

ORCHID DIVERSITY OF NORTHWESTERN HIMALAYA AND ITS CONSERVATION

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Abstract

North Western Himalayas comprises the states of Jammu and Kashmir, Himachal Pradesh, and Uttarakhand. The topography of NW Himalayan region is irregular and intercepted by valleys and plateaus of various extent and as such the stratification is not clear. There is a great diversity in the floristic pattern due to great altitudinal variation. The family orchidaceae exhibit enormous diversity and is represented by ca. 240 species. The paper highlights richness of the orchid diversity of the region and their conservation.

Introduction

THE PHYTOGEOGRAPHICAL region of North Western Himalayas comprises the states of Jammu & Kashmir, Himachal Pradesh and Uttarakhand. The unique flora of NorthWestern Himalayas has attracted numerous botanists over the last two centuries. The European botanists were the first to make botanical collections in this region in different parts evident from the collections of the plants housed in various herbaria. To mention a few important collectors Thomas Hardwick collected plants from the Alaknanda valley and William Moorcroft from Lahul and Spiti, Mangra and Kullu in Himachal Pradesh and from Kashmir.

With the establishment of Botanical garden at Saharanpur in the year 1821, a more systematic effort was made to collect plants. John Firminger Duthie wrote in 1906 the *Orchids of the North Western Himalayas* and for the first time gave an account of 173 species with 53 illustrations. After, the reorganization of the Botanical Survey of India in 1954 botanists like M.A. Rau (1961, 1963, 1964, 1968; Rau and Arora, 1973; Rau and Bhattacharya, 1966; Rau and Rao, 1960); T.A. Rao (1959, 1960, 1961, 1964), N.C. Nair (1964, 1966); U.C. Bhattacharya (1969); Goel and Bhattacharya, 1982; Bhattacharya and Goel, 1982; Bhattacharya *et al.*, 1982; Uniyal and Hajra 1991; Uniyal *et al.*, 1999, 2007; C.M. Arora and many others of the Survey have collected plants which include orchids as well. C.M. Arora of Botanical Survey of India studied the orchids of this region and introduced live plants in the orchid house of Northern circle and subsequently published an enumeration of the Orchids of NorthWestern Himalaya with Gunnar Seidenfaden in *Nordic Journal of Botany* in 1982. C.M. Arora (1969a,b,c,d, 1972a,b, 1978, 1980; Arora and Malhotra, 1979) also published several new records including some new species from this region. The Botanists from the universities and scientists of FRI,

Dehradun also collected orchids from this region and made valuable contributions. R.K. Gupta (1955, 1957, 1962, 1968) published many papers. Raizada, Naithani and Saxena (1981) published *Orchids of Mussoorie* and Som Deva and Naithani (1986) published an illustrated *Flora of the orchids of NorthWest Himalaya*. The illustration made by the authors based on voucher specimens and carry the name of the collector and their number, so that their authenticities can be verified. They have included 239 species with 260 illustrations. Earlier, Hajra (1983a,b,c,d; 1987a,b) and Vij and his associates (Vij *et al.*, 1982, 1983; Vij and Verma, 2005, 2007; Verma *et al.*, 2009) have also made observations and contributions, in the region, regarding new and/or rare threatened and endemic plants. Pathak *et al.* (2010) published an update on the medicinal orchids of Himachal Pradesh with brief notes on their habit, distribution, and flowering period. Most of the orchids are becoming rare in nature and many are faced with extinction unless right steps are taken towards their conservation soon. As an eye opener, it may be mentioned that out of ca. 240 species so far known from North Western Himalaya, almost 50% are threatened rare or endangered.

The members of the family Orchidaceae are highly evolved group of plants and have attracted many a person because of their exquisite flowers. They exhibit enormous diversity. According to the present estimate, based on literature survey and herbarium records about 1,331 species in 186 genera of Orchids are known from India (Misra, 2007) out of which 239 species belonging to 72 genera are known from NorthWest Himalaya (Deva and Naithani, 1986). They are perennial herbs with simple leaves with or without pseudobulbs and can be easily identified because of the presence of the lip of labellum which is a modification of one of the perianth of the inner whorl, a column in the centre, formed by the union of stamen and style, their pollen

grains form pollinia and they have minute seeds without endosperm. The flowering season varies in different species in various genera. In Northern India, not much work has been done on the cultivation and propagation of orchids except at Orchid Laboratory, Botany Department, Panjab University, Chandigarh where earlier Late Dr. Vij and his colleague Prof. Promila Pathak and presently Prof. Promila Pathak has taken a lead and alongwith her students, is doing commendable work.

