

# DIVERSITY, DISTRIBUTION PATTERN, AND INDIGENOUS USES OF ORCHIDS IN KANAWAR WILDLIFE SANCTUARY OF HIMACHAL PRADESH, NORTHWESTERN HIMALAYA

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## Abstract

The present investigation was carried out for the exploration of orchids in Kanawar Wildlife Sanctuary of Himachal Pradesh, NorthWestern Himalaya. Sixteen species of orchids representing nine genera were recorded. Amongst the species studied, 10 species were native to the Himalayan region and 2 were near endemic to the Indian Himalayan Region (IHR). Majority of these orchid species grow between 2501-2800 m. Eight different habitats were identified and majority of the orchid species were reported in shady moist habitat. Most of the species were used for curing various diseases/ailments by the inhabitants of the valley. *Dactylorhiza hatagirea* and *Malaxis muscifera*, the high altitude species were identified as Critically Endangered. Due to high commercial values of *D. hatagirea* and *M. muscifera* as medicine and food, these species are facing high anthropogenic pressure, leading to their rapid population depletion in the area. Therefore, regular monitoring of populations of orchids in relation to climate scenario has been suggested for understanding the dynamics of species and developing strategies for conservation.

## Introduction

THE HIMALAYA is the fascinating territory of the nature where the magnificence of the world's highest mountains is mirrored in the craggy beauty and unique culture of the people who live in its shadow. The Indian part of Himalayas covering an area of about 5 lakh km<sup>2</sup> (about 16.2% of country's total geographical area) forms the northern boundary of the country. It extends between latitudes 26°20' and 35°40' North, and longitudes 74°50' and 95°40' East. Most of the part of the Indian Himalayan Region (IHR) is covered by snow-clad peaks, glaciers of higher Himalayas and dense forest cover of mid Himalayas. The vegetation comprises of tropical, sub-tropical, temperate, sub-alpine and alpine types. Amongst the components of biodiversity, the orchids represent a unique and highly evolved group of monocot plants. The IHR supports about 8,000 flowering plants and family Orchidaceae is one of the species rich families of angiosperms (Ramudu and Khasim, 2015; Samant *et al.*, 2002). In India, the orchids are represented by 1141 species in 166 genera, of which 657 species are epiphytic and 484 are terrestrial and few are lithophytic as well (Kumar and Manilal, 1994). Orchids are considered as indicator species of habitat disturbances (Rose, 1999) and are worldwide famous for their charming and long lasting flowers. Apart from their ornamental significance, they find extensive utility in the traditional systems of medicine (Pathak *et al.*, 2010; Samant, 2002). The diversity of orchids decreases from NorthEast to NorthWest Himalayas (Deva and Naithani, 1986; Marpa

and Samant, 2012). Studies on orchid diversity have been carried out in Himachal Pradesh by various workers (Arora, 1986; Deva and Naithani, 1986; Duthie, 1906; Marpa and Samant, 2012; Rana *et al.*, 2008; Sharma *et al.*, 2015; Singh and Sharma, 2006; Verma *et al.*, 2013; Vij *et al.*, 2013). In general, a large number of studies have been carried out on orchids of IHR (Arora, 1986; Pangtey and Samant, 1991; Pangtey *et al.*, 1991; Samant *et al.*, 2002; Singh and Hajra, 1996; Vij *et al.*, 1983) but very few are available from protected areas. In Himachal Pradesh, also a very few studies are available for the protected areas (Rana *et al.*, 2008; Vij *et al.*, 1983). They, however, occasionally figure in some of the local floras of the state, and majority of them are terrestrial in habit (Chowdhery and Wadhwa, 1984; Dhaliwal and Sharma, 1999; Rana *et al.*, 2008; Singh and Rawat, 2000). While exploring the floristic diversity of the Kanawar Wildlife Sanctuary, an attempt has been made to: i) assess and identify the orchid diversity; ii) assess the status and distribution pattern of native and endemic orchids; iii) assess the economically important orchid diversity; iv) assess orchid diversity for threat categories, and v) suggest management options for their conservation.

