

ORCHID DIVERSITY IN BASUKEDAR REGION (RUDRAPRAYAG DISTRICT) OF UTTARAKHAND

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Abstract

Uttarakhand harbours 73 genera and 231 species of orchids out of which 54% are terrestrial, 41% epiphytic and 5% are saprophytic. Extrinsic rarity in orchids is a reflection of anthropogenic threatening processes which directly limit or reduce the distribution and abundance of species, such as collection of wild orchids or land clearance. Habitat protection could be one of the most important *in situ* conservation strategies for orchids. Microclimatic conditions play an important role in the establishment and distribution of orchid species. In the present study, an extensive field survey was carried out from the lower catchment area of Mandakini river (tropical forest) up to the upper sacred forest of Khombherav, in Garhwal division. A total 17 genera with 19 species were recorded. Majority of orchids were found epiphytic followed by terrestrial distributed between 1000-2600 m. Species of *Dendrobium* and *Oberonia* were found to be dominant. *Coeloglyne cristata*, *Pholidota articulata*, and *Satyrium nepalense* were found to be used by local people as a medicine.

Introduction

ORCHIDS EXHIBIT incredible range of diversity in shape, size and colour of their flowers. They are important aesthetically, medicinally and are also regarded as ecological indicators (Joshi *et al.*, 2009). Due to various reasons like over-exploitation, illegal trade, encroachment of land, and change in climate, orchids species are threatened rampantly (Pant *et al.*, 2007; Shrestha, 2000). Most of these species have been categorized as critically endangered, rare and listed under appendix II of CITES. Two-third of orchid species are epiphytes, with terrestrial species comprising the remaining third, yet almost half of the extinct species are terrestrial herbaceous perennials (IUCN, 1999). Thus terrestrial orchids represent a life form class which is likely to experience a greater extinction risk as a result of the multiplicity of threatening processes, particularly under current climatic change scenario.

Material and Methods

Study Area

The study area *i.e.* Basukedar is located in Rudraprayag district of Uttarakhand (Fig. 1). The site is surrounded by high peak mountains like Kartik Swami (North facing), Chaukhamba, Badani and Banger strips, of these former two are the high peak mountain and latter one are the cluster of small hillocks. The surveyed area is extended from lower catchments of Mandakini (30°25'50.60" N Lat. 79°04'00.49" E Lon.) to an upper temperate forest

(30°27'22.68" N - 78°59'15.94" E) of Khom Bhairav sacred grove. In the present study, orchid taxa and their richness have been reported from 8 sites (lower catchments of Mandakini, Peepalkoti, Matanga-paali, Ghanj-Basukedar, Chenna gad, Dadoli-kaanda, lower/upper Chamachauri, Khom-forest sacred grove) and 5 forest types (lower mixed Pine-*Rhus* forest, mid Oak-*Myrica* dominant forest, Pure pine stand, upper *Alnus* dominant forest, and broad leaved Oak-lauraceous forest) were selected for study of orchid richness.

Field Survey, Data Collection, and Preparation of Herbaria

The field survey was carried out to study the richness of orchid taxa with a graded elevation of opted sites of different zones from February to April (2015) to April-July (2016). The occurrence of different species with their habitat and microclimatic conditions were recorded. Lower areas were dominated by the mixed *Rhus-Mallotus*-pine stand, middle area with *Quercus-Myrica* forest and upper area with broad leaved *Quercus*-lauraceous vegetation. The lower ranges (950-1400 m) were dominated by *Dalbergia sissoo*, *Engelhardtia spicata*, *Pinus roxburghii*, and *Rhus parviflora*. The vegetation at upper zone (1400-2600 m) comprises mainly of *Myrica esculenta*, *Quercus floribunda*, *Q. leucotrichophora*, and *Q. semicarpifolia* which were found to be the most preferred phorophytes of the epiphytic orchid species. The plants were collected from different parts of the host tree, rock fissures, and forest floor and the samples were kept in the blotting sheets. Data was collected for presently studied orchid species of Rudraprayag district

