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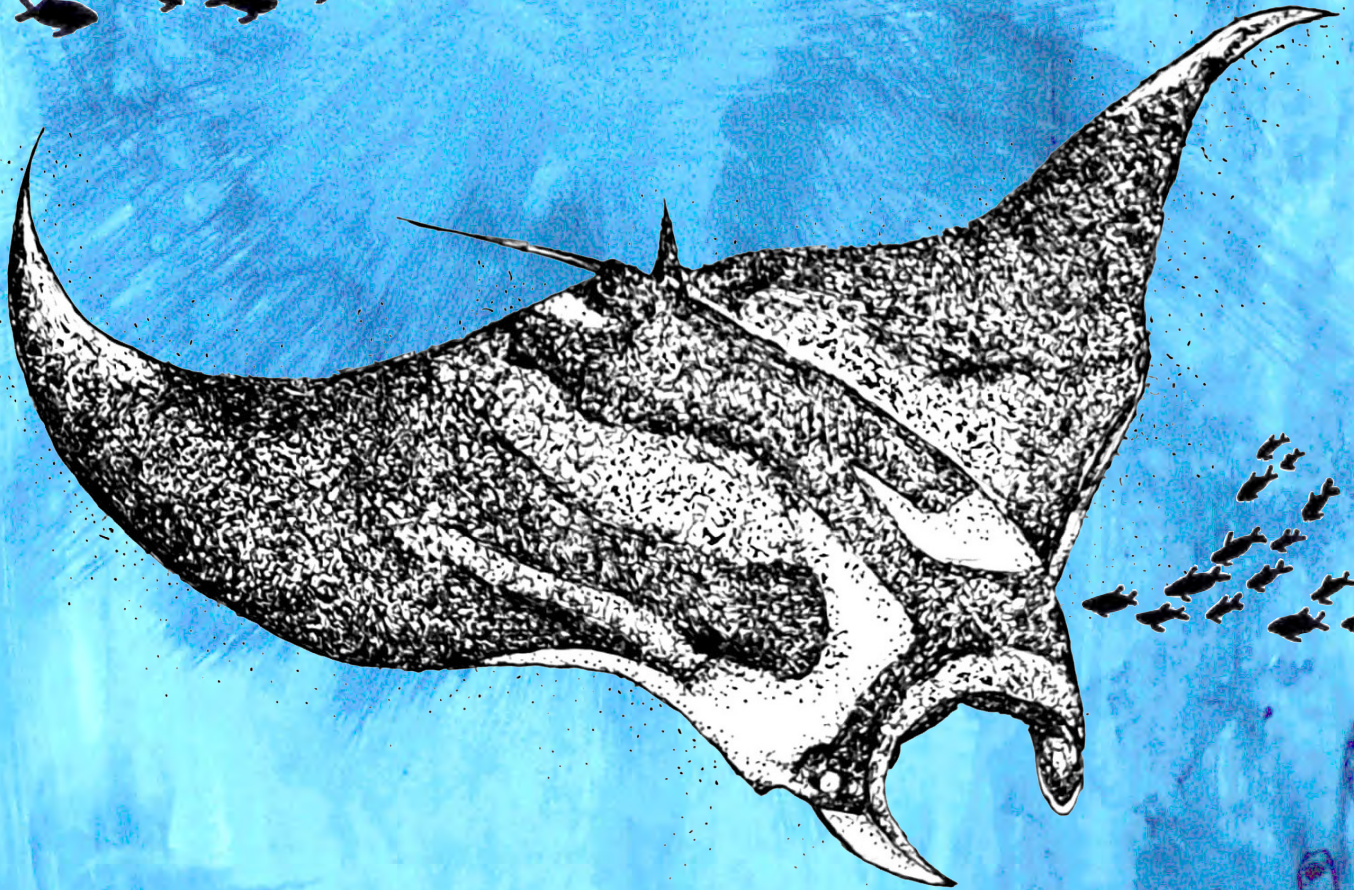
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Cover: Giant Oceanic Manta Ray *Mobula birostris* in ink on acrylic wash by Elakshi Mahika Molur adapted from scientific illustration by Roger Hall.

INTRODUCTION

Polypores or polyporoid fungi represent an artificial assemblage of wood decaying fungi classified under various orders of *Agaricomycetes* of *Basidiomycota* (Kirk et al. 2008; Mycobank 2023). These fungi are characteristic in having annual to perennial, resupinate to effused-reflexed to pileate basidiocarps with gymnocarpic hymenium and poroid hymenophore. Polypores show remarkable variation with respect to micromorphological features such as hyphal system, ancillary structures, basidia and basidiospores. These fungi play vital role in the recycling of carbon due to their ability to degrade lingo-cellulosic substances of the wood. There are reports in literature about the use of fructifications of these fungi for curing many diseases (Dai et al. 2007; Song et al. 2008; Chen et al. 2016; Singh et al. 2016).

