J. Orchid Soc. India, 27 (1-2): 53-60, 2013 ISSN 0971-5371

PHENOLOGY, DISTRIBUTION PATTERN, ENDEMISM, AND PHYTO-GEOGRAPHIC AFFINITIES OF THE GENUS *ERIA* LINDL. (ORCHIDACEAE) IN INDIA

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Abstract

Present communication deals with the information on flowering and fruiting time, distribution pattern, endemism and phyto-geographic affinities of 60 taxa (57 species and 3 varieties) of genus *Eria* Lindl. (Orchidaceae), in India.

Introduction

ERIA LINDL. is one of the largest and polymorphous genus of Orchidaceae with about 370 taxa (Mabberley, 2008), have considerable amount of heterogeneity amongst the infra-generic taxa. The genus is uniquely characterized by having free lateral sepals, glabrous leaves and sheaths, and 8 pollinia in two groups of four, joined together by their caudicles to a common elastic, viscid substance. A total of 60 taxa (57 species, 3 varieties) were recognized from India as a result of revisionary studies on the genus *Eria* for the modern Flora of India (Agrawala, 2009). Due to high heterogeneity prevailing within this genus, it has been divided into several sections in putting species with similar set of characters together. Indian species of *Eria* fit into 13 such sections namely *Eria* Lindl., *Bambusifolia* Hook.f., *Conchidium* Lindl., *Cylindrolobus* Blume, *Dendrolirium* Blume, *Hymenaria* Lindl., *Myceranthes* Rchb.f., *Pinalia* Lindl., *Secundae* Leavitt, *Strongyleria* Pfitz., *Trichosma* Lindl., *Tylostylis* Lindl., and *Xiphosium* Lindl.

Present communication is aimed to provide details of flowering and fruiting time, distribution pattern, endemism and phyto-geographic affinities among all species of *Eria* found in India. The presented information is compiled from study of large number of live as well as herbarium specimens (including type specimens), available literature, field study across the country and the floristic and monographic work from neighboring countries available on the genus *Eria*.

Phenology

Phenology or the flowering and fruiting period of a plant is controlled by its genetic factors and thus, most of the species have definite flowering and fruiting seasons. Most of the orchids flower once in a year, so also the members of the genus *Eria*. Sometimes, different populations of the same species growing in different phyto-geographical regions may have different flowering times. The mid-point of the extreme recorded dates of flowering of a particular species is considered as its mean flowering time. The environmental factors like photoperiod, sunlight, temperature, altitude, *etc.* play significant role in inducing flowering in plants.

During the present study, three distinct flowering seasons were observed, the predominant being the monsoon season (June-September), followed by pre-monsoon (March-May) and post-monsoon (October-February) seasons. In the pre-monsoon season, with the onset of spring season in March, there is rise in atmospheric temperature and increase in the day-length, which breaks the vegetative dormancy of the plants set in winter and induces flowering in many species. Some species under the sections *Dendrolirium, Conchidium, Strongyleria, Secundae* and *Hymenaria* flower during this season. Flowering in dry season is ideal for pollination due to better visibility and higher activity of the pollinators during this period. Most of species in the genus generally occur in the areas which receive the monsoon rain during June to September. Species under the section *Pinalia* and *Hymenaria* and some species of section *Conchidium* flower during this period. Species belonging to the sections *Bambusifolia, Cylindrolobus, Trichosma, Xiphosium* and some members of *Conchidium*, flower after the monsoon period is over and winter season sets in.

