18MBO42C
Core: Paper – IX
Plant Ecology, Conservation and Phytogeography

UNIT –5

Dr. S. Premalatha
Assistant Professor
PG and Research Department of Botany
Government Arts College (autonomous)
Coimbatore -18
Mobile No : 9894214939

Unit – V

Plant geography: Plant distribution – concept, Age and Area hypothesis; Theory of Continental drift; Theory of endemism; Patterns: Cosmopolitan, pan tropical, continuous, discontinuous,endemic distribution; Plant indicators; Phytogeographical domains of World and India.

Age and Area Hypothesis:

This hypothesis was proposed by J. W. Willis (1915) on the basis of his extensive studies of geographical distribution of certain plant species in tropics. On the basis of his findings Willis postulated that the species which evolved earlier occupy greater areas than those which appeared later in the evolutionary sequence. According to this hypothesis, the frequency of a species over an area is directly proportional to its age in scale of evolution and age of species is directly related with the area of its distribution. Thus a small area of distribution of a species will indicate its relative young age. Willis has quoted several examples such as Impatiens, Primula, Gentiana, Rhododendron in support of his hypothesis. Genus Coleus may be quoted here as an example in support of this hypothesis. There are two species of Coleus namely C. elongatus and C. barbatus. The former species is endemic while the latter is widely distributed. On the basis of areas under distribution of these species Willis considered C. elongatus less evolved and derived from C barbalins. Willis has also pointed out that the majority of endemics are found to be members of large and successful genera.

. Introduction

The biotic and abiotic facts that influence the patterns and types of distribution.

The abiotic factors include climate, soil and relief.

The biotic interactions include competition, predation and symbiosis.

Patterns and Distribution of Living Organisms

The distribution of living organisms by spatial patterns and temporal variations is determined by many factors such as historical changes.

What is most puzzling is how these organisms have got where they are and how they maintain themselves in the face of perturbations that are part of nature.

There are a number of biotic and abiotic factors that are used to explain the past and present patterns of distribution.

These are generally biological factors such as adaptation, predation and competition on the one hand and physical factors such as climate, soil and light on the other.

Plate tectonics and continental drift are identified as being responsible for the splitting in pieces of a once continuous distribution.
The different patterns of distribution that one can observe on the earth's surface are partly due to a combination of physical factors, which provide an envelope within which the life processes function.

Spatial and temporal patterns

Spatially, for instance, vegetation is gregarious, i.e. it grows together in groups of various sizes and shapes. This is because plants are immobile and tend to cluster where growth conditions are favourable.
Clumpness in vegetation is of ecological importance because it supports the theory of plant associations, what is commonly called plant co-existence.
Clumpness is an adaptation mechanism, which plants use to counteract any environmental imbalances.

This they achieve by means of morphological, behavioural and physiological properties. By modifying micro climatic conditions, for instance, plants create conditions that are favourable for the invasion of others, which on their own would not be able to succeed. These requirements are not important to faunal population, which can avoid harsh environmental conditions by migration.
In the long term or short term, basic distributions can be seen as periodic or non-periodic and continuous or discontinuous.
A good example of this is the occurrence of ephemerals with the onset of rains.

Clearly, variations in the distribution of organisms are a response to variations in physical and biological parameters. Each species, therefore, occupies a limited area, which it is best specialized to exploit. Within a habitat the distribution of a species tends to be characterized by a gradient. If a cross-section is taken, the number of the species in a population decreases, then increases then decreases and eventually disappears along a gradient of population factors. At the margins of this factor, the species population disappears because the individuals cannot be maintained.

Continuous distributions of living organisms are rare in nature because even the environmental variables that determine them are highly variable.
What is discussed as once continuous distribution of certain, organisms that was split by continental drifts and plate tectonics, is therefore questionable.
Fossil records on the flora of Africa suggest that neighbouring populations join during favourable periods but separated at wide intervals when conditions were harsh. The degree of merging is still questionable.

Evolutionary disjoints are said to be species which were once widely distributed but were split or made to contract into isolated patches because of climatic changes.

Survival in adjacent habitat eventually becomes unbearable because the species is not adapted to the conditions therein.
Surrounding habitats act as geographical barriers. The latter have to be crossed for further distribution of the species to occur. Examples of these barriers are terrains, climate, water bodies and landmasses.

Mountains provide obstacles to the spreading of plant species in the form of extreme temperatures and long distances to flightless organisms; they provide unfavorable substrate consisting of rocky and shallow soils which cannot support the existence and hence the expansion of certain organisms. Cold and hot climates are barriers to the distribution of warm and cold-blooded organisms, respectively.

A species range represents a response to the physical environment in which all organisms live. The physical environment consists of non-living (abiotic) components such as rock, air and water, which are products of the lithosphere (rock strata), atmosphere (air masses) and hydrosphere (water bodies) of the earth.

Continental-drift theory-

Alfred Wegener proposed that the disjunct landmasses containing similar geologic features were once continuous. They drifted apart as a result of the great rift in the crust of the earth. The surface of our planet is made of several large plates about 100-150 km thick which move very slowly across the surface of a more fluid core. Most of these plates have major land-masses or whole continent on them, so that as the plates move around, the continents also move with respect to one another. This movement is called continental-drift. It appears from various types of evidence that at one time all the present land masses were joined together in one huge super continent called Pangea.

