



## *Ophioglossum Madhusoodanianii*: A new report from menal forest, Rajasthan

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### Abstract

The discovery of new plant species and their documentation is crucial for understanding biodiversity and conserving ecosystems. This research paper reports the discovery of *Ophioglossum madhusoodanianii*, a species of adder's-tongue fern, in the Menal Forest of Rajasthan, India. Previously reported from Kerala and other parts of the Western Ghats, this finding marks a significant extension of the species' known range. This study provides a detailed account of the morphological characteristics, habitat, and ecological significance of *Ophioglossum madhusoodanianii*, highlighting its importance in the context of the floristic diversity of Rajasthan.

**Keywords:** *Ophioglossum*, floristic diversity, menal forest, fern diversity

### Introduction

Ophioglossaceae, commonly known as the adder's-tongue ferns, represents a small family of ferns characterized by their unique morphology and reproductive strategies. The genus *Ophioglossum* is known for its limited distribution, with many species being rare and localized. *Ophioglossum madhusoodanianii* was first described in the southern parts of India, particularly in the state of Kerala, and has since been considered endemic to the Western Ghats. The discovery of this species in Rajasthan's Menal Forest, a region known for its arid and semi-arid landscapes, suggests a broader distribution than previously understood.

Studies on *Ophioglossum* have largely focused on taxonomy, distribution, and evolutionary biology, with particular attention given to its unique reproductive structures and chromosome counts, which are among the highest in the plant kingdom (Wagner, 1993).

In India, the genus has been well-documented in the Western Ghats, a biodiversity hotspot that houses several rare and endemic species. Madhusoodanan and Sulaiman (2015) <sup>[12, 13]</sup> first described *Ophioglossum madhusoodanianii* from the Western Ghats, specifically from the state of Kerala. This species was distinguished by its solitary, fleshy, and erect frond, as well as its distinctive sporophore. Subsequent studies by Chandra *et al.* (2017) <sup>[2]</sup> emphasized the species' restricted distribution and its preference for the moist, shaded environments typical of the Western Ghats.

The floristic diversity of Rajasthan has been relatively under-explored compared to other regions of India. However, studies such as those by Singh and Shetty (1993) <sup>[23]</sup> have provided foundational insights into the region's plant diversity, particularly within the dry deciduous forests. These studies suggest that Rajasthan's unique climatic conditions and varied topography contribute to a distinct assemblage of flora, with several species adapted to the arid and semi-arid conditions.

The discovery of *Ophioglossum madhusoodanianii* in Menal Forest represents a significant range extension for the species. This finding aligns with recent trends in botanical research, which have increasingly recognized the potential for undiscovered species or range extensions in under-

explored areas (Kumar *et al.*, 2020) <sup>[9]</sup>. Moreover, it challenges the traditional assumptions about the ecological requirements of *Ophioglossum* species, suggesting that they may possess a broader ecological amplitude than previously documented.

The rarity and localized nature of *Ophioglossum* species have also raised concerns about their conservation status. The IUCN Red List has identified several species within the genus as vulnerable or endangered, primarily due to habitat loss and degradation (IUCN, 2019) <sup>[8]</sup>. In light of this, the discovery of *Ophioglossum madhusoodanianii* in a new geographic region underscores the need for continued exploration and conservation efforts, particularly in areas that are not traditionally recognized as biodiversity hotspots.

### Materials and Methods

The study was conducted in Menal Forest, located in the Bhilwara district of Rajasthan, during the monsoon season of 2021-2024. The region is characterized by dry deciduous forests, with a climate that varies from hot summers to cool winters. Field surveys were carried out to identify and document the fern species in the area. Specimens of *Ophioglossum madhusoodanianii* were collected, photographed, and compared with the existing herbarium records. Morphological analysis was conducted following standard botanical protocols, and the identification was confirmed using existing literature and taxonomic keys.

