ADVANCED

So long as this earth is full of nature (wild plants and animals), the human race is going to flourish"
Charakasamhita (4th - 5th Cent. A.D.)

Of all the nine planets, only the earth is known as "the living sphere". The presence of air and water make life and its continued existence possible on earth. Scientists however continue to probe the skies for the possible existence of extra terrestrial life.

Biodiversity or Biological diversity pertains to the variety of species including plants, animals, human beings, microorganisms and ecosystems in a region, country, continent or the entire globe. Biodiversity comprises every form of life from the tiniest microbe to the mightiest beast or tree.

How may species exist?

The greatest challenge to mankind is perhaps the estimation of biodiversity, for it would require millions of mandays of painstaking work by highly trained biologists.

The number of living organisms on earth has been roughly estimated to be between 5 and 50 million or more, though only about 1.4 million have been described, of which 750,000 are insects, 40,000 are invertebrates, 250,000 are plants and 360,000 pertain to the microbiota. According to some recent estimates, the number of insects alone may be as high as 10 million, but many believe it is more likely to be around 5 million. Most of the undescribed species are in the rain forests.

There is a tremendous difference in the number of species belonging to each category of organism.

Relative number of described species in major taxa

Taxon	No.of described species
Monera (bacteria, blue-green algae)	4,760
Fungi	46,983
Algae	26,900
Plantae (multicellular plants)	248,428
Protozoa	30,800
Porifera (sponges)	5,000
Coelenterata (jellyfish, corals, comb jellies)	9,000
Platyhelminthes (flatworms)	12,200
Nematoda (roundworms)	12,000
Annelida (earthworms, etc.)	12,000
Mollusca (mollusks)	50,000
Echinodermata (starfish etc.)	6,100
Insecta	751,000
Non-insect Arthropoda (mites, spiders, crustaceans, etc.)	123,161
Pisces (fish)	19,056
Amphibia (amphibians)	4,184
Reptilia (reptiles)	6,300
Aves (birds)	9,040
Mammalia (mammals)	4,000

Source: Sinha, Rajiv K. 1997, Global biodiversity, the library of life and the secret of human existence on earth, INA Shree Publishers, Jaipur, India.

TYPES OF BIODIVERSITY

Biodiversity can be studied at three different levels : genetic, species and ecosystem.

Genetic diversity

It is concerned with the variation in genes within a particular species. Many billion individuals are produced through sexual reproduction. Each differs from the other in its hereditary constitution or the genetic information contained in its genes. It is this difference which has given us beautiful butterflies, roses, parakeets or coral in a myriad hues, shapes and sizes.

Examples: Brown Bear, Sloth Bear, Himalayan Black Bear; Himalayan Tahr, Nilgiri Tahr

Species diversity

It refers to the variety of living organisms on earth. Species differ from one another markedly in their genetic makeup and do not interbreed in nature. Closely related species however have much of their hereditary material in common. For instance, humans and chimpanzees have about 98.4 per cent of the same genes.

Ecosystem diversity

This refers to the variety of habitats. A habitat is the sum total of the climate, vegetation and geography of a region. There are several kinds of habitats around the world. Change in climatic conditions is accompanied by a change in vegetation as well. For instance cactus and thorny scrub replace grassland or forests as the climate changes from temperate to hot and dry. Each species is adapted to a particular kind of environment. As the environment changes, species best adapted to that environment become predominant. Thus the variety or diversity of species in the ecosystem is influenced by the ecosystem itself. Geographical changes within an ecosystem lead to genetic diversity or diversity within the same species. In India the Himalayan Tahr is found in the Eastern Himalayas, while the Nilgiri Tahr inhabits the slopes of the southern Western Ghats.

Examples: Corals, Grasslands, Wetland, Desert, Mangrove, Tropical rain forests, etc.

THE MEGADIVERSE NATIONS

Biodiversity is not evenly distributed among the world's countries. Barely a dozen countries lying partly or entirely in the tropics account for 60 to 70 percent of the world's biodiversity. They are referred to as Megadiverse Nations. Species richness or diversity is high in the tropics and the cold depths of the oceans as both these regions are somewhat protected from disturbances due to inaccessibility. Rapid change in environment as at the seashore and long tracts of mountains also account for high species turnover.

The 12 megadiverse nations of the world

The countries on the megadiversity list include Brazil, Colombia, Ecuador, Peru, Mexico, Zaire, Madagascar, Australia, China, India, Indonesia and Malaysia.

Countries	No.of.mammals	No.of.birds	No.of.reptiles	No.of.amphibians	No.of.angiosperms
Australia	255	-	686	197	23,000
Brazil	428	622	467	516	55,000
China	394	1195	270	265	27,000
Columbia	359	1721	383	407	45,000
Ecuador	280	1447	345	358	15,000
India	350	1200	353	197	15,000
Indonesia	515	1519	600	270	20,000
Madagascar	-	250	269	144	10,000
Malaysia	293	1200	294	171	15,000
Mexico	449	1010	717	282	25,000
Peru	361	1703	297	251	20,000
Zaire	409	1086	280	216	10,000

Source: Global biodiversity strategy, Guidelines for action to save, study and use earth's biotic wealth, sustainably and equitably, World Resource Institute (WRI), the World Conservation Union (IUCN), United Nations Environment Programme (UNEP), 1992.

