

Distribution and Conservation of orchid species richness in India

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ABSTRACT :

The orchid-rich regions in India are the North-Eastern region, particularly the Eastern Himalaya, Meghalaya, Mizo or Lushai Hills and the Naga Hills; Sikkim in particular, rich with orchids. The vegetation in Western Ghats reported orchids are *Bulbophyllum*, *Cymbediums*, *Dendrobiums*, *Pholidota* and *Eulopia*. Eastern Himalaya, especially the genera like *Bulbophyllum*, *Dendrobium*, *Coelogyne* and *Eria* are very common. About 700 species have been reported from North-Eastern India; in the state-wise, 324 species in Meghalaya, 500 in Arunachal Pradesh, 453 in Sikkim and 226 in Mizoram.

The orchid flora of India show geographical affinities with other parts of the world. In Eastern Ghats, a much fewer number of orchids are found when compared to Western Ghats. Some of orchids commonly distributed in Eastern Ghats of India, particularly Andhra Pradesh are *Acampe praemorsa*, *Aerides odoratum*, *A. multiflorum*, *Cymbidium aloifolium*, *Gastrochilus calciolaries*, *Malaxis rheedii*, *Oberonia arnottiana*, *O. brunoniana*, *O. denticulate*, *O. ensiformis*, *O. falconeri*, *Pholidota pallida*, *Vanda spathulata*, *V. tessellata*, *V. testaceae* etc. Orchids conservation by *insitu* and *exsitu* methods.

Keywords: Orchids distribution, Eastern Himaylas, Westren Ghats, Geographical affinities, Endemism, Conservation strategies.

INRODUCTION :

The Orchidaceae constitute one of the largest families of flowering plants comprising about 779 genera and 22,500 species (Mabberley, 2008). It contributes about 40 per cent of the Monocotyledons (Rasmussen, 1985). In India, it represents second largest flowering plant family with 1,141 species in 166 genera and contributes about 10% of Indian flora (Jain, 1980; Kumar & Manilal, 1994). Orchids are the most fascinating plants by reason of their diversity and specialization in floral and vegetative features (Pijl & Dodson, 1966; Holttum, 1977; Dahlgren *et al.*, 1985). They are unique in forms, colours and flower structure. However the vegetative organization is variable throughout the family (Dressler, 1993). In general they possess velamen roots / root tubers, rhizome, pseudobulbs, leaves

and attractive flowers. During evolutionary process orchids have adapted to distinct environments, so that they can grow as epiphytes, terrestrials, lithophytes or saprophytes (Black, 1973). These environmental variations contribute for structural modifications in vegetative structure (Pabst & Dungs, 1975). All most 75% of family is represented by epiphytic orchids (Atwood, 1986).

ORCHID GEOGRAPHICAL DISTRIBUTION :

The vegetation and orchid distribution in India especially in Western Ghats, Eastern Ghats and Eastern Himalaya, and geographical affinities of orchids with other parts of the world. The orchid-rich regions in India are the North-Eastern region, particularly the Eastern Himalaya, Meghalaya, Mizo or Lushai Hills and the Naga Hills; Sikkim in particular, rich with orchids; North-Western Himalayan region and also Western Ghats, the detached Pulney, Nilgiri and Biligirirangan Hills (Rao, 1979). The Himalayan kingdoms such as Nepal and Bhutan also have rich orchid diversity. Orchids occur in other parts of the country, but they are few and scattered. They are found in different altitudes, from 150 m. to 2500 m. Mostly they thrive in warm humid weather, occurring in dense tropical rain forests, as well as in temperate cloud forests. Generally maximum orchid diversity is found in tropics.

Eulophia epidendrea were recorded (Abraham & Vatsala, 1981). As we get nearer to the mountain ranges there is an increase in density of orchid population. As we go up to 300-600 m, the vegetation increased its density; some species viz., *Aerides ringens*, *Dendrobium ovatum*, *Oberonia brunoniana* and *Polystachya flavescens* appeared. About 267 orchid species were reported from Western Ghats of India (Kumar, 1991). Totally 125 endemic orchids from this region, of which 98 species were endemic to Western Ghats and 27 had their distribution extending to Eastern Ghats (CAMP Report, 2001).

