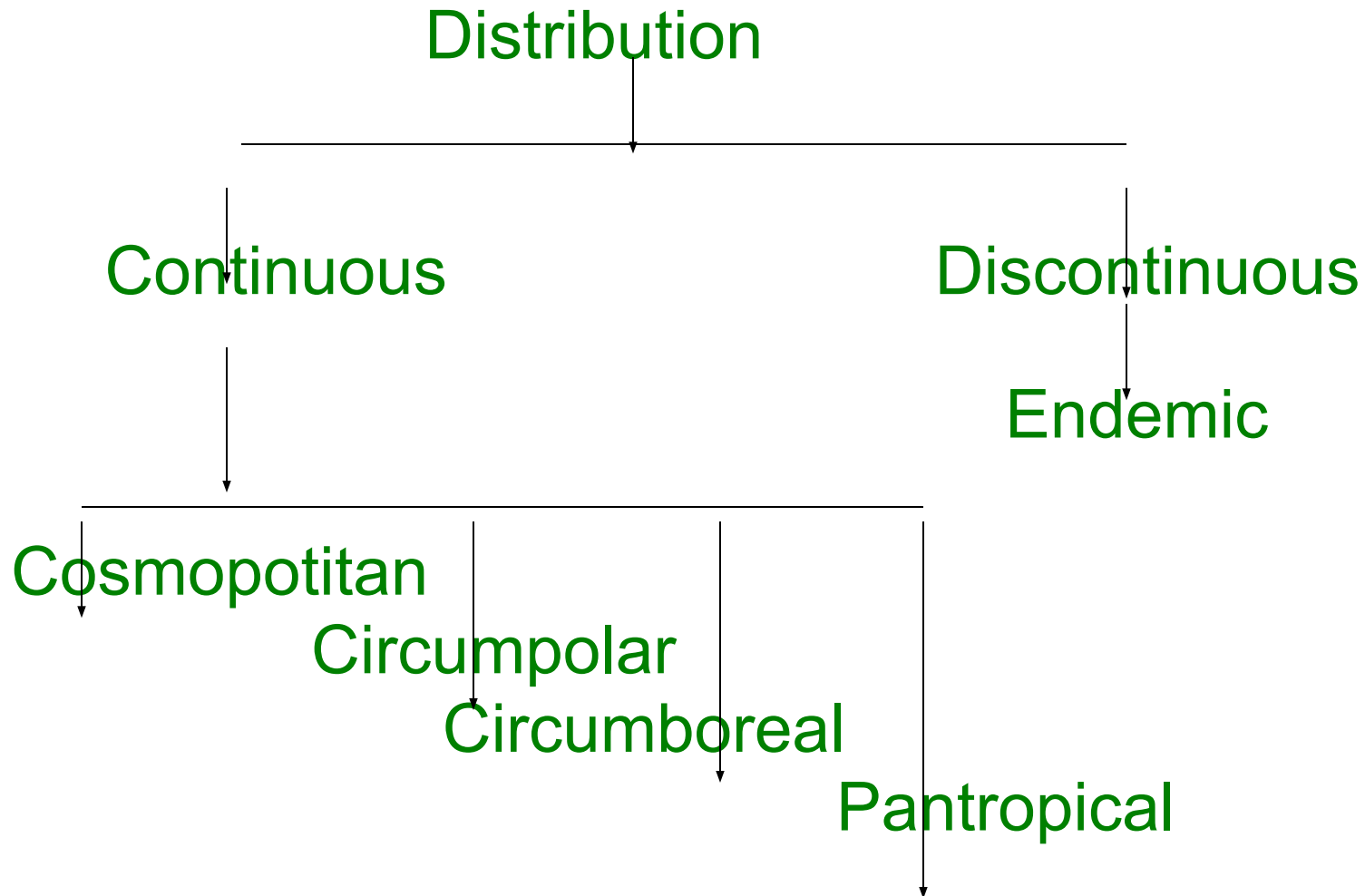


Biogeography

- *bios* = life; *geo* = earth; *graphein* = to write.
- Aspects of distribution of an organism:
 - Geographic range, extent where the organism normally occurs
 - Geologic range, distribution in the time – past and present; and
 - Ecological distribution, or the major biotic communities.

