

STATUS, DISTRIBUTION, AND CONSERVATION OF ORCHIDS IN GREAT HIMALAYAN NATIONAL PARK OF HIMACHAL PRADESH, NORTH WESTERN HIMALAYA

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Abstract

The Indian Himalayan region (IHR), one of the richest bio-geographic zones of India, stretches to about 3,000 km in length and varies from 220-300 km in width. It covers nearly 17% of the total geographical area and 3.8% of India's population. The location, climate and topography of the IHR have endowed it with rich and diverse life forms. The Great Himalayan National Park (GHNP) is one of the World Heritage sites, located in Kullu district of Himachal Pradesh, NorthWestern Himalaya. It is well known for its rich faunal and floral diversity and important habitat for a large number of rare and threatened species. While exploring the floristic diversity of the GHNP, the intensive surveys were conducted to identify the diversity, distribution and status of the orchids. Rapid sampling method for the qualitative assessment and quadrat method for the quantitative assessment have been followed. A total of twenty one species of orchids representing 16 genera were recorded. These orchids were distributed between 2428-3820 m amsl and represented the shady moist, alpine meadows/ thatches, grassland, riverine, rocky, shrubby and dry habitats. The species were analysed for nativity, threat categories and indigenous uses. Amongst the species, 12 species were natives and 9 species were non-natives. Of the total species, 6 species were found in the sites sampled for quantitative assessment of vegetation. *Calanthe tricarinata* was recorded in maximum sites (10 sites), followed by *Dactylorhiza hatagirea* (8 sites), *Malaxis muscifera*, *Platanthera edgeworthii*, (2 sites each) and *Epipactis helleborine* and *Gymnadenia orchidis* (1 site each). Maximum orchids were found in shady moist habitat (15 species), followed by rocky (4 species), dry (2 species) and alpine, riverine and grassland (1 species each). The density of *Calanthe tricarinata* ranged from 0.05-1.3 Indm², *Dactylorhiza hatagirea*, 0.06-0.8 Indm², *Epipactis helleborine*, 0.45 Indm², *Gymnadenia orchidis*, 0.15 Indm², *Malaxis muscifera*, 0.15-0.4 Indm² and *Platanthera edgeworthii*, 0.25-0.35 Indm². Some of the species have medicinal properties and used for curing sores, eczema, fever, burns, blood purifier, tonic, cough, cold, cut, sexual disability, rheumatism, nervous disorder, female disorder, kidney disorder, spermopiotic, urinary problems, dysentery, sterility, etc. Maximum species were used as tonic (8 species), followed by for curing blood problems (6 species), fever, cough, spermopiotic and female disorder (3 species each) and burns, expectorant, cold, rheumatism, urinary disorder, dysentery, epilepsy (2 species each). Among the species, *Cypripedium himalaicum*, *Dactylorhiza hatagirea*, and *Habenaria intermedia* were found to be Endangered and *Cypripedium cordigerum*, *Malaxis muscifera*, and *Platanthera edgeworthii* as Vulnerable and *Herminium monorchis* Near Threatened and remaining species as Least Concern. Present study suggests that studies on various aspects like habitat ecology of these orchids for understanding the dynamics of their population, mass multiplication following conventional and *in vitro* propagation methods; educational and awareness programmes for the conservation of orchids need to be carried out.

Introduction

THE INDIAN Himalayan region (IHR), one of the richest bio-geographic zones of India stretches about 3,000 km in length and 220-300 km in width. It covers nearly 17% of the geographical area and 3.8% of India's population. It is one of the mega diverse regions of India and supports about 8,000 flowering plants species (Samant *et al.*, 1998; Singh and Hajra, 1996). Himachal Pradesh, which forms a part of the North Western Himalaya, is a repository of medicinal and aromatic plants. 5 National Parks, 33 Wildlife Sanctuaries and 01 Biosphere Reserve have been notified so far in the state covering 11% of the total area. It supports supreme, natural, and socio-economically important orchids (Chauhan, 1999; Deva and Naithani, 1986, Samant, 2002). Family Orchidaceae is the richest species family of angiosperms (Samant, 2002; Singh and Hajra, 1996) and it comprises about 779 genera