This began to split in half about 200 million years ago to form Laurasia and Gondwanaland. Gondwanaland was a Southern hemisphere continent, centered around the South Pole and composed of what are now India, Africa, Australia, New Zealand, South America and Antarctica. This super continent seems to have begun to break up in the Jurassic about 190 million years ago. Australia started to drift northward about 90 million years ago and gradually separated off from Gondwanaland until it was completely detached about 50 million years ago and moved northwards. The earliest contact of India with the Asian landmass took place towards the end of Palaeocene

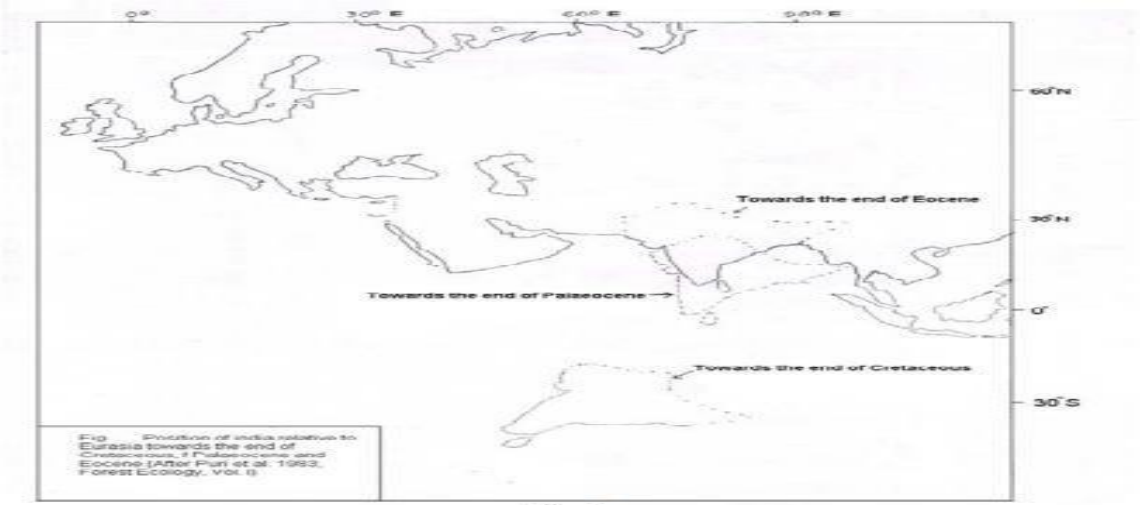


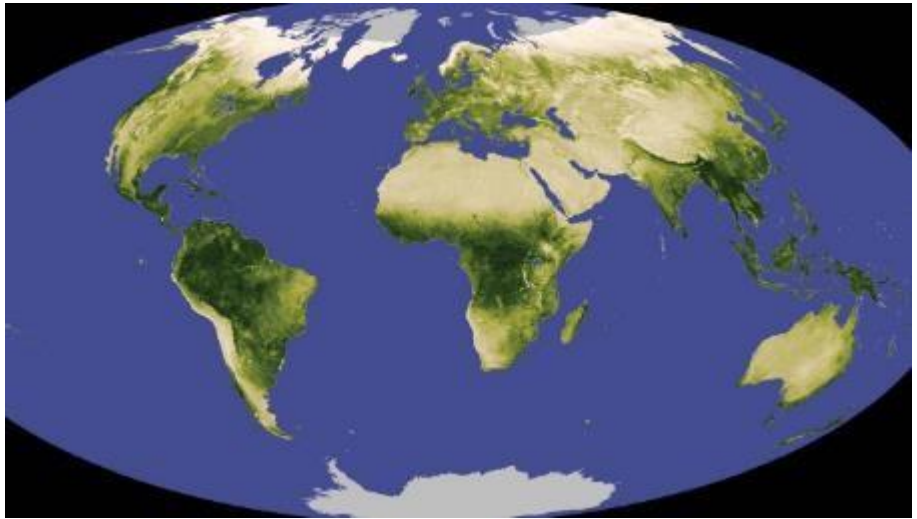
Fig. 1

AREA DISTRIBUTION PATTERN

Some taxa are uniformly distributed in the area and give rise to ‘Continuous distribution’ while others may have isolated patches of areas widely separated apart. These constitute ‘Discontinuous distribution’ pattern.

a. Continuous Intercontinental ranges- the area of a taxon or of a vegetation feature is never really continuous. Of continuous intercontinental ranges, four main types may be considered: the cosmopolitan, the circumpolar, the circumboreal and the pantropic.

1. Cosmopolitan- These taxa are distributed all over the globe. They occur in all six widely inhabited continents, e.g., many weeds and lower groups of cryptogams.



2. .Circumpolar- taxa distributed around the North or South Pole e.g. *Saxifraga oppositaefolia*, *Eutrema edwardsii*.

Saxifraga oppositifolia ...

Saxifraga oppositifolia (Purple ...

Eutrema edwardsii

Eutrema edwardsii

3. Circumboreal- taxa distributed around the boreal zone e.g. Ribes (Gooseberries) and Danthonia (poultry grass).

Gooseberry ~ Ribes uva-crispa Plant ...

Danthonia compressa

4. Pantropic- taxa occurring practically throughout the tropics and sub-tropics or at least widespread in the tropical region of Asia, Africa and America, e.g,. Palm family (Arecaceae).

Palm Tree Arecaceae Family High ...

