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POPULATION ASSESSMENT AND THREAT CATEGORIZATION OF ENDANGERED MEDICINAL ORCHID *MALAXIS ACUMINATA D. DON*. FROM NORTH-WEST HIMALAYA

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Abstract

Studies on population assessment and threat categorization in selected populations of Malaxis acuminate D. Don., a rare, terrestrial, endangered medicinal orchid of Himalayan region and an important "Astverga" plant were undertaken. Status was determined on site-to-site basis as well as for entire Kumaun region. Based on species occurrence in selected areas, the species were identified as critically endangered to endangered in different sites studied. The results also revealed that natural distribution of the species was narrowing down due to habitat destruction and over exploitation. Immediate remedial measures are needed for the conservation of natural sites to ensure sustainable mode of utilization.

Keywords: *Malaxis acuminata D. Don.; orchid; population assessment; endangered.*

Introduction

The Himalayan region has an area of 531,250sqkm spread over 12 states and constitutes about 16.16% of India's total geographical area. It has about 1,748 species of medicinal plants distributed in Indian Himalayan Region [1]. In recent years, increasing attention is being paid to medicinal plant value both due to their economic and conservation concern [2]. Overexploitation of rhizome and other parts for medicinal use and consequent degradation of natural habitat are reported to be the major threat to these plants. Many species of Himalayan medicinal plants are considered as most endangered and listed in Red Data Book of Indian plants [3].

Orchids occupy a wide range of habitats and exhibits highly specialized morphological, structural and physiological characteristics [4]. The Family Orchidaceae is distributed from tropical to alpine areas of the world with over 35,000 species belonging to 800 genera. 166 genera with 1141 species are represented in India [5], of which 240 species are distributed in Uttarakhand State [6]. Most of the orchid species are facing different degrees of threats to their survival due to habitat loss, the fragmentation of populations, genetic drift, and anthropogenic pressures. To protect these species in their natural habitats, the government of India has imposed a ban on the commercial exploitation of orchids.

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Malaxis acuminata D. Don., belongs to family Orchidaceae, is a rare, terrestrial perennial, endangered medicinal orchid of Himalayan region [7]. It is a 10-25cm long herb, leaves ovate lanceolate, flower pale green tinged purple, distributed in temperate to sub alpine areas between 1800-2300 m in the Himalayan region [8]. The pseudobulbs of this plant are well known for its medicinal value in Indian System of Medicine (ISM) and traded with name Jeevak since time immemorial.

Malaxis acuminata is a Rasayana and belongs to the *Astverga.* It constitutes a group of eight drugs, which form an important constituent of a number of *Ayurvedic* preparations with the help of which wonderful cures have been claimed, but these drugs have not been properly identified even today [9]. Pseudobulbs are used in *skin* diseases (Kushtha), *piles* (Arsha), *diseases of children* (Balrog), *burning sensation* (Daha), *fistula-in-ano* (Bhagandra) [1]. Locally the bulbs are used in bronchitis as well as given as a tonic [10]. Paste of pseudo bulb can be applied externally in case of insect bites, and when mixed with other plants are used in the treatment of rheumatism [11]. Its swollen stem is sweet, refrigerant, aphrodiasiac, styptic, antidysentric, febrifuge and tonic. It is used in conditions of sterility, vitiated condition of pitta and vata, seminal weakness, internal and external haemorrhages, dysentery, fever, emaciation and general debility [12].

The regular harvesting of this species for medicinal purposes along with habitat degradation and other biotic interferences in its distribution ranges has decreased natural populations. This species has now been assessed as endangered based on perceptions of changes of species parameters, although quantitative data are lacking, and surveying is recommended to collect such information [13]. Keeping in view the importance of *Malaxis acuminata* in the present study, attempts have been made for population status, habitat assessment and threat categorization of this herb in the Kumaun region of Uttarakhand.