Flowers are arranged in racemes in the genus *Eria* and generally open in ascending order (acropetal) *i.e.*, the basal flowers in an inflorescence mature and open first, followed by the apical ones. However, in some species of the section *Cylindrolobus*, the apical flowers mature and open first. In majority of summer and winter flowering species, flowers appear on the plants with fully formed pseudobulbs and leaves. Whereas, in some

Received: April 23, 2013; Accepted September 5, 2013

species like *Eria extinctoria* and *Eria exilis,* flowers develop after falling of leaves and before development of new shoots. In the monsoon flowering species, flowers develop simultaneously with the development of leaves and pseudobulbs. In most of the species, the flowering period is short. The flowers take one to two wks to completely open and remain fresh for another one to two wks. Fruits are developed after the fertilization, which depends on the success of the pollinator in dropping the pollinia brought from the compatible counterpart. In the genus *Eria*, development of the fruit is initiated after one or two wks of full bloom. Fruits generally take one to several months to mature and dehisce. Table 1 shows the flowering and fruiting period observed in different species of the genus *Eria* in India.

Distribution Pattern

The genus *Eria* is an old world genus and is mainly distributed from tropical Asia to Indo-Pacific where it spreads from the Himalayas, Indian Penninsula, Sri Lanka to China, Myanmar, Japan, and SouthEast Asian countries to Pacific Islands, Australia and New Zealand.

Table 1. Species of the genus *Eria,* in India with their flowering and fruiting period.

Species	Flowering	Fruiting
Eria acervata Lindl.	June - August	July- October
E. alba Lindl.	April - August	July - September
E. albiflora Rolfe	July - September	-
E. amica Rchb.f.	February – June	May – October
E. andamanica Hook.f.	February – June	June – August
E. arunachalensis A. N. Rao	March - April	-
E. bambusifolia Lindl.	October - January	February onwards
E. biflora Griff.	September – November	November - February
E. bipunctata Lindl.	July – September	October - December
E. bractescens Lindl.	February – June	July onwards
E. bractescens var. *affinis* (Griff.) Hook.f.	May - June	June - July
E. bractescens var. *kurzii* Hook.f.	March - May	June - August
E. braccata (Lindl.) Lindl.	July - October	September - December
E. carinata Gibson ex Lindl.	November - January	February onwards
E. clausa King & Pantl.	February – March	April - May
E. clavicaulis Wall. ex Lindl.	July - October	-
E. corneri Rchb.f.	August - September	October
E. connata J. Joseph *et al.*	July - August	August - September
E. coronaria (Lindl.) Rchb.f.	October – February	February - May
E. crassicaulis Hook.f.	October - December	-
E. cristata Rolfe	February - March	-
E. discolor Lindl.	February – June	May - July
E. excavata Lindl.	June - July	August- October
E. exilis Hook.f.	October - January	December - March
E. extinctoria (Lindl.) Oliv.	March - April	May - June
E. ferruginea Lindl.	April - June	July - September
E. filiformis (Wight) Rchb.f.	July - September	September- November
E. glandulifera Deori & Phukan	March - April	-
E. globulifera Seidenf.	July - August	-

Table 1. Species of the genus *Eria*, in India with their flowering and fruiting period (contd.).

Species	Flowering	Fruiting
E. graminifolia Lindl.	June - August	August- October
E. javanica (Sw.) Blume	July - September	October- December
E. hegdei Agrawala & H.J. Chowdhery	March - April	-
E. kamlangensis A.N. Rao	July - August	-
E. lacei Summerh.	March – April	-
E. lasiopetala (Willd.) Ormerod	January – April	April - August
E. lohitensis A.N. Rao *et al.*	May – June	-
E. meghasaniensis (S.Misra) S.Misra	September – October	October - March
E. microchilos (Dalzell) Lindl.	July - October	September- November
E. muscicola (Lindl.) Lindl.	June - August	August - October
E. mysorensis Lindl.	July - November	August - February
E. nana A. Rich.	July - November	September - January
E. nana var. *brevilinguis* (J. Joseph & Chandras.) Agrawala & H.J. Chowdhery	July – October	September - November
E. obesa Lindl.	February - March	April - May
E. occidentalis Seidenf.	July - August	August - September
E. paniculata Lindl.	January - May	June - December
E. pannea Lindl.	April - June	July - September
E. pauciflora Wight	July - September	October - December
E. polystachya A. Rich.	July – November	November - February
E. pseudoclavicaulis Blatt.	August – September	-
E. pudica Ridl.	May - July	August - September
E. pulchella Lindl.	February – March	-
E. pumila Lindl.	July - January	August - March
E. pusilla (Griff.) Lindl.	September – December	October - May
E. reticosa Wight	May – October	August - December
E. sharmae H.J. Chowdhery *et al.*	February - March	April - May
E. spicata (D.Don) Hand.-Mazz.	July - September	October - December
E. stricta Lindl.	November - February	February - April
E. sutepensis Rolfe ex Downie	June – August	-
E. tomentosa (Koenig.) J.D. Hook.	April - July	June onwards
E. vittata Lindl.	December - March	March - May

