

Current status and distribution of mycoheterotrophic Orchids of India^a

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Abstract

The present study enumerates a total of 40 species belonging to 18 genera. Of these 12 are endemic to India. The genera *Gastrodia* and *Neottia* have the greatest number of species. The greatest diversity of mycoheterotrophic orchids is found in eastern and western Himalayas. They are distributed mainly in the sub-tropical and warm temperate zones of India. The present paper is an attempt to provide up-to-date information on mycoheterotrophic orchids in respect to their diversity, distribution in different floristic regions, different eco-climatic regions and their status.

Résumé

Statut actuel et distribution géographique des orchidées mycohétérotrophiques en Inde – La présente étude énumère quarante espèces d'orchidées mycohétérotrophiques, appartenant à dix-huit genres. Parmi ces derniers, douze sont endémiques d'Inde. Les genres *Gastrodia* et *Neottia* comptent le plus grand nombre d'espèces. On trouve la diversité en orchidées mycohétérotrophiques la plus importante dans l'Himalaya oriental et l'Himalaya occidental. Elles sont essentiellement distribuées dans les zones sub-tropicales et tempérées chaudes. Nous souhaitons ici fournir des informations actualisées sur ces orchidées en matière de diversité, de distribution dans les différentes régions floristiques et selon les différentes régions éco-climatiques, et de statut.

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Introduction

Orchidaceae is one of the largest flowering plant families in India having 1,331 species in 184 genera (Misra, 2007) and contributes almost 7.6 % of the flowering plants of India. They exhibit a highly specialized floral structure, an advanced pollination mechanism, an unique partnership with mycorrhiza, and microscopic seeds that lack reserve food material (Arditti & Ghani, 2000). For germination and continued growth, orchids require the presence of a compatible fungal partner (Peterson *et al.*, 1998). The mycorrhizal fungi provide major nutrients such as carbon and nitrogen (Smith & Read, 1997). The mycorrhiza is retained throughout the life of some achlorophyllous terrestrial orchids. This completely fungus-dependent life of orchids referred to as the mycoheterotrophic mode of growth (Leake, 1994; Merckx, 2013).

India, with its diverse climatic and topographic conditions, is one of the major orchid habitats of the world. A very large variety of beautiful orchids exhibiting terrestrial, epiphytic and mycoheterotrophic habits are found abundantly in our forests. The mycoheterotrophic orchids are unique due to the specific set of habitat conditions and intricate association with the specific fungus in a delicately balanced ecosystem. They are usually, but incorrectly described as 'saprophytic' orchids (Leake, 1994). These plants are unlike the common orchids: they do not produce chlorophylls and can therefore not photosynthesise. As a result they completely depend on fungi throughout the life to obtain carbohydrates. In undisturbed primary forests, the decaying leaf litters constitute the topsoil, which is very light and rich in nutrients. Most of orchids prefer to grow in such habitats. They grow in soil rich in decaying organic substances and derive their nutrients from the soil through a mycoheterotrophic interaction with a symbiotic fungus. Most of the mycoheterotrophic orchids are rather small plants, and therefore not easy to detect. However, a few are quite large, especially the *Erythrorchis* and *Galeola* species, which can be 2 to 4 m tall, and sometimes even taller. They are mostly confined to the primary forests and high rainfall areas of the eastern Himalayas of India. In India Bose & Bhattacharjee (1980) described 25 species of mycoheterotrophic orchids in a total of 11 genera. In 1994, Kumar & Manilal recorded 38 species in 16 genera, in 2000, Karthikeyan recorded 35 species in 18 genera, and Singh *et al.* (2001) listed 46 species in 18 genera. The latest count, published by Misra in 2007 was 42 mycoheterotrophic species in 18 genera.

The present paper deals with a new enumeration of these orchids based on the earlier reports and extensive field surveys. An attempt was also made to update the knowledge about diversity, correct designation, and distribution within the different floristic regions of India. Also, the present status and conservation issues are discussed.

Materials and methods

India lies between 8 and 37°N latitude and between 68 and 97°E longitude. It covers an area of 3,287,800 square kilometres. To the south, the east, and the west, it is bordered by oceans. Its northern side is part of the Himalaya. The Indian climate is mainly influenced by the oceans and the Himalaya. In the southern and the far eastern part of the country, the climate is typically tropical. In the north, the climate is temperate and very arid. The vegetation varies from tropical evergreen forests on the west coast and in the northeast to alpine forests in the Himalaya in the north (Champion & Seth, 1968). Overall, 692,027 square kilometres (21 % of the total area of India) are covered by forests (FSI, 2011). According to Chatterjee (1939), India can be divided into the following floristic regions: Western Himalaya, Eastern Himalaya, Indus plains, Gangetic plains, Central India, Western Ghats (Malabar), Deccan Plateau, Assam and the Andaman & Nicobar Islands (Fig. 1).

