

Terrestrial Orchids of Rajasthan, India

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Abstract

During present investigation a total fifteen species of terrestrial orchids belonging to six genera were recorded from the Rajasthan state. Two endemic terrestrial orchids (*Eulophia ochreatea* and *Peristylus stocksii*) which are endemic to India, also found in Rajasthan. *Peristylus lawii* was reported for the first time from the state. *Habenaria thailandica* (Syn: *Habenaria gibsonii* var. *foetida* Blatt. & McCann) was reported from Sitamata Wildlife Sanctuary for first time. Udaipur, Sirohi, Chittorgarh, and Pratapgarh Districts are reported with highest diversity of orchids.

Introduction

Orchids show diverse morphological and phenotypic characteristics both in vegetative and reproductive parts. The family Orchidaceae represents one of the biggest and most diverse families of angiosperms comprised of approximately 736 genera and 27,800 species [1]. India harbors a rich orchid diversity, comprising 1,256 taxa distributed across 155 genera [2]. In India, orchids can be found from plain areas to the mountains, however the number of these plants varies from region to region depending on the local climate.

This is the first study of terrestrial orchids in Rajasthan. It is essential to understand the present status of the orchid population in all wild habitats of Rajasthan. The initial work of the orchid study has been done by Mehta [3], who documented six species in Rajasthan. Singh [4] reported two orchids in "Flora of Banswara District, Rajasthan". Shetty [5] documented four terrestrial species i.e., *Eulophia ochreatea*, *Habenaria digitata*, *Habenaria marginata*, and *Zeuxine strateumatica* in state geographical boundaries.

Sharma [6] recorded two new orchid species i.e., *Eulophia herbacea* and *Geodorum densiflorum*. All terrestrial orchid species have been reported from the semi-arid part of Rajasthan [7] i.e., *Eulophia ochreatea*, *Geodorum recurvum*, *Habenaria digitata*, *Habenaria marginata*, *Habenaria longicorniculata*, *Habenaria furcifera*, *Habenaria plantaginea*, *Nervilia aragoana*, *Peristylus stocksii*, and *Zeuxine strateumatica*. All the previous studies by [5, 7-14] confirm that orchid species confined only in Southern and Eastern part of Rajasthan, no orchid species documented in western part of state because of its adverse climate conditions for orchid.

The more conducive environment of southern region supports for orchids growth. This study bridges the knowledge gap by documenting terrestrial orchids across Rajasthan's districts, offering insights into the state's orchid diversity.

Methods

Detailed exploration and study of orchid flora of Rajasthan were conducted in different forested areas. This study was done during different seasons, especially summer and monsoon when almost all orchids bear flowers and exhibit abundant and luxuriant growth and development. Standard methods for collection and preservation were used [15]. Periodic field surveys were carried out to locate various species of orchids from various geographical areas and geographic regions of Rajasthan.

Study Area

The survey was carried out in the state of Rajasthan, the northwest part of India. It occupies 2.4 % of India's geographic area, situated between 23°3' to 30°12' N latitude (Borkunda village in Banswara District in the south to Kona village of Sri Nagar District in the north) and 69°30' to 78°17' E longitudes (From Silana village of the Dholpur district in the East to Katra village of the Jaisalmer District in the west) (Fig. 1).

The Aravalli divides the climate of the state into two distinct parts. In the western part of the Aravalli range, the climate is marked by temperature extremes, while the climate in the east is semi-arid and comparatively milder. It supports comparatively dense, deciduous vegetation in eastern part. The state receives the monsoon currents from the Bay of Bengal and the Arabian Sea. From East to West of the Aravalli, rainfall drops quickly and noticeably, rendering Western Rajasthan the driest region in India. The summer months have the lowest relative humidity, whereas rainy season is when the humidity is at its highest, especially from mid-July to mid-August (90%).

