

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

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### Abstract

The present study has been conducted in Khokhan Wildlife Sanctuary of Kullu district, Himachal Pradesh. Intensive and extensive surveys were conducted for the collection of orchid species. Rapid sampling for the qualitative and quadrat method for quantitative assessment has been followed. Total 16 species of orchids representing 11 genera were recorded. These species were distributed between 1,500-2,750 m amsl in shady moist, dry, and degraded habitats. The orchid species were analysed for nativity, endemism, indigenous uses, and threat categories. Amongst the species, 07 species were natives and 09 species were non-natives to the Himalayan Region. The species namely *Platanthera edgeworthii*, *Satyrium nepalense*, and *Habenaria pectinata* were Near Endemic and *Habenaria intermedia* was Endemic to Indian Himalayan Region. Of the total species, 06 species were found in the sites sampled for quantitative assessment of vegetation. *Epipactis helleborine* was recorded in maximum sites (05 sites), followed by *Calanthe tricarinata* (03 sites), *Habenaria intermedia*, *Herminium lanceum*, and *Malaxis muscifera* (02 sites, each) and *Epipactis latifolia* (01 site). Maximum species were found in shady moist habitat (06 spp.), followed by dry (03 spp.), and degraded (01 sp.) habitats. Quantitative assessment of the orchid species revealed their density very low i.e., < 1.0 ind m<sup>-2</sup>. Some of the species were used to cure sores, eczema, fever, burns, cough, cold, cuts, rheumatism, nervous disorder, female disorder, kidney disorder, urinary problems, dysentery etc. Maximum species (04 spp.) were used as tonic, followed by some to cure fever (03 spp.), eczema, sores, and urinary problems (02 spp., each). Amongst the part used, tuber and arial part (05 spp., each) were utilized maximum. *Habenaria intermedia* was Endangered, *Malaxis muscifera* and *Platanthera edgeworthii* were Vulnerable and *Epipactis helleborine*, *Herminium monorchis*, and *Satyrium nepalense* were Near Threatened and remaining species were under Least Concern category. Frequent monitoring of habitats using quadrat method is suggested to understand the impact of climate change and anthropogenic activities on the population of orchid species.

### Introduction

THE HIMALAYAN Region is the biodiversity rich area and supports about 8,000 species of flowering plants. Amongst the Angiosperms, the family Orchidaceae is regarded as one of the largest, most diverse, and distinctive family (Singh and Hajra, 1996; Samant, 2002), with estimates of about 25,000 to 35,000 species (Dressler, 1993). In India, it contributes about 10% of Indian flora with 184 genera and 1331 species (Kumar and Manilal, 1994). Orchids are nature's most extravagant group of flowering plants distributed throughout the world. They are the most significant ornamental plants, known for their beauty, colour combinations, and shape of their flowers. Himachal Pradesh, a hilly and mountainous state in the North Western Himalaya, is one of the richest reservoirs of unique orchid species. It supports 29 Wildlife Sanctuaries, 05 National Parks, and 01 Biosphere Reserve. Most of these protected areas are unexplored and under exploration especially for orchid diversity. In the Indian Himalayan Region (IHR), a large number of studies have been carried out on the orchids (Arora, 1986; Balodi, 1987; Barman *et al.*, 2016; Bhatti *et al.*,

2017; Deva and Naithani, 1986; Duthie, 1906; Kumar *et al.*, 2016, 2017, 2018; Pangtey *et al.*, 1991; Samant, 2009; Samant *et al.*, 1995; Sharma *et al.*, 2017; Verma *et al.*, 2013, Vij *et al.*, 1983). In Himachal Pradesh also, studies on orchid diversity have been carried out by some workers (Lal *et al.*, 2004; Marpa and Samant, 2012; Pathak *et al.*, 2010, 2011a; Rana *et al.*, 2008, Verma *et al.*, 2015, Sharma *et al.*, 2015; Barman *et al.*, 2016; Kumar *et al.*, 2017; Prakash *et al.*, 2018). However, a very few studies are available for the protected areas of the state. Therefore, the present attempt has been made to: i) assess orchid diversity of Khokhan Wildlife Sanctuary and gather information on indigenous uses; ii) analyze orchid species for nativity, endemism, and threat categories; and iii) suggest management options for conservation.