In India, it is widely distributed throughout the country except in the states of Jammu and Kashmir, Punjab, Haryana, Rajasthan, Delhi and Union Territories like Lakshadweep, Dadra and Nagar Haveli, Pondicherry and Chandigarh. North West Himalaya at Himachal Pradesh is the western global limit of this genus. Distribution of this genus in India ranges from the hot humid coastal rain forests to the high Himalayan temperate forests. The highest diversity of the genus is found in the Himalayan region having favorable climatic condition for the growth of epiphytes. Out of the 11 phyto-geographical regions recognized in India (Chowdhery and Murti, 2000), Eastern Himalaya and NorthEast India harbours maximum number of taxa (36 and 32 respectively), followed by Western Ghats (13 taxa), Western Himalaya (9 taxa), Andaman and Nicobar

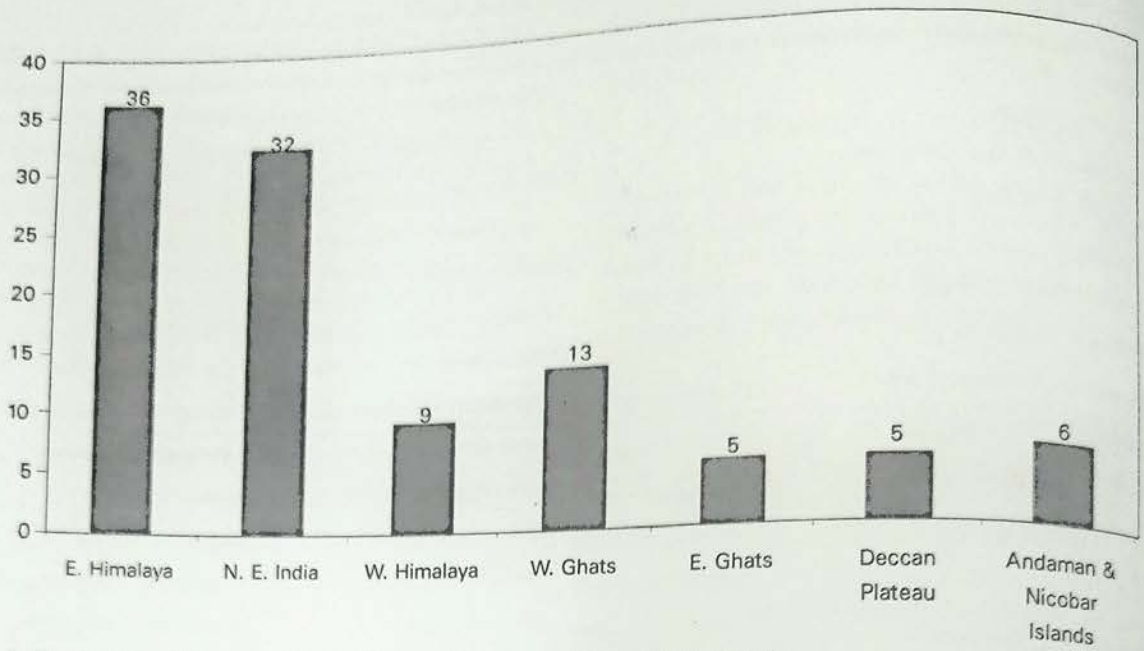

Fig. 1. Distribution of the genus *Eria* in different phyto-geographical regions of India.

