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To Evaluate their Distributional Details, Together with their Habitat, Associated Vegetation, Flowering/ Fruiting period and Possible Threats to their Natural Populations

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Abstract: The majority of orchid species display their blossoms throughout the summer, with some species blooming earlier at lower altitudes and others blooming later at higher ones. In most instances, the fruit set was between 60% and 90%. modest seeds with a relatively modest amount of air space within them (11.122-34.052%) were often generated by species with a greater fruit set (>90%).. The soil pH ranged from 6.20 to 7.80, and the species varied in their favored growing conditions as it pertained to C, N, P, and K. The organic carbon (%) concentration in soils varied significantly across many species, with values as low as 0.462±0.013 for Spiranthes sinensis and as high as 6.422±0.010 for Oreorchis indica. Comparing Habenaria stenopetala to Oreorchis indica, the nitrogen quantity (Kg/ha) varied between 311.626±1.135 and 941.252±0.947. Typically, orchids like soils that have a low phosphorus concentration, and it is believed that the mycorrhizal partner satisfies this need. In the case of Dithrix griffithii, it was the lowest at 8.762±0.433 and the highest in Oreorchis micrantha, at 64.638±0.449. The soil potassium concentrations varied significantly, with Habenaria stenopetala having a range of 161.552±3.588 and Platanthera edgeworthii having a range of 656.532±1.073. The three polymorphic species (Crepidium acuminatum, Herminium lanceum, and Satyrium nepalense) showed a low level of genetic diversity across distinct morphotypes, with (P) values of 15.1%, 13.2%, and 11.4% respectively. Each locus (A) had an average of 1.15, 1.32, and 1.14 alleles.

Keywords: Habitat, Vegetation, Flowering, Fruiting, Threats and Natural

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INTRODUCTION

In India, orchids have a long history of medicinal usage dating back to the Vedic era (Kaushik, 1983; Handa, 1986). Rejuvenating formulations and tonics like 'Chyavanprash' (Dey, 1982) include a variety of orchid species used in Ayurvedic medicine, including Malaxis acuminata (Rishbhak), Malaxis muscifera (Jeevak), Habenaria intermedia (Ridhi), and Habenaria edgeworthii (Vridhi). Many authors have listed the various medicinal uses of Indian orchids (Hegde and Ingalhalli, 1988; Chauhan,1990; Kumar et al, 2000; Singh, 2001; Rao, 2004; Nayak et al, 2005; Dash et al, 2008); these have been reported to cure rheumatism (Acampe papillosa, A. praemorsa, Rhynchostylis retusa), malignancy (Goodyera pubescens, Vanda testacea), respiratory (Coelogyne henryi, Dactylorhiza hatagirea), orthopaedic (Cymbidium aloifolium, Dendrobium transparent, Eria panned), cardiac (Eulophia campestris, E. dabia), dysentery (Liparis rostrata, Satyrium nepalense) and nervous (Cymbidium elegans, Dendrobium nobile) disorders. The antimicrobial activities of many orchids have also been investigated (Ghanaksh and Kaushik, 1999 a, b; Dayamma and Rampal, 2002; Lai et al, 2004). Papilionanthe, Renanthera, Cattleya, Arachnis, Aranthera, Arundina, Cattleya, Coelogyne, Cymbidium, Dendrobium, Paphiopedilum, Vanda, etc., are just a few of the many orchid genera found in India. These species are highly prized for their ornamental qualities and are used extensively in hybridization (Kumar et al, 2001).

Numerous significant taxonomic additions have emerged concerning orchids since Linnaeus's (1753) systematic treatment of the subject, with the majority of these contributions focusing on vegetative and/or floral features. Dressier subsequently presented a phylogenetic approach that relied on morphological, palynological, anatomical, and cytological evidences (1993). The reticulate pattern of continuous morphological variability in orchids is a result of free gene flow across specific limits; however, most of the previous classification schemes relied on exo-morphological features, which has led to debates about the validity of these schemes. New and innovative genotypes may be created artificially or naturally by taking use of orchids' remarkable capacity for gene pool interchange at both the inter- and intra-generic levels. According to Vij and Gupta (1997), there are now over 1,00,000 commercially produced orchid hybrids, with hundreds more being introduced year, both naturally and artificially. Proposing a universal categorization scheme for the family is further complicated by this ongoing stage of speciation. Consequently, it is becoming more and more clear that a legitimate and widely accepted contemporary taxonomic system based on cytological, embryological, ecological, and morphological (both internal and exterior) characteristics is crucial for determining particular and generic boundaries.

