BIODIVERSITY STUDIES

[M.Sc.-II (Environmental Botany) SEM-III, P-IV, U-III]

BOTANY DEPARTMENT, SIES ASCS (AUTONOMOUS)

ENDEMISM

A species found in a particular region and not anywhere in the world is said to be endemic to that region and this unique phenomenon is termed as endemism. This concept was introduced by A. P. de Candolle (1820) who referred to it as a taxonomic unit or its species, limited to one region. The term 'endemic' is used to denote a species, genus or other group confined to a small area like a group of islands, a mountain chain or a comparatively small country like South Africa, bounded by sea or by a marked alteration of climate.

Plants which are widely scattered exhibiting various types of discontinuous range are called **polyendemics** in contrast to those whose range in each case is confined to a single geographically restricted area. Such plants are called as **endemics**. A plant may be said to be endemic to a certain state, to a country or a continent. An **endemic area** is the area of a species or taxon that is in its distribution, is limited to some single natural region, or habitat, the history or conditions of which mark it off from others.

Since the term 'endemic' signifies that that the organisms live with their own type, H. N. Ridley (1925) had proposed the term '**epibiotic'** signifying survivors, to distinguish those endemics which are relics of the lost flora. These are the old ones whose range was far more extensive than it is today, and which being remnants or survivors of former floras, are called as **relic endemics**. They are also termed as **paleo-endemics**. A good example is the Giant Redwoods of the Western USA, which used to be extremely widespread in the northern hemisphere. Another good example is the plant *Welwitschia mirabilis* found in the Namib Desert. Some also consider endemics, or **micro-endemics** for those organisms, which are related to, or evolved from other plants in the same area. They are '**newborn'** species, relatively young taxa, characteristic of newer portion of the earth's surface. When ecological conditions change, there is a tendency for such new forms to evolve, bound to a particular region of special habitat conditions. Such plants are called **neo-endemics**. A plant may be said to be endemic to a certain state, country or a continent. Besides other factors some geographical barriers like mountains or seas are also responsible for endemism.

High level of endemism is a characteristic feature of islands. This is due to isolation of islands from the mainland by vast sea or oceans. The greater the distance from the mainland, the larger is the proportion of endemic species in that island. In Hawaiian Islands, which are the most isolated islands from the mainland and most remarkable adaptive radiations occurred, more than 90% of species are endemic and rapid evolution

has occurred among the plants and animals there. The proportion of endemism in some other islands are given. For eg. 70% in Fiji, 72% in New Zealand, 66% in Madagascar, 64% in Galapagos, etc.

The percentage of endemism in large subcontinent like India is 30%. In marine ecosystem the richest centres of endemism are the coral reefs. In wet tropical and moist tropical forests of South America, about $3/4^{th}$ of the total 8,550 species of vascular plants are endemic.

Among 25 terrestrial biodiversity hotspots identified by Myers *et al* (2000) among the world, nine leading hotspots contain 30% of all plants and 25% of all species of vertebrate animals covering only 0.7% of earth's land surface. They are richer in endemics than any other hotspots. The eight hottest hotspots of the world on the basis of number of endemics are the Caribbean, Brazil's Atlantic forest, Madagascar and Indian islands, Eastern Arc and coastal forests of Tanzania/Kenya, Sundaland, Philippines, Indo-Burma and Western Ghats/Sri Lanka.

The biodiversity in India is due to heterogenous aggregation of biota from the Oriental, Palaearctic and Ethiopian regions. In India, the Himalayan biogeographic zone could evolve a high proportion of endemic taxa, eg. 60 species of balsams. In the Trans-Himalayan zone (desert plateau of Tibet, Lahaul-Spiti districts of Himachal Pradesh and Ladakh), the endemism is quite high. One of the world's 25 hotspots, the Eastern Himalayas in India is rich in flowering plants including primitive genera like *Magnolia* and *Betula*, and animals including some reptiles, amphibia, butterflies and mammals, showing high degree of endemism.

Another hotspot, the Western Ghats has about 1800 endemic species of plants which constitute about two-thirds of the endemic species of higher plants of India. Thirteen species of the 29 species of Dipterocarpaceae are present in this region. Several species of fish, reptiles, amphibians, birds and mammals are endemic to this region. Some rodents and primates are also endemic to this place.