### Material and Methods

#### Study Area

Present study has been conducted in the Khokhan Wildlife Sanctuary (KhWLS) of the Kullu district, Himachal Pradesh (Fig. 1). The Khokhan Wildlife Sanctuary (31°50'10"N-31°53'24"N Latitudes and

77°03'21"-77°06'55" E Longitudes; area: 14.94 km<sup>2</sup>; altitudinal range 1,500-2,787 m amsl) supports diverse habitats, species and communities of the sub-tropical and temperate zones and temperature ranges between -10°C to 25°C, annual rainfall is 1000 mm and snowfall is 250 mm. The vegetation comprises of sub-tropical and temperate types and mainly dominated by evergreen coniferous and broad leaved evergreen and deciduous species. These forests support a large number of sensitive biodiversity elements including orchids, medicinal and aromatic plants, wild edibles, threatened, native and endemic plants, and unique faunal diversity.

*Survey, Sampling, Identification, and Data Analysis*

Extensive field surveys were conducted for the qualitative and quantitative assessment of orchid diversity in Khokhan Wildlife Sanctuary from 2016-2019. Habitats were identified based on the physical features. For qualitative 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 (Aswal and Mehrotra, 1994; Chowdhery and

Wadhwa, 1984; Dhaliwal and Sharma, 1999; Pangtey *et al.*, 1991; Samant, 1993; Singh and Rawat, 2000). For quantitative assessment, quadrat method was followed. Within a plot of 20m x 20m, 20 quadrat of 1m x 1m were randomly laid. Data were analyzed for density (Dhar *et al.*, 1997; Joshi and Samant, 2004). Species were analyzed for nativity, endemism, and threat categories. Nativity of the species was identified by following (Samant *et al.*, 1998; Samant and Joshi, 2005; Lal, 2007; Sharma *et al.*, 2014). Endemism of the species was identified based on their distribution and 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 (Himalayan region of Afganistan, Pakistan, Baluchistan, Tibet, Nepal, Bhutan, and Adjacent States of the IHR) were considered as near endemic. 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 of the villages