Major Threats

Most of the orchids are becoming rarer in nature and many are faced with extinction unless right steps are taken towards their conservation. The reasons for these precarious conditions of our beautiful orchids in this region are many. Foremost among them is the disturbance of the natural habitat of the orchids owing to human encroachments brought about by an ever increasing population pressure which necessitates the cleaning of forest for agricultural purposes and construction of new roads. Further, the lopping of trees

for fodder for the domesticated herbivorous animals and for firewood, by the poor rural people are some of the reasons for depletion of natural habitat of the orchids. Extensions of residential areas, habitat fragmentation, habitat degradation as a result of grazing etc. are some of the anthropogenic activities responsible for habitat loss. Natural calamities like cloudbursts triggering landslides in the high altitude are also one of the causes for loss of orchids in their natural habitat. Table 1 indicates a list of species which needs immediate attention and have comparatively greater ornamental value.

In Table 2, the species are arranged habit wise in alphabetic order with phenological data and altitudinal range. It is estimated that about 74 genera with 231 species occur in this region. These includes 127 terrestrial species belonging to 39 genera; 92 epiphytic species with 28 genera and 12 saprophytes with 7 genera. *Habenaria* Willd. is the largest terrestrial genus with 17 species and *Dendrobium* Swartz is the largest epiphytic genus with 16 species.

Table 1. List of orchid species with ornamental potential.

Sr. No.	Orchid species	Sr. No.	Orchid species
1	<i>Anoectochilus roxburghii</i> (Wall.) Lindl.	25	<i>D. normale</i> Falck.
2	<i>Aphyllorchis gollani</i> Duthie	26	<i>D. porphyrochilum</i> Lindl.
3	<i>A. parviflora</i> King and Pantl.	27	<i>D. primulinum</i> Lindl.
4	<i>Bulbophyllum cariniflorum</i> Rchb.f.	28	<i>Didicea cunninghamii</i> King and Prain ex King and Pantl.
5	<i>B. hookeri</i> (Duthie) J. J. Sm.	29	<i>Diplomeris hirsuta</i> (Lindl.) Lindl.
6	<i>B. secundum</i> Hook.f.	30	<i>Eria occidentalis</i> Seident.
7	<i>Calanthe alpina</i> Hook.f.	31	<i>Eulophia hormusjii</i> Duthie
8	<i>C. alismaefolia</i> Lindl.	32	<i>E. mackinnonii</i> Duthie
9	<i>C. brevicornu</i> Lindl.	33	<i>E. obtusa</i> (Lindl.) Hook.f.
10	<i>C. mannii</i> Hook.f.	34	<i>Flickingeria fugax</i> (Rchb.f.) Seident.
11	<i>C. pachystalis</i> Rchb.f. ex Hook.f.	35	<i>F. hesperis</i> Seident.
12	<i>C. plantaginea</i> Lindl.	36	<i>Galeola falconeri</i> Hook.f.
13	<i>C. puberula</i> Lindl.	37	<i>Gastrochilus distichus</i> (Lindl.) Kuntze
14	<i>Chiloschista usneoides</i> (D. Don) Lindl.	38	<i>Goodyera biflora</i> (Lindl.) Hook.f.
15	<i>Coelogyne cristata</i> Lindl.	39	<i>Kingidium deliciosum</i> (Rchb.f.) Sweet
16	<i>Cymbidium longifolium</i> D. Don	40	<i>K. taenialis</i> (Lindl.) Hunt.
17	<i>C. indioides</i> D. Don	41	<i>Liparis cespitosa</i> (Thow.) Lindl.
18	<i>C. lowianum</i> Rchb.f.	42	<i>L. platyrachis</i> Hook.f.
19	<i>Cypripedium cordigerum</i> D. Don	43	<i>Neottia listeroides</i> Lindl.
20	<i>C. elegans</i> Rchb.f.	44	<i>Neottianthe secundiflora</i> (Hook.f.) Schitr.
21	<i>C. himalaicum</i> Rolfe	45	<i>Oberonia ensiformis</i> (J.E. Sm.) Lindl.
22	<i>Dendrobium denneanum</i> A.F.G. Kerr.	46	<i>O. griffithiana</i> Lindl.
23	<i>D. gamblei</i> King and Pantl.	47	<i>Oreorchis indica</i> (Lindl.) Hook.f.
24	<i>D. heterocarpum</i> Wall. ex Lindl.	48	<i>Poneorchis nana</i> (Schitr.) Soo.