### Results

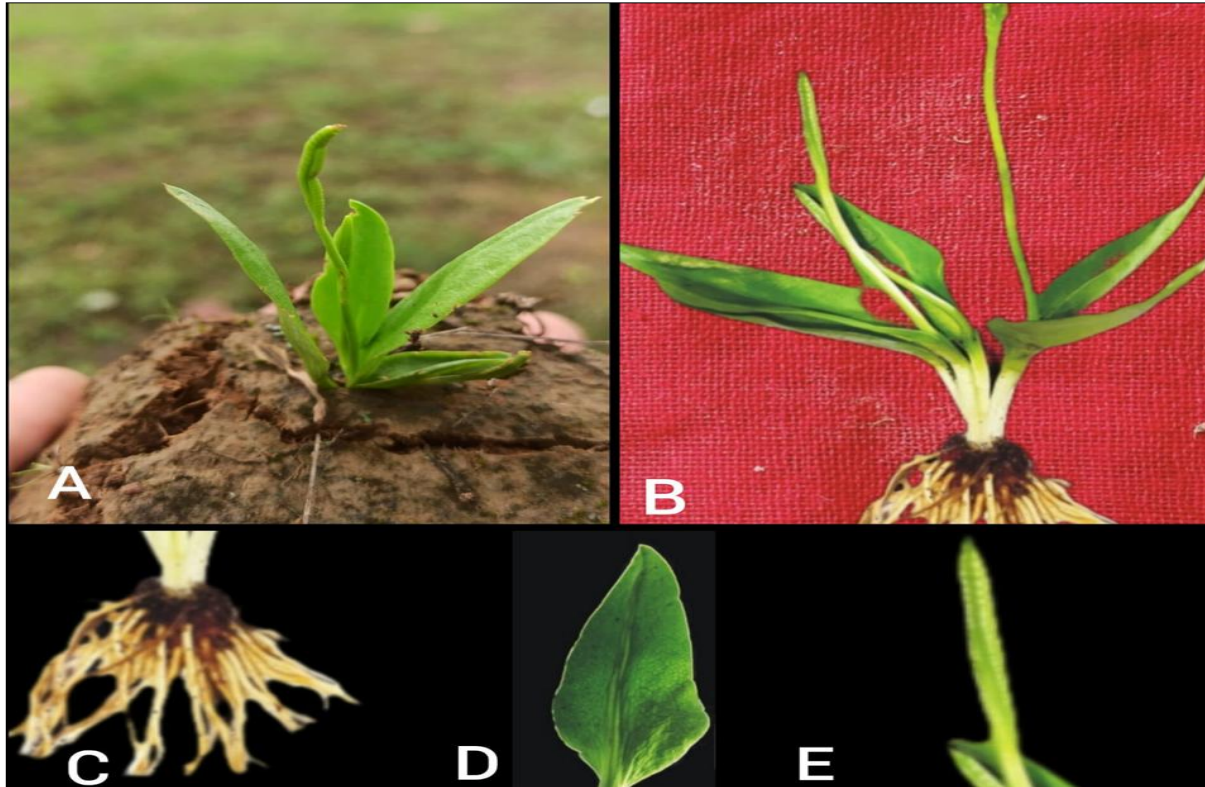
The specimens collected from Menal Forest match the description of *Ophioglossum madhusoodanianii* as outlined in previous studies. The ferns were found growing in areas with moist soil with grasses. Morphological features include a single, erect, and fleshy leaf with a spore-bearing spike (sporophore), characteristic of the *Ophioglossum* genus. The presence of this species in Menal Forest is particularly noteworthy due to the region's contrasting ecological conditions compared to the Western Ghats.