Patterns of Distribution



Continuous Distribution

- 1. Cosmopolitan Distribution:** - Distributed throughout the world in all climatic zones. *Chenopodium album*, *Urtica dioica*, *Poa annua*
- 2. Circumpolar Distribution:-** *Saxiphraga oppositaefolia*, distributed in a belt around north pole.
- 3. Circumboreal Distribution:-** Distributed in a near continuous belt in temperate region of northern and/or southern hemisphere. *Alnus*, *Acer* etc.
- 4. Pantropical Distribution:-** *Bauhinia*, *Dalbergia*, *Ocimum*, *Cassia*, *Eugenia*, *Phyllanthus* distributed throughout the tropical belt.

Discontinuous Distribution

- A taxon distributed in two or more widely separated geographical areas

Discontinuous Distribution

Discontinuity	Distribution	Examples
Arctic-alpine	Arctic region and high altitudes	<i>Saxifraga, Silene</i>
Mediterranean	Around Mediterranean sea in Europe and Africa	<i>Olea, Cistus, Ceratonia</i>
Tropical	In two or more parts of tropics	<i>Pandanus, Coffea arabica, Viola abyssinica, Nepenthes, Anona, Agathis, Adansonia digitata</i>
Antarctic	South America, New Zealand and Some Islands	
Intercontinental	Several places within the same continent	<i>Drosera, Rubia, Erica, Daboecia</i>

Two reasons

- (a) Range has become discontinuous because **individuals simply disappeared** from the intervening areas, and
- (b) The range of species was **never contiguous** but **propagules** (seed, spores, vegetatively reproducing organs) from the original area reached distant sites.

Endemic Distribution

Endemism: Confinement of plant species, genus or a family to a certain restricted area.

- Endemics are taxa of very restricted distribution in small areas.
- India:-
 - **60% indigenous dicots**
 - **20% indigenous monocots**

Endemic taxa

- Found in some isolation areas are perhaps the remnants of their ancient stock.
- Environmental or geological changes may lead to the occurrence of taxa in disjunct areas

<i>Tribulus rajasthanensis</i>	- Rajasthan/Gujrat
<i>Hopea andamamica</i>	- Amdamans
<i>Cryptomeria japonica</i>	- Japan
<i>Eucalyptus</i>	- Australia
<i>Rumex punjabensis</i>	- Punjab
<i>Cycas beddome</i>	- Cuddapah (AP)
<i>Dipterocarpus santalinus</i>	- Cuddapah (AP)

(A) Nature of endemism

- Restricted in occurrence to a particular region, mountain or island.
- In the course of climatic or geological changes, distribution of the taxon may have been reduced.

(B) Neo-endemism

Closely related spp. in same or adjacent areas developed due to following.

- ❖ Mutation
- ❖ Chromosomal rearrangement
- ❖ Polyploidy

(C) Holo-endemism

- The phase of endemic species which lies between its origin, spread and perhaps subsequent loss due to extinction.

(D) Paleo- endemism

- Ancient endemics, which represent remnants of older species, that usually occur in geologically old land masses.
 - They are taxonomically isolated components, which have no closely related species.

- “**Progressive, expanding or neoendemics**” - young species, whose distribution is narrow in the beginning and it is likely to grow in its area in course of time.
- “**Retrogressive endemics**” - species on account of their gradual dwindling gets restricted to a small region
- “**Relic endemics**” - Some species which had extensive distribution in the past, but are narrowly distributed today. This change may be due to geographical and climatic changes.
- “**Local endemics**” - Even among endemics some are restricted to a very localized spot.
- “**Pseudo endemics**” - Sometimes, a few mutants appear which do not compete successfully, and therefore disappear quickly.

Phytogeography

- Study of present and past geographical **distribution of plants** on the earth.
- Study of present and past areas and the elucidation of **origin and history of development of floras**.