Results

In the current study, fifteen terrestrial orchid species from six genera were documented from Rajasthan (Table 1). Except *Zeuxine strateumatica*, they show active growth around the rainy season (June–September) (Table 2). *Epipactis veratrifolia* was the only lithophytic orchid present on rocks of Menal waterfall.

The genus *Habenaria* was the most dominant, represented by six species. *Eulophia* and *Peristylus* followed with three species each, while *Epipactis*, *Nervilia*, and *Zeuxine* were represented by a single species.

Among the 33 districts, the most orchid species were found in Udaipur and Chittorgarh (9 each), followed by Pratapgarh (8), Sirohi (7), Baran and Rajsamand (4 each), Banswara (3), Bhilwara, Pali and Dungarpur (2), Sri Ganganagar, Bikaner, Bharatpur, Dausa, Jaipur, Tonk, Ajmer, Bhilwara, Kota and Jhalawar represent only single species of orchids (Fig. 2; Table 1). Representative images of some orchids, captured *in situ* during the survey are shown in the figure 3 and 4.

Discussion

According to the detailed inventory, a total of fifteen species of terrestrial orchids from six genera were reported from the state of Rajasthan. A new species *Peristylus lawii* was reported first time from the state [12]. *Habenaria thailandica* (Syn: *Habenaria gibsonii* var. *foetida* Blatt. & McCann) was reported from

Sitamata Wildlife Sanctuary of Rajasthan for the first time [14]. There is no orchid species that is endemic to Rajasthan but two terrestrial orchid species i.e., *Peristylus stocksii* and *Eulophia ochreata* are endemic to India [2, 16].

It was revealed that some of those species which were recorded earlier on a particular area were not found in present investigation but some orchids are found in new areas. Due to introduction of IGNP (Indira Gandhi Nahar Pariyojana), now *Zeuxine strateumatica* is being found in Bikaner district. This indicates new geographic conditions in arid areas of state.

Excessive use of orchids also made them vulnerable sometimes. In the present investigation, *Eulophia ochreata* was found exploited in the Mount Abu area. Natural threats are altered rain cycle, dependency on pollinators, aging of host trees and orchids and threat by invasive species whereas artificial/anthropogenic pressures are deforestation (logging), unscrupulous agricultural practices, mining, over-exploitation of valuable species, livestock grazing, inadequate urban development, plantation operations and plantation of non-orchid host trees, tourism and religious spots and pilgrimage.

Conclusion

There have been several studies on orchids in various regions, but a comprehensive account of the terrestrial orchids of the state of Rajasthan was lacking. In present investigation, fifteen terrestrial species were recorded. Udaipur, Sirohi, Chittorgarh, and Pratapgarh districts are reported with highest diversity of orchids.

Declarations

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Author Contributions

Jai Singh, Amit Kotiya, and Deepanshu Kumawat conducted the field surveys and data collection. Amit Kotiya was responsible for the photography and visual documentation. Deepanshu Kumawat performed the data analysis and constructed the tables and maps. Shikha Gupta and Deepanshu Kumawat drafted the manuscript and contributed to the final writing and technical editing. All authors reviewed the manuscript.

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Data availability

All the data related to this research is included in the uploaded manuscript.

Code availability

Not applicable.

Ethics approval and consent to participate

The collection of plant specimens for the present study was carried out in accordance with applicable national and regional biodiversity and forest regulations. Prior to field sampling, the necessary permissions and permits were obtained from the relevant authorities wherever required. All collections were conducted responsibly and in compliance with institutional guidelines, ensuring minimal disturbance to natural populations and habitats. No protected or endangered species were collected.

Permissions to collect the plants

Prior permission for plant sample collection was obtained from the Additional Principal Chief Conservator of Forest and Chief Wildlife Warden, Rajasthan vide Order No. F 19 (02) Permission/CWLW/2017/2080–86 dated 03/07/2020. All procedures were carried out in accordance with the terms and conditions specified in the permit, ensuring minimal disturbance to natural habitats and compliance with applicable regulations.