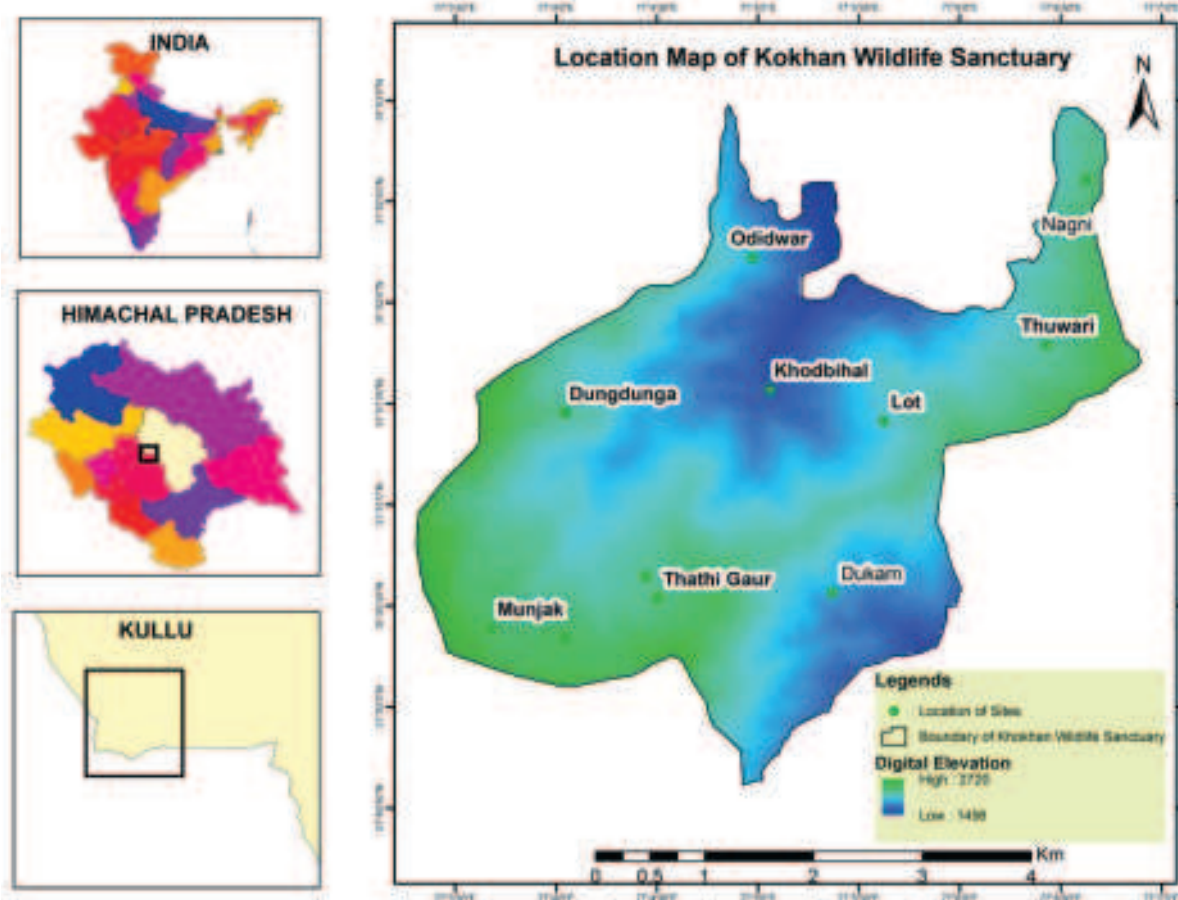


Fig. 1. Map of Khokhan Wildlife Sanctuary, District Kullu, Himachal Pradesh.

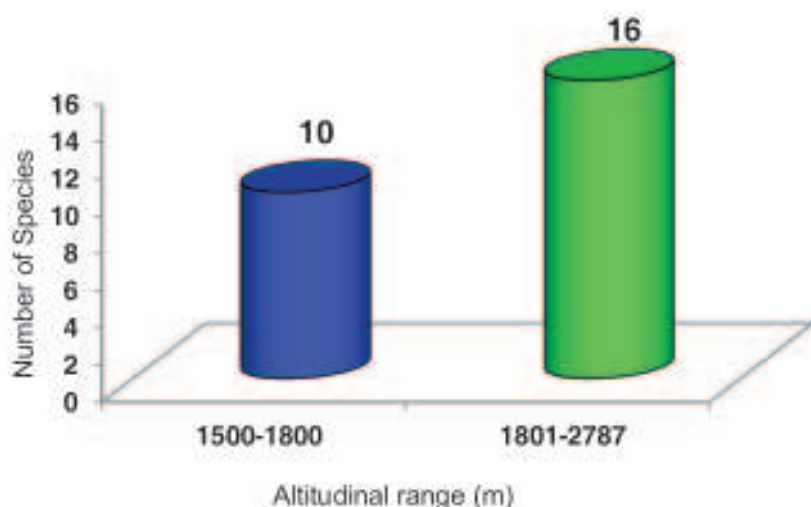


Fig. 2. Altitudinal distribution of orchids in Khokhan Wildlife Sanctuary.

namely, Lot, Rulgi, Kharka, Churgran, Chowkidhar, and Janahal were interviewed and information gathered (Samant and Pant, 2006; Lal and Samant, 2015; Pandey and Singh, 2016; Pathak *et al.*, 2010; Kumar *et al.*, 2017).