Keeping in mind the diverse vegetation and climatic conditions exhaustive fungal forays were conducted in the different parts of Himachal Pradesh, Punjab, and Union Territory of Chandigarh. During these forays some interesting polypore fructifications were collected. Based on details pertaining to macro and micro-morphological characters and comparison with published literature (Singh & Bakshi 1961; Singh 1966; Bakshi 1971; Ryvarden & Johansen 1980; Ding 1989; Roy & De 1996; Leelavathy & Ganesh 2000; Foroutan & Vaidya 2007; Bhosle et al. 2010; Ranadive et al. 2011; Sharma 2012; Ryvarden & Melo 2014; Ranadive & Jagtap 2016; Kaur et al. 2017; Brar et al. 2018; Manoharachary et al. 2022, Vinjusha & Kumar 2022, Index Fungorum 2023; Mycobank 2023) these were identified as *Fomes dahlia* Henn., *Ganoderma tropicum* (Jungh.) Bres., *G. tsunodae* (Yasuda ex Lloyd) Sacc. and *Xanthoperenniporia maackiae* (Bondartsev & Ljub.) B.K.Cui & Xing. It is pertinent to mention here that *Fomes dahlia*, *Ganoderma tsunodae* and *Xanthoperenniporia maackiae* are recorded as new to India and *Ganoderma tropicum* as new to Himachal Pradesh and Union Territory of Chandigarh.

MATERIAL AND METHODS

The polypore fructifications were collected during the fungal forays executed in various localities of Himachal Pradesh (28–30 July 2011, 20–23 August 2011, & 02–05 April 2016), Union Territory of Chandigarh (25–28 September 2019 & 07–10 October 2019), and Punjab (15–18 December 2018) (Image 1). The details pertaining to the type and nature of the fruiting body, colour, and

appearance of abhymenial and hymenial surface and margins were noted down. The collected specimens were dried in an electric drier at temperature range of 40–45°C and preserved using 1,4-dichlorobenzene in zip lock bags.

For microscopic details, crush mount and free hand section preparations were made using 3%, 5%, & 10% KOH solutions, Congo red (1% in distilled water), Phloxine (1% in distilled water), Cotton blue (1% in lactophenol), Melzer's reagent (0.5 g iodine + 1.5 g KI + 20 g chloral hydrate + 20 ml distilled water), and water. The outline of different microscopic structures was drawn using compound microscope at 100x, 400x, and 1000x with the help of camera lucida. The colour standards are cited as per Kornerup & Wanscher (1978). The identified specimens were submitted to the Herbarium, Department of Botany, Punjabi University, Patiala (PUN).

RESULTS

***Fomes dahlia* Henn., Aoshima,**

Bull. Tokyo Sci. Mus., n.s.: 429 (1971). (Image 2)

Macroscopic characteristics: Fruiting body annual, pileate, pileus up to 16.5 × 13.2 × 1.8 cm, sub-stipitate, solitary, flabelliform; abhymenial surface laccate, concentrically zonate, rugose, greyish-brown to reddish-brown to dark brown when fresh, not changing much on drying; pilear crust very thin, covered with spore dust; hymenial surface poroid, whitish when fresh, greyish-white to yellowish-white on drying; pores suborbicular, 5–7 per mm; dissepiments up to 80 µm wide, entire; context homogenous, zonate, reddish-brown, up to 10 mm wide; tubes light brown, up to 8 mm in depth; stipe lateral, up to 5 cm long, and 4 cm wide, reddish-brown; margins acute, reddish-brown on both abhymenial and hymenial side, sterile up to 2.3 mm on hymenial side.

Microscopic characteristics: Hyphal system trimitic; generative hyphae hyaline, septate, with clamps, up to 4 µm in width, branched, thin-walled; skeleto-binding hyphae yellowish-brown to brown, aseptate, up to 6.2 µm in width, branched, thick-walled, with very narrow lumen; binding hyphae sub hyaline, aseptate, up to 3.4 µm in width, frequently branched, thick-walled, with wide lumen. Pilear crust irregular hymenioderm; cuticular elements sub clavate, thick-walled, yellowish-brown to brown, 42.6–60 × 9.6–10.2 µm, sometimes lobate. Basidia clavate to sub clavate, 14.2–15.3 × 5.1–5.7 µm, with basal clamp, tetrasterigmate; sterigmata up to 3.4 µm long. Basidiospores ellipsoid to broadly ellipsoid, 9.0–13.6 × 6.2–9.6 µm, uniguttulate, truncate at non

