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Full Length Research Paper

Habitat studies for conservation of medicinal orchids of Uttarakhand, Western Himalaya

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An extensive sampling was conducted for medicinal orchids in the state of Uttarakhand between the years 2003 to 2005 covering an altitudinal range of 600 – 3600 m. Transects of 1 km length were laid randomly in various habitat types depending upon the geographical coverage of the habitats. Six medicinal orchid species belonging to four genera were recorded in different habitats. *Dactylorhiza hatagirea* and *Habenaria intermedia* are highly endangered in the state. A total of seven habitat types were identified where medicinal orchids were found. Among seven habitats Banj-oak habitat was found the most suitable habitat for the orchids followed by Mixed-oak and Banj Grassy Slopes.

Key words: Uttarakhand, medicinal orchids, habitat, Banj-oak, *Dactylorhiza hatagirea, Habenaria intermedia*.

INTRODUCTION

Orchids occupy a wide range of habitats and exhibit highly specialized morphological, structural and physiological characteristics (Dressler, 1990). Terrestrial orchids usually grow on the ground where sufficient moisture and shade are available and most of them generally appear during the rainy season. In the state of Uttarakhand, the distribution of the orchids is extremely patchy (Jalal, 2005). The state has 237 species of orchids (Jalal et al., 2008), of these 12 are medicinally important (Jalal et al., 2008). Mostly the tubers of these orchids are used in medicine. Many of these orchids face the extreme danger of extinction due to over-exploitation and habitat destruction. Orchids require a special kind of environment and habitat. Not only are they very habitat specific but within a habitat also, they require unique micro-climatic conditions to survive and perpetuate. To formulate the conservation plan for a particular area and to understand the ecology of the species, studies on quantitative information play a vital role (Uniyal et al., 2002). At the same time it is also important to identify the habitat types preferred by orchids so that habitat wise conservation strategies can be applied. Demographic studies are essential to understand the relationship between natural dependent plants and the community in which they are found (Zotz and Schmidt, 2006) in a much better and clearer way. The present study is a rapid exercise to identify the habitat types preferred by medicinally important orchids.

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MATERIALS AND METHODS

Study area

The study was conducted in the state of Uttarakhand (28'44" N to 31'28" N latitude and 77'35" E to 81'01" E longitude) of India. It encompasses an area of 53,485 sq. km., comprises thirteen districts (Figure 1). The altitudinal ranges vary from 300 m to > 7817 m asl. The climate is influenced by the monsoon pattern of rainfall. Generally, the average annual rainfall ranges between 200 and 250 cm. There are six forest types known to occur in the state which include tropical moist deciduous forests, tropical dry deciduous forests, sub-tropical pine forests, Himalayan moist temperate forests, Himalayan dry temperate forests, sub alpine and alpine forests (Champion and Seth, 1968).

Data collection

An extensive sampling was conducted between the months of June and September (monsoon), 2003 to 2005 covering an altitudinal range 600 - 3600 m. A rapid survey was done in forty-one localities (Figure 1). A total of seven habitat types were identified which were used by medicinal orchids (Table 1). Transects of 1 km length were laid randomly in various habitat types depending upon the geogra-

Figure 1. Study area map with sampling sites.

Table 1. Summary of habitat types.

Habitat types (with abbreviation)	Total plots	Remark
Alpine grassy slopes (AGS)	120	Dominated by *Danthonia cachmyriana* grass
Herbaceous meadows (HM)	200	Gentle and moist slopes in the sub-alpine region dominated by many alpine herbs species
Mixed oak (MO)	280	*Q. leucotrichophora* and *Q. floribunda*
Banj-oak (BO)	360	*Quercus leucotrichophora*
Banj grassy slopes (BGS)	400	*Q. leucotrichophora* forest between grassy patches
Grassy slopes (GS)	200	Lower elevational grassy slopes
Oak-pine (OP)	240	*Q. leucotrichophora* and *Pinus roxburghii*

phical coverage of the habitats. At every 50 m interval 1 m x 1 m plot was laid, resulting in 20 plots in a kilometre of transect. Total 1820 plots were laid in seven habitat types. Since the number of samples were not uniform in each of the habitat types Coleman's rarefaction (Colwell and Coddington, 1994) was used. Data were computed using software EstimateS ver. 7.5 (Colwell, 1997) by randomizing the sample order 1000 times. Population study such as percentage frequency (%F) and density (D/m²) was calculated according to the formulae given by Curtis and McIntosh (1950). Jaccard's index was also calculated to see the similarity between different habitats. The similarity values were obtained by means of the formula ISj = a/a + b + c, where ISj is the index of similarity, a the total number of orchid species common between the habitats, b the total numbers of species unique to the first habitat and c the total number of species unique to the second habitat.