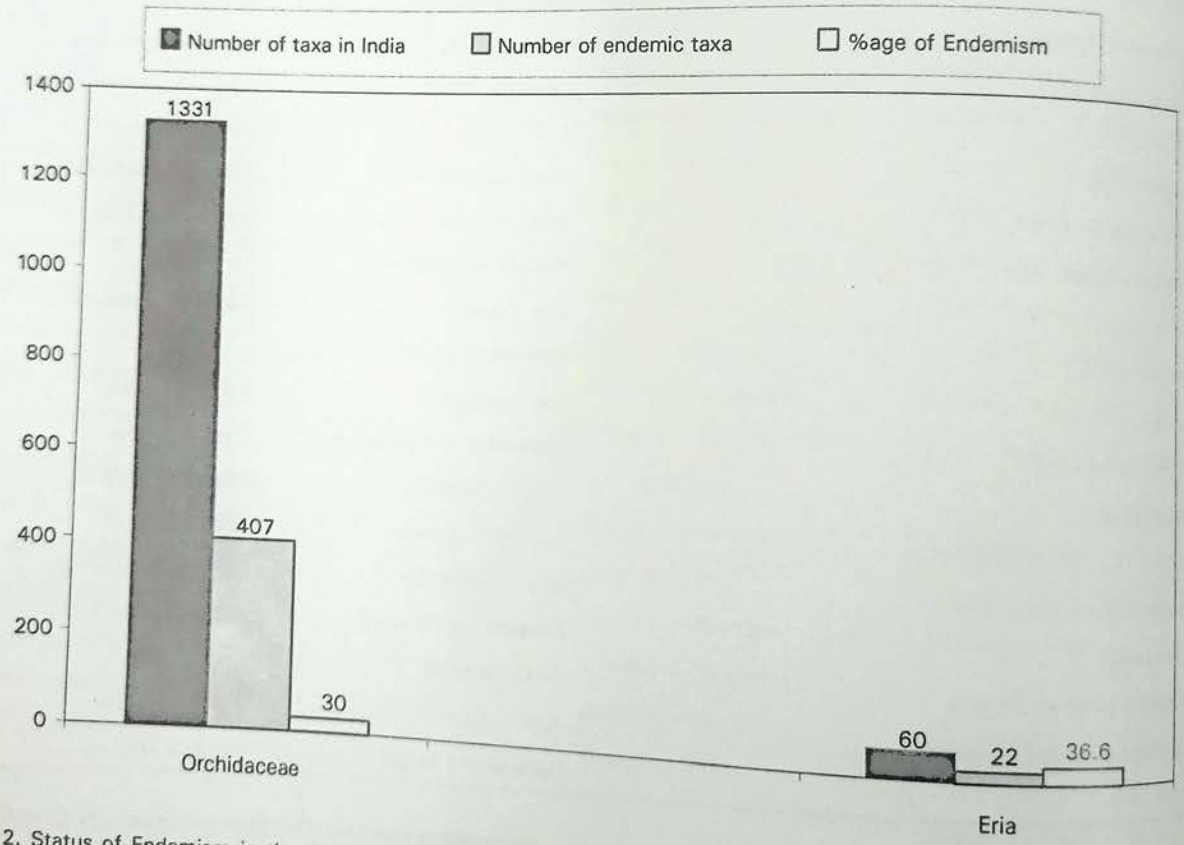

Fig. 2. Status of Endemism in the family Orchidaceae and the genus *Eria* in India.

Islands (6 taxa) and Deccan Plateau and Eastern Ghats (5 taxa each) (Fig. 1).

The orchid species diversity in the Himalayan region decreases gradually from the moist, humid Eastern Himalaya to cold, arid Western Himalaya. For the genus *Eria*, Himachal Pradesh is the westernmost limit of its global distribution. The altitudinal distribution of the genus ranges from the coastal mangrove forests of Andaman and Nicobar Islands at sea level up to 2500 m in the temperate forests of the Himalayas. There is no report of specific requirement for altitude

Table 2. Endemic taxa of genus *Eria* and their distribution in India.