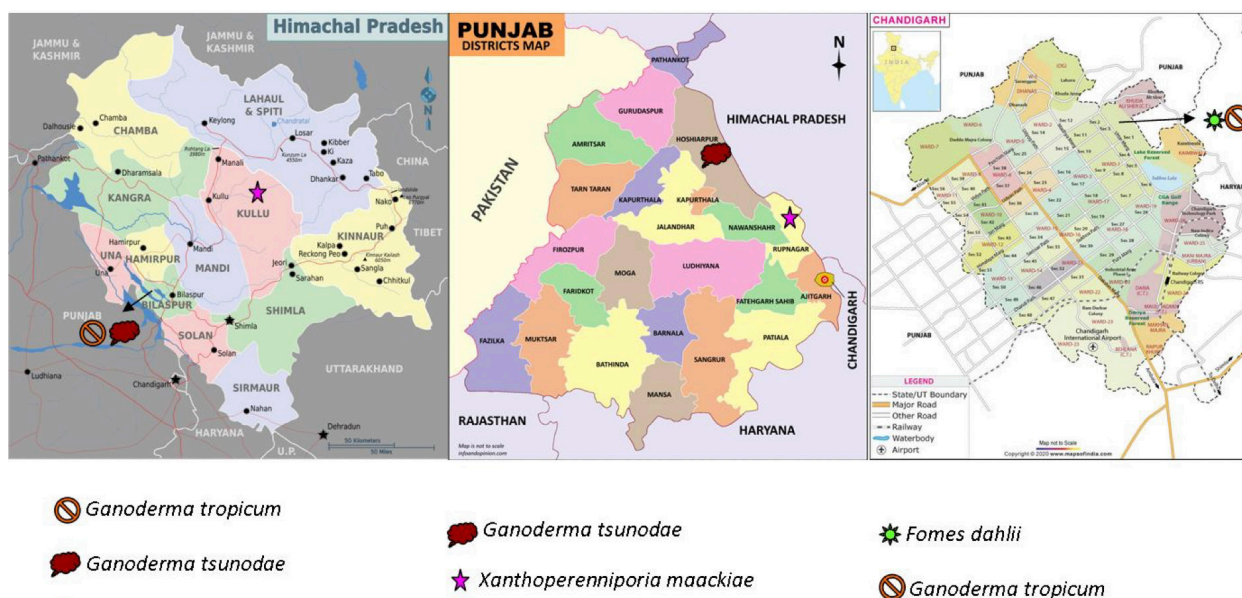


Image 1. Localities of specimen collection.

apiculate end, bitunicate, exospore thin, subhyaline, smooth, endospore thick, brownish, echinulate, tunics connected by inter-wall pillars, inamyloid, acyanophilous.

Collection examined. India, Union Territory of Chandigarh, Lake Reserve Forest, on an angiospermous stump, Avneet 11171 (PUN), 08 October 2019.

Remarks: This species is peculiar in having laccate fruiting body, homogenous context and irregular hymenoderm and causes white rot of angiospermous wood (Ryvarden & Melo 2014). Ding (1989) described it as *Ganoderma dahlia* from China, Philippines and other parts of tropical and subtropical Asia. Presently it is described as *Fomes dahlia* following Mycobank (2023) and is a new record for India.

Ganoderma tropicum (Jungh.) Bres.,

Annales Mycologici 8(6): 586 (1910) – *Polyporus tropicus* Jungh., Praemissa in floram cryptogamicam Javae insulae: 63 (1838). (Image 3)

Macroscopic characteristics: Fruiting body annual, pileate, pileus up to $5.8 \times 6 \times 1$ cm, stipitate, solitary, sub-reniform, sub-flabelliform; abhymenial surface weakly laccate, more or less non laccate towards the margins, faintly zonate, yellowish-brown to reddish-brown when fresh, brownish-orange to violet brown on drying; pilear crust very thin; hymenial surface poroid, whitish when fresh, greyish-white to pale grey on drying; pores round to angular, 4–6 per mm; dissepiments up to 90 μ m wide, entire; context homogenous, zonate, brown, up to 6 mm wide; tubes light brown to brown, up to 3 mm in depth;

stipe lateral, up to 3.2 cm long, and 2.2 cm wide, violet brown; margins obtuse, brownish orange on abhymenial side and pale grey on hymenial side, sterile up to 3 mm on hymenial side.

Microscopic characteristics: Hyphal system trimitic; generative hyphae hyaline, septate, with clamps, up to 3.4 μ m in width, branched, thin-walled; skeleto-binding hyphae yellowish-brown to brown, aseptate, up to 4.5 μ m in width, branched, thick-walled, with very narrow lumen; binding hyphae subhyaline, aseptate, up to 3.1 μ m in width, frequently branched, thick-walled, with wide lumen. Pilear crust regular hymenoderm; cuticular elements sub clavate, thick-walled, yellowish-brown to brown, $35.5\text{--}53 \times 7.9\text{--}8.6$ μ m. Basidia not seen. Basidiospores ellipsoid, $7.3\text{--}9.6 \times 4.5\text{--}6.8$ μ m, truncate at non apiculate end, bitunicate, exospore thin, subhyaline, smooth, endospore thick, brownish, echinulate, tunics connected by inter-wall pillars, inamyloid, acyanophilous.