Different floristic regions were surveyed during 2001-2012. The following field data were collected: habitat type, flowering time, altitude at which the plants grow. In some cases, herbarium specimens were collected, but in general we resorted to taking in situ photographs. Data was also taken from the available literature: Hooker, 1888-1890; King & Pantling, 1898; Duthie, 1906; Santapau & Kapadia, 1966; Pradhan, 1976 & 1979; Bose & Bhattacharjee, 1980; Deva & Naithani, 1986; Katakai, 1986; Kumar & Manilal, 1994; Chowdhery, 1998; Hynniewta *et al.*, 2000; Pearce & Cribb, 2002; Diwakar & Pandey, 2005; Misra, 2004 & 2007; Das & Khumbongmayum 2006; Jayanthi *et al.* 2006; Kumar *et al.* 2008; Seidenfaden, 2008; Govaerts *et al.* 2012.

Furthermore, herbarium materials from CAL, DD, BSD, BSI, BLAT, PBL and WII were examined during visits in these herbaria.

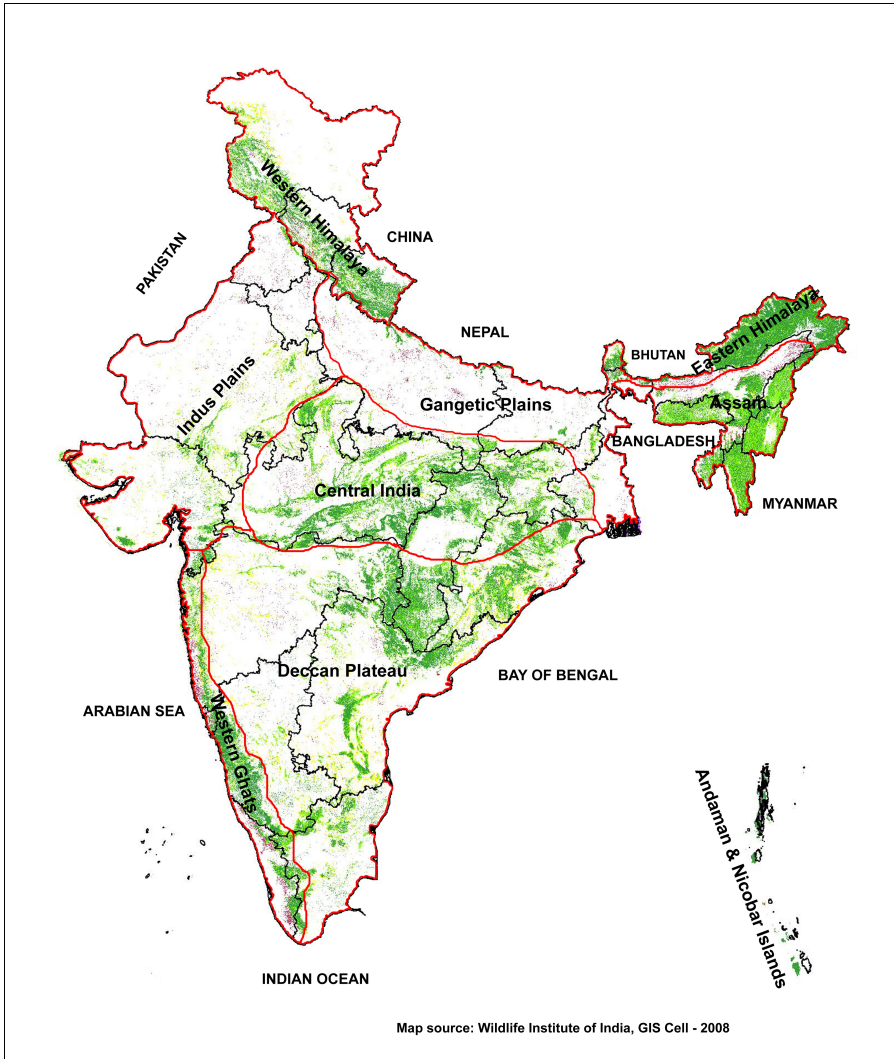


Fig. 1: Map of India showing the different floristic regions

Results and discussion

The present study shows a total of 40 species (Table 1, Plate 1). The difference in species as compared to the counts made by previous authors is due to the fact, that in the course of nomenclatural updates, some species have been merged with others and have thus been reduced to synonyms.