Table 2. List of epiphytic and terrestrial orchids with their altitude and flowering period. (contd.)

Species	Flowering	Approx. Altitude (m)
<i>Epipogium tuberosum</i> Duthie	August-September	2500
<i>Eulophia</i> R. Br. ex Lindl.		
<i>E. bicallosa</i> (D. Don) P.F.Hunt & Summerh.	March-April	upto 1000
<i>E. dabia</i> (D. Don) Hochr.	April-May	upto 1500
<i>E. explanata</i> Lindl.	May-June	upto 1000
<i>E. flava</i> (Lindl.) Hook.	June-July	1000
<i>E. graminea</i> Lindl.	March-April	upto 1000
<i>E. herbacea</i> Lindl.	June-July	upto 1000
<i>E. mackinnonii</i> Duthie	July-August	800
<i>E. obtusa</i> (Lindl.) Hook.	July-August	1500-2000
<i>Galeola</i> Lour.		
<i>G. falconeri</i> Hook.	July-August	1000-2000
<i>Geodorum</i> Jackson		
<i>G. densiflorum</i> (Lam.) Schitr.	June-July	800
<i>Goodyera</i> R. Br.		
<i>G. biflora</i> (Lindl.) J.D.Hook.	July-August	1500-2000
<i>G. foliosa</i> (Lindl.) Benth. ex Clarke	October-November	1500-2000
<i>G. fusca</i> (Lindl.) J.D.Hook.	August-September	3500-4000
<i>G. procera</i> (Ker. Gawl.) W.J.Hook.	May-June	500-1000
<i>G. repens</i> (L.) R. Br.	July-August	2500-3500
<i>G. viridiflora</i> (Bl.) Coll.	August-September	1500-2000
<i>Gymnadenia</i> R. Br.		
<i>G. orchidis</i> Lindl.	July-August	2500-3500
<i>Habenaria</i> Willd.		
<i>H. aitchisonii</i> Reichb.f.	July-August	2000-3500
<i>H. arietina</i> J.D. Hook.	July-August	1500-2500
<i>H. clavigera</i> (Lindl.) Dandy	July-August	2000-3500
<i>H. commelinifolia</i> (Roxb.) Wall. ex Lindl.	August-September	upto 1000
<i>H. digitata</i> Lindl.	August-September	upto 1500
<i>H. diphylla</i> Dalz.	August-September	upto 600
<i>H. edgeworthii</i> J.D.Hook.	August-September	1500-2500
<i>H. ensifolia</i> Lindl.	August-September	500-3000
<i>H. furcifera</i> Lindl.	August-September	600-1500
<i>H. intermedia</i> D. Don	August-September	1500-2500
<i>H. latilabris</i> (Lindl.) J.D. Hook.	August-September	1500-2500
<i>H. longifolia</i> Buch.-Ham. ex Lindl.	August-September	500-1500
<i>H. marginata</i> Coleb.	August-September	500-1000
<i>H. pectinata</i> (J.E. Sm.) D. Don	August-September	1500-3000
<i>H. plantaginea</i> Lindl.	August-October	500-1000
<i>H. pubescens</i> Lindl.	August-September	500-1000
<i>H. stenopetala</i> Lindl.	August-September	600-2000
<i>Hemipilia</i> Lindl.		
<i>H. cordifolia</i> Lindl.	August-September	1500-2000

Table 2. List of epiphytic and terrestrial orchids with their altitude and flowering period. (contd.)