Consent to participate

Not applicable.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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Tables

Table 1 Checklist of Terrestrial orchids collected from Rajasthan

S. No.	Species	District								
		Banswara	Baran	Bharatpur	Bhilwara	Chittorgarh	Dungarpur	Pali	Pratapgarh	Rajsamand
1.	<i>Epipactis veratrifolia</i> Boiss. & Hohen.				+	+				
2.	<i>Eulophia herbacea</i> Lindl.					+			+	
3.	<i>Eulophia ochreatea</i> Lindl.	+	+			+	+	+	+	+
4.	<i>Eulophia recurva</i> (Roxb.) M.W.Chase, Kumar & Schuit.					+			+	
5.	<i>Habenaria digitata</i> Lindl.		+			+			+	
6.	<i>Habenaria furcifera</i> Lindl.					+			+	+
7.	<i>Habenaria thailandica</i> Seidenf.					+			+	
8.	<i>Habenaria longicorniculata</i> J.Graham									+
9.	<i>Habenaria marginata</i> Colebr.									
10.	<i>Habenaria plantaginea</i> Lindl.									
11.	<i>Nervilia concolor</i> (Blume) Schltr.	+	+			+	+			
12.	<i>Peristylus constrictus</i> (Lindl.) Lindl.					+			+	
13.	<i>Peristylus lawii</i> Wight									
14.	<i>Peristylus stocksii</i> (Hook.f.) Kraenzl.									
15.	<i>Zeuxine strateumatica</i> (L.) Schltr.**	+	+	+	+			+	+	+

Note: [+ for Species present; blank for Species absent; ** species were also reported in Bikaner, Jaipur, Dausa, Tonk, Ajmer, Jhalawar, Kota and Sri Ganganagar District.

Table 2 Showing Phenology of orchid species

No.	Species	Phenology	
		Flowering	Fruiting
1.	<i>Epipactis veratrifolia</i> Boiss. & Hohen.	February-March	April-July
2.	<i>Eulophia herbacea</i> Lindl.	June-July	August
3.	<i>Eulophia ochreatea</i> Lindl.	June - October	September – October
4.	<i>Eulophia recurva</i> (Roxb.) M.W.Chase, Kumar & Schuit.	June – July	August – February
5.	<i>Habenaria digitata</i> Lindl.	July	August - September
6.	<i>Habenaria furcifera</i> Lindl.	August- September	October–November
7.	<i>Habenaria thailandica</i> Seidenf.	July – August	October – November
8.	<i>Habenaria longicorniculata</i> J.Graham	August-September	September – October
9.	<i>Habenaria marginata</i> Colebr.	August–October	October–November
10.	<i>Habenaria plantaginea</i> Lindl.	August – September	September – October
11.	<i>Nervilia concolor</i> (Blume) Schltr.	May-June	June
12.	<i>Peristylus constrictus</i> (Lindl.) Lindl.	July-September	September–October
13.	<i>Peristylus lawii</i> Wight	July-August	August-September
14.	<i>Peristylus stocksii</i> (Hook.f.) Kraenzl.	July-August	August
15.	<i>Zeuxine strateumatica</i> (L.) Schltr.	January – March	March