Phytogeography of India

- **Peculiar physiographic, climate and biotic features.**
- **Subcontinent stretches out between tropical and subtropical belts.**
- **Climate is chiefly modified by oceans and mountains.**

Three distinct seasons

- **Cold winter**
- **Hot summer**
- **Monsoon**

Vegetation of India

- Champion and Seth recognized 16 major types of forests in India.
- Edaphic and biotic factors have been taken into account for recognizing subgroups.

(A) Moist Tropical Forests

(B) Dry Tropical Forest

(C) Montane Subtropical Forest

(D) Montane Temperate Forests

(E) Sub Alpine Forests

Grassland Vegetation

- Natural grasslands (as climax formation) are not present, but occur only during succession.
- Three types of grasslands
 1. **Xerophilous** that occur in dry regions of north west India under **semi-arid conditions**.
 2. **Mesophilous** which are extensive grass flats or savannas and occur in **moist deciduous forests of Uttar Pradesh**.
 3. **Hygrophilous** which are called **wet savannas**.

Grassland Types in India

1. Sehima-Dicanthium type

- Whole of peninsular India – Southern Parts of Maharashtra, Madhya Pradesh, Orissa, Andhra Pradesh, Tamil Nadu, Karnataka, South West Bengal.

2. Dicanthium-Cenchrus-Lasiurus type

- Subtropical arid and semi-arid regions – North Gujrat, Rajasthan, Western UP, Punjab & Haryana

3. Phragmites-Saccharum-Imperata type

- Gangetic plains, Brahmaputra valley, extending west ward to plains of Panjab.

4. Themeda-Arundinella type

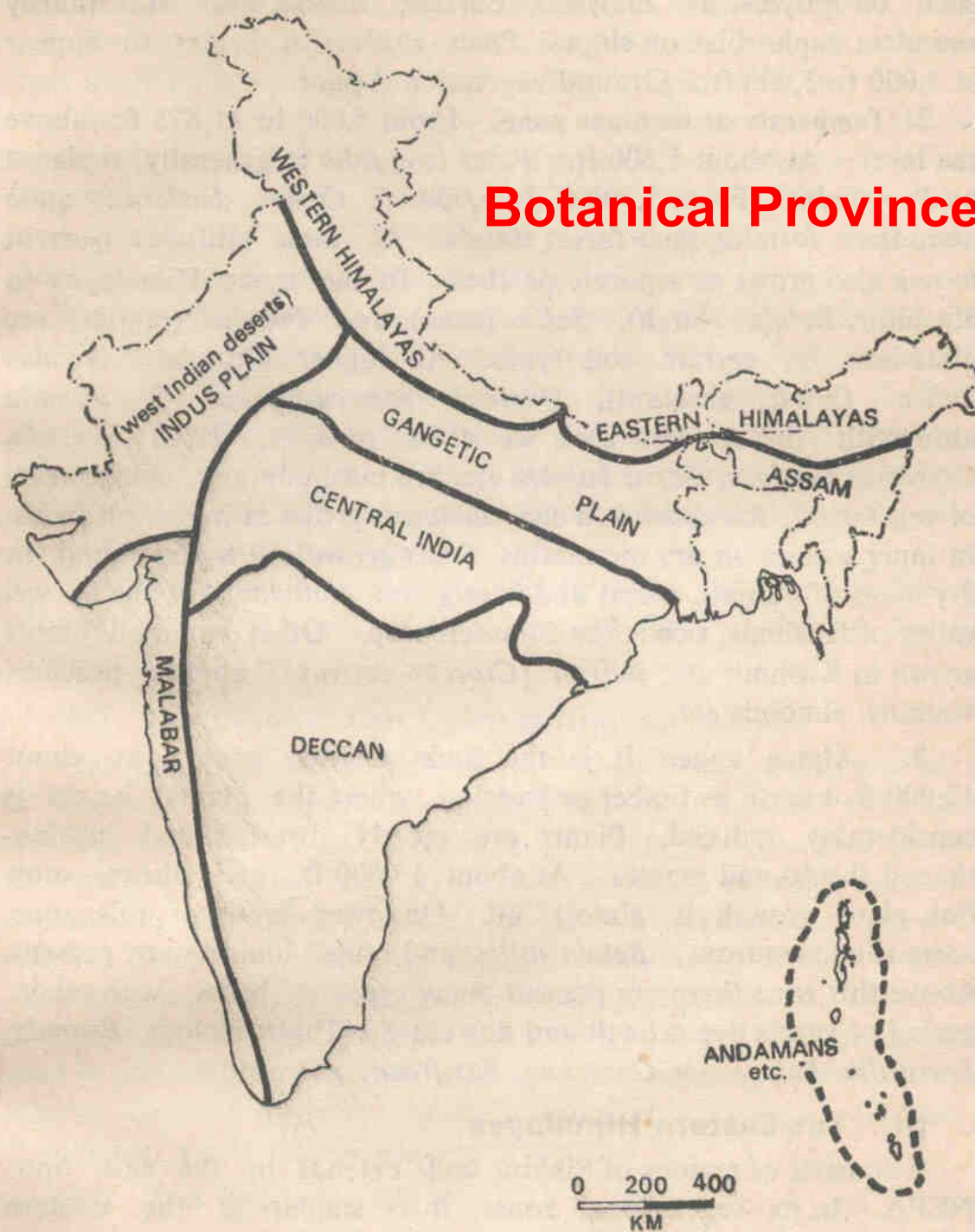
- Entire Northern and NE mountain tracts in Manipur, Assam, WB, UP, Punjab, Himachal Pradesh, J&K.