## Results

### Diversity and Distribution Pattern

A total 16 species of orchids representing 11 genera were recorded. Amongst the genera, *Epipactis* (03 spp.) and *Habenaria*, *Herminium*, and *Platanthera* (02 spp., each) were dominant (Table 1). These species were found between 1,500-2,750 m amsl and represented the shady moist, grassland, riverine, degraded, rocky, and dry habitats. Maximum orchids were found in shady moist habitat (06 spp.), followed by dry (03 spp.) and

degraded (01 sp.) habitats. Of the total species, 10 species were recorded from sub-tropical zone (1500-1800 m amsl) and 16 species from temperate zone (1801-2787 m) (Fig. 2).

### Site Representation and Density of Orchids

Of the total species, 06 species were found in the sites sampled for quantitative assessment of vegetation. *Epipactis helleborine* was recorded in maximum sites (05 sites), followed by *Calanthe tricarinata* (03 sites), *Habenaria intermedia*, *Herminium lanceum*, *Malaxis muscifera* (02 sites, each), and *Epipactis latifolia* (01 site). The density of *Calanthe tricarinata* ranged from 0.20-0.37 Ind m<sup>-2</sup>, *Epipactis latifolia*, 0.35 Ind m<sup>-2</sup>, *Epipactis helleborine*, 0.07-0.30 Ind m<sup>-2</sup>, *Habenaria intermedia*, 0.07-0.25 Ind m<sup>-2</sup>, *Herminium lanceum*, 0.15-0.20 Ind m<sup>-2</sup>, and *Malaxis muscifera* 0.22-0.25 Ind m<sup>-2</sup>.

### Nativity, Endemism, and Threat Categorization

Of the total species, 07 species *i.e.*, *Calanthe tricarinata*, *Epipactis helleborine*, *Epipactis royleana*, *Habenaria intermedia*, *Habenaria pectinata*, *Platanthera edgeworthii*, and *Platanthera latilabris* were native. *Platanthera edgeworthii*, *Satyrrium nepalense*, and *Habenaria pectinata* were Near Endemic, and *Habenaria intermedia* was Endemic to Indian Himalayan Region (Fig. 4). *Habenaria intermedia* was Endangered, *Malaxis muscifera*, and *Platanthera edgeworthii* were Vulnerable and *Epipactis helleborine*, *Satyrrium nepalense*, and *Herminium monorchis* were Near Threatened and remaining species were under Least Concern category.

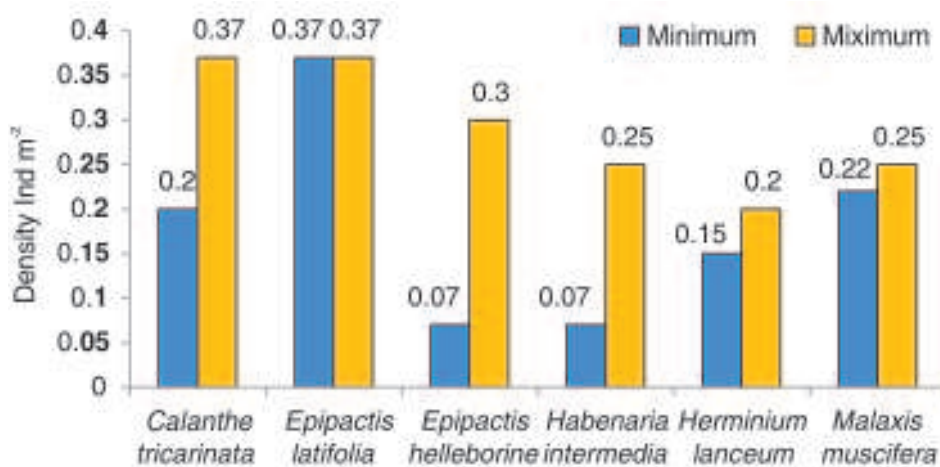


Fig. 3. Species wise density of orchids in Khokhan Wildlife Sanctuary

### Indigenous Uses

Some of the orchid species have medicinal properties and used to cure sores, eczema, fever, burns, cough, cold, cut, rheumatism, nervous disorder, female disorder, kidney disorder, urinary problems, dysentery *etc.* Maximum species were used as tonic (04 spp.), followed by some to cure fever (03 spp.), eczema, sores, and urinary problems, (02 spp., each). Amongst the part(s) used, tubers and aerial parts (05 spp., each) were utilized maximum,

