

BIODIVERSITY: VALUE AND SERVICES

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6.1 INTRODUCTION

The earth's biodiversity has taken more than 3000 million years to evolve, and today, it forms the basis for survival of the human species and other life forms on our planet. When we speak of global biodiversity we speak of the totality of genetic strains, species and ecosystems in the entire world.

Many of these ecosystems coexist in larger units called biogeographic regions. W.A. Rodgers and H.S. Panwar of the Wildlife Institute of India grouped India's natural habitats into 10 major biogeographic zones. The climate and biodiversity of ten zones are discussed in this unit. Endangered and endemic species of these zones are also mentioned.

Global biodiversity hot spots, including those in India, which is a megabiodiverse country are also discussed in this Unit.

One way would be to understand the "resource" or "use" value of various components of biodiversity which are used by humans. Biodiversity has also, however, great "non-resource" or "non-use" value such as maintaining ecosystem functions.

Expected Learning Outcomes

After completing the study of this unit you should be able to:

- ❖ define biodiversity;
- ❖ explain different levels of biodiversity i.e. genetic diversity, species diversity, ecosystem diversity;
- ❖ enumerate and analyse the wild life species that occur in the different biogeographic zones of India;
- ❖ list global biodiversity hot spots and reasons for varied biodiversity in different ecosystems/countries and discuss the criteria for identifying global biodiversity hot spots; and
- ❖ explain the value of diversity in terms of direct vs. indirect use, extractive vs. non-extractive use and resource vs. non-resource use.

6.2 DEFINING BIODIVERSITY

Biodiversity is the diversity of and in living nature. Diversity, at its heart, implies the number of different kind of objects, such as species. However, defining biodiversity or measures of biodiversity is not so simple.

The 1992 Earth Summit in Rio de Janeiro defined biodiversity as:

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.

SAQ 1

Define biodiversity.

6.3 LEVELS OF BIODIVERSITY

There are three levels of diversity viz. **genetic**, **species** and **ecosystem** diversity. In effect, these levels cannot be separated. Each is important, interacting with and influencing the others. A change at one level can cause changes at the other levels.

6.3.1 Genetic Diversity

Genetic diversity is the “fundamental currency of diversity” that is responsible for variation. This is the diversity of basic units of hereditary information which are passed down generations found within a species (e.g. different varieties of the same species). Different varieties of mango or rice are examples of genetic diversity within species.

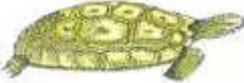
It is genetic diversity that allows a species to adapt to changing environmental conditions such as a lower rainfall, or a higher temperature year round.

6.3.2 Species Diversity

Species diversity means the differences between species (both domesticated and wild). It is the most visible component of biodiversity as implied by the word 'species' which literally means outward or visible form. This is why we often tend to describe biological diversity in terms of the number of species in a particular area or at the global level.

There are different estimates of extant (i.e. currently existing) species on earth which range from about five to 100 million, but a figure of about **12.5 million** is the most widely accepted. Of these, only about **1.7 million species have been described** as yet. In terms of sheer numbers alone, **insects and micro-organisms are the most abundant life forms on earth. (Box 6.1)**

Box 6.1: Known species of flora and fauna in the world

	4,500 species of mammals
	10,000 species of birds
	12,000 species of amphibians and reptiles
	22,000 species of fish
	400,000 species of invertebrates (excluding insects)
	960,000 species of insects, approximately 600,000 of which are beetles
	270,000 species of plants
	70,000 species of fungi
	4,000 species of bacteria
	5,000 species of viruses

6.3.3 Ecosystem Diversity

Ecosystem diversity means the variation between different types of ecosystems. Different species of animals, plants and micro-organisms interact with each other and their physical environment (such as water or minerals). Groups of organisms and their nonliving environment, and the interactions between them, form functional dynamic and complex units that are termed ecosystems. These systems help maintain life processes vital for organisms to survive on earth.

Species are not evenly distributed around the globe. Some ecosystems such as tropical rain forests and coral reefs are very complex and host a large number of species. Other ecosystems such as deserts and arctic regions have less biodiversity but are equally important.

It is believed that there is a positive relationship between species diversity and an ecosystem's stability and resilience (i.e. ability to resist disturbances).

An ecosystem having higher diversity means the number of species and interactions between them which constitute the food web, is large (Fig.6.1a). In such a situation, the elimination of one species would have little effect on ecosystem balance. In sharp contrast, the number of species in the food web of a simple ecosystem is small (Fig.6.1b). So loss of any one species has far more serious repercussions for the integrity of the ecosystem itself.

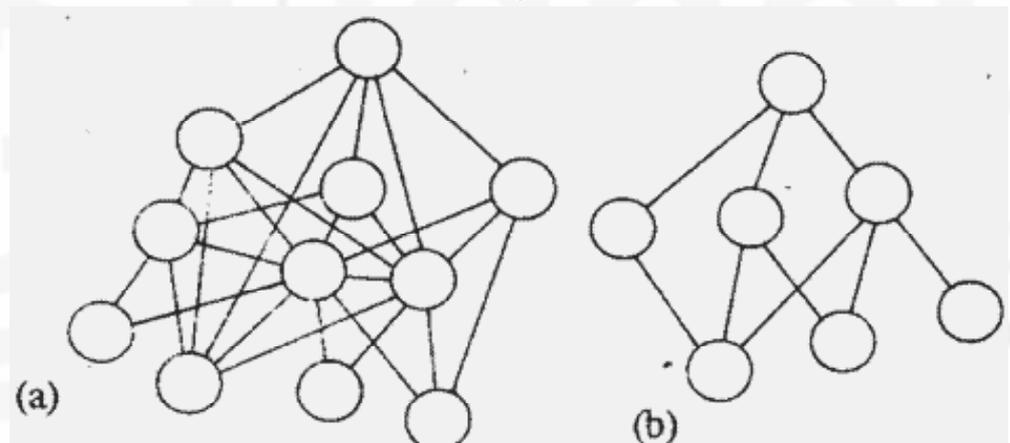


Fig. 6.1: The two illustrations give comparative picture of ecosystems with high: a) and low; b) species diversity. The circles represent organisms. **Note:** The complex, linkage in (a) only a few links in (b). The increased numbers of links are believed to confer stability to the ecosystem.

SAQ 2

Differentiate between genetic and species diversity.