Typical rain forests was found at an elevation of 600-1300 m with dense canopy and very little light penetration. Epiphytes were rare in this zone due to poor light penetration. The terrestrial orchids such as *Acanthephippium bicolor*, *Calanthe masuca* and *Eulophia macrostachya* were recorded from this zone. At an elevation of 1700-2300 m., it is too cold and dry for epiphytic orchids. *Habenaria* spp. and its allies continue to occupy the meadows through at a diminished frequency. Above 2300 m altitude orchids disappeared gradually (Abraham & Vatsala, 1981). The north-eastern region of India is bordered by China in the north, Bhutan and Nepal in the West, Bangladesh in south and Myanmar in the east. Tropical orchids enjoy humid and warm environment and grow luxuriantly during rainy season.

Eastern Himalaya comprising an area of 83,578 km., has a massive forest cover with the altitudinal variation from 170-5,000 m. It receives an annual rainfall ranging from 700 to 6,500 mm resulting in big and small rivers and rivulets and therefore a humid climate prevails through out the year; this favour orchids to flourish in all vegetational types. Depending on their habitat, broadly four orchid-rich zones are recognized in Eastern Himalaya, especially in Arunachal Pradesh (Hegde, 1984).

1. Tropical Evergreen rain-forest zone: altitude from 170 to 900 m., 2. Sub-tropical Forest zone: from 900-1800 m.(A)Mixed wet forest belt(B)Mixed or Pine (partially dry) forest belt. 3. Temperate forest zone: from 1800 to 3,500 m. 3. Alpine forest zone: 3,500-5,000 m. Tropical evergreen rain-forest zone is characterized by broad leaved evergreen vegetation with high rainfall, warm temperature and humidity (90-100%). Both epiphytic and terrestrial orchids are equally distributed in this zone.

The genera like *Bulbophyllum*, *Dendrobium*, *Coelogyne* and *Eria* are very common in this zone. Some of the bulbophyllums that are present in this zone are: *B. capillipes*, *B. clarkeanum*, *B. delitescens*, *B. hirtum*, *B. reptans*, *B. sikkimense*; and dendrobiums are *D. acinaciforme*, *D. aduncum*, *D. anceps*, *D. aphyllum*, *D. cathcartii*, *D. cumulatum*, *D. lituiflorum*, *D. moschatum*, *D. nobile* etc. Subtropical forest zone receives comparatively lesser rainfall; however, cooler and humid conditions are prevailed in this zone. Both epiphytes and terrestrials are present in this zone.

Some of the saprophytic species such as, *Cymbidium eburneum* and *Eulophia zollingeri* are present in mixed wet forest belt of this zone. The spectacular orchid *Paphiopedilum fairieanum* known as 'Lost Lady Slipper Orchid' is found in isolated patches in West Kameng district of mixed forest belt (Hegde, 1984). Some epiphytic species of *Bulbophyllum*, *Coelogyne*, *Cymbidium* and *Dendrobium* are invariably found in subtropical forest zone. Some of dendrobiums present in this zone are *D. chrysanthum*, *D. falconeri*, *D. wardianum* etc., and bulbophyllums are *B. acutifolium*, *B. affine*, *B. cauliflorum*, *B. leopardianum* etc. Temperate forest zone is characterized by moderate rain-fall, frost in the form of heavy fog and short period snowfall. Few epiphytes as well as terrestrials are distributed in this zone. The *Bulbophyllum* species (epiphytes), *Calanthe mannii* and *Satyrium nepalense* (both terrestrials) and *Galeola falconeri* (saprophyte) are quiet common in this zone. Alpine zone is snow covered for 4-6 months and a few terrestrial orchids are distributed in this zone. About 700 species have been reported from North-Eastern India (Kataki *et al.*, 1984; Hegde, 1987); in the state-wise, 324 species in Meghalaya (Kataki,

1986), 500 in Arunachal Pradesh (Hegde, 1984), 453 in Sikkim (Pollunin & Stainton, 1985) and 226 in Mizoram (Singh *et al.*, 1990).

