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ORCHIDS OF BANDLI WILD LIFE SANCTUARY, HIMACHAL PRADESH, NORTHWEST HIMALAYA

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Abstract

The paper deals with diversity, distribution pattern, phyto-associates and conservation of orchids at Bandli Wild Life Sanctuary (WLS), Himachal Pradesh, North West Himalaya. Vast altitudinal variation (750-2160m amsl) in this Protected Area (PA) has resulted in occurrence of 9 ground growing orchid species that are chiefly distributed between 1100-2000 m altitude. *Habenaria* with 4 species is the best represented genus and is followed by *Herminium* (2 species), and *Epipactis*, *Gastrodia* and *Nervilia* (1 species each). Majority of the orchids occupy either steep grassy slopes or narrow open hilltops with scattered trees and shrubby elements; only *Habenaria marginata* was recorded from a low altitude locality along the sides of a seasonal water channel. Collection of fuel wood and fodder, and grazing are main anthropogenic activities that might affect normal growth and regeneration of orchids in the sanctuary.

Introduction

ORCHIDS ARE globally known for their stunningly beautiful flowers of incredible sizes, shapes and colours, and are mainly distributed in tropical and subtropical regions of the world where positive factors (high humidity and thick vegetation) for their growth and development prevail. Though chiefly cultivated as ornamental plants, some orchid species are also rich in phytochemical contents such as alkaloids, triterpenoids, flavonoids and stilbenoids, and are used to cure a variety of human ailments such as nervous and skin disorders, dysentery, joint pain, malaria, and malignancy *etc*. (Lawler, 1984; Singh and Duggal, 2009). More than 1,300 species in about 190 genera are recorded in India of which nearly 350 species are endemic to the country (Misra, 2007; Singh, 2001). Himachal Pradesh, a mountainous state in North Western segment of Indian Himalayan Region (IHR) is home for over 76 orchid species majority of which (68) are ground growing in habit (Chowdhery and Wadhwa, 1984; Deva and Naithani, 1986; Verma *et al.*, 2009; Vij *et al.*, 1982). The changing environmental conditions and expanding urbanization have resulted in shrinkage and degradation of natural habitats in the state, and such alterations necessitate the importance of periodic field surveys so as to keep abreast with actual orchid diversity at different locales. In this connection, field surveys were organized in different areas of Himachal Pradesh, and information about orchids of Bandli Wild Life Sanctuary is provided here.

Bandli Wild Life Sanctuary (31' 25" - 31' 29" N latitude, 76' 52" - 76' 56" E longitude) is a small protected area (PA) of 41.33 km^2 located in district Mandi of Himachal Pradesh. It occurs in a hilly terrain with abrupt slopes, and the remarkable altitudinal variation (750-2160 m amsl) makes its climate ranging from subtropical to temperate. The Satluj river flows close to its South Western boundary and there are a few natural water sources in the sanctuary. However, amiable temperature that ranges between 1-35^0 C during the year and ideal annual rainfall (around 1500 mm) have helped in better colonization of various phyto-elements including orchids.

Material and Methods

Bandli Wildlife Sanctuary was visited on monthly intervals during years 2009-2010 and information on orchid diversity, distribution pattern, possible threats and major phyto-associates were recorded on field book along with detailed morphological notes. As per the instructions of Forest Department (Himachal Pradesh), no specimen was collected, and the species were only photographed in their natural habitats. To study density of different orchid species in the sanctuary, whole landscape was divided into 3 altitudinal gradients (Hill Base, 750-1200m; Mid Hill, 1200-1800m; Hill Top, 1800-2150m). These were further subdivided into 9 (3 in each) different sites at an altitudinal gap of 150-200m. The survey route was changed during each visit and therefore fresh 3 sites were selected at each altitudinal gradient during every month. At each site, 10 random quadrats each of 1m^2 were laid during every month. The density of each orchid species was calculated based on the data of the months of their actual physical occurrence in the sanctuary. For example, *Epipactis helleborine* came above ground during May and the whole plant withered during October. So in this case, the density is calculated on the basis of a total of 540 quadrats (180 in each

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Table 1. Diversity, distribution pattern and herbaceous phyto-associates of orchids at Bandli Wild Life Sanctuary, Himachal Pradesh.

