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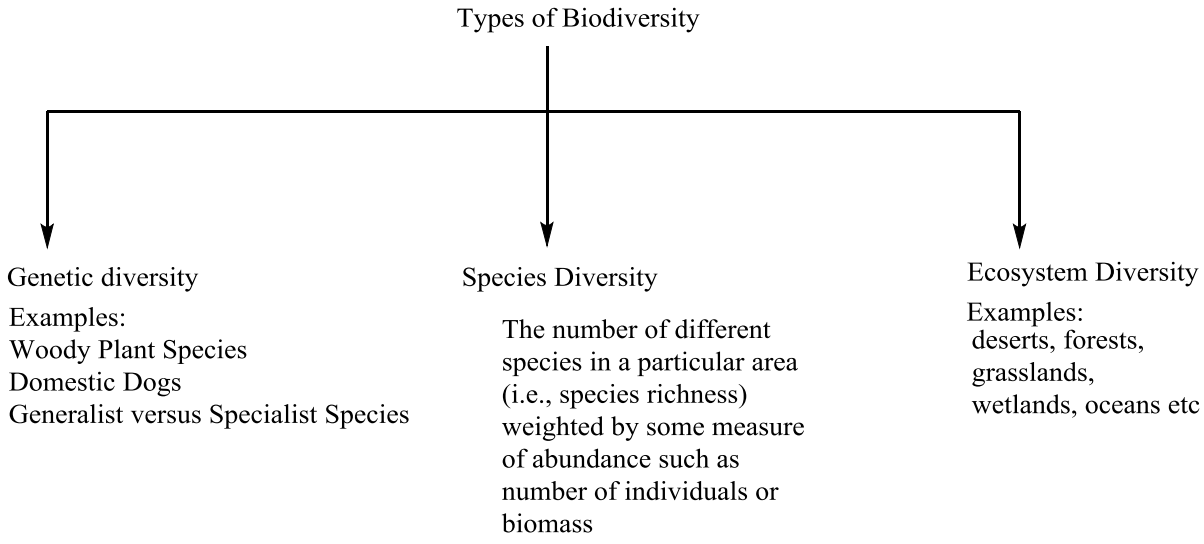
1. **Biodiversity:**

(a) Defination

(b) Why is biodiversity important?

(c) Biodiversity examples

2. **Types of Biodiversity**



Genetic diversity: https://www.toppr.com/guides/biology/molecular-genetics/genetic-diversity/

Species Diversity: https://cnx.org/contents/b1V5w1wU@3/Species-Diversity

3. **Threats to Biodiversity**

(a) The Threat of Urbanization

(b) The Threat of Pollution

(c) The Threat of Climate Change

(d) The Threat of Invasive Species

1. Biodiversity

Biodiversity is a term which describes every living organism within a single ecosystem or habitat, including numbers and diversity of species and all environmental aspects such as temperature, oxygen and carbon dioxide levels and climate. Biodiversity can be measured globally or in smaller settings, such as ponds.

b) **Why is Biodiversity Important?**

Without biodiversity, the health of the planet is at stake. Every single species has a role to play, although some – like viruses and disease-carrying mosquitoes – are considered to be damaging to the well-being of humans and other organisms and steps are being taken to eradicate them.

A healthy ecosystem has a rich level of biodiversity. The less inhabitable an ecosystem, the less life it can support. For example, a single organism ecosystem was recently discovered deep in a South African gold mine, where only one type of bacteria – *Desulforudis audaxviator* – is able to survive. Should something drastic happen to affect the health of this bacteria and it becomes extinct, there is no other organism to take advantage of this inhospitable environment. In other terrestrial, aquatic or marine environments, a lack of biodiversity of plant life (producers) means the numbers of consumers are limited.