6.4 THE BIOGEOGRAPHIC ZONES OF INDIA AND THEIR BIODIVERSITY

The country has been divided into ten biogeographic zones: *Trans-Himalayas*, *Himalayas*, *Indian Desert*, *Semi-Arid*, *Western Ghats*, *Deccan Peninsula*, *Gangetic Plains*, *North-East India*, *Islands*, and *Coasts*. (Fig. 6.2). This

classification was developed at the Wildlife Institute of India by Rodgers & Panwar (1988) and it is being largely followed. What are these biogeographic zones? These represent the major species groupings. In addition, each of these ten zones indicates a distinctive set of physical, climatic and historical conditions. The Himalayas and Gangetic Plains are examples of two adjacent but obviously extremely different zones.

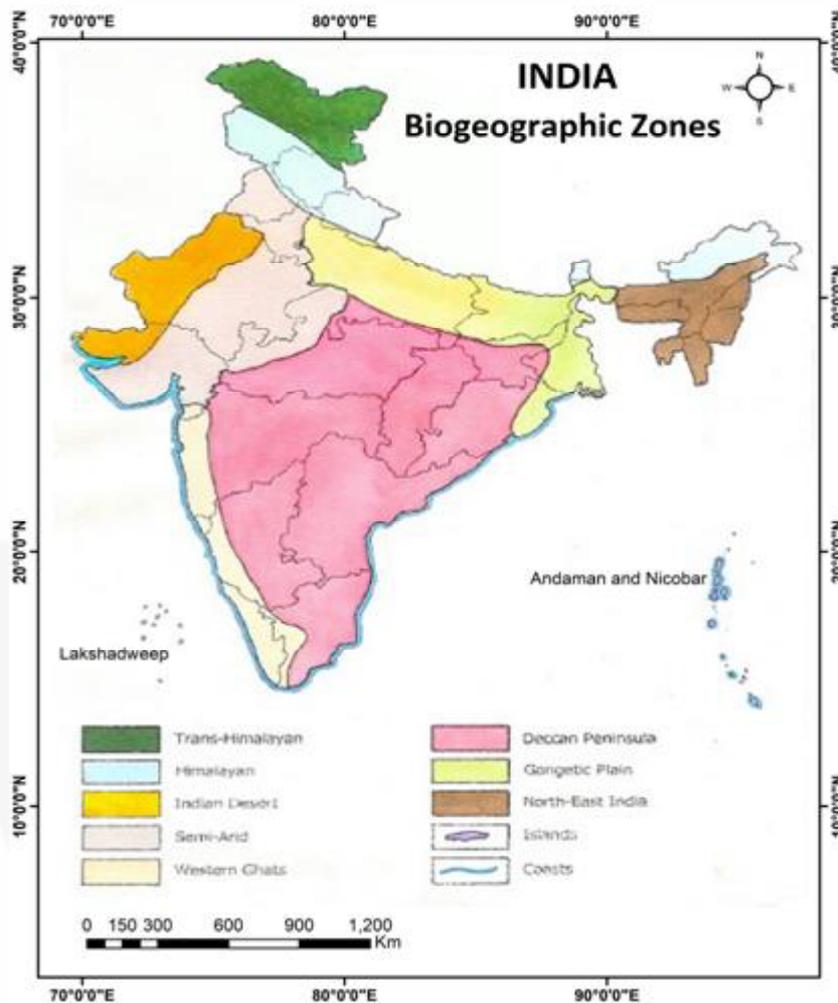


Fig.6.2: The biogeographic zones of India. From: W. A. Rodgers and H.S. Panwar, 1988. Planning a wildlife protected area network in India. Vol. 1, Department of Environment, Forests and Wildlife, Govt. of India.

6.4.1 Zone 1: The Trans-Himalayas

This zone has an area of about 1,86,200 sq. km and it covers mainly Ladakh and Lahul-Spiti. This zone is much more extensive than the area within India. Taking the topography into account, the area comes out to be around 2.6 million sq. km, with altitude between 4,500 and 6,000 m @mean sea level.

The Wildlife of the Trans-Himalayas Zone

This zone represents an extremely fragile ecosystem, because of its harsh climatic conditions and the inhospitable terrain.

The vegetation of Ladakh and Lahul-Spiti is largely a sparse alpine steppe. In addition, several endemic species also occur here. This area within India,

along with Pakistan and Tibet, has the richest wild sheep and goat communities in the whole world. There are eight distinct species and sub-species of sheep (Fig. 6.3 a-d).

The flatter plateaux have a distinct grazing community comprising of Wild Yak, Tibetan Ass, Tibetan Gazelle, Ibex and Tibetan Antelope (see Fig. 6.4 a-e). In addition to these herbivores, there is an equally distinctive set of carnivores including Snow Leopard, Indian Wolf, Pallas's Cat, Fox and smaller animals like Marbled Pole Cat, Pika and Marmot (see Fig. 6.5 a-d). Of these the Pallas's Cat is endemic to this area. The lakes and marshes too, have a distinctive avifauna including the spectacular Black-necked Crane, which is a migratory bird. Avifauna refers to the birds of an area collectively.

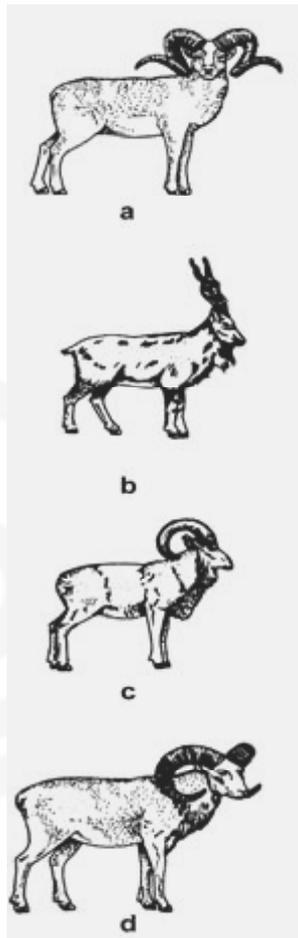


Fig. 6.3: Sheep species found in the Trans-Himalayan zone, a) Urial (*Ovis orientalis*); b) Nayan (*Ovis ammon hodgsonii*); c) Marco polo (*Ovis ammon polii*); and d) Markhor (*Capra falconeri*).