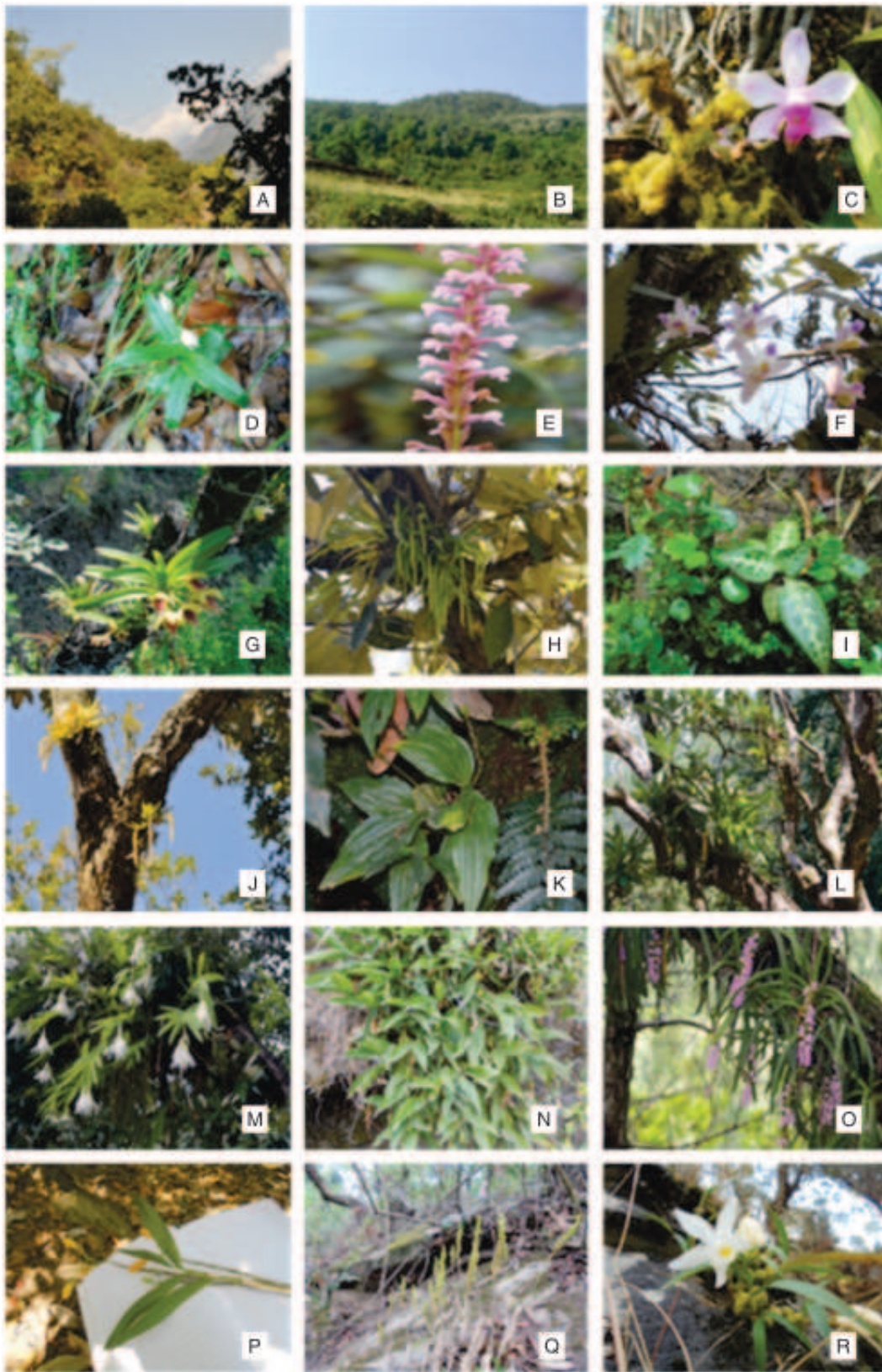


Fig. 2. A-R. Orchid species and their habitats from the study site: A, Tropical forest; B, Temperate forest; C, *Kingidium taenialis*; D, *Cephalanthera longifolia*; E, *Satyrium nepalense*; F, *Dendrobium amoenum*; G, *Vanda cristata*; H, *Oberonia ensiformis*; I, *Goodyera repens*; J, *Oberonia falconeri*; K, *Crepidium acuminatum*; L, *Cymbidium longifolia*; M, *Thunia alba*; N, *Pholidota articulata*; O, *Aerides multiflora*; P, *Dendrobium fimbriatum*; Q, *Zeuxine flava*; R, *Coelogyne cristata*.

