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DIVERSITY, DISTRIBUTION AND CONSERVATION OF ORCHIDS IN NARGU WILDLIFE SANCTUARY, NORTHWEST HIMALAYA

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Abstract

Like other parts of the Indian Himalayan Region, Himachal Pradesh also supports unique orchid flora. In the present investigation, extensive field surveys were conducted to study the orchid diversity of Nargu Wildlife Sanctuary during 2010-2015. During exploration of the floristic diversity, total 15 species of orchids representing 12 genera were recorded between 970-4052 m, amsl. These were analyzed for nativity and endemism. Eleven species were natives and four non-natives; 2 species were near endemic and one species (*Habenaria edgeworthii*) was endemic to Indian Himalayan Region. Among genera, *Habenaria*, *Herminium*, and *Malaxis* (2 species each) were dominant. Different plant parts *i.e.*, leaves (6 species), aerial parts and tubers (4 species each), bulbs (2 species), roots and rhizomes (1 species each) were used by the inhabitants for various therapeutic uses. Three species namely *Dactylorhiza hatagirea*, *Herminium monorchis* and *Malaxis muscifera* have been identified as Critically Endangered, 04 species (*Habenaria edgeworthii*, *Malaxis acuminata*, *Nervilia plicata*, and *Neottia listeroides*) as Endangered, 03 species (*Habenaria pectinata*, *Herminium lanceum* and *Spiranthes sinensis*) as vulnerable and 05 species (*Calanthe tricarinata*, *Epipactis helleborine*, *Goodyera fusca*, *Satyrium nepalense* and *Vanda cristata*) as near threatened. Habitat degradation, over exploitation, and complex nutrient requirement are causing rapid decrease in the population of these species in the area. Therefore, study on habitat ecology of these species requires priority attention. In addition, educational and awareness programmes on status and conservation and involvement of inhabitants in conservation would help in their conservation and management.

Introduction

THE INDIAN Himalayan Region (IHR) supports about 8,000 flowering plants and family Orchidaceae is one of the species rich families of angiosperms (Samant, 2002; Singh and Hajra, 1996). Orchids are worldwide famous for their charming and long lasting flowers and the family Orchidaceae comprises 22,500 species and 779 genera, second largest to Asteraceae; they form a diverse group of plants and represent a peak in the evolution of monocots. In India, 9% of flora (1300 species and 140 genera) is composed of orchids and is present predominantly in temperate Himalaya (Yonzone *et al.*, 2010). These are terrestrial, epiphytic and saprophytic in nature and are cultivated for beautiful flowers and widely known for their economic importance but less for their medicinal value. The diversity of orchids decreases from North East to North West Himalaya (Chowdhery and Wadhwa, 1984; Deva and Naithani, 1986; Marpa and Samant, 2012; Samant, 2002, 2009; Samant *et al.*, 1995). The north Indian hill state, Himachal Pradesh, is also very well known for its typical topography, large altitudinal range, and diverse habitats, and is representative of natural, unique and socio-economically important biodiversity. It supports 32 Wildlife Sanctuaries; 02 National Parks and 01 Biosphere Reserve. Most of the protected areas are unexplored and under explored especially for orchid diversity. On the other hand, medicinal properties and traditional uses of orchids are very poorly studied in this state till now. Further, scanty populations of these plants due to their complex nutrition requirement and anthropogenic activities make them highly vulnerable.

In general, in Himachal Pradesh, a very few studies have been carried out on Orchids (Arora, 1986; Chowdhery and Agrawala, 2013; Deva and Naithani, 1986; Duthie, 1906; Marpa and Samant, 2012; Samant, 2009; Samant *et al.*, 1995; Verma *et al.* 2013; Vij *et al.*, 1983, 2013). In general, mention of orchids has been also made in the floristic studies by many workers (Chowdhery and Wadhwa, 1984; Collett, 1902; Dhaliwal and Sharma, 1999; Kaur and Sharma, 2004; Lal *et al.*, 2004; Rana *et al.*, 2008; Singh and Rawat, 2000; Singh and Sharma, 2006; Sharma, 2008, 2013; Singh, 2007; Thakur, 2012), but 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 Nargu Wildlife Sanctuary and gather information on indigenous medicinal uses; ii) analyze orchid species for nativity, endemism, and threat categories; and iii) suggest strategy and management plan for the conservation of orchid diversity.