12 Different Types of Palm Trees Found ...

Arecaceae: Palm Famil...

b. Discontinuous ranges- In discontinuous or disjunct ranges, the plants are separated by wider gaps which cannot be overcome or crossed by the propagules. The main causes of discontinuity are environmental (due to particular topographic, climatic, edaphic or biotic characteristics of tracts separating the areas). Following are the familiar discontinuous ranges

1. Arctic – Alpine : Taxa distributed in arctic region and in mountainous system of temperate zone. e..g. *Salix herbacea*, *Saxifraga oppositaefoilia*.

Salix herbacea - Wikipedia

Salix herbacea - Wikipedia

Salix herbacea - L.

Saxifraga oppositifolia ...

Saxifraga oppositifolia (Purple ...

2. North Atlantic: Taxa distributed in North America and Europe and also some times locally in Asia. e.g. *Lycopodium inundatum* and *Spiranthes* sp.

Lycopodiella inundata - Wikipedia

Lycopodium inundatum | New York Flora ...

Spiranthes cernua - Wi...

3. North Pacific : Taxa distributed chiefly in North America and Eastern Asia, e.g. *Torreya* (Torrey pine) *Symplocarpus foetida*.

What is it Torrey pine. Encyclopedia

Torreya taxifolia - Wikip...

Torrey Pine, Pinus torreyana

Symplocarpus foetidus - Wikipedia

Symplocarpus foetidus - Wikispecies

4. North—South American : Taxa distributed in North and South America but lacking continuity in between, e.g. Sarraceniaceae (pitcher-plant family)

Sarraceniaceae | Descripti...

Sarraceniaceae | Description, Carnivory ...

5. Europe – Asian : Taxa distributed in Europe and Asia but lacking continuity between. e.g. *Leontice altaica*, *Cimicifuga foetida*.

Leontice Stock Photos ...

Takht. (Leontice altaica Pall. var ...

Леонтица алтайская (...

Cimicifuga - Wikipedia

Cimicifuga Foetida Hig...

6. Mediterranean : Taxa distributed at European and African shore of Mediterranean sea. e.g. *Platanus*

Platanus orientalis - EUFORGEN Eur...

Platanus - Wikipedia

7. Tropical : Taxa distributed in two or more separate tropical regions. e. g. *Buddleia*

Buddleia - planting, prunin...

Buddleia Production Tips | Walters ...

470 Buddleia ideas | butterfly bush ...

8. South pacific : Taxa distributed at least in South America and New Zealand. e.g. *Jovellana*

Jovellana violacea - Art and Science of ...

Jovellana violacea - Wik...

Jovellana violacea - Wikispecies

Jovellana punctata - Teacup Flower

9. South Atlantic : Taxa distributed at least in South America and Africa. e.g. *Asclepias.*

Asclepias L. | Plants of the World ...

Butterfly Milkweed

Tuberosa Asclepias Plants for Sa...

10. Antarctic : Taxa distributed on Arctic mainland and parts of South America, New Zealand and Austral islands. e. g. *Nothofagus*.

Nothofagus nervosa | Rauli, Raoul beech ...

Nothofagus Threatened With Extinction ...

Nothofagus antarctica | TreeEbb ...

11. Gondwana type : Taxa distributed in more than one continent which tends to embrace Africa, Madagascar, India and Australia. e.g. some sedges.

Sedges and Grasses – Plant Talk

Cyperaceae - Wikipedia

Types Of Umbrella Sedge Plants - What ...

Grasses versus Sedges age and numbers

INTRODUCTION

When a species is found only in a particular geographical region because of its isolation, soil and climatic conditions, it is said to be endemic. Endemic plants are special because they are found in only one location on the planet, and nowhere else.

These are distributions, which are confined to areas of origin.
Tectonic processes and past climatic changes have been predicated as being responsible for wiping out world vegetation.
If changes are gradual, some organisms will avoid death and take refuge in suitable habitats. If they are erratic, the organisms will become extinct. The Pleistocene ice age has similar effects in USA and Europe. They wiped out populations of vulnerable species while in southern warmer areas and on mountains on which ice formation was limited some organisms migrated behind denied ice; others remained confined to refugia probably due to their inability to overcome barriers.

Most flora on sea islands or mountain tops have high levels of endemism. On the East African mountains, for instance, the lobelia species on Mt Kenya is endemic. Alternatively, endemism is associated with organisms that have recently evolved and have therefore not had enough time to spread. 59 Lastly, some endemic species could be on their way to extinction as changes in their habitats have reached such an intolerable state that they cannot compete successfully for soil and space.