From the ground up, or from the ocean floor up, biodiversity increases soil formation, nutrient storage, energy storage, recycling, and the breaking down of toxins and

pollutants. **Rich biodiversity will speed the recovery of the environment after a natural disaster.** Just days after a savannah fire, new plant life springs up from those species which allow their seeds to be blown by the wind, or from those whose seeds can withstand high temperatures.

Biodiversity also has a role to play in the stability of the ecosystem and global climate. Deforestation removes trees responsible for the conversion of carbon dioxide into oxygen. This increase in carbon dioxide levels in the air is partially (but significantly) responsible for global warming. Deforestation also leads to soil erosion where other species of plant suffer, with the forming of desert-like areas as a result. The domino effect of this means less food for herbivores (primary consumers) and a consequent reduction in populations due to competition. And with fewer herbivores, one can expect reduced populations of omnivores and carnivores. As every organism has a role to play in its ecosystem, the act of deforestation without (at minimum) replanting lost mature trees, can be catastrophic both locally and globally.

c) **Biodiversity Examples**

Scientists have named three different levels of biodiversity: genetic diversity, species diversity, and ecosystem diversity. Together, they form a set of data that can describe the biodiversity of an area of land, freshwater or sea. The area can be large or small. We can look at the ecological biodiversity of Mississippi. Or of China. Or the Great Barrier Reef. On a smaller scale, we can describe the biodiversity of a local forest, park or pond. One might also look at the biodiversity of the human gut, or of a teaspoon of soil. These are all ecological habitats or ecosystems in which biodiversity can be measured.

Ecological biodiversity is measured by looking at its three levels of genetic, species and ecosystem diversity.

2. Types of Biodiversity

Genetic Diversity

Genetic diversity refers to the differences in the **genetic make-up of a distinct species and to the genetic variations within a single species**. It concerns DNA (or RNA in some viruses) sequences. Humans, for example, have different eye and skin colors, hair textures, propensity for disease, reactions to pollutants, heights, hormone levels and so on. We are the same species but have genetic variations which make us diverse. This means that if one individual dies when stung by a bee, others will not and are able to carry on to ensure the success of the species.

Plants of the same species can diversify to be able to live in alternative habitats. Mangrove trees – a diverse group of around eighty different species – have diversified to successfully survive and reproduce in salt water. This change was due to genetic mutations which allowed them to move from aquatic into marine ecosystems, and so increase the biodiversity of a different region and ensure the survival of the species. As with humans, genetic diversity in other organisms can affect any aspect of that organism's make up. From size to color, to diet, to function, and everything in between.

Genetic diversity of corn kernel colors

Species Diversity

Species diversity relates to numbers and spread – how many different species live in an ecosystem and how are they distributed? When considering only the number of different

species within an ecosystem we then talk of species richness. **Species richness only considers the number of different species in an ecosystem**, not their distribution.

There are approximately 391,000 different species of plant on the planet, although some are at risk of becoming extinct and many have not yet been discovered. Obviously, speaking of the distribution of every one of these plant species would take a long time. Unless as part of scientific research, global species diversity is usually described in the terms of species richness – how many species there are – although **the terms species diversity and species richness are not synonyms of one another**.

The South African gold mine mentioned earlier on has a species diversity of one which is (therefore) equally distributed. In the soil, the greatest biomass is composed of micro-organisms, where fungi are by far the most common.

Soil is itself an ecosystem

Species diversity

the number of different species in a particular area (i.e., species richness) weighted by some measure of abundance such as number of individuals or biomass.

Species richness

The number of different species in a particular area

Species evenness

The relative abundance with which each species are represented in an area.

Phylogenetic diversity

the evolutionary relatedness of the species present in an area.

Morphological species concept

species are the smallest natural populations permanently separated from each other by a distinct discontinuity in the series of biotype (Du Rietz, 1930; Bisby and Coddington, 1995).

Biological species concept

a species is a group of interbreeding natural populations unable to successfully mate or reproduce with other such groups, and which occupies a specific niche in nature (Mayr, 1982; Bisby and Coddington, 1995).