Mehra & Vij (1974) studied the ecological adaptations and distribution pattern of Darjeeling and Sikkim Himalayan orchids. They opined that the taxa at lower elevation generally bloom early whereas those at higher altitudes come to flowering later. Epiphytes were abundant in Darjeeling and Sikkim due to high humidity and heavy rainfall, than in the Western Himalaya. Some epiphytes at the lower altitudes, viz., *Coelogyna cristata*, *C. uniflora*, *Cymbidium devonianum*, *C. elegans*, *Pholidota imbricata*, *Thunia alba* etc., were also grown as lithophytes at higher elevations (Mehra & Vij, 1974).

The genus *Dendrobium* Sw. with about 104 species is considered to be the largest one followed by *Bulbophyllum* Thou. On the other hand, about 18 genera are monotypics, represented by single species (Singh, 2001).

Sikkim also comes under Eastern Himalaya, is a biogeographic region with magnificent reservoir of biodiversity in general and orchid diversity in particular. The area shares the similar type of floral and faunal composition with its neighbouring countries such as Bhutan and China (Luckson, 2007). The altitudinal variation ranges from 380 m at Melli to 8598 m at the top of Mount Kangchendzonga. The average annual rainfall ranges from 2000-2500 mm in the temperate areas of Sikkim, but south district receives comparatively less rainfall and remains almost dry for the most part of the year. Out of 1229 orchid species occurring in India, 523 species is from Sikkim alone (Luckson, 2007).

From tropical zone of the Sikkim Himalayan region some epiphytic *Dendrobium* species such as *D. formosum*, *D. farmerii*, *D. jenkinsii*, *D. aphyllum*, *D. moschatum* were reported (Luckson, 2007). Besides, *Bulbophyllum roxburghii*, *B. leptanthum*, *B. cornu-cervi*, *B. tortuosum* are also distributed in this zone. In sub-tropical zone also some epiphytic species such as *B. reptans*, *B. guttulatum*, *B. hirtum*, *Dendrobium moschatum*, *D. densiflorum*, *D. chrysanthum* are distributed. According to Luckson (2007), having tropical warm humid climate, North Eastern India is conducive for holding maximum number of epiphytes as compared to South India. He has brought out some interesting findings, these are (1) most of *Dendrobium* species require open tree canopy; (2) the natural home for *D. aphyllum* lies between 400-500 m altitude, but now it is found to occupy upto 1700 m; he is of opinion that this vertical climb demonstrated by this species is due to warming of surrounding climate; similarly *D. amoenum* occurring below 1000 m altitude is now seen to grow naturally at Gangtok (Sikkim) at an elevation of 1900 m. According to Luckson (2007), these are all happened with response to global warming.

ENDEMISM

In India, the peninsular region has a high degree of endemism and it is a second richest endemic centre after Himalaya (Jalal & Jayanthi, 2012). Some of *Bulbophyllum* and *Dendrobium* spp. endemics to India are given in Table 1. The Peninsular region is a part of Indian plate of Gondwana land and most of the endemics of this region are palaeoendemics. Highest degree of endemism is found in Western Ghats whereas lesser level in Eastern Ghats of India (Nayar, 1996). According to Jalal & Jayanthi (2012), about 2 species of *Aerides*, 15 spp of *Bulbophyllum*, 2 spp of *Coelogyne*, 11 spp *Dendrobium* and 6 spp *Eria* are endemics to peninsular India along with *Habenaria* (25 spp.) *Oberonia* (17 spp). The Western Ghats has maximum 123 endemic orchid species followed by Deccan plateau and Eastern Ghats.

Samant (2002) reported 19 endemic orchid species to the Himalayan region whereas 63 species extend their distribution to adjacent regions such as Bhutan, Nepal, Tibet, Pakistan and Afghanistan.

GEOGRAPHICAL AFFINITIES

The orchid flora of India show geographical affinities with other parts of the world. The West Himalayan orchids show relationship with Mediterranean and Eurasian species whereas East Himalayan exhibit predominance of Indo-Malayan elements (Khasim *et al*, 2013). On the other hand, orchids of Southern India show African as well as South-East Asian affinities. Interestingly, some orchids of Southern India, such as *Cottonia peduncularis*, *Diplocentrum recurvum*, *Ipsa malabarica*, *Seidenfadeniella chrysantha*, *Sirhookera lanceolata*, *S. latifolia* etc., were also recorded in the Peninsular India and Sri Lanka (Kumar & Manilal, 1994). About 60 per cent of the Indian Orchids show South-East Asian affinities (Singh, 2001).