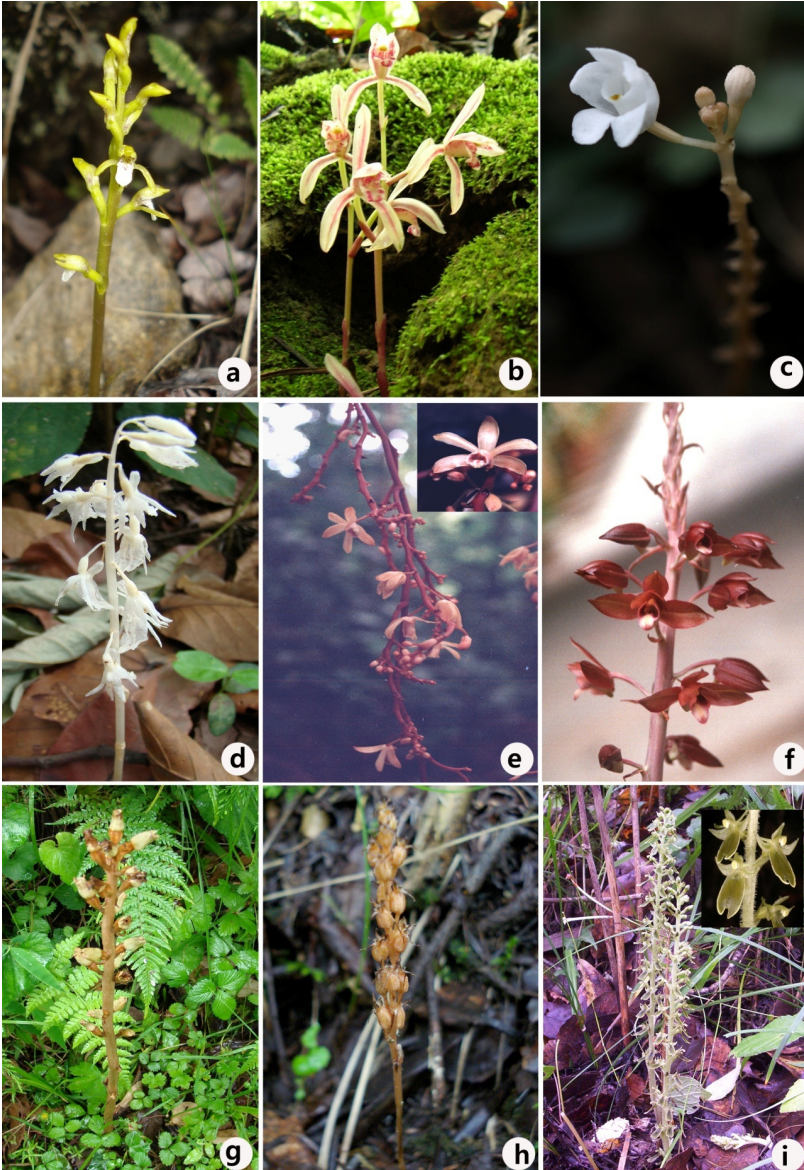


Plate 1: (a) *Corallorhiza trifida*, (b) *Cymbidium macrorhizon*, (c) *Didymoplexis pallens*, (d) *Epipogium roseum*, (e) *Erythrorchis altissima*, (f) *Eulophia zollingeri*, (g) *Gastrodia falconeri*, (h) *Neottia acuminata*, (i) *Neottia listeroides*

S.N.	Species	Distribution in floristic regions / eco-climatic regions and altitude / flowering time / status
1	Aphyllorchis alpina King & Pantl.	Eastern Himalaya: Sikkim and Arunachal Pradesh/warm temperate to alpine regions between 2,000 m and 3,900/ August/Rare
2	Aphyllorchis gollanii Duthie	Western Himalaya: Uttarakhand/cool temperate region at altitude 2,700 m/August/Rare
3	Aphyllorchis montana Rchb.f. <i>Aphyllorchis prainii</i> Hook.f.	Eastern Himalaya: Sikkim; Western Ghats: Kerala; Deccan Plateau: Andhra Pradesh/tropical to cool temperate regions between 600 m and 2,800 m altitude/June-September/Locally frequent
4	Chamaegastrodia asraoa (J. Joseph & Abbar.) Seidenf. & A.N.Rao <i>Evvardia asraoa</i> J. Joseph & Abbar. <i>Evvardianthe asraoa</i> (J. Joseph & Abbar.) C.S.Kumar	Eastern Himalaya: Meghalaya/subtropical region at altitude 1,500 m/August-September/Rare
5	Chamaegastrodia shikokiana Makino & F. Maek.	Eastern Himalaya: Arunachal Pradesh/tropical and subtropical regions between 500 m and 1,000 m/May-June/Rare
6	Chamaegastrodia vaginata (Hook.f.) Seidenf. <i>Aphyllorchis vaginata</i> Hook.f.	Eastern Himalaya: Arunachal Pradesh/subtropical region at altitude 1,500 m/June/Rare
7	Corallorhiza trifida Chatel. <i>Corallorhiza anandae</i> Malhotra & Balodi	Western Himalaya: Uttarakhand/sub-alpine region between 3,000 m and 3,500 m/May-August/Rare
8	Crepidium aphyllum (King & Pantl.) A.N.Rao <i>Microstylis aphylla</i> King & Pantl.	Eastern Himalaya: Sikkim and Arunachal Pradesh/tropical region between 200 m and 500 m/June-July/Rare. Endemic