Species	Flowers	Distribution range in the sanctuary (m)	Number of sites and species density (individuals/ m^2)			Major herbaceous associates
			Hill Base	Mid Hill	Hill Top	
Epipactis helleborine (L.) Crantz	Green, flushed more or less with red violet, drooping July-August	1500-2050	00 (00)	07 (0.050)	01 (0.011)	*Achyranthes aspera, Begonia picta, Capillipedium parviflorum, Chrysopogon* sp., *Cymbopogon distans, Cyperus niveus, Gnaphalium affine, Imperata cylindrica, Micromeria biflora, Microsorum membranaceum, Plantago lanceolata, Polystichum discretum, Thalictrum foliolosum*
Gastrodia falconeri D. L. Jones and M. A. Clem.	Light red-brown tinged with yellow, sub-erect, tubular July-August	1990	00 (00)	00 (00)	01 (0.016)	*Bergenia ciliata, Capillipedium parviflorum, Carex nubigera, Cymbopogon martinii, Dichanthium annulatum, Heteropogon contortus, Impatiens sulcata, Micromeria biflora, Onychium lucidum, Plantago lanceolata, Polystichum squarrosum, Thalictrum javanicum*
Habenaria ensifolia Lindl.	Green with yellowish lip July-August	1200-1900	00 (00)	05 (0.053)	02 (0.013)	*Achyranthes aspera, Athyrium pectinatum, Asplenium dalhousiae, Barleria cristata, Bothriochloa pertusa, Chrysopogon* sp., *Eleocharis tetraquetra, Heteropogon contortus, Paspalum distichum, Plantago ovata, Pycreus nitens, Stachys tibetica, Thelypteris dentata*
Habenaria marginata Coleb.	Greenish yellow August	750-850	09 (0.125)	00 (00)	00 (00)	*Ageratum conyzoides, Arisaema helleborifolium, Cheilanthes bicolor, Commelina obliqua, Digitaria granularis, Equisetum debile, Leptochloa chinensis, Martynia annua, Paspalidium flavidum, Pteris vittata, Rumex nepalensis, Sporobolus indicus, Setaria verticilliata*
Habenaria pectinata (J. E. Sm.) D. Don	Greenish-white July-August	1400-2000	00 (00)	04 (0.060)	02 (0.013)	*Athyrium pectinatum, Bothriochloa pertusa, Cheilanthes bicolor, Cymbopogon distans, Eleocharis tetraquetra, Heteropogon contortus, Imperata cylindrica, Leucas lanata, Maharanga emodi, Micromeria biflora, Primula denticulata, Thalictrum foliolosum*
Habenaria plantaginea Lindl.	White August-September	820-950	05 (0.041)	00 (00)	00 (00)	*Achyranthes aspera, Adiantum venustum, Curcuma aromatica, Digitaria ciliaris, Heteropogon contortus, Impatiens sulcata, Oxalis acetosella, Pteris cretica, Selaginella chrysocaulos, Stachys tibetica, Steria italica*
Herminium lanceum (Thunb. ex Sw.) Vuijk	Green July-August	1500-1950	00 (00)	11 (0.106)	03 (0.020)	*Arisaema wallichianum, Capillipedium parviflorum, Chirita pumila, Carex nubigena, Dichanthium annulatum, Eryngium billardieri, Fimbristylis pierotii, Heteropogon contortus, Imperata cylindrica, Leptochloa chinensis, Micromeria biflora, Polystichum discretum, Pteris cretica, Thalictrum foliolosum*
Herminium monophyllum (D. Don) P. F. Hunt & Summerh.	Yellow green, secund July-August	800-1200	06 (0.058)	02 (0.016)	00 (00)	*Achyranthes aspera, Anthemis cotula, Capillipedium parviflorum, Chirita pumila, Cymbopogon distans, Digitaria granularis, Leptochloa chinensis, Dryopteris cochleata, Ipomoea purpurea, Mazus surculosus, Polystichum squarrosum, Polytrichum* sp., *Porella* sp.
Nervilia gammieana (Hook. f.) Schltr.	Pink with pale green lip May-June	940	01 (0.026)	00 (00)	00 (00)	*Adiantum venustum, Anthemis cotula, Alloteropsis cimicina, Arisaema wallichianum, Digitaria ciliaris, Eleusine indica, Impatiens sulcata, Imperata cylindrica, Portulaca oleracea, Pteris vittata, Rumex hastatus*