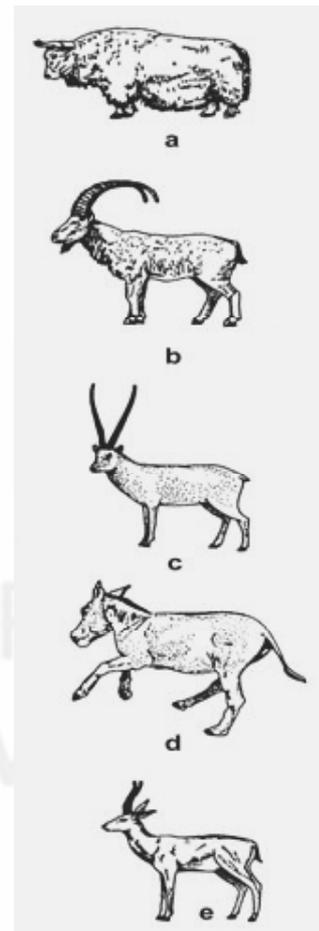


Fig. 6.4: Some herbivores of the trans-himalayan zone, a) Wild yak (*Bos grunniens*); b) Gazelle chinkara (*Gazella gazella*); c) Tibetan ass (*Equus hemionus*); d) Ibex (*Capra ibex*); and e) Tibetan antelope (*Pantholops hedgsoni*).

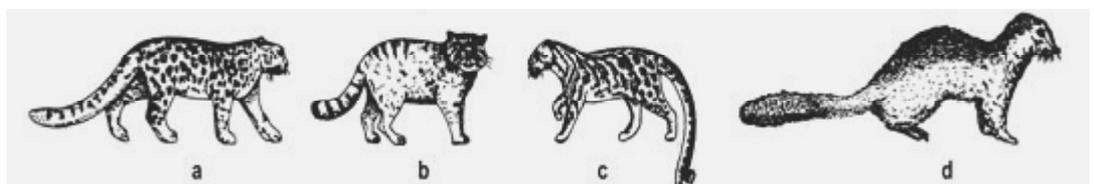


Fig. 6.5: Some carnivores of the trans-himalayan zone, Marmot (*Marmot caudate*).

6.4.2 Zone 2: The Himalayas

The Himalayan mountain ranges in India stretch for over 2,000 km from east to west.

The Wildlife of the Himalayan Zone

The Himalayan zone is one of the richest areas of India in terms of habitat and species diversity.

First let us look at the wildlife within the altitudinal and longitudinal range of Himalayas. These are:

- i) The **lower sub-tropical foot-hills**. These have typical mixed deciduous community merging into Chir Pine (Fig. 6.6a) and then Ban Oak.
- ii) The **temperate areas**. These lie below 3,500 m. This zone has a complex mixture of vegetation types with forests of Maples (Fig. 6.6b) and Walnuts, Moru and Oak (Fig. 6.6c), and a variety of conifers such as the Blue Pine, Fir and Spruce (Fig. 6.6d-g).

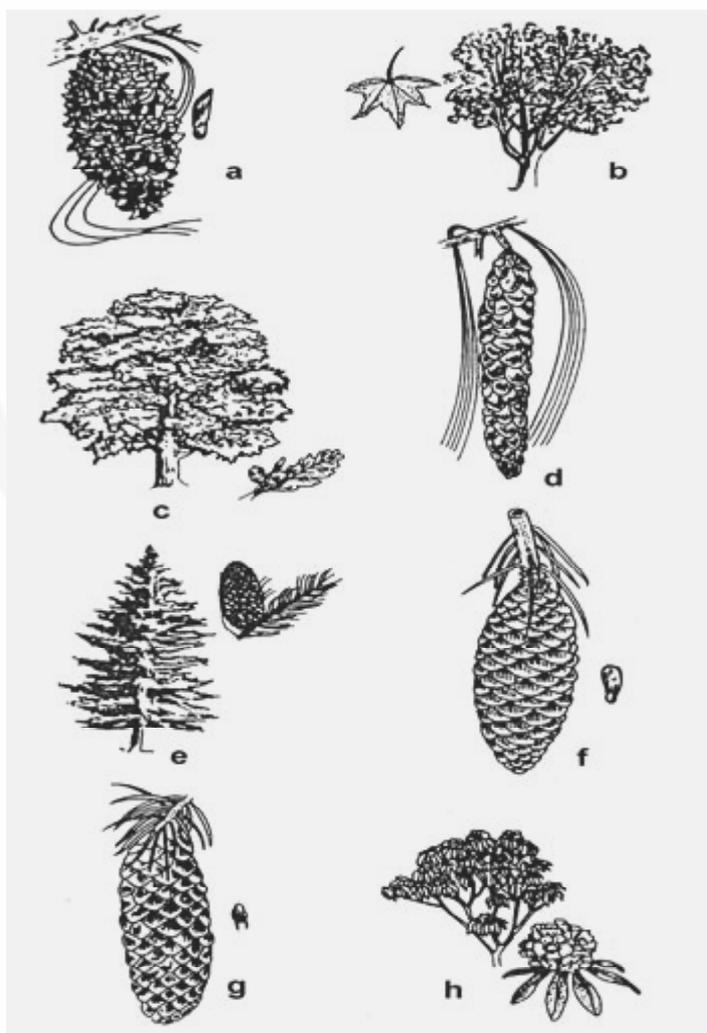


Fig. 6.6: Some representative members of the Himalayan vegetation, a) Chir pine (*Pinus roxburghii*) a cone; b) Maple (*Acer* sp.); c) Oak (*Quercus* sp.); d) Blue pine (*Pinus wallichiana*) a cone; e) Fir (*Abies* sp.). Tree and a cone; f) Spruce (*Picea smithiana*) found in Western-Himalayas, a tree and a cone; g) Spruce (*Picea spinulosa*) from Eastern Himalayas, a cone; h) Rhododendron (*Rhododendron* sp.)

- iii) The **sub-alpine area**. This area has forest and scrub vegetation of Birch and Rhododendrons (Fig. 6.6h) interspersed with grasslands with several kinds of herbs.
- iv) **The Western Zone**: This is a comparatively drier area with Deodars (Fig. 6.7) and Blue Pine.
- v) **The Central Zone**: There is a poor representation of large herbivores. Ibex, Markhor and Hangul populations have dwindled significantly.
- vi) **The Eastern Zone**: Mishmi Takin a herbivore, is found here (Fig. 6.8). This area has a higher tree line, and supports arboreal forest animals at higher altitudes.