Materials and method

Study area

The study was conducted in temperate regions of Kumaun. Five districts of Kumaun viz. Almora, Bageshwar, Champawat, Nainital and Pithoragarh were selected for population study of four herbs mentioned above as these five districts cover temperate region of Kumaun. The study area was surveyed extensively and totals 22 sites for *Malaxis acuminata* were identified on the basis of (a) habitat attributes (altitude/ slope/ aspect), (b) population size and (c) accessibility for data collection. A district wise geographical description of the study areas is given in Table 1.

Table 1. Districts wise Studied Sites

S. No.	District	Study sites
1.	**Almora** Located between 29° 36' North Latitude and 79° 30' East Longitude at an altitude of 1638 meter Sea level (msl).	Dunagiri, Pandavkholi, Kausani, Chaubatia, Jageshwar
2.	**Bageshewar** Located between 29°42'40" to 30°18'56" North Latitude and 79°23' to 80.9° East Longitude. The district is lies at an altitude of 1646 msl.	Kotmanya, Chaukri, Khati
3.	**Champawat** Located between 29°5'and 29°30' in Northern Latitude and 79°59' and 80°3'at the center of Eastern Longitude with an altitude of 1615 msl.	Lohaghat, Devidhura, Khetikhan, Banlekh
4.	**Nainital** Located between29°23' North Latitude and 79°30' East Longitude at a height of 1939 msl.	Kilburry, Bhowali, Ramgarh, Salyura, Bhatrojkhan
5.	**Pithoragarh** Located between 29.4° to 30.3° North Latitude and 80° to 81° East Longitude at a height of 1645 msl.	Lilam, Thal, Munsyari, Berinag, Didihat,

Population studies, habitat assessment and threat categorization

In nature *Malaxis acuminata* (Fig. 1) sprouts in April last to May and reaches to senescence by the end of October. Considering this, phytosociological study was carried out in August-September when the species attained maximum growth. For population studies, temperate regions of Kumaun mentioned above were visited at regular interval during three consecutive years (2007-2010). Pockets of 100×100 m were identified and marked on each region of *Malaxis acuminata*. Vegetation sampling was conducted through vertical belt transects [14]. Since the distribution range is narrow and topography is very diverse, approximately 60 m long and 30 m wide transects were laid across each pocket. Transects were divided into three stands of 20 X 10 m size as replicates and ten quadrats of 1.0X1.0m size were laid randomly in each stand. Individuals of all species were counted in each quadrat. To determine status of the species mean values of each quantitative parameter of three stands of transect were considered for further interpretation.

Data were analyzed for population study such as frequency (%F), density (D, plant m^{-2}), A/F ratio, relative frequency, relative density, relative dominance and total basal cover (TBC, cm^2m^{-2}) was calculated following Misra [15].

Fig. 1. *Malaxis acuminata* in natural habitat

$$\text{Frequency} = \frac{\text{Total number of quadrats in which species occured}}{\text{Total number of quadrats studied}} \times 100 \quad (1)$$

$$\text{Density} = \frac{\text{Taotal number of individual species in all quadrats}}{\text{Total number of quadrats studied}} \quad (2)$$

$$\text{Abundance} = \frac{\text{Tatal number of individuals of a species in all quadrats}}{\text{Total number of quadrats in which species occured}} \quad (3)$$

$$A/_F \text{ ratio} = \frac{\text{Abundance}}{\text{Frequency}} \quad (4)$$

Distribution pattern of the species was analyzed on the basis of abundance to frequency (A/F) ratio. Value of A/F < 0.025 was categorized regular, between 0.026-0.050 random and > 0.050 contiguous type of distribution [16]. Similarly relative values of frequency, density and dominance were calculated following the methods of Misra [15] and Kershaw [16] as:

$$\text{Relative Frequency} = \frac{\text{Percent frequency of species}}{\text{Total frequency of the community}} \times 100 \quad (5)$$

$$\text{Relative density} = \frac{\text{Density of species}}{\text{Total density of the community}} \times 100 \quad (6)$$

$$\text{Relative dominance} = \frac{\text{Total basal cover of species}}{\text{Total basal cover of community}} \times 100 \quad (7)$$

$$\text{Basal cover} = \frac{(\text{Cbh})^2}{4\pi} \quad (8)$$

where *Total Basal Cover (TBC) = Mean basal cover × Density* and
Importance Value Index (IVI) = Relative frequency + Relative density + Relative dominance.