Table 1. Diversity, distribution, nativity, endemism, indigenous uses, and threat status of orchids in Khokhan Wildlife Sanctuary of Himachal Pradesh, NorthWestern Himalaya.

Taxa	Local name	Altitudinal range (m)	Habitat	Nativity	Status	Part/s used	Indigenous uses and practices
<i>Brachycorythis obcordata</i> (Lindl. ex Wall.) Summerh.	Gamdol	1500-2000	1	As Trop	LC	Rz	Rhizome is used as expectorant, astringent, and as energy tonic.
<i>Calanthe tricarinata</i> Lindl.	Monkey Orchid	2200-2700	1, 2, 4, 7	Reg Himal	LC	Lf, Bb	Leaf paste applied on sores and eczema.
<i>Cephalanthera longifolia</i> (L.) Fritsch.	Hacchu fool	1800-2500	1	Europe	LC	Rz, Ap	Decoction of the leaves and bulbs used in Sores, eczema, and as aphrodisiac.
<i>Epipactis helleborine</i> (L.) Crantz	Broad Leaved Helleborine	1600-2700	1, 2, 3, 4	Reg Himal	NT	Lf, Rz	Tubers are used to treat insanity, gouts, headache, and stomachache.
<i>E. latifolia</i> (Lindl.) Hook.f.	-	2500-2700	1	Europe, As Bor	LC	Rz	Decoction of rhizome used to cure nervous disorder.
<i>E. royleana</i> Lindl.	Red Flowered Helleborine	1800-2700	1,6	Reg Himal	LC	Wp, R	The powder of dried rhizome is used to cure wounds.
<i>Habenaria intermedia</i> D. Don**	Ridhi	1500-2750	1, 4	Reg Himal	EN	Wp	Whole plant is used as tonic and tuber paste is used to cure various diseases such as hyperpiesia, fever cough, asthma, leprosy, and skin diseases.
<i>H. pectinata</i> D. Don*	Ridhi	1500-2700	1	Reg Himal	LC	Lf, Tb, R	Leaf juice applied in snake bites and tubers used against arthritis.

Table 1. Diversity, distribution, nativity, endemism, indigenous uses, and threat status of orchids in Khokhan Wildlife Sanctuary of Himachal Pradesh, NorthWestern Himalaya (Contd.).

Taxa	Local name	Altitudinal range (m)	Habitat	Nativity	Status	Part/s used	Indigenous uses and practices
<i>Herminium lanceum</i> (Thunb. ex Sw.) Vuijk	Muskorchid	1500-2500	1, 4, 6	Reg Himal	LC	Ap	Extract of plant given in suppressed urination.
<i>H. monorchis</i> (L.) R.Br.	Muskorchid	2200-2700	1,6	Europe As Bor	NT	Ap, Wp, R	Decoction of the whole plant is used for curing urinary problems and as a tonic.
<i>Malaxis muscifera</i> (Lindl.) Kuntze	Jeevak	2000-2750	1, 4, 6, 7	Europe	V	Bb	Decoction of stem is used in sterility, seminal weakness, dysentery, fever and general debility as a tonic.
<i>Pachystoma pubescens</i> Blume	Pink kunai	1500-1900	1, 2, 8	Java	-	-	-
<i>Platanthera edgeworthii</i> * (Hk.f. ex Collett) R.K.Gupta	Ridhi	2600-2700	1, 2, 7	Reg Himal	V	Tb, Lf,	Tuber and leaf powder is used as a blood purifier.
<i>P. latilabris</i> Lindl.	Bog orchid	2500-2750	1, 4	Reg Himal	LC	Wp	Whole plant is used in herbal medicine.
<i>Satyrium nepalense</i> D. Don*	Salam Mishri	1600-2500	4,8	Ind Or	NT	Ap, Tb	Decoction of tubers and stems is used to treat diarrhoea, dysentery, fever, malaria, and as a nutritional supplement.
<i>Spiranthes sinensis</i> (Pers.) Ames	Lady's Tresses	1500-2500	1, 2	Europe; As, Aus	LC	Ap, Tb	The mixture of dried flower powder and oil is applied on affected body parts and extract of the leaves used to cure diarrhoea.