India is one of the richest nations in terms of biological diversity. India owes this to its position in the tropical and subtropical latitudes with their inherent wealth of life. Rapid change in environment occurs at the long coastline and at the edges of the deserts. India also possesses islands like the Andaman and Nicobar and Lakshadweep with their own endemic species, and mountain ranges like the Himalayas and the Western and Eastern Ghats. All these factors help to make it a megadiverse nation.

Group	No. of species in India	No.of species in the world
Mammals	372	4,231
Birds	1224	8400
Reptiles	408	5375
Amphibians	197	2000
Fishes	2546	23,400
Flowering Plants	15000	800,000

Two of India's great mountain ranges, the Eastern Himalayas and the Western Ghats have been designated among the world's eighteen 'hotspots' of biodiversity. The third most significant area of biodiversity in India is the island ecosystem of the Andamans and Nicobar.

No. of endemic species found in the hotspots of megadiverse India

Region	Mammals	Plants	Reptiles	Amphibians
E. Himalayas	not available	3500	20	25
Western Ghats	7	1600	91	84
Andaman and Nicobar	33	144	23	2

WHY IS BIODIVERSITY NECESSARY?

Does the earth really need to have about 50 million different species? If some species are lost or become extinct, the total number would be affected only minutely. So why is the conservation of biodiversity of utmost importance today? The answer to these questions lies in the web of life that links each and every form of life on earth.

The food chain

The building blocks of plants, animals and humans are identical, and are made up of the four elements, carbon, oxygen, nitrogen and hydrogen. These elements are available in the environment in the air, water and soil. However, only green plants can absorb nitrogen from the soil through their roots and use sunlight and water by a process called photosynthesis to produce energy. They are known as producers. Animals and humans get their food only by consuming plants or other animals. Therefore they are known as consumers.

The chain that links consumers to producers is called the food chain or web of life. Every living creature is to be found on a food chain. There are several food chains and depending on the environment it can be complex or simple.

All life on earth is interdependent and man is only a strand in this delicate web of relationships.

Food chains in water

Consider a very short and simple food chain in water . Green algae are eaten by water fleas, which are in turn eaten by hydras. An example of a slightly longer chain is, plankton - krill - small fish - predator fish - seal - man.

Food chains on land

Insects like the caterpillars feed on green leaves which are eaten by small birds like the sparrow. Carnivorous birds like the hawk hunt the sparrows. When the hawk dies its remains are returned by other insects like the sexton beetle to the soil, where they become nutrients for the tree.

Green grass is eaten by grazing animals like the deer, bison, zebra and cattle. These are in turn eaten by carnivores like the lion, tiger, leopard and man.

Grasshoppers eat grass and are themselves eaten by frogs. Snakes eat frogs and rodents.

Fig trees are pollinated by tiny insects called fig wasps. The female wasp enters a fig flower to lay her eggs and dies. In the process she brings in fig pollen which fertilises the flower to produce the fig fruit. The eggs develop in the flower to larvae which feed on the fruit and become adult wasps that mate within the flower. The female wasp - whose life span is only two days - then leaves covered with the pollen in search of a fig in flower. Thus both fig trees in fruit and in flower should be present throughout the year. Fruit eating mammals hence have figs throughout the year and help in the dispersal of its seed just as they disperse seeds of other fruits. Therefore other plants are also dependent on the fig wasp which initiates the pollination.

All food chains are fragile. If a link in the chain is broken, it sets off a series of reactions.

If snakes are destroyed the population of rats and moles would increase dramatically and they would devour crops and grains at an alarming rate.

The use of pesticides destroys insects, but this also starves the birds. The predator birds dependent on small birds and rats for their food then reduce in number and the rat population will go unchecked.

If the predator animals are hunted down, the grazing animals multiply in large numbers and will eat up all the green grass, leaving the land barren and unproductive.

In contrast, if the predators were in excess of the grazing animals they would overrun the land and man, himself short of food, will become their prey.

When the ocean currents become unusually cold, plankton do not survive and this ultimately leads to the death of seals - the staple food of the Eskimos.

An important conclusion that can be drawn on studying the food chain is that the amount of green plants in any environment should be much more than the animals or insects that feed on them and they in turn should be in excess of the predator species. This is the origin of the famous Chinese saying that ***"only one tiger can live on a hill"***. In the ecological pyramid only one consumer is shown at the apex while the broad base is filled with the green plants.

Thus the importance of each and every creature in the web of life is evident. Tampering with the food chain only produces negative results, leading to the destruction of species. This shows why biodiversity and all its components are essential to maintain the balance of nature. Man is only a strand in the delicate web of relationship in the global ecosystem. Every time a species becomes extinct, the strand is broken and man himself moves closer to his doom.

The seriousness of the problem is multiplied enormously when the plants get extinct, as they form the base of the ecological pyramid constituting the "primary producer" of the food chain upon which depend all other species of life including human beings. Loss of plants breeds desertification and loss of soil wealth.

Our own species is subject to evolutionary processes just as any other life form and the more we learn about other species, the better will we be equipped to manage ourselves.

The greater the diversity of wild species the greater is the opportunity for the production of new varieties. Almost all crops and livestock on which we depend for food production are hybrids - the result of cross breeding - originally from wild species. Compared to their wild ancestors, hybrid species are vulnerable to an epidemic or any abnormal climatic variation, which may completely wipe them out. Without their wild ancestors, it might not be possible to replace them.

The medicinal qualities of a variety of plant species are yet to be unfolded. The greater the variety of wildlife we conserve, the more will we be able to learn from it.

