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Production of Courseware  -Content for Postgraduate Subjects

## 1. Details of Module and its Structure

Module Detail	
<b>Subject Name</b>	BOTANY
<b>Paper Name</b>	Ecology
<b>Module Name/Title</b>	Biogeographical zones
<b>Module Id</b>	
<b>Pre-requisites</b>	Distribution of species (biology), organisms, and ecosystems in geographic space and through time.
<b>Objectives</b>	To understand the concept of biogeographical zone and distribution of species.
<b>Keywords</b>	Phyto- geography, Zoo- geography, Flora, Fauna.

### Structure of Module / Syllabus of a module (Define Topic / Sub-topic of module )

<b>Biogeographical zones</b>	Trans Himalayan, Himalayan, The Indian Desert, The semi- Arid, Western ghats, The Deccan peninsula, The Gangetic plain, Coasts, North-East, The Islands
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## 2. Development Team

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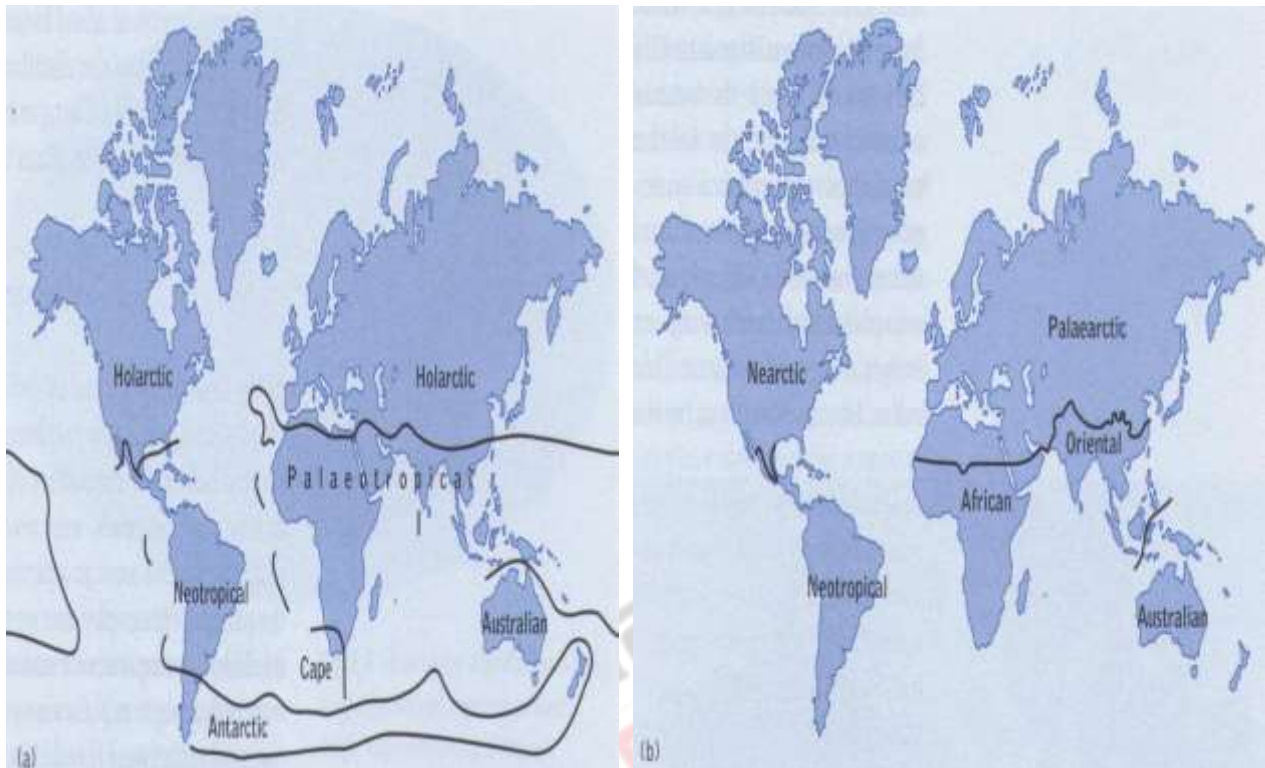
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## BIOGEOGRAPHICAL ZONES OF INDIA