and 22,500 species (Mabberley, 2008). It is a widespread family of flowering plants with flowers often colourful and fragrant. In India, it represents second largest plant family and contributes about 10% of Indian flora with 184 genera and 1331 species (Kumar and Manilal, 1994). From the time that orchids were first imported from the Bahamas to Britain (in the early 18th century) these flowers have been cultivated for their commercial value and have been successfully hybridized and variegated. Many orchids are now propagated by tissue culture methods. The diversity of orchids decreases from NorthEast to NorthWest Himalaya (Deva and Naithani, 1986; Marpa and Samant, 2012; Pangtey and Samant, 1991; Samant, 2002, 2009; Samant *et al.*, 1995). Studies on orchid diversity have been carried out in Himachal Pradesh (Arora, 1986; Chowdhery and Agrawala, 2013; Deva and Naithani, 1986; Duthie, 1906; Marpa and Samant, 2012; Samant, 2002; Sharma *et al.*, 2015; Verma *et al.*, 2013; Vij *et*

al., 2013). In general, mention of orchids has been also made in the floristic studies by many workers (Chowdhary and Wadhwa, 1984; Collett, 1902; Dhaliwal and Sharma, 1999; Kaur and Sharma, 2004; Rana *et al.*, 2008; Sharma, 2008; Singh and Rawat, 2000; Singh and Sharma, 2006), but a very few studies are available for the protected areas of the state. Therefore, an attempt has been made to; i) assess the orchid diversity qualitatively and quantitatively in Great Himalayan National Park; ii) analyze orchid species for nativity, endemism, and threat categories; iii) assess orchid species for economical importance; and iv) suggest management options for the conservation of orchid diversity.

Materials and Methods

Study Area

Present study has been conducted in the Great Himalayan National Park (GHNP; 31°38'28"N-31°51'58"N Lat. and 77°20'11"E-77°45'52"E Long.; area: 1171 km²) of the Kullu district, Himachal Pradesh. The Great Himalayan National Park has been declared as UNESCO World Heritage Site on June, 2014. The area is characterized by deep river valleys and Steep Mountain slopes with an altitudinal range of 1000-6248 m amsl. The temperature varies from -4°C to 38°C. The slope-wise distribution of area shows that > 50% of the area of GHNP lies between the slope categories of 27°-45°. The vegetation comprises of sub-tropical, broad leaved, temperate, coniferous forests, alpine scrubs and alpine herbaceous vegetation which supports a large number of sensitive biodiversity elements

including orchids, medicinal and aromatic plants, wild edibles, rare, endangered, native, endemic and wild relatives of crop plants. The inhabitants are largely dependent on the horticultural and agricultural crops and floristic diversity for medicinal, food, fuel, fodder, house building, making agricultural tools, fiber, religious and various other purposes.

Surveys, Sampling, Identification and Data Analysis

Extensive surveys were conducted for the qualitative and quantitative assessment of orchid diversity in GHNP. 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 and Samant, 1991; Samant, 1993; Singh and Rawat, 2000). For quantitative assessment, quadrat method was followed. Within a plot of 20×20m, 20 quadrat of 1×1m were randomly laid. Data were analyzed for density (Dhar *et al.*, 1997; Joshi and Samant, 2004; Samant and Joshi, 2005). Species were analyzed for nativity, endemism and threat categories. Nativity of the species was identified by following Anonymous (1883-1970); Lal, 2007; Samant and Joshi, 2005; Samant *et al.*, 1996a; Sharma and Samant 2014. Endemism of the species was identified based on their altitudinal range 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 neighbouring countries (Himalayan