Table 1. Collection data of orchid species of Rudraprayag District of Garhwal Himalaya.

| Species | Habitat | Host/phorophytes | Local status | Forest type | Altitude |
|--|---------|---|--------------|----------------|--------------------|
| <i>Goodyera repens</i> (L.) R. Br. | TT | - | R | MTF-O | 2536 m |
| <i>Zeuxine flava</i> (Wall. ex Lindl.) Benth. ex J. D. Hook. | TT | - | R | MTF-U, MTF-O | 1654 m |
| <i>Kingidium taenialis</i> (Lindl.) P. F. Hunt | ET | <i>Pyrus pashia</i> , <i>Quercus leucotrichophora</i> | R | MTF-U, MTF-O | 1694 m |
| <i>Rhynchostylis retusa</i> (L.) Bl. | ET | <i>Mangifera indica</i> | R | MTRF | 1049 m |
| <i>Aerides multiflora</i> Roxb. | ET | <i>Euphorbia royleana</i> | NT | MTRF | 1175 m |
| <i>Vanda cristata</i> Lindl. | ET | <i>Rhus parviflora</i> , chinu (LN) | NT | MTRF, MTF-U | 1000, 1615 m |
| <i>Gastrochilus calceolaris</i> (J. E. Sm.) D. Don | ET | <i>R. arboreum</i> , chinu (LN) | NT | MTF-O, MTF-U | 1455, 1620 m |
| <i>Dendrobium amoenum</i> Wall. ex Lindl. | ET | <i>Alnus nepalensis</i> , <i>P. pashia</i> | NT | MTF-U, MTF-O | 1607 m |
| <i>D. fimbriatum</i> W. J. Hook. | ET | <i>Q. leucotrichophora</i> , <i>Rhododendron arboreum</i> | NT | MTF | 1607, 1901 m |
| <i>Bulbophyllum triste</i> Reichb. f. | ET | Chinu (LN) | NT | MTF-O,U. | 1388, 1644 m |
| <i>Pholidota articulata</i> Lindl. | ET | <i>R. arboreum</i> , <i>Mallotus philippensis</i> , <i>Q. leucotrichophora</i> , <i>P. pashia</i> | NT | MTRF, MTF-O,U. | 1000, 1471, 1620 m |
| <i>Coelogyne cristata</i> Lindl. | ET | Chinu (LN) | NT | MTF-O | 1431, 1615 m |
| <i>Thunia alba</i> (Lindl.) Reichb. f. | ET | <i>Q. leucotrichophora</i> | R | MTF | 1769 m |
| <i>Oberonia falconeri</i> J.D. Hook. | ET | <i>Casearia graveolens</i> , mahwa, oak (LN) | NT | MTRF-MTF | 1471, 1385 m |
| <i>Oberonia ensiformis</i> (J.E. Sm.) Lindl. | ET | <i>Q. leucotrichophora</i> | R | MTF | 1400m |
| <i>Crepidium acuminatum</i> (D. Don) Szlach | TT | - | T | MTF | 1431 m |
| <i>Cymbidium longifolium</i> D. Don | ET | <i>R. arboreum</i> (specific) | R | MPF | 1700, 1934 m |
| <i>Satyrium nepalense</i> D. Don. | TT | - | R | MTF-O.K.M. | 1556, 1941 m |
| <i>Cephalanthera longifolia</i> (L.) Fritsch. | TT | - | R | MTF-O.K.M. | 2536 m |

TT, Terrestrial; ET, Epiphytic; LN, Local Name; R, Rare; NT, Not Threatened; T, Threatened; MTF-O.K.M.U, Mixed Temperate Forest-Oak, Kharsu, Moru, Uteesh; MTRF, Mixed Tropical Rain Forest; MPF, Mixed Pine Forest.

14.3%), then *Rhus parviflora*, *Pyrus pashia*, *Eurya acuminata* (3/10.7%), *Mangifera indica*, *Euphorbia royleana*, *Casearia graveolens* (2/7.1%) and *Mallotus philippensis*, *Engelhardtia spicata*, *Alnus nepalensis* with the least figure (1/3.6%) of orchid species (Fig. 4).

Density

Out of the total (54.0 plants/ha) density figure, the maximum value was computed for *Pholidota articulata* (18.8 inds/m²), followed by *Zeuxine flava* (7.7 inds/m²), *Bulbophyllum triste* (3.5 inds/m²), *Coelogyne cristata* (3.2 inds/m²), *Cymbidium longifolium*, *Dendrobium fimbriatum* (2.8 inds/m²), *Aerides multiflora* (2.4 ind/m²), *Vanda cristata* (2.2 ind/m²), *Oberonia falconeri* (2.0 inds/

m²), *Dendrobium amoenum* (1.9 inds/m²), *Gastrochilus calceolaris*, *Thunia alba* (1.8 inds/m²), *Oberonia ensiformis* (1.1 inds/m²), *Rhynchostylis retusa* (0.7 inds/m²), *Kingidium taenialis*, *Crepidium acuminatum* (0.5 inds/m²), *Satyrium nepalense* (0.2 inds/m²), *Goodyera repens* (0.1 inds/m²) and least figure was computed for *Cephalanthera longifolia* (0.045 inds/m²), (Fig. 3).