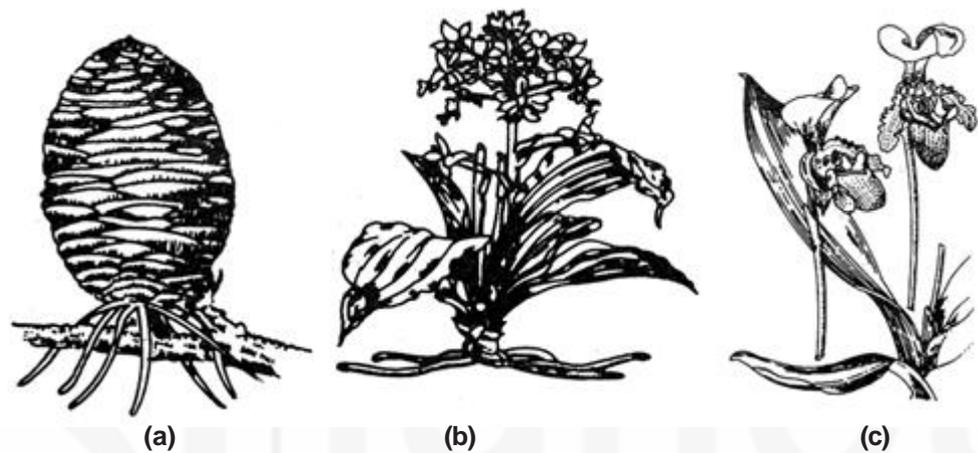


Fig. 6.7: Deodars, *Cedrus deodara* predominates the western zone of Himalayas, b,c) Orchids constitute characteristic vegetation of the Eastern Himalayan zone.

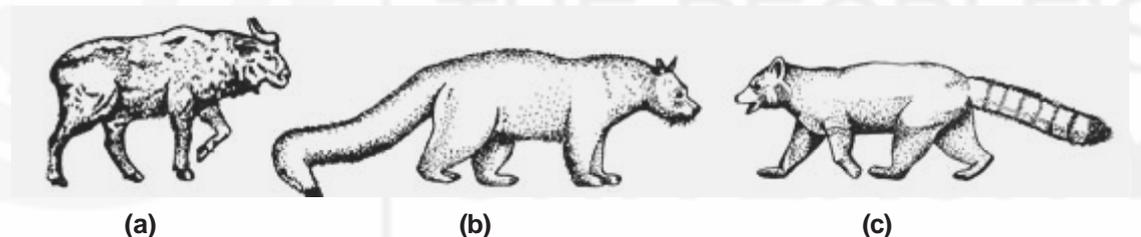


Fig. 6.8: Some animal species of the Eastern Himalaya, Takin (*Budorcas s.p.*)

Endemism is high in nearly all groups of plants and animals found here. In addition to the endemic species there are quite a few endangered species in high altitude region.

6.4.3 Zone 3: The Indian Desert

This zone is located in the western part of the country and is also known as the Thar desert. It covers west Gujarat and west Rajasthan. Parts of Punjab and Haryana were once a part of this desert, but the irrigated cultivation has changed the situation there.

The Wildlife of the Indian Desert

The wildlife of the desert zone is peculiar not because of its great diversity or density, but because of the extraordinary ecological adaptations to the desert

conditions. Several of the species are endemic to Thar Desert. Desert Fox, Desert Cat (Fig. 6.9a), Houbara Bustard and some Sand Grouse species are restricted only to the Thar area. *Prosopis cineraria*, *Salvadora oleoides* are common trees of Indian desert.

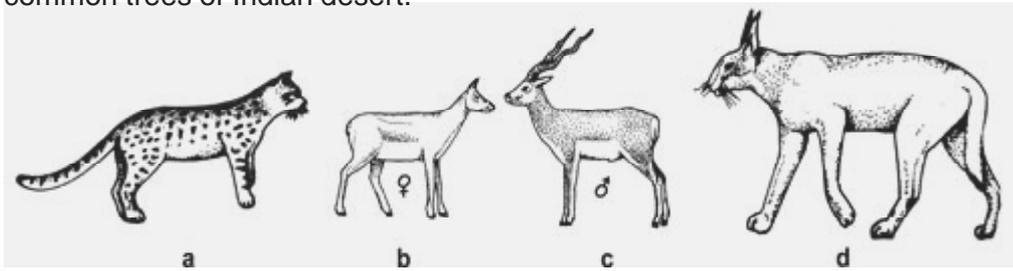


Fig. 6.9: Desert cat (*Felis libyca*).

6.4.4 Zone 4: The Semi-Arid

This zone with an area of 508,000 sq. km occupies 15% of the total area in our country. The presence of several grass species and palatable shrubs in these areas has made them a favourite of a vast number of wildlife species.

The Wildlife of the Semi-Arid Zone

This zone has strong biological links with western Asia, primarily with Pakistan, Iran, Middle-east and Northern Africa. Many of the plants found here show African affinity, e.g., *Acacia* sp. (see Fig. 6.10). The fauna consists of larger Herbivores-Blackbuck, Chowsingha, Gazelle and Nilgai. (Fig. 6.11)

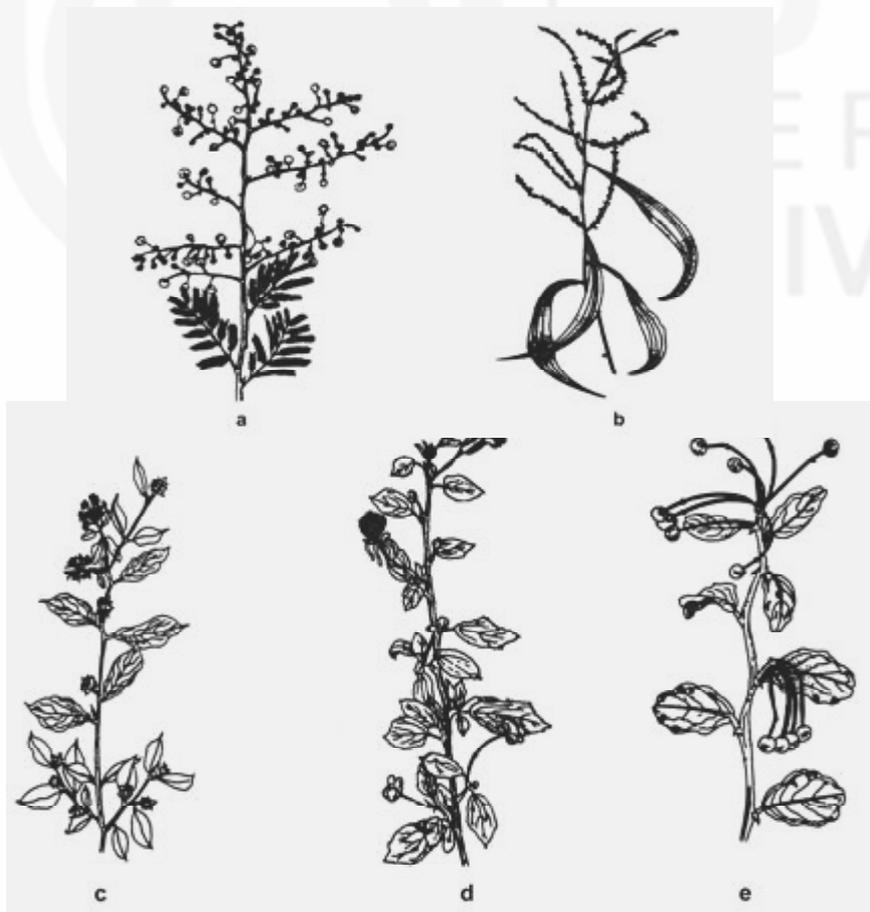


Fig. 6.10: Plants of the semi-arid zone, *Acacia leucophloea* (Ronj).