Name of the endemic taxa	Distribution
Eria albiflora Rolfe	Tamil Nadu, Karnataka
E. andamanica Hook.f.	Andaman and Nicobar Islands
E. arunachalensis A. N. Rao	Arunachal Pradesh
E. bractescens var. *kurzii* Hook.f.	Andaman and Nicobar Islands
E. crassicaulis Hook.f.	Meghalaya, Sikkim
E. filiformis (Wight) Rchb.f.	Kerala, Tamil Nadu, Karnataka, Maharashtra, Goa, Gujarat
E. exilis Hook.f.	Kerala, Karnataka, Maharashtra
E. glandulifera Deori & Phukan	Meghalaya, Arunachal Pradesh
E. hegdei Agrawala & H. J. Chowdhery	Arunachal Pradesh
E. kamlangensis A. N. Rao	Arunachal Pradesh
E. lohitensis Haridasan *et al.*	Arunachal Pradesh
E. meghasaniensis (S. Misra) S. Misra	Orissa
E. microchilus (Dalzell) Lindl.	Kerala, Karnataka, Tamil Nadu, Maharashtra, Goa
E. mysorensis Lindl.	Tamil Nadu, Karnataka, Maharashtra
E. nana A. Rich.	Kerala, Tamil Nadu, Karnataka
E. nana var. *brevilinguis* (Joseph & Chandrasek.) Agrawala & H. J. Chowdhery	Kerala, Tamil Nadu
E. occidentalis Seidenf.	Uttarakhand
E. pauciflora Wight	Kerala, Tamil Nadu, Karnataka
E. polystachya A. Rich.	Kerala, Tamil Nadu, Karnataka, Maharashtra
E. pseudoclavicaulis Blatt.	Kerala, Tamil Nadu
E. reticosa Wight	Kerala, Karnataka, Tamil Nadu, Maharashtra, Uttarakhand
E. sharmae H. J. Chowdhery *et al.*	Arunachal Pradesh

by any species of the genus however, maximum number of species occurs between 500 to 1500 m altitude. *Eria lasiopetala* (Willd.) Ormerod, *E. bractescens* Lindl. and *E. muscicola* (Lindl.) Lindl. are the most widely spread species whereas, many of the recently and some of earlier described species are known from one or two localities only.

Endemism

Endemism denotes confinement of biological taxa to a restricted area which may range from a small habitat to a bio-geographical region, usually isolated by geographical or temporal barriers. The diverse climatic and habitat conditions in India provide favorable conditions for speciation and endemism. In the present study, 22 taxa (36.6%) in the genus were found endemic (Table 2). Apart from these, there are certain species which have very narrow range of distribution and confined to one or two localities outside India. Percentage of endemism in the genus *Eria* is higher as compared to the entire Orchidaceae family (Fig. 2). The high degree of endemism in the genus may be attributed to its highly specific climatic and habitat requirements. Peninsular region has the highest concentration of endemic species as compared to rest of the country. Western Ghats (84.6%) has the maximum percentage of endemism followed by the Eastern Ghats (60%) and Deccan Plateau (60%) while the Himalayan and NorthEast Indian region despite having much higher species diversity have very low percentage of endemism [Western Himalaya (22.2%); Eastern Himalaya (16.6%); NorthEast India (6.2%)], which may be due to the constant intermixing of the species from the adjoining countries like Nepal, Bhutan, Bangladesh, Myanmar, China, Thailand, Indo-China and