5. Temperate-Alpine type

- High hills of Northern mountain belt in J&K, Himachal Pradesh, Punjab, UP, West Bengal & Assam



Botanical Provinces of India



Botanical Provinces of India

- Floristic regions

1. Western Himalayas

- Extends from Kumaon to Kashmir and has annual rainfall up to 2000 mm.
- Altitudinally three zones of vegetation corresponding to three climatic belts.

a) Submontane zone:-

- Extends up to 1500 meters altitude and comprises mostly Siwalik ranges.
- Forests are tropical and subtropical.
- *Shorea robusta*, *Dalbergia sissoo*, *Ficus glomerata*, *Eugenia jambolana*, *Acacia catechu*, *Zizyphus*, thorny succulent *Euphorbias* on the slopes.

b) Temperate zone

- Montane temperate forest up to 3500 meters.
- *Quercus, Acer, Ulmus, Rhododendron, Betula, Salix, Populus, Prunus, Fraxinus, Pinus, Cedrus, Picea and Taxus.*

c) Alpine zone

- Above 3500 meters up to about 4500 meters (Snow line).
- Vegetation is alpine forest and scrub merging into meadows.
- *Abies, Betula, Juniperus and bushy Rhododendron.*
- Herbs near the snowline include *Primula, Potentilla, Polygonum, Geranium, etc.*

2. Eastern Himalayas

- North Eastern region characterized by more rainfall, less snow and higher temperature.
- Three zones:

a. Tropical zone

- Up to about 1800 meters.
- Tropical semi-evergreen or moist deciduous forests.
- *Shorea robusta*, *Acacia catechu*, *Dalbergia sissoo*, *Terminalia*, *Albizza*, *Cedrela*, *Dendrocalamus* etc.

b. Temperate zone

- Extends between 1800 to 3800 meters.
- Typical montane temperate forests dominated by *Oaks, Michelia, Quercus, Pyrus, Symplocus, Eugenia* etc., at lower levels;
- Conifers such as *Abies, Pinus Larix, Tsuga* and *Juniperus* and also *Salix, Rhododendron Arundinaria* etc, at higher levels

c. Alpine zone

- Beyond the temperate zone,
- Up to 4500 meters altitude.
- Alpine vegetation
- *Juniperus* and *Rhododendron*

3. Indus Plains

- Arid and semi arid regions of Punjab, Rajasthan, Kutch, parts of Gujarat and Delhi.
- Rainfall is less than 700 mm.
- Tropical thorn forest in semi arid region
- Typical desert in the arid region.
- Xerophytes, *Acacia nilotica*, *A. Senegal*, *A. leucophloea*, *Anogeissus pendula*, *Salvadora*, *Capparis*, *Albizzia*, *Grewia*, and *Calotropis*.