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Materials and Methods

Study Area

The Nargu Wildlife Sanctuary (NWLS) (31˚46' to 32˚05' N Latitudes and 76˚50' to 77˚04' E Longitudes) is located in the Mandi district of Himachal Pradesh (Fig 1). This Sanctuary was notified in 1972. It covers an area of over 278 km^2 with an altitudinal range, 970-4052 m amsl; the temperature ranges between -10^{o}C to 35^{o}C and mean annual rainfall is 1400 mm. It

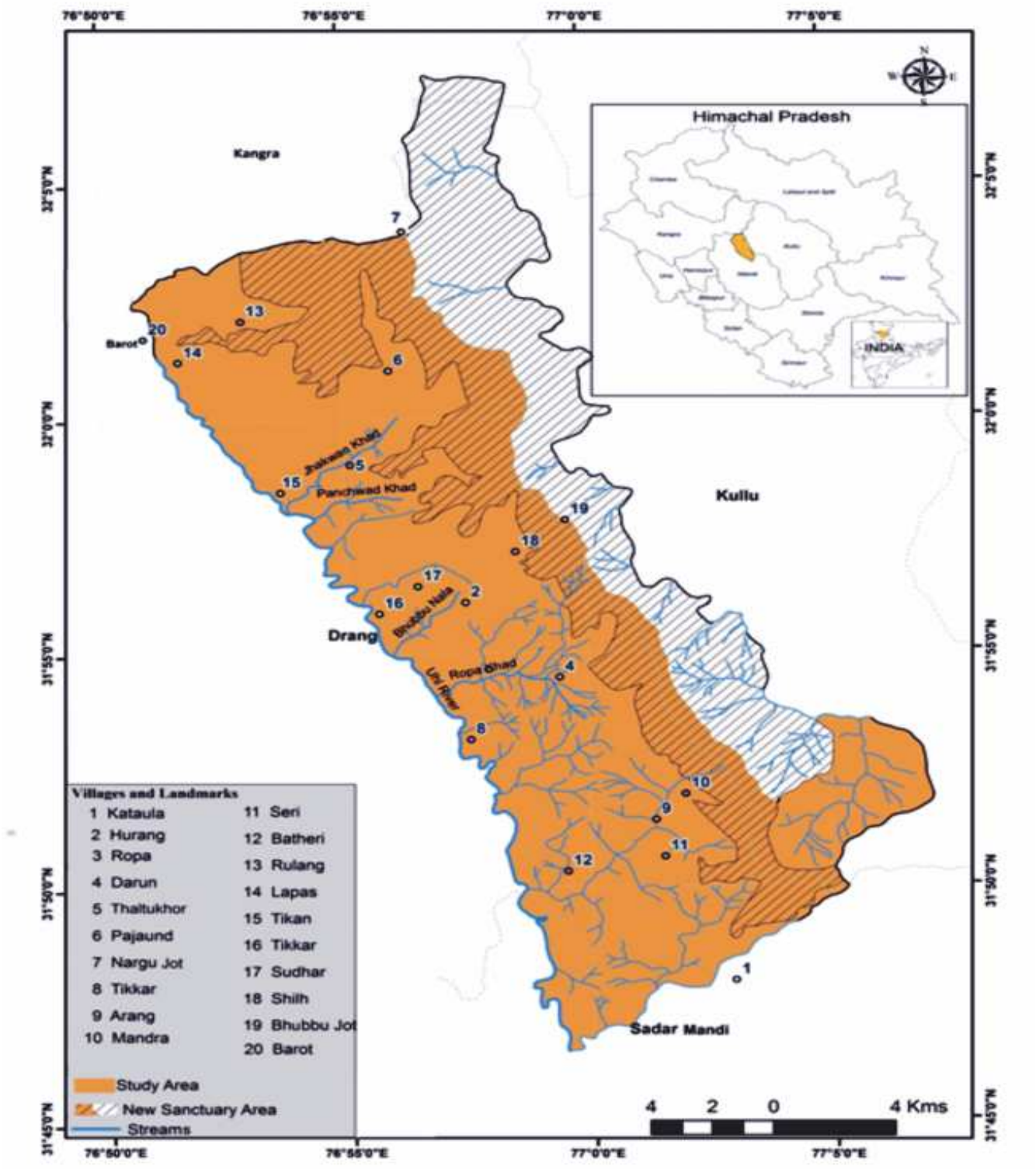

Fig. 1. Map of the study area showing Nargu Wildlife Sanctuary

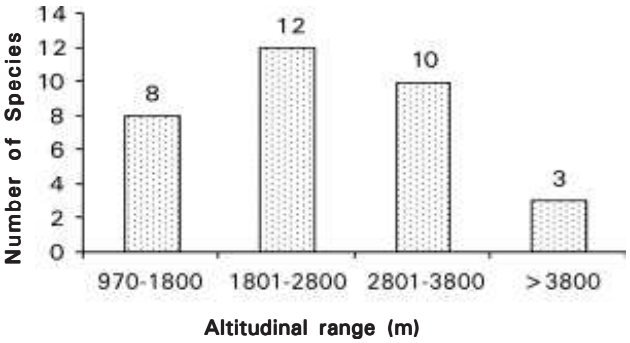

Fig. 2. Altitudinal distribution of the orchids in Nargu Wildlife Sanctuary

represents sub-tropical, temperate, sub-alpine and alpine vegetation. The Sanctuary is rich in biodiversity including a large number of mammals and birds. The NWLS has a huge permanent settlement. The inhabitants are dependent on the Sanctuary for their sustenance. The Sanctuary area is now been rationalized as per notification (No. FFE-B-F (6)-16/ 1999-Nargu; Dated November 29, 2013) of Government of Himachal Pradesh, Department of Forests, but the present study has been conducted in the old area of the Sanctuary.

Surveys, Sampling, Identification and Data Analysis

The extensive and intensive field surveys were conducted to study the orchid diversity of the NWLS during 2010-2015. The rapid sampling of the species was done and the samples of each species were collected for proper identification. For each species, information on habit, habitat, altitudinal range, population size, indigenous uses, *etc*. was collected. The species were identified with the help of flora and literature (Deva and Nathani, 1986; Dhaliwal and Sharma, 1999; Duthie, 1906; Pangtey *et al.*, 1991; Samant, 1993; Singh and Rawat, 2000). Species were analyzed for nativity, endemism and threat categories. Nativity of the species was identified following Anonymous (1883-1970), Samant (2002), and Samant *et al*. (1998). Endemism of the species was identified based on their distributional range and following Dhar and Samant (1993) and Samant *et al*. (1998). Species confined to the IHR were considered as endemic, and those with a distribution extending to neighboring countries (Himalayan region of Afghanistan, Pakistan, Tibet, Nepal, Bhutan and adjacent states of the IHR) were considered as near endemic. For assessing the threat categories of the orchid species, habitat preference, population size, distribution range and use values were collectively used following Rana and Samant (2010). Information on the indigenous uses of the species is based on the available literature and interviews with the inhabitants of Sanctuary.