Collections examined: India, Himachal Pradesh: Bilaspur, Bassi, on angiospermous stump, Harpreet 5283 (PUN), 30 July 2011; Union Territory of Chandigarh, Lake Reserve Forest, on angiospermous stump, Avneet 11172 (PUN), 08 October 2019.

Remarks: This species is characteristic in having weakly laccate fruiting body, regular hymenoderm and smaller basidiospores. It is also reported to cause white rot of hard woods (Ryvarden & Melo 2014). Previously, Vinjusha & Kumar (2022) described it from different localities of Kerala. However, it being described for the

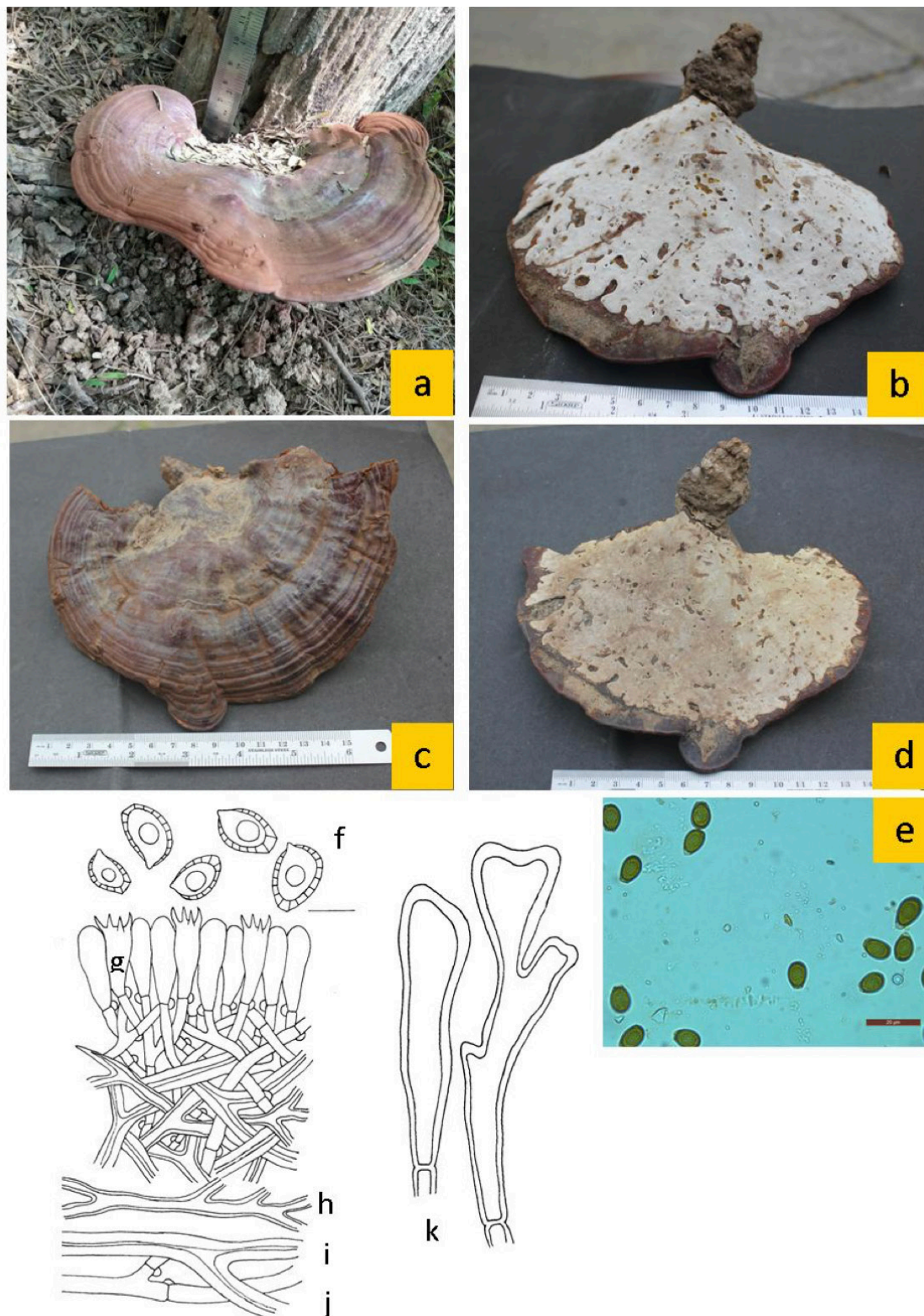


Image 2. *Fomes dahlia* (a–d fruiting body showing): a—abhymenial surface (fresh) | b—hymenial surface (fresh) | c—abhymenial surface (dry) | d—hymenial surface (dry) | e—photomicrograph showing basidiospores | f—basidiospores | g—basidia | h—binding hyphae | i—skeletobinding hyphae | j—generative hyphae | k—cuticular elements.

