahitya Parishad (KSSP) - the People's Science Movement of Kerala -and finally the government was forced to abandon the project. In a Post-Gandhian perspective, the movement was totally a non-violent one in a non-political space.

As has already been noted, the modern development models failed to address the fundamental base of the human habitation, the environment. In this context, there are many attempts to go beyond the established models of development by local initiatives, which include the resistance against the annihilation of the forest reserve in the name of 'development' and also, the local initiatives for formulating a nature-friendly model of development. The movement in the Silent Valley is noted for its non-political character and admired for its seminal contribution towards creating awareness among the people on the importance of protecting the evergreen forests.

Aims and Objectives

After studying the Unit, you will be able to understand:

- The importance of protecting the forests through people's initiative
- The basic characteristics of the 'new social movements'
- The catastrophic effects of the big projects on environment
- The power of non-violent interest articulation in the civil society and
- The importance of a vibrant civil society in a democratic system.

11.2 THE IMPORTANCE OF 'SILENT VALLEY'

The Silent Valley National Park is one of the last undisturbed rain forests and tropical moist evergreen forests in India. The park is located in the Nilgiri Hills, Palakkad District in Kerala, South India. The first English intrusion into the watersheds of the Silent Valley area was in 1847 by the botanist Robert Wight. The British named the area 'Silent Valley' because of a perceived absence of noisy Cicadas**.** It is estimated to have a continuous record of not less than 50 million years of evolution. In 1914 the forest of the Silent Valley area was declared a Reserve Forest. However, from 1927 to 1976 portions of the Silent Valley forest area were subjected to forestry operations.

The Silent Valley is rectangular, 7 km (east-west) X 12 km (north-south). Located between 11o03' to 11o13' N latitude and 76o21' to 76o35' E longitude, it is separated from the eastern and northern high altitude plateaus of the (Nilgiris Mountains) by high continuous ridges including Sispara Peak (2,206 m) at the north end of the park. The park gradually slopes southward down to the Palakkad plains and to the west it is bound by irregular ridges. The altitude of the park ranges from 658 m to 2328 m at Anginda

Peak, but most of the park lies within the altitude range of 880 m to 1200 m. Soils are blackish and slightly acidic in the evergreen forests where there is good accumulation of organic matter.

The Kuntipuzha River stretches the entire 15 km length of the park from north to south and fall into the Bharathapuzha. Kuntipuzha divides the park into a narrow eastern sector of width 2 kilometers and a wide western sector of 5 kilometers. The river is characterised by its perennial crystal clear water. The main tributaries of the river, Kunthancholapuzha, Karingathodu, Madrimaranthodu, Valiaparathodu and Kummaathanthodu originate on the upper slopes of the eastern side of the valley. The river is uniformly shallow, with no flood plains or meanders. Its bed falls from 1,861 m to 900 m over a distance of 12 km, the last 8 km being particularly level with a fall of only 60 m. Kuntipuzha is one of the less torrential rivers of the Western Ghats, with a pesticide-free catchment area.

Silent Valley gets copious amounts of rainfall during the monsoons, but the actual amount varies within the region due to the varied topography. The mean annual rainfall ranges from over 5000 mm in the Neelikal area in the west to around 3200 mm on the eastern side of the park. The park being completely enclosed within a ring of hills has its own micro-climate and probably receives some convectional rainfall in addition to rain from two monsoons. In general the rainfall is higher at higher altitude and decreases from the west to east due to the rain shadow effect. Eighty per cent of the rainfall occurs during the south-west monsoon between June and September. It also receives significant amount of rainfall during the north-east monsoon between October and November. The mean annual temperature is 20.2°C. The hottest months are April and May when the mean temperature is 23°C and the coolest months are January and February when the mean temperature is 18°C. The relative humidity is consistently high (above 95%) between June and December because of the high rainfall.