## Materials and Methods

### Study Area

The present study has been conducted in Kanawar Wildlife Sanctuary (KWLS), which was established in

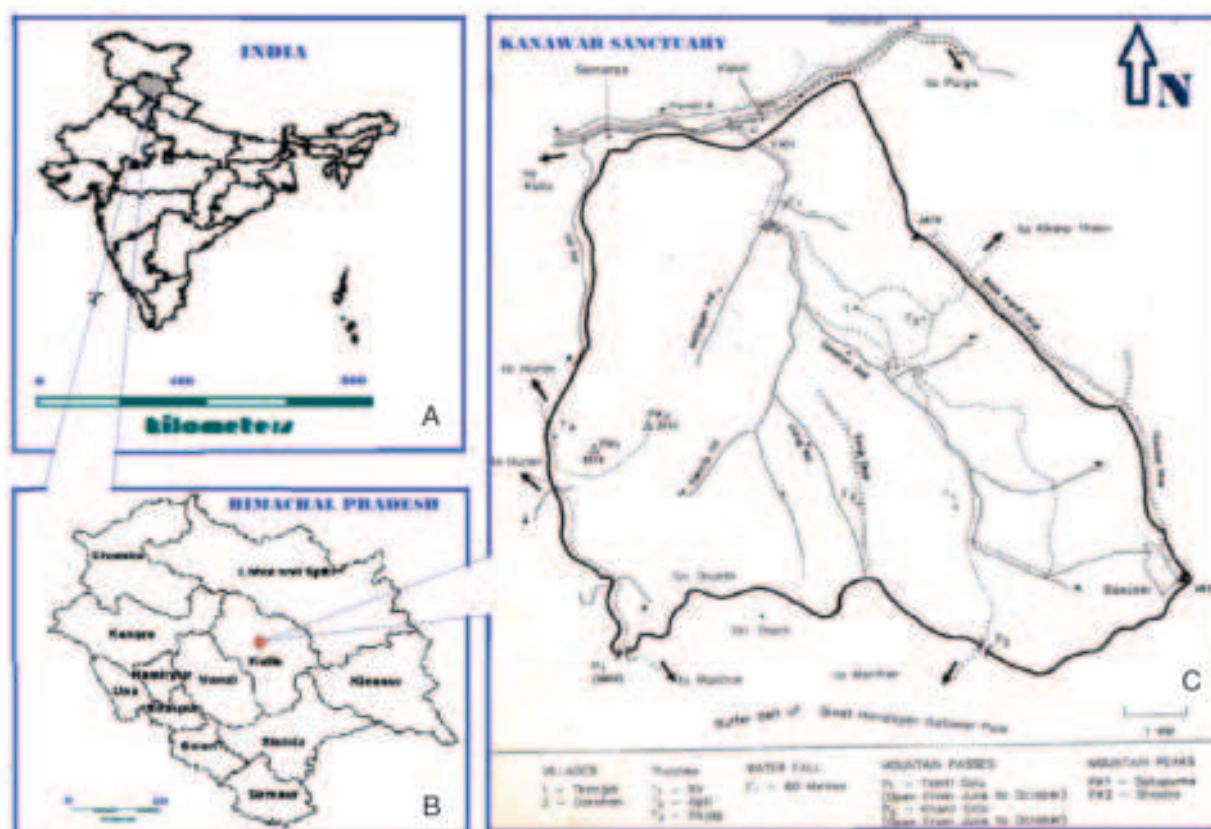


Fig. 1. Location map of the Kanawar Wildlife Sanctuary (KWLS) of Kullu District, Himachal Pradesh: A, Map of India showing the state of Himachal Pradesh; B, Himachal Pradesh showing Kullu District; C, KWLS (Kullu District).

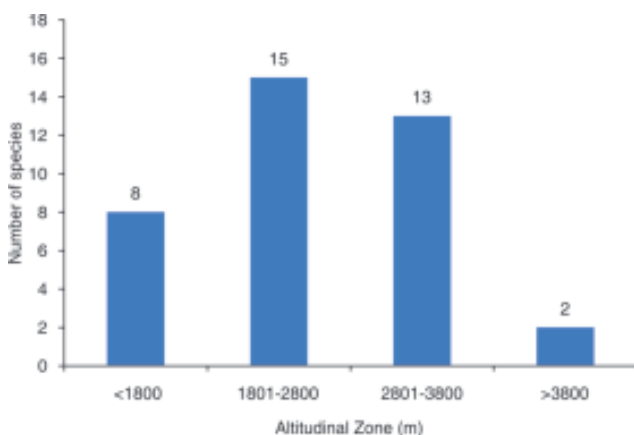


Fig. 2. Altitudinal distribution of orchids in Kanawar Wildlife Sanctuary.

