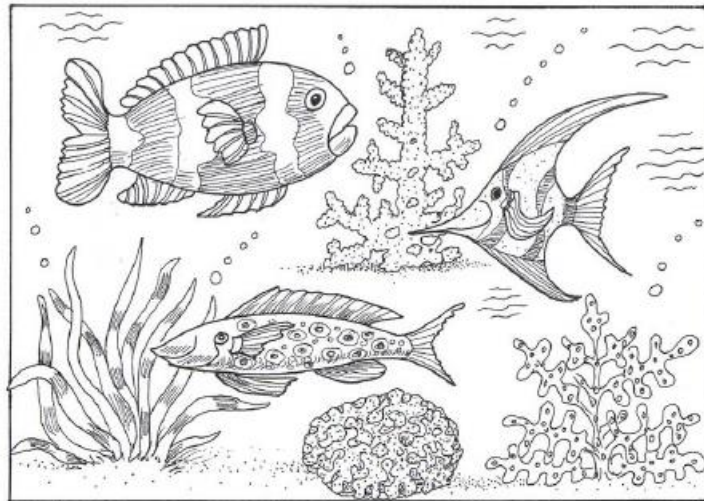


**ENS18203: Biodiversity and Resource Management**  
**Credit II: Biodiversity**

**1.1. Biodiversity: Status and importance, India as a mega-diversity nation**

**BIODIVERSITY:**

Animals, plants and human beings do not exist in isolation. All living things are connected to each other and to their non-living environment such as soil, rocks, air, rivers and the sea. Figure 1 shows a marine environment. You can see different types of fish, different corals and aquatic plants. These organisms depend on each other and on their environment. For example, the corals serve as a home for the smaller fish to escape attack or for breeding purposes.



**Figure 1: Marine biodiversity**

A tree in a forest (e.g. Ferney Valley or Black River Gorges) can be home to many insects. You can see many mosses, orchids and fungi under its canopy. The tree can also be visited by many birds, reptiles and mammals which find food, shelter and breeding places. These animals and plants in the tree are all dependent on each other. The tree provides a habitat for all these organisms. These interconnections which support and link these living things in a web of life are known as biodiversity. The word 'biodiversity' is a combination of two words: bio and diversity. It refers to the variety of life on Earth and the natural patterns it forms. Biodiversity includes all living things, such as plants, animals and microorganisms that exist in a certain area (air, soil, water). The

biodiversity we see today, is the result of billions of years of evolution shaped by natural processes and the influence of humans.

The biological diversity or biodiversity is 'the variety of life', and refers collectively to variation at all levels of biological organization. Many more formal definitions of biological diversity or biodiversity (we shall use the two terms interchangeably) have been proposed, which develop this simple one (DeLong 1996 reviewed 85 such definitions!). Of these, perhaps the most important and far-reaching is that contained within the Convention on Biological Diversity (the definition is provided in Article 2). This landmark treaty was signed by more than 150 nations on 5th June 1992 at the United Nations Conference on Environment and Development, held in Rio de Janeiro, and came into force approximately 18 months later. The Convention states that:

*'Biological diversity' means the variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems".*

['inter alia' means 'among other things'.] Biodiversity is the variety of life, in all of its many manifestations. It encompasses all forms, levels and combinations of natural variation and thus serves as a broad unifying concept.

#### **TYPES OF BIODIVERSITY:**

Biodiversity can be of three types.

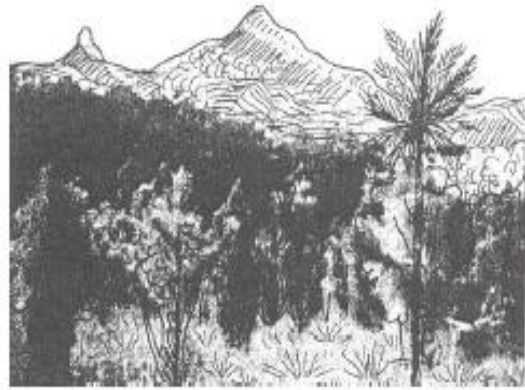
- **Ecosystem biodiversity**
- **Species biodiversity**
- **Genetic biodiversity**

**Ecosystem biodiversity:** To understand ecosystem biodiversity you should understand the word ecosystem. An ecosystem is an area where living things such as plants, animals and microorganisms live and interact with each other and with their environment. There are different

types of ecosystems and some of them are deserts, tropical rainforests, oceans, coral reefs, rivers and mountains.