The valley is famous for many rare species of birds and animals. Birdlife International listed 16 bird species in Silent Valley as threatened or restricted: Nilgiri Wood-pigeon, Malabar Parakeet, Malabar Grey Hornbill, White-bellied Tree pie, Grey-headed Bulbul, Broad-tailed Grass bird, Rufous Babbler, Wynaad Laughing Thrush, Nilgiri Laughing Thrush, White-bellied Short wing, Black-and-rufous Flycatcher, Nilgiri Flycatcher, White-bellied Blue-flycatcher, Crimson-backed Sunbird and Nilgiri pipit. Rare bird species found here include Ceylon Frogmouth and Great Indian Hornbill. The 2006 winter bird survey discovered Long-legged Buzzard, a new species of raptor at Sispara, the park's highest peak. The survey found 10 endangered species recorded in the IUCN Red List including the Red winged crested cuckoo, Malabar Pied Hornbill, Pale harrier. The area is home to 15 endemic species including the Black-and-orange Flycatcher. It recorded 138 species of birds including 17 species that were newly observed in the Silent Valley area. The most abundant bird was the Black bulbul.

The mammals in the valley include Gaur, largest of all wild cattle. There are at least 34 species of mammals at Silent Valley including the threatened Lion-tailed Macaque, Niligiri Langur, Malabar Giant Squirrel, Nilgiri Tahr, Peshwa's Bat (Myotis peshwa) and Hairy-winged Bat. There are nine species of bats, rats and mice. Fourteen troops of lion-tailed macaque, eighty-five troops of Nilgiri langur, fifteen troops of bonnet macaque and seven troops of Hanuman langur were observed. Of these, the Nilgiri langur was randomly distributed, whereas the lion-tailed macaque troops were confined to the southern sector of the Park. Bonnet macaques and Hanuman langurs were occasional visitors. The tiger,

leopard (panther), leopard cat, jungle cat, fishing cat, Common Palm Civet, Small Indian Civet, Brown Palm Civet, Ruddy Mongoose, Stripe-necked Mongoose, Dhole, clawless otter, sloth bear, small Travancore flying squirrel, Indian pangolin (scaly anteater), porcupine, wild boar, sambar, spotted deer, barking deer, mouse deer and gaur also live here. There are at least 730 identified species of insects in the park. 33 species of crickets and grasshoppers have been recorded of which one was new. 39 species of true bugs (six new) and two species of Homoptera (both new) have been recorded. 128 species of beetles including 10 new species have been recorded.

Over 128 species of butterflies and 400 species of moths live here. A 1993 study found butterflies belonging to 9 families. The families Nymphalide and Papilionidae contained the maximum number of species. 13 species were endemic to South India, including 5 species having protected status. 7 species of Butterflies were observed migrating in a mixed swarm of thousands of butterflies towards the Silent Valley National Park. In one instance an observer noted several birds attempting to catch these butterflies. The bird species included the Pied Bushchat Saxicola caprata, Nilgiri Pipit Anthus nilghiriensis, Tickell's Warbler Phylloscopus affinis, Greenish Leaf-Warbler Phylloscopus trochiloides and the Oriental White-eye Zosterops palpebrosa.

The flora of the valley include about a 1000 species of flowering plants, 108 species of orchids, 100 ferns and fern allies, 200 liverworts, 75 lichens and about 200 algae. In addition to facilitating recharge of the aquifer, water retention of the catchment basin and preventing soil erosion, every plant in the park from the smallest one celled algae to the largest tree in the forest has unknown potential for beneficial innovations in biotechnology.

Angiosperm flora currently identified here includes 966 species belonging to 134 families and 599 genera. There are 701 Dicotyledons distributed among 113 families and 420 genera. There are 265 Monocotyledons here distributed among 21 families and 139 genera. Families best represented are the Orchids with 108 species including the rare, endemic and highly endangered orchids Ipsea malabarica, Bulbophyllum silentvalliensis and Eria tiagii, Grasses (56), Legumes (55), Rubiaceae (49) and Asters (45). There are many rare, endemic and economically valuable species, such as cardamom Ellettaria cardamomum, black pepper Piper nigrum, yams Dioscorea spp., beans Phaseolus sp., a pest-resistant strain of rice Oryza Pittambi, and 110 plant species of importance in Ayurvedic medicine. Seven new plant species have been recorded from Silent Valley in 1996 including Impatiens sivarajanii, a new species of Balsaminaceae.