Phylogenetic species concept

a species is the smallest group of organisms that is diagnosably [that is, identifiably] distinct from other such clusters and within which there is a parental pattern of ancestry and descent (Cracraft, 1983; Bisby and Coddington, 1995).

Evolutionary significant unit

a group of organisms that has undergone significant genetic divergence from other groups of the same species. Identification of ESUs is based on natural history information, range and distribution data, and results from analyses of morphometrics, cytogenetics, allozymes and nuclear and mitochondrial DNA. Concordance of those data, and the indication of significant genetic distance between sympatric groups of organisms, are critical for establishing an ESU.

Ecosystem Diversity

The major habitat types from which all other smaller ecosystems derive are called terrestrial, marine and aquatic ecosystems. These three examples of ecosystem diversity contain further examples as subgroups. The marine ecosystem includes subgroups known as open marine,

ocean floor, coral reef, estuary, saltwater wetland estuary, and mangrove systems. Terrestrial heads six subgroups: tundra, grasslands, taiga, deciduous forest, rainforest, and desert. The smallest ecosystem of the three main groups, the aquatic ecosystem, can be further split into estuaries, wetlands, ponds, lakes, and rivers.

However small or large a particular area of the planet, the number of ecosystems that can be found within it define its ecosystem diversity. Deserts are, on the whole, the least diverse terrestrial ecosystem but may be split into sand, rock, bush and even oasis with its own group of mini-ecosystems (aquatic, date palm, a small area of wetland at the water's edge). Tropical rainforests are the most diverse of the terrestrial ecosystems, but many of these are biodiversity hotspots. This means that an ecosystem must contain at least 1,500 species of plants found nowhere else on earth (endemic" species) but have also lost at least 70% of its primary native vegetation. Unfortunately, there are over 36 biodiversity hotspots at this moment in time, some of which have undergone up to 95% of native vegitation loss. There is an overwhelming need for conservation in the modern world.

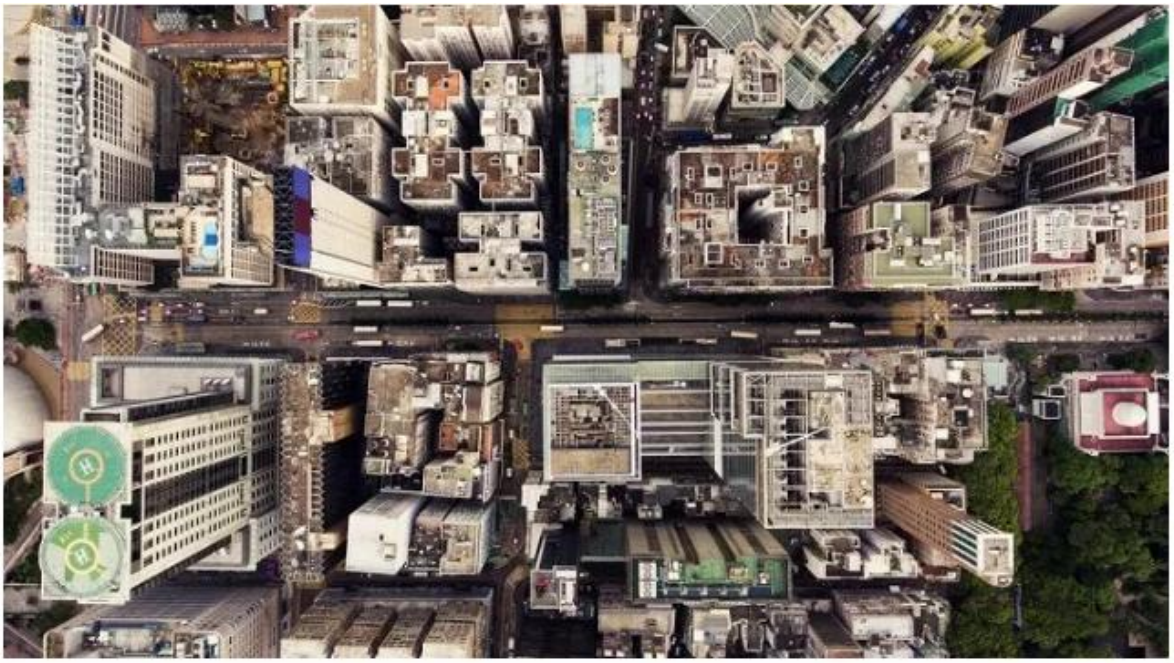
Within these diverse ecosystems, one must also consider trophic levels, how species interact with that specific ecosystem, climate, pollution or human impact and every other variable that is part of that particular habitat.