Table 1: List of the mycoheterotrophic orchids of India

with valid current name in bold, basionym (if any) and/or synonyms (if any) in italics

9	Crepidium saprophytum (King & Pantl.) A.N.Rao <i>Microstylis saprophyta</i> King & Pantl.	Eastern Himalaya: Sikkim/subtropical region at altitude 1,200 m/July/Rare. Endemic
10	Cymbidium macrorhizon Lindl. <i>Cymbidiopsis macrorhiza</i> (Lindl.) H.J. Chowdhery	Western Himalaya: Himachal Pradesh and Uttarakhand; Eastern Himalaya: Sikkim and Arunachal Pradesh; Assam: Meghalaya, Nagaland and Mizoram; Central India: Madhya Pradesh; Gangetic plains: Utter Pradesh and West Bengal/tropical to warm temperate regions between 600 m and 2,000 m/May-August/Locally frequent
11	Cyrtosia javanica Blume <i>Galeola javanica</i> (Blume) Benth. & Hook.f.	Eastern Himalaya: Arunachal Pradesh/subtropical to warm temperate regions between 1,000 m and 2,000 m/June-August/Rare
12	Didymoplexis himalaica Schltr.	Eastern Himalaya: Sikkim/warm temperate region at altitude 2,000 m/June/Rare
13	Didymoplexis pallens Griff.	Eastern Himalaya: Sikkim and Arunachal Pradesh; Assam: Assam; Western Ghats: Maharashtra, Goa, Karnataka, Kerala and Tamil Nadu; Deccan Plateau: Andhra Pradesh and Odisha; Gangetic plains: West Bengal/tropical to warm temperate regions between 300 m and 2,000 m/May-July/ Locally frequent
14	Didymoplexis seidenfadenii C.S. Kumar & Ormerod	Western Ghats: Kerala/tropical region up to 500 m/March/Rare. Endemic
15	Epipogium aphyllum Sw.	Western Himalaya: Jammu & Kashmir, Himachal Pradesh and Uttarakhand; Eastern Himalaya: Sikkim/warm temperate to cool temperate regions between 2,500 m and 3,500 m/July-September/Rare

Table 1: continued

16	<p>Epipogium roseum (D.Don) Lindl. <i>Lindorum roseum</i> D.Don <i>Epipogium africanus</i> Schltr. <i>Epipogium sessanum</i> S.N.Hegde & A.N.Rao <i>Epipogium indicum</i> H.J.Chowdhery <i>et al.</i> <i>Epipogium tuberosum</i> Duthie</p>	<p>Western Himalaya: Jammu & Kashmir, Himachal Pradesh and Uttarakhand; Eastern Himalaya: Sikkim, Arunachal Pradesh; Assam: Nagaland; Western Ghats: Karnataka, Maharashtra, Kerala and Tamil Nadu/tropical to warm temperate regions between 200 m and 3,000 m/July-October/ Locally frequent</p>
17	<p>Erythrorchis altissima Blume <i>Galeola altissima</i> (Blume) Rchb.f. <i>Erythrorchis ochobiensis</i> (Hayata) Garay</p>	<p>Eastern Himalaya: Assam, Arunachal Pradesh; Andaman & Nicobar Islands: Great Nicobar/tropical region between 200 m and 600 m/February-March/Locally frequent</p>
18	<p>Eulophia zollingeri (Rchb.f.) J.J.Sm. <i>Cyrtopera zollingeri</i> Rchb.f. <i>Eulophia sanguinea</i> (Lindl.) Hook.f.</p>	<p>Eastern Himalaya: Sikkim, Arunachal Pradesh and Meghalaya; Andaman & Nicobar Islands: Andaman Islands/tropical and sub-tropical regions between 200 m and 1,000 m/April-May/Locally frequent</p>
19	<p>Galeola cathartii Hook.f.</p>	<p>Eastern Himalaya: Sikkim/warm temperate region between 1,600 m and 2,000 m/June/Rare</p>
20	<p>Galeola falconeri Hook.f.</p>	<p>Western Himalaya: Uttarakhand; Eastern Himalaya: Sikkim and Arunachal Pradesh/subtropical to warm temperate regions between 1,000 m and 2,000 m/July-August/Rare</p>
21	<p>Galeola lindleyana (Hook.f. & Thomson) Rchb.f. <i>Cyrtosia lindleyana</i> Hook.f. & Thomson</p>	<p>Eastern Himalaya: Sikkim, Arunachal Pradesh, Meghalaya, Nagaland and Manipur/warm temperate to alpine regions between 1,800 m and 3,500 m/June-July/Rare</p>
22	<p>Galeola nudifolia Lour.</p>	<p>Eastern Himalaya: Sikkim, Assam and Arunachal Pradesh/tropical region between 300 m and 500 m/April-May/Rare</p>