Six distinct tree associations have been described in the valley. Three are restricted to the southern sector: (Cullenia exarillata & Palaquium ellipticum), (Palaquium ellipticum) and Mesua ferrea (Indian rose chestnut) and (Mesua ferrea & Calophyllum elatum). The remainders are confined to the central and northern parts of the Park: (Palaquium ellipticum & Poeciloneuron indicum), (Calophyllum elatum & Ochlandra sp.) and (Poeciloneuron indicum & Ochlandra sp.) A study of natural regeneration of 12 important tree species of Silent Valley tropical rain forests showed good natural regeneration of all 12 species. The species studied were Palaquium ellipticum, Cullenia exarillata, Poeciloneuron indicum, Myristica dactyloides, Elaeocarpus glandulosus, Litsea floribunda, Mesua nagassarium, Cinnamomum malabatrum, Agrostistachys meeboldii, Calophyllum polyanthum, Garcinia morella and Actinodaphne campanulata.

There is a huge hollow Kattualying tree here which can fit 12 people inside. Throughout human history about 10% of the genetic stock found in the wild has been bred into

palatable and higher yielding cereals, fruits and vegetables. Future food security depends on the preservation of the remaining 90% of the stock through protection of high biodiversity habitats like Silent valley.

The National Bureau of Plant Genetic Resources of Indian Council of Agriculturaal Research, ICAR (India), Plant Exploration and Collection Division has identified Silent Valley as high in bio-diversity and an important Gene Pool resource for Recombinant DNA innovations. An important example of use of wild germplasm is gene selection from the wild varieties of rice Oryza nivara (Central India) and Oryza Pittambi found in Silent Valley for the traits of broad spectrum disease resistance in high yielding hybrid rice varieties including IR-36, which are responsible for much of the green revolution throughout Asia.

11.3 THE HYDRO ELECTRIC PROJECT

At first, the Silent Valley got world attention not because of its rich natural diversity, but the successive struggle of the native people against the proposed hydroelectric project in the valley by the Kerala State Electricity Board [KSEB]. In 1928 the location on the Kunthipuzha River at Sairandhri was identified as an ideal site for electricity generation and in 1958 a study and survey of the area was conducted and a hydroelectric project of 120 MV costing Rs. 17 Crore was proposed by the Kerala State Electricity Board. Plans for a hydroelectric project that threatened the park's high diversity of wildlife stimulated an Environmentalist Social Movement in the 1970s called 'Save Silent Valley' which resulted in the cancellation of the project and the creation of the park in 1980. If the project was implemented, the reservoir would have submerged 8.3 km² of virgin rainforest and threatened the endangered Lion-tailed macaque. In 1976 the Kerala State Electricity Board announced a plan to begin dam construction and the issue was brought to the notice of the public.

The Kerala electricity board had started construction works in the proposed region. A vigorous public debate had taken place about the project. The scientific community, political parties, local people, activists and the civil society in general were included in this debate. However, the KSEB announced that it obtained clearance for the construction of the project from the Planning Board and the Science and Technology Department, Government of Kerala. But the fact is that it failed to obtain clearance from any of the concerned authority. The Morarji Desai government at the centre instructed the state government that sanction should be given to KSEB overruling the objections raised by the Science and Technology Department of Government of Kerala and the science community in the state. The project became a prestige issue for the KSEB, the Kerala government and the Prime Minister of the country. On the other side, the science community became more and more aware of the need for intensifying the resistance movement for protecting the rich diversity of the Silent Valley. Finally the science community in Kerala understood that they could not, on their own, fight the cause and they felt that coordinated efforts of both the scientific community and the local people were inevitable for the conservation of the forests.