EN, Endangered; V, Vulnerable; NT, Near Threatened; LC, Least Concern; Tb, Tuber; Bb, Bulb; Rz, Rhizome; Wp, Whole plant; Ap, Aerial part; Lf, Leaf; R, Root; Reg Himal, Himalayan Region; Bor, Boreal; As, Asia; As Trop, Tropical Asia; Aus, Australia; Ind Or, Indian Oriental; 1, Shady Moist; 2, Riverine; 3, Degraded; 4, Dry; 5, Bouldary; 6, Moist Alpine Slope; 7, Rocky; 8, Grassland; \*, Near Endemic; \*\*, Endemic.

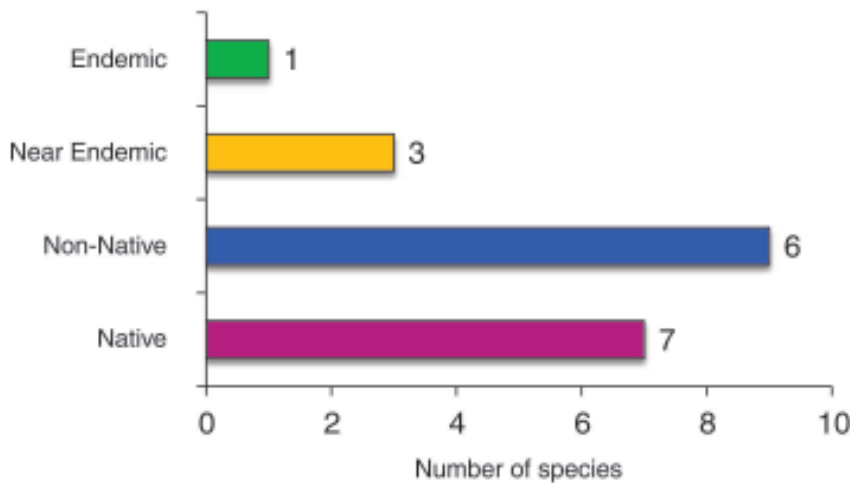


Fig. 4. Nativity and Endemism of orchids in Khokhan Wildlife Sanctuary.

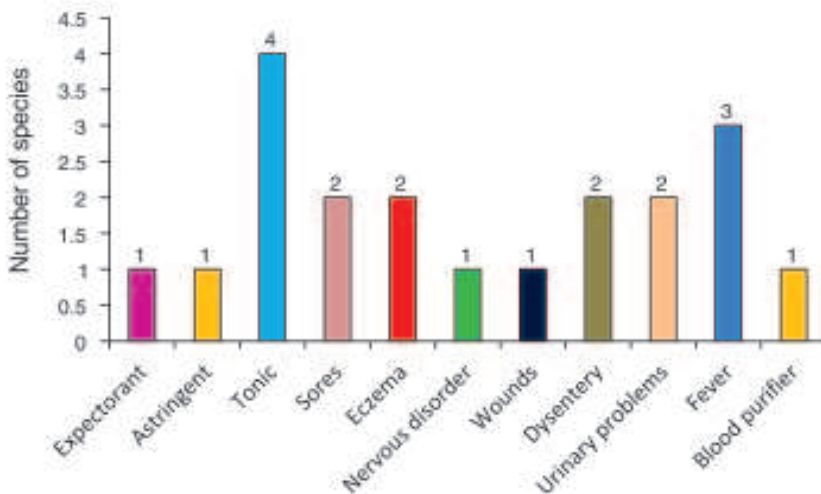


Fig. 5. Medicinal uses of orchids for curing different diseases.