**Fig 2: A desert ecosystem**



**Fig. 3: A mountain ecosystem**

Figure 2 and 3 shows two ecosystems (a desert and a mountain) respectively.

The desert is made up of sand, whereas, the mountain is made up of soil and rocks. The temperature on the mountain is cool and that in the desert is hot. The two different conditions prevailing, temperature and soil type, in these two ecosystems determine the types of organisms living there. Each ecosystem provides different kinds of habitats for the living things. This is called ecosystem biodiversity.

**Species diversity:** A species can be defined as a group or population of similar organisms that reproduce by interbreeding within the group. Members of a species do not normally reproduce with members of any other species.

Human beings, for example, belong to a single species — *Homo sapiens*

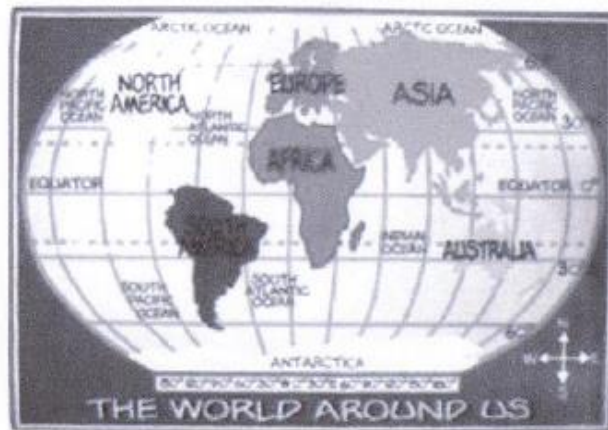


Fig. 4: Map of the world showing regions of human populations

Although there are different populations of humans with different characteristics in different parts of the Earth (fig. 4), they can all successfully interbreed with each other and produce fertile off springs. So, even though no two human beings are exactly alike, humans make up a single species because they reproduce among themselves. Biodiversity includes all living things, great and small, from elephants to bacteria that exist on our planet. Scientists have identified and named more than 1.4 million living species, including approximately 270,000 species of plants, 72,000 species of fungi, 1 million species of insects, 19,000 species of fish and 4,000 species of mammals (Source: *Alfredo Ortega, Biodiversity and Conservation: The web of life*).

All these species are interconnected and interdependent with each other in many ways. This is called species diversity.

**Genetic diversity:** You have just seen in the previous section that human beings belong to one single species. Though we all are humans, yet we are all different. These differences are due to genetic diversity, that is, the variety of **genes** (hereditary material) in a species.

Each species consists of individuals with their own particular genes. Genetic diversity can be seen in the various colours and shapes of apples or tomatoes in markets, the differences in human hair and eye colour and in the variations of birds' songs.

#### SPATIAL SCALES OF BIODIVERSITY:

Whittaker, (1972) described three terms for measuring biodiversity over spatial scales: alpha, beta, and gamma diversity.

**Alpha diversity:** refers to the diversity within a particular area or ecosystem, and is usually expressed by the number of species (i.e., species richness) in that ecosystem. For example, if we are monitoring the effect that British farming practices have on the diversity of native birds in a particular region of the country, then we might want to compare species diversity within different ecosystems, such as an undisturbed deciduous wood, a well-established hedgerow bordering a small pasture, and a large arable field. We can walk a transect in each of these three ecosystems and count the number of species we see; this gives us the alpha diversity for each ecosystem; see Table (this example is based on the hypothetical example given by Meffe et al., 2002 in Table below)

Hypothetical species	Woodland habitat	Hedgerow habitat	Open field habitat
A	X		
B	X		
C	X		
D	X		
E	X		
F	X	X	
G	X	X	
H	X	X	
I	X	X	
J	X	X	
K		X	
L		X	X
M			X
N			X
Alpha diversity	10	7	3
Beta diversity	Woodland vs. hedgerow: 7		Woodland vs. open field: 13
Gamma diversity	14		

(Source: Meffe et al., 2002)

If we examine the change in species diversity between these ecosystems then we are measuring the **beta diversity**. We are counting the total number of species that are unique to each of the ecosystems being compared. For example, the beta diversity between the woodland and the hedgerow habitats is 7 (representing the 5 species found in the woodland but not the hedgerow, plus the 2 species found in the hedgerow but not the woodland). Thus, beta diversity allows us to compare diversity between ecosystems.