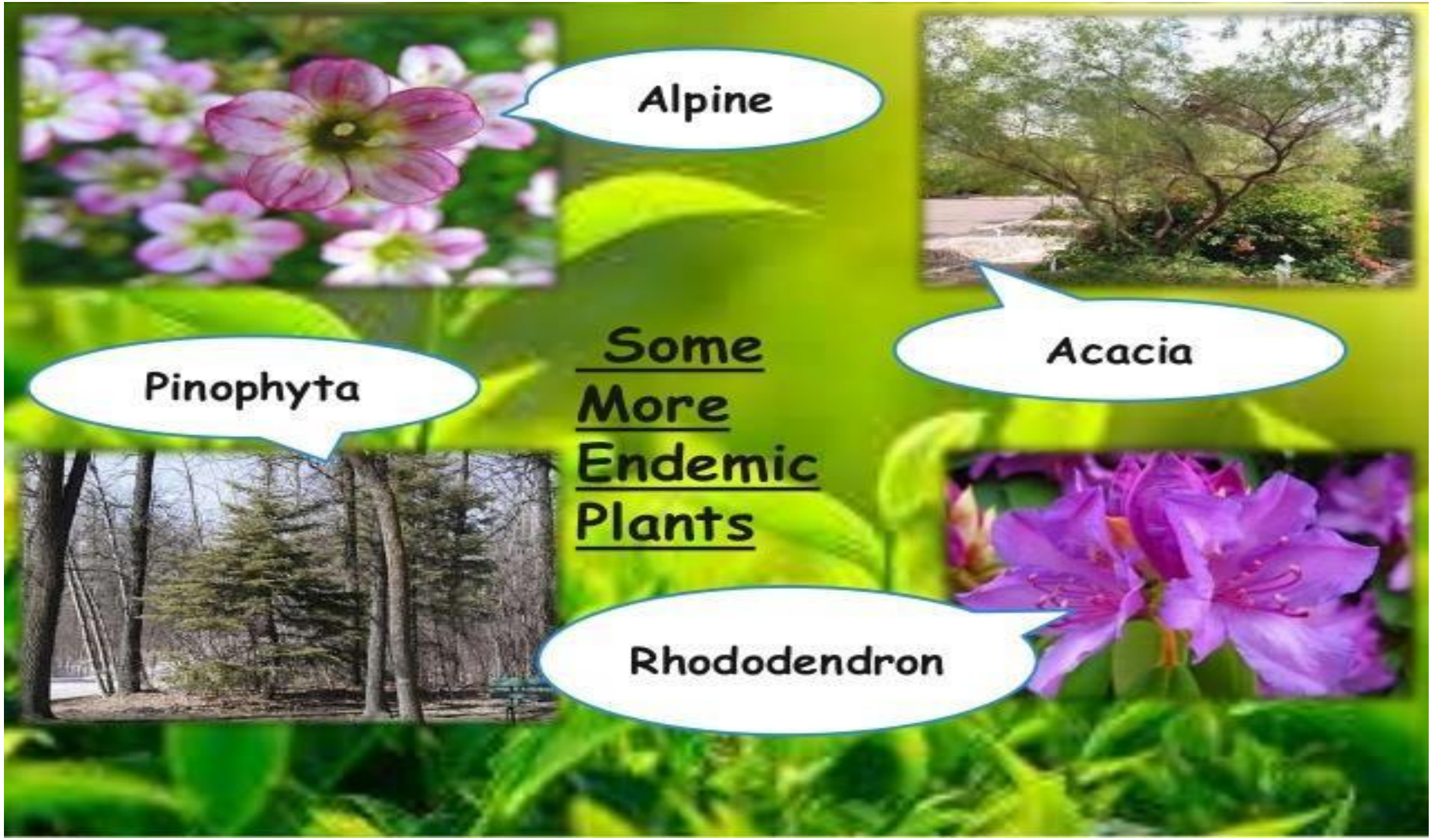

Causes for Endemism
CAUSES
Narrow ecological amplitude.
Poor adaptability.
Geographical barriers.
Changing climatic conditions.

FLORA OF INDIA

- The flora of India is one of the richest in the world due to the wide range of climate, topology and habitat in the country.
- There are estimated to be over 16,000 species of flowering plants in India, which constitute some 6-7 percent of the total plant species in the world.
- India is home to more than 45,000 species of plants, including a variety of endemics.

3.11.2 Western ghats

- The area comprises Maharastra, Karnataka, Tamilnadu and Kerela. Nearly 1500 endemic, dicotyledone plant species are found from Western ghats. 62% amphibians and 50% lizards are endemic in western Ghats.
- It is reported that only 6.8% of the original forests are existing today while the rest has been deforested or degraded.
- *Some common plants: Ternstroemia Japonica,* Rhododendron and Hypericum.
- *Some common animals: Blue bird, lizard, hawk.*


Alpine
Acacia
Some More Endemic Plants
Pinophyta
Rhododendron

ACACIA

Acacia is a genus of shrubs and trees belonging to the subfamily Mimosoideae of the family Fabaceae, described by the Swedish botanist Carl Linnaeus in 1773 based on the African species *Acacia nilotica*. Many non-Australian species tend to be thorny, whereas the majority of Australian acacias are not. It is found in Australia.

ALPINE

Alpine plants are plants that grow in the alpine climate, which occurs at high elevation and above the tree line. Alpine plants grow together as a plant community in alpine tundra. Alpine plants must adapt to the harsh conditions of the alpine environment, which include low temperatures, dryness, ultraviolet radiation, and a short growing season.It is found in Alps Mountain Range.

PINOPHYTA

Pinophyta is one of 12 extant division-level taxa within the Kingdom Plantae and 10 within the extant land plants. Pinophytes are gymnosperms, cone-bearing seed plants with vascular tissue. All extant conifers are woody plants with secondary growth, the great majority being trees with just a few being shrubs.

RHODODENDRON

Rhododendron is a genus of 1,024 species of woody plants in the heath family either evergreen or deciduous, and found mainly in Asia. Most species have showy flowers. Azaleas make up two subgenera of *Rhododendron*. They are distinguished from "true" rhododendrons by having only five anthers per flower. It is the national flower of Nepal.