In Andaman and Nicobar Islands, over 200 species of plants are strict endemics and 1300 species are not found anywhere else in India, but occur in Burma, Malaysia, Indonesia and Polynesia. The bird Andaman woodpecker is restricted to this region.

So, it has been observed that endemic flora and fauna are clustered around certain regions of the world. Endemic species are mostly confined in narrow restricted geographical ranges and are at high risk of extinction. So, if they are extinct in their range, they are lost forever with subsequent loss of the entire gene pool. Endemics are thus vulnerable to extinction because of their isolation in restricted habitat and low population size. As they are adapted to specialized habitats, they easily fall prey to introduced exotic species, changes in environmental quality and human induced habitat alteration. The abundance of the endemic species is also negatively correlated with the abundance of the non-endemic ones to which it is genetically inferior. Greater specialization and competitive inferiority make them vulnerable to extinction. Endemism increases

with the size of the area, but declines with increasing taxonomic level. It has been observed that high level of endemism occurs in warm or cold deserts. Plant endemism is directly proportional to productivity and they are frequently observed at higher elevations, but glaciated areas are poor in such species. Geographical biotopes like islands, ancient lakes, hot springs, etc are great repository of such endemic species as only few specialized species can adapt to such ecosystem. North Pole is poor in endemic species. The latitude, elevation, productivity, isolation and age determine endemism of a given habitat. There exists positive correlation between species (as well as generic and family level) richness and the degree of endemism. Areas of high endemism are areas of high species richness.

Distribution of endemic taxa are often used to determine conservation priority areas. A habitat rich in endemism usually has high species richness more so in the larger spatial scales. So endemic taxa are usually represented as umbrella species in the protected areas. They also act as sensitive indicators of anthropogenic disturbances. Besides, these taxa often also attract tourism.

ENDEMIC AND EXOTIC PLANTS OF INDIA

The percentage of endemic plant species under different groups mentioned in the fifth report of the Convention of Biological Diversity (CBD), 2014 reported by the Botanical Survey of India (BSI) are given in the table below.

No.	Plant Group	% Endemism
1.	Angiosperms	22.57%
2.	Gymnosperms	10.81%
3.	Pteridophytes	15.47%
4.	Bryophytes	25.64%
5.	Algae	26.91%

According to this report, nearly about 4045 species of flowering plants endemic to India are distributed amongst 141 genera belonging to 47 families. These are concentrated in the floristically rich areas of North-east India, the Western Ghats, the North-west Himalaya and the Andaman and Nicobar Islands. Some endemic and exotic plant species of India are illustrated as follows.

Endemic Plant Species of India: -

1. *Artocarpus hirsutus* (Moraceae) – These are trees with milky latex, up to 38 metres tall, girth can be up to 3.3m. They are fairly common in evergreen and semi-evergreen forests from south Maharashtra to Kanyakumari in elevations from 80 – 900 m. Leaves are densely hirsute beneath when young. Flowers are unisexual. Fruit is sub-globose or ellipsoid, echinate.
2. *Diospyros sylvatica* (Ebenaceae) – These are canopy trees up to 35m tall, girth 2.5m. They are endemic to the evergreen forests from Bhimashankar to Kanyakumari in 200 – 1300m elevations. The leaf lamina is concave in between the secondary nerves. Leaf apex is acuminate. Flowers are dioceous, fruit is globose.
3. *Hopea ponga* (Dipterocarpaceae) – It is commonly known as 'pongu' or 'kaiga'. These are endemic to Goa and Karnataka in elevations from 400 – 700m. They are trees, up to 24m tall, girth up to 1.5m. Leaves are tomentose, finely velvety. Petiole is very stout and has a velvety texture. Fruits are with two long enlarged wing like calyx lobes.
4. *Myristica malabarica* (Myristicaceae) – Commonly called as Kattujathi, these are trees up to 34m tall, girth up to 2.5m. They are endemic to Western Ghats in elevations from 40 – 240m. Leaves are glabrous above and glossy glaucous below, with secondary nerves 8 – 11 pairs. Fruit is oblong, pubescent, seed covered with yellow aril.
5. *Vateria indica* (Dipterocarpaceae) – Commonly known as Indian copal tree or White dhamar, these are large trees, up to 33m tall, girth up to 2.7m. They are endemic to Western ghats in elevations from 40 – 840m. Leaves are swollen at the tips; apex acuminate or obtuse. Flowers with yellow anthers; fruit is oblong, pale brown and persistent calyx.
6. *Arenga wightii* (Arecaceae) – This is commonly called the Wild coconut. These are tall palm trees, with trunk up to 8m tall. They are frequent in evergreen forests mostly along the ghats on steep slopes from Uttar Kanada to Kanyakumari in elevations from 400 – 800m. Leaves are with more than 50 pairs of leaflets. Flowers are cream – coloured and unisexual. Fruits are green, globose, hard, 2.5m across.
7. *Agasthiyamalaia pauciflora* (Clusiaceae) – It is commonly known as Poothakkali. It is a monotypic genus, narrowly distributed only in Agasthyamalai and Ashambu hills of Trivandrum and Kanyakumari district in elevations from 700 – 1200 m. Leaves have obscure secondary nerves on their under surface. Flowers are white in axillary fascicles. Fruits are ovoid with a beak, dehiscent.
8. *Syzygium tamilnadensis* (Myrtaceae) – It is commonly known as Kallunjaval. They are trees, up to 24m tall, girth up to 1.5m. This species seems to exhibit two leaf forms. The low elevation form shows oblong elliptic lanceolate leaves and is seen at elevations up to 1200 m in Kodagu and Wayanad districts. The high elevation form is seen at 1500 – 2200 m in Shola forests of Nilgiris and Megamalai