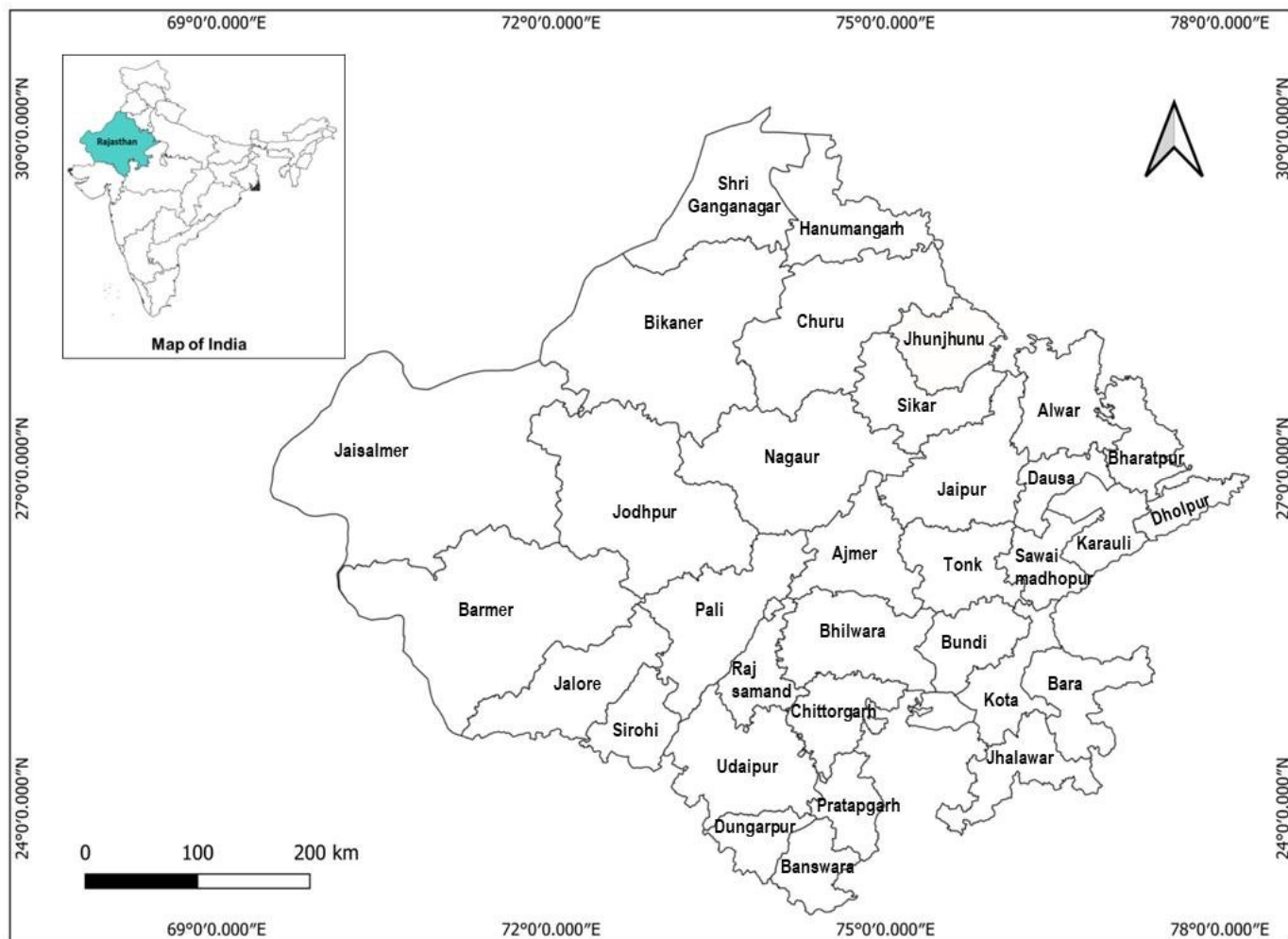


Figure 1
Study area Map (Rajasthan State, India)