Orchids are mostly sexual, and their seeds are tiny and non-endospermic. The embryos within are severely underdeveloped, and they need a certain kind of mycorrhizal connection to germinate. Orchid seeds may be described with great specificity in terms of size, shape, color, and other characteristics (Arditti, 1979). Several authors (Mutsuura et al., 1962; Healey et al, 1980; Weatherhead et at, 1986; Arditti, 1992; Kurzweil, 1993; Rani et al., 1993; Molvary and Kores, 1995; Pathak et at, 2001) have addressed various aspects of orchid seeds, including their development, structure, anatomy, morphology, physiology, ecology, and phytogeography. Several authors have utilized seed morphometries to understand the morphological, systematic, and phylogenetic relationships of these plants (Schultes and Pease, 1963; Senghas, et al, 1974; Barthlott, 1976; Arditti et al., 1979, 1980; Barthlott and Zeigler, 1980, 1981; Khurana et al, 1985; Prutsch et al, 2000; Arditti and Ghani, 2000; Gamarra et al, 2007). Research of this kind has received surprisingly little attention in India. Looking through the literature, we found a few papers on this topic (Garg et al., 1992; Vij et al, 1992; Augustine et al, 2001; Swamy et al., 2004a), but there isn't much data to draw conclusions about the taxonomic importance of orchid seeds.

LITERATURE REVIEW

In their 2023 publication, Müller, Nowicki, Barthlott, and colleagues Conservation planning must include analyses of species diversity and endemism trends. Consequently, the fact that such patterns are almost unthinkable in tropical nations that are both very varied and understudied poses a serious challenge to efforts to preserve biodiversity. Therefore, it is critical to create prediction models that are efficient with current species distribution data and can provide clues on where to focus conservation efforts geographically. The findings of a preliminary investigation into the diversity of the subtribe Pleurothallidinae of orchids (331 species mapped) in Bolivia's Andean rain forests are presented in this article. Comparing the results of an inventory-based mapping approach with those of a taxon-based mapping methodology reveals that species ranges are determined by abiotic (humidity and temperature, with altitude being an indicator of the latter) and historical (distance from collection localities) factors. There is a robust relationship between the distribution of sample locations and the patterns of diversity and endemism depending on taxon. Using both mapping methodologies to critically assess and compare data may help with useful conservation suggestions, even if the inventory-based approach is more trustworthy. Finally, we draw some real-world findings that might inform conservation efforts.

In, (Taylor, Gunnar, et al., 2021) — For more than a hundred years, the vast variety of orchids has fascinated scientists. Nevertheless, our understanding of the complex spatial patterns shown by these orchids on a larger scale remains limited. Orchid diversity patterns on islands are especially puzzling. The majority of islands do not have a lot of orchids, however there are a few that are particularly diverse. The complicated patterns may only be deciphered by considering the vast functional variations among orchids. Biogeographical studies surprisingly fail to account for these distinctions. Using a detailed dataset of 454 islands, we investigated island biogeography. The three distinct kinds of plant life—epiphytes, geophytes, and non-geophytes—were defined and tested in our research. Orchid variety was found in different places on different islands and in different kinds of life. It is worth noting that epiphytes are mostly found in tropical climates, since the variety of epiphytic orchids grows substantially as temperatures rise. As the degree of seasonality rose, geophytes became more important, proving that they can survive harsh climates. The reactions shown by both epiphytes and non-geophytes, such as a negative correlation with seasonality, were associated with their need on continuously favorable circumstances. One possible explanation is that they do not have any organs for storing energy underground. The variables that contribute to the variety of orchids are intimately tied to and differ greatly across different forms of life, as this highlights. The important functional distinctions within and across plant groups should be taken into account in future research. Using this method, we can learn more about what causes complicated patterns of variety.

Brito, Thaline& Santos et. al. (2018) - The majority of the world's species are found in small, highly-specialized areas called "centres of endemism." The Belém Endemism Centre (BEC) is a notoriously extensively deforested region of Brazil's Amazon, situated in the region's easternmost region. We provide data on orchid bee assemblages derived from historical records found in entomological collections in this research. We categorized each species as common, moderate, or uncommon based on our calculations of occurrence frequency and dominance. We used the Jackknife estimator to build curves that show the estimated and observed richness. A total of 1,257 specimens representing 56 distinct species were found by us. From 1917 to 2009, these specimens were gathered. Notably, one of these species is a first for BEC. Since the 1970s, surveys have grown, and a smaller number of sites have yielded a larger number of specimens and species. According to the findings, the BEC is home to an exceptionally high population of orchid bees. Be that as it may, this discovery runs counter to the original plans for the whole region. The close proximity of places has made sampling efforts easier, and the low representation of uncommon species in collections might be a contributing factor to their high prevalence. Researchers comparing orchid bee faunas from various eras may use this species list and conservation status information, however. Together with information on the bees' historical responses to land use changes in the BEC region, this data may also help prioritize conservation efforts.

