

ORCHID DIVERSITY AT CHAIL WILDLIFE SANCTUARY, HIMACHAL PRADESH, NORTHWEST HIMALAYA

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Abstract

Present communication deals with orchid diversity at Chail Wildlife Sanctuary of Himachal Pradesh, NorthWest Himalaya. Field surveys (2011-2013) revealed the occurrence of 13 terrestrial orchid species under nine genera from within the geographical limits of this Sanctuary. Majority of these species were found to occupy moist and shady forest floors and produced flowers during the months of July and August. Some of them (*Crepidium acuminatum*, *Habenaria intermedia*, *Malaxis muscifera*, *Satyrium nepalense*) are valuable herbs, which are used in various rejuvenating preparations. All of the species are taxonomically enumerated and notes are provided on their gross habitat characteristics and general distribution.

Introduction

IN INDIA, the orchids are represented by more than 1300 species, of which nearly 350 are endemic to the country (Misra, 2007). Indian Himalayan Region (IHR) is one of the orchid-rich belts of India that alone houses about 850 species (Singh, 2001). Himachal Pradesh is a North Indian state located in NorthWestern part of the Himalayan range (30°22' to 33°12' N latitude, 75°47' to 79°04' E longitude). Vast geographical expanse (55672 km²) and remarkable altitudinal variations (350-7000 m) have resulted in profuse accumulation of various phyto-elements here, and orchids are also represented by 85 species (Vij *et al.*, 2013) in the state. Many of these are variously used for their therapeutic properties (Pathak *et al.*, 2010). The changing environmental conditions, land use patterns, and expanding urbanization have resulted in shrinkage and degradation of natural habitats, and such alterations necessitate the importance of periodic field surveys so as to keep abreast with actual orchid diversity at different locales. In this connection, field surveys were conducted in different areas of Himachal Pradesh, and information about orchids of Chail Wildlife Sanctuary is provided here.

Chail Wildlife Sanctuary (WLS) is located in Shimla and Solan Districts of Himachal Pradesh. With an area of 108.54 km² and elevation ranging between 1001 to 2180 m amsl, it represents a natural blend of sub-tropical and temperate Himalayan flora and fauna. The dominant forest tree is the white silver oak (*Quercus*

leuchotrichophora) mixed at lower altitudes with chir pine (*Pinus roxburghii*). *Rhododendron arboreum* forms pure stands at a few places but *Cedrus deodara* and *Pinus wallichiana* also grow scattered across the grassy slopes. The Sanctuary has within its boundaries, historical Chail town and a number of villages.

Material and Methods

A reconnaissance survey was taken up initially (2011) to find out different vegetational types in the study area. Later, plants were botanized thoroughly by regular field collection trips (2011-2013) covering various microhabitats and vegetational types. Plant specimens were collected preferably in flowering/fruiting stages. Observations on plant habit, gross habitat characteristics and flowering and fruiting periods were made during the field studies. Species identifications were done with the help of standard Floras (Deva and Naithani, 1986; Vij *et al.*, 2013), and by comparing the collected specimens with authentically identified ones at two national herbaria *i.e.*, Botanical Survey of India, Northern Circle (BSD) and Forest Research Institute, Indian Council of Forestry Research and Education (DD).

Results

A total of 13 orchid species belonging to nine genera of two subfamilies (Orchidoideae, Epidendroideae) were recorded from Chail Wildlife Sanctuary (WLS). Some orchids of Chail Wildlife Sanctuary, Himachal Pradesh have been listed in Table 1. and in Fig. 1A-G. Some of these are valuable herbs. *Crepidium acuminatum*,



Fig. 1 A-G. Some orchids of Chail Wild Life Sanctuary, Himachal Pradesh: A, *Brachycorythis obcordata*; B, *Crepidium acuminatum*; C, *Goodyera biflora*; D, *Habenaria pectinata*; E, *Habenaria intermedia*; F, *Liparis odorata*; G, *Satyrium nepalense*.

Habenaria intermedia, and *Malaxis muscifera* are important species used in *Ashtavarga* group of medicine (Kant *et al.*, 2012). *Satyrium nepalense*, on the other hand, is known for its aphrodisiac properties (Saklani *et al.*, 2011). In what follows, all of the species are taxonomically enumerated along with the notes on their flowering and fruiting periods, gross habitat characteristics, and general distribution.