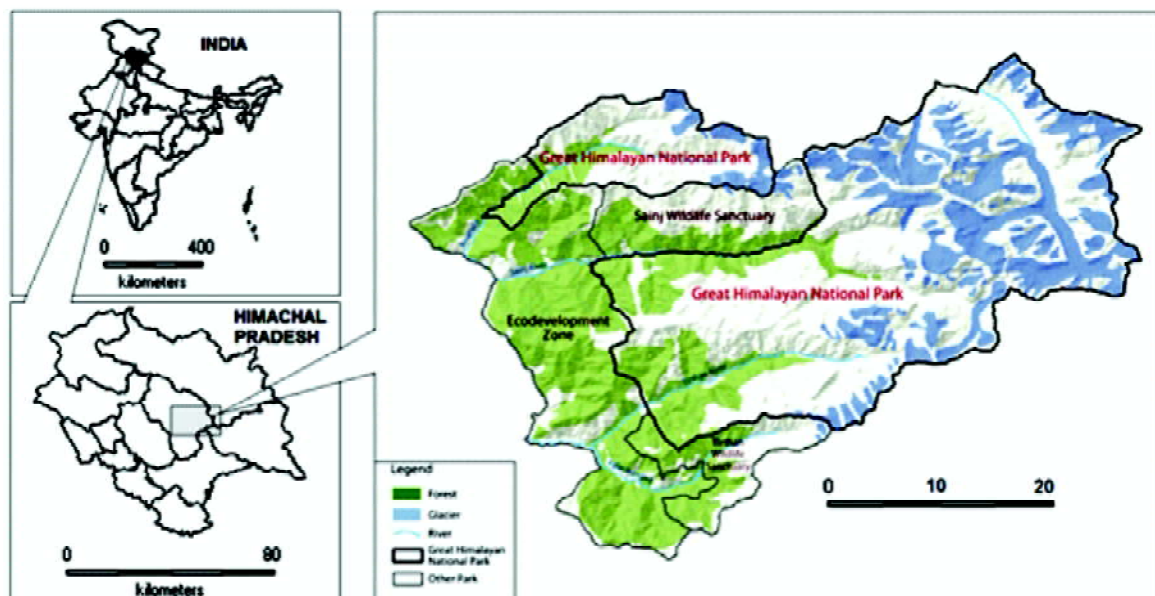


Fig. 1. Map of study area showing Great Himalayan National Park.

region of Afghanistan, 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 were interviewed and information gathered (Lal and Samant, 2015; Pandey and Singh, 2016; Samant and Pant, 2006).

Results

Diversity and Distribution Pattern

A total of 21 species representing 16 genera were recorded. Among the genera, *Cypripedium*, *Epipactis*, *Habenaria*, *Herminium* and *Platanthera* (2 species, each) were dominant (Table 1). These species were found between 2428-3820 m amsl and represented the shady moist, alpine meadows/thatches, grassland, riverine, rocky, shrubbery and dry habitats. Of these, 08 species of orchids were recorded in temperate zone (1801-2800 m amsl), 07 species in sub-alpine zone (2801- 3800 m amsl) and 02 species in the alpine zone (>3800 m amsl) (Fig. 2).

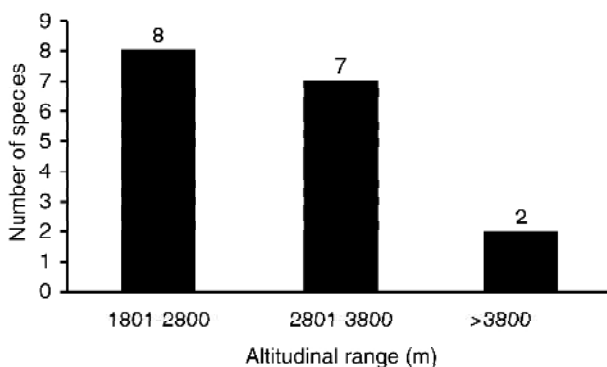


Fig. 2. Altitudinal distribution of the orchids in Great Himalayan National Park.

Habitat/Site Representation and Density of orchids

Of the total species studied, 6 species were found in the sites sampled for quantitative assessment of vegetation. *Calanthe tricarinata* was recorded in maximum sites (10 sites), followed by *Dactylorhiza hatagirea* (8 sites), *Malaxis muscifera* and *Platanthera edgeworthii* (2 sites, each) and *Epipactis latifolia* and *Gymnadenia orchidis* (1 site, each). Maximum orchids were found in shady moist habitat (15 spp.), followed by rocky (4 spp.), dry (2 spp.) and alpine, riverine, grassland (1 spp., each). The density of *Calanthe*

tricarinata, ranged from 0.05 -1.3 Indm², *Dactylorhiza hatagirea*, 0.06 - 0.8 Indm², *Epipactis latifolia*, 0.45 Indm², *Gymnadenia orchidis*, 0.15 Indm², *Malaxis muscifera*, 0.15-0.4 Indm², and *Platanthera edgeworthii*, 0.25-0.35 Indm². (Fig. 3).