CAUSES FOR BIODIVERSITY LOSS

Today, we are rapidly eliminating the conditions necessary for the continued existence of biodiversity due to overexploitation and ignorance. These losses have now reached critical levels and are beginning to be addressed as biodiversity loss. Mankind has altered the environment for millennia, causing some species to prosper and others to suffer. Human activity is now changing the natural environment at a rate unprecedented in evolutionary history.

Loss of biodiversity is a threat to civilization second only to thermo-nuclear war in its severity. The consequences could be quite incalculable. All other environmental problems like pollution, global warming and ozone depletion can be overcome but not erosion of biodiversity or extinction of species. Species once lost from the face of the earth cannot be brought back.

The major causes for biodiversity loss

Loss of biodiversity occurs when either the habitat essential for the survival of a species is destroyed, or particular species are destroyed. The former is more common as habitat destruction is a fallout of development. The latter reason is encountered when particular species are exploited for economical gain or hunted for sport or food. The African elephants whose numbers have drastically declined are ruthlessly killed for their tusks, while the lions and tigers are being hunted for sport and the dodo, a bird native to Mauritius, was exploited for its tasty flesh while at the same time its habitat was destroyed and thus became extinct.

Extinction of species may also be due to environmental factors like ecological substitutions, biological factors and pathological causes which can be caused by nature or man.

Natural causes for the loss of biodiversity

Natural causes include floods, earthquakes, landslides, natural competition between species, lack of pollination and diseases.

Man-made causes for the loss of biodiversity

- Destruction of habitat in the wake of developmental activities like housing, agriculture, construction of dams, reservoirs, roads, railway tracks, etc.

According to Food and Agricultural Organisation (FAO), the closed tropical forests are disappearing at the rate of 7.5 mha per year and the open forests at the rate of 3.8 mha a year. According to UNEP, roughly 16-20 mha of tropical forests are being burnt or axed each year. i.e. more than the size of a football pitch every second for various developmental activities and for meeting the requirements of food, fodder and fuel for the growing human and livestock population.

The rate of deforestation in the tropics is much faster than in other parts of the world and is equivalent to about 21.5 ha/min. In India, about 1.5 mha of prime forests were felled during the 1980s. This has played a major role in the loss of biodiversity.

- Pollution, a gift of the industrial revolution can be given the pride of place for driving a variety of species in air, water and land towards extinction.

Motorcars, air-conditioners and refrigerators, the three symbols of a modern, affluent society, have been instrumental in global warming and ozone depletion. They have drastically altered the climate with disastrous effects on the various species. Factories and power stations spewing out poisonous gases and effluents have fouled up the environment bringing death and disease to many species. Oil spills and discharge of sewage have ravaged the oceans and coastal habitats.

- A large number of species are threatened by overhunting, poaching and illegal trade. In 1979, Africa had an estimated 1.3 million elephants. Less than 650,000 are left today.
- Indiscriminate use of toxic chemicals and pesticides and overexploitation of wildlife resources for commercial purposes are responsible for the rapid decline in the number of some species. The tiger for instance is hunted for its claws and other parts believed to be effective cures for various ailments of man. Snakes and crocodiles are killed in large numbers for their skin and minks, sable, ermine, etc., are in demand for the luxury and warmth of their fur.
- Genetic erosion arises from the loss (due to commercial and anthropogenic pressures) of habitats rich in biodiversity and from the disappearance of the traditional conservation practices of wild species in their habitats by rural and tribal people.

"We can marvel at the colours of a butterfly, the grace of a giraffe, the power of an elephant, the delicate structure of a diatom. Every time a species goes extinct, we are irreversibly impoverished"

Norman Myers, (1986).

Even the loss of a single species is a tragedy, because each form of life is a storehouse of irreplaceable genetic resources. Extinction is an irreversible process and when a species becomes extinct it sets off a cascade of extinctions.

What is the present rate of extinction of species?

In the past, extinctions were mainly effected by natural causes. But today man is the cause of most if not all extinctions. According to current estimates, on an average 900,000 vertebrate species have become extinct every 1 million years during the last 200 million years. This is roughly about 90 species every century. In the case of higher plants it is estimated that roughly 1 species has become extinct every 27 years.

In recent years oceanic islands have suffered mass extinctions due to destruction of lowland forests and introduction of predators, disease and aggressive, weedy plants by man. Since their area is small the population of species in a given area is limited. It is easier for smaller numbers of species to be destroyed completely. Coral reefs are marine equivalent of rain forests and are to a greater variety of species than any other in the marine environment; but, their submerged plight is less obvious than that of the rain forests. The movement of a trawler through them is the equivalent of a bulldozer through the rain forests. About 75% of birds and mammals that have become extinct in recent years were island dwelling species.

The rapid destruction of the tropics and other diverse ecosystems has given rise to a genuine fear that a quarter of the world's biodiversity is under risk of extinction in the next 20-30 years. Available data suggests, that one species has become extinct every four years between 1600 and 1900 A.D. But from 1900 onward, the extinction rate averages one per year. In the last four hundred years, 120 species of mammals and 225 species of birds have become extinct in the world.

IUCN CATEGORIES OF THREAT

All plant and animal species are in a state of dynamic equilibrium and form a closed web in a stable ecosystem. However, even under natural conditions, extinction of species is brought about by geological and evolutionary changes in time and space. Natural disasters like earthquakes, floods and forest fires are the cause of habitat loss. The loss of habitat has been accelerated due to the predominance of the human beings on the land and the accompanying industrial revolution and population explosion. As a result, some of the most beautiful and interesting plant and animal species have been lost forever.