RESULTS

Six medicinal orchid species belonging to four genera were recorded in different habitats. Out of six species, four species viz *Malaxis muscifera* (Jeewak), *Malaxis acuminata* (Rishbhak), *Habenaria intermedia* (Ridhi) and *Habenaria edgeworthi* (Virdhi) are used for preparation of tonics such as 'Chyavanparas' in the Indian System of Medicine (ISM). *Dactylorhiza hatagirea* (D. Don) Soo and *H. intermedia* D. Don are highly endangered in the state. IUCN (International Union for Conservation of Nature) categorized *H. intermedia* as an endangered species (EN) and *D. hatagirea* has been categorized as critically

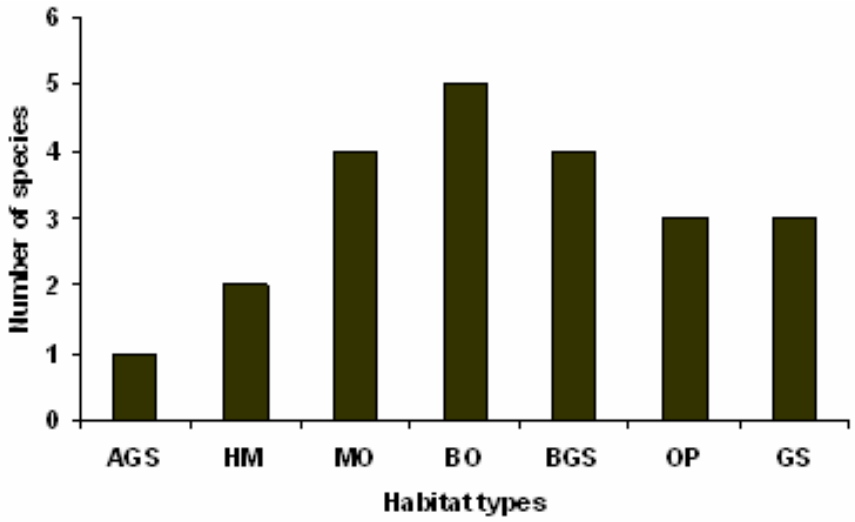

Figure 2. Species richness in different habitat types.

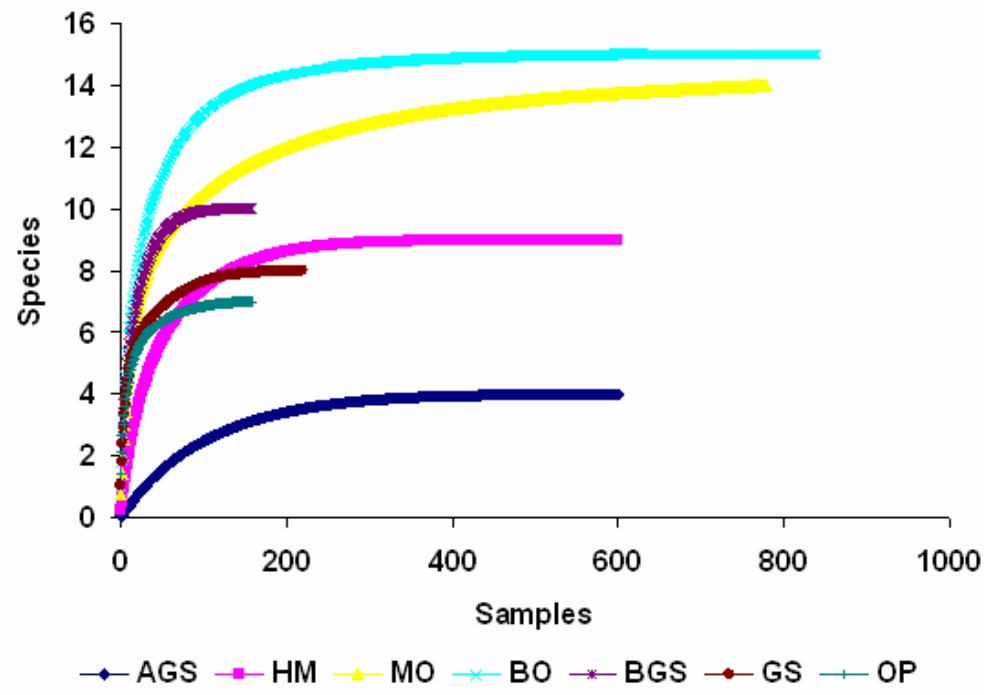

Figure 3. Sample based Coleman's rarefaction species area curves.