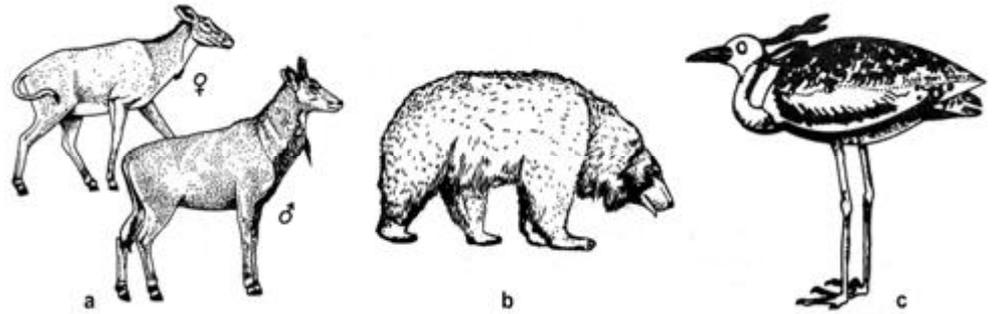


Fig. 6.11: Some faunal elements of the semi-arid zone, a) Nilgai (*Boselaphus tragocamelus*), female (♀) and male (♂) Sloth bear (*Malurus ursimus*), and c) Lesser florican (*Syphoetides indica*).



Fig. 6.12: A twig of *Myristica* along with a fruit.

6.4.5 Zone 5: The Western Ghats (Biodiversity Hot Spot)

The Western Ghats represent one of the major tropical evergreen forest regions in India. The total area of Western Ghats is about 160,000 sq. km. In the west, the zone is bound by the coast and in the east, it shares boundary with the Deccan peninsular zone. The tropical evergreen forests occupy about one third of the total area of this zone. In recent years, a large chunk of the forest cover has been lost and this zone is now of great conservation concern, more so because of its exceptional biological richness. About two-thirds of India's endemic plants are confined to this region. However, the potential of many of these species is yet to be tapped. Besides harbouring diverse biological communities, the forests in this zone also play an important role in maintaining the hydrological cycle.

The well known species found exclusively in Western Ghats include the following:

Among Primates – Nilgiri Langur and Lion-tailed Macaque (Fig.6.13b,c)

Rodents – Platacanthomys, the Spiny Dormouse

Squirrels – Several subspecies of *Ratufa indica* with separate forms in Maharashtra, Mysore, Malabar and Tamil Nadu Ghats. The Grizzled Squirrel is restricted to two localities in the drier Tamil Nadu forest.

Carnivores – Malabar Civet in southern evergreen forests, Rusty spotted Cat in northern deciduous forests.

Ungulates – Nilgiri Tahr (Fig. 6.13d) in Nilgiris to Agastyamalai montane grassland.

Hornbills – Malabar Grey Hornbill (Fig. 6.13e).

In addition to the above endemic species, the other species found are: Tiger, Leopard, Dhole (Fig. 6.13f), Sloth Bear, Indian Elephant and Gaur (Fig. 6.13g).