Species Description

A. Subfamily Orchidoideae

1. *Brachycorythis obcordata* (Lindl.) Summerh., Kew Bull. 10: 243. 1955; Deva & Naithani, Orch. Fl. N. W. Himal. 107. t. 48. 1986. *Platanthera obcordata* Lindl., Gen. Sp. Orchid. Pl. 290. 1835. *Orchis obcordata* Buch.-Ham. ex D. Don, Prodr. Fl. Nepal. 23. 1825.

nom. illeg. Gymnadenia obcordata (Lindl.) Rchb.f., *Otia* Bot. Hamburg. 32. 1878. *Habenaria galeandra* auct. non (Rchb. f.) Benth.; Hook. f., Fl. Brit. India 6: 163. 1890; Collett, Fl. Siml. 506. 1902; Duthie, Ann. Roy. Bot. Gard. (Calcutta) 9: 194. t. 144. 1906.

Terrestrial. *Stem* 8-18 cm long, greenish brown or tinged with purple, base sheathed with leaf bases. *Tubers* 2, oval-oblong. *Leaves* 5-7, spreading, membranous, alternate, overlapping, dark green, with bright purple band down the centre, oblong-lanceolate, obtuse or subacute, 2-5 × 1-2.5 cm. *Inflorescence* raceme, 4-10 cm, lax, 10-15 flowered. *Floral bracts* leaf like, lanceolate, longer than the flowers at least at base of inflorescence. *Flowers* pale purple, 1-1.3 cm across. *Sepals* subequal, 3-veined; the dorsal ovate,

subacute, 6-7 × 2-2.5 mm; the laterals lanceolate. *Petals* shorter than sepals, 3-veined, lanceolate, subacute. *Lip* simple to obscurely 3-lobed, spurred, broadly triangular to broadly obcordate, mucronate, surface papillose, 7-9 × 6-7 mm. *Spur* conical, stout, small. *Column* short, 1-1.5 × 1-2 mm, without foot. *Pollinia* 2, narrowly obovate, caudicles short.

Flowering

August-October.

Habitat

Semi exposed forest floors and bushy grassy slopes.

Distribution

India (Himachal Pradesh to Arunachal Pradesh,

Table.1. Orchids of Chail Wildlife Sanctuary, Himachal Pradesh.

Sr. No.	Orchid species	Gross habitat in WLS	Flowering and fruiting months	Distribution range (m)
Subfamily Orchidoideae				
1.	<i>Brachycorythis obcordata</i> (Buch.-Ham.ex D.Don) Summerh.	Semi exposed forest floors and bushy grassy slopes	August-October	1500-2000
2.	<i>Goodyera biflora</i> (Lindl.) Hook. f. J.D.Hook.	Moist, shady forest floors.	June-August	1500-2100
3.	<i>G. repens</i> (L.) R. Br.	Moist and shady forest floors and somewhat exposed situations.	June-August	1800-2180
4.	<i>Habenaria intermedia</i> D. Don	Shady-moist forest floors to somewhat exposed situations.	July-September	1500-2100
5.	<i>H. marginata</i> Coleb.	Open grasslands.	August-September	700-1000
6.	<i>H. pectinata</i> (J.E.Sm.) D. Don	Semi shady or open grasslands and road embankments.	July-September	1500-2180
7.	<i>Herminium lanceum</i> (Thunb. ex Sw.) Vujik	Shady or somewhat exposed situations.	July-September	1250-2180
8.	<i>Satyrium nepalense</i> D. Don	Grows on grassy slopes and forest openings.	August-October	1500-2180
Subfamily Epidendroideae				
9.	<i>Crepidium acuminatum</i> (D. Don) Szlach.	Moist, shady and humus rich forest floors	July-September	1750-2180
10.	<i>Epipactis gigantea</i> Dougl. ex J.D. Hook.	Open grasslands and partially shady floors.	July-September	2000-2180
11.	<i>E. helleborine</i> (L.) Crantz	Open or partially shady floors.	July-September	1500-2100
12.	<i>Liparis odorata</i> (Willd.) Lindl.	Open grassy slopes.	July-September	1800-2100
13.	<i>Malaxis muscifera</i> (Lindl.) Kuntze	Grows on grassy slopes and forest openings.	July-September	1800-2180

Meghalaya, Nagaland, Central India), Nepal, Bhutan, Thailand at about 1500-2000 m.