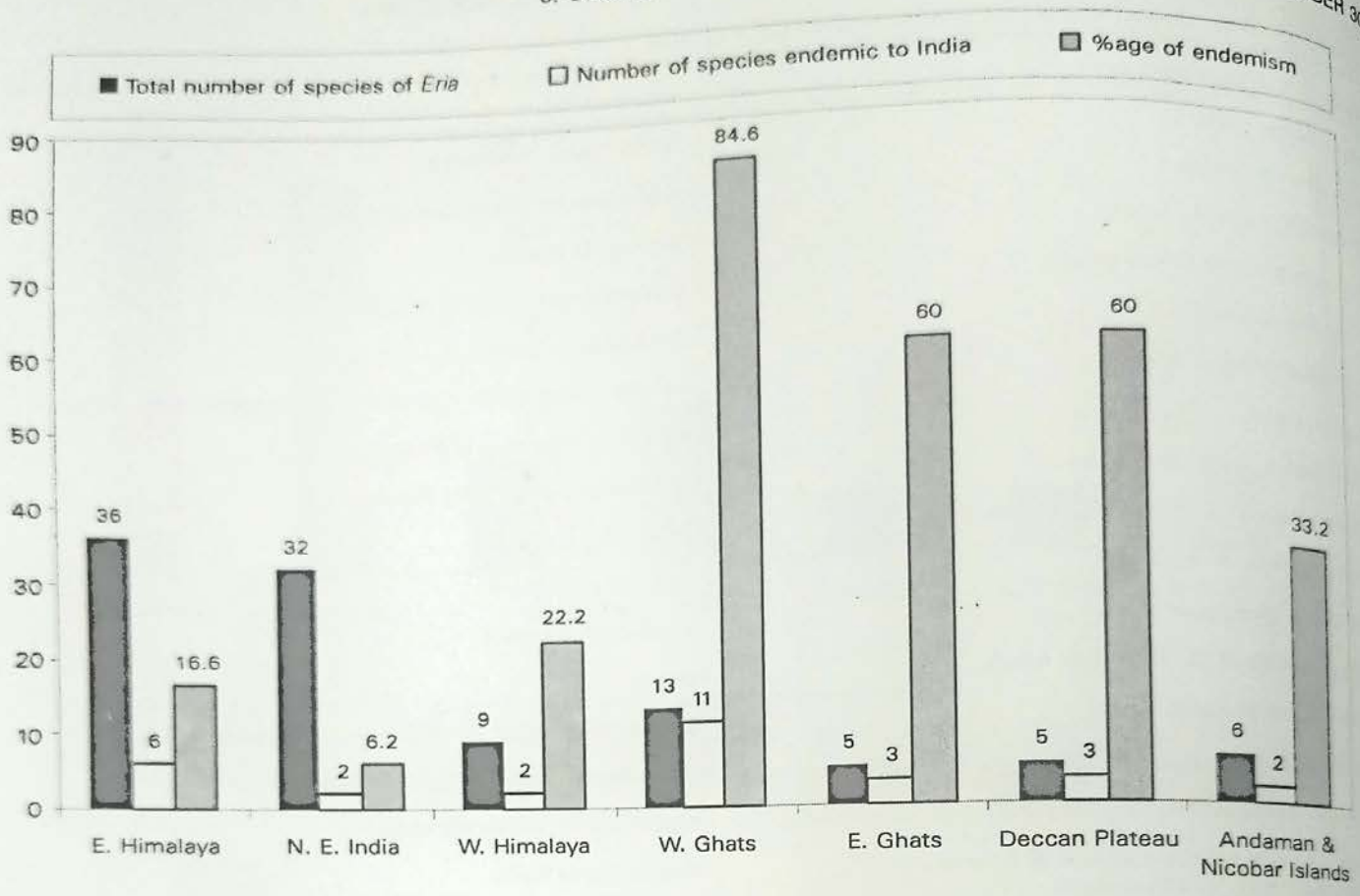

Fig. 3. Endemism in the genus *Eria* in different phyto-geographical regions of India.