**Gamma diversity** is a measure of the overall diversity for the different ecosystems within a region. Hunter, (2002) defines gamma diversity as "geographic-scale species diversity". In the example in Table, the total number of species for the three ecosystems 14, which represent the gamma diversity.

#### GLOBAL BIODIVERSITY:

Estimates on the number of Earth's current species range from 2 million to 10 of which about 1.7 million have been databased thus far and over 80 percent have not yet been described.

In other related studies, around 1.9 million extant species are believed to have been described currently, but some scientists believe 20% are synonyms, reducing the total valid described species to 1.5 million. In 2013, a study published in Science estimated there to be  $5 \pm 3$  million extant species on Earth. Another study, published in 2011 by PLoS Biology, estimated there to be 8.7 million  $\pm$  1.3 million eukaryotic species on Earth.

Kingdoms	Described species	Estimated total species
Bacteria	4,000	1,000,000
Protoctists (algae, protozoa, etc.)	80,000	600,000
Animals	1,320,000	10,600,000
Fungi	70,000	1,500,000
Plants	270,000	300,000
TOTAL	1,744,000	14,000,000

(Source: UNEP-WCMC 2010)

#### HOT SPOTS OF BIODIVERSITY:

The earth biodiversity is distributed in specific ecological regions. There are over a thousand major ecoregions in the world. Of these, 200 are said to be the richest, rarest and most distinctive natural areas. These areas are referred to as the Global 200. It has been estimated that 50,000 endemic plants which comprise 20% of global plant life, probably occur in only 36 hot spots in the world.

Countries which have a relatively large proportion of these hot spots of diversity are referred to as mega diversity nations.

A biodiversity hotspot is a biogeographic region with a significant reservoir of biodiversity that is under threat from humans. To qualify as a biodiversity hotspot on Myers 2000 edition of the hot spot- map, a region must meet two strict criteria:

1. It must contain at least 0.5% or 1,500 species of vascular plants as endemics, and
2. It has to have lost at least 70% of its primary vegetation.

Around the world, at least 36 areas qualify under this definition. These sites support nearly 60% of the world's plant, bird, mammal, reptile, and amphibian species, with a very high share of endemic species. Four regions that satisfy these criteria exist in India subcontinent and are:

- 1. Himalaya:** Includes the entire Indian Himalayan region (and that falling in Pakistan, Tibet, Nepal, Bhutan, China and Myanmar)
- 2. Indo-Burma:** Includes entire North-eastern India, except Assam and Andaman group of Islands (and Myanmar, Thailand, Vietnam, Laos, Cambodia and southern China)
- 3. Sundalands:** Includes Nicobar group of Islands (and Indonesia, Malaysia, Singapore, Brunei, Philippines)
- 4. Western Ghats and Sri Lanka:** Includes entire Western Ghats (and Sri Lanka)

**1. Himalaya:** Stretching in an arc over 3,000 kilometers of northern Pakistan, Nepal, Bhutan and the northwestern and northeastern states of India, the Himalaya hotspot includes all of the world's mountain peaks higher than 8,000 meters. This includes the world's highest mountain, Sagarmatha (Mt. Everest) as well as several of the world's deepest river gorges. This immense mountain range, which covers nearly 750,000 km<sup>2</sup>, has been divided into two regions: the Eastern Himalaya, which covers parts of Nepal, Bhutan, the northeast Indian states of West Bengal, Sikkim, Assam, and Arunachal Pradesh, southeast Tibet (Autonomous Region of China), and northern Myanmar; and the Western Himalaya, covering the Kumaon-Garhwal, northwest Kashmir, and northern Pakistan. While these divisions are largely artificial, the deep defile carved by the

antecedent Kali Gandaki River between the Annapurna and Dhaulagiri mountains has been an effective dispersal barrier to many species. The abrupt rise of the Himalayan Mountains from less than 500 m to more than 8,000 m results in a diversity of ecosystems that range, in only a couple of hundred kilometers, from alluvial grasslands (among the tallest in the world) and subtropical broadleaf forests along the foothills to temperate broadleaf forests in the mid hills, mixed conifer and conifer forests in the higher hills, and alpine meadows above the tree line.