2. *Goodyera biflora* (Lindl.) Hook. f., Fl. Brit. India 6: 114. 1890; Collett, Fl. Siml. 496. 1902; Duthie Ann. Roy. Bot. Gard. (Calcutta) 9: 167. t. 127. 1906; Nair, Fl. Bash. Himal. 273. 1977; Chowdhery & Wadhwa, Fl. Himachal Pradesh 3: 683. 1984; Deva & Naithani, Orch. Fl. N. W. Himal. 53. t. 17. 1986.

Terrestrial. *Stem* stout, leafy, reddish, sometimes decumbent and rooting from the nodes. *Roots* cord like. *Leaves* 4-7, spreading, leathery-soft, ovate, obtuse or sub acute, dark bluish-green and finely veined on upper surface, lower surface white or pale with reddish tinge, 2.5-4 × 1.5-2.5 cm. *Inflorescence* raceme, not much longer than the leaves, dense with 2-8 flowers, pubescent. *Floral bracts* reddish, tipped with green, lanceolate, acute, longer than ovary. *Flowers* large, 2-2.5 cm long, white flushed yellow and pink. *Sepals* subequal, lanceolate, acute; the dorsal 22-25 × 5-7 mm, recurved at the apex; the laterals slightly shorter than dorsal, almost straight, connate at the base. *Petals* nearly equal to lateral sepals but narrower, linear-lanceolate, falcate, acute, adpressed to the dorsal sepal. *Lip* white, tinged with yellow, shorter than sepals, saccate at the base and tapering into a long, recurved, undulate margined beak; sac hairy within. *Column* short, concave in front. *Pollinia* 2, light yellow, on long slender connate caudicles.

Flowering

June-August.

Habitat

Moist, shady forest floors.

Distribution

India (Himachal Pradesh to Arunachal Pradesh), Nepal, China, Taiwan. Korea and N. Vietnam. 1500-2500 m.

3. *Goodyera repens* (L.) R. Br. in W. T. Aiton, Hortus Kew. 5: 198. 1813; Hook. f., Fl. Brit. India 6: 111. 1890; King & Pantl., Ann. Roy. Bot. Gard. (Calcutta) 8: 279. t. 370. 1898; Collett, Fl. Siml. 496. 1902; Duthie, Ann. Roy. Bot. Gard. (Calcutta) 9: 165. 1906; Nair, Fl. Bash. Himal. 273. 1977; Chowdhery & Wadhwa, Fl. Himachal Pradesh 3: 684. 1984; Deva & Naithani, Orch. Fl. N. W. Himal. 58. t. 21. 1986; Dhaliwal & Sharma, Fl. Kullu Dist. 609. 1999.

Terrestrial. *Stem* erect, stout, glabrous, arising from rhizomes, 10-25 cm tall, leafy below, bracteate above. *Leaves* subrosulate at base of stem, abaxially pale green, adaxially deep green with white venation, ovate to ovate-elliptic. *Inflorescence* raceme, 5-11 cm long,

dense with 25-45 flowers. *Floral bracts* linear-lanceolate, acuminate, equaling or longer than ovary. *Flowers* opening weakly, white, tinged with green, small; pedicel and ovary cylindric-fusiform, 3-5 mm, sparsely pubescent. *Sepals* subequal, ovate, acute, connivent, glandular pubescent, 3.5-4.5 × 2.2-2.6 mm; the dorsal narrower. *Petals* nearly equal to sepals but narrower, apex falcately acute, adhering on the inner margins of the dorsal sepal, the edges slightly erose-dentate. *Lip* about as long as sepals, saccate at the base, apical lobe short, ovate, subacute, concave, the edges somewhat undulate, sac smooth inside. *Column* short, without appendages. *Pollinia* 2, yellow, clavate, sessile, ca. 1 mm.

Flowering

June-August.

Habitat

Moist and shady forest floors and somewhat exposed situations.

Distribution

India (Jammu & Kashmir to Arunachal Pradesh, Assam), Pakistan, Myanmar, China, Japan, Korea, Russia, Europe, N. America. 1800-3700 m.

4. *Habenaria intermedia* D. Don, Prodr. Fl. Nepal. 24. 1825; Hook. f., Fl. Brit. India 6: 138. 1890; Collett, Fl. Siml. 502. t. 164. 1902; Duthie, Ann. Roy. Bot. Gard. (Calcutta) 9: 180. t. 131. 1906; Nair, Fl. Bash. Himal. 275. 1977; Chowdhery & Wadhwa, Fl. Himachal Pradesh 3: 686. 1984; Deva & Naithani, Orch. Fl. N. W. Himal. 139. t. 68. 1986.