*“The study of what organisms lives where on earth and why”*- (From Humphries and Parenti, 1999)

Biogeography is the study of the distribution of species (biology), organisms, and ecosystems in geographic space and through time. This subject has started receiving the attention in 19<sup>th</sup> century (MoEF & Kalpavriksh2004). Biogeography is divided into 2 parts: i.) Phyto- geography that deals with origin, distribution, & environmental relationships of plant and ii.) Zoo- geography that deals with the migration & distribution of animals.



Source: BIOGEOGRAPHY, SEVENTH EDITION, FIGURE 2.2 (Part 2)

Figure 1: Diagrammatic sketch of the world showing (A) Floral Kingdoms, and (B) Zoogeographical regions, (Cox and Moore 2006)

### Bio-Geographical Classification of India

India is one of the 12<sup>th</sup> Mega diverse regions of world. (Mexico, Columbia, Madagascar, Ecuador, Cameroon, Peru, Brazil, Jaira, China, Malaysia, Indonesia and India) Myers *et al* 2001.

India can be conveniently divided into ten major regions based on geography, climate and pattern of vegetation seen and the communities of mammals, birds, reptiles, amphibians, 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 plants and animal species.

Bio-geographic classification of India describing 10 bio-geographic zones in India are further divided into 25 secondary units called biogeographic provinces giving weight to particular communities separated by dispersal barriers or gradual change in environmental factors (Rodgers et. al., 2002). The classification was done using various factors such as altitude, moisture, topography, rainfall, etc. Biogeographic zones were used as a basis for planning wildlife protected areas in India.

The 10 bio-geographic zones which are distinguished clearly in India and each harbour its own assemblage of animal and plant communities. These 10 zones described in Table 1 and Figure 2.

Table 1: Biogeographic zones and biotic provinces of India

Biogeographic zones	Biotic provinces
1. Trans-Himalayan	1A Tibetan
2. Himalayan	2A North-West Himalaya
	2B West Himalaya
	2C Central Himalaya
	2D East Himalaya
3. Desert	3A Kutch
	3B Thar
4. Semi-arid	4A Punjab
	4B Gujarat-Rajwara
5. Western Ghats	5A Malabar Coast
	5B Western Ghat Mountains
6. Deccan Peninsula	6A Deccan Plateau South
	6B Central Plateau
	6C Eastern Plateau
	6D Chhota Nagpur
7. Gangetic Plain	7A Upper Gangetic Plain
	7B Lower Gangetic Plain
8. Northeast India	8A Brahmaputra Valley
	8B Assam hills
9. Islands	9A Andaman Islands
	9B Nicobar Islands
	9C Lakshadweep Islands
10. Coasts	10A West Coast
	10B East Coast

Source: Ecology environment and resource conservation, Table 7.4 (Part 7) Singh *et al* (2006)