Species	Flowering	Approx. Altitude (m)
<i>Herminium</i> Guettard		
<i>H. josephii</i> Reichb.f.	July-August	2500-3500
<i>H. kumaunensis</i> Deva & Naithani	July-August	3000-3500
<i>H. lanceum</i> (Thunb. ex Swarts) Vuijk	July-August	1200-2500
<i>H. mackinnonii</i> Duthie	July-August	1500-2000
<i>H. monophyllum</i> (D. Don) P.F.Hunt. & Summerh.	July-August	600-1500
<i>H. monorchis</i> (L.) R. Br.	July-August	2500-3500
<i>H. pugioniforme</i> Lindl. ex J.D. Hook.	July-August	3500-4000
<i>Liparis</i> Rich.		
<i>L. cespitosa</i> (Thou.) Lindl.	July-August	1000-1500
<i>L. cordifolia</i> J.D.Hook.	September-October	600-1000
<i>L. deflexa</i> J.D.Hook.	July-August	1500
<i>L. glossula</i> Reichb.f.	July-August	1500-2000
<i>L. platyrachis</i> J.D.Hook.	July-August	2000-2500
<i>L. paradoxa</i> (Lindl.) Reichb.f.	July-August	1500
<i>L. rostrata</i> Reichb.f.	December	1600
<i>L. resupinata</i> Ridl.	July-August	1500-2000
<i>Listera</i> R. Br.		
<i>L. longicaulis</i> King & Pantl.	July-August	3000-3500
<i>L. nandadeviensis</i> Hajra	August	3000
<i>L. ovata</i> (L.) R. Br.	June-July	2000-3000
<i>L. pinetorum</i> Lindl.	June-July	3000-3500
<i>L. tenuis</i> Lindl.	July-August	1000-3000
<i>Malaxis</i> Sol. & Sw.		
<i>M. acuminata</i> D. Don	July-August	1500-2000
<i>M. biaurita</i> (Lindl.) Kuntze.	July-August	700
<i>M. cylindrostachya</i> (Lindl.) Ktze.	July-August	2000-3000
<i>M. latifolia</i> J.E. Sm.	July-August	1800
<i>M. mackinnonii</i> (Duthie) Ames	July-August	600-1000
<i>M. muscifera</i> (Lindl.) Ktze	July-August	1700-3000
<i>Neottianthe</i> (Richb.) Schltr.		
<i>N. calcicola</i> (W.W. Sm.) Schltr.	July-August	3000
<i>N. secundiflora</i> (J.D.Hook.) Schltr.	August-September	3000
<i>Nervilia</i> Comm. & Gaud.		
<i>N. aragoana</i> Gaud.	June-July	700-1500
<i>N. falcata</i> (King & Pantl.) Schltr.	May-June	800
<i>N. gammieana</i> (J.D.Hook.) Schltr.	June-July	700
<i>N. infundibulifolia</i> Blatt. & McCann	July-August	800
<i>N. mackinnonii</i> (Duthie) Schltr.	June-July	700-1000
<i>N. plicata</i> (Andr.) Schltr.	May-June	700-1000
<i>N. prainiana</i> (King & Pantl.) Seidentf.	May-June	700-1000
<i>Oreorchis</i> Lindl.		
<i>O. foliosa</i> (Lindl.) Lindl.	June-July	2500
<i>O. indica</i> (Lindl.) J.D.Hook.	July-August	2000

Table 2. List of epiphytic and terrestrial orchids with their altitude and flowering period. (contd.)