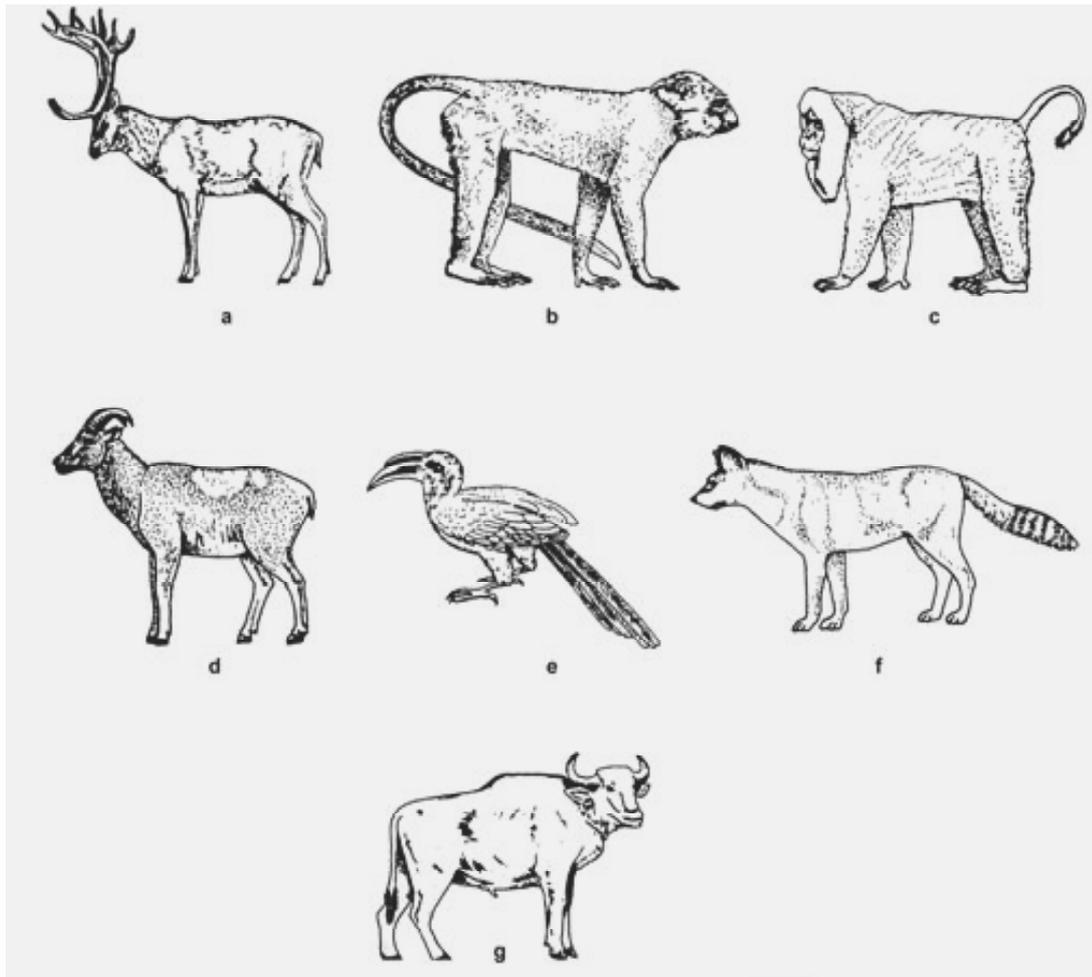


Fig. 6.13: The faunal elements of Western Ghats, a) Swamp deer (*Cervus duvauceli*); b) Nilgiri langur (*Presbytis johni*); c) Lion-tailed macaque (*Macaca silenus*); d) Nilgiri Tahr (*Hemitragus hylocrius*); e) Malabar grey hornbill (*Tockus birostris*); f) Dhole (*Cuon alpinus*); and g) Gaur (*Bos gaurus*).

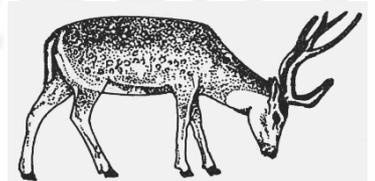


Fig. 6.14: Chital (*Axis axis*) found in the Deccan Peninsula.

6.4.6 Zone 6: The Deccan Peninsula

This zone covers the largest area in India that amounts to about 43% of the total land mass, and about 1,421,000 sq. km area. Though a large area of this zone has been greatly altered by humans, still some forest areas exist, particularly in Madhya Pradesh, Maharashtra and Odisha.

This zone has deciduous forest, thorn forests and degraded shrublands. There are small areas of semi-evergreen forests in the Eastern Ghats and, dry evergreen forests or thorn scrub on the coastal side of the plains of Andhra Pradesh and Tamil Nadu.

The faunal species are widespread throughout the whole zone, e.g., Chital (Fig. 6.14), Sambar, Nilgai, Chowsingha, Barking Deer, and Gaur. Some

species such as the Blackbuck are restricted to dry open area. Small, relict populations of species also exist, e.g., Elephant (Bihar-Odisha, and Karnataka-Tamil Nadu) and Wild Buffalo (in a small area at the junction of Odisha, M.P. and Maharashtra).

6.4.7 Zone 7: The Gangetic Plain

This zone has one of the most fertile areas in the world, and it supports a dense and growing human population. It covers an area of about 359,400 sq km. The original vegetation found in most of the area is no longer there, as a major portion of this area has been brought under cultivation.



Fig. 6.15: Gangetic dolphin (*Platanista gangetica*) found in the gangetic plains.

The Wildlife of the Gangetic Plains

Small relict populations of Nilgai, Blackbuck and Chinkara, interspersed with dense cultivation presently exist in the western areas.

The wetlands and rivers also contain Crocodile – Mugger and Gharial - populations, relict populations of Gangetic Dolphin (Fig. 6.15) and a rich, fresh-water turtle community having over 20 species.

6.4.8 Zone 8: North-East India

North-East India represents the transition zone between the India, Indo-Malayan and Indo-Chinese regions as well as the meeting point of Himalayan mountains and Peninsular India. It is one of the most important zones in the Indian Subcontinent for its rich biological diversity and a large number of endemic species.

The Brahmaputra valley of this zone contains unique natural vegetation – swamps, grasslands and fringing woodlands and forests. The fauna consists of Rhinoceros, Buffalo, Swamp Deer, Hog Deer, Pygmy Hog and Hispid Hare. This area also contains the largest elephant populations. This is also the fly-way for waterfowl and other birds travelling between the warmth of the subcontinent and their summer grounds in Siberia and China.

6.4.9 Zone 9: The Islands

In this category we shall discuss the Andaman and Nicobar group of islands in the Bay of Bengal, and the Lakshadweep in the Arabian Sea. The Andaman and Nicobar islands are a long group of 348 north-south oriented islands.

The zone possesses a unique kind of plant and animal life exhibiting a high degree of endemism. One finds these islands with impoverished mammal fauna. This may be largely due to the isolation of Andaman and Nicobar islands and the small island size. Amongst mammals, species of rodents and bats dominate.

Out of the 15,000 species of flowering plants found in India, some 2,200 species are found in these islands (two such species are shown in Fig. 6.16). Over 200 are strict endemics.

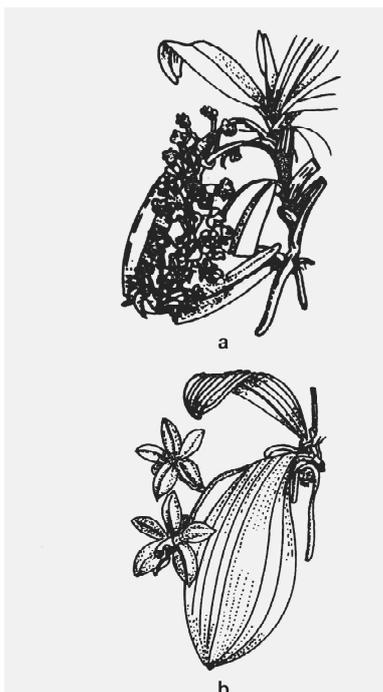


Fig. 6.16: Two orchid species of Andaman and Nicobar Islands; a) *Aerides emerici*; b) *Palaenopsis speciosa*.

6.4.10 Zone 10: The Coasts

India has a vast coastal stretch of about 5689 km (Srinivasan, 1969). On the west, the Arabian Sea washes the shores of Gujarat, Maharashtra, Goa, Karnataka and Kerala States. On the east, the Bay of Bengal washes the coasts of Sunderbans in West Bengal, Odisha, Andhra Pradesh and Tamil Nadu states. The southern promontory of Indian Peninsula is bathed by the Gulf of Manar and Indian Ocean, along the coasts of southern portions of Tamil Nadu.