#### **SPECIES DIVERSITY AND ENDEMISM**

<b>Taxonomic Group</b>	<b>Species</b>	<b>Endemic Species</b>	<b>Endemism (%)</b>
<b>Plants</b>	<b>10,000</b>	<b>3,160</b>	<b>31.6</b>
Mammals	300	12	4.0
Birds	977	15	1.5
Reptiles	176	48	27.3
Amphibians	105	42	40.0
Freshwater Fishes	269	33	12.3

**2. Indo-Burma:** The Indo-Burma hotspot encompasses 2,373,000 km<sup>2</sup> of tropical Asia east of the Ganges- Brahmaputra lowlands. Formerly including the Himalaya chain and the associated foothills in Nepal, Bhutan and India, the Indo-Burma hotspot has now been more narrowly redefined as the Indo-Chinese sub region. The hotspot contains the Lower Mekong catchment. It begins in eastern Bangladesh and then extends across north-eastern India, south of the Brahmaputra River, to encompass nearly all of Myanmar, part of southern and western Yunnan Province in China, all of the Lao People's Democratic Republic, Cambodia and Vietnam, the vast majority of Thailand and a small part of Peninsular Malaysia. In addition, the hotspot covers the coastal lowlands of southern China (in southern Guangxi and Guangdong), as well as several offshore islands, such as Hainan Island (of China) in the South China Sea and the Andaman Islands (of India) in the Andaman Sea. The hotspot contains the Lower Mekong catchment.

The transition to the Sundal and Hotspot in the south occurs on the Thai-Malay Peninsula, the boundary between the two hotspots is represented by the Kangar-Pattani Line, which cuts across the Thailand-Malaysia border, though some analyses indicate that the phytogeographical and zoogeographical transition between the Sundaland and Indo-Burma biotas may lie just to the



north of the Isthmus of Kra, associated with a gradual change from wet seasonal evergreen dipterocarp rainforest to mixed moist deciduous forest. Much of Indo-Burma is characterized by distinct seasonal weather patterns. During the northern winter months, dry, cool winds blow from the stable continental Asian high-pressure system, resulting in a dry period under clear skies across much of the south, center, and west of the hotspot (the dry, northeast monsoon). As the continental system weakens in spring, the wind direction reverses and air masses forming the southwest monsoon pick up moisture from the seas to the southwest and bring abundant rains as they rise over the hills and mountains. A wide diversity of ecosystems is represented in this hotspot, including mixed wet evergreen, dry evergreen, deciduous, and montane forests. There are also patches of shrub lands and woodlands on karst limestone outcrops and, in some coastal areas, scattered heath forests. In addition, a wide variety of distinctive, localized vegetation formations occur in Indo-Burma, including lowland floodplain swamps, mangroves, and seasonally inundated grasslands.

#### **SPECIES DIVERSITY AND ENDEMISM**

<b>Taxonomic Group</b>	<b>Species</b>	<b>Endemic Species</b>	<b>Endemism (%)</b>
<b>Plants</b>	<b>13,500</b>	<b>7,000</b>	<b>51.9</b>
Mammals	433	73	16.9
Birds	1,266	64	5.1
Reptiles	522	204	39.1
Amphibians	286	154	53.8
Freshwater Fishes	1,262	553	43.8

**3. SUNDALAND:** The Sundaland hotspot covers the western half of the Indo-Malayan archipelago, an arc of some 17,000 equatorial islands, and is dominated by two of the largest islands in the world: Borneo (725,000 km<sup>2</sup>) and Sumatra (427,300 km<sup>2</sup>). More than a million years ago, the islands of Sundaland were connected to mainland Asia. As sea levels changed during the Pleistocene, this connection periodically disappeared, eventually leading to the current isolation of the islands. The topography of the hotspot ranges from the hilly and mountainous regions of Sumatra and Borneo, where Mt. Kinabalu rises to 4,101 m, to the fertile volcanic soils of Java and