Species	Flowering	Approx. Altitude (m)
<i>Oreorchis micrantha</i> Lindl.	June-July	2000-2500
<i>Pachystoma</i> Blume		
<i>P. senile</i> (Lindl.) Rehb.f.	March-April	700-1000
<i>Pecteilis</i> Rafin		
<i>P. gigantea</i> (L.) Rafin	September-October	700-2000
<i>P. triflora</i> (D. Don) Tang & Wang	August-September	700-2000
<i>Peristylus</i> Blume		
<i>P. affinis</i> (D. Don) Seident.	July-August	2000
<i>P. constrictus</i> (Lindl.) Lindl.	July-August	800
<i>P. duthiei</i> (J.D.Hook.) Deva & Naithani	August-September	2000
<i>P. elisabethae</i> (Duthie) Gupta	July-August	2000
<i>P. fallax</i> Lindl.	July-August	2000
<i>P. goodyeroides</i> (D. Don) Lindl.	July-August	700-2000
<i>P. lawii</i> Wight	July-August	700
<i>Phaius</i> Lour.		
<i>P. tankervilleae</i> (L'Herit.) Bl.	May-June	700
<i>Platanthera</i> L.C. Rich.		
<i>P. arcuata</i> Lindl.	June	2000
<i>P. stenantha</i> (J.D.Hook.) Soo	July-August	1500-2000
<i>Ponerorchis</i> Rehb.f.		
<i>P. chusua</i> (D. Don) Soo	July-August	3500-4000
<i>P. nana</i> (Schltr.) Soo	July-August	3000-4000
<i>P. renzii</i> Deva & Naithani	July-August	3300
<i>Satyrium</i> Swartz		
<i>S. ciliatum</i> Lindl.	August-September	2000-3000
<i>S. nepalense</i> D. Don	July-August	2500-3000
<i>Spiranthes</i> L.C. Rich.		
<i>S. sinensis</i> (Pers.) Ames	May-July	700-2000
<i>S. spiralis</i> (L.) C. Koch.	May-June	1200
<i>Tropidia</i> Lindl.		
<i>T. pedunculata</i> Bl.	May-June	700
<i>Zeuxine</i> Lindl.		
<i>Z. flava</i> (Wall. ex Lindl.) Benth. ex J.D.Hook	April-May	1200-1500
<i>Z. seidentadenii</i> Deva & Naithani	March-April	700
<i>Z. strateumatica</i> (L.) Schltr.	February-March	700-800
Epiphytic		
<i>Acampe</i> Lindl.		
<i>A. carinata</i> Griff.	October-December	700-1500
<i>A. rigida</i> (Buch.-Ham. ex Sm.) Hunt	September-October	1500
<i>Aerides</i> Lour.		
<i>A. multiflora</i> Roxb.	June-July	700-1500
<i>A. odorata</i> Lour.	June-July	700-1500
<i>Bulbophyllum</i> Thouars		
<i>B. careyanum</i> (W.J.Hook.) Spreng.	October-November	1400

Table 2. List of epiphytic and terrestrial orchids with their altitude and flowering period. (contd.)

Species	Flowering	Approx. Altitude (m)
<i>Bulbophyllum cariniflorum</i> Reichb.f.	June-July	1000-1500
<i>B. helenae</i> (Kuntze) J.J. Sm.	May-June	1500
<i>B. hookeri</i> (Duthie) J.J. Sm.	September-October	1400
<i>B. leopardinum</i> (Wall.) Lindl.	October-November	1600
<i>B. polyerthizum</i> Lindl.	March-April	700-1000
<i>B. reptans</i> (Lindl.) Lindl.	October-November	1400
<i>B. trixte</i> Reichb.f.	March-April	1200
<i>B. umbellatum</i> Lindl.	May-June	1200
<i>B. wallichii</i> Reichb.f.	September-October	1200
<i>Chiloschista</i> Lindl.		
<i>C. urneoides</i> (D. Don) Lindl.	Feb.-March	1500
<i>Clerostoma</i> Blume		
<i>C. asperum</i> (Reichb.f.) Garay	July-August	800
<i>Coelogyne</i> Lindl.		
<i>C. cristata</i> Lindl.	April-May	700-1500
<i>C. nitida</i> (Wall. ex D. Don) Lindl.	May-June	1500
<i>C. ovalis</i> Lindl.	September-October	700-1000
<i>C. stricta</i> (D. Don) Schltr.	April-May	1400
<i>Cryptochilus</i> Wall.		
<i>C. lutea</i> Lindl.	May-June	1200
<i>Cymbidium</i> Swartz		
<i>C. aloifolium</i> (L.) Swartz.	April-May	1000
<i>C. cyperifolium</i> Lindl.	March-April	1500
<i>C. eburneum</i> Lindl.	March-April	1200
<i>C. hookerianum</i> Reichb.f.	Feb.-March	1500
<i>C. indoides</i> D. Don	October-November	1500
<i>C. longifolium</i> D. Don	September-October	1400
<i>Dendrobium</i> Swartz		
<i>D. amoenum</i> Wall. ex Lindl.	May-June	700-1200
<i>D. aphyllum</i> (Roxb.) Fishcher	May-June	800
<i>D. bicameratum</i> Lindl.	August-September	1500
<i>D. candidum</i> Wall. ex Lindl.	April-May	1500
<i>D. chrysanthum</i> Lindl.	August-September	1600
<i>D. chryseum</i> Rolfe	May-June	1500
<i>D. crepidatum</i> Lindl.	April-May	1400
<i>D. denudens</i> D. Don	August-September	1500
<i>D. heterocarpum</i> Lindl.	May-June	1500
<i>D. macrostachyum</i> Lindl.	June-July	700
<i>D. monticola</i> P.F.Hunt & Summerh.	August-September	1400
<i>D. moschatum</i> (Buch.-Ham.) Swartz	June-July	1500
<i>D. normale</i> Falc.	May-June	1500
<i>D. porphyrochilum</i> Lindl.	April-June	1600
<i>D. primulinum</i> Lindl.	April-May	700-1200
<i>D. transparens</i> ex Lindl.	May-June	1500
<i>Eria</i> Lindl.		