1954, under section 26 of WPA, 1972 with an area of 61 Km<sup>2</sup>. The KWLS lies between 31°55' to 32°01'N latitudes and 77°17' to 77°23'E longitudes and an altitudinal range from 1,600 to 4,800 m. The study area supports a large number of sensitive biodiversity elements which include medicinal, wild, edible, rare, endangered, native and endemic species. The study area is a very narrow valley with the mountains rising steeply on both sides, allowing a couple less hours of

light than in other areas. There are only two villages *i.e.*, *Grahan* and *Thunja* located in the Sanctuary. In the Sanctuary, numerous thatches (*i.e.*, sheep resting places) are there. The area in general represents young immature topography, controlled both by structure and lithology of the under rocks. The soil is known to be of five types *i.e.*, lateritic, red, sandy, loamy and alluvial, which depends upon the underlying rocks and the effect of various agencies from time to time. The area is mainly represented by sub-tropical, temperate, sub-alpine and alpine vegetation and consists of three distinct seasons *i.e.*, summer (mid April-mid June), rainy (mid June-September), and winter (November-mid March). The study area receives precipitation both in the form of snowfall and rainfall. The temperate and sub-alpine forests are mainly dominated by broad leaved deciduous, evergreen and evergreen coniferous species, and alpine meadows are dominated by alpine shrubs and herbaceous species.

*Surveys, Sampling, Identification, and Data Analysis*

Total 18 sites were surveyed and sampled for the qualitative and quantitative assessment of the orchids during 2015-2017. Habitats were identified based on the physical features of the region. For qualitative

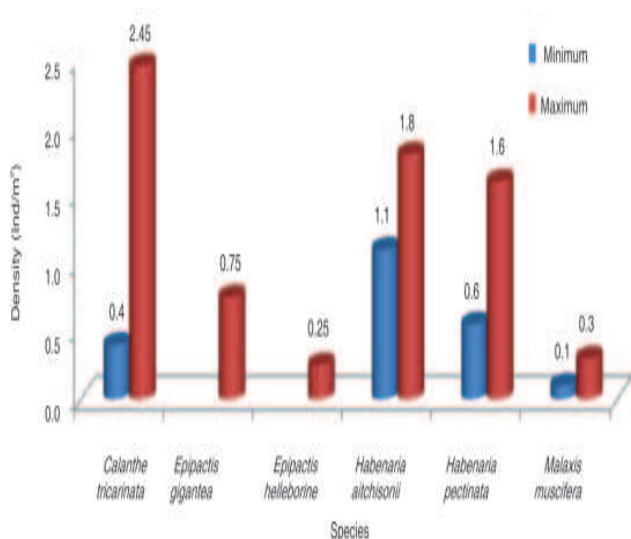


Fig. 3. Site representation and density of orchids in Kanawar Wildlife Sanctuary.

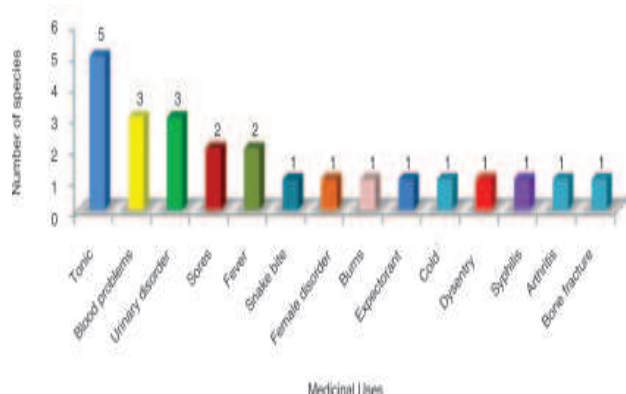


Fig. 4. Medicinal uses of orchids in Kanawar Wildlife Sanctuary.

assessment, rapid sampling was done and the sample of each species was collected and identified with the help of local and regional floras and literature (Barman *et al.*, 2016; Chowdhery and Wadhwa, 1984; Dhaliwal and Sharma, 1999; Kumar *et al.*, 2016, 2017; Pangtey *et al.*, 1991, Sharma *et al.*, 2017). For quantitative assessment, quadrat method was followed. Within a plot of 20×20 m, 20 quadrats of 1×1 m were randomly laid. Data was analyzed for density (Dhar *et al.*, 1997; Joshi and Samant, 2004). Soil samples were collected from the centre and four corners of each plot, which were up to 20 cm depth. All the samples were mixed together and a composite sample measuring 200 g was stored in airtight polythene bags and brought to the laboratory for the analysis of physico-chemical properties (Singh *et al.*, 2005). Species were analyzed for nativity, endemism, and threat categories. Nativity of the species was identified by following Samant (1993); Samant and Joshi (2005); and Sharma and Samant, (2014). Endemism of the species was identified based on their distribution