Results

Diversity and Distribution of Orchids

In total, 15 species of the orchids representing 12 genera were recorded between 970-4052 m, amsl. These orchid species were found in diverse habitats *viz.*, shady moist forests, alpine meadows, moist rocks, boulders, *etc*. Of these, 8 species of orchids were recorded from the sub-tropical zone (970-1800 m), 12 species in the temperate zone (1801-2800 m), 10 species in the sub-alpine zone (2801–3800 m),

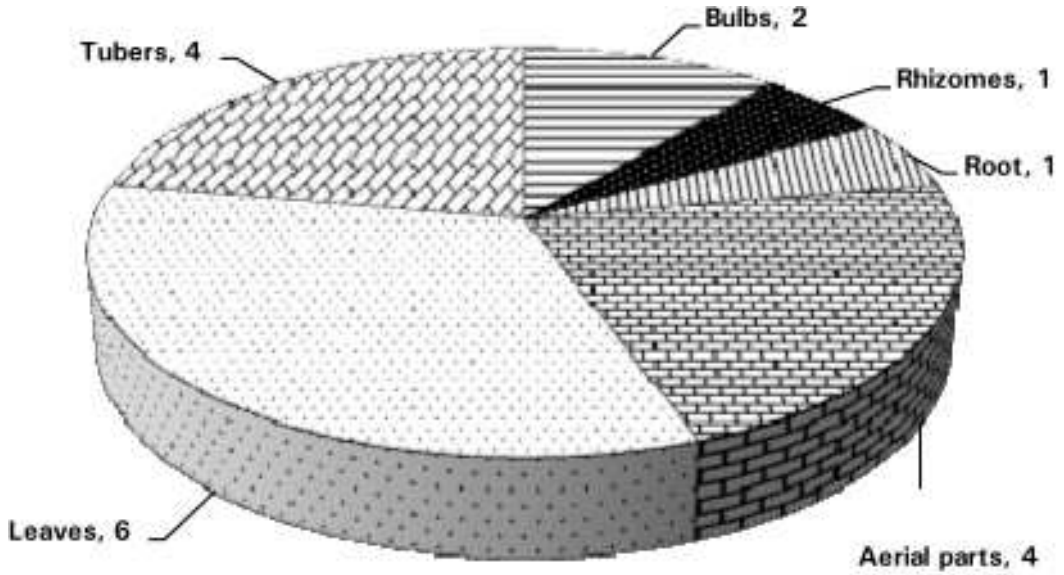

Fig. 3. Parts of medicinally important orchids used in Nargu Wildlife Sanctuary

Table 1. Diversity, distribution, indigenous uses, and conservation of orchids in Nargu Wildlife Sanctuary.

Taxa	Habitats	Altitudinal range (m)	Nativity	Status	Part/s used	Indigenous uses
Calanthe tricarinata Lindl.	SM, DR	2000-3300	Reg Himal	NT	Leaf, Bulb	Used to cure sores and eczema, and as aphrodisiac
Dactylorhiza hatagirea D. Don	SM, MAS	2800-3870	Reg Himal Europ Afr Bor Or	CR	Tuber	Used as antibiotic, blood purifier, tonic, and expectorant and for curing wound, bone fracture, cough, cold, cuts, sexual disability, rheumatism
Epipactis helleborine (L.) Crantz	SM	2500-3650	Reg Himal	NT	Leaf, Rhizome	Used as aphrodisiac and used to cure fever, blood purification
Goodyera fusca Hook.f.	DAS, BO	3000-3900	Reg Himal	NT	Aerial Part	-
*Habenaria edgeworthii*** Hook.f. ex Collett	SM	1500-3000	Reg Himal	EN	Tuber	Used as blood purifier and rejuvenator
H. pectinata D.Don*	SM	1400-3500	Reg Himal	VU	Leaf, Roots	Used for curing joint pains
Herminium lanceum (Thunb. ex Sw.) Vuijk	SM, MAS	1200-3000	Reg Himal	VU	Aerial Part	Used for curing urinary problems
H. monorchis (L.) R.Br.	SM, RI, MAS	2000-4000	Europ As Bor	CR	Aerial Part	Used as tonic
Malaxis acuminata D. Don	SM	1600-2500	Reg Himal	EN	Stem/Leaf	Used as blood purifier, aphrodisiac, spermopiotic and for curing burning sensation, arthritis
M. muscifera (Lindl.) Kze.	SM, MAS	1800-3200	Europ	CR	Bulb	Used as aphrodisiac, styptic, and febrifuge; and for curing dysentery, tonic, burns, debility, sterility
Neottia listeroides Lindl.	SM	1800-3600	Reg Himal	EN	Aerial Part	-
Nervilia plicata L.	RI	1050-1200	Reg Himal	EN	Stem/Leaf	Used as antidiabetic
Satyrium nepalense D.Don*	SM, MAS	1500-3200	Ind Or	NT	Tuber	Used as energizing tonic, aphrodisiac and for curing dysentery, malaria
Spiranthes sinensis (Pers.) Ames.	SM, DE	1100-2800	China As Temp	VU	Tuber	Used for curing tuberculosis, haemoptysis, debility, snake bite, sore throat, cough, leucorrhea, diabetes
Vanda cristata Lindl.	SM, E	1300-2100	Reg Himal As Trop	NT	Leaf	Used as tonic and expectorant