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Species	Flowering	Approx. Altitude (m)
<i>Eri alba</i> Lindl.	June-July	1000-1400
<i>E. amica</i> Reichb.f.	March-April	1500
<i>E. coronaria</i> (Lindl.) Reichb.f.	October-November	1500
<i>E. graminifolia</i> Lindl.	May-July	1500
<i>E. muscicola</i> (Lindl.) Lindl.	August-September	1400
<i>E. occidentalis</i> Seident.	July-August	1500
<i>E. pubescens</i> (W.J.Hook.) ex Steud.	May-June	1500
<i>E. reticosa</i> Wight	August-September	1500
<i>E. spicata</i> (D. Don) Hand.-Mazz.	August-September	800-1200
<i>Flickingeria</i> Hawkes		
<i>F. fugax</i> (Reichb.f.) Hawkes	April-May	1500
<i>F. hesperis</i> Seident.	May-June	1600
<i>Gastrochilus</i> D. Don		
<i>G. acutifolius</i> (Lindl.) Ktze	November-December	1500
<i>G. calceolaris</i> (J.E.Sm.) D. Don	April-May	700-1500
<i>G. distichus</i> (Lindl.) Ktze	April-May	500-2000
<i>G. inconspicuus</i> (J.D.Hook.) Ktze	June-July	1500
<i>Kingidium</i> P.F. Hunt		
<i>K. deliciosum</i> (Reichb.f.) Sweet	July-August	1500
<i>K. taeniale</i> (Lindl.) P.F. Hunt	April-May	1500
<i>Liparis</i> Rich		
<i>L. cespitosa</i> (Thou.) Lindl.	July-August	1500
<i>Luisia</i> Gaud.		
<i>L. brachystachys</i> (Lindl.) Bl.	March-April	700
<i>L. trichorrhiza</i> (W.J.Hook.) Bl.	March-April	700
<i>L. zeylanica</i> Lindl.	March-April	1500
<i>Oberonia</i> Lindl.		
<i>O. acaulis</i> Griff.	August-October	1500
<i>O. ensiformis</i> (J.E.Sm.) Lindl.	May-July	700-1000
<i>O. falconeri</i> J.D.Hook.f.	September-October	700-1000
<i>O. griffithiana</i> Lindl.	March-June	1500
<i>O. indifolia</i> (Roxb.) Lindl.	October-November	700-1000
<i>O. myosurus</i> Lindl.	July-August	1500
<i>O. pachyrachis</i> Reichb.f. ex J.D.Hook	August-September	700-1000
<i>O. prainiana</i> King & Pantl.	April-May	800
<i>O. pyrulifera</i> King & Pantl.	September-October	1500
<i>Ornithochilus</i> Wall. ex Hook.f.		
<i>O. difformis</i> (Wall. ex Lindl.) Schltr.	July-August	1500
<i>Otochilus</i> Lindl.		
<i>O. lancilabius</i> Seident.	October-November	1500
<i>Pelatantheria</i> Ridl.		
<i>P. insectifera</i> (Reichb.f.) Ridl.	August-September	1500
<i>Pholidota</i> Lindl. ex Hook.		
<i>P. articulata</i> Lindl.	July-August	1500
<i>P. imbricata</i> W.J.Hook.	July-August	1500-1800