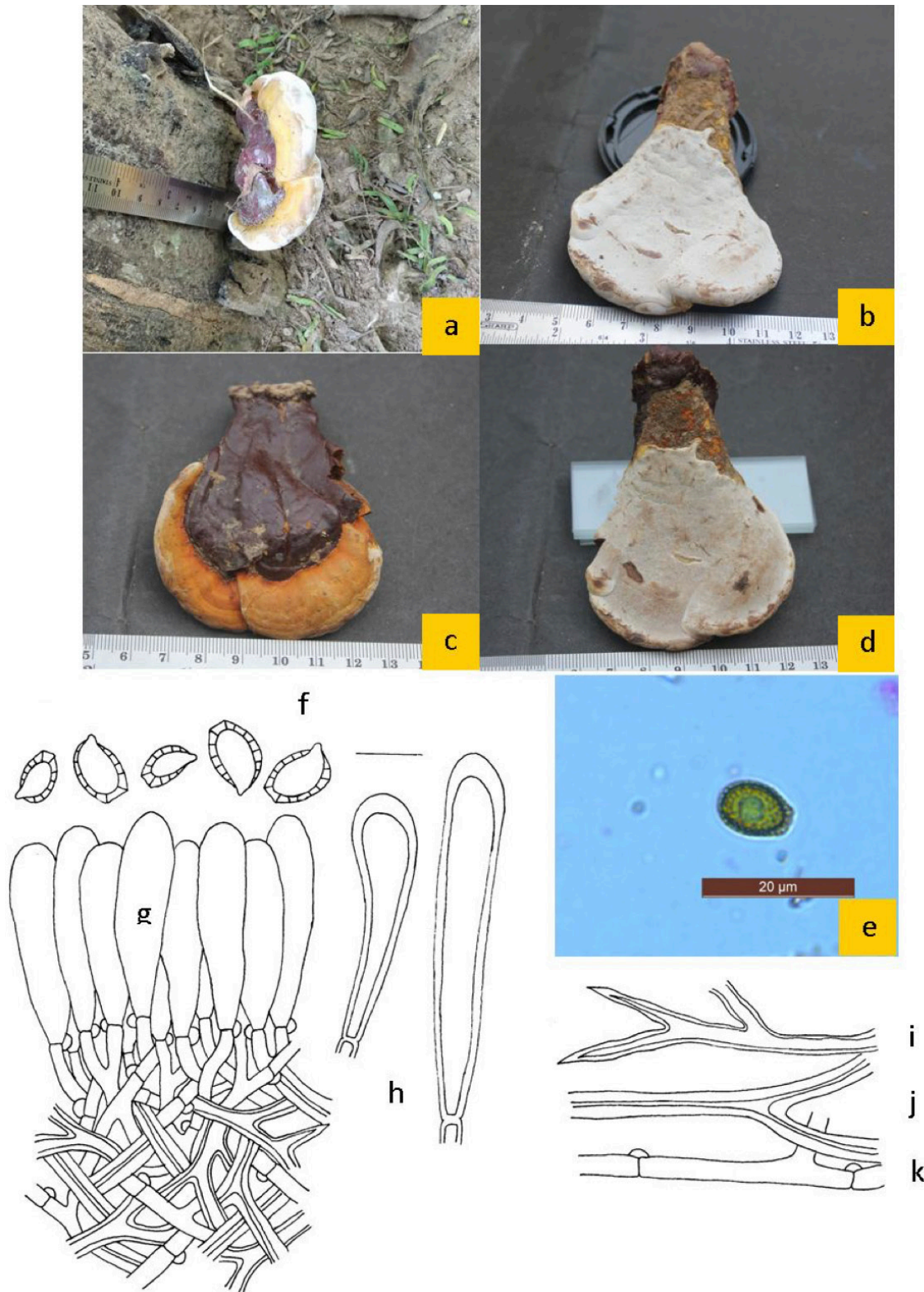


Image 3. *Ganoderma tropicum* (a–d fruiting body showing: a—abhymenial surface (fresh) | b—hymenial surface (fresh) | c—abhymenial surface (dry) | d—hymenial surface (dry) | e—photomicrograph showing a basidiospore | f—basidiospores | g—basidiole | h—cuticular element | i—binding hyphae | j—skeletobinding hyphae | k—generative hyphae.

first time from Himachal Pradesh and Union Territory of Chandigarh.