Abbreviations used: CR, Critically Endangered; E, Endangered; VU, Vulnerable; NT, Near Threatened; Afr, Africa; As, Asia; Bor, Boreal; Europ, Europe; Himal, Himalaya; Ind, India; Or, Oriental; Reg, Region; Temp, Temperate; Trop, Tropical *, Near endemic; **, Endemic; Bo, Bouldery; DAS, Dry alpine slope; DE, Degraded; DR, Dry forest; MAS, Moist alpine slope; RI, Riverine; Sh, Shrubberies and SM, Shady moist forest

3 species in the alpine zone (>3800 m) (Fig. 2). Eleven species (*Calanthe tricarinata*, *Dactylorhiza hatagirea*, *Epipactis helleborine*, *Goodyera fusca*, *Habenaria edgeworthii*, *Habenaria pectinata*, *Herminium lanceum*, *Malaxis acuminata*, *Neottia listeriodes*, *Nervillia plicata* and *Vanda cristata*) were natives and 4 species non-natives; 2 species (*Habenaria pectinata* and *Satyrium nepalense*) were near endemic and one species *i.e.*, *Habenaria edgeworthii* was endemic to the Indian Himalaya (Table1). Among genera, *Habenaria*, *Malaxis* and *Herminium* (2 species each) were dominant.

Indigenous Uses

Different plant parts *i.e.*, leaves (6 species), aerial parts and tubers (4 species each), bulbs (2 species), and rhizome and root (1 species each) were used by the inhabitants for various therapeutic uses (Fig. 3). For instance, tubers of *Habenaria edgeworthii* (known as *Riddhi* in Ayurveda) are considered to be blood purifier and energy booster; *Habenaria pectinata* were used for joint pains by the local folks. Aerial parts of *Goodyera fusca* were considered as very good appetizers. *Malaxis acuminata* (known as *Jeevak* in Ayurveda) was a key *Ashtavarga* plant and used for curing arthritis, blood purification and as aphrodisiac. *Malaxis muscifera* was considered to be a very good health tonic and a potential aphrodisiac. Likewise, other species were used for curing various ailments such as sores, eczema, paralysis, wounds, bone fracture, cough, cold, cuts, sexual disability, rheumatism, fever, blood purification, cold, dysentery, sterility, leucorrhoea, diabetes and malaria, *etc*. and also used as aphrodisiac, antispasmodic, sedative, febrifuge, appetizer and tonic (Table1 and Fig. 4). Due to extensive over use and unscientific extraction, the density of these species is decreasing at an alarming rate. The populations of *Dactylorhiza hatagirea*, *Malaxis acuminata* and *Malaxis muscifera* are decreasing very fast due to habitat degradation and their commercial exploitation.