and by following Dhar and Samant (1993) and Samant *et al.* (1998). Species confined to IHR were considered as endemic and those with a distribution extending up to neighboring countries *i.e.*, Himalayan region of Afghanistan, Pakistan, Baluchistan, Tibet, Nepal, Bhutan and adjacent states of the IHR were considered as near endemic (Samant *et al.*, 1998). For the assessment of threat categories of orchid species, habitat preference, population size, distribution range and utilization values were collectively used by following Rana and Samant (2010). For indigenous uses, local inhabitants were interviewed and information was gathered (Lal and Samant, 2015; Pandey and Singh, 2016; Samant and Pant, 2006; Samant *et al.*, 1996a; Sharma and Samant 2017).

## Results

### Diversity and Distribution Pattern

A total of 16 species of orchids belonging to 9 genera were recorded (Fig. 6-9; Table 2). *Goodyera* (2 spp.), *Calanthe* (2 spp.), *Epipactis* (2 spp.), *Habenaria* (3 spp.), *Herminium* (2 spp.) and *Malaxis* (2 spp.) represented the maximum diversity. Three genera namely, *Cephalanthera*, *Dactylorhiza* and *Platanthera*, each was represented by a single species. Of these, 8 species of orchids were recorded from <1800 m altitudinal zone, followed by 1801-2800 m zone (15 spp.); 2801-3800 m zone (13 spp.) and >3800 m (2 spp.) respectively (Fig. 2). Overlapping of the species within above altitudinal zones has been observed. These species were found maximum in shady moist habitat (15 spp.), followed by riverine (13 spp.), water courses (12 spp.), dry forest (5 spp.), alpine moist, rocky and shrubby (2 spp., each) and bouldary (01 sp.) habitats.

### Site Representation and Orchid Density

Of the total species, 6 species were found in the sites sampled for quantitative assessment of vegetation. *Calanthe tricarinata* was recorded in maximum sites (12 sites), followed by *Malaxis muscifera* and *Habenaria aitchisonii* (3 sites, each), *H. pectinata* (2 sites) and *Epipactis gigantea* and *E. helleborine* (1 site, each). The density of *Calanthe tricarinata* ranged from 0.4-2.45 Ind m<sup>-2</sup>, *Epipactis gigantea*, 0.75 Ind m<sup>-2</sup>, *Habenaria aitchisonii*, 1.1-1.8 Ind m<sup>-2</sup>, *Malaxis muscifera*, 0.1-0.3 Ind m<sup>-2</sup>, *Epipactis helleborine*, 0.25 Ind m<sup>-2</sup>, and *Habenaria pectinata*, 0.6-1.6 Ind m<sup>-2</sup> (Fig. 3).

### Physico-Chemical Soil Properties

Physico-chemical properties of soil collected from the representative orchid habitats indicated wide variations

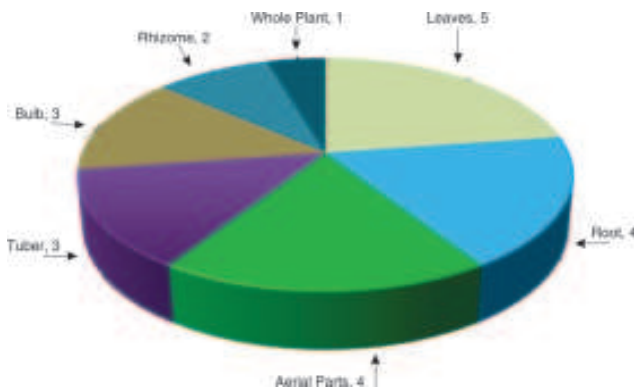


Fig. 5. Plant parts of orchids used for medicinal purposes in Kanawar Wildlife Sanctuary.

in soils with respect to their moisture, nitrogen and carbon contents (Table 1). Generally, soil moisture content ranged from 10.17%-65.52%, pH, 5.47-7.47, total nitrogen, 0.23-1.07% and organic carbon, 0.78-8.62%.

Table 1. Physico-chemical properties of soil in different sites supporting orchids in Kanawar Wildlife Sanctuary.