Terrestrial. *Tubers* oblong. *Stem* terete, base covered with 2-3 loose sheaths, 20-50 cm long. *Leaves* 4-5, spreading, fleshy, alternate, scattered, ovate-oblong, acuminate, 6-15 × 2-5 cm. *Inflorescence* raceme, 10-15 cm long, stout, lax, with 2-6 flowers. *Floral bracts* leaf like, broadly lanceolate, acuminate, equaling or longer than ovary. *Flowers* white or greenish white, 4-5 cm across. *Sepals* persistent; the dorsal smaller but broader than the laterals, ovate-lanceolate, acute, forming hood with petals, 2.1-2.3 × 1 cm, apex recurved; the laterals spreading, falcately lanceolate, acuminate, tips reflexed. *Petals* white, as long as dorsal sepal, falcately lanceolate, obtuse, margins minutely ciliolate. *Lip* green, except the longer white claw, 3-lobed, longer than the sepals, 3.5-4 cm long, papillose towards the base, mid lobe linear, side lobes deeply pectinate. *Spur* longer than ovary, stout, tapering towards apex. *Column* short, without foot. *Pollinia* 2, elongate, bipartite, 5-6 mm long, granular, with slender caudicles as long as pollinia, viscidium minute.

Flowering

July-September.

Habitat

Shady-moist forest floors to somewhat exposed situations.

Distribution

India (Himachal Pradesh to Sikkim, Meghalaya), Pakistan, Nepal, Tibet. 1500-2800 m.

5. *Habenaria marginata* Colebr. in W.J. Hooker, Exot. Fl. 2: t. 136. 1824; Hook. f., Fl. Brit. India 6: 150. 1890; Collett, Fl. Siml. 504. 1902; Duthie, Ann. Roy. Bot. Gard. (Calcutta) 9: 184. t. 136. 1906 et Fl. Upper Gangetic Plain 3: 226. 1920; Chowdhery & Wadhwa, Fl. Himachal Pradesh 3: 687. 1984; Deva & Naithani, Orch. Fl. N. W. Himal. 145. t. 72. 1986

Terrestrial. *Tubers* oblong-ellipsoid. *Stem* erect, greenish, 10-20 cm long. *Leaves* 3-5, sessile, clustered near the bottom or radical and flat on ground, somewhat fleshy, oblong or slightly oblanceolate, obtuse, with pale yellow margins, 2.5-7 × 1-3 cm. *Inflorescence* spike, 5-12 cm long, lax or dense with 5-15 flowers. *Floral bracts* ovate lanceolate, acuminate, equaling the ovary, with pale ciliolate margins. *Flowers* greenish-yellow, 1.3-1.5 cm across. *Sepals* subequal, 7-9 × 6-7 mm; the dorsal erect, broadly ovate, concave; the laterals reflexed, falcately oblong-lanceolate, subacute or acuminate, spreading or deflexed. *Petals* as long as sepals, erect, ovate-oblong, cohering with dorsal sepal to form hood, falcate from the broad base, obtuse. *Lip* longer than the sepals, 10-12 mm long, 3-partite; mid lobe linear or narrow-oblong, obtuse, shorter, margins reflexed; side lobes as long as or longer than the middle one, spreading, narrowed with incurved tips. *Spur* as long as ovary, stout, laterally compressed at apex, 8-10 mm long. *Column* short, broad. *Pollinia* 2, obovoid-oblong, ca. 2.5 × 1 mm, granular, with stout caudicles, viscidium larger.

Flowering

August-September.

Habitat

Open grasslands.

Distribution

India (Jammu & Kashmir to Uttarakhand, Bihar, West Bengal, Madhya Pradesh, Gujarat, Rajasthan, Orissa, Chhattisgarh, Jharkhand, Andhra Pradesh, Tamil Nadu,

Karnataka, Maharashtra), Pakistan, Nepal, Bhutan, Myanmar, Thailand. 500-1050 m.