The concentration of dominance (CD) was computed by Simpson's Index [17].

For threat assessment, two criteria, i.e. population estimation (density and number of mature individuals) and extent of occurrence (number of populations/plots) were used as per IUCN Red List Categories [18]. During the study, only flowering plants were considered as mature individuals and taken further for population estimation. Species having mature individuals < 250 was considered as critically endangered, < 2,500 as endangered and < 10,000 as vulnerable. Similarly, species having single population was categorized as critically endangered, < 5 populations as endangered and < 10 populations as vulnerable. Furthermore, status was assigned separately for each natural site as well as for entire Kumaun region.

Results

The frequency of *Malaxis acuminata* was found maximum (90%) in Lohaghat followed by (80%) in Dunagiri, Kausani, Jageshwar, Kotmunya, Chaukri, Khetikhan, Bhowali and Lilam and it was found minimum (50%) in Berinag (Fig. 2). Density was maximum (15.30 plant m^{-2}) in Dunagiri and minimum (1.70 plant m^{-2}) in Kilburry (Fig. 3).

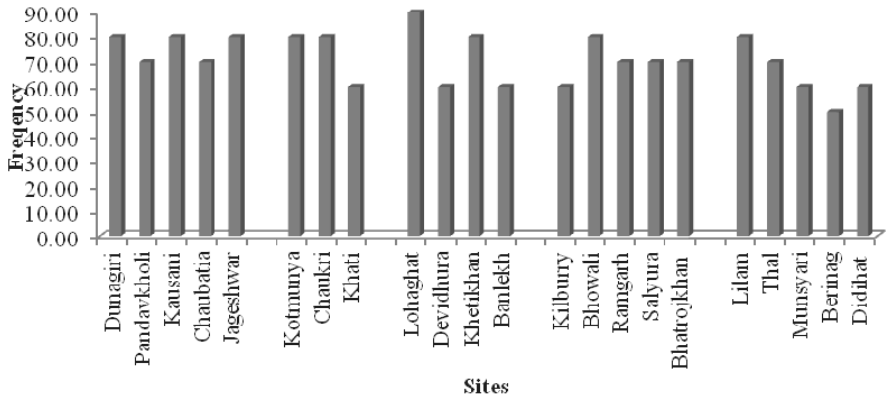

Fig. 2. Frequency of *Malaxis acuminata* at different sites

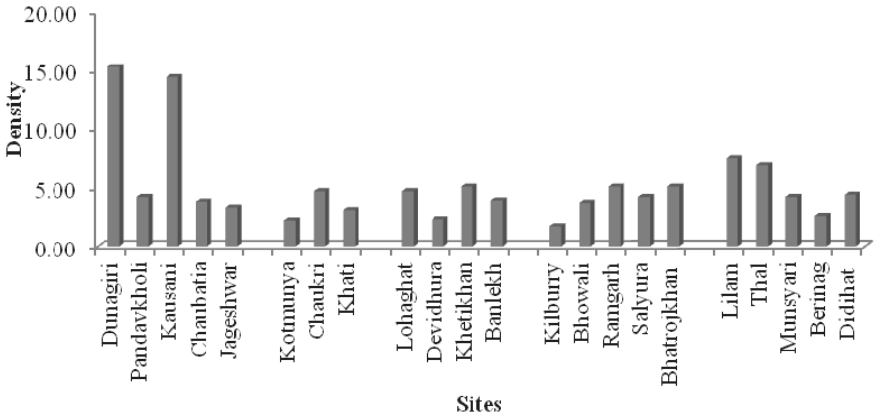

Fig. 3. Density of *Malaxis acuminata* at different sites

Abundance was found maximum (19.13) in Dunagiri and minimum (2.75) in Kotmunya (Fig. 4). Total basal cover (TBC) was maximum (11.68cm^2/m^2) in Dunagiri and minimum (1.02 cm^2/m^2) in Devidhura (Fig. 5). *Important Value Index* (IVI) was found maximum (136.57) in Dunagiri and minimum (32.73) in Devidhura (Fig. 6).