Malaysia. Andaman and Nicobar Islands too have less degree of endemism (33.2%) due to the constant migration and mixing of elements from Myanmar, Thailand and Malaysia (Fig. 3). When the total number of endemic taxa of *Eria* in India is compared with the number of endemic taxa in different phyto-geographical

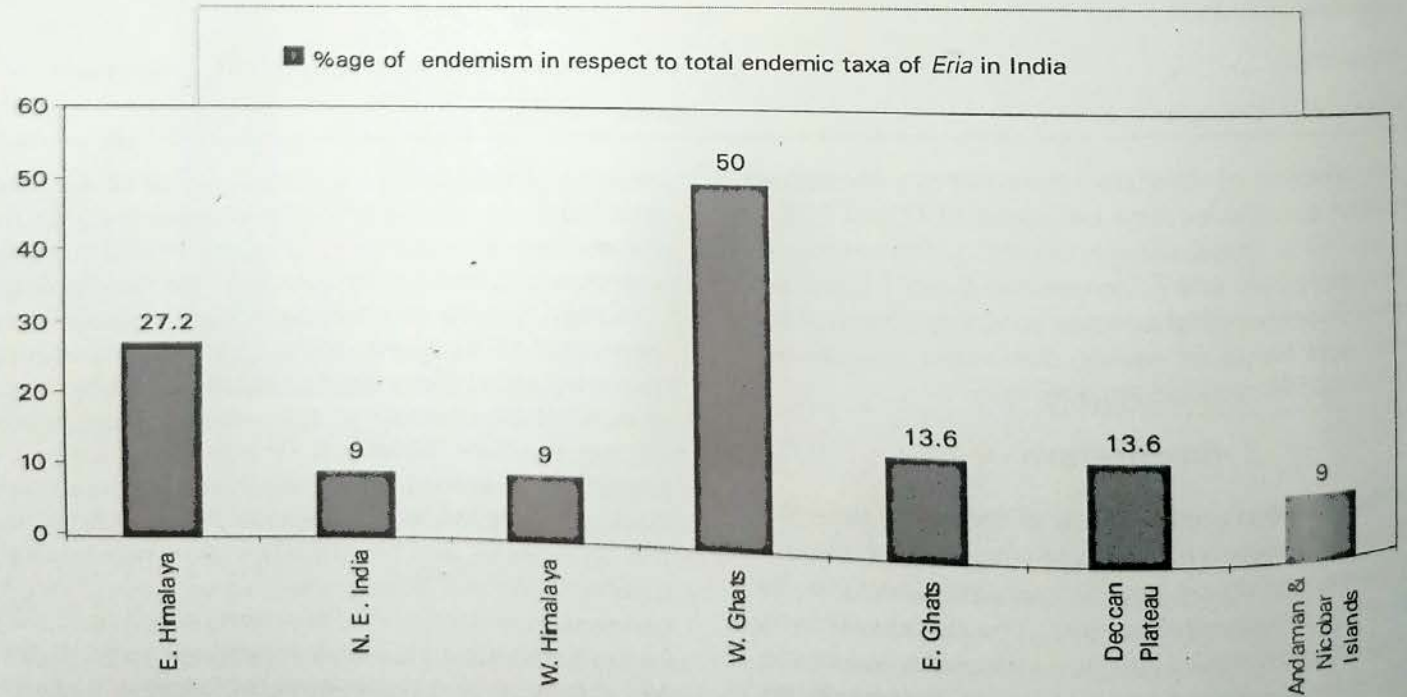

Fig. 4. Degree of endemism within the genus *Eria* in different phyto-geographical regions of India.