The accepted categories of existence or otherwise of plant and animal species is given below based on the International Union for Conservation of Nature and Natural Resources (IUCN).

Normal

Species whose population levels are considered to be normal for their survival.

Endangered

Species which are in danger of extinction. The survival of such species is difficult if the negative factors that have led to a decline in their population continue to operate. Endangered species include those whose numbers have been reduced to a critical level and those whose habitats are under threat.

Examples: Black buck, Crocodile, Wild ass, Indian rhino, Lion, Lion tailed macaque.

Vulnerable

Species whose population has declined to levels from where it is likely to move into the endangered category in the near future, if the negative factors continue to operate.

Examples: Blue sheep, Asiatic elephant, Gangetic dolphin.

Rare

Species with a small population that are at present neither endangered nor vulnerable but are at considerable risk. These species may move into the endangered or vulnerable category if the negative factors affecting them continue to operate.

Examples: Himalayan Brown Bear, Wild Asiatic Buffalo, Desert Fox and Hornbill.

Extinct

Those species which are not found after repeated searches of known or likely areas where they may occur. A species may be extinct from a local area, region, country, continent or the whole earth.

Examples: Asiatic Cheetah, Pink Headed Duck or Dodo.

Endemic

These are species which occur in a restricted area usually isolated by natural or geographical barriers.

Examples: Andaman Teal, Nicobar Pigeon and Andaman Wild Pig.

Animals in Danger

As wildlife become extinct or their population declines, the balance of nature is severely upset. The disappearance of a wild species can alter a food chain, upsetting the delicate balance between predator and prey and cause insect pests to multiply. Malaria is on the upsurge in Asia because of over harvesting of bull frogs which eat the mosquitoes spreading the disease.

Out of 350 species of mammals, 81 are greatly endangered. There are about 2100 species and sub species of birds which are endangered. Of the reptiles, the important ones are a species of tortoises, 5 species of monitor lizards and 3 species of crocodiles and turtles. Some snakes are hunted for their flesh, skin, hide, shell, teeth, bones etc.

Plants in Danger

Studies undertaken on flora in several parts of the world have shown that many plant species are in danger of extinction while some have become extinct recently. The International Union for Conservation of Nature and Natural Resources (IUCN) have estimated that about 10% of the world vascular plant species totalling about 20,000 to 25,000 species are under varying degrees of threat.

Endangered	Abies pindrow, Drosera burmannivahi
Vulnerable	Colchicum S.P, Luceum S.P., Magnolia griffithii.
Rare	Drosera burmanni, Gnetum ula.

BIOSPHERE RESERVES

The concept of biosphere reserves is the key to achieving the objectives of the MAB (Man and the Biosphere Programme) which aims at striking a balance between conserving biodiversity, encouraging economic and social development and preserving cultural values. Biosphere reserves are areas of terrestrial and marine ecosystems where, through appropriate management mechanisms, the conservation of ecosystems and their biodiversity is ensured. Biosphere reserves are designed to bring people and nature together to demonstrate how to both use and preserve nature.

In 1968, the UNESCO conference on the conservation and rational use of the biosphere within UNESCO was held. The primary goal of UNESCO-MAB is the exchange of scientific knowledge and management experience. There are currently more than 375 biosphere reserves in 85 countries, forming a global network of scientists and natural resource managers working to maintain the longterm survival of fragile ecosystems.

The biosphere can be defined in two different ways.

From the perspective of the physical scientist, the biosphere is that part of the earth that contains living organisms, viz., the atmosphere, the crust of the earth and water.

From the perspective of the ecologist, the biosphere is that part of the planetary ecosystem that is composed of living organisms. If we define all organisms as belonging to a single subsystem, that subsystem would be called Biosphere.

The biosphere encompasses all the life in air, water and soil.

Biosphere reserves in India

The basic purpose of creating biosphere reserves is the conservation of the biotic community as a whole. So far we have 7 biosphere reserves and 7 other potential sites have been identified to be declared as biosphere reserves.

Established Biosphere Reserves in India

Name of the Reserve	State	Area (sq.km.)
Nokrek	Meghalaya	50
Manas	Assam	600
Great Nicobar	Andaman & Nicobar	1,045
Nandadevi	Uttar Pradesh	2,000
Similipal	Orissa	2,750
Nilgiri	Karnataka, Kerala and Tamil Nadu	5,520
Sunderbans	West Bengal	10,330
Gulf of Mannar	Tamil Nadu	10,500

Proposed Biosphere Reserves in India

Name of the Reserve	State	Area (sq.km.)
Kaziranga	Assam	760
Kanha	Madhya Pradesh	940
North Andamans	Andaman & Nicobar	1,376
Namdapha	Arunachal Pradesh	2,500
Thar Desert	Rajasthan	3,162
Uttarkand	Uttar Pradesh	3,940
Rann of Kutch	Gujarat	5,000

BIOSPHERE RESERVES IN SOUTH INDIA

The Nilgiri Biosphere Reserve has been formed as per the guidelines of the UNESCO in tropical, terrestrial environmental ecosystem on 23.9.1986. The biosphere reserve extends over Karnataka, Kerala and Tamil Nadu in South India, and encompasses an area of approximately 5670 sq. km. The Nilgiri Biosphere Reserve covers certain forest areas in the Nilgiris, Periyar and Coimbatore districts. It includes the forested slopes of Nilambur and Nilgiri, the upper Nilgiri plateau, the Silent Valley and Siruvani Hills.