Plant Indicators

Plant indicators are also used to determine optimum use of land resources for forest, pasture, and agricultural crops.

The occurrence, character and behaviour of a plant are thus indicator of the combined effect of all factors prevailing in a habitat. Since a plant species or plant community acts as a measure of environmental conditions, it is referred to as biological indicator or bio-indicator or phyto-indicator.

Table 12.1. Plant indicators for different types of soils.

Plant Indicators	*Characteristic of soil*
Salvadora oleoides	High calcium and boron, good soil suitable for crop plants
Zizyphus nummularia	Good soil for agriculture
Prosopis cineraria	Good soil for crop plants provided irrigation is there
Peganum harmala	Soil is rich in nitrogen and salts and good for agriculture
Butea monosperma	Heavy alkaline soil
Capparis decidua	Alkaline soil
Rumex acetosella	Acid grassland soil
Pinus and Juniperus	Uranium rich soil
Salsola, Sueda spp.	Saline water condition
Andropogon scoparium	Sandy loam type soil
Argemone mexicana	Recently disturbed or flooded soil
Lippia nodiflora and *Rumex* species	Nitrate rich soils

Plant indicators of forest

Some plants indicate the characteristic types of forest and they grow in an area which is not disturbed.

Narengaporphyrocoma is a grass which binds the soil. In such a soil sal (Shorearobustd) can be cultivated. Viola species in western Himalayas is a suitable indicator for plantation of Cedrusdeodara and Pinus.

Plant indicators for Soil types:

Many plants indicate the characteristic soils.

For example, Casuarinaequisetifolia, Ipomoea grow in sandy soil. Sacchammmunja prefers to grow in sandy loams. Imperatacylindrica and Vetiveriazizanioides grow on clayey soils. Cotton prefers to grow in black soil.

Plants indicators for soil reaction:

Many plants indicate whether the soil is acidic or basic.

For example, Rumexacetosa. Rhododendron, Polytrichum and Sphagnum indicate acidic soils.

Plant indicators for minerals:

Many plants indicate the presence of characteristic minerals in the soils. These plants are called metallocoles or metallophytes.

The following plants grow in the presence of specific metals:

(i) Diamond:

Vallozia Candida grows in presence of diamond in Brazil.

(ii) Gold:

Equisetum arvense, Lonicera confuse, Papaverlibonoticum, Alpiniaspeciosa, Thuja species indicate the presence of gold minerals in the soil.

(iii) Silver:
Eriogoniumovalifolium indicates the presence of silver minerals in soils in U.S.A.
(iv) Mercury:
Stellariasetacea grows in Spain in mercury rich soils,
(v) Uranium:
Astragalus species grows in USA in uranium rich soils,
(vi) Selenium:
Astragalus species, Neptuniaamplexicaulis, Stanleyapinnata, Onopsiscondensator, etc. grow in selenium rich habitat.
(vii) Copper:
Viscariaalpina in Norway, Gymnoleaacutiloba in America, Gypsophila
patrini in USSR grow on the soil rich in copper.
(viii) Zinc:
Viola calaminara, V. lutea in Europe grow on the soil rich in zinc minerals,
(ix) Boron:
Salsolanitrata, Eurotiacerutoides grow in boron rich soils.
(x) Cobalt:
Silenecobalticola in Congo and Nyssa sylvatica grow in America in cobalt rich soils.

Biodiversity Hotspots across the World

1. Madagascar 2. Philippines Block 2 Community and Ecosystem 118 3. Sundaland (South East Asia) 4. Brazil's Atlantic Forest 5. Caribbean 6. Indo-Burma 7. Western Ghats and Sri Lanka 8. Eastern Arc and Coastal Forests of Tanzania/Kenya