Species	Site representation	Altitude/Altitudinal Range (m)	pH	Moisture (%)	Nitrogen (%)	Carbon (%)
<i>Calanthe tricarinata</i>	12	2133-3080	5.47-7.47	17.61-65.52	0.23-1.07	0.78-8.62
<i>Epipactis gigantea</i>	1	4111	6.04	41.87	0.42	3.63
<i>E. helleborine</i>	1	2469	6.4	10.17	0.37	1.25
<i>Habenaria aitchisonii</i>	3	2473-2816	6.01-6.54	25.74-50.26	0.23-0.37	1.17-3.74
<i>H. pectinata</i>	2	2020-2894	5.47-6.11	41.4-26.58	0.42-0.61	5.30-7.10
<i>Malaxis muscifera</i>	3	2305-2634	6.22-7.47	20.59-62.11	0.37-0.56	1.17-7.25

**Nativity and Endemism**

Amongst the species, 10 species i.e., *Calanthe plantaginea*, *C. tricarinata*, *Dactylorhiza hatagirea*, *Epipactis helleborine*, *Goodyera biflora*, *G. fusca*, *Habenaria pectinata*, *Malaxis acuminata*, *M. muscifera*, and *Platanthera edgeworthii* were native to the Himalayan region and 6 species namely, *Cephalanthera longifolia*, *Epipactis gigantea*, *Habenaria aitchisonii*, *Habenaria goodyeroides*, *Herminium lanceum* and *H. monorchis* were non-natives. Amongst the species, *Dactylorhiza hatagirea* and *Platanthera edgeworthii* were Near Endemic.

**Threat Categorization**

Of the total species studied, 2 species namely, *Dactylorhiza hatagirea* and *Malaxis muscifera* were categorized as Critically Endangered and 3 species namely, *Goodyera biflora*, *Malaxis acuminata*, and



Fig. 6-9. Some representative orchids of Kanawar Wildlife Sanctuary: 6, *Dactylorhiza hatagirea*; 7, *Calanthe tricarinata*; 8, *Malaxis acuminata*; 9, *Habenaria aitchisonii*.

Table 2. Diversity, distribution, indigenous uses and status of orchids in Kanawar Wildlife Sanctuary.

Species	Altitudinal range (m)	Habitat	Nativity	Part/s used	Status	Indigenous Uses and practices
<i>Calanthe tricarinata</i> Lindl.	1600-3300	1, 2, 3, 5	Reg Himal	Lf, Pb	LC	Used to cure sores and eczema
<i>C. plantaginea</i> Lindl.	1700-2900	1,2,3	Reg Himal	-	LC	-
<i>Cephalanthera longifolia</i> (L.) Fritsch.	2300-3000	1, 3	Europe Afr Bor As Temp	Rh, Ap	LC	Used as tonic
<i>Dactylorhiza hatagirea</i> (D. Don) Rolfe*	2600-3400	3	Reg Himal Europe Afr Bor Oriens	Tu	CN	Used to treat bone fracture, fever, wounds, as expectorant, tonic and astringent, and is also edible
<i>Epipactis gigantea</i> Dougl. ex J. D. Hook.	2500-4200	1, 2, 3	Am Bor As Temp	-	R	Used to cure fever
<i>E. helleborine</i> (L.) Crantz	2300-3400	1, 2, 3, 12	Reg Himal	Lf, Rh	LC	Used for curing fever and as an aphrodisiac
<i>Goodyera biflora</i> (Lindl.) J. D. Hook.	1600-2500	1,4	Reg Himal	Ap	V	Decoction is used as blood purifier
<i>G. fusca</i> (Lindley) J. D. Hook.	3000-4300	1,4	Reg Himal	-	LC	-
<i>Platanthera edgeworthii</i> (Hook. f. ex Collett) R. K. Gupta*	1600-3300	1, 3	Reg Himal	Tu, Lf, Rt	V	Used as blood purifier, rejuvenator, cooling and spermopiotic
<i>Habenaria aitchisonii</i> Reichb.f.	2200-3300	1, 2, 3	Reg Bor Temp	Ap	LC	-
<i>H. pectinata</i> (J.E.Sm.) D. Don	1600-3500	1	Reg Himal	Lf, Tb,Rt	LC	Decoction is given in snake bites and arthritis.
<i>H. goodyeroides</i> D. Don	1600-2200	1, 3	Ind Or Malaya	-	LC	-
<i>Herminium lanceum</i> (Thunb. ex Sw.) Vujik	2000-3000	1, 3, 8, 11	Java	Pb	LC	Decoction is used to cure urinary diseases.
<i>H. monorchis</i> (L.) R. Br.	2200-3600	1, 3, 8, 11	Europe As Bor	Ap,Wp, Rt	NT	Decoction of the whole plant is used to cure urinary problems and as tonic.
<i>Malaxis acuminata</i> D. Don	1600-3400	1, 3	Reg Himal	Lf, Rt	V	Tonic
<i>M. muscifera</i> (Lindl.) Ktze.	1600-3400	1, 3	Reg Himal	Pb	CN	Used as tonic, aphrodisiac and styptic for curing dysentery, debility, sterility and paste is used in burns.