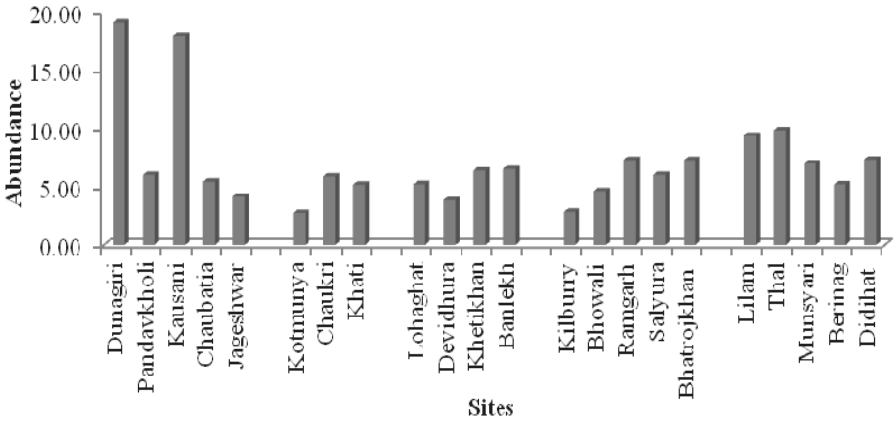

Fig. 4. Abundance of *Malaxis acuminata* at different sites

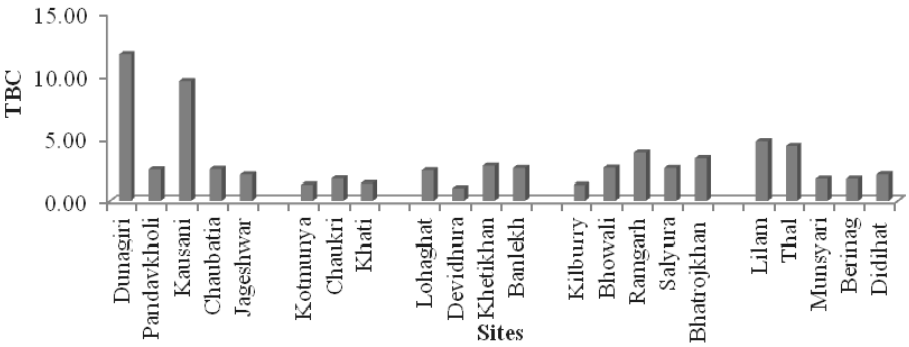

Fig. 5. TBC of *Malaxis acuminata* at different sites

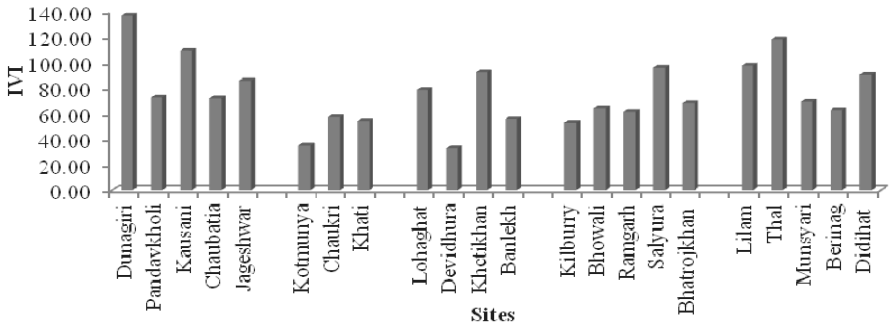

Fig. 6. *Importance Value Index (IVI)* of *Malaxis acuminata* at different sites

Concentration of dominance (Cd) was highest (0.29) in Dunagiri and lowest (0.10) in Kotmunya. Distribution pattern (A/F ratio) of the species was found contiguous in all the sites except Jageshwar, Kotmunya and Kilburry where its distribution was random. As per IUCN Red List Categories, data on extent of occurrence (number of populations/plots) indicate endangered status of the species in most of the sites studied except Salyura, Lilam and Thal where its status was critically endangered and population estimation (density and number of mature individuals) indicate critically endangered status for the species in all the sites studied and overall status for Kumaun region was found Vulnerable and Endangered (Table 2).