Diversity and Dominancy

In the present study, the maximum species diversity of orchid was found in tropical forest zone (1000-1400 m), followed by temperate (1400-2000 m) and least at higher altitude (2000-2600 m). With increasing altitude, the species diversity was recorded at elevation between

Table 2. Habitat, locality, associated vegetation, quantitative analysis, flowering to fruiting period in presently studied orchid species.

| Species | Habitat (locality) | Associated vegetation | Flowering/ Fruiting period |
|--|--|---|-------------------------------|
| <i>Satyrium nepalense</i> D. Don | Forest floor, rocks edges, open, cool, shady, damp site/Near Langad, Rimchee (near Syur) | <i>Galium aparine</i> , <i>Desmodium</i> , <i>Pteris</i> , <i>Angiopteris</i> , <i>Athyrium</i> , <i>Anaphalis</i> , <i>Dipsacus</i> , <i>Cichorium</i> | Jul-Oct |
| <i>Kingidium taenialis</i> (Lindl.) P.F. Hunt | Bark/Vandhar, Kyark | Mosses, <i>Asplenium</i> , <i>Microsorium</i> , Crustose lichen, <i>Smilax</i> | NR |
| <i>Zeuxine flava</i> (Wall. ex Lindl.) Benth. ex J. D. Hook. | Rock surface, forest floor/Vandhar, Chamachauri | Ground mosses, <i>Oxalis</i> , <i>Hedera</i> , <i>Galium</i> , <i>Smilax</i> | Feb-Apr |
| <i>Vanda cristata</i> Lindl. | Rough or unruffled bark/nearby Mandakini river, Vandhar | Mosses, <i>Asplenium</i> , <i>Microsorium</i> , Crustose lichen, <i>Aerides</i> , <i>Coelogyne</i> , <i>Pholidota</i> , <i>Bulbophyllum</i> | May-Jul |
| <i>Gastrochilus calceolaris</i> (J. E. Sm.) D. Don | Rough or smooth bark/Dadoli, Vandhar | <i>Bulbophyllum</i> , <i>Coelogyne</i> , <i>Hedera</i> , <i>Vanda</i> , Lichens | NR |
| <i>Aerides multiflora</i> Roxb. | Unruffled or rough bark/Aamdhar, nearby Mandakini river | Lichens, Mosses, <i>Vanda</i> , <i>Asplenium</i> , <i>Microsorium</i> | Jun-Aug |
| <i>Goodyera repens</i> (L.) R. Br. | Forest substratum, open, cool, damp, grassy land/near Khomdev sacred forest | <i>Anemone</i> , <i>Ranunculus</i> , <i>Fragaria</i> , <i>Selaginella</i> , <i>Parochetus</i> , <i>Hedera</i> | Aug-Oct |
| <i>Rhynchostylis retusa</i> (L.) Bl. | Dark-brown bark/near Mandakini, Peepalkoti | Mosses, <i>Microsorium</i> , Lichens | Apr-Sep |
| <i>Dendrobium amoenum</i> Wall. ex Lindl. | Rough fissured or smooth bark/near Syur, Chamachauri | Lichens, Mosses, <i>Pholidota</i> , <i>Coelogyne</i> | May-Jul |
| <i>D. fimbriatum</i> W. J. Hook. | Coarse, hardy bark/Vandhar, near Syur | Lichens, Mosses | NR |
| <i>Bulbophyllum triste</i> Reichb. f. | Smooth or rough, rusty bark/Dadoli, Chamachauri | Lichens, Mosses, <i>Asplenium</i> , <i>Pholidota</i> , <i>Vanda</i> | NR |
| <i>Pholidota articulata</i> Lindl. | Ground substratum, rocky plane, cool, shady or sunny site/near Mandakini, Vandhar | Lichens, Mosses, <i>Coelogyne</i> , <i>Vanda</i> , <i>Dendrobium</i> | Apr-May |
| <i>Coelogyne cristata</i> Lindl. | Forest floor, rock floor, open sunny or shady localities/Basukedar, Chamachauri | Mosses, Lichens, <i>Berginia</i> , <i>Begonia</i> | Mar-Jun |
| <i>Crepidium acuminatum</i> (D. Don) Szlach | Forest floor, open, cool, moisture, shady places/Dadoli, Ghanj-forest | <i>Selaginella</i> , <i>Reinwarditia</i> , <i>Begonia</i> , <i>Berginia</i> , <i>Barleria</i> , <i>Cheilanthes</i> | Aug-Oct |
| <i>Oberonia ensiformis</i> (J.E. Sm.) Lindl. | Rough corky bark, open, dry or cool, sunny or shady area/Dadoli, Basukedar | <i>Microsorium</i> , Lichens, Mosses, <i>Pholidota</i> , <i>Pepromia</i> | May-Sep |
| <i>O. falconeri</i> J.D. Hook. | Brown rough textured bark/Aamdhar, near Mandakini | Mosses, Lichens, <i>Aerides</i> | Jul-Nov |
| <i>Thunia alba</i> (Lindl.) Reichb. f. | Bark/Vandhar | Mosses, Crustose lichens | NR |
| <i>Cymbidium longifolium</i> D. Don | Grooved papery bark/Chena-gad, Khomdev sacred forest | Mosses | NR |
| <i>Cephalanthera longifolia</i> (L.) Fritsch. | Forest substratum, open, cool, damp, uneven slopes/Khomdev sacred forest | <i>Viola canescens</i> , Ground mosses | May-Sep |