3. **Threats to Biodiversity**

The greatest threat leading to the loss of biodiversity is the human race. As our population grows together with our need for food, water, industry, transportation, and home comforts, it takes over natural ecosystems and replaces them with unnatural ones. Even in these, other organisms can adapt and successfully reproduce, but the levels of biodiversity as compared to the replaced environment are significantly lower.

(a) **The Threat of Urbanization**

The city of London, for example, is becoming home to increasingly more wildlife who have adapted to live in an urban environment. Fox populations are large, feeding on rats, mice, and garbage. Plant life is not enough to support large populations of herbivores and in this unnatural ecosystem are in a group of their own. Instead of having a group of producers (plants) feeding primary consumers (herbivores) who feed secondary, tertiary and quaternary consumers (omnivores and carnivores), it is often human food waste that becomes the urban producer. Humans import their food from other agricultural ecosystems.



The newest ecosystem – the city

(b) **The Threat of Pollution**

We have already discussed the dramatic effects of deforestation upon the climate and biodiversity. Global warming and pollution are the largest abiotic threats to biodiversity, but the cause of these abiotic threats is biotic – us. Heavy metals and plastics in the seas not only reduce the numbers of a species but can render an area completely uninhabitable. The industrial revolution of the mid-eighteenth to mid-nineteenth century in Europe turned skies black with smoke and poisoned rivers and plant life, killing consumers, too. Today, the fine dust from car exhausts largely replaces coal.

(c) **The Threat of Climate Change**

Higher temperatures through climate change mean increased biodiversity in some regions (mangrove trees are moving to areas previously too cold, wine-making is taking off in areas previously unsuitable for growing grapes). In other regions, the higher temperatures cause destruction. In the winter months, for example, caribou scrape through the ice to reach plant life preserved in the equivalent of a natural refrigerator. As global temperatures rise, this extra food source decomposes and the caribou has no winter food source unless it moves much further north. Higher Arctic springtime temperatures also bring swarms of flying insects to the icy north much earlier than usual. Caribou are so distressed by these biting flies that they will even change their migrating paths, meaning they also have to look for new sources of food instead of relying on familiar feeding grounds. In escaping from these flies, caribou also spend less time feeding. Furthermore, they also have to compete for the meager plant life when other herbivores, previously kept away by the cold, arrive and thrive through adaptive radiation.

(d) **The Threat of Invasive Species**

Yet there are still many threats to biodiversity that may not (always) be the fault of the human being. The proliferation of an invasive species, for example, may be the result of an opportunistic move into another species' territory. Still, **human transportation systems are primarily to blame for the introduction of pests into other countries via air and sea**. Consider the American gray squirrel decimating red squirrel populations in England and the introduction of the Colorado beetle in Europe which caused countless potato crops to fail, for example.