Table 2. Population Status and Assignment of Threat Categories of *Malaxis acuminata* in Kumaun Himalaya

District	Sites	F	Rfr	D	Rden	A	A/F	TBC	Rdom	IVI	D	Distribution	Populations	Mature Individuals	Status
Almora	Dunagiri	80.00	13.11	15.30	50.66	19.13	0.24	11.68	72.79	136.57	0.29	Contiguous	4.00	153.00	EN*, CR**
	Pandavkholi	70.00	11.11	4.20	23.33	6.00	0.09	2.50	37.85	72.30	0.13	Contiguous	2.00	42.00	EN*, CR**
	Kausani	80.00	10.96	14.40	46.91	18.00	0.23	9.59	51.03	108.90	0.25	Contiguous	4.00	144.00	EN*, CR**
	Chaubatia	70.00	11.48	3.80	26.21	5.43	0.08	2.52	33.97	71.65	0.13	Contiguous	3.00	38.00	EN*, CR**
	Jageshwar	80.00	13.56	3.30	22.76	4.13	0.05	2.08	49.40	85.71	0.14	Random	3.00	33.00	EN*, CR**
Bageshwer	Kotmunya	80.00	8.89	2.20	6.98	2.75	0.03	1.28	19.01	34.88	0.10	Random	2.00	22.00	EN*, CR**
	Chaukri	80.00	11.59	4.70	16.49	5.88	0.07	1.77	29.16	57.24	0.15	Contiguous	2.00	47.00	EN*, CR**
	Khati	60.00	10.34	3.10	13.03	5.17	0.09	1.39	30.50	53.87	0.15	Contiguous	2.00	31.00	EN*, CR**
Champawat	Lohaghat	90.00	12.16	4.70	19.67	5.22	0.06	2.42	46.53	78.36	0.12	Contiguous	3.00	47.00	EN*, CR**
	Devidhura	60.00	10.71	2.30	13.14	3.83	0.06	1.02	8.88	32.73	0.14	Contiguous	2.00	23.00	EN*, CR**
	Khetikhan	80.00	15.09	5.10	26.70	6.38	0.08	2.79	50.36	92.16	0.16	Contiguous	2.00	51.00	EN*, CR**
	Banlekh	60.00	10.91	3.90	19.21	6.50	0.11	2.61	25.36	55.48	0.15	Contiguous	2.00	39.00	EN*, CR**
Nainital	Kilburry	60.00	9.84	1.70	9.55	2.83	0.05	1.26	33.02	52.40	0.16	Random	2.00	17.00	EN*, CR**
	Bhowali	80.00	15.69	3.70	21.76	4.63	0.06	2.63	26.90	64.35	0.13	Contiguous	2.00	37.00	EN*, CR**
	Ramgarh	70.00	11.48	5.10	22.08	7.29	0.10	3.86	27.84	61.40	0.12	Contiguous	2.00	51.00	EN*, CR**
	Salyura	70.00	12.50	4.20	23.73	6.00	0.09	2.61	59.49	95.72	0.15	Contiguous	1.00	42.00	CE*, CR**
	Bhatrojkhan	70.00	12.28	5.10	26.70	7.29	0.10	3.40	28.85	67.83	0.16	Contiguous	2.00	51.00	EN*, CR**
Pithoragarh	Lilam	80.00	12.31	7.50	28.09	9.38	0.12	4.77	56.99	97.39	0.14	Contiguous	1.00	75.00	CE*, CR**
	Thal	70.00	12.96	6.90	32.39	9.86	0.14	4.40	72.65	118.01	0.17	Contiguous	1.00	69.00	CE*, CR**
	Munsyari	60.00	11.32	4.20	24.71	7.00	0.12	1.74	33.06	69.09	0.14	Contiguous	2.00	42.00	EN*, CR**
	Berinag	50.00	10.20	2.60	14.53	5.20	0.10	1.73	38.09	62.82	0.14	Contiguous	2.00	26.00	EN*, CR**
	Didihat	60.00	11.76	4.40	23.40	7.33	0.12	2.09	54.91	90.08	0.15	Contiguous	2.00	44.00	EN*, CR**
Overall status for Kumaun region															Vu**, EN**

