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New Record of *Ophioglossum jaykrishnae* S.M.Patil et al. in Menal Forest, Rajasthan, India

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Abstract: ***During fieldwork in the Menal Forest of Rajasthan, a distinct population of Ophioglossum L. was discovered. Specimens were collected and subjected to thorough laboratory analysis through systematic investigation. The species, characterized by its reddish-brown to pink hue and 2 to 4 lanceolate, erect trophophylls per rhizomorph, has been identified as Ophioglossum jaykrishnae. This marks the first recorded occurrence of O. jaykrishnae in the Menal Forest region of Rajasthan. Initially described as a new species from Gujarat, India, in 2020, it was later documented in Maharashtra in December 2023. This paper provides an in-depth examination of O. jaykrishnae, with a focus on its taxonomy, morphology, habitat, and ecological significance.***

Keywords: *Ophioglossum jaykrishnae*, Menal Forest, Rajasthan, taxonomy, ecological significance, new record

1. Introduction and Review

The genus ***Ophioglossum* L.** (Ophioglossaceae), commonly known as adder's-tongue ferns, represents one of the most ancient and evolutionarily significant lineages of vascular pteridophytes (Goswami, 2012). Characterized by their simple morphology-typically a single sterile trophophyll and a fertile sporangia-bearing spike-these ferns have long fascinated botanists due to their high chromosome numbers and specialized reproductive biology (Goswami, 2012; Patel et al., 2018). Globally distributed, the genus finds one of its major centers of diversity in India, particularly within the humid, biodiverse corridors of the Western Ghats and the Eastern Himalayas (Joshi & Mistry, 2012; Chandra et al., 2017). These regions have been the focal point for the discovery and description of numerous species, underpinning our understanding of the genus's taxonomy and ecology (Dongare & Patil, 2013; Gadpayale, 2014).

In contrast, the arid and semi-arid regions of northwestern India, particularly Rajasthan, have traditionally been perceived as impoverished in terms of pteridophyte diversity due to prevailing xeric conditions. Consequently, botanical explorations for ferns in this region have been limited. However, recent discoveries have begun to challenge this notion, revealing that specialized microhabitats, such as shaded ravines and seasonally moist grasslands near water bodies, can serve as refugia for fern species, including members of the genus ***Ophioglossum***.

The species ***Ophioglossum jaykrishnae*** S.M.Patil et al. exemplifies the recent advancements in understanding the genus's diversity within India. It was first described as a new species from Gujarat by Patil and colleagues, distinguished by its distinctive reddish-brown to pinkish coloration, subterranean tuberose-subglobose rhizomorph, and lanceolate trophophylls. Shortly thereafter, its distribution was extended to the state of Maharashtra (Jadhav, 2023), indicating a broader range along India's western belt than previously assumed.

The discovery of ***O. jaykrishnae*** in Gujarat and Maharashtra aligns with a pattern of recent novelties and range extensions within Indian ***Ophioglossum***, such as the earlier description of a pink-brown species by Yadav and Goswami (2010) and other new species (Patel et al., 2018). These findings highlight the ongoing potential for discovery even in relatively well-studied groups and underscore the importance of continued floristic surveys.

This paper reports the first occurrence of ***Ophioglossum jaykrishnae*** in the Menal Forest of Rajasthan, a significant range extension that further expands the known ecological amplitude of the species into a semi-arid biome. This discovery not only enriches the floristic inventory of Rajasthan but also emphasizes the critical conservation importance of microhabitats within arid landscapes that support unique and disjunct populations of plant species, including high-value medicinal herbs (Sharma & Sharma, 2024). The present study provides a detailed morphological account, habitat description, and discusses the ecological and conservation implications of this significant new record.

2. Material and Methods

Field studies were conducted in the Menal Forest of Rajasthan, an area known for its arid and semi-arid conditions, from June to September each year from 2021 to 2024. The Menal Forest is characterized by its dry deciduous vegetation and rocky terrain, providing a unique environment for fern species.

During these field visits, the focus was on investigating the spatiotemporal niches, distribution patterns, and variations among *Ophioglossum* species, particularly *Ophioglossum jaykrishnae*. Specimens of *Ophioglossum jaykrishnae* were

carefully collected from their natural habitats and transported to the laboratory and preserved in FAA for detailed analysis.

The laboratory analysis involved a thorough examination of morpho-taxonomic features using national and regional floras, botanical books, research journals, and periodicals. This included a detailed review of the species' reproductive structures, frond morphology, and other distinguishing characteristics. Both in situ observations and laboratory analyses were conducted to ensure a comprehensive understanding of the species.

Floristic accounts were prepared through systematic treatment, and comparisons were made with existing literature to verify species identification and identify any unique features of *Ophioglossum jaykrishnae* observed in Menal Forest.

The outcomes of this study offer valuable insights into fern diversity in arid and semi-arid regions of India and highlight the significance of Menal Forest as a site for ongoing botanical research.