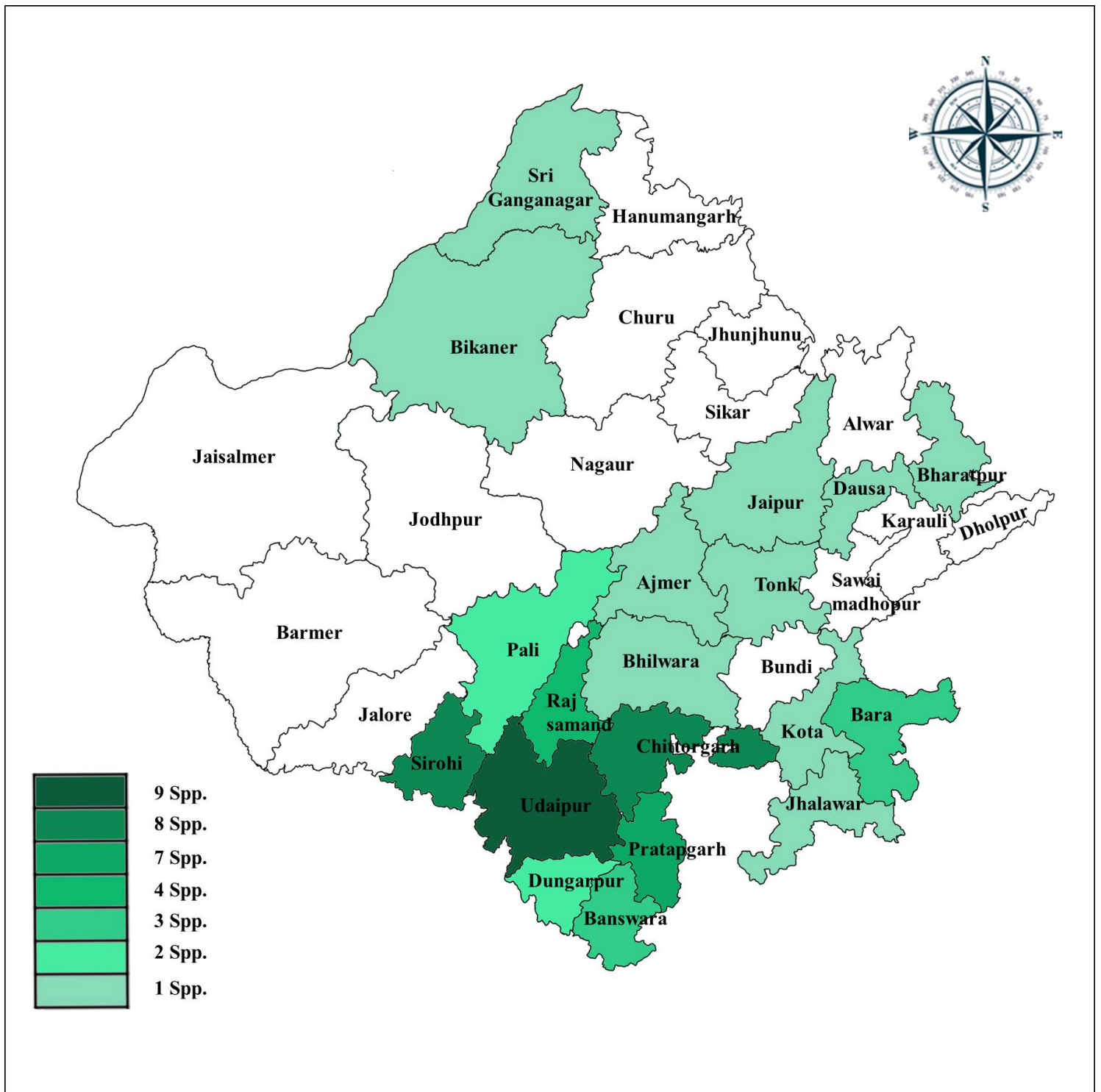


Figure 2

Study area map with distribution pattern of orchid richness in Rajasthan State

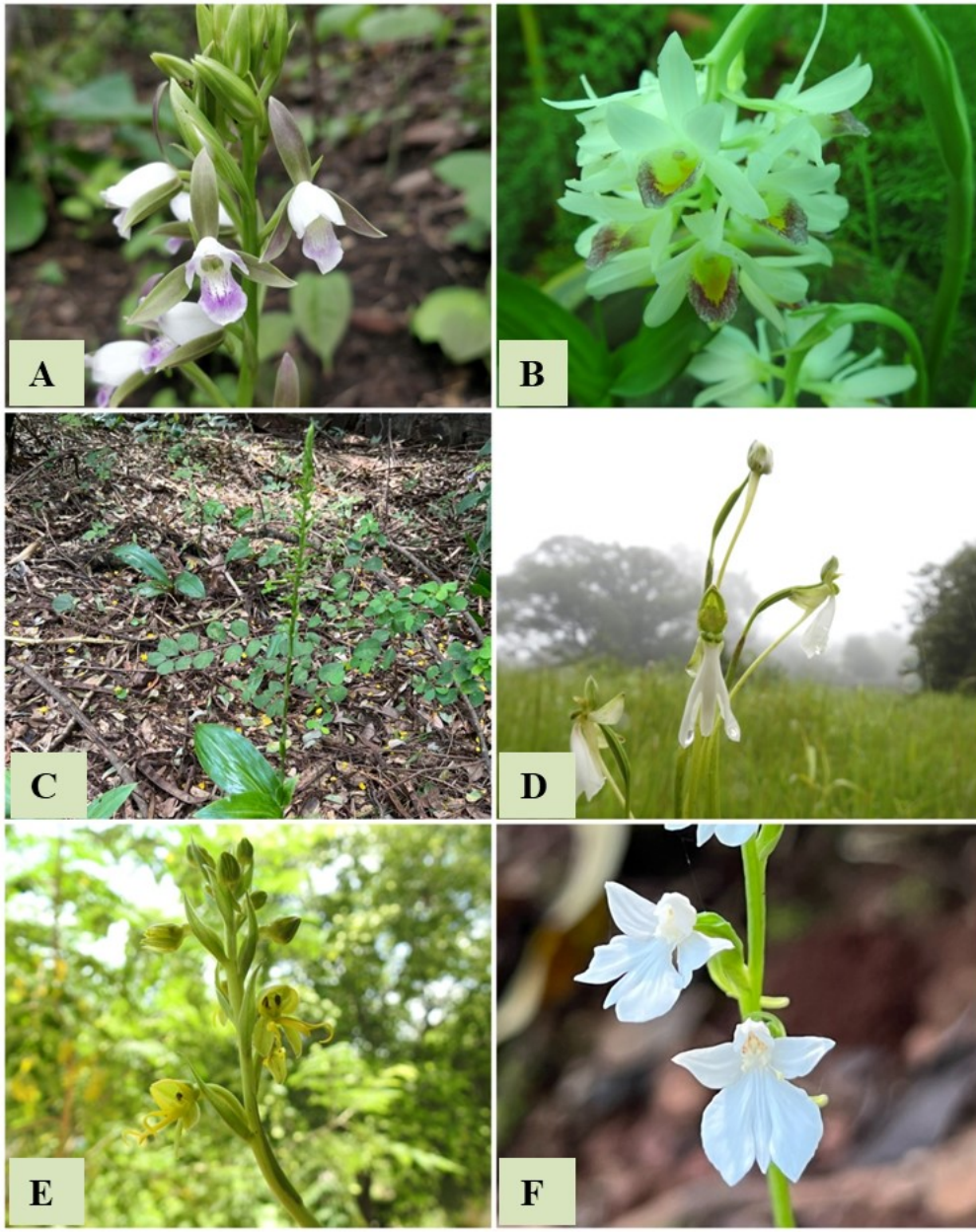


Figure 3

Terrestrial orchid species in Rajasthan, India: A. *Eulophia herbacea*, B. *Eulophia recurva*, C. *Habenaria furcifera*, D. *Habenaria longicorniculata*, E. *Habenaria marginata*, F. *Habenaria plantaginea*.