(e) **The Threat of Overexploitation**

Overexploitation is another threat to biodiversity, again a largely human threat. **Overfishing and overharvesting either remove competition for other species causes a huge shift in the stability of species richness and diversity**. By removing too many of one species of fish, fishers allow other species to take over, perhaps upsetting the delicate balance between producer and consumer. Alternatively, fishers remove too many fish of a wide range of species, not immediately upsetting the balance of fish species but causing a drop in

population and lower reproduction rates that allows certain types of plankton or algae to take over. The latter can cover large areas of fresh or salt water and remove the oxygen, causing a dead zone where nothing except anaerobic bacteria can survive. In agriculture, the **overharvesting of crops leads to a lack of nutrients in the soil**, where farmers then add nitrogen-containing fertilizers to make up for this loss. Nitrogen contributes greatly to global warming and climate change. A vicious circle of action and effect which slowly reduces biodiversity on first a local and finally a global scale.

4. **Benefits of Biodiversity**

Species can have instrumental or intrinsic (inherent) value. When of use to humans, either as a pleasing aspect (a pet dog) or a useful one (willow bark as a pain killer), they are instrumental. If a species has other value beyond its use to the human race, it has intrinsic value. This would include the fact that a species is part of the world's natural history. New discussions regarding the ethics of human effects upon biodiversity sway towards agreeing that every species has intrinsic value.

Without biodiversity, ecosystems would produce less. If one species of plant type produces one type of flower for one species bee, who produces honey for one species of honey badger who provides food for one cheetah, the balance is much too delicate. If a sudden heavy downpour kills most of the bees and drowns the flowers, the entire food chain is lost. **The higher the number of species that can be supported in an ecosystem, the higher the rate of survival for every organism inside that ecosystem. Including the human species**.

Thanks to the planet's huge biodiversity we have been able to produce medicines for the sick, grow new types of crops in areas which used to suffer regular famine, enjoy the colors and scents of a fantastic range of flowers, eat a varied diet with no need for deficiencies, and explore the splendor of the world's different habitats as we travel. Biodiversity is not only necessary for survival, but it is also extremely beautiful.

Biogeographic Classification of India:

Our country can be conveniently divided into ten major regions, based on the geography, climate and pattern of vegetation seen and the communities of mammals, birds, reptiles,

amphibia, insects and other invertebrates that live in them. Each of these regions contains a variety of ecosystems such as forests, grasslands, lakes, rivers, wetlands, mountains and hills, which have specific plant and animal species.

India, being a vast country, shows a great diversity in climate, topography and geology and hence the country is very rich in terms of biological diversity. India's biological diversity I one of the most significant in the world, since India has only 2% of the total landmass of the world containing about 6% of the world's known wildlife

5. **India's Biogeographic Zones**

1. The cold mountainous snow covered Trans Himalayan region of Ladakh.
2. The Himalayan ranges and valleys of Kashmir, Himachal Pradesh, Uttarakhand, Assam and other North Eastern States.
3. The Thar Desert of Rajasthan.
4. The semi arid grassland region of the Deccan plateau Gujarat, Maharashtra, Andra Pradesh, Karnataka and Tamil Nadu.
5. The Western Ghats in Maharashtra, Karnataka and Kerala.
6. The Deccan Peninsula
7. The Gangetic and Bhramaputra plains.
8. The Andaman and Nicobar Islands
9. The Northeast States of India,
10. The long western and eastern coastal belt with sandy beaches, forests and mangroves

1. The cold mountainous snow covered Trans Himalayan region of Ladakh.

This area is very cold and arid (4,500 Œ 6,000 mts. above msl). The only vegetation is a sparse alpine steppe. Extensive areas consist of bare rock and glaciers. The faunal groups best represented here are wild sheep and goats (chief ancestral stock), ibex, snow leopard, marbled cat, marmots and black-necked crane.

Figure: Macro polo sheep-ratio of horn length to body weight exceeds that of any animal in the world.

2. **The Himalayan ranges and valleys of Kashmir, Himachal Pradesh, Uttarakhand, Assam and other North Eastern States.**

The fantastic altitude gradient results in the tremendous biodiversity of the Himalayan region. Flora and fauna vary according to both altitude and climatic conditions: tropical rainforests in the Eastern Himalayas and dense subtropical and alpine forests in the Central and Western Himalayas. The lower levels of the mountain range support many types of orchids. On the eastern slopes, rhododendrons grow to tree height.