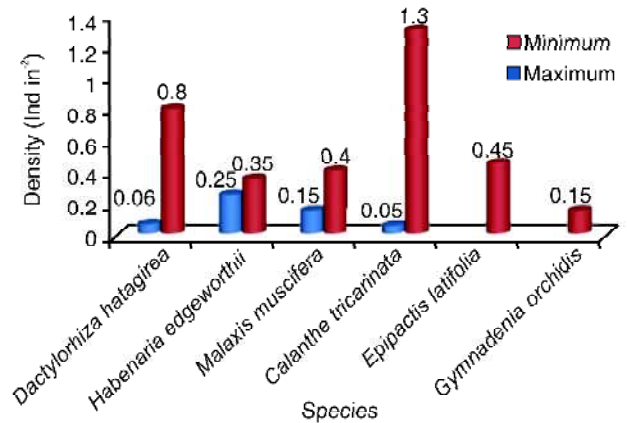


Fig. 3. Species wise density of some orchids in Great Himalayan National Park

Nativity and Endemism

Amongst the studied species, 11 species i.e., *Calanthe tricarinata*, *Cypripedium cordigerum*, *Dactylorhiza hatagirea*, *Epipactis royleana*, *Galeola lindleyana*, *Gymnadenia orchidis*, *Habenaria intermedia*, *H. pectinata*, *Oreorchis indica*, *Platanthera edgeworthii* and *P. latilabris* were natives and 10 species namely *Brachycorythis obcordata*, *Cephalanthera longifolia*, *Cypripedium himalaicum*, *Epipactis helleborine*, *Eulophia dabia*, *Goodyera repens*, *Herminium lanceum*, *H. monorchis*, *Malaxis muscifera* and *Spiranthes sinensis* were non-natives. Amongst the species, *Habenaria intermedia* was endemic and *Dactylorhiza hatagirea*, *Cypripedium cordigerum*, *C. himalaicum*, *Gymnadenia orchidis* and *Platanthera edgeworthii* were near endemic.

Threat Categorization

Among the orchid species studied, 03 species namely, *Cypripedium himalaicum*, *Dactylorhiza hatagirea* and *Habenaria intermedia* were endangered and 03 species, namely, *Cypripedium cordigerum*, *Malaxis muscifera* and *Platanthera edgeworthii* were vulnerable, *Herminium monorchis* near threatened and remaining species as least concern (Table 1).

Indigenous Uses

Of the total orchid species recorded, some of them have

Table 1. Diversity, distribution, status and indigenous uses of orchids in GHNP, NorthWestern Himalaya.

Taxa	Local Name	Altitudinal Range (m)	Habitat	Nativity	Status	Part/s Used	Indigenous Uses and Practices
<i>Brachycorythis obcordata</i> (Buch.-H am. ex D. Don) Summerh.	Gamdol	1500-2000	1	Asia Tropical	LC	Tb	Tonic
<i>Calanthe tricarinata</i> Lindl.	-	2200-3000	1, 2, 4, 11	Reg Himal	LC	Lf, Bb	Decoction of the leaves and bulbs is used to cure sores, eczema and as aphrodisiac.
<i>Cephalanthera longifolia</i> (L.) Fritsch.	-	1800-2500	1	Europe	LC	Rz, Ap	Tonic
* <i>Cypripedium cordigerum</i> D. Don	-	2500-3000	4	Reg Himal	V	Rz, R, Ap	Mental disorders
* <i>C. himalaicum</i> Rolfe ex Hemsl.	-	3000-4300	4	China Occ Sikkim Nepal	EN	Wp	Ornamental
<i>Dactylocriza hatagirea</i> (D. Don) Rolfe	Hathpanja	2800-3000	1, 4, 5, 9, 10, 11, 12	Reg Himal Europe Afr Bor Oriens	EN	Tb	Antibiotic, fever, control bleeding, burns, blood purifier and tonic, expectorant and in wound healing, bone fracture, cough, cold, cuts, sexual disability, rheumatism, many ayurvedic and Unani medicine preparation
<i>Epipactis helleborine</i> (L.) Crantz	-	2000-2800	1	Reg Himal	NT	Lf, Rz	Fever, blood purification, aphrodisiac
<i>E. royleana</i> Lindl.	-	1800-3500	1,9	Reg Himal	LC	Wp, R	Fodder, food, ornamental, spermopiatic,
<i>Eulophia dabia</i> (D. Don) Hochr.	-	1500-2400	4	China	LC	Tb	Blood purifier, appetizer, cardiac ailments, aphrodisiac tonic
<i>Galeola lindleyana</i> (Hook.f. & Thomson.) Rchb.f.	-	1200-2400	1	Reg Himal	-	Ap	Rheumatism