3. Morphological Characteristics

The morphology of *Ophioglossum jaykrishnae* S.M.Patil *et al* in the Menal Forest is consistent with descriptions from other regions, with some notable adaptations potentially influenced by the local environment:

Ophioglossum jaykrishnae is typically small to medium in size, ranging from 4 to 8 cm in height. The plant exhibits a dark brown to pinkish color, with a distinctive morphology suited to its environment. The rhizomorph is subterranean, measuring 0.3-0.5cm, and is tuberose-subglobose in shape. It gives rise to a few fibrous roots and occasionally stoloniferous extensions. The common stalk is 0.5-0.8 cm long, subterranean to terranean, and white. The trophophylls, which are the sterile fronds, range from 0.5 to 0.7 cm in length, with 1 to 2 present per rhizomorph make 30-60^0 angle with fertile stalk. These fronds are brownish-pink green, lanceolate in shape with an acute apex, a nearly truncate base, and entire margins. The pseudo-costa is present, and the leaf base is not sheathing. The fertile segment measures 3-5 cm long, emerging from the base of the lamina. It is round, abaxially grooved, and brownish green, sometimes pinkish. The strobili are 0.5-1.5 cm long, thick, with an acute-acuminate apex, The sporangia are arranged in 4-8 pairs within two alternate rows. The spores are globose, 20-35 µm in diameter, trilete, with a tuberculate-varicose exine.

Habitat- *Ophioglossum jaykrishnae* in this habitat typically prefer for moist, shaded environments. This population was found in open grassland, suggesting that microhabitats within Menal Forest may provide suitable conditions for fern species typically found in more humid regions.

4. Implications for Fern Biodiversity in Rajasthan

The discovery of *Ophioglossum jaykrishnae* in Rajasthan is a remarkable extension of the known range of this species and suggests that the state may harbor other undiscovered fern species. This finding challenges the traditional view of Rajasthan as a region with limited fern diversity and highlights the importance of targeted botanical surveys in underexplored areas.

5. Conservation Considerations

As an area not typically associated with fern diversity, Menal Forest may face unique conservation challenges. The limited distribution and specific habitat requirements of *Ophioglossum jaykrishnae* make it vulnerable to habitat disturbance, including deforestation, grazing, and changes in water availability. Conservation strategies should focus on protecting the microhabitats that support this species and promoting awareness of its ecological importance.

6. Results and Discussion

This study focused on a reddish-brown to pink *Ophioglossum* species collected from June to September in the Menal Forest of Rajasthan, an area relatively underexplored for fern diversity. This forest provided a unique opportunity to document and analyze fern species within an intriguing habitat.

Field investigations were carried out in two distinct locations within the Menal Forest, revealing *Ophioglossum* populations with a sporadic distribution across open grasslands near water bodies. These populations were found in association with other *Ophioglossum* species, including *O. costatum* R. Br., *O. gramineum* Willd., *O. lusitanicum* L., *O. nudicaule* L. f, *O. petiolatum* Hook, and *O. reticulatum* L.

The collected specimens were analyzed both in their natural habitat and in the laboratory. Herberium specimens SUHB 1053 of *O. Jaykrishnae* are now submitted at Sangam university, Bhilwara Rajasthan.

7. Conclusion

The discovery of *Ophioglossum jaykrishnanii* in Menal Forest, Rajasthan, is a significant addition to the region's botanical diversity. This finding underscores the need for continued exploration of Rajasthan's flora, particularly in microhabitats that may harbor rare or endemic species. Protecting *Ophioglossum jaykrishnanii* and its habitat is crucial for preserving the biodiversity of the Menal Forest and enhancing our understanding of fern distribution in arid and semi-arid environments.

Figure 1: A: *Ophioglossum jaikrishnae in Habitat, B: Close-up View of Ophioglossum jaikrishnae Leaf and Roots, C: View of Ophioglossum jaikrishnae Sporophyte, D: View of Ophioglossum jaikrishnae root, E: Detailed View of Spike. F: spore of Ophioglossum jaikrishnae (Colour Fig.)*

Table 1: Comparative Morphology of *Ophioglossum indicum* B.L.Yadav & H.K.Goswami and *Ophioglossum jaykrishnae* S.M.Patil *et al*

Feature	*Ophioglossum indicum*	*Ophioglossum jaykrishnae*
General Size and Color	3-6 cm in height; Pinkish green	4-8 cm in height; reddish-brown to pinkish
Rhizomorph	Subterranean, knob shape; 0.2-0.4 cm tall	Subterranean, tuberose-subglobose; 0.2-0.4 cm; slender, fistular rhizoids (5-8)
Common Stalk	0.8-1.1 cm long, subterranean to terranean, white	0.8-1.3 cm long, subterranean to terranean, white
Trophophylls (Sterile Fronds)	0.5-1 cm long; brownish-green to green; lanceolate; acute apex; entire margin; pseudo-costa present; parallel venation	0.5-2.5 × 0.25-0.5 cm; brownish-pink; lanceolate; simple, apex acute; cuneate-truncate base; entire margin; pseudo-costa present; parallel venation; no sheathing base
Fertile Segment (Fertile Frond)	2-4 cm long; round; often dark brown or reddish	4-5 cm long; round; dark brown, sometimes pinkish; abaxially grooved
Strobili (Sporangia Clusters)	0.5-1.5 cm long; thick; acute-acuminate apex; green pink; 8-10 pairs of sporangia in two alternate rows	0.5-1.5 cm long, dark brown-pink; 4-8 pairs of sporangia, slightly alternate in two rows
Spores	Globose; 16-28 µm in diameter; trilete	Globose; 25-35 µm in diameter; trilete; tuberculate-varicose exine

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Declaration

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Authors Contribution

Mrs. Shreya Shekhawat performed the analysis and identified the species and prepared the manuscript. Dr. Shahdab Hussain supervised the whole analysis and manuscript.

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