Bali, the former dominated by 23 active volcanoes. Granite and limestone mountains rising to 2,189 m are the backbone of the Malay Peninsula. Politically, Sundaland covers a small portion of southern Thailand (provinces of Pattani, Yala, and Narathiwat); nearly all of Malaysia (nearly all of Peninsular Malaysia and the East Malaysian states of Sarawak and Sabah in northern Borneo); Singapore at the tip of the Malay Peninsula; all of Brunei Darussalam; and all of the western half of the megadiversity country of Indonesia, including Kalimantan (the Indonesian portion of Borneo, Sumatra, Java, and Bali). The Nicobar Islands, which are under Indian jurisdiction, are also included. Sundaland is bordered by three hotspots. The boundary between the Sundaland Hotspot and the Indo-Burma Hotspot to the northwest is here taken as the Kangar-Pattani Line, which crosses the Thailand-Malaysia border. Wallacea lies immediately to the east of the Sundaland Hotspot, separated by the famous Wallace's Line, while the 7,100 islands of the Philippines Hotspot lie immediately to the northeast. Lowland rainforests are dominated by the towering trees of the family Dipterocarpaceae. Sandy and rocky coastlines harbor stands of beach forest, while muddy shores are lined with mangrove forests, replaced inland by large peat swamp forests. In some places the ancient uplifted coral reefs support specialized forests tolerant of the high levels of calcium and magnesium in the soils. Infertile tertiary sandstone ridges support heath forest. Higher elevations boast montane forests thick with moss, lichens, and orchids, while further up, scrubby subalpine forests are dominated by rhododendrons. At the very tops of the highest mountain peaks, the land is mostly rocky and without much vegetation.

#### **SPECIES DIVERSITY AND ENDEMISM**

<b>Taxonomic Group</b>	<b>Species</b>	<b>Endemic Species</b>	<b>Endemism (%)</b>
<b>Plants</b>	<b>25,000</b>	<b>15,000</b>	<b>60.0</b>
Mammals	380	172	45.3
Birds	769	142	18.5
Reptiles	452	243	53.8
Amphibians	244	196	80.3
Freshwater Fishes	950	350	36.8

**4. WESTERN GHATS AND SRI LANKA:** The Western Ghats of southwestern India and the highlands of southwestern Sri Lanka, separated by 400 kilometers, are strikingly similar in their geology,

climate and evolutionary history. The Western Ghats, known locally as the Sahyadri Hills, are formed by the Malabar Plains and the chain of mountains running parallel to India's western coast, about 30 to 50 kilometers inland. They cover an area of about 160,000 km<sup>2</sup> and stretch for 1,600 km from the country's southern tip to Gujarat in the north, interrupted only by the 30 km Palakkad Gap. Sri Lanka is a continental island separated from southern India by the 20-meter-deep Palk Strait. The island, some 67,654 km<sup>2</sup> in size, has been repeatedly connected with India between successive inter-glacial, most recently until about 7,000 years ago by a land bridge up to about 140 kilometers wide. The Western Ghats mediates the rainfall regime of peninsular India by intercepting the southwestern monsoon winds. The western slopes of the mountains experience heavy annual rainfall (with 80 % of it falling during the southwest monsoon from June to September), while the eastern slopes are drier; rainfall also decreases from south to north. Dozens of rivers originate in these mountains, including the peninsula's three major eastward-flowing rivers. Thus, they are important sources of drinking water, irrigation, and power. The wide variation of rainfall patterns in the Western Ghats, coupled with the region's complex geography, produces a great variety of vegetation types. These include scrub forests in the low lying rain shadow areas and the plains, deciduous and tropical rainforests up to about 1,500 m, and a unique mosaic of montane forests and rolling grasslands above 1,500 m. Precipitation across Sri Lanka is dependent on monsoonal winds, resulting in much of the island experiencing relatively low rainfall (less than 2,000 millimeters per year), except for the southwestern "wet zone" quarter, where precipitation ranges to as much as 5,000 millimeters per year. While dry evergreen forests occupy almost the entirety of the "dry zone," dipterocarp-dominated rainforests dominate the lowlands of the wet zone, and some 220 km<sup>2</sup> of tropical montane cloud forest still persist in the central hills, which rise to a maximum altitude of 2,524 m.