### Morphological features

Terrestrial plants, 12–20 cm tall, perennial herbs. The underground rhizomorph is tuberous, subglobose to discoid,

with the trophophore emerging from a central depression, measuring 6–10 mm in diameter, fleshy, and covered with reddish-brown scales. The aerial parts consist of 1–3 trophophores per tuber, erect, reaching a height of up to 20 cm, and divided into two parts: the trophophyll and sporophyll. The trophophore originates from the tuber and gradually narrows into a common stalk with the sporophore. The boundary between the trophophores and stalks is indistinct at the base, where the basal region is terete, 1–2

mm in diameter, and white. The trophophyll is flat, 5–10 cm long, 1–1.8 cm wide, dark green, and tapers to an acute apex. Sporophores measure 8–13 cm in length, emerging at the base of the trophophores and comprising a long stalk and a fertile spike. The stalks are 5–10 cm long, about 1.5 mm in diameter, and semicircular. Fertile spikes are 2–4 cm long, bearing 30–55 pairs of sporangia, with a sterile tip of 1–2 mm. The spores are whitish, globose, with an equatorial diameter of up to 35  $\mu$ m.



**Fig 1:** A *Ophioglossum madhusoodanianii* in Habitat, B: Close-up View of *Ophioglossum madhusoodanianii*, C: View of *Ophioglossum madhusoodanianii* root, D: Close up view of *Ophioglossum madhusoodanianii* leaf E: Detailed View of Spike.

**Discussion**

The discovery of *Ophioglossum madhusoodanianii* in Rajasthan extends the known geographical range of the species, raising questions about its ecological adaptability and potential undiscovered populations in other parts of

India. The discovery also emphasizes the importance of continued botanical exploration in under-researched areas like the Menal Forest, which may harbor other undocumented species

**Table 1:** Comparison of morphological and micromorphological characters between *Ophioglossum madhusoodanananii* and *Ophioglossum costatum*

| Characters             | <i>O. madhusoodanananii</i>  | <i>O. costatum</i>  |
|------------------------|--|---|
| Rhizomorph             | Subglobose to discoid  | Globose   |
| Strobilus              | Frequently branched  | Unbranched  |
| Sporangium arrangement | Opposite, mature spike exhibits a spiral pattern from the middle   | Alternating, with a straight alignment of sporangia throughout  |
| Number of sporangia    | 35–60 pairs  | 20–35 pairs   |
| Trophophyll            | Lanceolate, terminating in an acute apex   | Lanceolate to ovate, with an obtuse-mucronate apex  |
| Fusion of sporophore   | From the base of the trophophore   | From the mid-region of the trophophore  |
| Spore                  | 35–40 $\mu$ m; distal view: exine with widely spaced pits, tubercles present in pits; margin pentagonal to circular (appearing foveolate). Proximal view: laesurae are unequal, narrow, with deep pits; margins surrounded by radially extended cells. | 25–30 $\mu$ m; distal view: exine with narrowly spaced pits, no tubercles; margin hexagonal. Proximal view: laesurae are equal, wide, not depressed; surface and margin have cells with shallow lumens. |
| Spike tip              | Sterile, sterile region 1–2 mm in length   | Fertile, no sterile region present  |
| Venation               | Veins diverge from the base and form anastomosing patterns through the trophophyll, also forming smaller areoles.  | Veins create large areoles with free-ending veinlets at the margins.  |

The rhizomorph structure in *O. madhusoodanananii* is subglobose to discoid, contrasting with the globose rhizomorph of *O. costatum*. Notably, the sporangium arrangement in *O. madhusoodanananii* shifts to a spiral pattern in mature spikes, whereas *O. costatum* maintains an alternating, straight alignment. Additionally, differences in spore morphology, particularly the size and sculpturing of the exine, further differentiate the two species. The sterile region at the tip of the spike is only present in *O. madhusoodanananii*, suggesting variation in reproductive structures. The detailed comparison of *O. madhusoodanananii* and *O. costatum* enhances our understanding of their morphological divergence and provides essential diagnostic features for species identification in the field.

### Conclusion

The reporting of *Ophioglossum madhusoodanianii* from the Menal Forest is a significant addition to the botanical records of Rajasthan and India. It highlights the need for comprehensive studies to assess the distribution, ecology, and conservation status of this species. Further research is required to understand the factors that enable this fern to survive in such diverse environments and to explore its potential range in other parts of the country. Conservation efforts should be directed towards protecting this species and its habitat, especially in the face of environmental changes and habitat degradation.

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