Table 2. List of epiphytic and terrestrial orchids with their altitude and flowering period. (contd.)

Species	Flowering	Approx. Altitude (m)
<i>Pteroceras</i> Hassk.		
<i>P. suaveolens</i> (Roxb.) Holtt.	June-July	1500
<i>Rhynchostylis</i> Blume		
<i>R. retusa</i> (L.) Bl.	June-July	800
<i>Smitinandia</i> Holttum		
<i>S. micrantha</i> (Lindl.) Holtt.	June-July	700
<i>Sunipia</i> Lindl.		
<i>S. bicolor</i> Lindl.	October-November	1500-2000
<i>Thelasis</i> Blume		
<i>T. longifolia</i> J.D.Hook.	July-August	1500
<i>Thunia</i> Rchb.f.		
<i>T. alba</i> (Lindl.) Reichb.f.	July-August	1500-2000
<i>Vanda</i> R. Br.		
<i>V. alpina</i> Lindl.	June-July	1500
<i>V. cristata</i> Lindl.	May-June	600-1500
<i>V. pumila</i> J.D.Hook.f.	May-June	600
<i>V. tessellata</i> (Roxb.) W.J.Hook. ex Don	June-July	600-1000
<i>V. testacea</i> (Lindl.) Reichb.f.	May-June	600-1000
<i>Vandopsis</i> Pfitz.		
<i>V. undulata</i> (Lindl.) J.J. Sm.	April-May	2000
Saprophytic		
<i>Aphyllorchis</i> Blume		
<i>A. gollani</i> Duthie	August	2500
<i>A. parviflora</i> King & Pantl.	June-July	3500
<i>Corallorhiza</i> Gagnebin		
<i>C. trifida</i> Chatelain.	July-August	3500
<i>Cymbidiopsis</i> H.J. Chowdhery		
<i>C. macrorhizon</i> (Lindl.) H.J. Chowdhery	July-August	600-2000
<i>Epipogium</i> Gmelin ex Borkhausen		
<i>E. aphyllum</i> (F.W. Schmidt) Sw.	August-September	2500-3500
<i>E. tuberosum</i> Duthie	August-September	2500
<i>Gastrodia</i> R. Br.		
<i>G. orobanchoides</i> (Falc.) Benth.	July-August	2500
<i>Galeola</i> Lour.		
<i>G. falconeri</i> Hook.f.	July-August	1500-2000
<i>Neottia</i> Guettard		
<i>N. kashmiriana</i> (Duthie) Beauv.	July-August	3000
<i>N. listeroides</i> Lindl.	August-September	2000-3000
<i>N. mackinnonii</i> Deva & Naithani	August-September	2000
<i>N. microglottis</i> (Duthie) Schltr.	August-September	2000-2500

Existing Measures for Conservation

So far not much work has been done to conserve the orchids in this region, except some preliminary steps for *insitu* conservation. National Parks, Wild Life

Sanctuaries, Biosphere Reserves *etc.*, have been established. These Protected Areas which are ultimate repositories of biological diversity in Natural habitat plays very important role in *insitu* Conservation of Orchids. In this region there are about 52 wild Life

Sanctuaries 12 National Parks, and some Biosphere reserves. The orchids in these Protected Areas are conserved, Uttarakhand (14.60%); Himachal Pradesh (12.80%), and Jammu and Kashmir (6.60%) are best covered states in PAS.