Hills and shows more elliptic orbicular and glaucous leaves. Fruit is globose, brownish red with a persistent calyx.

9. *Elaeocarpus gausseniii* (Elaeocarpaceae) – They are trees growing up to 20m tall. These are restricted only to the montane evergreen forests of Megamalai hills in elevations from 1400 – 1600 m. Leaves are small and obovate and flowers have less than 15 stamens. Fruits are spherical, one – seeded.
10. *Eugenia argentea* (Myrtaceae) – These are shrubs or small trees, up to 4m tall, girth up to 0.2m. The young parts of this plant are silvery tomentose. These are restricted to mid elevation forests, often along streams in Wayanad region of Kerala in elevations from 600 – 1300 m.
11. *Inula kalapani* (Asteraceae) – It is an erect herb, growing 30 – 45 cm tall. The species is endemic to Kameng district of Arunachal Pradesh and Khasi hills of Meghalaya. It grows near river bank and sandy soil, amidst grasses in open places down the hills at 1300-1500 m elevation. Stem simple or sparingly branched, pubescent or hirsute. Cypselae are minute and glabrous. Pappus 3 mm long, uniseriate, bristles 28–37, reddish.
12. *Inula macrosperma* (Asteraceae) – It is an erect herb, endemic to the high-altitude alpine regions of the Sikkim Himalayas. Stem is glabrous or pubescent, smooth, shining, soft, glabrous or sometimes pubescent, winged; wings narrow, membranous. Cypselae are oblong, compressed, strongly and prominently ribbed. Pappus 2.5 mm long, uniseriate, bristles 35–48, reddish.
13. *Nepenthes khasiana* (Indian pitcher plant) (Nepenthaceae) – It is a carnivorous plant endemic to the Khasi Hills of Meghalaya. The Khasi people call the plant *tiew-rakot*, which means demon-flower or devouring-plant. The plant has long, oblong-lancet shaped leaves. Some unusual leaves first look like normal leaves, then develop a tendril at their tip, and finally the tip of the tendril develops an amazing pitcher, with a lid on top. As the pitcher matures, the lid turns a reddish hue. When an insect goes inside, the lid closes, and the insect is eventually digested. This is believed to be the only species of Pitcher Plant found in India.
14. *Pterocarpus santalinus* (Leguminosae) – It is commonly known as Red Sanders. It is endemic to the southern part of the Eastern Ghats. These are tall trees that flower in dry season. The flowering is discontinuous and flowers open at night. *P. santalinus* is also prized for its hard, dark-purple, bitter heartwood. The colour and fragrance of *P. santalinus* heartwood are derived from santalins while the pleasant aroma is caused by the presence of terpenoids. *P. santalinus* stands have been in decline as a result of this overexploitation for commercial purposes, earning it an endangered status since 1997.
15. *Odisha cleistantha* (Orchidaceae) – It is a threatened orchid species endemic to the Koraput district of Odisha state. The flower has a flabelliform labellum and divergent stigma lobes. The flowers never open, which is indicated in the name of the species (cleistos means closed flowers).