6. *Habenaria pectinata* D. Don, Prodr. Fl. Nepal 24. 1825; Hook. f., Fl. Brit. India 6: 137. 1890; King & Pantl., Ann. Roy. Bot. Gard. (Calcutta) 8: 310. (not t. 406). 1898; Collett, Fl. Siml. 501. 1902; Duthie, Ann. Roy. Bot. Gard. (Calcutta) 9: 178. t. 130. 1906; Nair, Fl. Bash. Himal. 275. 1977; Chowdhery & Wadhwa, Fl. Himachal Pradesh 3: 687. 1984; Deva & Naithani, Orch. Fl. N. W. Himal. 147. t. 73. 1986.

Terrestrial. *Tubers* oblong. *Stem* stout, quadrangular, lower part sheathed, 20-30 cm long. *Leaves* 3-5, sessile, arranged in upper part of stem, ovate-lanceolate, acuminate, 5-8 × 1.5-2.5 cm. *Inflorescence* raceme, 8-12 cm long, dense, with many flowers. *Floral bracts* leaf-like, linear-lanceolate, acuminate, longer than flowers. *Flowers* greenish-white, ca 2.5 cm across. *Sepals* green, subequal, 12-14 × 5-7 mm; the dorsal erect, broadly lanceolate, obtuse; the laterals narrower, spreading, subfalcate, mucronate on the back below the reflexed tips. *Petals* white, as long as sepals, forming hood with dorsal sepal, falcately oblong, obtuse. *Lip* white, longer than the lateral sepals, ca. 15 mm long, 3-partite; mid lobe linear, obtuse, longer than the side lobes; side lobes spreading, deeply pectinate. *Spur* longer than ovary, stout, funnel shaped at base, apex curved outwards, 15-18 mm long. *Column* short, broad. *Pollinia* 2, narrowly elliptic, ca. 2.5 × 1 mm, granular, bipartite, with long, stout, curved caudicles, viscidium small.

Flowering

July-September.

Habitat

Semi shady or open grasslands and road embankments.

Distribution

India (Jammu & Kashmir to Arunachal Pradesh), Pakistan, Nepal, Bhutan, China. 1500-3500 m.

7. *Herminium lanceum* (Thunb. ex Sw.) Vuijk, Blumea 11 (1): 228. 1961; Seidenfaden, Dansk Bot. Ark. 31 (3): 20. t. 7. 1977; Deva & Naithani, Orch. Fl. N. W. Himal. 159. t. 82. 1986; Dhaliwal & Sharma, Fl. Kullu Dist. 612. 1999; Kaur & Sharma, Fl. Sirmour 599. 2004. *H. angustifolium* (Lindl.) Benth. & Hook. f., Gen. Pl. 3: 622. 1880; Hook. f., Fl. Brit. India 6: 129. 1890; King & Pantl., Ann. Roy. Bot. Gard. (Calcutta) 8: 332. t. 434. 1898; Collett, Fl. Siml. 499. t. 163. 1902; Duthie, Ann. Roy. Bot. Gard. (Calcutta) 9: 197. 1906; Nair, Fl. Bash. Himal. 276. 1977; Chowdhery & Wadhwa, Fl. Himachal Pradesh 3: 687. 1984.

Terrestrial. *Tubers* small, oblong or ellipsoid. *Stem* 15-50 cm long, base covered with tubular sheaths. *Leaves* usually 3, spreading/ drooping, somewhat fleshy, linear-lanceolate, acuminate, with long sheathing base. *Inflorescence* spike, 6-18 cm long, dense, with many flowers. *Floral bracts* linear-lanceolate, acuminate, shorter than or equal to ovary. *Flowers* green, small, 4-6 mm across. *Sepals* subequal, oblong, obtuse, spreading, 3.5-4.5 × 1.2 mm, the dorsal forming hood with petals. *Petals* equal to or slightly shorter than sepals, 3-3.5 × 1 mm, linear, acute, narrower. *Lip* often pendulous, oblong, 4-10 × 1-2 mm, base dilated and concave, furcately 3-lobed near middle; disk ridged; lateral lobes linear, 2-7 mm; mid-lobe oblong to triangular, to ca. 1 mm, apex acute to obtuse. *Column* ca. 0.8 mm; *Pollinia* 2, globose, caudicles short, viscidium minute.

Flowering

July-September.

Habitat

Shady or somewhat exposed situations.

Distribution

India (Jammu & Kashmir to Arunachal Pradesh, Assam, Meghalaya, Manipur, Nagaland, Mizoram, Tripura), Nepal, Bhutan, Myanmar, China, Taiwan, Korea, Thailand, Philippines, Vietnam, Malaysia, Japan. 1200-3000 m.