Threat Categorization

The analysis for threat categories revealed that 03 species namely *Dactylorhiza hatagirea*, *Herminium monorchis* and *Malaxis muscifera* were Critically Endangered; 04 species namely *Habenaria edgeworthii*, *Malaxis acuminata*, *Nervilia plicata*, and *Neottia listeroides* were Endangered and 03 species namely *Habenaria pectinata*, *Herminium lanceum* and *Spiranthes sinensis* were Vulnerable; 05 species namely *Calanthe tricarinata*, *Epipactis helleborine*, *Goodyera fusca*, *Satyrium nepalense* and *Vanda cristata* were Near Threatened.

Discussion

The state of Himachal Pradesh supports relatively very less number of orchids as compared to West, Central and Eastern Himalaya (Deva and Naithani, 1986; Samant, 2002, 2009). Of the 15 species presently recorded, 11 species were native to the Himalaya and remaining 4 were non-native. A total of 2 species were observed as near-endemic for the IHR. Except *Vanda cristata*, all the other species were terrestrial and mostly preferred shady moist habitats, clearly indicating thereby that the environmental conditions are not suitable for the epiphytic orchids, in the region. As the sub-tropical and temperate regions represent the best habitats for the growth and development of the orchids, critical investigation of the habitats is essentially required, besides regular monitoring of these habitats so as to understand the dynamics of these species. The orchids are inherently slow growers and due to their complex nutritional requirements, they germinate poorly in nature which further adds to their poor populations and making them more vulnerable.

In general, IUCN Red Lists and Red Data Books, and CAMP (Conservation Assessment and Management Plan) workshops have helped in the prioritization of the species and have been playing crucial role in guiding the conservation priorities since long (Goraya *et al.*,

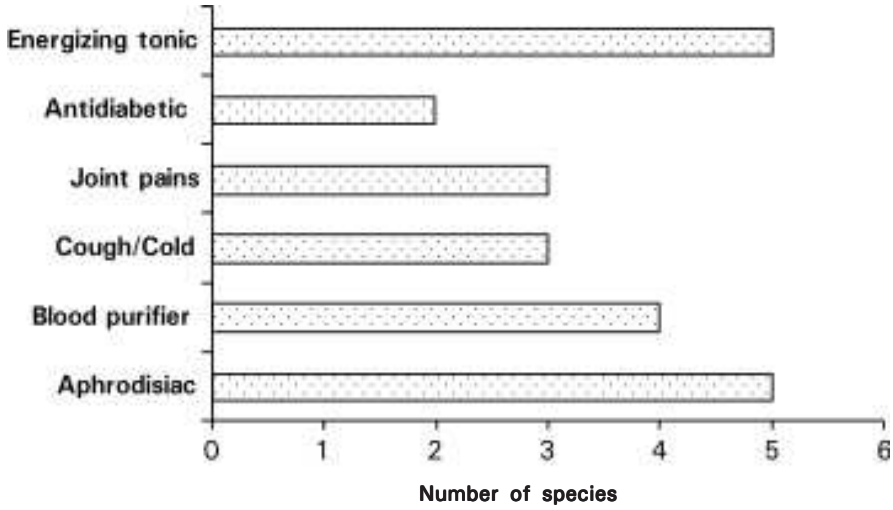

Fig. 4. Number of medicinal uses of orchids in Nargu Wildlife Sanctuary.

2013; Nayar and Sastry, 1987, 1988, 1990; Ved *et al.*, 2003). However, at local level very few studies have been carried out following the IUCN criteria. The local level threat categorization of the species has been considered as the best approach for developing appropriate strategy and management plan (Rana and Samant, 2010). Following the similar approach in the present study, 03 species were identified as Criticaly Endangered, 04 species as Endangered and 03 species as Vulnerable. The major causes for this were the over exploitation and habitat degradation. 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 for the inhabitants on conservation; and their participation for conservation management are suggested.

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