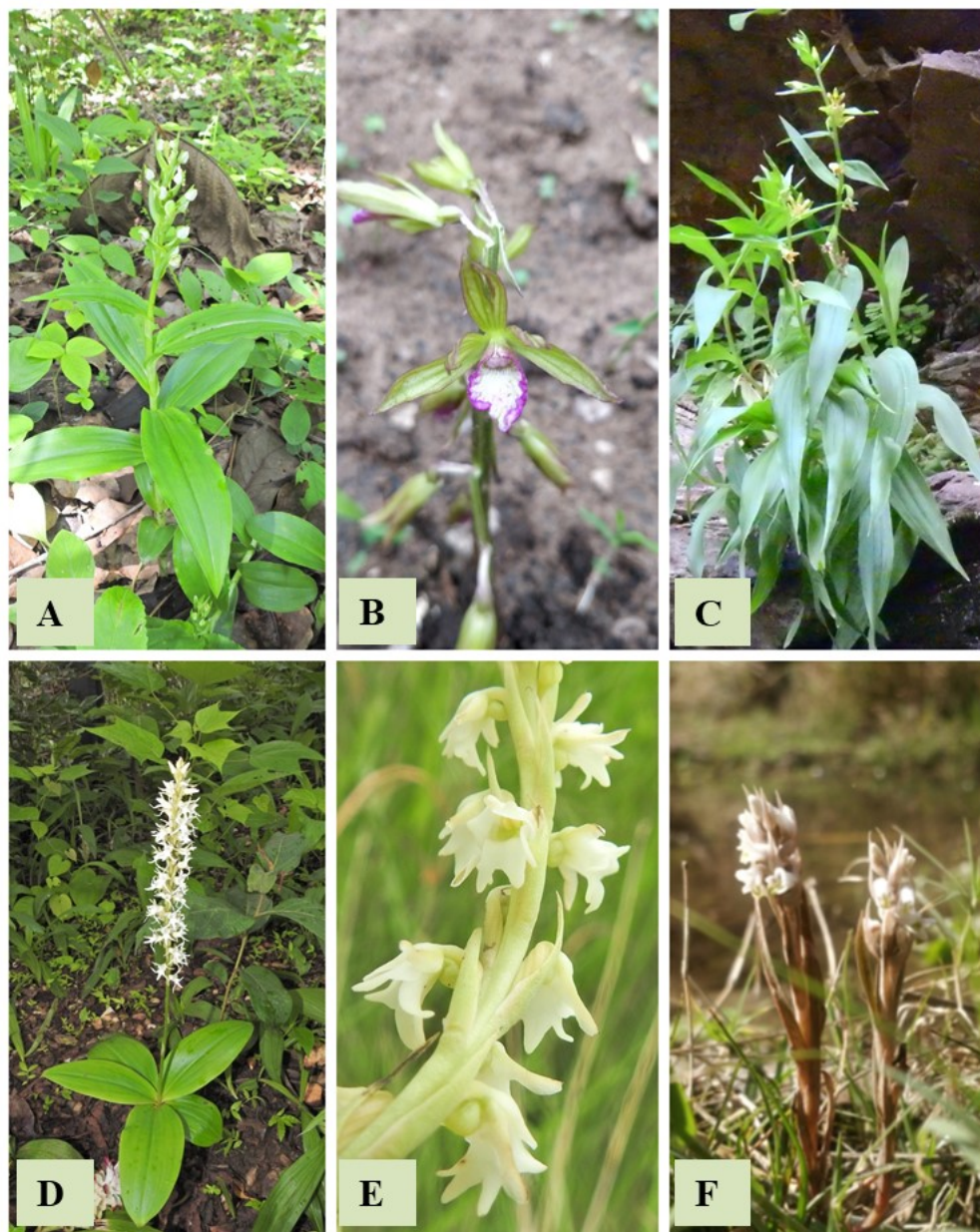


Figure 4

Terrestrial orchid species in Rajasthan, India: A. *Habenaria thailandica*, B. *Nervilia concolor*, C. *Epipactis veratrifolia*, D. *Peristylus constrictus*, E. *Peristylus lawii*, F. *Zeuxine strateumatica*.

Supplementary Files

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