NR, Not Recorded.

1000-1200 m, followed by 9 at 1200-1400 m, then 7 at 1400-1600 m, 3 at 1600-1800 m, 2 at 1800-2000 m, 2 at 2000-2200 m and at last 1 at 2200-2600 m). The dominant species found were *Dendrobium* (2), *Oberonia* (2), followed by *Aerides* (1), *Bulbophyllum* (1), *Cephalanthera* (1), *Coelogyne* (1), *Crepidium* (1), *Cymbidium* (1), *Gastrochilus* (1), *Goodyera* (1), *Kingidium* (1), *Pholidota* (1), *Rhynchostylis* (1), *Satyrium* (1), *Thunia* (1), *Vanda* (1), and *Zeuxine* (1).

Local Status and Therapeutic Value

Most of the orchid species are categorized as near threatened (9/48%) and rare (9/47%) apart from *Crepidium* species which has been placed in threatened category (1/5%). Of the total (19) documented orchid species, *Pholidota*, *Coelogyne* and *Satyrium* have medicinal properties and are used to heal the ailments of native people of that region.

Discussion

In the present study, the diversity of orchid species in different habitat of Basukedar region was found to be rich; the locality represents varied topographical features, diverse habitat, socio-economically significant plant communities and ecosystem. This study gives an informative data regarding species richness, density, abundance, a pattern of distribution, association, phenological behaviour and their ecological status. The orchid populations are decreasing with graded elevation, which clearly signifies that the prevailing environmental conditions at higher elevation are not optimum for the growth of orchid populations. Earlier Deva and Naithani (1987) studied the orchid flora of North West Himalaya and recorded morphology, distribution, locality, and flowering period for many orchid species including from Garhwal and Kumaun as well. Joshi *et al.* (2009) studied diversity of orchids in Uttarakhand and their conservation strategy with special reference to their medicinal importance. Jalal *et al.* (2010) conducted extensive surveys of the orchids in various eco-climatic zones of Uttarakhand and reported status, distribution and habitats of orchids. Marpa and Samant (2012) also studied orchid diversity in Askot Wildlife Sanctuary, West Himalaya and hinted at their conservation status.

Orchid taxa are categorized under the Convention on International Trade in Endangered species of Wild Fauna and Flora (CITES) under schedule VI of the Wild Life Protection Act (1972). Orchids became threatened due to overgrazing by livestock, anthropogenic factors, natural factors (forest fire; landslide) and climatic factors (precipitation, rate of rainfall). The conservation strategies and public awareness is essential for maintaining viable

populations. Many orchids have a high market value because of their application in multiple areas as in crude drug synthesis, for an ornamental purpose (due to their beautiful and long-lived flowers). Pathak *et al.* (2010) also reported medicinal potential of various orchids as the dried and powdered tubers in some of these are also consumed as energizing tonic. Over exploitation of aerals and below ground parts by native and non-native people leave a severe impact over the existing populations of orchids. Awareness programmes regarding the value of orchids and promotions for maintenance of the orchid populations by giving incentives to local people may prove helpful in conservation programme. Higher authorities, nature lovers, volunteers and NGOs are needed to be oriented themselves in exercises by organizing various programmes of orchid conservation. However, there is an urgent need to study orchid diversity in the region and their conservation status from unexplored areas so that suitable conservation strategies may be planned, in future.

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