There are some orchids very common in India as well as other parts of Asian countries given in Table 2. In Andaman and Nicobar islands there were about 104 species recorded. It has been reported that around 15 species are endemic out of which *Grosourdia*, *Macropodanthus*, *Malleola* and *Plocoglottis* recorded were not found in mainland India. Some orchid genera viz., *Coelogyne*, *Cymbidium* and *Vanda* reported from peninsular India and Himalayas are also distributed in South-East Asian Countries like Thailand, Myanmar, China, Bhutan and Sri Lanka.

The Burmese-Thai elements represented by *Bulbophyllum crassipes*, *B. rufinum*, *Cleisostoma elegans* and *Coelogyne quadratiloba* were recorded from Andamans. Malaysian elements represented by *Appendicula reflexa*, *Dendrobium pensile*, *Phalaenopsis tetrapsis* and *Schoenorchis minutifolia* were recorded from Nicobars. Similarly, *Acampe rigida*

reported from North Andamans has been distributed in the mainland India, Sri Lanka, Malaysia, South Africa and Madagaskar (Diwakar *et al.*, 2005). Some orchids such as *Luisia tenuifolia*, *Oberonia wightiana* and *Vanda wightii*, that are distributed in peninsular India, were also recorded from Sri Lanka (Fernando & Ormerod, 2008).

Table 1.*List of some genera endemic to India

Taxa	Phytogeographical regions in India		
	Western ghats	Eastern ghats	North East Himalaya
<i>Calanthe</i> Lindl.			
<i>C. keshabii</i> Lucksom	--	--	+
<i>C. trulliformis</i> King & Pantl.	--	--	+
<i>C. uncata</i> Lindl.	-	-	+
<i>C. whiteana</i> King & Pantl.	--	--	+
<i>Coelogyne</i> Lindl.			
<i>C. albolutea</i> Rolfe	--	--	+
<i>C. ghatakii</i> Paul, Basu & Biswas	--	--	+
<i>C. glandulosa</i> Lindl.	+	--	--
<i>C. griffithii</i> J.D. Hook.	--	--	+
<i>C. hitendrae</i> Das & Jain	--	--	+
<i>C. mossiae</i> Rolfe.	+	--	--
<i>C. nervosa</i> A. Rich.	+	--	--
<i>C. raizadae</i> Jain & Das	--	--	+
<i>C. schultesii</i> Jain & Das	--	--	+
<i>Cymbidium</i> Lindl.			
<i>C. gammieanum</i> King & Pantl.	--	--	+
Phytogeographical regions in India			

Taxa	Western ghats	Eastern ghats	North East Himalaya
<i>Eria</i> Lindl.			
<i>E. acutifolia</i> Lindl.	--	--	+
<i>E. albiflora</i> Rolfe	+	--	--
<i>E. andamanica</i> J.D. Hook	+	--	--
<i>E. calamifolia</i> J.D. Hook	--	--	+
<i>E. connata</i> Joseph, Hegde & Abba	--	--	+
<i>E. crassicaulis</i> J.D. Hook	--	--	+
<i>E. dalzellii</i> Lindl.	+	+	--
<i>E. exilis</i> J.D. Hook	+	--	--
<i>E. ferruginea</i> Lindl.	--	--	+
<i>E. mysorensis</i> Lindl.	+	--	--
<i>E. nana</i> A. Rich	+	--	--
<i>E. pauciflora</i> Wight	+	--	--
<i>E. polystachya</i> A. Rich.	+	--	--
<i>E. pseudoclavicaulis</i> Bhatt & McCann	+	--	--
<i>E. scabriliguis</i> Lindl.	--	--	+
<i>E. tiagii</i> Manilal, Satish & J. J.wood	+	--	--
<i>E. sharmae</i> Chowdhury, Giri & Pal	--	--	+
<i>Gastrochilus</i>			
<i>G. affinis</i> .(King & Pantl.) Ktze.	--	--	+
<i>G. arunachalensis</i> A.N. Rao	--	--	+