Flora and Fauna

The forest types found in the Nilgiris are, thorn scrub forest, dry deciduous forest, moist deciduous forest, wet evergreen forest, montane forest and grasslands (sholas) and marshes and swamps. Woody climbers and epiphytes are also found. Some of the common trees found here are sandal, Indian rosewood, bijasal, jackfruit, jamun, ironwood, rhododendron, hill gooseberry, etc. Many varieties of orchids and the unique kurinji shrub that produces a blue coloured flower to which the Blue Mountains owe their name are also found here. Climbers like the black pepper and numerous herbs thrive here.

Animals like the elephant, bison, lion tailed macaque, sloth bear, pangolin, Nilgiri tahr, etc., birds like the great Indian hornbill, Nilgiri pipet, Nilgiri wood pigeon, Nilgiri flycatcher, etc., and numerous snakes and invertebrates are common here.

Gulf of Mannar Biosphere Reserve

The Gulf of Mannar Biosphere Reserve is situated along the southern coast of Tamil Nadu. The biosphere reserve includes the Gulf, the adjoining coasts and also the small islands dotting the gulf. The reserve was set up on 18th February 1989 and covers an area of about 10,500 sq.km. The reserve also includes a Marine National Park.

The Gulf of Mannar with its islands provides a unique habitat for the living organisms, that are in close intimacy with water.

Flora and Fauna

About 160 species of algae have been recorded here of which some 30 species are edible seaweeds. The area is also rich in sea grasses which provide food for sea mammals, particularly the dugong. The mangrove vegetation of the islands consists of species of rhizophora, avicennia, brugeira and ceriops.

The Gulf area has beautiful coral reefs that harbour a wide variety of marine vegetation and animals. Productive beds of pearl oysters, prawn species, edible bivalves, sea anemones, ascidarians and the sea cow Dugong dugon occur in the Gulf and the Palk Bay.

Mammals like langur, jungle cat, smooth Indian otter, etc., birds like grey billed pelican, black ibis, spotted crane, Indian river tern, etc., reptiles such as crocodile, starred tortoise, sand boa, etc., and fishes such as salmon, heckel, etc., are found along the island.

MARINE BIODIVERSITY

The long and complex process of evolution of life began below the surface of the sea. Today oceans form the largest environment for living organisms on earth. A huge variety of living organisms inhabit every part of the ocean - from the surface water to the deepest depth. The inhabitants range from the billions of microscopic creatures that thrive on the surface water to the gigantic blue whales. The forms of animals and plant life in the waters are incredible in their biological diversity.

The ocean provides shelter to different kinds of life forms, thereby acting as a greater reservoir of marine biodiversity. By year 2000, 60% of the world's population will live or depend on the marine ecosystem.

Marine biodiversity includes 28 phyla of animals and 13 phyla of endemic animals. If plants and protista are considered, 88% of all phyla are found to be marine. Coral reefs and the mangrove vegetation zone are known as the most diverse communities in the seas. They include micro organisms such as algae, fungi, bacteria, protozoa, viroids and viruses, many species of mammals, fish, sponges and crustaceans. These animals form a place of high biological diversity. Therefore the world's biological diversity greatly depends on the ocean.

Until very recently, it was considered that man could not change the seas and their biological diversity. In the ocean, changes are taking place similar to those on land and much more rapidly. In the coastal zone, significant consequences can be expected of the Green House Effect and while human activities continue to extend beyond the shelf-edge, even those deep-sea reservoirs of biological diversity may be at risk.

On the other hand, marine ecosystems are most vulnerable to large-scale environmental changes. The oceans absorb all our waste and this alters the marine biological diversity, as they do not have internal adaptability. Proper conservation methods and sustainable management should be inculcated to restore this fast-changing habitat with its unique biodiversity.

MANGROVE ECOSYSTEM

Mangroves are salt-tolerant forest ecosystems of tropical and sub-tropical regions of the world. Along the sandy and rocky shores of estuaries and muddy sea coast, in places where any other tree would perish as a seedling, beneath daily tides and a salty diet, live and grow a special type of trees called the Mangrove vegetation. Mangroves anchor themselves to the soil by sending out long roots from trunks and branches. These act as stilts to support the tree and prevent it from toppling over. The muddy water where they live contains very little oxygen, but mangroves have an ingenious solution to this problem. The trees send out a second air-breathing root system.

Mangroves are the spawning grounds, nurseries and feeding grounds for economically important fishes and crustaceans. They act as a buffer zone and offer protection to vulnerable communities such as coral reefs. They also stabilize bottom sediments, control local mean water level and the direction of flow. The mangrove ecosystem acts as a shield against cyclones and high tide winds. The mangrove ecosystem acts as a permanent reservoir of biodiversity wherein it supports many fishes, shrimps, crabs, trees, birds, etc.

Recently, mangroves are exploited directly or indirectly for food, fodder, fuel, timber, medicines and fisheries. It is estimated that during the last thirty years, almost 28% of the mangrove regions in India have been reclaimed for agricultural purposes, industrialisation and urbanisation. This is causing serious ecological imbalances in the coastal environment. Aquaculture is also disturbing and displacing this unique ecosystem.

CULTURE AND BIODIVERSITY

Despite all threats, species diversity and diversity within species still thrive. Their continued existence is due to farmers and others like the several tribal communities living within the forest. Their cultural practices and knowledge systems have helped to nurture biodiversity.