16. *Citrus assamensis* (Rutaceae) – It is commonly called the Adajamir and is restricted to the districts of Cachar, Khasi Hills and Sylhet district of East Pakistan. This tree is valued for its highly sour juice of its fruits having peculiar aromatic flavour.
17. *Eriocaulon raipurense* (Eriocaulaceae) – It is a small tree endemic to Raipur and Surjuga districts of Chattisgarh. This species is closely allied to *E. hamiltonianum* but differs in size and apex of involucral bracts and white pilose nature of floral bracts.
18. *Chlorophytum bharuchae* (Asparagaceae) – It is commonly called the Phulbaji and is a high erect perennial herb, occasionally found on the rocky hills of Western ghats, endemic to the Bharuch region of Gujarat. It has a tuberous root. Flowers are white.
19. *Berberis kashmiriana* (Berberidaceae) – It is popularly called the Kashmir Barberry, endemic to the Kashmir region. It is a prickly shrub, 1 – 2m tall. The stem is hairless, pale yellow, round to somewhat grooved.
20. *Berberis manipurana* (Berberidaceae) – It is popularly called the Manipur Barberry, endemic to Manipur state. It grows as an evergreen shrub, about 2 – 3 m tall. The stem is terete or angled, branched sparsely, glabrous, upper branches verrucose, lower ones terete.
21. *Hardwickia binata* (Caesalpinaceae) – It is commonly called as Anjan. It is a medium or large deciduous ornamental tree, endemic to Champaran region of Bihar and Palamau region of Jharkhand. It has graceful, drooping slender branches; crown is conical in early life, becoming broader later.
22. *Ceropegia panchganiensis* (Asclepiadaceae) – Commonly called as Khartundi, it is very specific in its habitat requirements and therefore restricted in distribution. It is an erect tuberous herb, perennial, 30-50 cm high. It is restricted to the Satara and Ahmednagar districts of Maharashtra state. It is represented by about 100 individuals at Mahabaleshwar and about 50 individuals at Harishchandragad. The tubers are edible.

Exotic Plant Species of India: -

Many alien plant species are either purposely introduced in India from other countries and cultivated for purposes like food, forage, timber, ornamentation, etc. while there are some species which find their way due to carelessness and spread as weeds. Some such exotic species are described below.

1. *Acacia farnesiana* (Mimosaceae) – It is commonly known as Fragrant Acacia. It is a native of tropical South America and introduced in India before 1832. It is a shrub or a small tree, widely distributed throughout India. It is occasionally found in thorny scrub and dry degraded forests and often creates close thickets through which cattle cannot move.
2. *Argemone mexicana* (Papaveraceae) – It is commonly known as Prickly Poppy. It is an annual prickly herb, native to tropical central and south America, introduced in India in the 17th century. It is an

aggressive colonizer. It grows as a common winter season weed in cultivated fields, scrub lands and fringes of forests.