It was very clear that the authorities who proposed the dam construction have not taken into consideration the kind of destruction that would set in motion in the entire geographical area. In this context it is worthwhile to note that the disastrous earthquake in Koyna in 1968 had been attributed to the weight of water in the Koyna reservoir. The effect of Aswan High Dam on the Nile Delta had been disastrous. Stoppage of flooding

and consequent loss of fertility, increase of soil toxicity due to absence of flooding, reduction of still and consequent rapidity of current causing accelerated erosion of banks, stagnation of water and consequent increase in mosquitoes and diseases especially bilharzias had all added together. The Idukki Project Hydel project in Kerala submerged the entire natural forests. It was widely understood that the proposed dam would alter the eco-system of the valley.

11.4 MOVEMENT AGAINST THE PROJECT

It is very important to note that an environmental movement like the *Silent Valley Movement* got national attention during the 1980s when the state-led development projects were dominating the scene. The dams were viewed as the 'icons' of development. The movement, in unequivocal terms, underlined the importance of protecting the environment for the generations to come. Protecting the lion tailed Macaque became the symbol of non–violent struggle to save the evergreen forests from total destruction. Many environmental groups like the Narmada Bachao Andolan (NBA), Bombay Natural History Society (BNHS) and Silent Valley Action Forum participated in the campaign. The prominent leaders were Vandana Shiva, Medha Patkar, Sundarlal Bahuguna, Baba Amte and Sunita Narain. The campaigns launched through the media, both print and electronic, generated public opinion in favour of the protection of the ecosystem of the silent valley.

As is stated elsewhere, the movement was first initiated by the local people and was subsequently taken over by the Kerala Sastra Sahitya Parishad (KSSP). Various scientific studies conducted by KSSP unequivocally emphasised the need for the protection of ecosystem in its pristine form for serving the interests of mankind. It was the biologist leaders of KSSP who identified the importance of protecting the valley because of its rich biodiversity. They had arranged several public meetings to educate the people. As a result most modern technical terms like the 'genetic diversity' became a household word in Kerala. Even concepts like 'gene pool' and 'deme' became part of the general vocabulary. The studies of the KSSP revealed that very limited section of the people would benefit from the proposed project; specifically, a large chunk of the electricity produced there would go for industrial purposes. Another argument was that by destroying the forest, the energy sources of vast majority of the poor people would be lost once and for all. The KSSP generated public opinion against the project. It had science groups all over the state and through newsletters and journals it had spread the message among the students and youth as also the general public. It had sent a memorandum to the Kerala government about the issues and problems involved. It had organised street plays, exhibitions, public debates, and also conducted a 'marathon march' which covered around 400 villages. The student community also rose against the proposed project and it was the first time in the history of the state where the students agitated for the protection of the environment. Some celebrities who were actually not part of the environment movement like KPS Menon (Sr.) extended support to the cause of the Silent Valley.

The campaign of KSSP was based on a distinct understanding of the following factors:

1. Vested interests, those who reap benefit from the felling of trees from deep forests and other similar activities, were getting protection from the powerful political class.

2. The achievements of Science and Technology are indiscriminately used for the promotion of the interests of the upper crest in the society.

3. It is the responsibility of the People's Science Movement to fight for the protection of the interests of common man and to be in the forefront of struggles to protect the environment to make the planet earth safe for the future generations.

4. Forest conservation is possible only through diverting people's struggles against the policies of the State, which is supporting the interests of certain sections of the population.

As a result of the massive campaign launched by KSSP, the Central Government appointed Dr. M.S. Swaminathan, a leading plant geneticist and agricultural Scientist to enquire about the issue. He visited the Silent Valley area and suggested that 389.52 km^2 including the Silent Valley (89.52 km^2), New Amarambalam (80 km^2), Attappadi (120 km^2) in Kerala and Kunda in Tamilnadu (100 km^2) reserve forests, should be developed into a National Rainforest Biosphere Reserve.