Taxa	Phytogeographical regions in India		
	Western ghats	Eastern ghats	North East Himalaya
<i>G. corymbosus</i> A.P. Das & Chanda.	--	--	+
<i>G. crassilabris</i> (King & Pantl.) Garay	--	--	+
<i>Luissia</i>			
<i>L. micrantha</i> J.D. Hook.	--	--	+
<i>L. recurva</i> Seidenf.	--	--	+
<i>L. volucris</i> Lindl.	--	--	+
<i>Malaxis</i>			
<i>M. andamanica</i> (King & Pantl.) Balakr. & Vasud.	+	--	--
<i>M. aphylla</i> (King & Pantl.) Tang & Wang	+	--	--
<i>M. intermedia</i> (A. Rich.) Seidenf.	+	--	--
<i>M. josephiana</i> (Richh.f.) Ktze.	--	--	--
<i>Oberonia</i>			
<i>O. agastyamalayana</i> Sathish	--	--	--
<i>O. anamalayana</i> Joseph	+	--	--
<i>O. angustifolia</i> Lindl.	--	--	+
<i>O. auriculata</i> King & Pantl.	--	--	+
<i>O. balakrishnanii</i> R. Ansari	+	--	--
<i>O. bellii</i> Blatt. & McCann	+	--	--
<i>O. brachyphylla</i> Blatt. & MaCann	+	--	--
<i>O. brunoniana</i> Wight	+	--	--
Phytogeographical regions in India			

Taxa	Western ghats	Eastern ghats	North East Himalaya
<i>O. platycaulon</i> Wight	+	--	--
<i>O. ritaii</i> King & Pantl.	--	--	--
<i>O. wynadensis</i> Sivadasan & R.T. Bala	+	--	--
<i>O. verticillata</i> Wight	+	--	--
<i>Pholidota</i> Lindl.			
<i>P. convallariae</i> (Reichb.f.) J.J.Sm. var. <i>breviscapa</i> Deori & Joseph	--	--	+
<i>Tainia</i> Lindl.			
<i>T. khasiana</i> J.D. Hook	--	--	+
<i>Vanda</i> Lindl.			
<i>V. jainii</i> A.S. Chauhan	--	--	+
<i>V. stangeana</i> Reich.f.	--	--	+

* Kumar & Manilal (1994); Jalal & Jayanthi (2012)

(--)= absent/ not reported , (+)= present

The Eastern Ghats of India, a long chain of broken hills and Crystalline metamorphic rocks, include a line of mountain ranges running from north-east to south-west in parallel ridges; altitude ranges from a few meters to 1750 m. The Eastern Ghats spread mainly through three states, viz. Odissa (three districts), Andhra Pradesh (14 districts) and Tamil Nadu (seven districts). In Andhra Pradesh, the Eastern Ghats run as a chain with an interruption between Godavari and Krishna deltas and in parallel ridges in remaining districts (Subba Rao, 2005). Ephemeral rivers such as Nagavali, Vamsadhara and Sarada have their origin in Eastern Ghats. Relicts of ancient mountains such as Nallamalai, Veligonda, Palakonda in the middle and the Shevroys and Pachamalais in the south belong to Eastern Ghats (Kumar & Manilal, 1994).

MEASURES FOR ORCHID CONSERVATION :

National parks, Wildlife sanctuaries, Biosphere reserves have been established for *insitu* conservation of orchids. These protected areas which are ultimate repositories of biological diversities in natural habit play important role in *insitu* conservation of orchids. In

north western Himalayas about 52 wildlife sanctuaries, 12 National parks and some biosphere reserves. The orchids of these protected areas are conserved. In India particularly Uttarakhand, Himachal Pradesh and Jammu and Kashmir are the best States for orchid conservation (De & Medhi, 2014).

The most effective method of orchid conservation is *in situ* methods. Establishment of Gene Banks, Orchidaria, Botanic gardens. In northern India some of the Botanic gardens established in universities especially orchid center at Department of Botany, Punjab University Chandigarh by Prof. Promila Pathak. Multiplication of orchid by tissue culture methods in Punjab University orchid center (Hossain et al., 2009; Pathak and Vij 2017). BSI also maintained germplasm of orchids.

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