



# New Distribution of Bioluminescent Fungi, *Omphalotus olearius* and *Filoboletus manipularis* in Vansda National Park, Gujarat, India

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Received: October 27, 2025

Revision Submitted: February 12, 2026

Accepted: February 22, 2026

**Abstract:** Fungi play a crucial role in terrestrial ecosystems as decomposers, symbionts, and pathogens, contributing significantly to biodiversity. Among them, bioluminescent fungi, which produce light through a chemical reaction involving luciferase and luciferin, represent a remarkable phenomenon. These fungi are primarily found in the Basidiomycota division, with a few exceptions, and are believed to aid in spore dispersal by attracting insects. Despite their significance, bioluminescent fungi remain understudied, particularly in certain regions. This study documents the new distribution of *Omphalotus olearius* and *Filoboletus manipularis* in Vansda National Park, Gujarat, India. Observations conducted during field surveys from June to October 2024 revealed bioluminescent fungi growing on decaying substrates, emitting a characteristic green glow at night. This study highlights the need for further research on the ecological roles of bioluminescent fungi and calls for conservation efforts to protect these unique species in Vansda National Park, contributing to a broader understanding of fungal diversity in India.

**Keywords:** Bioluminescent fungi, Vansda National Park, Biodiversity, Conservation.

## 1. INTRODUCTION

Fungi play a crucial role in terrestrial ecosystems as decomposers, symbionts, and pathogens (Mueller et al., 2007). They are also among the most biodiverse groups of organisms on Earth (Hawksworth, 2001). Mushrooms, a type of macrofungi, belong to the phyla Ascomycota and Basidiomycota within the fungal kingdom.

Bioluminescent organisms represent one of nature's most remarkable phenomena, with various groups—including animals, plants, fungi, and bacteria—exhibiting the ability to produce light (Pandey and Sharon, 2017). In fungi, this trait is exclusive to the division Basidiomycota, except for *Xylaria hypoxylon*, which belongs to Ascomycota (Becker and Stadler, 2021). The bioluminescence process involves an enzyme luciferase, which catalyses the oxidation of the substrate luciferin in the presence of oxygen. This reaction releases excess energy as visible light typically perceived as a pale green glow observable in complete darkness (Kaskova et al., 2017; Patil and Yadav, 2022). Research suggests may play a role in enhancing spore dispersal by attracting insects (Fleiss and Sarkisyan 2019; Patil and Yadav, 2022). This emitted light, often termed "cold light," produces minimal heat. To date, approximately 103 species of bioluminescent fungi have been documented (Desjardin et al., 2008; Chew et

al., 2014; Desjardin et al., 2016; Weinstein et al., 2016; Karunarathna et al., 2020; Dauner et al., 2021; Oba and Hosaka, 2023). In India, notable records include *Nothopanus eugrammus* and *Omphalotus olearius* (Vrinda et al, 1999), followed by the discovery of *Mycena deeptha* in Kerala (Aravindakshan and Manimohan 2014), *Roridomyces cf. phyllostachydis* (Karunarathna et al., 2020), *Mycena chlorophos* (Arya et al., 2021; Koli et al., 2024; Jude et al., 2024), and *Armillaria mellea* (Patil and Yadav, 2022). This study aims to expand knowledge of fungal diversity in Vansda National Park, particularly bioluminescent fungi, which have not been previously documented in the region.

## 2. MATERIALS AND METHODS

During field surveys conducted from June to October 2024 in Vansda National Park, Gujarat, bioluminescent fungi were observed on decaying substrates, including branches, roots, and leaves. By day, the fungi displayed colours ranging from bright orange to yellowish-orange, white to cream, or pale pink. At night, emitted a characteristic green bioluminescence. Over a month-long observation period, six distinct locations of bioluminescent fungi were documented. Specimens were photographed using an iPhone 13 and identified based on existing literature. Further identification was carried out by cross-

Available online: March 13, 2026

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referencing the collected data with standard literature, monographs, and specialized books on mycology. Online databases such as www.mycology.com and Fungi ID @ MycoAsia were also consulted for accurate species confirmation. All collected specimens were subsequently deposited in the Department of Biology, B.K.M. Science College, Valsad, Gujarat, India, ensuring proper curation for future research and reference.

### 3. RESULTS AND DISCUSSION

Field survey conducted in Vansda National Park during June–October 2024 resulted in the documentation of bioluminescent fungi from six locations. The geographic distribution and GPS coordinates of all bioluminescent fungal collection sites within Vansda National Park are presented in Figure 1. Two species were recorded growing on decaying woody substrates and leaf litter both species exhibited distinct green bioluminescence during nocturnal observation.

The macromorphological features and bioluminescent characteristics of the recorded species are illustrated in Figure 2. Dorsal, ventral, and luminescent views of *Omphalotus olearius* are shown in Figure 2A–C, while corresponding dorsal, ventral, and luminescent views of *Filoboletus manipularis* are depicted in Figure 2D–F.

