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Endemism: An Overview

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ABSTRACT

The term endemic is used to denote a species, genus or other group confined to a small area like Single Island, a group of islands, a mountain chain or a comparatively small country like South Africa or West Australia, largely bounded by sea or by a marked alteration of climate. A plant may be said to endemic to a certain state, to a country or to a continent. Although there is no country or islands that have all its species endemic, yet it is very common to find genera with all their species endemic. The present paper deals with types of endemic, habitat for endemics, factor responsible for endemism and endemism in Uttar Pradesh and India.

KEYWORDS : Endemism, Paleoendemism, Neoendemism, Hot spots

Introduction

Endemism is an ecological word meaning that a plant or animal lives only in a particular location, such as a specific island, habitat type, nation or other defined zone or endemism is the association of a biological taxon with a unique and well-defined geographic area. The opposite of endemism is cosmopolitan distribution or cosmopolitan is the antithesis of endemic, and refers to a taxon which is extremely widespread in many world regions. Highest numbers of endemic taxa are found in Australian region. All important islands and mountain chain (except isolated piece of the country like Italy) from 48^0 N to South wards possess endemics. Maximum proportion of endemism is found in West Australia and South Africa regions. All the southern land masses have great number of species confined to themselves i.e. endemism is higher in old landmasses than in young e.g. land of northern hemisphere which are covered by the Pleistocene ice sheets have lower number of endemics. Endemics are especially common in mountainous countries and it worth noting that most islands are also mountainous. Botanists have long been accustomed to look upon endemic forms as the oldest. According to Willis age-and-area hypothesis, most endemic species are considered to be youthful i.e. youngsters rather old relic. The concept of endemism includes two types of organisms whose areas are confined to a single regions: endemics (which are relatively youthful species), and epibiotics (which are relatively old relic species).

Types of Endemism

There are two types of endemism - paleoendemism and neoendemism

Paleoendemic species: Paleoendemism means that a species used to live in a large area but now lives only in a smaller area. These species are often systematically isolated taxa, whose distribution areas represent the remnants of originally larger distribution ranges that have been reduced due to environmental changes.

Illustration: Formation of paleoendemic species can be understand by taking following hypothetical example. Species A is widely distributed throughout the whole mountain range. A change of the environmental conditions in the region leads to a reduction to the distribution of species A. Species A does not totally distinct; it survives in a small area at the periphery of its former distribution range. Now Species A is paleoendemic species of this area.

Neoendemic species: Neoendemism means that a species has recently appeared which is closely related to the main species or one that has formed following hybridization and is now classified as a separate species. This is a common process in plants especially those which exhibit polyploidy. These species result from the divergent adaptation to differing environmental conditions thereby leading to the formation of new species that are locally distributed. The evolution of neoendemic plant species is often triggered by polyploids. The endemic species may have a higher ploidy level than its related taxa (apoendemics), or it may be diploid while its related taxa have a higher ploidy level (patroendemics). In cases where the endemic taxon and its related taxa are of equal ploidy level, the endemic species are called schizoendemics. Apo-, patro-, and schizoendemics are further subdivisions of neoendemic.

Illustration: Formation neoendemic species can be understand by taking following hypothetical example. Species B is immigrates to the area and colonizes the upper region of mountain chain. As a result, the population of species B gets separated and the two subpopulations are isolated from each other. Since the environmental conditions of the two subpopopulations are not identical they show different adaptations. The divergent evolution in the subpopulation may lead to formation of new species or subspecies that are locally distributed called neoendemic species.

Habitat for Endemics

High endemism usually occurs in areas that have been isolated for a long time, such as islands or isolated forest fragments. In these regions there are usually high rates of speciation. Areas with high levels of endemism do not necessarily have high biodiversity levels. Tropical forests show a high degree of species richness and endemism. Endemic taxa are restricted to specific areas such as oceanic islands, peninsular regions, mountain peaks and unique geographical areas. Globally 'botanically interesting' areas are rich in endemics, especially islands. Endemic types are most likely to develop on islands because they are isolated. This includes remote island groups, like the Hawaiian Islands, the Galápagos Islands, and Socotra. Endemism can also occur in areas which are separated from other similar areas like the highlands of Ethiopia, or large bodies of water like Lake Baikal. Endemics can easily become endangered or extinct because of only living in a small area. They are also vulnerable to the actions of man, including the introduction of new organisms.

Factors Responsible for Endemism

Stebbins, (1942) has given a genetical explanation for the for the endemic. He also told that such taxa have depleted their store of genetic variation (biotype depletion) and they are unable to expand their range. There are multiple causes of rarity and endemism. Three primary factors i.e. geographical area, ecological breadth and isolation describe the distribution of endemics. Endemics are found on all landmasses of the world, both continents and island, and in all major biomes. Neither genetics, ecology, nor history alone will suffice to explain the origin of endemic taxa. Stebbins (1980) has given the gene pool/ niche interaction theory to explain origin of rarity and endemism. "According to theory, the primary cause of localized or endemic distribution patterns is adaptation to a combination of ecological factors that are themselves localized. Factors of soil texture and chemical composition are the most important but by no means the only ones. Next to the climatic and edaphic factors, those inherent into the gene pool of the population are of critical importance. They include the total amount of variability, the amount of variability that can be released at any one time, and the amount of variation that can be generated with respect to those particular characteristic that affect most strongly the establishment of new population"