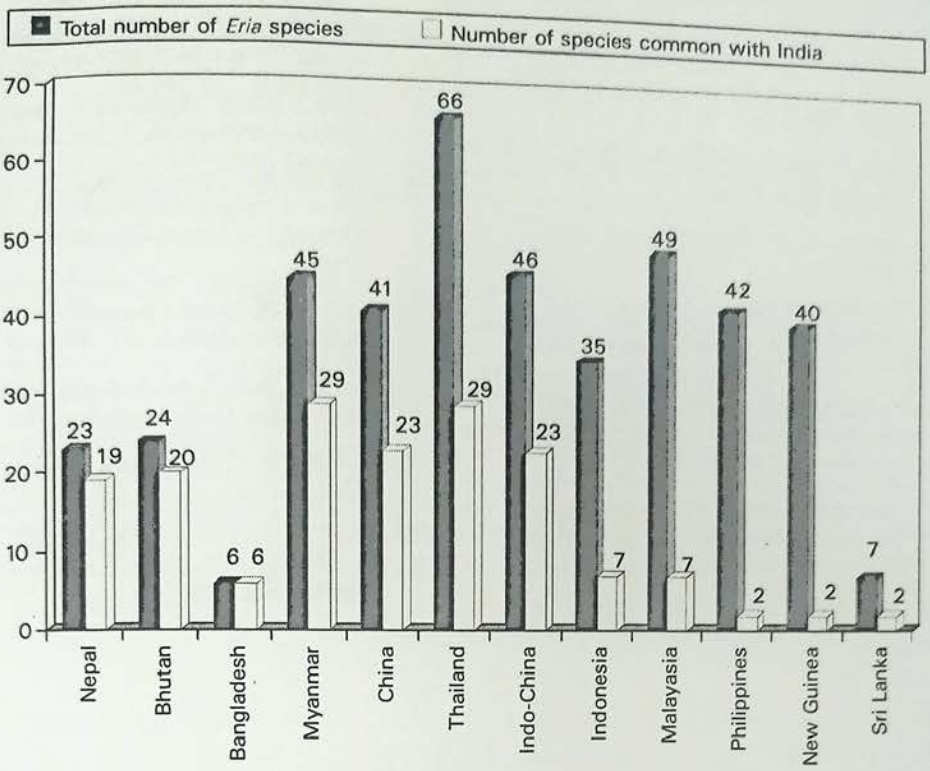

Fig. 5. Number of *Eria* species occurring in India, which are common with other countries.

regions, it is observed that Western Ghats have the maximum representative (50%) of endemic elements, followed by Eastern Himalaya (27.2%), Eastern Ghats (13.6%), Deccan Plateau (13.6%), NorthEast India, Western Himalaya and Andaman and Nicobar Islands (9% each) (Fig.4).

Phytogeographical Affinities

In spite of the richness and great diversity of Indian Flora, J. D. Hooker (1904) was of the opinion that the Indian flora is a mixture of floras of the surrounding countries like Malaysia, Thailand, Tibet, China, Japan and Africa. Study of various Floras and taxonomic accounts of the neighboring countries [Bajracharya (2001), Banerji (1982), Comber (1990), Huda (2007), Jayaweera (1981), Kress *et al.*, (2003), Leavitt (1909), Pearce and Cribb (2002), Schlechter (1912), Seidenfaden (1982, 1992), Seidenfaden and Wood (1992)] revealed that many species of the genus *Eria* are common with neighboring countries. It is because the Himalayan region is a continuous bio-geographical zone, which extends from Afghanistan, through Pakistan, India, Nepal, Bhutan, China and culminates in Myanmar, their flora exhibit close relationship. Thus, many of the Indian Himalayan species show close affinity with the species occurring in Nepal, Bhutan, China, Tibet and Myanmar, whereas the North-East Indian species are closely related to the Myanmar, Bangladesh, Thailand, Malaysian elements (Fig. 5). Western Himalaya (Himachal Pradesh) is the westernmost limit of the global distribution of the genus and prevents its westward migration. Despite the high degree of endemism in Peninsular India, its species are closely related with those from Sri Lanka. The flora of Andaman Islands show close affinity to the flora of Myanmar, Indo-China, Thailand and Malaysia whereas Nicobar Islands flora has closer links with that of Eastern and Southern territories of Malaysia, Indonesia and Pacific Islands due to similarity in habitats.

Acknowledgement

The authors are thankful to the Director, Botanical Survey of India, Kolkata and the Scientist-in-charge, Botanical Survey of India, Gangtok for facilities and encouragements. Financial assistance from Government of India, Ministry of Environment and Forests, New Delhi is also thankfully acknowledged.

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