Ganoderma tsunodae (Yasuda ex Lloyd) Sacc.,

Sylloge Fungorum 23: 139 (1925) – *Polyporus tsunodae* Yasuda ex Lloyd, Mycological Writings 5(55): 792 (1918). (Image 4)

Macroscopic characteristics: Fruiting body annual, pileate, pileus up to $10 \times 7.5 \times 4.5$ cm, sessile, solitary, somewhat fleshy, applanate; abhymenial surface non-laccate, pale yellow to light orange when fresh, not changing much on drying; hymenial surface poroid, greyish-brown to light brown when fresh, not changing much on drying; pores suborbicular, 3–4 per mm; dissepiments up to 100 μ m wide, lacerate; context homogenous, yellowish-white, up to 3 mm wide; tubes greyish-brown, up to 1.4 mm in depth; margins obtuse, pale yellow on both abhymenial on hymenial side, sterile up to 1 mm on hymenial side.

Microscopic characteristics: Hyphal system trimitic; generative hyphae hyaline, septate, with clamps, up to 3.4 μ m in width, branched, thin-walled; skeletal hyphae yellowish-brown to brown, aseptate, up to 5 μ m in width, branched, thick-walled, with very narrow lumen; binding hyphae sub hyaline, aseptate, up to 4 μ m in width, frequently branched, thick-walled, with wide lumen. Pilear surface composed of agglutinated generative and skeletal hyphae. Basidia not seen. Basidiospores ovoid to broadly ellipsoid, $12.2\text{--}18.2 \times 7.9\text{--}11.1$ μ m, uniguttulate, truncate at non apiculate end, bitunicate, exospore thin, subhyaline, smooth, endospore thick, brownish, echinulate, tunics connected by inter-wall pillars, inamyloid, acyanophilous.

Collections examined: India, Himachal Pradesh: Bilaspur, Manjari, on dried tree of *Dalbergia sissoo*, Harpreet 5566 (PUN), 22 August 2011; Punjab: Hoshiarpur, Dasuya Forest Division, on *Mangifera indica*, Avneet 11173 (PUN), 18 December 2018.

Remarks: It is characteristic in having non laccate fruiting body and comparatively larger basidiospores. It is reported to cause white rot of dead and living hardwoods and conifers (Ryvarden & Melo 2014). The former reports of this species are from China, Japan, and Taiwan (Ding 1989; Mycobank 2023).

Xanthoperenniporia maackiae (Bondartsev & Ljub.) B.K.Cui & Xing, Ji,

J. Fungi 9(2): 173 (2023) – *Fomitopsis maackiae* Bondartsev & Ljub., Botanicheskie Materialy Otdela Sporovyh Rastenij Botanicheskogo Instituti Imeni V.L. Komarova 15: 103 (1962). (Image 5)

Macroscopic characteristics: Fruiting body perennial, resupinate to effused-reflexed to pileate, pileus up to $1.7 \times 1.2 \times 2$ cm, sessile, imbricate; abhymenial surface concentrically zonate, radially sulcate, light brown to brown when fresh, not changing much on drying; hymenial surface poroid, yellowish-white to orange white when fresh, not changing much on drying; pores round, 5–6 per mm; dissepiments up to 85 μ m wide, entire; context homogenous, yellowish-white, up to 0.8 mm wide; tubes yellowish-white to orange white, indistinctly stratified, composed of two layers, each layer up to 0.6 mm in depth; margins acute, light brown on abhymenial side, yellowish white on hymenial side, sterile up to 1 mm on hymenial side.

Microscopic characteristics: Hyphal system dimitic; generative hyphae hyaline, septate, with clamps, up to 3.7 μ m in width, branched, thin-walled; skeletal hyphae yellowish-brown, aseptate, up to 8.1 μ m in width, thick-walled, with very narrow lumen. Cystidia absent. Basidia subclavate, $9.3\text{--}15.3 \times 5.3\text{--}7.8$ μ m, with basal clamp, tetrasterigmate; sterigmata up to 2.5 μ m long. Basidiospores ellipsoid, $5.6\text{--}7.2 \times 4.3\text{--}5$ μ m, truncate at non apiculate end, thick-walled, subhyaline, smooth, dextrinoid, cyanophilous.

Collections examined: India, Himachal Pradesh: Kullu, Banjar, 3 km from Jalori towards Shoja, on coniferous log, Ellu 11175 (PUN), 04 April 2016; Punjab: Rupnagar, Forest Rest House, on *Dalbergia sissoo* Avneet and Avneet 11174 (PUN), 28 September 2019.

Remarks: This species is peculiar in having resupinate to effused-reflexed fructifications with dimitic hyphal system and smaller, truncate basidiospores. It was earlier placed in genus *Perenniporia* and has been reported to cause white rot (Ryvarden & Melo 2014). As per Mycobank (2023) this species is distributed in China and Russia.

