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Orchid diversity of Rey River Valley, Gangtok: an unexplored treasure trove of Sikkim

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Abstract: Rey river valley, Gangtok, Sikkim is an unexplored area of Sikkim in terms of plant diversity focusing specifically on orchids. During our exploration and elaborate field surveys during the year 2022 - 2023, a total 33 of species under 24 genera of wild orchids have been documented from this area out of which two rare holomycotrophic orchid species namely, *Gastrodia sikkimensis* and *Didymplexiella siamensis* as a new record to science and a generic record for India have been reported respectively. Checklist of wild orchids of Rey river valley along with brief details of the study area, newly discovered orchid species and notes related to conservation of the orchid species have been discussed in this current communication.

Introduction

Orchids, belonging to the family Orchidaceae, are one of the largest and most diverse flowering plants, comprising over 25,000 species and more than 100,000 hybrids (Chase et al., 2015). These plants are known for their complex and often intricate flowers, which have evolved sophisticated mechanisms to attract specific pollinators, ensuring effective reproduction (Dressler, 1993).The distribution of orchids spans across the globe, with species found on every continent except Antarctica. They thrive in various habitats, from tropical rainforests to arid deserts, showcasing their adaptability (Pridgeon et al., 1999). Orchids can be classified into three main types based on their growing habits: epiphytic (growing on other plants), terrestrial (growing in the ground), and lithophytic (growing on rocks) (Arditti, 1992). One of the key characteristics of orchids is their unique floral morphology. Orchids typically possess three sepals and three petals, with one petal often modified into a labellum or lip, which serves as a landing platform for pollinators (Cozzolino & Widmer, 2005). Additionally, the reproductive organs of orchids are fused into a single structure called the column, which facilitates efficient pollination (Darwin, 1877). Orchids have significant ecological and economic importance. They play crucial roles in their ecosystems by forming intricate relationships with pollinators and mycorrhizal fungi, which aid in nutrient absorption (Smith & Read, 2008). Economically, orchids are prized for their ornamental value, contributing to a substantial global horticultural industry (Hinsley et al., 2018). In conclusion, orchids are remarkable plants that exhibit a wide range of morphological and ecological adaptations. Their global distribution, unique floral structures, and ecological roles make them a fascinating subject of study in the plant kingdom.

Sikkim, a small northeastern state of India, boasts an impressive diversity of orchids, making it a significant region for orchid research and conservation. The unique geographical and climatic conditions of Sikkim contribute to its rich orchid flora, with over 500 species recorded in the region (Rao, 2012). The

state's varied topography, ranging from tropical lowlands to alpine regions, provides diverse habitats for orchids. The subtropical and temperate forests, in particular, are rich in epiphytic orchids such as species from the genera *Dendrobium*, *Coelogyne*, and *Bulbophyllum*(Lucksom, 2007). These epiphytic orchids grow on trees, drawing moisture and nutrients from the air and rain.Terrestrial orchids, which grow in the soil, are also abundant in Sikkim. Notable genera include *Paphiopedilum* (the lady's slipper orchids), *Cymbidium*, and *Goodyera*. The terrestrial orchids of Sikkim often thrive in the forest understorey and grasslands, showcasing a wide range of floral morphologies and adaptations (Yonzone & Rai, 2011). One of the most striking features of Sikkim's orchid diversity is the presence of many endemic species, which are found nowhere else in the world. For example, *Paphiopedilum fairrieanum*, an orchid species endemic to Sikkim, is highly prized for its unique and attractive flowers (Rao, 2012).The conservation of orchid diversity in Sikkim is of paramount importance, given the ecological and economic value of these plants. Orchids play a crucial role in their ecosystems, particularly in their interactions with pollinators and mycorrhizal fungi, which are essential for their growth and reproduction (Kumar & Rao, 2012). Additionally, the horticultural appeal of orchids contributes to local economies through trade and tourism. Efforts to conserve Sikkim's orchid diversity include the establishment of protected areas and orchid sanctuaries, such as the Deorali Orchid Sanctuary in Gangtok. These conservation measures aim to protect the natural habitats of orchids and prevent over-collection and habitat destruction (Lucksom, 2007). Sikkim's orchid diversity is a remarkable aspect of the region's natural heritage. The state's rich and varied orchid flora underscores the importance of ongoing research and conservation efforts to preserve these unique and valuable plants.

Methodology

Area of study: The study was conducted during 2022- 2023 covering all the seasons from within the 3 sq.km area of Rey river valley, Gangtok district, Sikkim. This area is an ecologically rich landscape with an immense diversity of wild orchids and other angiosperms. Geographically the area is located between approximately 27° 33' 78" N latitude and 88° 62'15" E longitude. The climate of the area is moist with warm summer and moderate cold winter with mean annual temperature ranging from 18- 20 °C. The mean annual rainfall of the area is approximately 3000-3500 mm. Vegetation of the semi-urban area of Rey river valley can be considered as moist deciduous comprising ample bamboo groves with scattered trees of *Alnus nepalensis, Schima wallichii* etc.

Photographs of the orchids in flowering condition were taken in their natural habitat and their phenology also been noted. Vegetative characters and floral morphology of some species were noted after stereo-microscopic examination in the laboratory of Department of Botany, Sikkim University. Relevant literatures (Singh et al. 2019, Gogoi et al., 2021) and keys were consulted for the identification of the species. Identified specimens have been mounted into herbarium sheets following standard herbarium procedures (Jain & Rao 1977)

and have been stored at the herbarium section of Department of Botany, Sikkim University.