endangered in CAMP (Conservation Assessment and Management Plan) status (Kala, 2000), critically rare (IUCN status) and is listed under appendix II of CITES (Convention of International Trade in Endangered Species) (Uniyal et al, 2002). The tuber of *D. hatagirea* is used as nervine tonic, aphrodisiac and to relieve hoarseness of voice (Asolkar et al., 1992).

Among seven habitats, Banj-oak (BO) habitat (5) had the maximum number of orchid species followed by Mixed-oak (MO) and Banj Grassy Slopes (BGS), which had four species each (Figure 2). Alpine Grassy Slopes (AGS) had only one species (*D. hatageria*) and the moist slopes of this habitat support ideal condition for this critically rare species. Sample based rarefaction curves also show the highest species richness in the Banj-oak followed by Mixed-oak and Banj Grassy Slopes habitats (Figure 3). Habitat-wise density and frequency of each species is given in the Table 2. In the habitat HM, species

Table 2. Density and frequency of medicinal orchids in different habitats.

Species	AGS		BGS		BO		GS		HM		MO		OP	
	D	F	D	F	D	F	D	F	D	F	D	F	D	F
Dactylorhiza hatageria	0.7	27							0.4	20				
Habenaria edgeworthii			0.5	26	0.4	20	0.6	23			0.4	20		
Habenaria intermedia			0.6	28	0.9	40	1.0	39			0.6	18	0.5	17
Malaxis acuminata					1.9	13					1.1	23	2.4	17
Malaxis muscifera			0.2	5	0.3	10			0.3	8	0.2	8		
Satyrium nepalense			0.5	20	0.5	25	0.7	30			0.7	24	0.3	10

D = density/m^2, F = frequency (%).

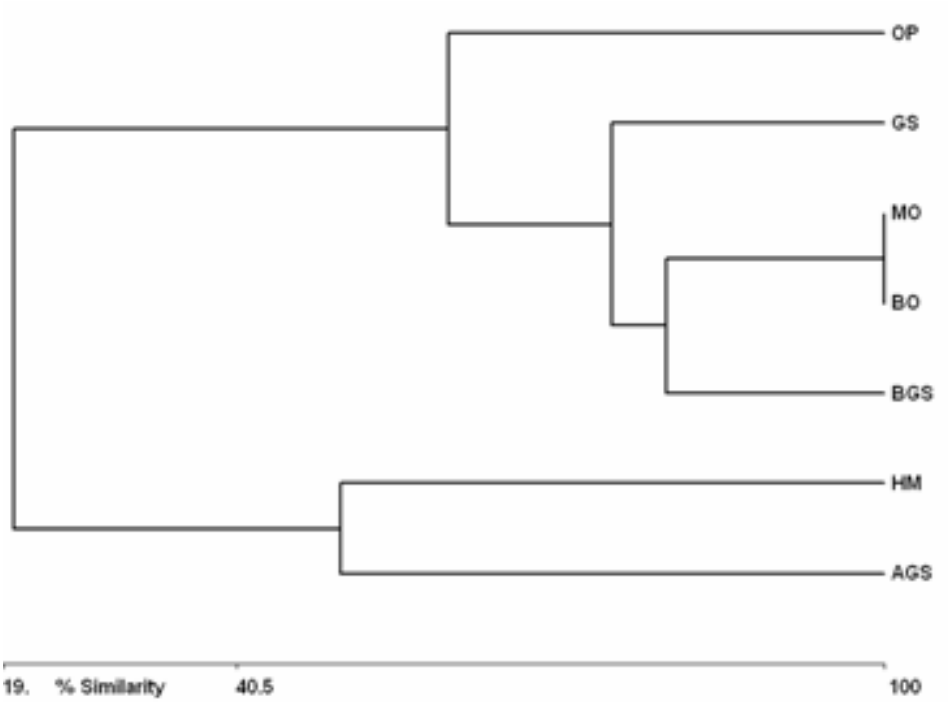

Figure 4. Phenogram derived from Jaccard's similarity values for different habitats.