*Based on extent of occurrence; **Based on population estimation

Shady moist slopes and under canopy of *Quercus leucotrichophora* and *Cedrus deodara* trees are the major habitats of *Malaxis acuminata.* In some places it is also found under the canopy of *Myrica esculenta* and *Rhododendron arboreum* with *Quercus leucotrichophora* and

Cedrus deodara. Dominant associates of *Malaxis acuminata* at most sites were *Roscoea procera*, *Thalictrum foliolosum*, *Valeriana wallichii*, *Rumex nepalensis* and *Oxalis corniculata.* Other dominant associates of the species were *Galingsoga parviflora*, *Asparagus curillus*, *Potentilla fulgense* and *Polygonum* sp. Main threats to the species in most of the sites were Habitat degradation, human interference and over exploitation. Other threats to the species were trade, grazing and harvested for medicine etc (Table 3).

Table 3. Site Characteristics of Selected Populations of *Malaxis acuminata*

District	Sites	Altitude (m)	Habitat	Dominant species	Threats
Almora	Dunagiri	2400	Moist grassy slope with *Quercus leucotrichophora* A. Camus and *Myrica esculenta* Buch- Ham.	*Achyranthes bidentata* Blume, *Paspalum scrobiculatum* Linn., *Roscoea procera* Wall., *Rumex nepalensis* Spreng.,*Berberis aristata* D.C.	Habitat degra-dation , Human interference
	Pandavkholi	2682	Moist gentle slope with *Quercus leucotrichophora* A. Camus and *Myrica esculenta* Buch- Ham.	*Roscoea procera* Wall., *Paspalum scrobiculatum* Linn., *Berberis aristata* D.C., *Rumex nepalensis* Spreng.	Human interference
	Kausani	1890	Moist shady slope with *Quercus leucotrichophora* A. Camus and *Cedrus deodara* Roxb. ex D.Don.	*Hedychium spicatum* Buch. Ham., *Arisaema speciosum* (Wall.)Mart., *Geum alatum* Wall., *Valeriana wallichii* D.C.	Habitat degradation
	Chaubatia	1829	Gentle grassy moist slope with *Rhododendron arboreum* Smith., *Quercus leucotrichophora* A. Camus and *Myrica esculenta* Buch- Ham.	*Roscoea procera* Wall., *Valeriana wallichii* D.C., *Rumex nepalensis* Spreng., *Hedychium spicatum* Buch. Ham.	Over Exploitation, Grazing
	Jageshwar	1950	Moist grassy slope with *Quercus leucotrichophora* A. Camus and *Myrica esculenta* Buch- Ham.	*Geum alatum Wall*., *Valeriana wallichii* DC., *Rumex nepalensis* Spreng., *Paspalum scrobiculatum* Linn.	Habitat degra-dation , Human interference
Bageshwer	Kotmunya	2050	Shady moist slopes with *Rhododendron arboreum* Smith. and *Quercus leucotrichophora* A. Camus	*Potentila fulgense* Wallich ex Hook., *Ageratum conyzoides* Linn., *Rubia cordifolia* Linn., *Reinwardtia indica* Dum., *Paspalum scrobiculatum* Linn.	Trade, Over Exploitation
	Chaukri	2010	Moist grassy slope with *Quercus leucotrichophora* A. Camus	*Galingsoga parviflora* Cav., *Rubia cordifolia Linn.*, *Valeriana wallichii* D.C., *Reinwardtia indica* Dum.,	Habitat degradation
	Khati	2160	Steep grassy slopes with *Quercus leucotrichophora* A. Camus	*Rubia cordifolia* Linn., *Skimmia laureola* Sieb. and Zucc. ex Walp., *Strobulanthis* sp., *Asparagus curillus* Buch- Ham.	Habitat degra-dation , Human interference
Champawat	Lohaghat	2050	Moist shrubberies with *Quercus leucotrichophora* A. Camus,*Cedrus deodara* Roxb. ex D.Don. and *Myrica esculenta* Buch-Ham.	*Polygonum* sp., *Valeriana wallichii* D.C., *Paspalum scrobiculatum* Linn.,*Oxalis corniculata* Linn.	Habitat degradation , Human interference