Machado, Antonini Y., et al. (2017) - Both the protection of biodiversity and the interpretation of ecological data depend on an understanding of spatial patterns and geographic beta-diversity. Tropical forests, and the Amazon Rainforest in particular, are famous for the rich diversity of species found there and the fact that various parts of the forest have quite varied species compositions. We set out to determine how different plateaus in the central Amazonian region of Brazil affected the diversity and turnover of orchid bee species by analyzing the effects of isolation, climate, and area. When studying the effects of geographical and environmental factors on the diversity, evolution, and composition of bee populations, we used variance partitioning methods. We hypothesised that a core group of orchid bee species would be present on every plateau, and that bigger plateaus would have a greater variety and number of orchid bees. Furthermore, we postulated that the amount of phylogenetic variety would be lower on smaller plateaus. Among the nine plateaus that served as sample locations, we found 55 different kinds of bees. Fifteen of these species were identified as singletons, meaning they were discovered just once. The species richness decline was significantly affected by the extent of the plateaus. The similarity in species composition also decreased significantly as the distance and climate difference across sample locations grew. There was a clear correlation between species richness and phylogenetic diversity, but this varied between sample locations.

Cardoso, Domingos, Särkinen, Tiina, et. al., 2017 -Finding lesser PDFaith in the smallest plateaus and bigger PDFaith in the biggest plateaus was seen, albeit not directly connected to the size of the plateau area (. The relevance or importance of anything is what we mean when we talk about its significance. In order to make conclusions regarding the patterns and development of plant diversity in the area, it is common to use massive floristic databases to evaluate the diversity and composition of the Amazon tree flora. them should be mentioned that these datasets have major problems with their approach and the material that comes out of them. An exhaustive database of seed plant species native to the Amazon jungle has been assembled by our team. Data in this collection comes from voucher specimens that have been positively recognized by taxonomic experts, and the information is based on credible published sources. To address the continuing argument over the number of plant species in the Amazon, this exhaustive list might be used as a starting point. Ecological and evolutionary studies may also make use of it to learn more about the history and purposN.e of the abundant Amazonian forest's incredible biodiversity.

MATERIALS AND METHODS

From 2010 to 2013, researchers in Himachal Pradesh conducted periodic field surveys to identify orchids in four distinct climate zones: subtropical, warm temperate, cold temperate, subalpine, and alpine. Results are based on five soil replicates collected randomly from five different localities. In case of restricted species occurrence, soils were collected only from one or two localities from the base of distantly distributed plants. Soil samples were collected from near the base of orchid plant by using soil corer from a depth of 10-20 cm (Misra, 1968). The efficient dissemination of any plant species relies on seeds. Using light and scanning electron microscopy, the features of 31 species gathered from various locations in the research region were examined at present. In order to do this, we tagged two or three blooming individuals of the same orchid species in the field using paper tags soaked in paraffin wax Healthy mature leaves of the selected plants were harvested in field, wrapped in aluminium foil, placed in chill packs and brought to the laboratory. The material so collected was either processed immediately or stored at 4˚C to process within 48 hrs.

DATA ANALYSIS

Flowering and fruiting periods

All of the presently studied orchids possessed beautiful flowers. Majority of them came into flower during the months of July (28 species) and August (26 species). The number of species in bloom progressively declines towards both sides of these months; none of the species was observed in flowering during the months of November, December, January and February. Fruit formation took one to one and a half month after the beginning of flowering; maximum fruit set (26 species) was seen during the month of August. The fruit set was not found similar in all of the presently studied species and it ranged between 60-90% in majority of cases. The lowest (26.45%) fruit set was seen in *Crepidium acuminatum* and the highest (96.26%) in *Rhynchostylis retusa*. Fruit dehiscence and seed dispersal was complete before the onset of winter season.

Figure 1: Orchids of Himachal Pradesh. A-B, Cypripedium cordigerum D. Don; C-D, Goodyera biflora (Lindl.) Hook. f.