In 1983, the Central Government instructed the State government to abandon the Project and on November 15, the Silent Valley forests were declared as a National Park. On September 7, 1985, the Silent Valley National Park was formally inaugurated. On September 1, 1986 Silent Valley National Park was designated as the core area of the Nilgiri Biosphere Reserve. Since then a long-term conservation effort has been undertaken to preserve the Silent Valley ecosystem.

The Silent valley movement was in several ways crucial to other environmental movements in India. The seminal contribution of the Silent Valley movement is that it educated people regarding the importance of environmental protection. It is further realised that effective environmental protection can be achieved only through the active participation of local people in collaboration with the Science Community with the committed involvement of the civil society.

11.5 SUMMARY

It is very significant to note that the post-industrial developmental models totally discarded the importance of protecting the environment for the very survival of the mankind on the planet earth. In most of the developing countries, the building up of huge dams was the symbol of modern development. In India it was viewed as the 'Temples of Development'. However, the construction of big dams brings forth several environmental problems. But it was overshadowed by the slogans of national development and nation building. In the name of development, the native people were evacuated from their home land and the forests of rich diversity were destroyed. In this scenario, the active involvement of the civil society actors for the conservation of the forests and the natural resources has redrawn the boundaries of politics. The new social movements addressed these problems through the victim's angle and deconstructed the very idea of development. The Silent Valley movement was the beginning of such movements in India. It is very clear that the rejuvenation of the Gandhian developmental discourse is the need of the time.

11.6 TERMINAL QUESTIONS

1. Write an essay on the Silent Valley Movement.

2. How do you look at the Silent Valley Movement from the angle of the new social movements?

3. Explain the role of the KSSP in the Silent Valley movement.

4. The Silent Valley activism is a new beginning to the forest conservation. Elucidate.

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Case study: Save the Western Ghats Movement (SWGM)

The Save the Western Ghats Movement (SWGM) was a landmark event in environmental activism in India. It was one of the first of its kind in the country and became the model for numerous campaigns all over India.

Save Western Ghats March

- This year marks the 30th anniversary of the remarkable but relatively little known ‘Save Western Ghats March’, a response to the socio-ecological challenges the area grappled with.

- A diverse set of people – scientists, anthropologists, sociologists, activists, journalists and local communities—marched together for 100 days along the length of ghats and met at a conference in Goa to discuss the issues.

- The march was as much an exercise in envisioning the future as it was an acknowledgement of the past—of the extreme richness of this ancient mountain range that extends from River Tapti to Kanyakumari.

- Straddling six states, from Gujarat to Kerala and Tamil Nadu, the 1600-odd kilometre-long Western Ghats is home to an astonishing diversity of life and supports innumerable human communities and cultures.

- It is an ecosystem that is 50 million years old; humans made an entry here only 12,000-15,000 years ago.

- 250 million people living in peninsular India are nourished by the many rivers that originate here.

- The forests are also home to hundreds of globally threatened species, including rare and unique ones like the Malabar torrent toad, the Nilgiri langur, Wroughton's free-tailed bat, the Nilgiri laughing thrush and many species of caecilians, the limbless amphibians.

- The Western Ghats are recognised today as one of the world's top 35 biodiversity hotspots and for very good reason.

- The idea of a 'biodiversity hotspot' was first articulated only in 1988.

- The mountain range is dotted by a number of wildlife sanctuaries, national parks, tiger and elephant reserves and traditional sacred groves (devrai in Maharashtra, deverakadu in Kodagu and kavu in Kerala) that have existed for centuries.

- Previous initiatives include 1970s agitation to save Silent Valley in Kerala from a dam project, the large conservation research and action project initiated here under the aegis of the Critical Ecosystem Partnership Fund (CEPF).

- A much more recent effort was to declare large parts of the ghats ecosensitive.

- It is estimated that only a third of the mountain range is still under natural vegetation, and this too is highly fragmented and degraded.

- The Save Western Ghats March from three decades ago remains hugely relevant – the Western Ghats are unique, important and still under threat.