The Wildlife of Coasts

The geology of coasts is very varied and accordingly, five main communities have been described:

- Mangroves – that have a variety of community types from seaward to landward facing areas of estuaries, lagoons and deltas.
- Sandy beaches, including raised beaches and distinctive plant communities such as *Casuarina* – *Calophyllum* – *Pandanus*.
- Mud flats with a range of successional stages to completely terrestrial vegetation.
- Raised corals and rocky coast lines.
- Marine angiosperm pastures

An endemic species is one that is restricted to a given area and is not found elsewhere.

Some of the interesting coastal wildlife species include: Dugong; Hump-back Dolphin of estuarine turbid waters; Estuarine or salt-water Crocodile; Olive Ridley, Green, Hawksbill, Leather and Loggerhead sea Turtles; the Estuarine Turtle – *Batagur basker* of Sunderbans and the huge Soft-shell Estuarine Turtle; *Pelochelys birbornii* off the Utkal-bengal Coast fish – mud skippers or semi-terrestrial Gobies, small Crabs in association with Anemones; avifaunal communities of mangrove, mud flats and lagoons. In the higher regions of mangroves, there are Spotted Deer, Pigs, Monitor Lizards, Monkeys, and the Sunderban Tiger.

6.5 BIODIVERSITY HOT SPOTS

Hot spots are areas that are extremely rich in species, have high endemism and are under constant threat.

Myers (1988) identified 18 regions or “Hot spots” around the world. Interestingly these areas contain nearly 50,000 endemic plant species, or 20% of the world’s plant species, in just 746,000 km², or 0.5% of the Earth’s total land surface. A subsequent study done by the World Conservation Monitoring Centre, U.K. identified 21 “hot spots”. A more recent study by Conservation International, which carries forward the work of Myers, has identified 34 global “biodiversity hot spots”. These 34 hot spots cover only 1.4 percent of the Earth’s land surface but contain about 44% of all vascular plants and 35% of vertebrates (excluding fishes), and 96% of the world’s most threatened primate species. Among the 34 hot spots of the world four are found in India

An endemic species is one that is restricted to a given area and is not found elsewhere.

Green Nations

Plants, insects anything mentioned in a biology text book qualifies as a bioresource. Countries with vast bioresources are called Mega-Diverse.

Mega Diverse countries

Eighteen countries that control 70 percent of the world’s bioresources have got together: India, China, Zaire, Indonesia, Columbia, Mexico, Ecuador, Kenya, Peru, Venezuela, Costa Rica, Bolivia, Malaysia, Madagascar, Philippines, South Africa, Congo and conservation priority in the selection of countries is based on species richness and species endemism

extending into neighbouring countries – the Western Ghats/Sri Lanka Indo-Burma region (covering the Eastern Himalayas); the Himalayas; Sundaland (covers the Nicobar group of Islands) (Fig. 6.17). These areas are rich in floral wealth and endemism, not only in flowering plants but also in reptiles, amphibians, swallow tailed butterflies and mammals.

Tropical moist forests are believed to be the richest terrestrial ecosystems on earth. In the marine environment, coral reefs also possess extremely rich biodiversity. It is now suspected, however, that the richness of species diversity on sea floor may be equal or even greater than coral reefs.

Some countries are richer in biodiversity than others. Generally, the economically poor developing countries in tropical areas are richer in biodiversity than developed countries in temperate areas.

Small tropical oceanic islands have relatively fewer species due to their isolation, but they generally possess large number of endemics. Mauritius has a native flora of 878 higher plant species, of which 329 are endemic.

6.6 INDIA: A MEGA - BIODIVERSITY COUNTRY

Why India is one of the mega-diversity countries?

- Four hot spots out of 34 global biodiversity hot spots are in India with its neighbouring countries.
- The endemics of Indian biodiversity is high. About 33% of the recorded flora is endemic to the country. Of the 49,219 plant species, 5150 are endemic and distributed into 141 genera under 47 families corresponding to about 30% of the world's recorded flora.
- India has 26 recognised endemism centres that are home to nearly a third of all the flowering plants identified and described to date in the country.
- India has two major realms called the Palaeretic and the Indo-Malayan and three biomes i.e. tropical humid forests, tropical deciduous forests and the warm deserts/semi-deserts.
- India has ten biogeographic regions.
- India is one of the 12 centres of origin of cultivated plants.

SAQ 3

Which parameters place India in the list of mega biodiversity countries?

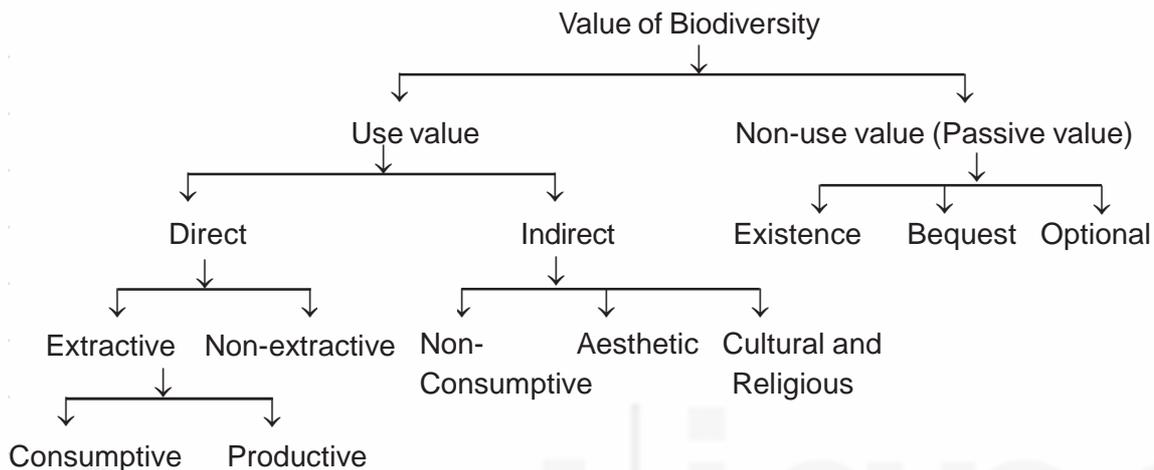
6.7 USE VALUES OF BIODIVERSITY

Despite its importance, determining the value or worth of biodiversity is

complex and often a cause for debate. This is largely due to the fact that the worth placed on biodiversity is a reflection of underlying human values, and **these values vary dramatically both among societies and individuals.**

In this Unit, we include spiritual, cultural and aesthetic values as a subset of indirect values or services, as they provide a service by enriching our lives.

Classification of values of biodiversity is provided in a key form below for your easy understanding.



6.7.1 Direct Use Value

Direct use values are for those goods that are ensured directly e.g. food and timber. Maintaining a wide range of components of biological diversity can be of direct use, especially in the fields of agriculture, medicine and industry.