Population analysis and associated vegetation

Quantitative analysis of various terrestrial orchid species was done in the study area by measuring their density, abundance and frequency. the data on these parameters along with dominant herbaceous elements and possible threats faced by their natural populations. Minimum species density [individual(s)/ m2] was observed to range between 0.50 (*Goodyera repens*, *Platanthera latilabris*) and 3.30 (*Satyrium nepalense*), and maximum between 0.88 (*Habenaria commelinifolia*) and 9.23 (*Androcorys monophylla*). The mean value of density was minimum (0.77±0.29) in *Habenaria commelinifolia* and maximum (6.54±1.60) in case of *Androcorys monophylla*; both of which belong to subfamily Orchidoideae. In Epidendroideae, *Epipactis gigantea* and *Crepidium acuminatum* were observed to have minimum and maximum species density at 1.08±0.61 and 3.37±1.27 respectively. Both mycoheterotrophs were found to have species density ranging between 1.37±0.40 (*Gastrodia falconeri*) and 1.40±0.49 (*Cymbidium macrorhizon*). Species density has been observed competitively more in case of species inhabiting shady forests, shrubby grasslands and grassy slopes.

Species abundance was lowest (1.30) in case of *Dactylorhiza hatagirea*. Another Orchidoid

Table 1. Geographical affinities of the presently studied orchids

S.No.	Nameofspecies	Occurrence in Himachal Pradesh(HP) and other states/countries/geographical areas*															
		HP	JK	PHC	UK	1	2	3	4	5	6	7	8	9	10	11	12
1.	*Androcorysmonophylla*	+	-	-	+	+	-	-	-	-	-	-	-	-	-	-	-
2.	*Brachycorythisobcordata*	+	-	-	+	-	+	-	-	+	-	-	-	+	-	-	-
3.	*Crepidiumacuminatum*	+	-	-	+	+	+	+	-	+	-	-	-	+	+	+	+
4.	*Cymbidiummacrorhizon*	+	-	-	+	+	+	-	-	-	-	+	-	-	+	+	+
5.	*Cypripediumcordigerum*	+	+	-	+	+	+	-	-	-	-	+	-	+	-	+	-
6.	*Dactylorhizahatagirea*	+	+	-	+	+	+	-	-	-	-	+	-	+	-	+	-
7.	*Dieniacylindrostachya*	+	+	-	+	+	+	-	-	-	-	+	-	+	+	+	-
8.	*Dithrixgriffithii*	+	+	-	+	-	+	-	-	-	-	+	-	-	-	-	-
9.	*Epipactisgigantea*	+	+	-	+	+	+	-	-	-	-	+	+	+	-	+	-
10.	*Epipactishelleborine*	+	+	-	+	+	+	-	-	-	-	+	+	+	-	+	-
11.	*Eulophiaherbacea*	+	-	-	+	+	+	+	-	+	-	-	-	-	-	+	+
12.	*Eulophiahormusjii*	+	-	-	+	+	+	-	-	-	-	+	-	-	-	-	-
13.	*Gastrochiluscalceolaris*	+	+	-	+	+	+	-	+	-	-	-	-	+	+	+	+
14.	*Gastrodiafalconeri*	+	+	-	+	-	+	-	-	-	-	+	-	-	-	-	-
15.	*Goodyerabiflora*	+	-	-	+	+	-	-	-	-	-	-	-	-	-	-	-
16.	*Goodyerarepens*	+	+	-	+	+	+	-	-	-	-	+	-	+	-	+	-
17.	*Habenariaaitchisonii*	+	+	-	+	+	+	-	-	-	-	+	+	+	-	-	-
18.	*Habenariacommelinifolia*	+	-	-	+	+	+	+	-	-	+	-	-	+	+	-	+
19.	*Habenariadigitata*	+	-	-	+	-	+	+	-	-	-	+	-	-	-	-	+
20.	*Habenariaintermedia*	+	+	-	+	+	+	-	-	-	-	+	-	-	-	-	-
21.	*Habenariamarginata*	+	+	-	+	+	+	+	-	-	-	+	-	+	+	-	+