8. *Satyrium nepalense* D. Don, Prodr. Fl. Nepal. 26. 1825; Hook. f., Fl. Brit. India 6: 168. 1890; King & Pantl., Ann. Roy. Bot. Gard. (Calcutta) 8: 338. t. 444. 1898; Collett, Fl. Siml. 507. t. 168. 1902; Duthie, Ann. Roy. Bot. Gard. (Calcutta) 9: 201. 1906; Nair, Fl. Bash. Himal. 278. 1977; Chowdhery & Wadhwa, Fl. Himachal Pradesh 3: 692. 1984, err. '*nepalensis*'; Deva & Naithani, Orch. Fl. N.W. Himal. 201. t. 109. 1986.

Terrestrial. *Tubers* oval or ovoid-oblong. *Stem* glabrous, stout, base covered with sheaths, 5-30 cm long. *Leaves* 2-3, spreading, fleshy, narrowly elliptic, oblong or ovate-lanceolate, subacute, 4-15 (-18) × 1-7 cm, base broad and sheathing. *Inflorescence* spike, 5-15 cm long, stout, dense or lax, with many flowers. *Floral bracts* oblong-lanceolate, acuminate, deflexed, longer than ovary. *Flowers* pink or white, sweet scented, 8-15 mm across. *Sepals* subequal, ciliolate; the dorsal oblanceolate-spathulate, obtuse, 5-6 × 1.5 mm; the laterals oblong, pellucid gland dotted, 5-6 × 2.5 mm. *Petals* as long as but narrower than sepals, obtuse. *Lip* superior, hooded, broadly oblong, keeled on the back, with 2 long spurs. *Spurs* extending beyond the ovary, 10-12 mm long. *Column* curved, expanded at

apex, 4-5 mm long. *Pollinia* 2, pyriform, bipartite, with slender caudicles, viscidium thick, discoid.

Flowering

August-October.

Habitat

Grows on grassy slopes and forest openings.

Distribution

India (Jammu & Kashmir to Arunachal Pradesh, Nagaland, Manipur, Meghalaya, S. India), Pakistan, Nepal, Bhutan, Tibet, Myanmar, China, Sri Lanka. 1500-3000 m.

B. Subfamily Epidendroideae

9. *Crepidium acuminatum* (D. Don) Szlach., Fragm. Florist. Geobot., Suppl. 3: 123. 1995. *Malaxis acuminata* D. Don, Prodr. Fl. Nepal. 29. 1825; Nair, Fl. Bash. Himal. 276. 1977; Chowdhery & Wadhwa, Fl. Himachal Pradesh 3: 689. 1984; Deva & Naithani, Orch. Fl. N. W. Himal. 309. t. 176. 1986. *Microstylis wallichii* Lindl. Gen. Sp. Orchid. Pl. 20. 1830; Hook. f., Fl. Brit. India 5: 686. 1890; King & Pantl., Ann. Roy. Bot. Gard. (Calcutta) 8: 16. t. 18. 1898; Collett, Fl. Siml. 491. t. 162. 1902; Duthie, Ann. Roy. Bot. Gard. (Calcutta) 9: 87. 1906.

Terrestrial. *Pseudobulbs* ovoid or oblong, tufted. *Stem* 10-20 cm long, base sheathed. *Leaves* 3-4, spreading, membranous, ovate-lanceolate, acute or acuminate, 6-10 × 3-5 cm. *Inflorescence* raceme, 6-10 cm long, lax, with many flowers. *Floral bracts* small, lanceolate, sub-acute or acuminate. *Flowers* yellow-green tinged with purple, 10-12 mm across. *Sepals* oblong, ca 6 × 2 mm, with recurved margins; the dorsal shorter than laterals, subacute; the laterals broader, obtuse. *Petals* linear, equal to or longer than lateral sepals, margins recurved. *Lip* narrowly ovate or triangular, tip notched or divided into 2 lobules at apex, auricles widely separated, straight or slightly overlapping. *Column* small, fleshy, with rounded arms, ca 2 mm long. *Pollinia* 4, obovoid, viscidium minute.

Flowering

July-September.

Habitat

Moist, shady and humus rich forest floors.

Distribution

India (Himachal Pradesh to Arunachal Pradesh, Meghalaya, Assam, Nagaland, Manipur, Mizoram)

Tripura, Madhya Pradesh), Nepal, Bhutan, China, Thailand, Myanmar. 1750-2300 m.