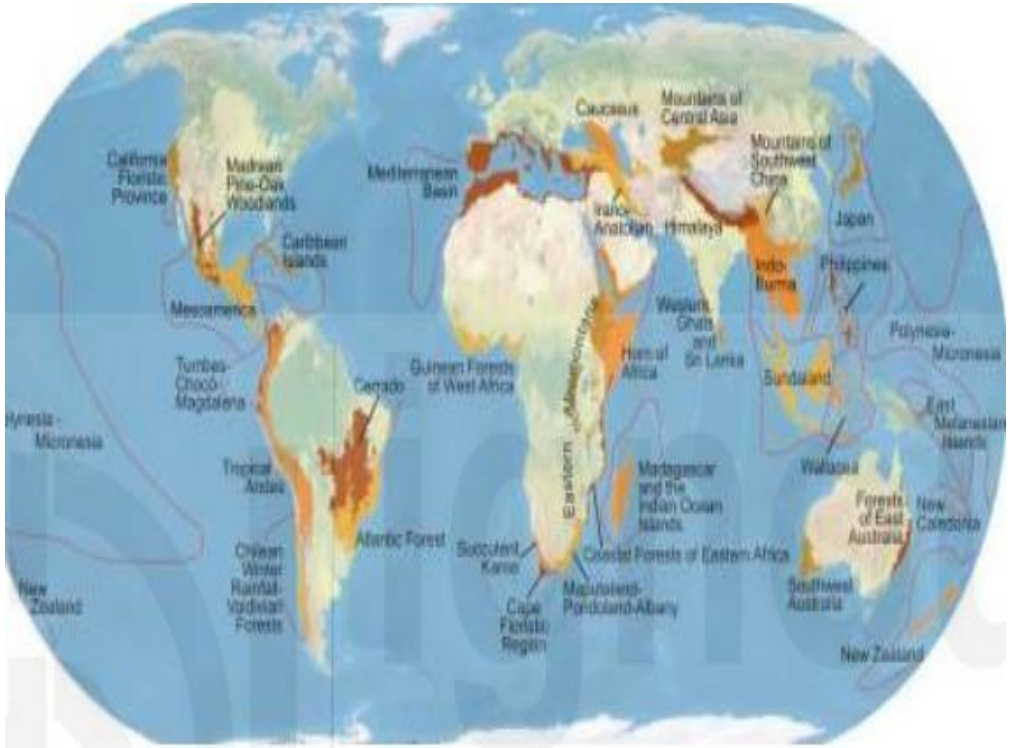


Fig. 10.3: Map indicating hot spot areas of the world.

Fig. 10.1: Diagrammatic representation to show that vegetation types are related to temperature and precipitation.

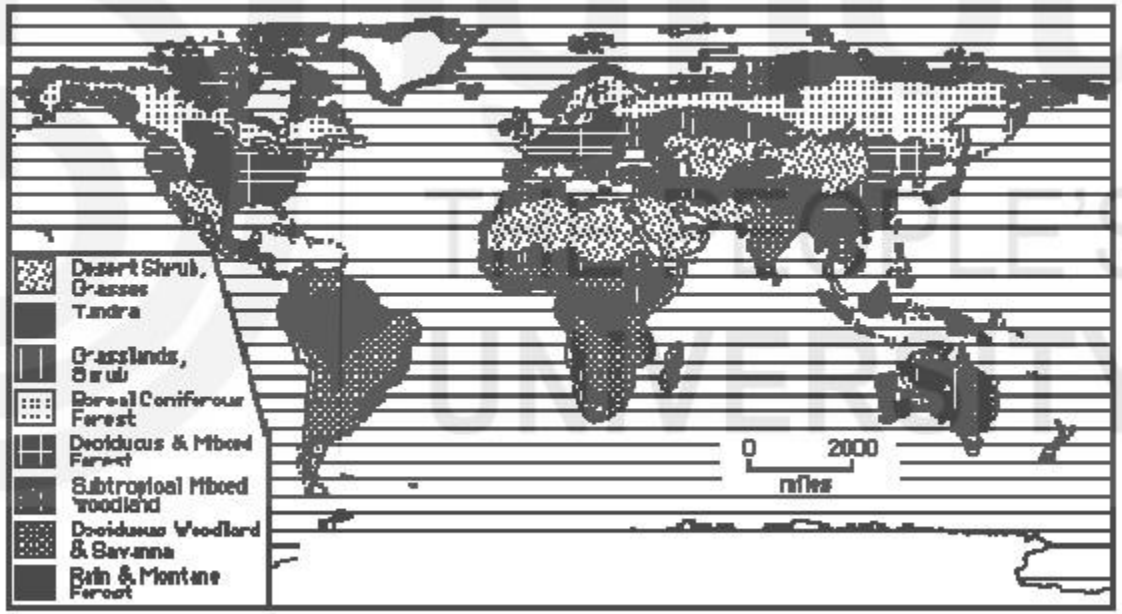
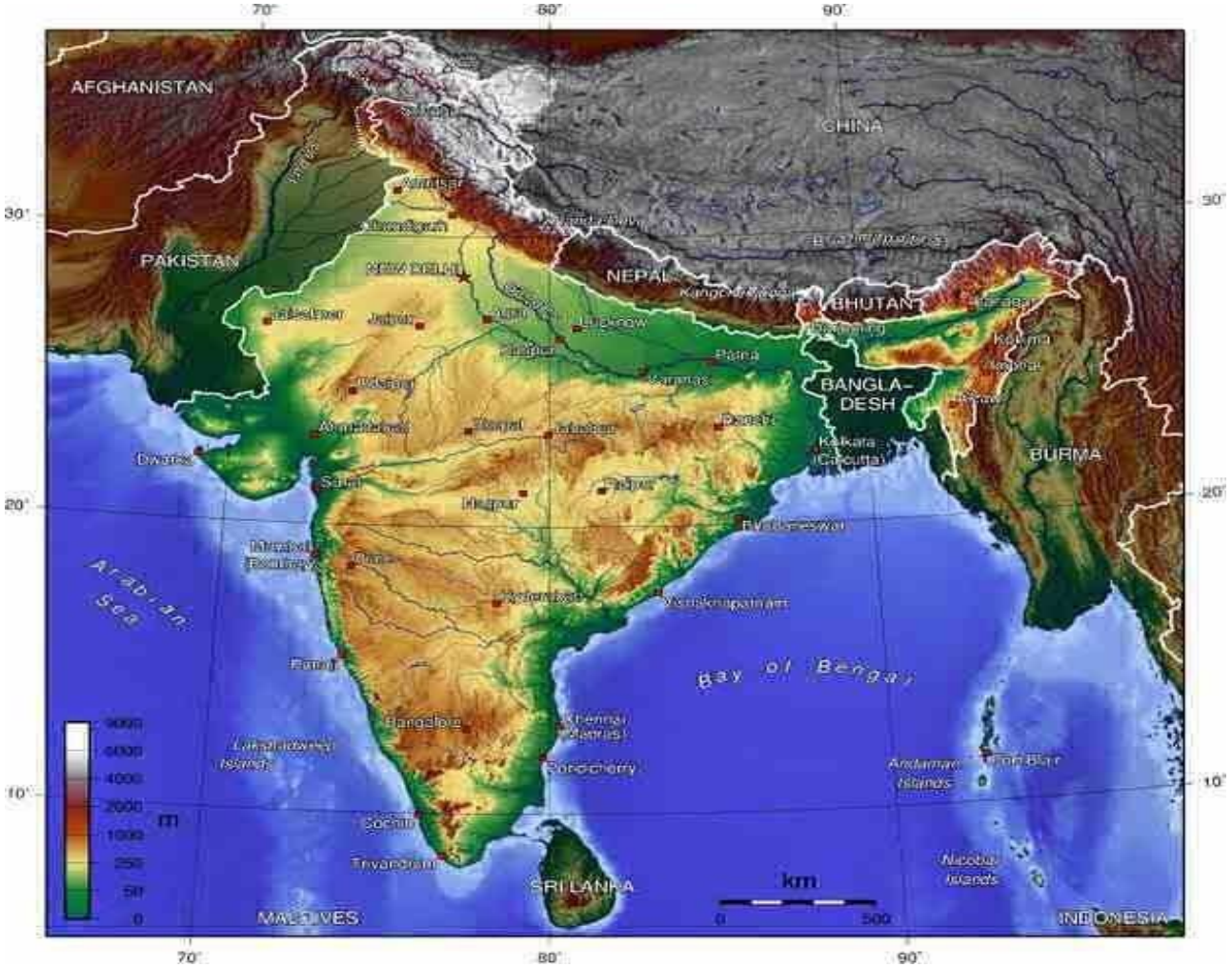