Table 1: continued

23	Gastrodia arunachalensis S.N.Hegde & A.N.Rao	Eastern Himalaya: Sikkim and Arunachal Pradesh/subtropical region at altitude 1,100 m/July–August/Rare. Endemic
24	Gastrodia dyeriana King & Pantl.	Eastern Himalaya: Sikkim/warm temperate region between 1,500 m and 2,200 m/August/Rare. Endemic
25	Gastrodia elata Blume	Eastern Himalaya: Sikkim/warm and cool temperate regions between 2,000 m and 3,300 m/August–September/Rare
26	Gastrodia exilis Hook.f.	Eastern Himalaya: Arunachal Pradesh; Western Ghats; Kerala/tropical region up to 100 m/September–November/Rare
27	Gastrodia falconeri D.L.Jones & M.A.Clem.	Western Himalaya: Jammu & Kashmir, Himachal Pradesh and Uttarakhnad/warm temperate to alpine regions between 2,000 m and 3,500 m/June–August/Rare
28	Gastrodia mishmensis A.N.Rao, Harid. & S.N.Hegde	Eastern Himalaya: Arunachal Pradesh/subtropical region up to 1500 m/August–September/Rare. Endemic
29	Gastrodia silentvalleyana C.S.Kumar et al.	Western Ghats: Kerala/tropical region up to 500 m/August/Rare. Endemic
30	Lecanorchis sikkimensis N.Pearce & P.J.Cribb	Eastern Himalaya: Sikkim/warm temperate region between 1,800 m and 2,000 m/May–June/Rare
31	Neottia acuminata Schltr. <i>Aphyllorchis parviflora</i> King & Pantl.	Western Himalaya: Uttarakhnad; Eastern Himalaya: Sikkim/warm temperate to alpine regions between 2,500 m and 3,500 m/June–September/Rare

Table 1: continued

32	Neottia inayati (Duthie) Schltr. <i>Listera inayati</i> Duthie <i>Listera kashmiriana</i> Duthie <i>Neottia kashmiriana</i> (Duthie) Schltr.	Western Himalaya: Jammu & Kashmir/warm temperate region at altitude 2,500 m/July/Rare. Endemic
33	Neottia listeroides Lindl. <i>Listera lindleyana</i> (Decne.) King & Pantl.	Western Himalaya- Jammu & Kashmir, Himachal Pradesh, Uttarakhand; Eastern Himalaya- Sikkim, Arunachal Pradesh/warm temperate to alpine regions between 2,000 m and 3,600 m/July-August/Locally frequent
34	Neottia mackinnonii Deva & H.B.Naithani	Western Himalaya: Uttarakhand/subtropical region between 800 to 1,500 m/August-September/Rare. Endemic
35	Neottia microglottis (Duthie) Schltr. <i>Listera microglottis</i> Duthie	Western Himalaya: Uttarakhand/warm temperate to cool temperate regions between 2,000 m and 2,400 m/August-September/Rare. Endemic
36	Neottia pantlingii (W.W.Sm.) Tang & F.T.Wang <i>Aphyllorchis pantlingii</i> W.W.Sm.	Eastern Himalaya: Sikkim/subalpine and alpine regions between 3,000 m and 3,700 m/August/Rare. Endemic
37	Risleya atropurpurea King & Pantl.	Eastern Himalaya: Sikkim/subalpine and alpine regions between 3,500 m and 4,200 m/June-July/Rare
38	Stereosandra javanica Blume	Eastern Himalaya: Arunachal Pradesh/tropical and subtropical regions between 200 to 800 m/May-June/Rare
39	Stigmatodactylus paradoxus (Prain) Schltr. <i>Pantlingia paradoxoxa</i> Prain	Eastern Himalaya: Sikkim/warm temperate region between 1,800 m and 2,000 m/September/Rare. Endemic
40	Yuania prainii King & Pantl.	Eastern Himalaya: Sikkim/warm temperate region at altitude 2,000 m/May-July/Rare

Table 1: continued

The list of mycoheterotrophic orchids is provided in alphabetical order. The current name is given followed by its basionym and synonyms if any. The table also provides information about the distribution in floristic regions of India, the flowering period, the altitude at which the plants were encountered and a statement about the status of the plant. This information is complemented by a map, a graph and photographs. Fig. 1 depicts the map of India showing the different floristic regions. Fig. 2 depicts a graphical representation of diversity of mycoheterotrophic orchids in the different floristic regions of India and Fig. 3 shows the distribution of mycoheterotrophic orchids in the various eco-climatic regions of India.