10. *Epipactis gigantea* Douglas ex Hook., Fl. Bor.-Amer. 2: 202. 1839; Duthie, Ann. Roy. Bot. Gard. (Calcutta) 9: 162. 1906; Deva & Naithani, Orch. Fl. N. W. Himal. 37. t. 9. 1986; Dhaliwal & Sharma, Fl. Kullu Dist. 608. 1999; Kaur & Sharma, Fl. Sirmaur 599. 2004. *E. royleana* Lindl., Gen. Sp. Orchid. Pl. 461. 1840; Hook. f., Fl. Brit. India 6: 126. 1890; Collett, Fl. Siml. 499. 1902; Nair, Fl. Bash. Himal. 272. 1977; Chowdhery & Wadhwa, Fl. Himachal Pradesh 3: 682. 1984.

Terrestrial. *Rhizome* elongated. *Stem* erect, glabrous, leafy, 25-40 cm high, base sheathed. *Roots* densely clustered on rhizome. *Leaves* 5-7, spreading, membranous, ovate-lanceolate or nearly circular, 5-12 × 3-6 cm. *Inflorescence* raceme, lax, with 5-30 flowers. *Floral bracts* lanceolate, acute, 10-23 × 5-7 mm decreasing in length towards apex. *Flowers* green, veined red and with reddish-yellow lip, 2.3- 2.6 cm across, drooping. *Sepals* subequal, 9-15 × 5-6 mm, spreading; the dorsal ovate, acute; the laterals obliquely lanceolate. *Petals* slightly shorter than sepals, broadly ovate, acute. *Lip* longer than the sepals, glabrous; hypochile obovate, saccate, 9-10 mm long, with a cuneate base, 10-15 mm broad; epichile narrowly ovate, 5-8 mm long, 5-6 mm broad. *Column* short, stout, 7-10 × 2-3 mm, with two lateral horns below clinandrium. *Pollinia* 2, narrow, ca. 1 mm long.

Flowering

July-September.

Habitat

Open grasslands and partially shady floors.

Distribution

India (Jammu & Kashmir to Arunachal Pradesh), Nepal, Bhutan, SE Tibet,

Afghanistan, Pakistan, NW America. 2000-4000 m.

11. *Epipactis helleborine* (L.) Crantz, Stirp. Austr. Fasc. ed. 2, 2: 467. 1769; Deva & Naithani, Orch. Fl. N. W. Himal. 39. t. 10. 1986. *Epipactis latifolia* (L.) All., Fl. Pedem. 2: 152. 1758; Hook. f., Fl. Brit. India 6: 125. 1890; King & Pantl., Ann. Roy. Bot. Gard. (Calcutta) 8: 271. t. 363. 1898; Collett, Fl. Siml. 498. 1902; Duthie, Ann. Roy. Bot. Gard. (Calcutta) 9: 160. 1906; Nair, Fl. Bash. Himal. 271. 1977.

Terrestrial. *Rhizome* short, woody. *Stem* erect, leafy, 20-40 cm high, slender or robust. *Roots* clustered on rhizome. *Leaves* many, spreading, membranous, ovate

or lanceolate, acute, the uppermost bract like. *Inflorescence* raceme, lax or dense, 8-15 cm long. *Floral bracts* lanceolate, acute, decreasing in length towards apex. *Flowers* green, flushed more or less with red violet, 1.5-2.2 cm across, drooping. *Sepals* subequal, sometimes brown veined; the dorsal ovate, acute, 8-9 × 3.5-4.5 mm; the laterals ovate to lanceolate, acute. *Petals* 8-9 × 3-4 mm, ovate, acute, keeled at the base. *Lip* stretched forward; hypochile cup shaped, 7-8 mm long, green outside and glossy dark-brown inside; epichile cordate, with acute or reflexed tip, 4-5 mm long, margins crenulate, two smooth or slightly wrinkled bosses at the base. *Column* short, stout, 6-8 × 3-4 mm. *Pollinia* 2, ca 1 mm long, narrow.

Flowering

July-September.

Habitat

Open or partially shady floors.

Distribution

India (Jammu & Kashmir to Arunachal Pradesh), Nepal, Bhutan, Afghanistan, Pakistan, Europe, Iraq, N. Africa, Hong Kong, Japan, Myanmar. 1500-4000 m.