22.	*Habenariapectinata*	+	+	-	+	+	+	-	-	-	-	+	-	+	-	+	-
23.	*Habenariaplantaginea*	+	+	-	+	+	+	+	-	-	+	-	-	-	-	-	-
24.	*Habenariapubescens*	+	-	-	+	+	+	-	-	-	-	-	-	-	+	-	-
25.	*Habenariastenopetala*	+	+	-	+	+	+	-	-	+	-	-	-	+	-	-	+
26.	*Herminiumlanceum*	+	+	-	+	+	+	-	-	-	-	+	-	+	+	+	+
27.	*Herminiummonorchis*	+	+	-	+	+	+	-	-	-	-	+	-	+	-	+	-
28.	*Liparisodorata*	+	-	-	+	+	+	-	-	-	-	-	-	-	-	+	+
29.	*Liparisrostrata*	+	+	-	+	+	+	-	-	-	-	+	-	-	-	-	-
30.	*Oreorchisindica*	+	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-
31.	*Oreorchismicrantha*	+	+	-	+	+	+	-	-	-	-	+	-	+	-	-	-
32.	*Pecteilisgigantea*	+	+	-	+	-	+	+	-	-	-	+	-	-	-	-	-
33.	*Peristylusaffinis*	+	-	-	+	+	+	-	-	-	-	-	-	-	-	+	+
34.	*Platantheraclavigera*	+	-	-	+	+	+	-	-	-	-	-	-	-	-	-	-
35.	*Platantheraedgeworthii*	+	+	-	+	+	+	-	-	-	-	+	-	-	-	-	-
36.	*Platantheralatilabris*	+	+	-	+	+	+	-	-	-	-	-	-	-	-	+	-
37.	*Rhynchostylisretusa*	+	+	-	+	+	+	+	+	+	+	-	-	+	+	+	+
38.	*Satyriumnepalense*	+	+	-	+	+	+	+	-	-	+	+	-	+	-	+	+
39.	*Spiranthessinensis*	+	+	+	+	+	+	+	-	+	+	+	+	+	+	+	+
Total		**39**	25	1	39	33	36	10	2	6	5	23	4	20	10	19	14

*JK, Jammu and Kashmir; HP, Himachal Pradesh; PHC, Punjab, Haryana and Chandigarh; UK, Uttrakhand; 1, Central Himalaya (Nepal); 2, Eastern Himalaya/NE India;3, Peninsular India; 4, Andaman and Nicobar islands; 5, Bangladesh; 6, Srilanka; 7, Pakistan; 8, Afghanistan; 9, Bhutan; 10, Myanmar; 11, China; 12, Thiland; +, present; -, not present.

Associated vegetation showed quite variations in different localities of the study area. General vegetation of different climatic zones has been highlighted the dominant associated herbs in various habitats of each of the orchid species. Majority of the terrestrials grew in association with grasses, ferns and bryophytes. The epiphytes, on the other hand, show a close association of their roots with lichens and mosses supported by the host trees.

Possible threats to orchid species

During present field visits, the orchid habitats in majority of the localities were found under different anthropogenic pressures that might be jeopardizing the natural regeneration and size of orchid populations. These threats were categorized in seven main classes: 1, loss of habitat (loss or shrinkage of habitats due to one or more of the reasons such as forest clearing for constructing houses, hydro-electric projects, roads, or for expanding agricultural fields); 2, overgrazing (grazing animals eat away young inflorescences and/ or fruits, and also uproot the underground perennating plant parts such as roots, rhizomes, pseudobulbs and tubers); 3, extraction of plant parts from wild (plant parts of some species are extracted from their wild populations because of their therapeutic importance); 4, fodder and fuel wood collection (grass collection along with other herbs including orchids, and harvesting of leaves from trees/ shrubs for fodder); 5, unregulated tourism (littering in habitats with non-biodegradable objects such as polythene bags, biscuit/ chips wrappers, and plastic glasses/ bottles); 6, invasive species (gradual replacement of native species including orchids by some exotic weeds such as *Ageratum conyzoides*, *Lantana camara*, *Parthenium hysterophorus*, etc.); and 7, forest fires and landslides (that lead to destruction of vegetation and fragmentation of habitats). Habitat loss was observed in case of all of the species and three of these (*Crepidium acuminatum*, *Platanthera latilabris*, *Satyrium nepalense*) were observed facing all of the above-*mentioned* threats. Though all of the above-mentioned anthropogenic activities may influence orchid germination, growth and development directly or indirectly, the exact degree of their effect on orchid populations was not investigated under the present scope of study.

CONCLUSION

Orchid diversity in Himachal Pradesh's subtropical, warm temperate, cold temperate, subalpine, and alpine climate zones was the intended focus of the present research. Quantitative study (density, frequency, abundance) of their populations and soil properties of natural habitats were conducted, together with information on the distribution pattern of various species, range of habitats, blooming and fruiting seasons, and potential threats. Consideration was given to the taxonomic, phylogenetic, and phytogeographical significance of seed characteristics. The genetic relationships between the morphotypes of three polymorphic species were also the subject of biochemical investigations. Following the presentation of the data in the previous pages, this section will examine these findings in the context of the literature. Quantitative study (density, frequency, abundance) of their populations and soil properties of natural habitats were conducted, together with information on the distribution pattern of various species, range of habitats, blooming and fruiting seasons, and potential threats.

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