	Devidhura	1720	Gentle moist slope with *Quercus leucotrichophora* A. Camus and *Cedrus deodara* Roxb. ex D.Don.	*Potentilla fulgense*, *Valeriana wallichii* D.C., *Paspalum scrobiculatum* Linn.,*Hedychium spicatum* Buch- Ham.	Habitat degradation , Grazing
	Khetikhan	1800	Steep moist slope with *Quercus leucotrichophora* A. Camus and *Cedrus deodara* Roxb. ex D.Don.	*Oxalis corniculata* Linn., *Potentilla fulgense*, *Roscoea procera* Wall., *Urtica dioica* Linn.	Habitat degradation
	Banlekh	1850	Moist shady place with *Quercus leucotrichophora* A. Camus, *Myrica esculenta* Buch- Ham. and *Rhododendron arboretum* Smith.	*Hedychium spicatum* Buch. Ham.,*Valeriana wallichii* D.C., *Paspalum scrobiculatum* Linn., *Strobulenthis* sp.	Human interference
Nainital	Kilburry	2250	Steep grassy slopes with *Quercus leucotrichophora* A. Camus	*Skimmia laureola* Sieb. And Zucc. ex Walp, *Cynodon dactylon* (Linn.) Pers., *Ageratum conyzoides* Linn., *Potentilla fulgense*	Habitat degra-dation , Human interference
	Bhowali	1720	Moist shady places with *Quercus leucotrichophora* A. Camus	*Valeriana wallichii* D.C., *Hedychium spicatum* Buch. Ham., *Geum alatum* Wall., *Roscoea procera* Wall.,	Habitat degradation
	Ramgarh	1950	Gentle moist shady slope with *Quercus leucotrichophora* A. Camus and *Cedrus deodara* Roxb. ex D.Don.	*Thalictrum foliolosum* D.C., *Valeriana wallichii* DC., *Hedychium spicatum* Buch. Ham., *Roscoea procera* Wall.,	Over Exploitation, Human interference
	Salyura	1700	Grassy slope with *Quercus leucotrichophora* A. Camus and *Myrica esculenta* Buch- Ham.	*Rumex nepalensis* Spreng., *Polygonum* sp.,*Thalictrum foliolosum* D.C., *Strobulenthis* sp.	Habitat degradation , Grazing
	Bhatrojkhan	1700	Moist grassy slope with *Quercus leucotrichophora* A. Camus	*Roscoea procera* Wall., *Rumex nepalensis* Spreng., *Paspalum scrobiculatum* Linn., *Hedychium spicatum* Buch. Ham.,	Habitat degradation
Pithoragarh	Lilam	1850	Moist, shady slope with *Quercus leucotrichophora* A. Camus and *Cedrus deodara* Roxb. ex D.Don.	*Reinwardtia indica* Dum., *Skimmia laureola* Sieb. And Zucc. ex Walp, *Galium aparine* Linn., *Asparagus curillus* Buch- Ham.	Over Exploitation, Trade
	Thal	2950	Shady moist place with *Quercus leucotrichophora* A. Camus	*Valeriana wallichii* D.C., *Galium aparine* Linn., *Reinwardtia indica* Dum., *Galingsoga parviflora* Cav.	Habitat degra-dation , Human interference
	Munsyari	2135	Moist, shady steep slope with *Quercus leucotrichophora* A. Camus and *Cedrus deodara* Roxb. ex D.Don.	*Galium aparine* Linn., *Erigeron aegyptiacus* L., *Galingsoga parviflora* Cav., *Strobulanthis* sp.	Harvested for Medicine, Trade
	Berinag	1740	Gentle shady moist slope with *Quercus leucotrichophora* A. Camus	*Asparagus curillus* Buch- Ham. , *Thalictrum foliolosum* D.C., *Viola canesense* Wall., *Urtica dioca* Linn.	Habitat degradation
	Didihat	1725	Moist grassy slope with *Quercus leucotrichophora* A. Camus and *Cedrus deodara* Roxb. ex D.Don.	*Polygonum* sp., *Asparagus curillus* Buch- Ham. , *Thalictrum foliolosum* D.C.,*Valeriana wallichii* D.C.	Human interference