Monal-bird of nine colours

Animals of Himalayas show several behavioural and physiological adaptations. Sambar and muntjac are found in the subtropical foothills; serow, goral and the Himalayan thar are found in the temperate and subalpine regions; snow leopard and brown bear inhabit the alpine region. Carnivores are the most elusive of all mammals in the Himalayas. There are a variety of carnivores in the higher mountains, some of which are rare and threatened with extinction.

3. **The Thar Desert of Rajasthan**

The natural vegetation consists of tropical thorn forests and tropical dry deciduous forests, sandy deserts with seasonal salt marshes and mangroves are found in the main estuaries. Typical shrubs are phog growing on sand dunes. Sewan grass covers extensive areas called pali.

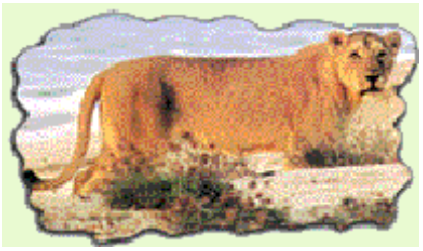
Last surving wild Ass

Thar desert possesses most of the major insect species. 43 reptile species and moderate bird endemism are found here. No niche of the Thar is devoid of birds. The black buck was once the dominant mammal of the desert region, now confined only to certain pockets. The gazelle is the only species of the Indian antelope of which the females have horns. Nilgai the largest antelope of India and the wild ass, a distinct subspecies, is now confined to the Rann of Kutch which is also the only breeding site in the Indian subcontinent for the

flamingoes. Other species like desert fox, great Indian bustard, chinkara and desert cat are also found.

4. **The semi arid grassland region of the Deccan plateau Gujarat, Maharashtra, Andra Pradesh, Karnataka and Tamil Nadu.**

The semi-arid region in the west of India includes the arid desert areas of Thar and Rajasthan extending to the Gulf of Kutch and Cambay and the whole Kathiawar peninsula. The natural vegetation consists of tropical thorn forests and tropical dry deciduous forests, moisture forests (extreme north) and mangroves. The sandy plains have a few scattered trees of Acacia and Prosopis. The gravelly plains have Calotropis, Gymnosporia, etc. The rocky habitats are covered by bushes of Euphorbia while species of Salvadora and Tamarix occur mainly near saline depressions. The lion of Gir is the endemic species in this zone.



Last surving Asiatic lion

5. **The Western Ghats in Maharashtra, Karnataka and Kerala.**

They cover only 5% of India's land surface but are home to more than about 4,000 of the country's plant species of which 1800 are endemic. The monsoon forests occur both on the western margins of the ghats and on the eastern side where there is less rainfall. This zone displays diversity of forests from evergreen to dry deciduous.

The Nilgiri langur, lion tailed macaque, Nilgiri tahr, Malabar grey hornbill and Most amphibian species are endemic to the Western Ghats.

Tiger - national animal

6. **The Deccan Peninsula**

The Deccan Peninsula is a large area of raised land covering about 43% of India's total land surface. It is bound by the Sathpura range on the north, Western Ghats on the west and Eastern Ghats on the east. The elevation

of the plateau varies from 900 mts. in the west to 300 mts. in the east. There are four major rivers that support the wetlands of this region which have fertile black and red soil. Large parts are covered by tropical forests. Tropical dry deciduous forests occur in the northern, central and southern part of the plateau. The eastern part of the plateau in Andhra Pradesh, Madhya Pradesh and Orissa has moist deciduous forests.