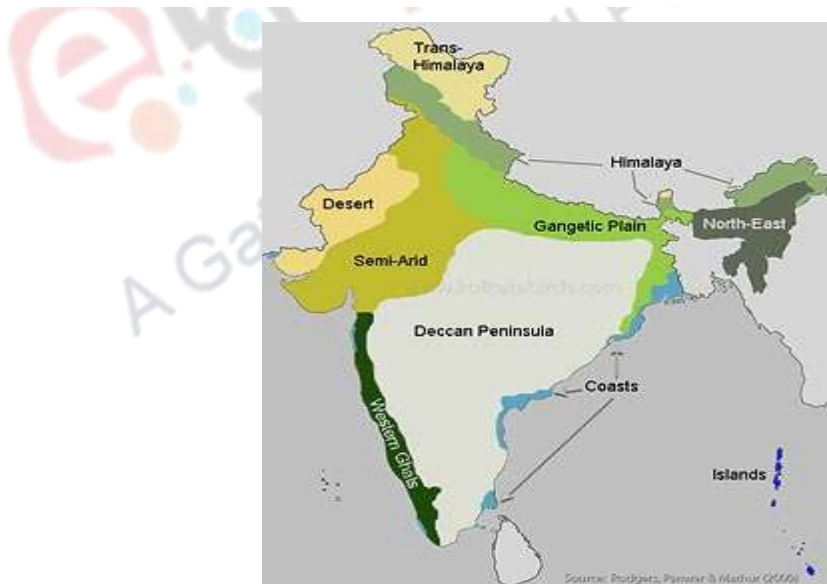


Photo: Rodgers, Panwar & Mathur

Figure 2: Map of India showing biogeographic zones

## 1. Trans- Himalayan



Constituting 5.6 percent of the country's geographical area, this zone includes high altitude cold and arid mountain areas, including cold deserts (Figure 2). An extension of the Tibetan Plateau, this zone has sparse alpine steppe vegetation with endemic species such as Ibex, Snow leopard, Black necked crane, marbled cat, Marmots. It supports some of the biggest populations of wild sheep and goats in the world as well as some rare species of fauna such as Snow Leopard (*Uncia uncia*). The black necked crane is the most distinctive bird of an impressive and distinct avifauna developed in lakes and marshes.



Figure 3: *Uncia uncia* (Snow Leopard)



Figure 4: *Impatiens glandulifera* (Himalayan Balsam)

## 2. Himalayan

Consisting of the entire Himalayan mountain range, this zone covers 6.4 percent of the total geographical area and has alpine and sub-alpine forests, grassy meadows and moist deciduous forests. More than 300 million population of the Indo-Gangetic plain are dependent on the Himalayan waters. The Himalayan zone has diverse habitats for a range of species including endangered ones such as Hangul (*Cervus eldi eldi*) and Musk Deer (*Moschus moschiferus*). In lower subtropical belt mixed deciduous forests occupy lowest elevations, they are replaced by chir pine (*Pinus roxburgii*) and then by banj oak (*Quercus leucotrichophora*) at around 2000m elevations.



Photo: J. Goodrich

Figure 5: *Moschus moschiferus* (Musk Deer)



Photo: Steve George

Figure 6: *Pinus roxburghii* (Chir pine)

### 3. The Indian Desert

Biogeographically, it is the eastward extension of the Sahara-Arabian desert system which spread through Iran, Afghanistan and Baluchistan to the Thar area on the Indo-Pakistan border. This arid zone falls west of the Aravalli hill range and comprises both the salt and sand deserts of north-western India. (Figure 2) constituting 6.6 percent of the country's geographical area, this zone also has large expanses of grasslands that support several endangered species such as the Great Indian Bustard (*Ardeotis nigriceps*). The plant species are *Acacia nilotica*, *Prosopis cineraria*, *Salvadora oleoides* and *Tecomella* spp. *Prosopis juliflora* and other species are becoming increasingly widespread.



Photo: Kiran Ghadge

Figure 7: *Gazella bennettii* (Chinkara)



Photo:ILRI

Figure 8: *Acacia nilotica* (Babul)

#### 4. The Semi- Arid

This zone covers 16.6 percent of the country. Although overall semi-arid, this zone also has several lakes and marshlands. The grasses and palatable shrub layer of this zone support the highest wildlife biomass. Many plant taxa have African affinity: *Acacia*, *Anogeissues*, *Balanites*, *Capparis*, *Grewia*. *Anogeissues pendula* forest community occurs only in this zone, on gentler slopes of the Aravalli and associated hill ranges. The endangered Asiatic Lion (*Panthera leo persica*) is also found in this zone, in the Gir forests of Gujarat (Figure 23A). The largest herbivores are Blackbuck, Chowsingha, Nilgai, and Gazelle. One part of this zone surrounds desert zone of western Gujrat and Rajasthan (Punjab, Haryana, Delhi, Rajasthan and Gujrat) and the other part consists of the rain- shadow areas behind the Western Ghats (Maharastra, Andhra Pradesh, Karnataka and Tamil Nadu).