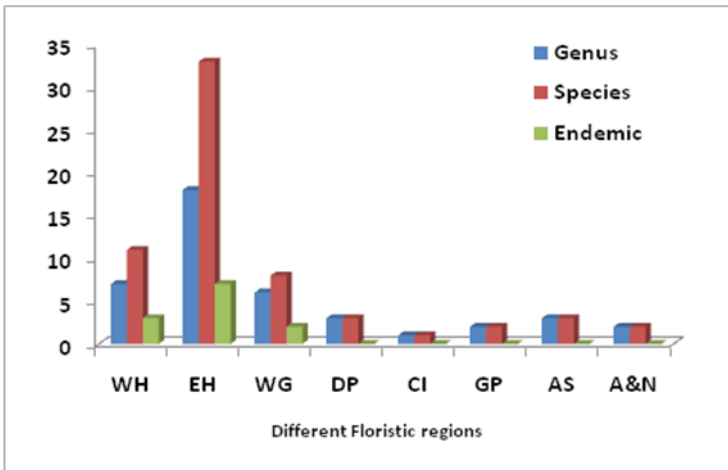


Fig. 2: Diversity of the mycoheterotrophic orchids in different floristic regions of India

WH- Western Himalaya, EH-Eastern Himalaya, WG- Western Ghats, DP- Deccan Plateau, CI- Central India, GP- Gangetic Plains, As- Assam, A&N- Andaman and Nicobar Islands

Mycoheterotrophic genera

These 40 species belong to 18 genera (Table 2) within the subfamilies *Epidendroideae*, *Neottioideae*, *Vanilloideae*, *Spiranθοideae* and *Vandoideae*. Twelve of these genera are endemic to India. Thirteen are true mycoheterotrophic (see Table 2) the rest of the genera being represented by both autotrophic and mycoheterotrophic species. Seven species belong within the genus *Gastrodia*. Six species belong in *Neottia*, four in *Galeola*.

Three species each are harboured within the genera *Aphyllorchis*, *Chamaegastrodia* and *Didymoplexis* whereas two species each are found for the genera *Crepidium* and *Epipogium*. One species each can be assigned to the genera *Corallorhiza*, *Cymbidium*, *Cyrtosia*, *Erythrorchis*, *Eulophia*, *Lecanorchis*, *Risleya*, *Stereosandra*, *Stigmatodactylus* and *Yoania*.

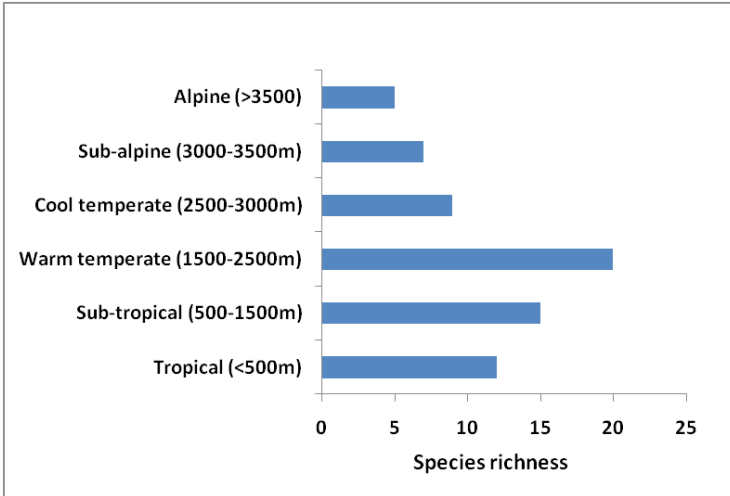


Fig. 3: Distribution of the mycoheterotrophic orchids in the different eco-climatic regions of India

Distribution in different Floristic regions

The distribution of the mycoheterotrophic orchids within the different floristic regions of India is shown in figure 2. Although present in all other regions of India, mycoheterotrophic orchids are apparently missing on the Indus plains. This may be due to the fact that the climate on those plains is very dry with rainfall being less than 70 cm per year. The largest number of these species is found in the Eastern (33 spp.) and Western Himalayas (11 spp.). In the Western Ghats there are eight species. The rainfall in both Himalayan regions averages 250 cm per year. The warm and humid climate of the tropical and sub-tropical valleys provides suitable habitat conditions for these orchids. Adequate amounts of water remain in the soil all year round and allows for active growth of the plants. The Gangetic plateau, Central India, Deccan Plateau, Assam and Andaman and Nicobar Islands have a very poor diversity of mycoheterotrophic orchids. Only two

species of mycoheterotrophic orchids have hitherto been reported from the Andaman and Nicobar Islands although the climate on these islands is warm and humid. However, one must take into account that these islands, with their difficult terrain, are very inaccessible and have not yet been sufficiently explored.