Traditional beliefs and practices have helped to preserve flora and fauna - in certain areas - in their pristine glory, as a great ecological heritage for modern civilisation. Traditional practices still followed by the tribals do not commercialize forest products and never exploit them in an unsustainable manner.

The universe along with its creatures belongs to the Lord. No creature is superior to any other. Human beings should not be above nature. Let no one species encroach over the rights and privileges of other species.

Isha-Upanishads (1500-600 B.C.)

Sacred groves - a wealth of diverse and rare species

Nature worship is a tribal belief based on the premise that all creations of nature have to be protected. Such beliefs have preserved several virgin forests in pristine form called Sacred Groves (the forests of God and Goddesses). These patches of forest or parts of large forests have been left untouched by the local people and any interference with them is banned. The practice dates back to about 3000 to 5000 B.C.

Certain societies revere a particular tree which they have preserved from time immemorial. The Mundas and the Santhal of Bihar worship mahua (Bassia latifolia) and kadamba (Anthocaphalus cadamba) trees and the tribals of Orissa and Bihar worship the tamarind (Tamarindus indica) and mango (Mangifera indica) trees during weddings. Many a banyan tree is considered as sacred in India.

Indian society comprises of several cultures, each with its own set of traditional methods of conserving nature and its creations. Sacred qualities are often ascribed to springs, mountain peaks, plants and animals which are closely protected. Troops of macaques and langurs are found around temples. Around Bishnoi villages in Rajasthan, herds of blackbuck, chinkara and nilgai roam.

In densely populated Bangladesh, the only surviving population of the turtle species, Trionyx nigricans, lives in a pond sacred to a Muslim Saint called Byazid Bostan.

BIODIVERSITY CONSERVATION

Having been through the reasons for the need for biodiversity and the effects of loss of biodiversity it becomes evident that ultimately the survival of the human race itself is threatened. Therefore the conservation of biological diversity is of paramount importance to the survival of man and only he can initiate and sustain a strategy for the same.

- The main objectives and advantages of biodiversity conservation are as follows:
- Conservation of biological diversity leads to conservation of essential ecological diversity to preserve the continuity of food chains.
- The genetic diversity of plants and animals is preserved.
- It ensures the sustainable utilisation of life support systems on earth.
- It provides a vast knowledge of potential use to the scientific community.
- A reservoir of wild animals and plants is preserved, thus enabling them to be introduced, if need be, in the surrounding areas.
- Biological diversity provides immediate benefits to the society such as recreation and tourism.
- Biodiversity conservation serves as an insurance policy for the future.

The Conservation practices should include:

Policy shifts and integrated land use

Policy amendments are the necessary first step towards conservation. National policies dealing directly with forestry or influencing biodiversity indirectly through land tenure, rural development, family planning or subsidies for pesticides or energy can have significant impacts on the conservation of biodiversity. For e.g., removing subsidies for forest clearing in Brazil is a powerful response to deforestation.

Four major international moves are afoot to conserve biodiversity.

- Owing to the need for more conservation funding in developing countries, the World Bank and the United Nations Development Programme (UNED) have established the Global Environmental Facility in 1990 on a three year pilot basis.
- The international biodiversity strategy programme organised by the World Resources Institute, the World Conservation Union and UNEP involving more than 40 governmental and nongovernmental organisations from around the world released the global biodiversity strategy in February, 1992.
- Under UNEP's auspices, more than 150 nations worked to negotiate a "Convention on Biological diversity" at the "Earth Summit", in Rio de Janeiro, Brazil in 1992. This convention seeks to establish a legal framework governing international financial support for biodiversity conservation, the identification of international conservation priorities, and the transfer of technologies for both the conservation and the use of biodiversity.
- The Earth Summit produced Agenda 21, a plan of action on a number of issues, including biodiversity conservation in the 21st century.

Ex situ conservation

Conserving biodiversity outside the areas where they naturally occur is known as ex situ conservation. Here, animals and plants are reared or cultivated in areas like zoological or botanical parks.

Reintroduction of an animal or plant into the habitat from where it has become extinct is another form of ex situ conservation. For example, the Gangetic gharial has been reintroduced in the rivers of Uttar Pradesh, Madhya Pradesh and Rajasthan where it had become extinct.

Seedbanks, botanical, horticultural and recreational gardens are important centres for ex situ conservation.

In situ conservation

Conserving the animals and plants in their natural habitats is known as in situ conservation. This includes the establishment of

- National parks and sanctuaries
- Biosphere reserves
- Nature reserves
- Reserved and protected forests
- Preservation plots
- Reserved forests

Agrobiodiversity conservation

After the introduction of cotton, tobacco, sugarcane, sunflower, soyabean and so on, farmers became victims of monocultures in their greed for money. Therefore many of the indigenous varieties of crops were lost. Moreover, the hybrid varieties of fruits and vegetables (e.g. tomatoes), introduced for pulp are more susceptible to disease and pests. Though hybrid varieties are preferred, traditional wild varieties of the seeds should be conserved for future use in the event of an epidemic which would completely wipe out the hybrids.

Botanical gardens, agricultural departments, seed banks etc., alone should not be given the responsibility of agrobiodiversity conservation. Every farmer, gardener an cultivator should be aware of his role in preserving and conserving agrobiodiversity.