Figure 9: *Panthera leo persica* (Asiatic Lion)



Figure 10: *Anogeissues latifolia* (dhaora)

#### 5. Western Ghats

Western Ghats is a mountain range running along the western coast of peninsular India, from Tapi River in the north to Kanyakumari in the south (Figure 1). The moist evergreen forests are most extensive in the Western Ghats. Constituting 4 percent of the country's geographical area, this zone supports tropical evergreen forests that are home to approximately 15,000 species of higher plants, of which around 4,000 (c.27 percent) are endemic. The rainfall is heavy; possibly more than 2,000mm in most areas but can exceed 5,000mm in some areas. Forests have been replaced by tea, coffee, cocoa, rubber, cardamom, chincona and other plantations. There are several endemic faunal species as well, such as the Nilgiri Langur (*Presbytis johnii*) and the Lion-tailed Macaque (*Macaca*



*silenus*). The Malabar grey hornbill is a good indicator of healthy and mature deciduous forest along the Western Ghats.



Photo: Ramki Sreenivasan

Figure 11: *Macaca silenus* (Lion-tailed Macaque)



Photo: Wikipedia.org

Figure 12: Evergreen forest

## 6. The Deccan Peninsula

This is the largest zone covering as much as 42 percent of the country. The Deccan highlands constitute the principle catchment for a number of South India's main river systems (Narmada, Tapti, Mahanadi, and Godavari). Sal (*Shorea robusta*) and teak (*Tectona grandis*), the precious timber species (Figure 23B). It supports some of the finest forests in India with abundant populations of deer and antelope species such as Chital (*Axis axis*), Sambar (*Cervus unicolor*) and Four-horned Antelope (*Tetracerus quadricornis*). There are small populations of Asian Elephants (*Elephas maximus*) and Wild Water Buffaloes (*Bubalus arnee*) as well (Figure 23A). Gharhial is restricted to some rivers.



Photo: Sandiego.zoo



Photo: Keralatourism.org

Figure 13: *Elephas maximus* (Asian Elephant)

Figure 14: *Tectona grandis* (Teak Forest)

## 7. The Gangetic plain

This is one of largest zones in India, stretching from Yamuna river eastwards across Uttar Pradesh, Bihar, West Bengal and coastal plains of Orissa (Figure 1). This represents one of the main fertile areas. This flat alluvial zone is topographically fairly homogenous and constitutes 10.8 percent of the country's geographical area. This zone supports many large and charismatic mammals such as One-horned Rhinoceros (*Rhinoceros unicornis*), Asian Elephant and Wild Water Buffalo. Other characteristic fauna includes Swamp Deer (*Cervus duvauceli*), Hog Deer (*Axis porcinus*) and Hispid Hare (*Caprolagus hispidus*). Sal (*Shorea robusta*) forest represents potential vegetation along the Himalaya and mixed dry deciduous forests in plains. Western areas hold relict populations of Rhino, Elephant, Buffalo, Swamp deer, etc



Photo: Maggiemcneill

Figure 15: *Rhinoceros unicornis* (Rhinoceros)



Photo: Jharkhand biodiversity board

Figure 16: *Shorea robusta* (Sal)

## 8. Coasts

The coastal zone constitutes 2.5 percent of the geographical area and covers beaches, mangroves, mud flats, coral reefs and marine angiosperm pastures. Sunderbans shared with Bangladesh is the largest contiguous mangrove area in the world. The Lakshadweep Islands having a biodiversity rich reef lagoon system are also included in this zone. The fauna are Dungdong, Hump-back dolphin of turbid estuarine waters, varied turtles, especially Batagur basker of Sunderbans estuary and



*Pelochelys bibronii* (Asian Giant Softshell Turtle).