### SPECIES DIVERSITY AND ENDEMISM

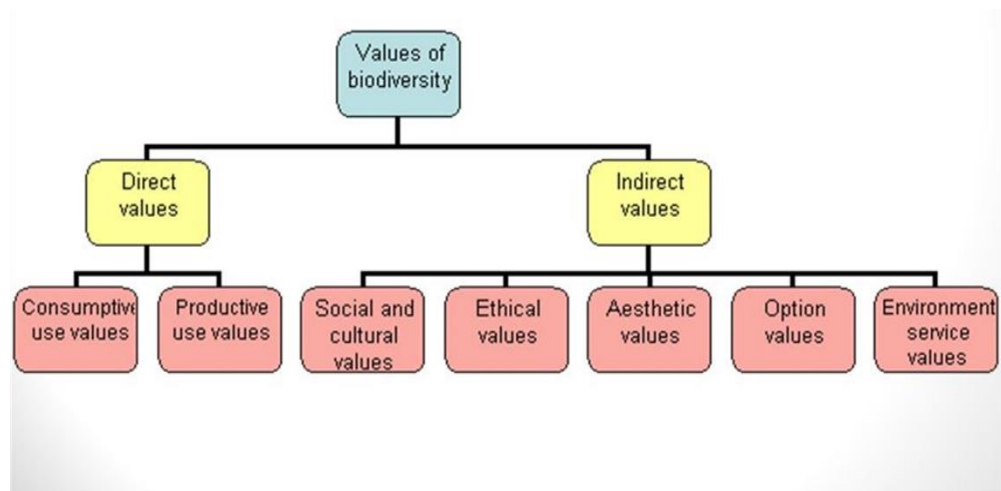
Taxonomic Group	Species	Endemic Species	Endemism (%)
<b>Plants</b>	<b>5,916</b>	<b>3,049</b>	<b>51.5</b>
Mammals	140	18	12.9
Birds	458	35	7.6
Reptiles	267	174	65.2
Amphibians	178	130	73.0
Freshwater Fishes	191	139	72.8

### MEGA DIVERSE NATIONS:

Just 17 of the world's 190 or so countries contain 70 percent of its biodiversity, earning them the title "mega diverse."

- United States of America
- Mexico
- Colombia
- Ecuador
- Peru
- Venezuela
- Brazil
- Democratic Republic of Congo
- South Africa
- Madagascar
- India
- Malaysia
- Indonesia
- Philippines
- Papua New Guinea
- China
- Australia

### IMPORTANCE OF BIODIVERSITY:



(Proposed by McNeely et al.1990)

**Consumptive use value:** The direct utilization of timber, food, fuel wood, fodder to local communities.

**Productive use value:** The biotechnologist uses bio rich areas to prospect and search for potential genetic properties in plants or animals that can be used to develop better varieties of crops that are used in farming and plantation programs or to develop better livestock.

**Social values:** 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.

**Ethical and moral values:** Ethical values related to biodiversity conservation are based on the importance of protecting all forms of life.

**Aesthetic value:** Knowledge and an appreciation of the presence of biodiversity for its own sake is another reason to preserve it. Quite apart from killing wildlife for food, it is important as a tourist attraction.

**Option value:** Keeping future possibilities open for their use is called option value. It is impossible to predict which of our species or traditional varieties of crops and domestic animals will be of great use in the future.

We obtain enormous benefits from biodiversity. These benefits can also be grouped in the form of resources, services and values as shown in Table below.

Resources	Services	Values
<ul style="list-style-type: none"><li>• Food and food products, such as bread, rice, vegetables, fruits, meat, fish</li><li>• Medicine such as <i>Aloe vera</i></li><li>• Industrial products such as paper, rubber, cloth (wool, cotton and silk)</li></ul>	<ul style="list-style-type: none"><li>• Maintain water cycle and rainfall</li><li>• Assist in soil formation by providing organic matter through litter formation</li><li>• Provide recreational activities such as film making, taking photos, watching birds, writing literature on wildlife</li><li>• Act as a buffer against flood and droughts</li><li>• Prevent soil erosion</li></ul>	<ul style="list-style-type: none"><li>• Use in religious ceremonies such as the '<i>tulsi plant</i>'</li><li>• Elephant, cow and snake are "holy" creatures in the hindu religion</li></ul>

## THREATS TO BIODIVERSITY:

**Habitat conversion:** When land is converted from a wild or semi-wild state to agriculture or urban development, many species are unable to persist. For example, butterfly diversity in the Amazon declines markedly if more than 30% of the forest is converted to agriculture (Brown, 1997).