4. Gangetic Plains

- Extends over Uttar Pradesh, Bihar, Bengal and parts of Orissa.
- Moderate amount of rainfall and most fertile soils.
- Vegetation chiefly of tropical moist and deciduous and dry deciduous forest type.
- *Dalbergia sissoo*, *Acacia nilotica*, *Saccharum munja*, *Butea monosperma*, *Madhuca indica*, *Terminalia arjuna*, *Buchanania lanzan*, *Diospyros melanoxylon*, *Cordia myxa*, *Azadirachta indica*, *Xanthium*, *Cassia*, *Amaranthus* etc.
- In Gangetic delta (South Bengal) mangrove vegetation is common.

5. Central India

- Madhya Pradesh, parts of Orissa and Gujarat.
- Rainfall 1500-2000 mm
- Vegetation thorny, mixed deciduous and teak type.
- *Tectona grandis*, *Madhuca indica*, *Diospyros*, *Butea*, *Dalbergia*, *Terminalia*, *Carissa*, *Zizyphus*, *Acacia*, *Mangifera* etc.
- Forests in many areas have been degraded to a grassland vegetation due to heavy grazing, burning and other biotic interferences.

6. Malabar (West Coast)

- Western coast - from Gujarat to Kanya Kumari
- Heavy rainfall
- Forests
 - tropical evergreen towards extreme west,
 - semi-evergreen towards interior
 - subtropical or montane temperate evergreen forests in Nilgiris and
 - mangroves near Maharashtra and Kerala coast.
- *Dipterocarpus indicus*, *Sterculia alata*, *Cedrela toona*, *Tectona grandis*, *Dalbergia latifolia*, bamboos
- Nilgiris- Shola forests- *Eurya japonica*, *Michelia nilagirica*

7. Deccan Plateau

- Extends all over peninsular India, that is, Andhra Pradesh, Tamil Nadu and Karnataka.
- Rainfall up to 1000 mm.
- Central hilly plateau has tropical dry deciduous forests of *Boswellia serrata*, *Tectona grandis* and *Hardwickia binata*
- Low eastern dry Coromandal coast has tropical dry evergreen forests of *Santalum album*, *Cedrela toona* and plants like *Acacia*, *Prosopis*, *Euphorbia*, *Capparis*, *Phyllanthus*

8. Assam

- Characterized by heavy rainfall (2000-10000 mm).
- Dense evergreen forest or sub-tropical.
- Evergreen forests - *Dipterocarpus macrocarpa*, *Mesua ferrea*, *Shorea robusta*, *Ficus elastica*, *Bambusa pallida*, *Dendrocalamus hamiltonii*, epiphytes and orchids.
- In the northern cooler region, wet hill forest include *Alnus*, *Betula*, *Rhododendron*, *Magnolia* etc.
- Hilly tracts also have pine forests of *Pinus khasiya* and *P. insularis*.

9. Andamans

- Varied type of vegetation:
 - mangroves at its coast and
 - evergreen forests of tall trees in the interior.
- *Rhizophora*, *Mimusops*,
Calophyllum, *Lagerstroemia* etc.

Dispersal Dynamics

- Spread of individuals away from their home sites.
- Dispersal movements are usually slow, and cover relatively short distances in the life time of an individual.
- Range expansion of the species into a new habitat or area.

Manner and Means of Dispersal

- Active process of transportation of disseminules from place to place. Implies not only dispersal but also a successful growth and establishment.
- Methods of dispersal
 1. Wind
 2. Water and ice
 3. Animals
 4. Mechanical means
 5. Human agency

Anemochory (Dispersal by wind)

- Various adaptations such as lightness, winged shape, hairyness.
- Fruits of *Holoptelia*, *Hiptage*, *Acer*, *Shorea* etc. are provided with wings.
- In many Compositae, the calyx is modified into hair like structure known as pappus.
- Seeds of *Calotropis*, *Holarrhena* and *Gossipium* are provided with either one or two tufts of hair or all over their body.