Direct use can involve the use of forests, wetlands or other ecosystems for timber extraction, collection of non-timber products, fishing, etc. Direct use values could be due to **extractive use** where resources are extracted and consumed, or due to **non-extractive use** when there is no extraction or removal of the resource that is used (e.g. bird watching, scientific research in an ecosystem).

6.7.2 Indirect Use Value

Indirect use value is for those services that support the items that are consumed. You will study about various indirect use values in this section.

Non-consumptive value

This is concerned more with nature's services which also make vital contributions to the welfare of society and to ecological processes without which our planet would be uninhabitable.

Aesthetic value

The appreciation of the aesthetic aspect of biodiversity is reflected in the trouble people take to maintain their home gardens, and the number of people throughout the world who visit national parks, botanical and zoological gardens, aquaria and places where one can experience natural landscapes or view diverse species.

Cultural and religious values

In all cultures of world, species and nature have inspired songs, superstitious beliefs, stories and folktales, and dance and drama, poetry, traditional crafts, local and national cuisines, local rituals, names of places, and even family and Christian names. The cultural value of biodiversity in human societies is often expressed in the respect for life forms or symbols of components of biodiversity. In some countries the tiger, lion, lizard, turtles and bison are part of religious and spiritual beliefs. For instance, the hanuman langur (*Semnopithecus entellus*) is considered sacred in India.

Ethical values

The ethical values of biodiversity highlight the intrinsic value of biodiversity for its own sake and it is independent of the varied economic, social and cultural uses of the large number of species by human communities. It underscores the fact that humans are only one of the millions of species that inhabit the earth, while each species is unique and is the result of evolutionary processes without human intervention, so that every species has a natural right to exist.

6.7.3 Non-use Value

Values for those things/organisms/entities – that we don't use but would consider as a loss if they were to disappear. These include **potential or option value**, **bequest value** and **existence value**.

- **Optional use values**

Optional values are associated with potential use in the future.

Accordingly one opts to conserve biodiversity based on the hope that it could be used directly or indirectly in the future, perhaps as a source of genetic material, for pharmaceuticals, or for crop enhancement.

- **Bequest value**

- **Existence value**

There may also be non-use existence values for components of biological diversity due to the value placed on biodiversity purely based on its continued existence, irrespective of whether or not it will ever be used.

SAQ 4

Discuss about direct and indirect use values of biodiversity.

6.8 SUMMARY

Let us summarize what you have learnt so far:

- The term biological diversity was coined by Thomas Lovejoy in 1980 and the term biodiversity was coined by E.O. Wilson. Biodiversity is a measure of the relative diversity among organisms present in different ecosystems. Biodiversity is the totality of genes, species and ecosystems of a region.

- There are three levels of diversity i.e. **genetic, species and ecosystem**. All these levels are interacting and influencing the others.
- Genetic diversity underlies the differences among individuals of a given species. Genetic diversity allows a species to adapt to changing environmental condition.
- Species diversity is the most visible component of biodiversity. It means the differences between species. There are about 12.5 million species in the world out of which 1.7 million species have been described.
- India has been divided into ten biogeographic zones viz; Trans-Himalayas, Himalayas, Indian Desert, Semi-arid, Western Ghats, Deccan Peninsula, Gangetic Plains, North East India, Islands and Coasts. Each of these zones has certain geographical as well as biological peculiarities.
- Biodiversity hot spots are areas that are extremely rich in species, have high endemism and are under constant threat. There are 34 hot spots in the world; 4 of which are found in India extending into neighbouring countries.
- India is among the world's mega biodiversity countries because of various reasons, viz. 4 hot spots, 26 recognised endemism centres, two major realms, three biomes and ten biogeographic regions.
- The value of biodiversity is often divided into two main categories i.e. **intrinsic or inherent value** and **extrinsic or utilitarian** value. Intrinsic value describes the worth of an organism, independent of its value to anyone or anything else. Utilitarian value refers to something's value as determined by its use or function.
- Use values can be direct or indirect. Direct use values are for those goods that are consumed directly, such as food or timber and indirect use value are for those services that support the items that are consumed, including ecosystem functions like nutrient cycling.
- Non-use or passive values are for those entities that we don't use but would consider as a loss if they were to disappear. These include **existence value, bequest value** and **option value**.

6.9 TERMINAL QUESTIONS

1. Define biodiversity. Explain different levels of biodiversity.
2. Enumerate and analyse the wild life species that occur in the different biogeographic zones of India.
3. Discuss the criteria for identifying global biodiversity hot spots.
4. Explain the use values of biodiversity.

6.10 ANSWERS

Self-Assessment Questions

1. 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.
2. Genetic diversity is the diversity of basic units of hereditary information which are passed down generations found within a species (e.g. different varieties of the same species). Species diversity means the differences between species (both domesticated and wild).
 3. Following parameters place India in the list of mega biodiversity countries:
 - i) Four hot spots out of 34 global biodiversity hot spots are in India with its neighbouring countries
 - ii) The endemics of Indian biodiversity is high. About 33% of the recorded flora is endemic to the country. Of the 49,219 plant species, 5150 are endemic and distributed into 141 genera under 47 families corresponding to about 30% of the world's recorded flora.
 - iii) India has 26 recognised endemism centres that are home to nearly a third of all the flowering plants identified and described to date in the country.
 - iv) India has two major realms called the Palaeretic and the Indo-Malayan and three biomes i.e. tropical humid forests, tropical deciduous forests and the warm deserts/semi-deserts.
 - v) India has ten biogeographic regions.
 - vi) India is one of the 12 centres of origin of cultivated plants.
 4. Refer to Sub Sections 6.7.1 and 6.7.2.

Terminal Questions

1. Refer to Sections 6.2 and 6.3.
2. Refer to Section 6.4.
3. Refer to Section 6.5.
4. Refer to Section 6.7.

6.11 FURTHER READING

1. WCMC (1992) *Global Biodiversity. Status of the earth's Living Resources*. Chapman & Hall.
2. National Biodiversity Action Plan and Strategy of India, (Draft of 2002).
3. IUCN (1999) *Resource Material on Biodiversity for General Certificate of Education*.
4. Glowka, L. et. al., (1994) *A Guide to the Convention on Biological Diversity*. IUCN Gland and Cambridge.

Internet Sites

<http://www.unep.ch/conventions/geclist.htm>

<http://www.epw.org.in>

<http://www.cites.org/eng/disc/what.shtml>