S. N.	Name of genera	Habit	No. of species
1	Aphyllorchis	True mycoheterotrophic	3
2	Chamaegastrodia	True mycoheterotrophic	3
3	Corallorhiza	True mycoheterotrophic	1
4	Crepidium	Mycoheterotrophic & autotrophic	2
5	Cymbidium	Mycoheterotrophic & autotrophic	1
6	Cyrtosia	True mycoheterotrophic	1
7	Didymoplexis	True mycoheterotrophic	3
8	Epipogium	True mycoheterotrophic	2
9	Erythrorchis	True mycoheterotrophic	1
10	Eulophia	Mycoheterotrophic & autotrophic	1
11	Galeola	True mycoheterotrophic	4
12	Gastrodia	True mycoheterotrophic	7
13	Lecanorchis	True mycoheterotrophic	1
14	Neottia	Mycoheterotrophic & autotrophic	6
15	Risleya	True mycoheterotrophic	1
16	Stereosandra	Mycoheterotrophic & autotrophic	1
17	Stigmatodactylus	True mycoheterotrophic	1
18	Yoania	True mycoheterotrophic	1

Table 2: List of the mycoheterotrophic orchid genera in India

Distribution in the different eco-climatic regions

The mycoheterotrophic orchids are distributed throughout the various eco-climatic regions of India (Fig. 3). With the increase in altitude the number of species steadily decreases. Their maximum diversity is found in warm temperate (20 spp.) and sub-tropical (15 spp.) regions followed by tropical areas (12 spp.), cool temperate areas (9 spp.), and sub-alpine regions (7 spp.). In the alpine regions only five species are found. Species such as *Aphyllorchis montana*, *Cymbidium macrorhizon*, *Didymoplexis pallens* and *Epipogium roseum* have a very wide range of distribution from tropical to cool temperate regions.

Status

So far forty species are reported from India of which thirty two species are rare and eight species are locally frequent (Table 1). Four species have not been collected during the past 100 years: *Didymoplexis himalaica* has not been collected again after the type collection from Teesta valley (Eastern Himalaya) in June of 1884, likewise *Aphyllorchis gollani* (first time collected from Nagtibba (Western Himalaya) in 1884), *Neottia inayati* (first time collected from Kashmir (Western Himalaya) in 1902) and *Neottia mackinnonii* (first time collected from Tehri (Western Himalaya) in 1901). This suggests that these species may have become extinct or extremely rare.

Threats and conservation

In India the natural habitats of these orchids are under tremendous pressure due to habitat destruction, habitat fragmentation, clear felling of primary forests for agricultural practices, climate change etc. Because of the clear-felling of primary forests, nearly 12.5 % of the global vascular flora faces possible extinction (Walter & Gillet, 1998). Very little is known about the ecology of mycoheterotrophic orchids. As the disappearance of the mycoheterotrophic orchids is mainly caused by the destruction of the habitats, the most ideal methods of conservation is the protection of these habitats. This should be paired with in-depth ecological research concerning the status of the forests and the orchids, their diversity, their population size, and all other aspects of their natural history.

Key to the mycoheterotrophic orchid genera of India

1a. Pollinia 4.....2
 1b. Pollinia 2.....9
 2a. Roots coralloid.....*Corallorhiza*
 2b. Roots not coralloid.....3
 3a. Plants with pseudobulb.....*Crepidium*
 3b. Plants without pseudobulb.....4
 4a. Flowers subcampanulate, not fully opening.....5
 4b. Flowers not campanulate, spreading.....6
 5a. Rhizome tuberous, unbranched.....*Stereosandra*
 5b. Rhizome not tuberous, branched.....*Yuania*

6a. Flowers minute, 1-5 mm across.....	7
6b. Flowers large, 1-4 cm across.....	8
7a. Flowers pale yellow.....	<i>Stigmatodactylus</i>
7b. Flowers blackish-purple.....	<i>Risleya</i>
8a. Plants erect; lip cymbiform.....	<i>Cymbidium</i>
8b. Plants scandent, lip not cymbiform.....	<i>Erythrorchis</i>
9a. Flowers campanulate; sepals & petals fused.....	10
9b. Flowers not campanulate; sepals & petals free.....	11
10a. Rootstock tuberous; stems pale yellow.....	<i>Didymoplexis</i>
10b. Rootstock not tuberous; stems brown.....	<i>Gastrodia</i>
11a. Plants tuberous at base.....	12
11b. Plants rhizomatous at base.....	13
12a. Flowers dull purple-red to brown, 3-4 cm across.....	<i>Eulophia</i>
12b. Flowers pale pink - white to pale yellow, 1-2 cm across.....	<i>Epipogium</i>
13a. Roots densely clustered like a bird's nest.....	<i>Neottia</i>
13b. Roots rhizomatous, not as above.....	14
14a. Fruit dry dehiscent; seeds winged.....	<i>Galeola</i>
14b. Fruits fleshy indehiscent; seeds wingless.....	15
15a. Lip not lobed.....	16
15b. Lip lobed.....	17
16a. Sepals and petals connivent.....	<i>Cyrtosia</i>
16b. Sepals and petals free, spreading.....	<i>Aphyllorchis</i>
17a. Calyculus present between ovary and sepals.....	<i>Lecanorchis</i>
17b. Calyculus absent between ovary and sepals.....	<i>Chamaegastrodia</i>