Fig. 1 a-k. Orchids of Bandli Wild Life Sanctuary: a, General view of the orchid habitats at Sanctuary; b, *Epipactis helleborine*; c, *Gastrodia falconeri*; d, *Habenaria ensifolia*; e, *Habenaria marginata*; f, *Habenaria pectinata*; g, *Habenaria plantaginea*; h, *Herminium lanceum*; i, *Herminium monophyllum*; j, *Nervilia gammieana*; k, Grazing livestock of wandering shepherds in the Sanctuary area.

altitudinal gradient) laid during 6 months (May-October).

Results and Discussion

A total of 9 ground growing orchid species belonging to 3 Epidendroid (*Epipactis* Zinn., *Gastrodia* R. Br., *Nervilia* Commers. ex Gaud.) and 2 Orchidoid (*Habenaria* Willd., *Herminium* L.) genera were recorded from Bandli Wild Life Sanctuary. *Habenaria* with 4 species is the best represented genus because of ability of its species to adapt themselves in varied climates within a wider altitudinal range (750-2000m). *Gastrodia* and *Nervilia*, on the other hand are quite localized in distribution and are represented by a single species each. Majority of these species were distributed between 1100-2000 m altitudes, and depending upon their optimal requirements for nutrients and light, occupied either steep grassy slopes or narrow open hilltops (Fig. 1a) with scattered trees (*Albizzia chinensis, Bauhinia purpurea, Euphorbia royleana, Ficus roxburghii, Mallotus philippinensis, Phoenix humilis, Phyllanthus emblica, Pinus roxburghii, Pyrus pashia, Quercus leucotrichophora, Rhododendron arboreum, Salix tetrasperma, etc.*) and shrubby (*Asparagus racemosus, Berberis aristata, Boehmeria platyphylla, Colebrookea oppositifolia, Cyathula capitata, Hamiltonia suaveolens, Hypericum perforatum, Lantana camara, Leptodermis lanceolata, Murraya koenigii, Prinsepia utilis, Rubus ellipticus, Urtica dioica, Vitex negundo, Woodfordia floribunda,* etc.) species. *Gastrodia falconeri* and *Nervilia gammieana* were shade loving and *Herminium monophyllum* generally occupied moss covered moist habitats. Table 1 summarizes details (floral characteristics and flowering period, distribution range, density at different altitudinal gradients, major herbaceous associates) regarding different orchid species (Fig. 1b-j) of the sanctuary. Though, in one or more altitudinal gradients, species density is even zero in case of different species, *Habenaria marginata,* despite of its narrower distribution range exhibited highest density (0.125). This suggests the role of prevailing microclimatic conditions at different sites that help in determining the actual population structure of various species. Phyto-associates of each orchid species varied with respect to study sites; however, grasses and ferns were invariably present. Earlier, Vij *et al.* (1998) demonstrated that there are many factors such as steepness and aspect of slopes, extent of exposure of habitats, types of phyto-associates, interspecific competition, nature of soil substrata, availability of suitable fungal and pollinator partners, etc. which decide the degree of successful establishment and further growth of orchid species at a particular area. Local people depend upon sanctuary area to fulfill their needs of fuel wood and fodder; however, grazing livestock (Fig.1k) of wandering shepherds (*gaddis*) is the main anthropogenic activity that might affect growth and regeneration of orchids in the sanctuary. Moreover, continuous degradation of the fragile and delicate ecosystem of the Protected Areas by exposing them to unwanted human interferences ultimately proves harmful to the interest of wildlife and also is contrary to the well conceived principles and objectives of wildlife conservation.

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