The most effective mechanism for conservation of orchids is *ex situ* methods. Orchidaria in the Botanic gardens and Establishment of gene banks are also important for conservation of orchids. In Northern India, some of the Botanic Gardens established in the universities especially in the orchid centre at Botany Department, Panjab University, Chandigarh where earlier Late Dr. Vij and now Prof. Promila Pathak is actively involved in research and development of orchids. Multiplication of orchids by tissue culture is also being done at this centre (Hossain *et al.*, 2009, 2010, 2012; Pathak and Vij 2001, 2007, 2012; Pathak *et al.*, 1992, 2001, 2011, 2012; Piri *et al.*, 2013; Vij and Pathak, 1988, 1989, 1992, 2006, 2010; Vij *et al.*, 1982, 1983, 1987). Botanical Survey of India is also maintaining germplasm of Orchids.

Measures to be Adopted to Save the Green Gold of Our Country

For any conservation programme management strategies should be formulated. First of all species wise status survey to know the exact population in the natural habitat *i.e.* quantitative analysis. Each inventory should list the exact population and describe habitat conditions required by the individual species.

Detailed research on biology of individual species is also necessary for proper management programme and for this purpose endemics should be given priority.

1. Establishment of Orchid Sanctuary

Prior to the declaration of an area as orchid sanctuary, the following important points should be taken into consideration :

- The host plants available in the area for epiphytic orchids
- Whether it is a primary forest or a secondary forest.
- Since the subtropical belts are generally rich in orchids, Prime importance should be given to protect this belt.
- The orchid sanctuaries should be set up in different climatic zones as follows : (a) Tropical (b) subtropical (c) Temperate (d) Sub alpine and Alpine

Since all species of orchids do not exist in one particular forest a place having comparatively more species of orchids should be declared as an orchid sanctuary and then other species may be introduced in the area from threatened habitats. The following are some of the Orchid rich areas in Uttarakhand :

- (a) Hindorakhal, a place in Tehri-Garhwal district, 8 km beyond Narendranagar on way to Agrakhal in the tropical belt is a good area. There is *Quercus incana* forest interspersed with *Euphorbia royleana*. Though the number of species of orchids are not many the richness in term of population density of the orchids is unique. As the area is till now comparatively free from biotic influence, action should be taken immediately. The significant species found in this area are *Coelogyne* spp., *Dendrobium amoenum* Wall, *D. bicameratum* Lindl; ex Lindl., *Eria spicata* (D. Don) Hand. Mazz., *Oberonia pachyrachis* Reichb.f. ex Hook.f., *Pholidota articulata* Lindl., *P. griffithii* Hook. f. *Rhynchostylis retusa* Blume, *Thunia alba* (Lindl.) Rechb.f., *Vanda cristata* Lindl. etc.
- (b) Mandal, a village in Chamoli district, 14 km away from Gopeshwar, the district headquarters, is also equally rich in orchids. The forest is controlled by the village Panchayat and if some alternative arrangement can be made for the fuel and fodder requirements of the villagers, this will be an ideal habitat for orchids conservation. *Calanthe mannii* Hook. f., *C. pachystalis* Rchb.f. ex Hook. f. *Cymbidium iridioides* D. Don, *Dendrobium* spp. are some of the orchids available in this area.
- (c) Askot Range, Pithoragarh Range (Shandev and Didihat), Dafia Dhoora and Kaffani Reserve Forest in Pithoragarh district, are also suitable for the establishment of orchid sanctuary. Out of ca 240 species known so far from Uttarakhand ca. 80 species have been recorded from these areas. *Bulbophyllum* spp., *Calanthe* spp., *Coelogyne* spp., *Cymbidium* spp., *Dendrobium* spp., *Eria* spp., *Flickingeria* spp. etc. are some of the orchids found in this area. The following host plants also should be preserved for the epiphytic orchids: *Alnus nepalensis*, *Engelhardtia spicata*, *Lyonia ovalifolia*, *Myrica esculenta*, *Pyrus* spp., *Rhododendron arboretum*, *Shorea robusta*, *Terminalia bellirica*, *Toona ciliata*, *Quercus* spp., etc.

2. Orchidaria should be established in the University Botany Departments

3. The growing of orchids by tissue culture method should be started in the Botany departments and research organizations of this region.

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