Fig. 10 2: Types of vegetation found in different parts of the world.

PHYTOGEOGRAPHICAL REGIONS OF INDIA

A phytogeographical region is defined as an area of uniform climatic conditions that possesses distinctly recognizable vegetation. India can be divided into nine phytogeographical regions (Chatterjee, 1962). The original classification is listed below. There is the absence of the term “Flora ofN” in the classification of the vegetation. The sequence must also be maintained. 1. Flora of Deccan 1. Western Himalayas 2. Flora of Malabar 2. Eastern Himalayas 3. Flora of Indus Plain 3. Indus Plain 4. Flora of Gangetic Plain 4. Gangetic Plain 5. Flora of Assam 5. Central India 6. Flora of Eastern Himalayas 6. Deccan 7. Flora of Central Himalayas 7. Western coasts of Malabar 8. Flora of Western Himalaya 8. Assam 9. Andaman and Nicobar Islands 9. Bay Islands of Andaman and Nicobar

Phytogeographical regions of India



Phytogeographical regions of India

- Phyto geographical regions are also called as Botanical regions.
- D. Chatterjee has divided India in to 9 botanical zones.

- 1. Western Himalayas.
- 2. Eastern Himalayas
- 3. Indus plain
- 4. Gangetic plain
- 5. Central India
- 6. Deccan
- 7. Western coasts Of Malabar
- 8. Assam
- 9. Andaman and Nicobar

Western Himalayas

- One of the most important botanical region of India.
- It consists of Kasmir, Himachal pradesh, part of Punjab.

- Average rain fall 100 cm to 200 cm.

- *Salmalia malbaricum*
- *Shorea robusta*
- *Butea monosperma.*

- *Dalbergia sisso*
- *Ficus glomeruta*
- *Eugenia species*

Eastern Himalayas

- Extend from Sikkim to Assam
- Heavy monsoon rainfall
- Less snow fall
- High humidity

- Rhododendron sp.

- *Terminelia*
- *Stericulia*
- *Anthocephalus cadamba*
- *Bauhinia*

- Michelia champaka
- Cinnamomum sp.
- Eugenia sp.

- Abies sp.
- Juniperous
- Tsuga sp.

Indus plains

- It includes punjab, Rajastan, Cutch, Delhi,
- Dry hot summer
- Dry cold winter
- Rain fall – Less than 70 cm
- Vegetation is mainly bushy and thorny.

- *Acacia arabica*
- *Prosopis sp.*
- *Salvodora sp.*
- *Zizyphus zuzuba*
- *Mangifera sp.*

Gangetic Plain

- Richest vegetation in India
- Covers U.P., Bihar, West Bengal and a part of Orissa.
- Rain fall- 50 to 150 cm
- Cultivable land

- Wheat, Jowar, Bajra, Urad, Moong,Red gram.

- Dry deciduous forests are common
- *Capparis*, *Dalbergia*, *Acacia* species are very common.