Hydrochory (Dispersal by water)

- Earliest mode of dispersal as the primitive plants were aquatic.
- In *Cocos nucifera*, *Lodoicea schellarum*, pericarp is modified as floating organs.
- Testa is buoyant in *Iris*, *Lamna*
- *Trapa*, *Eichhornia*, *Salvinia*, *Azolla* etc. are floating plants which are carried as a whole by flowing streams.

Zoochory (Dispersal by animals)

❖ Most effective means of dispersal

Three ways;

1. Swallowing them, passing them through and out of the digestive tract.
2. Carrying them attached to their outer surface and
3. Carrying them in mud adhering to their feet.

❖ Birds

❖ Grazing animals

❖ Hooks, spines, bristles, stiff hairs.

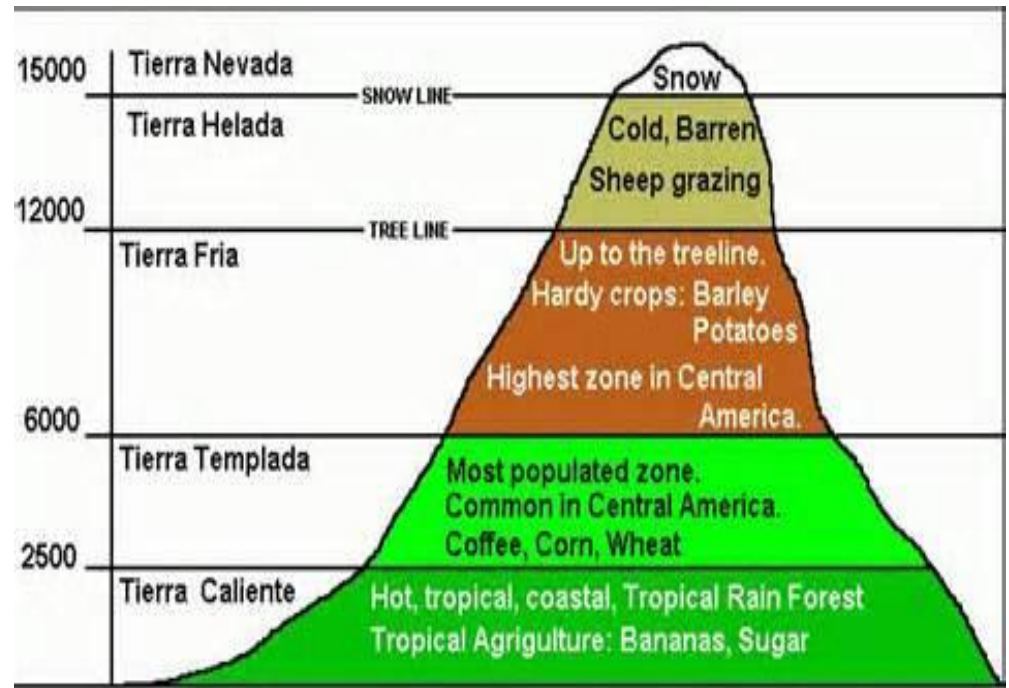
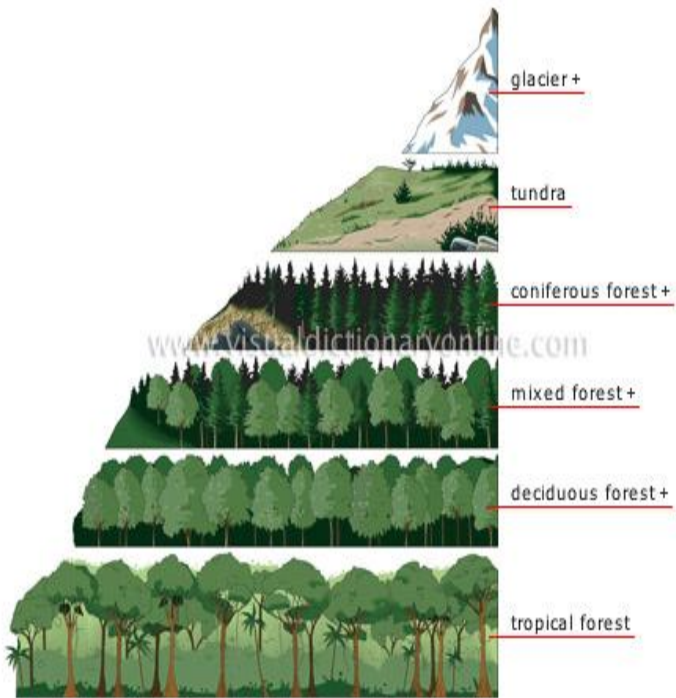
❖ *Tribulus, Xanthium, Achyranthus, Martynia, Aristida etc*