**Degradation:** Some human activities reduce the quality of habitat without destroying it completely. For example, pollution and pesticides can lower habitat quality, and reduce a species birth and survival rates, sometimes to the point that the species goes locally extinct.

**Fragmentation:** As small areas hold fewer species than large ones, and a collection of isolated habitat fragments may contain less biodiversity than a contiguous habitat of similar size.

**Harvesting:** Fishing or logging has a negative impact on the targeted species, as well as on any species that directly depend on the target species for food or shelter.

**Exotic species:** Humans have greatly accelerated the movement and introduction of species from one region or continent to another. This has included both the deliberate introduction of species with perceived agricultural or aesthetic benefits and accidental introductions of “hitchhikers” on trading activities.

**Climate change:** If temperature and rainfall patterns change to the point that a species can no longer thrive in the sites where it is currently found, then the species will decline unless it can either adapt to the changes or migrate to new, more suitable sites.

## BIODIVERSITY OF INDIA:

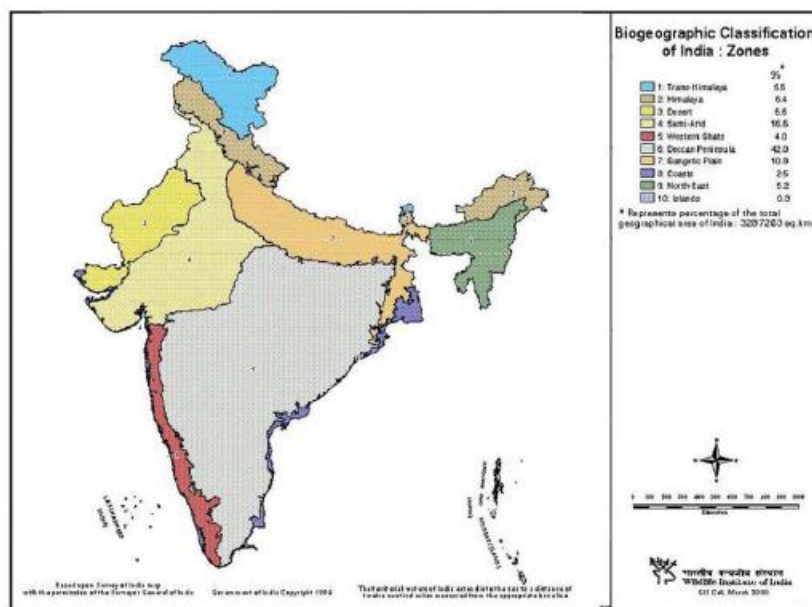
India is situated north of the equator between 66°E to 98°E and 8°N to 36°N. The varied edaphic, climatic and topographic conditions have resulted in a wide range of ecosystems and habitats such as forests, grasslands, wetlands, coastal and marine ecosystems, and deserts. The mountainous region covers an area close to 100 mha, arid and semi-arid zones are spread over 30 mha and the coastline is about 8000 km long (MoEF 2009). Indian region has over 130,000 species of plants and animals which have been scientifically documented. The country has been referred to as one of the top mega diversity region of the globe with only 2.5% of the global land area. Of the 34 globally

identified biodiversity hotspots, India harbours four hotspots, i.e., Himalaya, Indo-Burma, Western Ghats and Sri Lanka, Sundaland. The richness of the biodiversity of the region is largely due to the occurrence of rich diversity of species, genetic and ecological variabilities in different biogeographically and bioclimatically defined zones. In terms of plant diversity, India ranks tenth in the world and fourth in Asia. India represents nearly 11% of the world's known floral diversity with over 45,500 plant species. The richness of Indian plant species as compared to the world is shown in Table below.

Plant groups	No. of species		% of India to the world
	India	World	
Virus/Bacteria	850	8,050	10.6
Algae	7175	40,000	17.9
Fungi	14,500	72,000	20.1
Lichens	2223	13,500	16.4
Bryophytes	2500	14,500	17.2
Pteridophytes	1,200	10,000	12.0
Gymnosperms	67	650	10.3
Angiosperms	17,527	2,50,000	7.0

(Source: BSI, 2009)

About 11,058 species are endemic to Indian region, 6,200 of which belong to flowering plants alone. Eastern Himalaya and north-eastern region (about 2,500 species), peninsular India including western and Eastern Ghats (about 2,600 species), north-western Himalaya (about 800 species) and Andaman & Nicobar Islands (about 250 species) are the areas rich in endemic plants. As per the IUCN Red List (2008), India has 246 globally threatened floral species, which constitute approximately 2.9% of the world's total number of threatened floral species (8457). India is one of the 17 mega biodiversity countries in the world. The country is divided into 10 biogeographic regions (Figure below).