Results and Discussion

During thorough exploration and field survey at Rey river valley, Gangtok , following orchid species have been documented:

Sl. no.	Species name	Habitat	Flowering time
1.	*Acanthephippium striatum* Lindl.	Terrestrial	April-August
2.	*Bulbophyllum affine* Lindl.	Epiphytic	May-July
3.	*Bulbophyllum caudatum* Lindl.	Epiphytic	June-July
4.	*Bulbophyllum crassipes* Hook.f.	Epiphytic	September-November
5.	*Bulbophyllum odoratissimum* (Sm.) Lindl. ex Wall.	Epiphytic	May-July
6.	*Cleisostoma linearilobatum* (Seidenf. & Smitinand) Garay	Epiphytic	June-July
7.	*Coelogyne fuscescens* Lindl.	Epiphytic	October-January
8.	*Coelogyne prolifera* Lindl.	Epiphytic	May-June
9.	*Crepidium acuminatum* (D.Don) Szlach.	Terrestrial	June-September
10.	*Crepidium purpureum* (Lindl.) Szlach.	Terrestrial	July-September
11.	*Cymbidium aloifolium* (L.) Sw.	Epiphytic	April-August
12.	*Cymbidium lancifolium* Hook.	Terrestrial	June-September
13.	*Dendrobium aphyllum* (Roxb.) C.E.C.Fisch.	Epiphytic	April-June
14.	*Dendrobium fimbriatum* Dalzell	Epiphytic	April-June
15.	*Dendrobium nobile* Lindl.	Epiphytic	March-May
16.	*Didymoplexis pallens* Griff.	Mycoheterotrophic	February-June
17.	*Dienia ophrydis* (J.Koenig) Seidenf.	Terrestrial	June-August
18.	*Epipogium roseum* (D.Don) Lindl.	Mycoheterotrophic	April-September
19.	*Eria lasiopetala* (Willd.) Ormerod	Epiphytic	April-June
20.	*Liparis nervosa* (Thunb.) Lindl.	Terrestrial	July-August
21.	*Luisia trichorhiza* (Hook.) Blume	Epiphytic	April-May
22.	*Oberonia acaulis* Griff	Epiphytic	July-October
23.	*Peristylus goodyeroides* (D.Don) Lindl.	Terrestrial	June-July
24.	*Pholidota articulata* Lindl.	Epiphytic	July-August
25.	*Pholidota imbricata* Hook.	Epiphytic	March-August
26.	*Podochilus cultratus* Lindl.	Epiphytic	July-August
27.	*Rhynchostylis retusa* (L.) Blume	Epiphytic	May-July
28.	*Taeniophyllum glandulosum* Blume	Epiphytic	May-July
29.	*Thrixspermum formosanum* (Hayata) Schltr.	Epiphytic	June-October

30.	*Tropidia angulosa* (Lindl.) Blume	Terrestrial	August-November
31.	*Zeuxine affinis* (Lindl.) Benth. ex Hook.f.	Terrestrial	September-October
32.	*Zeuxine flava* (Wall. ex Lindl.) Trimen	Terrestrial	April-July
33.	*Zeuxine nervosa* (Wall. ex Lindl.) Benth. ex Trimen	Terrestrial	November-June

Recently, two extremely elusive holomycotrophic orchid species have been discovered from the bamboo thickets of Rey Valley (Khanal *et al.*, 2024a; 2024b).

1. *Gastrodia sikkimensis* M.Khanal & S. Sarkar: A novel mycoheterotrophic orchid found growing on decomposing leaf litter within the bamboo brakes with scattered deciduous trees of *Alnus nepalensis* and *Schima wallichii* and flowering time May–June, which is discovered from the bamboo groves of Rey river valley as new to science and endemic to India. The new species is named after the state of Sikkim.

2. *Didymoplexiella siamensis* (Rolfe ex Downie) Seidenfaden: *Didymoplexiella*, a holomycotrophic terrestrial orchid genus has been reported for the first time in India and the genus is represented by *D. siamensis* which has been reported from Rey river valley, Sikkim in the year 2024. This rare species grows on partly decomposed leaf litter, in a shady bamboo forest at 800–1100 m.s.l. & flowering time is May–June.

Additionally, two rare epiphytic orchids *Taeniophyllum glandulosum* & *Thrixspermum formosanum* (Khanal *et al.*,2022 a,b) were also reported as new records for Sikkim from Rey river valley area.

Recommendation related to Conservation:

During the field study at the Rey river valley we have observed considerable habitat loss due to anthropogenic disturbance including tree felling; habitat quality is decreasing due to pollution, climate change and other natural factors like landslides, soil erosion etc. As the wild orchids especially holomycotrophic orchids are extremely sensitive to habitat disturbances. It is now very important to take preventive measures to protect the loss of orchids in the area. Sensitization programmes with scientific outreach should be conducted at community level for the rescue and *ex-situ* conservation of the rare and endangered species whenever any alteration of host tree and habitat takes place ensuring biodiversity conservation.

Didymoplexiella siamensis (Rolfe ex Downie) Seidenfaden

Gastrodia sikkimensis .Khanal & Sarkar

Taeniophyllum glandulosum Blume

Thrixspermum formosanum (Hayata) Schltr.

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