Table 1. Diversity, distribution, status and indigenous uses of orchids in GHNP, North Western Himalaya (contd.)

Taxa	Local Name	Altitudinal Range (m)	Habitat	Nativity	Status	Part/s Used	Indigenous Uses and Practices
<i>Goodyera repens</i> (L.) R. Br.	-	2800-3000	1,2,7,9	Reg Bor Temp	LC	Ap, Tb	Decoction is used as appetizer; plant paste is applied externally in syphilis and blood purifier and for curing female disorder, cold, and kidney problems.
* <i>Gymnadenia orchidis</i> Lindl.	-	3500-4500	1, 4	Reg Himal	LC	Tb	Gastric and urinary disorder
** <i>Habenaria intermedia</i> D. Don	Ridhi	1500-2800	1	Reg Himal	EN	-	Tonic, expectorant and rejuvenator, fever, skin disease and blood disorder
<i>H. pectinata</i> (J.E.Sm.) D. Don	-	1500-3500	1	Reg Himal	LC	Lf, Tb, R	Snake bites and arthritis
<i>Hermidium lanceum</i> (Thunb. ex Sw.) Vujik.	-	1250-3000	9	Reg Himal	LC	Ap	Anti-suppressant properties
<i>H. monorchis</i> (L.) R.Br.	-	2200-3000	1,9	Europe As Bor	NT	Ap, Wp, R	Decoction of the whole plant is used in urinary problems, tonic
<i>Malaxis muscifera</i> (Lindl.) Ktze.	-	2000-3000	1, 7, 9, 11	Europe	V	Bb	Cooling, spermotioc, decoction is used as refrigerant, febrifuge, tonic, aphrodisiac and styptic for curing dysentery, debility, sterility and paste is used in burns.
<i>Oreorchis indica</i> (Lindl.) J.D. Hook.	-	2000-2500	1	Reg Himal	LC	-	-
* <i>Platanthera edgeworthii</i> (Hook.f. ex Collett) R.K.Gupta	-	2600-3000	1, 2, 11	Reg Himal	V	Tb, Lf, R	Blood purifier, rejuvenator, cooling and spermotioc
<i>P. latilabris</i> Lindl.	-	2500-3500	4	Reg Himal	LC	-	Herbal medicine
<i>Spiranthes sinensis</i> (Pers.) Ames	-	1500-2500	1	Europe As Aus	LC	Ap, Tb	Anti inflammatory, cancer, tonsillitis, sore throat, debility, cough, tuberculosis, haemoptysis

EN, Endangered; V, Vulnerable; NT, Near Threatened; LC, Least Concern; Tb, Tuber; Bb, Bulb; Rz, Rhizomes; Wp, Whole plant; Ap, Ariel part; Lf, Leaf; R, Root; Reg Himal, Himalayan Region; Bor, Boreal; Afr, Africa; As, Asia; Trop, Tropical; Temp, Temperate; Orient, Oriental; 1, Shady Moist; 2, Riverine; 4, Dry; 5, Bouldary; 7, Shrubby; 9, Moist Alpine Slope; 10, Dry Alpine Slope; 11, Rocky; 12, Grassland; *, Near Endemic and **, Endemic

medicinal properties and are used to cure sores, eczema, fever, burns, blood purifier, tonic, cough, cold, cuts, sexual disability, rheumatism, nervous disorder, female disorder, kidney disorder, spermopiotic, urinary problems, dysentery, sterility, etc. Maximum species were used as tonic (8 species), followed by blood problems (6 species), fever, cough, spermopiotic, female disorder (3 species, each) and burns, expectorant, cold, rheumatism, urinary disorder, dysentery, epilepsy (2 species, each) (Fig. 4). Inhabitants use different plant parts *i.e.*, aerial parts and tubers (08 species, each), rhizome (04 species), leaves, root and whole plant (03 species, each) and bulb (02 species) for medicinal use (Fig. 5).