12. *Liparis odorata* (Willd.) Lindl., Gen. Sp. Orchid. Pl. 26. 1830. *Malaxis odorata* Willd., Sp. Pl. 4: 91. 1805. *Empusa paradoxa* Lindl., Bot. Reg. 10: t. 825. 1824. *Liparis paradoxa* (Lindl.) Rchb. f. in W. G. Walpers, Ann. Bot. Syst. 6: 218. 1861. Hook. f., Fl. Brit. India 5: 697. 1890; King & Pantl., Ann. Roy. Bot. Gard. (Calcutta) 8: 27. t. 34. 1898; Collett, Fl. Siml. 492. 1902; Duthie, Ann. Roy. Bot. Gard. (Calcutta) 9: 92. 1906; Nair, Fl. Bash. Himal. 276. 1977; Deva & Naithani, Orch. Fl. N. W. Himal. 301. t. 171. 1986.

Terrestrial. *Pseudobulbs* narrowly ovoid, tufted. *Stem* stout, 8-16 cm long, base covered with many sheaths. *Leaves* 2-3, not much spreading, plicate, alternate, narrowly elliptic, lanceolate, sub-acute, 7-14 × 2-2.5 cm. *Inflorescence* raceme, erect, 5-10 cm long, lax, with 8-12 flowers. *Floral bracts* ovate-lanceolate, acute, shorter than ovary. *Flowers* green, with dull purple lip, 12-15 mm long. *Sepals* reflexed or revolute, unequal; the dorsal linear, blunt, spreading, 7 × 2.5 mm; the laterals broadly ovate, recurved. *Petals* reflexed, linear-oblong, obtuse ca 6 × 1.5 mm. *Lip* quadrate, abruptly deflexed from the middle, concave, 6-7 × 5 mm, basal part with two teeth like calli, apex broad, erose, shortly apiculate. *Column* elongate, upper half hood-like from two large rounded wings, 4-5 mm long. *Pollinia* 4, obovoid, waxy.

Flowering

July-September.

Habitat

Open grassy slopes.

Distribution

India (Himachal Pradesh to Arunachal Pradesh, Meghalaya, Manipur, Nagaland, Mizoram, West Bengal, Bihar), Nepal, Bhutan, Myanmar, China, Cambodia, Vietnam, Taiwan, Japan. 1800-2400 m.

13. *Malaxis muscifera* (Lindl.) Kuntze, Revis. Gen. Pl. 2: 673. 1891; Nair, Fl. Bash. Himal. 277. 1977, err. typogr. '*muscifera*'; Chowdhery & Wadhwa, Fl. Himachal Pradesh 3: 690. 1984; Deva & Naithani, Orch. Fl. N. W. Himal. 317. t. 181. 1986; Dhaliwal & Sharma, Fl. Kullu Dist. 614. 1999. *Microstylis muscifera* (Lindl.) Ridley, J. Linn. Soc. 24: 333. 1888; Hook. f., Fl. Brit. India 5: 689. 1890; King & Pantl., Ann. Roy. Bot. Gard. (Calcutta) 8: 20. t. 25. 1898; Collett, Fl. Siml. 491. 1902; Duthie, Ann. Roy. Bot. Gard. (Calcutta) 9: 89. 1906.

Terrestrial. *Pseudobulbs* ovoid. *Stem* 10-30 cm long, base covered with one or more tubular sheaths. *Leaves* 2, unequal, sessile, spreading, somewhat fleshy, ovate-round or ovate-lanceolate, obtuse or subacute, somewhat narrowed at the base to sheathing petiole, 3-10 × 2-4 cm. *Inflorescence* raceme, terminal, erect, stout, 6-12 cm long, lax or dense, with many flowers. *Floral bracts* small, lanceolate, sub-acute, shorter than ovary. *Flowers* yellow-green, minute, 2-3 mm across. *Sepals* subequal, oblong-lanceolate, sub-acute, 2.5-3 × 1-1.5 mm, *Petals* linear, subacute or acuminate, shorter than sepals. *Lip* fleshy, as long as sepals, broadly ovate, excavated at the base, side lobes obscure, convex, thickened. *Column* very small, fleshy, ca 1 mm long. *Pollinia* 4, sub-ovoid.

Flowering

July-September.

Habitat

Semi-shady forest floor as well on open grassy slopes.

Distribution

India (Jammu and Kashmir to Arunachal Pradesh), Nepal. 1800-3650 m.

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