- Mangrove vegetation is common in tidal regions in W.B.
- *Rhizophora sp.*
- *Sonneratia sp.*
- *Acanthus ilifolius*

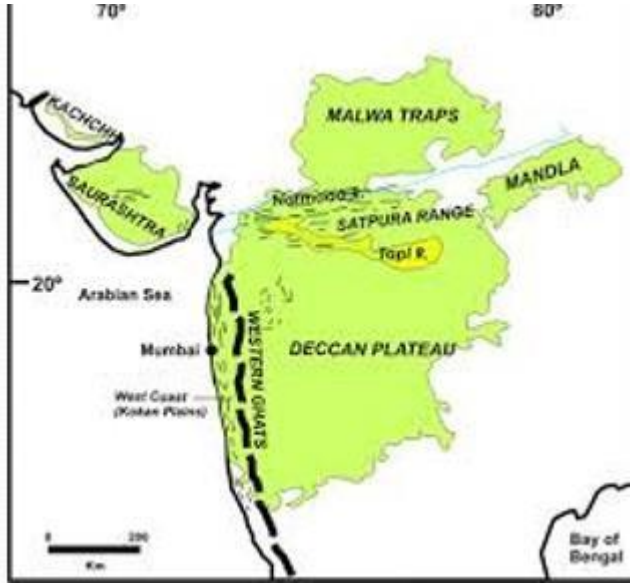
Central India

- Covers Madya pradesh and a part of Orissa, gujarat and Vindya.

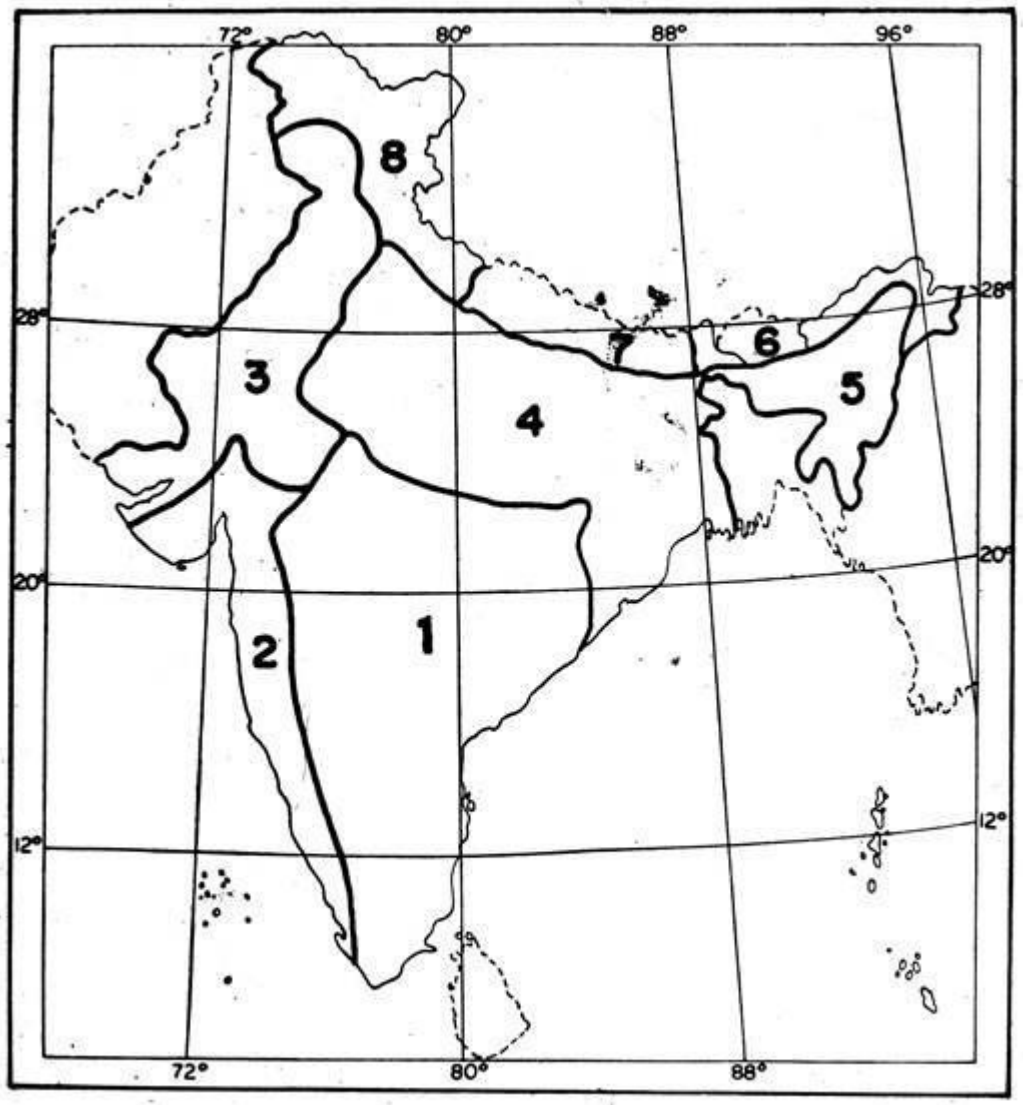
- Rain fall – 100 to 170 cm
- Thorny vegetation in open areas
- Teak and Sal trees are very common.

Deccan

- Includes Southern peninsular India
- Rain fall- 100cm.
- Divided in to Deccan plateau and coromondel coast.



- Teak forest are common.
- *Pterocarpus, Borassus,*
- *Clematis,*
- Coromondel coast consists of halophytic sp.


72°
80°
88°
96°
28°
20°
12°
1
2
3
4
5
6
8

MAP II


Map of india displaying geographic regions as affecting its bio-diversity
PAKISTAN
TIBET
NEPAL
Bhutan
DESERT
GANGETIC PLAIN
CENTRAL HIGHLANDS
DECCAN PLATEAU
Western Ghats
Eastern Ghats
Coromandel Coast
Myanmar
BAY OF BENGAL
INDIAN OCEAN
SRI LANKA