(Source: Rodgers and Panwar, 1988)

About 4,900 species of flowering plants are endemic to the country. These are distributed among 141 genera belonging to 47 families. It is estimated that 62 per cent of the known amphibian species are endemic to India of which a majority is found in Western Ghats. Approximately 65 per cent of the total geographical area has been surveyed so far. Based on this, over 45,500 species of plants and 91,000 species of animals have been described by the Botanical Survey of India (BSI) and Zoological Survey of India (ZSI) respectively. A relative comparisons of number of species in India and across world is presented below:

Group	Number of species in India (SI)	Number of species in the world (SW)	SI/SW (%)
Mammals	350	4629	7.6
Birds	1224	9702	12.6
Reptiles	408	6550	6.2
Amphibians	197	4522	4.4
Fishes	2546	21730	11.7
Flowering Plants	15000	250000	6.0



## INDIA AS MEGA DIVERSE NATION:

The large species richness and abundance are due to immense variety of climatic and altitudinal condition in country. These vary from the humid tropical Western Ghats to the hot desert of Rajasthan, from cold desert of Ladakh and the icy mountain of Himalayas to the warm coast of peninsular India and these includes ecosystem diversity is highest in the world, which represents forest ecosystems, grassland ecosystems, wetland ecosystems, coastal and marine ecosystems and the desert ecosystems. There are 10 Biogeography zones and 26 Biogeography provinces, which are representatives of all the major ecosystems of the world. The country constitutes only 2.4% of the world's land area, but having 11% of flora and 6.5% of fauna of the world. Approximately 65 per cent of the total geographical area has been surveyed so far. Based on this, over 46,000 species of plants which accounts for 15% of the known world plants in this 15000 species of the flowering plants, out of these 35% are endemic and located in 25 endemic centre and 588 genera of monocotyledons 22 are strictly endemic and 81,000 species of animals have been described by the Botanical Survey of India (BSI) established in 1890 and Zoological Survey of India (ZSI) established in 1916, respectively. This list is being constantly upgraded, specially in lower plants and invertebrate animals. The families with high percentage of endemic species include Berberidaceae(98%), Saxifragaceae(92%), Ranunculaceae(72%), Rosaceae(70%), Melastomaceae(56%), Balsaminaceae(44%), Acanthaceae(38%) and Asclepiadaceae(32%). In addition to the above India also possess 40 species of insectivorous plants, 130 species of primitive plants, 130 species of parasites and 70 species of saprophytes There are about 15000 species of angiosperm, 65 species of gymnosperms, 1232 species of pteridophytes, 2850 species of bryophytes, 6990 species of algae, 2075 species of lichens, 14500 species of fungi and more than 850 species of virus and bacteria are found in India. It contains 1, 27,000 species of the world of which more than 45,000 species are plants and more than 80,000 species are animals. India contains about 75000 animal species out of which 80% are insects. In animals 62% of amphibians which majority is found in Western Ghats and 32% of reptiles are endemic. There are no clear estimation about marine biota in Indian continent. Long coast line with 4, 52,468 sq. kms and extended economic zone of 20,13,510 sq. kms which are abundance of fish, crustaceans, corals, reptiles, seaweeds, molluscs and mammals. In India mangroves occur along the coastline

comprising a total area of 6740 sq.kms; which is nearly 12% of the world's mangrove areas. The country also has four Coral Reef Areas located in Gulf of Mannar, Gulf of Kutch, Lakshadweep and Andaman and Nicobar Islands. The Western Ghats in peninsular India, which extends in the southern states are treasure house of species diversity and has about 5000 species. It is estimated that almost one third of animal varieties found in India have taken in Western Ghat of Kerala alone. The country is also one of the 12 primary centres of origin of cultivated plants and domesticated animals. It is considered to be the homeland of 167 important plant species of cereals, millets, fruits, condiments, vegetables, pulses, fibre crops and oilseeds, and 114 breeds of domesticated animals.