D. hatageria (0.4 individuals/m^2) had the highest density and frequency (20%); however *M. muscifera* (0.3 individuals/m^2) had least density and frequency (8%). In the habitats BGS and BO, species *H. intermedia* had the highest density and frequency; however the species *M. muscifera* had the least density and frequency. In the habitat MO, *M. acuminata* (1.1 individuals/m^2) had the highest density and *M. muscifera* (0.2 individuals/m^2) had the least density, however species *Satyrium nepalense* (24%) had highest frequency and *M. muscifera* (8%) had the least frequency. In habitat GS, *H. intermedia* (1.0 individuals /m^2) showed the higher density and frequency (39%); however species *H. edgeworthii* had the least density and frequency. In habitat OP, *M. muscifera* (2.4 individuals/m^2) had the highest density and frequency; however species *S. nepalense* had least density and frequency. Among all the six medicinal orchids, the density and frequency of species *M. muscifera* was very low ranging from 0.2 - 0.3 individuals/m^2 and *M. acuminata* had the highest density.

To understand how close each habitat type was, Jaccard's similarity index was computed. The similarity values were used to generate the phenogram of Figure 4. Taking the index of similarity of ISj = 40.5 as a baseline, the habitats were grouped into two clusters. The analysis shows that the Mixed-oak and the Banj-oak habitats are closely related with the orchid species and the vegetation composition as well as highlights the fact that between them, maximum numbers of species (4) are shared. On the other hand, it was interesting to note that the habitat

pairs viz. Alpine Grassy slopes (AGS) and herbaceous meadows (HM) were somewhat isolated from the remaining habitat pairs. These habitats occur at higher elevations and are different, on the basis of vegetation as well as topography.

DISCUSSION

The most striking feature of the orchids is that they grow in the variety of habitats. Orchids need a specific microhabitat for their growth and development. Microhabitat conditions vary in different habitats. The occurrence of specific mycorrhizal fungus in the microclimate might also influence the habitat of the orchids (Hegde, 1982). According to Case (1962), the environmental factors that categorize orchid habitats are: soil requirements, freedom from competition, mycorrhiza, acidity, soil temperature and solar exposure. Seven habitat types were identified for medicinal orchids. Oak habitats (BO, MO and BGS) had the maximum diversity to help the growth of medicinal orchids. Species such as *H. edgeworthii* and *H. intermedia* generally prefer a canopy, which has less than 30% exposure to sun. *S. nepalense was* seen frequently at the edge of the forest and sometimes in open sunny meadows with moderate slopes. *M. acuminata* showed the highest density in the habitats BO, MO and OP because of its tendency to grow quickly. This species grows in colonies and one colony may contain 5 - 25 individuals. *M. acuminata* forms colonies in shady places, moist ground and in the areas that are wet and mossy. *M. muscifera* too prefer moist localities, but this species generally grows in a scattered way. It is clear that orchids need special microhabitat conditions and that these microhabitat features are responsible for their distribution. *D. hatageria* is only restricted to the Alpine Grassy Slopes (AGS) habitat and Herbaceous Meadows (HM) and from the conservation point of view, such species are more important. Species with specific habitat requirements have greater possibilities of extinction than the species with a broad habitat range (Samant et al., 1996).

The abundance of many orchid species is believed to have fallen to critical levels in recent years (Kull et al., 2006). Orchids are subjected to high levels of threats, through both natural and anthropogenic causes (Kull et al., 2006). It has been studied at various times that many known brands of herbal medicines use substitutes for some medicinal orchids due to their unavailability and one such example is that of *Eulophia dabia.* It is so rare today that it has been substituted by *S. nepalense*. This is due to the depletion of the population of these medicinal orchids in the state. The economic potential of these medicinal orchids can be assessed on the basis of their high market demand. The annual demand of the species *D. hatageria* is 5000 tons (Kala, 2004) and for the species *H. intermedia* it was 9995.5 kg during the year 2004 - 2005 in some localities of the state (Ahuja, 2003).

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