Asiatic wild buffalo the most impressive and magnificent animal in the world today

7. **The Gangetic and Bhramaputra plains.**

The Gangetic plain is one of India's most fertile regions. The soil of this region is formed by the alluvial deposits of the Ganges and its tributaries. The four important surface differences recognized in the geomorphology of the plains are

Bhabar - pebble studded zone with porous beds

Terai - marshy tract

Bhangar - older alluvium of the flood plain

Terai - marshy tract

Khadar -newer alluvium

Neel Gai

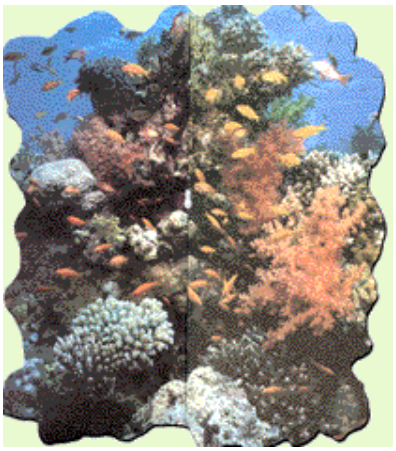
The Gangetic plains stretching from eastern Rajasthan through Uttar Pradesh to Bihar and West Bengal are mostly under agriculture. The large forest area is under tropical dry deciduous forest and the southeastern end of the Gangetic plain merges with the littoral and mangroves regions of the Sunderbans.

The fauna includes elephants, black buck, gazelle, rhinoceros, Bengal florican, crocodile, freshwater turtle and a dense waterfowl community.

8. **The Andaman and Nicobar Islands**

It is a group of 325 islands: Andaman to the north and

Nicobar to the south. The two are separated by about 160 kms. by the Ten Degree Channel of the sea. The rainfall is heavy, with both Northeast and Southwest monsoons. At present, 21 of the 325 islands in the Andaman & Nicobar Islands are inhabited. Many unique plants and animals are found here. About 2,200 species of higher plants are found here of which 200 are endemic. The Andaman & Nicobar Islands have tropical evergreen forests and tropical semievergreen forests as well as moist deciduous forests, littoral and mangrove forests.



Living corals

112 endemic species of avifauna, the Andaman water monitor, giant robber crab, 4 species of turtles, wild boar, Andaman day gecko and the harmless Andaman water snake are found only in these islands. The Narcondam hornbill found only in Narcondam is a large forest bird with a big beak. Coral reefs are stretched over an area of 11,000 sq.km. in the Andamans and 2,700 sq.km. in Nicobar.

9. **The Northeast States of India,**

Biological resources are rich in this zone. The tropical vegetation of northeast India is rich in evergreen and semievergreen rain forests, moist deciduous monsoon forests, swamps and grasslands.

The Indianone-horned rhinoceros largest of all existing rhinoceros

Mammalian fauna includes 390 species of which 63% are found in Assam. The area is rich in smaller carnivores. The country's highest population of elephants are found here

10. **The long western and eastern coastal belt with sandy beaches, forests and mangroves**

The natural vegetation consists of mangroves. Animal species include dugong, dolphins, crocodiles and avifauna. There are 26 species of fresh water turtles and tortoises in India and 5 species of marine turtles, which inhabit and feed in coastal waters and lay their eggs on suitable beaches. Tortoise live and breed mainly on the land.

Mangroves

Over 200,000 Olive Ridley turtles come to Orissa to nest in the space of three or four nights. The highest tiger population is found in the Sunderbans along the east coast adjoining the Bay of Bengal.

Lakshadweep consists of 36 major islands - 12 atolls, 3 reefs and 5 submerged coral banks - make up this group of islands more than three hundred kilometers to the west of the Kerala coast. The geographical area is 32 sq. km. and the usable land area is 26.32 sq. km. The fauna consists mainly of four species of turtles, 36 species of crabs, 12 bivalves, 41 species of sponges including typical coral, ornamental fishes and dugongs. A total of 104 scleractinian corals belonging to 37 genera are reported.

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