DISCUSSION

Among polyporoid genera being described presently the genera *Ganoderma* and *Fomes* have received greater attention of the mycologists due to their medicinal importance (Lee 2005; Joseph et al. 2009). The genus *Ganoderma* has been documented with 58 taxa while *Fomes* sensu stricto has been reported with only two taxa across India (Ranadive et al. 2011; Sharma 2012; Ranadive & Jagtap 2016; Manoharachary et al. 2022; www.fungifromindia.com). As far as the genus *Xanthoperenniporia* is concerned, one of the species, i.e., *X. tenuis* has earlier been described under

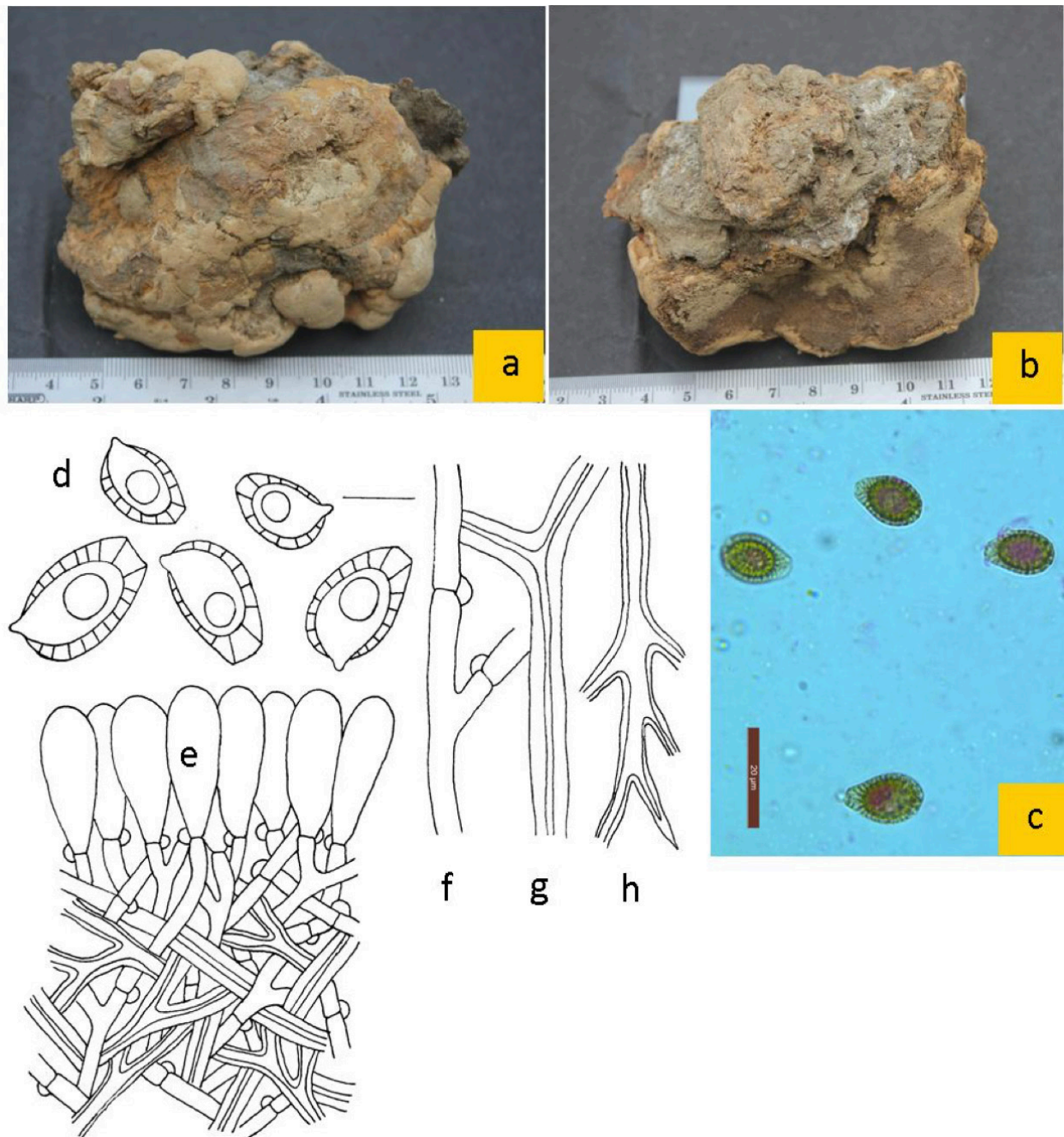


Image 4. *Ganoderma tsunodae* (a-b fruiting body showing): a—abhymenial surface | b—hymenial surface | c—photomicrograph showing basidiospores | d—basidiospores | e—basidiole | f—generative hyphae | g—skeletobinding hyphae | h—binding hyphae .

genus *Perenniporia* from India. The review of literature indicated account of 27 taxa of genus *Ganoderma* and one taxon each of genus *Fomes* and *Xathoperenniporia* from Himachal Pradesh, Punjab and Union Territory of Chandigarh. The present studies have added one species each to the list of Indian records of the genus *Ganoderma*, *Fomes*, and *Xathoperenniporia* while *Ganoderma tropicum* has been described as new to Himachal Pradesh and Union Territory of Chandigarh.