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Les Orchidaceae, avec 1 331 espèces réparties dans 184 genres, constituent l'une des plus vastes familles végétales d'Inde (7,6% des plantes à fleurs). Leur germination nécessite la présence d'un mycorhize adapté qui leur fournit les principaux nutriments, tels que carbone et azote. Chez certaines orchidées terrestres dépourvues de chlorophylle, ce champignon est conservé toute leur vie. On dit d'elles qu'elles ont un mode de vie mycohétérotrophique. Souvent désignées à tort comme saprophytes, ces orchidées ne produisent pas de chlorophylle et ne peuvent donc pas pratiquer de photosynthèse. Dans les forêts primaires non perturbées, la couche de feuilles en décomposition qui constitue la surface du sol est riche en nutriments et la plupart des orchidées préfèrent s'installer là. La plupart des orchidées mycohétérotrophiques sont les plantes plutôt petites, difficiles à repérer. Certaines, toutefois, sont très grandes, comme les *Erythrorchis* et les *Galeola*, qui peuvent atteindre des hauteurs de 2 à 4 m. Elles sont confinées aux forêts primaires et aux zones à forte pluviométrie de l'Himalaya occidental indien. Cet article propose une liste actualisée de ces orchidées, accompagnée d'informations sur leur diversité, leurs noms corrects, la distribution dans les différentes régions floristiques, et leur statut vis à vis de la conservation.

L'Inde couvre plus de 3 millions de km², entre 8 et 37° de latitude N et entre 68 et 97° de longitude E. Elle est bordée par les océans de tous côtés sauf au nord où elle se termine dans l'Himalaya et cette situation détermine fortement le climat. Celui-ci est tropical au sud et à l'extrême est, au nord, il est tempéré et très aride. La végétation varie depuis les forêts tropicales pérennes, sur la côte occidentale et au nord-est, jusqu'aux forêts alpines dans l'Himalaya. Au total près de 700 000 km² (21% du territoire indien) sont couverts de forêts. L'Inde peut être divisée en neuf régions floristiques (Fig.1). Plusieurs d'entre elles ont été explorées au cours des années 2001-2012. Outre les observations de terrains, l'étude a porté aussi sur la littérature pertinente et sur le matériel d'herbier.

Nous avons décompté 40 espèces d'orchidées mycohétérotrophiques. Le tableau 1 en donne le nom et diverses données. La figure 2 fournit une représentation graphique de la diversité observée dans les différentes régions floristiques et la figure 3 illustre la répartition dans les différentes zones éco-climatiques. Une clé d'identification est également proposée.

Ces 40 espèces appartiennent à 18 genres, dont 12 sont endémiques. Treize sont strictement mycohétérotrophiques, les cinq autres ayant également des espèces autotrophiques. Le genre représenté par le plus grand nombre d'espèces (7) est *Gastrodia*. Viennent ensuite *Neottia* (6), *Galeola* (4), *Aphyllorchis*, *Chamaegastrodia* et *Didymoplexis* (3 chacun), *Crepidium* et *Epipogium* (2), les autres genres n'étant représentés que par une unique espèce.

Les orchidées mycohétérotrophiques sont présentes dans toutes les régions floristiques hormis dans les plaines de l'Indus, probablement à cause de leur climat très sec. Le faible nombre d'espèces observées dans les Iles d'Adaman et Nicobar est peut-être dû aux difficultés d'accès.

Ces orchidées sont réparties dans les diverses zones éco-climatiques d'Inde selon le diagramme de la figure 3. Le nombre d'espèces décroît rapidement quand l'altitude croît. La diversité la plus grande est observée dans les zones sub-tropicales et la plus faible dans les zones sub-alpines.

A ce jour, 32 des 40 espèces sont considérées comme rares et 6 comme localement fréquentes. Quatre n'ont plus été collectées au cours des cents ans écoulés, *Didymoplexis himalaica*, *Aphyllorchis gollani*, *Neottia inayati* et *Neottia mackinnonii*. Elles sont soit déjà éteintes soit extrêmement rares. En Inde, les habitats naturels de ces orchidées sont soumis à de fortes pressions de destruction ou de fragmentation et au changement climatique.

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