Afr, Africa; Am, America; As, Asia; Austr, Australia; Bor, Boreal; Himal, Himalayan; Ind, Indian; Occ, Occidental; Or, Oriental; Reg, Region; Subtrop, Subtropical; Temp, Temperate; Trop, Tropical; 1, Shady moist forest; 2, Dry forest; 3, Riverine; 4, Rocky; 5, Bouldary; 6, Degraded; 7, Camping site; 8, Alpine moist slope; 9, Alpine dry slope; 10, Glacial moraine; 11, Shrubbery; 12, Water coarse; Ap, Aerial part; Pb, Pseudobulb; Fl, Flower; Fr, Fruit; Lf, Leaf; Rh, Rhizome; Rt, Root; Sd, Seed; Tu, Tuber; Wp, Whole plant; CN, Critically Endangered; V, Vulnerable; NT, Near Threatened; LC, Least Concern; R, Rare; \*, Near endemic.

*Platanthera edgeworthii* as vulnerable, only one species *i.e.*, *Herminium monorchis* as near threatened and remaining species as Least Concern (Table 2).

#### Indigenous Uses

Of the total recorded orchid species, most of them have medicinal properties and used by inhabitants of the region for curing various diseases such as sores, eczema, fever, burns, cough, cold, cuts, sexual disability, rheumatism, female disorder, kidney

disorder, urinary problems, dysentery, sterility, *etc.* and as blood purifier and tonic. Maximum species (5) were used as tonic, and for curing blood problems, urinary disorder, fever and sore burns (2 spp. each), as expectorant and for curing cold, dysentery, snake bite, arthritis, female disorder, burn, syphilis and bone fracture (1 spp., each) (Fig. 4). Inhabitants use different plant parts *i.e.*, leaves (5 spp. each), aerial part and root (4 spp. each), tuber and bulb (3 spp. each), rhizome (2 spp.) and whole plant (1 sp.) for medicinal purposes (Fig. 5).

## Discussion

The State of Himachal Pradesh (30° 22' 40" to 33° 12' 40" North latitudes and 75° 47' 55" to 79° 04' 20" East longitudes) covers the parts of Trans and NorthWestern Himalayan biogeographic provinces. The systemic studies of orchids in the IHR have shown that diversity of the orchids decreases from Eastern Himalaya to Trans and North Western Himalaya (Deva and Naithani, 1986; Pangtey *et al.*, 1991) and similar trend has been reported by studies on ecology of orchids in the IHR (Marpa and Samant, 2012; Rana *et al.*, 2008; Samant, 2002). The State Himachal Pradesh supports relatively very less number of orchids compared to Western, Central and Eastern Himalaya (Deva and Naithani, 1986; Samant, 2002). As compared to the worldwide dominance of epiphytic orchids, the terrestrial orchids are dominant in district Kullu of Himachal Pradesh (Rana *et al.*, 2008). The present study provides first hand information on 16 species of orchids growing in Kanawar Wildlife Sanctuary in district Kullu of Himachal Pradesh. Amongst the total species of orchids, 10 species were natives and 2 near endemics indicating the naturalness and uniqueness of the orchids and high conservation importance of the area. Most of the species are used in indigenous medicines to cure a variety of human ailments. *Dactylorhiza hatagirea* and *Malaxis muscifera* have been categorized as Critically Endangered in the present study area. Due to high commercial value as medicine and food, these species are facing high anthropogenic pressure, leading to rapid population depletion, in the area. In future, if over exploitation and habitat degradation continues, these species may become extinct from the area.

Since, the recorded orchids grow in a protected area, therefore regular monitoring of populations of the orchids in relation to climate change is urgently required to understand the dynamics of the species. Hence, there is a need to develop further strategies for the conservation of orchid species.

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