Discussion

Frequency of *Malaxis acuminata* was ranged between 50-90% at different population sites. Distribution of this species was found contiguous at most of the sites and random distributional range at few sites. Density of *Malaxis acuminata* was maximum (15.30 plant/m^2) in Dunagiri and minimum (1.70 plant/m^2) in Kilburry. Total basal cover (TBC) (11.68 cm^2/m^2) and important value index (IVI) (136.57) were also found maximum in Dunagiri. Concentration of dominance (Cd) of the region showed a slight variation. It was ranged 0.29-0.10 for the species. This may be attributed due to narrow range of distribution, habitat restriction and dominance of some species. Dominant associates of *Malaxis acuminata* at most sites were *Roscoea procera, Thalictrum foliolosum, Valeriana wallichii, Rumex nepalensis* and *Oxalis corniculata*.

Studies on quantitative assessment play a vital role in the ecology of the species [19]. It helps in determining the performance of populations under different sets of conditions and provides desired information about the specialized ecological requirements of a taxon [20]. The information, thus generated, has immense potential for contributing in conservation and management of rare threatened plant species [21-22]. Low population density across the surveyed populations indicates poor availability of the species in study area. However, random distribution in some sites and higher frequency of occurrence indicates that species have potential for better performance in these sites (habitats) in the region.

The status of *Malaxis acuminata* was found critically endangered and endangered in all the sites studied. The principal reason for species endangerment in Himalayan medicinal plant is the human interference in natural ecosystems, resulting in habitat destruction as well as a loss of other natural and biological factors. The use of wild plant resources and subsequent ecosystem alteration often leads to habitat fragmentation. Species susceptible to slack habitats are more fragile and have more difficulty in sustaining populations (especially small and narrowly distributed ones) and consequently this often leads to species endangerment. Habitat loss and degradation have been identified as the major factors, threatening 91% of plant species globally. In the 2000 IUCN Red List, India is ranked sixth for having the highest number of threatened plant species.

It was observed that the whole plant of the species is used for medicinal properties and individuals are uprooted indiscriminately. It is reported that harvesting of the whole plant is more destructive than the harvesting of fruits, seeds or leaves in isolation. Furthermore, the removal of the entire plant before seed maturation ceases the possibilities of development of future regeneration [23]. Poor distribution of *Malaxis acuminata* across the sites and its localized distribution in specific pockets (habitats) reflect its endangered status. This has a conservation implication, as the species with specific habitat requirements have greater possibilities of extinction than the species with broad habitat range [24]. The importance of Himalayan medicinal species of endangered or threatened status, and an urgent need for their conservation has recently been emphasized by many workers [25-26].

Conclusion

The present data on population status, habitat preference and threat categorization of the *Malaxis acuminata* would assist in the understanding of the ecology and development of the conservation plan with regard to the species. Although the species is listed as endangered but there is no management plan for conservation due to the lack of related information and collection of this species continues from the wild through illegal means. Domestication and cultivation of such medicinal orchids should be encouraged to fulfill market demand, which will increase the income of local people and reduce pressure on the natural habitat. Such

economically important orchids should be conserved with both *in situ* and *ex situ* methods of conservation.

If over-exploitation and habitat degradation of the species continues, it may disappear from the area within a few years. The occurrence of critically endangered, endangered and vulnerable medicinal plants indicates that high anthropogenic pressure, overexploitation, habitat degradation, habitat fragmentation and lack of awareness among inhabitants are the main causes of declining population of species.

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