Genetic Variation in Endemics

Small populations are greater hazard of going locally extinct. A limited range means that a small disturbance can carry away an endemic. Small populations are as responsive to environmental variation as larger ones. These population are more likely to hit the zero point and locally extinct. This small population process is analogous to genetic drift. Endemics are genetically depauperate. There are variety causes

of lowered genetic variation or polymorphism in endemics like reduced heterozygosity, decrease in mean number of alleles per locus or reduction in the proportion of polymorphic loci. One explanation for a reduction in polymorphism is that lowered heterozygosity is a response to selection to selection, for both neoendemic and paleoemdemic. Under selectively neutral circumstances, heterozygosity is influenced by effective population size. Small effective population size of endemics may be due to three reasons. The simplest reason is that endemics may have smaller total populations than widespread species. Here the lowered heterozygosity may be equilibrial and is likely to be permanent. According to some instances the genetic bottleneck is due to the origin of neoendemism. Such bottleneck may produce low level of genetic variation. A third possible avenue to neoendemism is inbreeding. Selfing reduces effective population size and hence heterozygosity (Kruckeberg and Rabinowitz, 1985).

Endemism in India

A biodiversity hotspot is a region that has 1500 or more endemic vascular plant species (or 0.5 % of the world total) and to qualify as a biodiversity hotspot, the region must have lost at least 70 % of its native vegetation. This concept is used to identify important regions deserving of exceptional conservation practices. Biodiversity hotspots are sometimes tantamount to high endemism ecoregions.

At present at international level 34 biodiversity hot spots have been recognized. Of these 34 hotspots 4 hotspots fall within the Indian political boundries (Mittermeier *et al*., 2004):

1. Indo-Burma covering Mizoram, Manipur, Nagaland, Meghalaya, Tripura and Andaman Islands,
2. Himalaya covering Jammu & Kashmir, Himachal Pradesh, Uttarakhand, northern part of West Bengal (Darjeeling), Sikkim, northern part of Assam and Arunachal Pradesh,
3. Western Ghats falls within the states of Tamil Nadu, Kerala, Karnataka, Goa, Maharashtra and Gujarat and
4. The Sundaland covering the Nicobar Islands.

Endemism at Generic Level (Willis, 1922)

No country has all of its genera endemic. Endemism increases as we move from North to South. Many endemics are regarded as young beginners but there is no logical reason why the same should not be true of endemic genera, which occur in similar places, and there is every probability in this favor. There is no relation between number of endemic species and number of endemic genera. The increase in the number of endemic genera of island or mountain chain is affected by three factors i.e. the number of endemic genera increases (i) with increase in size of islands or mountain (ii) with the isolation of the same, and (iii) with increased southern latitude, up to 45-50^0 S. Endemic species belong to the large and successful genera in greater proportion. In the same way endemic genera belong to large and successful families.

Generic Endemism in India

Peninsular India is the richest endemic centre. It harbours nearly 82% of the total endemic genera of the country. Hill tops provide a good environment for endemism next to islands. The species richness and high endemism in the Western Ghats is due to varied latitudinal and altitudinal gradients with varied rainfall and temperature. India has large number of endemic species. There is no endemic family in India. There are only 49 genera endemic to India, of which 36 are unispecific. Peninsular India has a high concentration of endemic genera (40 genera). The families, Poaceae, Apiaceae, Asteraceae and Orchidaceae account for nearly 51% of generic endemism in India among which Poaceae alone accounts for 27% (Irwin and Narasimhan, 2011). Higher number of endemic genera in Poaceae can be attributed to earlier stages in evolution and dynamism of the family. In India there are 20,074 species and 2991 genera (Karthikeyan, 2009). Of these 5752 species (i.e. 29%) are endemic. These are distributed in three major phytogeographical regions, viz., Indian Himalaya, Peninsular India and Andaman & Nicobar Islands (Nayar, 1996). Nayar (1996) reported 70 genera as endemic to the Himalaya whereas, Mitra & Mukherjee (2007) reported only 56 genera. Nayar (1996) recognized eight micro-endemic centres in the Western Ghats based on high percentage of endemism. The genera are mostly concentrated and widespread in these eight micro-endemic centres except a few very narrow endemics.

Endemic Species of Uttar Pradesh

In Uttar Pradesh, Khanna (2001) reported 10 endemic species belonging to 8 genera and 6 families. These endemic species along with their distribution are given in the table-2

Table-2 Endemics of Uttar Pradesh

S. No.	Name of the Species	Family	Place
1	*Rorippa pseudoislandica* H. J. Chowdhery & R. R. Rao	Brassicaceae	Hamirpur
2	*Derris kanjillalii* Sahni & H. B. Nathani	Fabaceae	Pilibhit
3	*Derris scandens* (Roxb.) Benth. var. *saharanpurensis* (Thoth.) Thoth.	Fabaceae	Saharanpur
4	*Indigofera thothathrii* Sanjappa	Fabaceae	Bahraich
5	*Diospyros holeana* Gupta & P.C. Kanjilal	Ebenaceae	Gonda
6	*Brachystelma laevigatum* Hook.f.	Asclepiadaceae	Gorakhpur
7	*Brachystelma pauciflorum* Dithie	Asclepiadaceae	Bahraich
8	*Alectra chitrakutensis* (Rau.) R. Prasad & R.D. Dixit	Scrophulariaceae	Banda
9	*Cymbopogon flexuosus* (Nees & Steud.) Wats. var. *microstachys* (Hook. f.) Bor.	Poaceae	Saharanpur and North Oudh
10	*Hemarthria hamiltoniana* Steud.	Poaceae	Upper Gangetic Plain

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