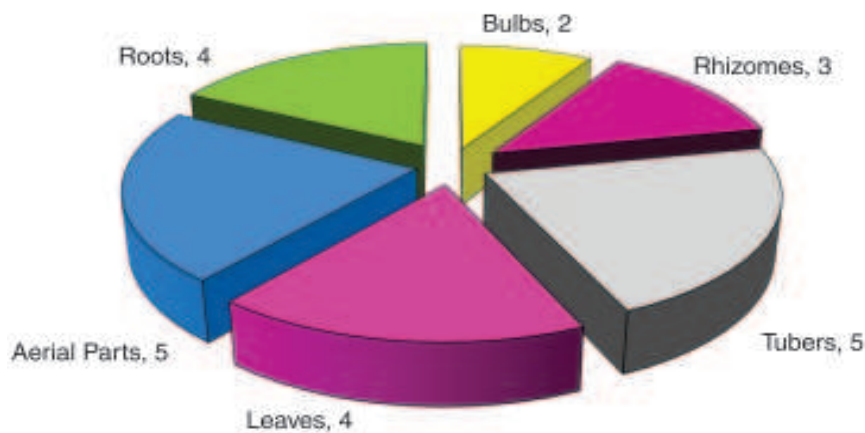


Fig. 6. Parts of medicinally important orchids used in Khokhan Wildlife Sanctuary.

followed by leaf and root (04 spp., each), rhizome (03 spp.), and bulbs (02 spp.). For instance, Leaf paste of *Calanthe tricarinata* was applied on sores and eczema; tubers of *Habenaria edgeworthii* was considered to be blood purifier and energy booster; leaf juice of *Habenaria pectinata* was applied to cure snake bites; leaf extract of *Spiranthes sinensis* was used to cure diarrhoea; and decoction made from tubers of *Satyrium nepalense* was used to cure dysentery and fever.

### Discussion

Orchids are globally known for their stunningly beautiful flowers of incredible shapes, sizes, and colours. They are widely distributed in tropical and subtropical regions of the world where favorable conditions such as high humidity and thick vegetation for their growth and development prevail (Verma *et al.*, 2011). The diversity of orchids in NorthWestern Himalaya is relatively very less compared to West, Central, and Eastern Himalaya (Deva and Naithani, 1986; Samant, 2002, 2009). Occurrence of 07 Native; 03 Near Endemic; and 01 Endemic species shows the importance, uniqueness, and conservation value of the orchid flora in Khokhan Wildlife Sanctuary. Threat categorization at local or regional level has been considered as the best approach for developing appropriate strategy and management plan (Rana and Samant, 2010). In the present study, occurrence of 01 Endangered (EN), 02 Vulnerable (VU), and 03 Near Threatened (NT) orchid species indicating high anthropogenic pressure particularly habitat degradation due to over grazing and overexploitation for commercial use. The temperate region