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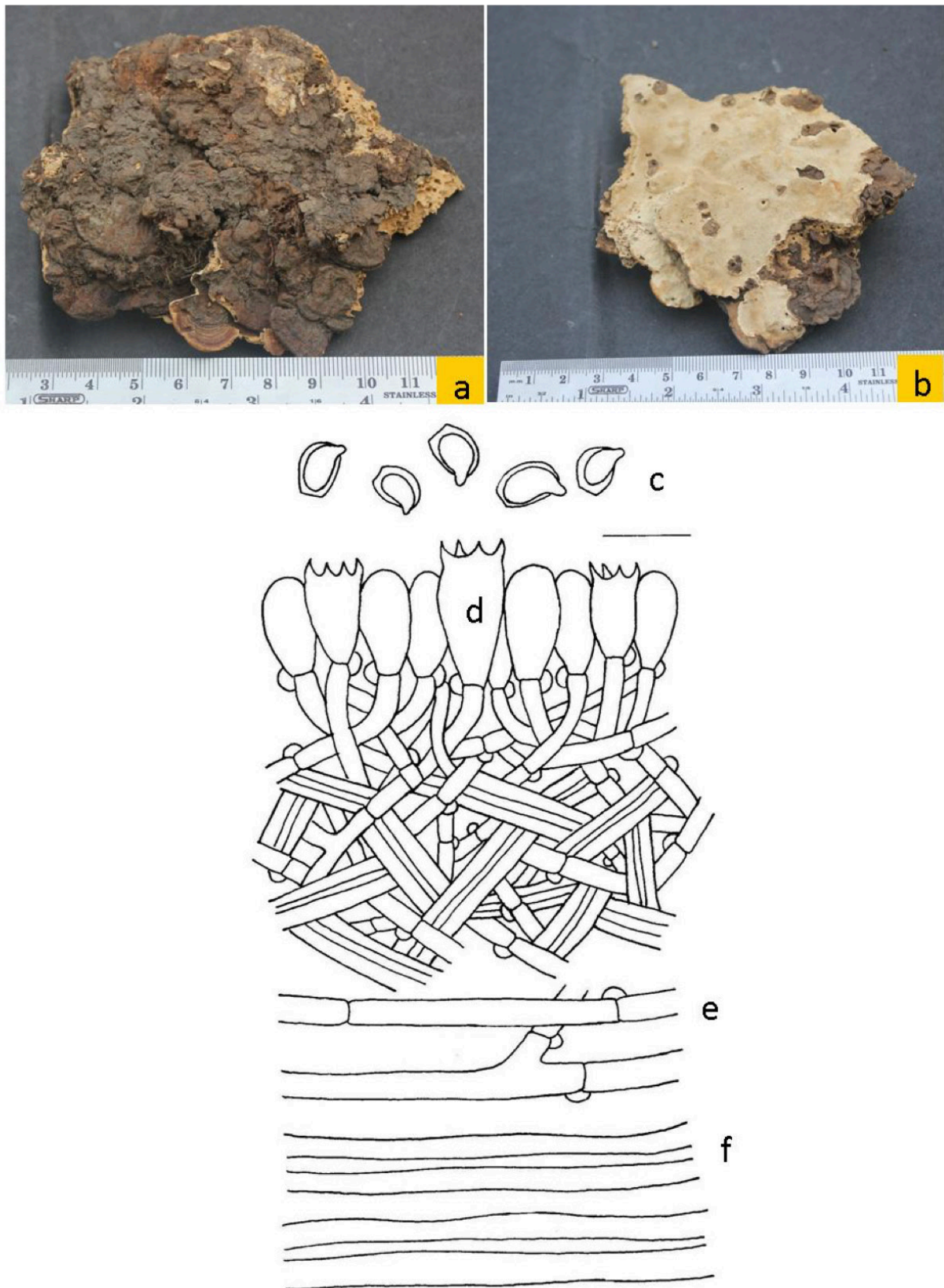


Image 5. *Xanthoperenniporia maackiae* (a–b fruiting body showing): a—abhymenial surface | b—hymenial surface | c—basidiospores | d—basidia | e—generative hyphae | f—skeletal hyphae.

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