3. *Borassus flabellifer* (Arecaceae) – It is commonly known as the Palmyra or the Toddy palm. It is a very large palm, native to tropical Africa, distributed commonly in the Deccan peninsula of India. It is an aggressive colonizer. It is cultivated and self-sown, occasionally found to be gregarious near cultivated fields, scrub lands and waste lands.
4. *Cassia alata* (Caesalpinaceae) – It is commonly called the Ringworm Cassia or the Roman candle. It is a shrub growing up to 2m tall, native to West Indies, but distributed throughout India. It was introduced as an ornamental plant. It is occasionally found in moist places and near forests.
5. *Cryptostegia grandiflora* (Asclepiadaceae) – It is commonly called the Rubber Vine. A climbing shrub with plenty of milky latex, it is a native of Madagascar. It was introduced as an ornamental plant. Being an aggressive colonizer, it is occasional in forests.
6. *Eichhornia crassipes* (Pontederiaceae) – It is the common water hyacinth. It is an aquatic herb, free-floating or rooted, native to tropical America, introduced in India during 1914 – 1916. It is an aggressive colonizer. It is abundant in still or slow floating waters and is a nuisance for aquatic ecosystems.
7. *Ipomoea carnea* (Convolvulaceae) – Commonly called the Lottapeesu, it is a native of Tropical America, introduced in India accidentally in early 20^{th} century. They grow as large erect shrubs up to 3m tall. It is an aggressive colonizer and a common weed of marshy lands and along the edges of tanks and ditches.
8. *Lantana camara* (Verbenaceae) – It is commonly called the Wild Sage. It is a native of tropical America, introduced in India as an ornamental shrub during 1809-1810. It grows as a straggling armed shrub, up to 2.5m tall. It is an aggressive colonizer and a common weed of forests, plantations, habitation, waste lands and scrub lands.
9. *Melilotus alba* (Papilionaceae) – It is an annual, erect herb, growing up to 50cm tall and a native of Europe. It is a common winter season weed of moist crop fields.
10. *Mimosa pigra* (Mimosaceae) – It is commonly called the Black Mimosa. It is a prickly mimosoid shrub, growing up to 3m tall; the stem has 5 ridges from which spines and bristles arise. A native of tropical North America, it is distributed in India in the Himalayas and Western Ghats. It is an aggressive colonizer and invades water courses and seasonally flooded wetlands.
11. *Mimosa pudica* (Mimosaceae) – It is the popular touch-me-not plant or the sleeping grass. It is a native of Brazil, introduced in India during the 16^{th} century. It is a prickly suffrutescent herb and an aggressive colonizer. It is a common weed of cultivated fields, scrub lands and degraded forests.

12. *Mirabilis jalapa* (Nyctaginaceae) – It is also called the 4 O'clock plant and is a native of Peru. An erect, much branched herb or undershrub, it is an aggressive colonizer. It runs wild in gardens and near habitations.
13. *Parthenium hysterophorus* (Asteraceae) – It is also called the Congress grass. It is a native of tropical north America, introduced accidentally in India in 1956. It is an annual erect herb, growing up to 1.5m tall. An aggressive colonizer, it is a common weed of cultivated fields, forests, overgrazed pastures, waste lands and gardens.
14. *Portulaca oleracea* (Portulacaceae) – It is commonly called the Purslane. It is native to tropical Central America, introduced to India before 1845 and presently cultivated as a leafy vegetable. It is a prostrate herb, branchlets green or purplish, succulent. It is also a weed of moist fields and gardens.
15. *Salvinia molesta* (Salviniaceae) – It is also called the Giant Salvinia or the Kariba weed. It is a floating, rootless aquatic fern, native to south eastern Brazil, reported in India during 1950. It is one of the world's most noxious aquatic weed. It is found in quiet water of lakes and ponds, ditches, slow flowing streams, backwater swamps, marshes and rice fields.
16. *Torenia fournieri* (Scrophulariaceae) – It is an annual erect herb growing up to 30 cm tall, native to Australia and introduced in India as an ornamental plant. It is an occasional weed of gardens and openings of moist forests in higher altitudes.
17. *Urena lobata* (Malvaceae) – It is a shrub with deeply lobed leaves and is a native of tropical Africa. It is an aggressive colonizer, common along railway tracks, roadsides and in degraded forests.
18. *Populus deltoides (*Salicaceae) – It is a tall tree commonly called the Poplar or cottonwood. It was introduced to India in the 1950s, from America. It is widely grown all over northern India and is considered as an agroforestry tree because of its desirable characteristics and multiple uses.
19. *Eucalyptus tereticornis* (Myrtaceae) – It is a tall tree with peeling bark introduced to India from Australia around 1790. Its cultivation has now spread to nearly the whole of the Indian subcontinent. The major problem with this tree is that it absorbs a large amount of groundwater, rendering the nearby plantations dry.
20. *Prosopis juliflora* (Caesalpinoideae) – It is locally known as 'kabuli kikar'. It is a shrub or small evergreen tree, generally 3 – 4 m high, introduced a century ago from South America. It has successfully established itself on almost all the habitats including saline lands, alkali lands, wastelands, roadsides, field boundaries and common lands. It is an ideal tree used to reclaim deserts and an important source of food, fodder, fuelwood, charcoal, timber and gum.

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