Conserved areas of Tamil Nadu

Wildlife sanctuaries	Area in hectares
Indira Gandhi Wildlife Sanctuary	96,003
Mundanthurai Wildlife Sanctuary	56,700
Srivilliputur Grizzled Squirrel Wildlife Sanctuary	48,520
Mudumalai Wildlife Sanctuary & National Park	39,946
Kalakad Wildlife Sanctuary	25,064
Mukurthi National Park	7,846
Point Calimere Wildlife Sanctuary	1,726
Vallanadu Blackbuck Wildlife Sanctuary	1,641
Gulf of Mannar National Park	623
Arignar Anna Zoological Park	510
Arignar Anna Zoological Park	510
Guindy National Park	300
Bird sanctuaries	
Pulicat Lake Bird Sanctuary	15,367
Vaduvur Bird Sanctuary	128
Kanjirangkulam Waterbird Sanctuary	104
Sithirangudi Waterbird Sanctuary	48
Udhaya Marthandapuram Bird Sanctuary	45
Vettangudipatti Waterbird Sanctuary	38
Biosphere Reserves	
Gulf of Mannar Biosphere Reserve	
Nilgiri Biosphere Reserve	
Categories of forests in Tamil Nadu	
Reserved Forest	1,948,600 hectares
Protected Forest	252,800 hectares
Unclassified Forest	61,400 hectares
Total area under forest cover	2,262,800 hectares

CONSERVED AREAS OF INDIA

The biodiversity in India is being conserved through the establishment of Sanctuaries, National Parks , Biosphere Reserves , Reserved Forests, etc., after the Wildlife Protection Act, 1972. But even before this Act had been passed, some states had their own legislations and the Indian Forest Act of 1927 allowed the setting up of wildlife sanctuaries.

Some of the important wildlife regulation acts are:

- Elephant Preservation Act, 1879
- The Indian Fisheries Act, 1897
- Wild Birds and Wild Animals Protection Act, 1912
- The Indian Forest Act, 1927
- Bengal Rhinoceros Act, 1932
- Haily National Park Act, 1936
- Bombay Wild Animals and Wild Birds Protection Act, 1951
- The Cruelty Against Animals Act 1960
- The Wild Life (Protection) Act, 1972
- The Forest (Conservation) Act, 1980
- Wildlife (Protection) Amendment Act, 1991
- The Conservation of Forest and Natural Ecosystems Act, 1994

National Parks and Sanctuaries

These have been created exclusively for protecting the wild flora and fauna in all parts of India and for the purpose of protecting and propagating wildlife.

Biosphere Reserves

Their basic purpose is the conservation of the biotic community as a whole. So far we have 7 biosphere reserves and 7 other potential sites have been identified to be declared as biosphere reserves.

Botanical Gardens

Their main objective is to study and conserve the diversity of plant life of a region or nation. This is known as ex-situ conservation under which rare and threatened plants may be raised in a botanical garden so as to conserve them for posterity. There are about 78 well established gardens in India.

Zoological Parks

Zoos or Zoological Parks are important centres for the ex-situ conservation of wild animals, particularly those which are rare and threatened with extinction. There are about 109 zoological parks, 53 deer parks, 13 safari parks, 7 snake parks, 26 breeding or education centres and 7 aquariums presently working for conservation.

PROJECTS TO SAVE THREATENDED SPECIES

Project Tiger

Project Tiger was initiated as a Central Sector Scheme in 1973 with 9 tiger reserves located in different habitat types in 9 different states. There are totally 18 Reserves in 13 states. At present tiger Conservation has been viewed in India not only as an effort to save an endangered species but, with equal importance, also as a means of preserving biotypes of sizeable magnitude.

Crocodile Breeding Project

The project was started in Orissa and then extended to several other states in April 1975 with UNDP assistance. The main objective was to protect the three endangered species of crocodiles namely - Gavialis gangeticus, Crocodylus palustris and the salt water crocodile, Crocodylus porosus.

Lesser Cats Project

The project was launched in 1976 with the assistance of WWF in India for conservation of four species of lesser cats e.g. Felis bengalensis Kerr, Felis marmorta Martin, Felis lemruinki Vigors Horsfield and Felis viverrina Bennet, found in Sikkim and Northern part of West Bengal.

The Manipur Brow-antlered Deer Project

This was launched in 1981 in Manipur to save the brow-antlered deer (Cerevus eldi eldi) which is on the verge of extinction. The habitat includes 35 sq.km. of park and sanctuary. The population of the deer has increased from 18 to 27.

Project Elephant

It was launched in 1991 to protect the Asiatic elephant which is also a highly endangered species because of large scale poaching.

Project Rhino

It was launched in 1987 in Kaziranga Wildlife Sanctuary in Assam to save the lesser one horned rhinoceros from extinction. It covers an area of 430 sq.km. and is the natural of the dwindling rhino.

Class	Threatened	Extinct
Mammalia	53	2
Aves	69	2
Reptiles	23	-
Amphibia	3	-
Invertebrates	22	-
Total	170	4

Category of threat	Number of species
Endangered	24
Rare	45
Vulnerable	49
Indeterminate	28
Insufficienty known	24
Extinct	4

Himalayan musk deer project

This was launched in 1981 to save the endangered musk deer which is facing extinction. Captive breeding has yielded good results.

Project Hangul

This project was launched in 1970 in Kashmir valley to save the highly endangered Kashmir stag (Cerevus elaphus hanglu) which is facing extinction. As a result their population has increased to about 500 now.