#### 3.1. *Omphalotus olearius*

Commonly known as the jack-o'-lantern mushroom, *Omphalotus olearius* produces clustered fruiting bodies measuring 7–20 cm across. Initially convex with an enrolled margin, the caps flatten with maturity, eventually developing an upturned, wavy edge. The surface is smooth

and typically bright orange to yellowish-orange. Pileus 2–6.5 cm diam. fleshy, convex expanding plane, umbonate, depressed, umbilicate or even infundibuliform, surface chrome yellow, sunflower yellow or dark yellow becoming light yellow to amber yellow with radial innate fibril, dry, margin thin, often lobate and split, incurved, non-striate. Lamellae decurrent, pastel yellow to yellow up to 3 mm wide, luminescent in the dark, crowded, with lamellulae of varying lengths edge entire, concolorous. stipe 2.5–5.5 cm × 2–8 mm, central to excentric, often curved, cylindrical or more often attenuated towards the base, solid, surface concolorous to the pileal surface, appressed fibrillose, dry. annuals nil. Smell pleasant, fruity. Context yellow up to 5 mm wide, tough, composed of interwoven 3–10 µm broad hyphae. Basidiospores 3.8–5.3 × 3–3.8 µm long subglobose to broadly ellipsoid, smooth, hyaline, inamyloid. Voucher number: 242

#### 3.2. *Filoboletus manipularis*

It is known as the reticulated luminous mushroom, *Filoboletus manipularis* forms clusters of fruiting bodies with relatively uniform morphology. At maturity, the pileus diameter ranges from 0.5 to 6.0 cm, with stipes measuring 2.0 to 7.0 cm in length. The pileus shape varies—conical, rounded, plane, or depressed, sometimes umbonate—while its colour ranges from white to cream, beige, or pale pink. Pileus 0.5–2.0 cm in diam., conico-campanulate to convex with conical umbo, hygrophanous, translucently reticulate, finely white pruinose, whitish, grayish to hyaline when moist, purely white to yellowish dried up. Hymenophore tubular, adnate or adnate-emarginate with a slightly



**Figure 1.** GPS Coordinates of Bioluminescent Fungi in Vansda National Park. Navsari, Gujarat

decurrent tooth. Tubes 1.5-4 mm long, arranged in radial rows, numbering 5-7 in a row, with angular-round pores 0.5-1 mm wide, white. Stipe 20-60 × 0.5-2.5 mm, cylindrical, thickened in the base, hollow, white to hyaline, completely white pruinose. Basidiospores 6.2-7.5 × 4.4-5.1 μm, white, smooth, ellipsoid to broadly ellipsoid, amyloid<sup>22</sup>. Voucher number: 351

The documentation of *Omphalotus olearius* and *Filoboletus manipularis* in Vansda National Park significantly expands the known distribution of bioluminescent fungi in India. These findings are noteworthy because previous records of such species were limited to southern and northeastern regions of the country (Vrinda et al, 1999; Aravindakshan and Manimohan 2014; Arya et al, 2021). The present study confirms the presence of bioluminescent fungi in western India for the first time, highlighting Vansda National Park's potential as an underexplored biodiversity hotspot.

Fungal bioluminescence, though a well-documented phenomenon, remains ecologically enigmatic. One prevailing hypothesis is that light emission attracts insects, aiding in spore dispersal, thereby enhancing reproductive success (Fleiss and Sarkisyan, 2019; Patil and Yadav, 2022). The observed bioluminescence in Vansda National Park

species, particularly visible on decaying wood and plant matter, supports the idea that these fungi play active roles in forest decomposition processes. Furthermore, their presence indicates healthy, undisturbed microhabitats rich in organic substrate and moisture critical requirements for the growth of such specialized fungi (Desjardin et al., 2008; Kaskova et al., 2017).

The ecological sensitivity of mushrooms makes them valuable bioindicators for environmental changes. Bioluminescent fungi, due to their unique visibility and habitat specificity, may serve as sentinel species for monitoring forest health (Becker and Stadler, 2021). However, deforestation, habitat fragmentation, and climate change pose serious threats to fungal biodiversity (Hawksworth and Lucking, 2017). The scarcity of comprehensive fungal surveys in India, especially within western states like Gujarat, underlines the importance of localized field research and documentation.

This study also demonstrates the effectiveness of simple field techniques visual observation in darkness, digital photography, and morphological identification based on established taxonomic keys for identifying macrofungi. Nonetheless, integrating molecular tools, such as DNA barcoding, in future research could provide more accurate



**Figure 2.** Bioluminescent fungi (A) Dorsal view of *Omphalotus olearius* (B) Ventral view of *Omphalotus olearius* (C) Luminescent view of *Omphalotus olearius* (D) Dorsal view of *Filoboletus manipularis* (E) Ventral view of *Filoboletus manipularis* (F) Luminescent view of *Filoboletus manipularis*

taxonomic resolution and uncover cryptic diversity (Nilsson et al., 2019). By documenting these species in Vansda National Park, this study contributes to the broader understanding of fungal distribution in India and emphasizes the need for conservation efforts to protect these unique organisms and their habitats.

#### 4. CONCLUSION

The discovery of *Omphalotus olearius* and *Filoboletus manipularis* in Vansda National Park marks the first report of bioluminescent fungi from Gujarat, expanding their known range in India. These findings underscore the ecological richness of Vansda National Park and the importance of preserving its forested habitats. As bioluminescent fungi offer insight into forest health, ecological processes, and evolutionary adaptation, continued exploration and conservation of fungal diversity are essential. The present study also demonstrates that systematic field surveys, nocturnal visual observation, digital photography and detailed morphological analysis are effective and reliable techniques for the identification and documentation of bioluminescent macrofungi. This study advocates for increased fungal documentation efforts and habitat protection strategies to safeguard these unique and understudied organisms.

#### Acknowledgments

We express our gratitude to the Wildlife Warden of Gujarat State, India, for granting the necessary permissions for fieldwork. We would also like to thank the Head of the Biology Department and the staff of B.K.M. Science College for their support.

#### Authors' Contribution

Conceptualisation: Dilipkumar Patel, Jigitsa Patel; Methodology: J. Patel, D. Patel; data Collection: J. Patel; Data Analysis: D. Patel, J. Patel; Writing Original Draft: J. Patel; Writing Reviewing and Editing: D. Patel. authors have read and agreed to the published version of the manuscript.

#### Conflict of interest

The authors declares that they have no conflict of interest.

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