Photo: Telegraph.co.uk

Figure 17: *Sousa teuszii* (Hump-back dolphin)



Photo: Laura sinpetru

Figure 18: Mangrove forest

### 9. North- East

It is one of the richest in communities, in species and is characterized by diverse habitats and long-term geological stability. The North-East zone covers 5.2 percent of India’s geographical area. There are significant levels of endemism in all floral and faunal groups. It is only in the north-east that the full richness of the large herbivore fauna typical of alluvial grasslands can still be found: rhinoceros, buffalo, elephant, swamp deer, hog deer, pygmy hog and hispid hare. The region represents an important fly away for waterfowl and other herds seasonally migrating.



Photo: Shergarh.com

Figure 19: *Rucervus duvaucelii* (Swamp deer)



Photo: Floralpin.de

Figure 20: *Cypripedium parviflorum* (Yellow lady’s slipper orchid)

## 10. The Islands

Although this zone covers only 0.3 percent of the country's geographical area, it is nonetheless important from the biodiversity perspective. The Andaman and Nicobar Islands have some of India's finest tropical evergreen moist forests and show high degree of endemism in flora and fauna. The importance of this zone is its species richness and endemism of plants and birds. Because of isolation of islands and their relatively small size, mammal fauna is poor. Most species are of rodents and mammals.



Photo: James A. Foley

Figure 21: Coral community

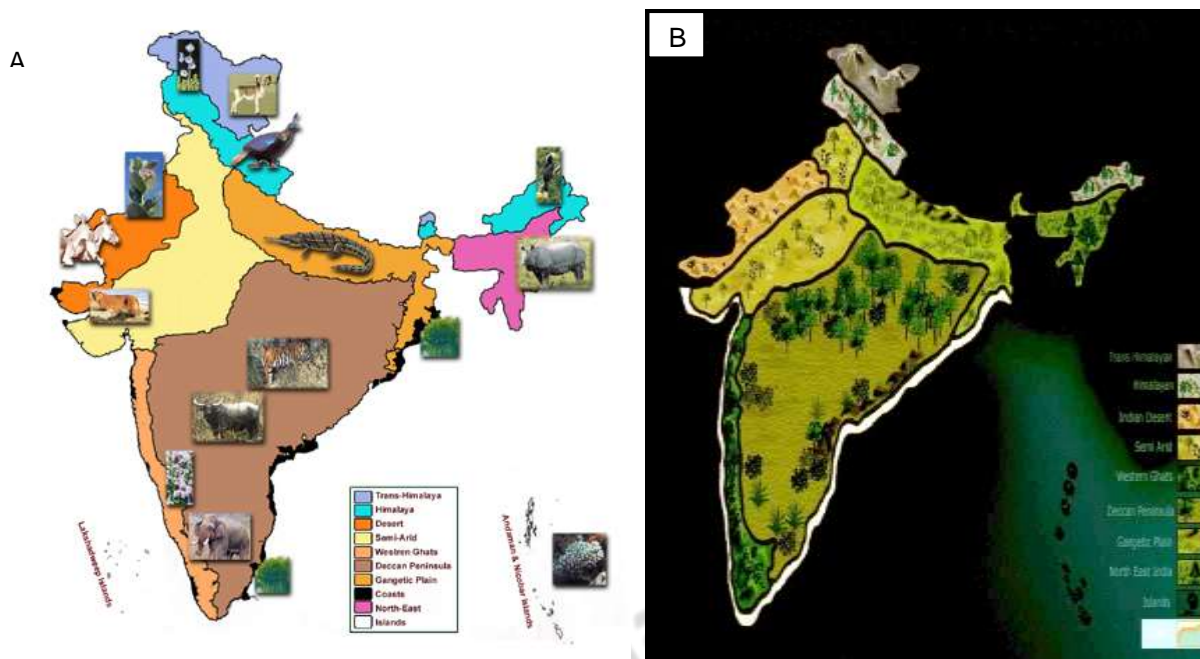


Photo: Gielenaroma.nl

Figure 22: *Dipterocarpus turbinatus* (Garjan)

A Gateway to .





Source: <http://cpreec.org/pubbook-ecozone.htm>

Figure 23: Bio geographical maps of India depicting distribution of (A) fauna and (B) flora

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