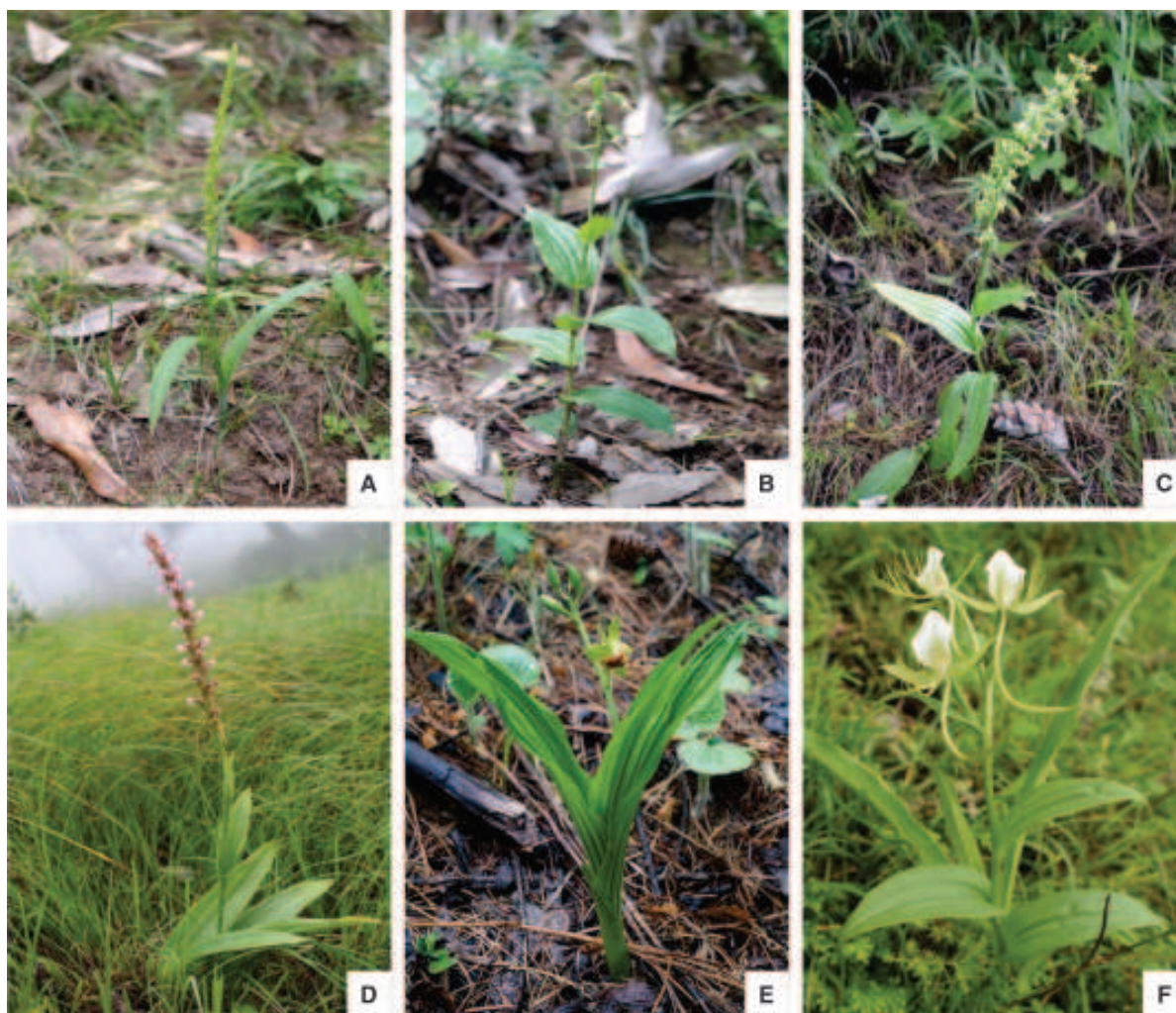


Fig. 7. Orchid diversity in Khokhan Wildlife Sanctuary of Kullu District, Himachal Pradesh. A, *Herminium lanceum*; B, *Epipactis helleborine*; C, *Platanthera edgeworthii*; D, *Satyrium nepalense*; E, *Calanthe tricarinata*; F, *Habenaria intermedia*.

represents the best habitat for the growth and development of the orchids in the Sanctuary. Therefore, periodical monitoring of habitats using standard ecological methods is required on priority basis. Education and awareness programmes for the local inhabitants and officials of Forest Department are required to educate them on the importance and conservation of orchids.

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