Barriers to Dispersal

- **Feature of the physical or biological agency that restricts or prevents dispersal of plants is a barrier. Barriers are always relative and a barrier for one species may well be main dispersal route for another.**
- **Water might be barrier for a terrestrial species but normally is not for a aquatic species.**
- **Three classes or barriers:**
 1. **Physiographic or physical barriers such as land, water, elevation, soil;**
 2. **Climatic barriers such as temperature, humidity, rainfall, sunlight etc., and**
 3. **Biotic or biological barriers such as lack of food and the presence of enemies or effective competitors.**

Different kinds of barriers:

1. **Topographic barriers:** -Physical factors as high and extensive mountain ranges.
2. **Climatic barriers:-** Extremes of temperature and moisture.
3. **Vegetation as barrier:-** . Plants serve as food and a means of shelter for animals. Thus depending upon their selective food habits, animals remain confined to areas with vegetation of their choice.
4. **Extensive water bodies:** - Effective physical barriers to distribution of amphibians, reptiles and mammals.
5. **Land masses:-** Barriers to the dispersal of marine life.



ALTITUDINAL ZONATION

Zoogeographic Regions of World

- I. **Palaeartic region:-** Largest region includes whole of Europe, northern China, Japan, erstwhile USSR, northern part of Africa and Persia etc.
- II. **Ethiopian region:-** Includes whole of Africa and Arabia, Madagascar and Mauritius. Divided into east African, west African, south African and Malagasy sub regions.
- III. **Oriental region: -**
 - Includes all the tropical parts of Asia, like India, Sri Lanka, south China, Malaysia, and Malayan islands.
 - Climatic conditions of this region are much varied.
 - Desert in the north of Indian sub-region.
 - Tropical in southern portion of India and Sri Lanka.
 - Temperate in Bhutan. .
 - Major part occupied by luxuriant forest vegetation.

Faunal characteristics(Oriental Region):

- a) Fishes-** Freshwater fishes are more common,
- b) Amphibians-** Represented by nine families. (tree frogs), true frogs, salamanders.
- c) Reptiles-** 35 families, true vipers, pit vipers, sea snakes, turtles, freshwater snakes, tree snakes, Pythons, crocodiles, water lizards, geckos, some iguanas.
- d) Aves-** 71 families, babblers, sunbirds, king crows, woodpeckers, barbets, cuckoos, kingfishers, pigeons, doves, fowls, peacocks etc.
- e) Mammals-** 35 families, hedgehogs, shrews, flying lemurs, old world monkeys, cats, bear, dogs.

IV. Australian region

- Include the whole of Australia, New Zealand, New Guinea, and adjoining islands, particularly those of Pacific Ocean.
- Fauna is represented by 134 families of terrestrial vertebrates, of which 30 are specific to the region including 8 families of mammals, 17 of birds, 3 of reptiles, and 2 of amphibians. Kangaroos, Wombats, Tuatara, Bandicoots, Marsupial. Birds of Paradise,.

V. Neotropical region:

- Comprises southern Mexico, Central and South America, West Indies, and Galapagos island. Tropical region with luxuriant forests.

VI. Neoarctic region:

- Greenland and North America up to the center of Mexico.

Thank you