Conservation - A People's Movement

If all the beasts were gone, we would die from a great loneliness of spirit... All things are connected. Whatever befalls the earth, befalls the children of the earth

Chief Seattle, 1854

Protecting the environment is everyone's responsibility. There is an urgent need for awareness about the devastation of the environment brought about by man's greed in a materialistic era. The swelling population of the world is insatiable in its demand for food, water, air and land. As more forests are cleared, the biodiversity they were to is lost forever. About the middle of the 21st century we will see the last of the primary tropical forests and the extinction of over half of the 1.4 million named species. The poorer but more populous nations will scrape up every available resource in their losing battle for survival. The never ending needs of man will make deep inroads into natural resources and will undoubtedly take him closer to extinction with each day. Only such of those species which have survived for several million centuries like the cockroach, will survive the catastrophe.

There is an increased awareness among the people towards the conservation of ecologically sensitive areas. Greenpeace - a group devoted to environmental protection - was responsible for helping to ban whaling. Closer home, the Chipko movement initiated by Sunderlal Bahuguna stopped felling of trees in some parts of the Himalayas. The Silent Valley which would have been flooded had the proposed dam been built was also saved by the intervention of environmental activists and groups. In our own small way each of us can contribute to conserving biodiversity in one form or the other. Some of the activities in the areas of environmental conservation include :

- Holding rallies and marches to bring about a mass awakening to environmental issues like deforestation, construction of dams or factories in environmentally sensitive areas like the Silent Valley, etc.
- Conducting action oriented programmes like social forestry, one house, one tree project, afforestation projects, etc.
- Spreading awareness through mass media like television, radio and publications.
- Creating awareness through environmental training programmes, folkart media like street plays, etc.
- Introducing environmental legislation to tackle the sensitive environmental issues.
- Mass movements like Chipko, Narmada bachao andolan, etc.

What can we do to save biodiversity?

Every individual can make a small though significant effort in the race to save our planet and conserve biodiversity. Man is only yet another of nature's creatures and not an alien to the other life-forms. He has no more right to destroy nature than any other being. We should treat all animals and plants with compassion.

"Man does not have the right to destroy what he cannot create. The human being is not an alien to exploit it".

Granth Sahib

- We should curb our greed for products made out of animal parts like skin, fur, ivory, bones, nails, etc., to discourage wildlife traders and poachers, and spare the remaining animals.
- Adopt vegetarianism which would require fewer animals to be fattened for slaughtering and more plants to be grown for food.
- Plant trees wherever possible as they are beneficial in supporting diversity, cleaning the atmosphere, improving the soil and in so many more ways.

"The tree is a peculiar organism of unlimited kindness and benevolence and makes no demand for its sustenance, and extends generously the products of its life activity. It affords protection to all beings, offering shade even to the axemen who destroy it".

Gautama Buddha (487 B.C.)

- Avoid using insecticides, pesticides and inorganic fertilizers and try to use natural plant based substitutes wherever possible. Paper and cloth should replace plastic and polyester which are non biodegradable and damage the ecosystem.
- Use the effluent of one industry as the raw material of another. Ash from power plants can be used to make cement, while waste from trout farms and pharmaceutical plants can be used as fertiliser.
- We should strive to plan our activities and minimise our needs in order to generate less waste. Waste like paper, glass and plastic should be recycled and used to conserve our rapidly diminishing natural resources. About 75% of glass is recycled and used in Holland and Germany.
- Make children aware of their surroundings and the need for biodiversity.
- We should follow traditional agricultural practices. Exotic and hybrid varieties of plants and chemicals used as insecticides only exhaust the land as against natural farming practices which are in accordance with nature.
- Make use of sustainable technologies like smokeless chulhas, ground water recharging unit, wind energy, solar power, etc.

CONVENTION OF BIOLOFICAL DIVERSITY

The Convention on Biological Diversity was signed by 156 nations and the EC in Rio de Janeiro, June 1992. For the convention to come into force, 30 countries need to ratify it. The aim of the convention is to save species and plants from extinction and their habitats from destruction.

The developed countries are looking for a sustainable supply of biological resources from the developing countries and easy access to them as well. The developing countries lacking the technology to exploit their resources are inviting the developed countries to do so. This has resulted in the developed nations channelling out the benefits of these natural resources. The developing countries are now demanding a higher share of the accrued economic benefits. The developed nations are also concerned by the unsustainable exploitation of natural wealth, particularly rainforests.

Key points from the Convention on Biological Diversity

The aim of the Convention on Biological Diversity is 'the conservation of biological diversity, the sustainable use of its components and the fair and equitable sharing of the benefits arising out of the utilization of genetic resources. The convention stipulates that Parties must :

- develop national strategies for the conservation and sustainable use of biological resources;
- establish protected areas, restore degraded ecosystems, control alien species, and establish ex-situ conservation facilities;
- establish training and research programmes for the conservation and sustainable use of biodiversity and support such programmes in developing countries;
- promote public education and awareness of the conservation and sustainable use of biodiversity;
- recognize the right of governments to regulate access to their own genetic resources, and, wherever possible, grant other Parties access to genetic resources for environmentally sound uses;
- encourage technology and biotechnology transfer particularly to developing countries;
- establish an information exchange between the parties on all subjects relevant to biodiversity;
- promote technical and scientific cooperation between parties (particularly to developing countries) to enable them to implement the convention;
- ensure that countries that provide genetic resources have access to the benefits arising from them; and
- provide financial resources to developing countries/parties to enable them to carry out the requirements of the convention.

Source: Global Biodiversity, United Nations Environment Programme, Nairobi, Kenya