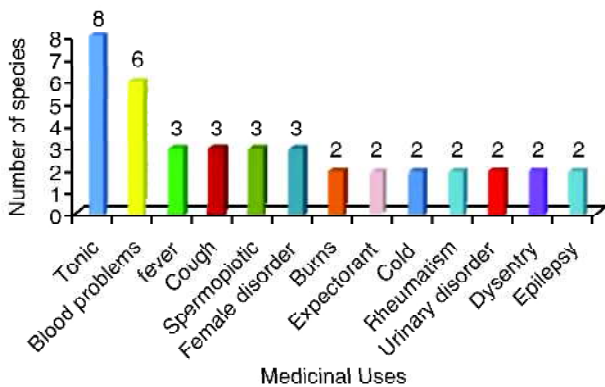


Fig. 4. Number of medicinal uses of orchids in Great Himalayan National Park.

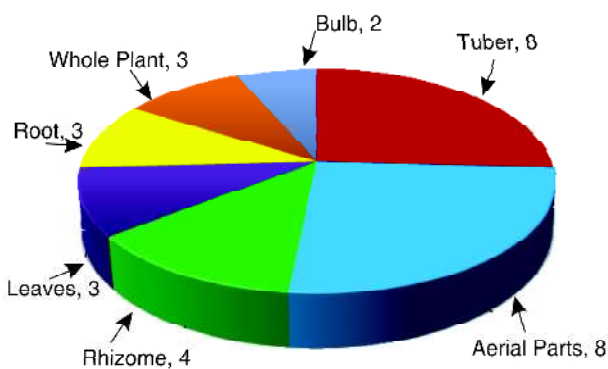


Fig. 5. Part of medicinally important orchids used in Great Himalayan National Park.

Discussion

The Great Himalayan National Park is one and only World Heritage site in Himachal Pradesh. It represents typical topography with diverse habitat, species, communities and ecosystems. In addition to the unique

group of plants and their diversity, it supports natural and unique orchid species. During the extensive survey in the GHNP 21 species of orchids were recorded. The study provides information on diversity, distribution pattern, nativity, endemism, indigenous uses and threat categorization of orchids in GHNP, Kullu district in Himachal Pradesh. Orchids are among the most highly prized of ornamental and medicinal plants. Orchids with their bewildering range of flowers and beautiful colour combinations provide a source of profound aesthetic value. The systemic studies of orchid in the IHR have shown that, diversity of the orchids decreases from Eastern Himalaya to Trans, North Western Himalaya (Deva and Naithani. 1986; Pangtey and Samant, 1991a) and similar trend has been reported by studies on ecology of orchids in IHR (Marpa and Samant, 2012; Rana *et al.*, 2008; Samant, 2002). Occurrence of 12 native and 01 endemic and 05 near endemic species shows the naturalness and uniqueness of the orchid flora. The study indicates that, number of orchid species decrease from temperate (1801-2800 m) to sub - alpine (2801-3800 m) and alpine (>3800 m) regions. This clearly shows that the severe climatic conditions support only specific species in the high altitude region. Over exploitation of the roots, whole plant, bulbs, tubers, and rhizomes may lead to extinction of the species from natural habitats. Presence of endangered and vulnerable species of orchids also shows that these species are either being overexploited for one's own use or commerce and tubers eaten by wild animals lead to their poor regeneration in natural habitat. Earlier Barman *et al.* (2016) and Kumar *et al.* (2016) also attempted to study diversity and distribution of orchids in Kullu district in Himachal Pradesh.

Due to habitat degradation and changing environmental conditions, the species of orchids are facing high degree of threats. Therefore, habitat monitoring, development of conventional and *in vitro* propagation protocols, mass multiplication of the species, establishment and maintenance in the *in situ* and *ex situ* conditions, educational and awareness programs for the inhabitants and their participation for conservation management are suggested to maintain the gene pool of such unique and valuable group of plants for future generation.

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