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Research Article

Taxonomic Inventory of Macrofungi from Amrabad Tiger Reserve, Eastern Ghats, India

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ABSTRACT: The present study represents the diversity, substrate associations, and ecological roles of macrofungi in Amrabad Tiger Reserve (ATR), Nallamala hills, Eastern Ghats, India, where systematic fungal inventories remain scarce. Opportunistic surveys were carried out from July to October 2025, covering monsoon and early post-monsoon periods, across shaded forest interiors, bamboo-dominated patches and other moisture-rich microhabitats. Macrofungi were noted on a variety of substrates, including dead wood, leaf litter, soil, living trees, bamboo litter, termite mounds, animal pellets, and insect hosts. A total of 87 species, belonging to 36 families with 2 orders were documented, with the Phylum Basidiomycota dominating the Ascomycota. The species richness was high in the family Agaricaceae and Polyporaceae (9), followed by Xylariaceae (8), Omphalotaceae (6), Marasmiaceae, Psathyrellaceae, Entolomataceae and Hydnangiaceae. Moderate numbers of families were observed representing Fomitopsidaceae, Hymenochaetaceae, Mycenaceae, and Tremellaceae, and several families were represented by one or two species. Saprophytic fungi, mainly wood-decaying and litter-inhabiting forms, dominating the assemblage, indicating their important role in decomposition and nutrient cycling. Species richness was high in shaded, moisture habitats, especially bamboo dominated landscapes and besides the streams. The results highlight the ecological importance of macrofungi in forest functioning and emphasize the significance of integrating fungal diversity into biodiversity monitoring and conservation strategies in tropical dry deciduous ecosystems.

Keywords: Bamboo Dominated Patches, Decomposition, Eastern Ghats, Nallamala Hills, Nutrient Cycle, Macrofungi.

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1. INTRODUCTION

Mushrooms are macrofungi with a worldwide distribution and considerable ecological importance, contributing to a wide range of ecosystems (Karavani et al., 2018). They are fleshy, spore-bearing fruiting bodies of fungi belonging to major Phyla Ascomycota and Basidiomycota, which develop from an underground network of hyphae known as mycelium (Ramsbottom, 1989; Das, 2010). Macrofungi play a significant role in decomposition and nutrient recycling, thereby maintaining ecosystem productivity and stability (Alam et al., 2022; Thormann, 2006). Their diversity and occurrence are also considered important indicators of ecosystem health and environmental disturbance (Egli, 2011).

Apart from their ecological importance, wild mushrooms have long been used as food and medicine, contributing to the livelihoods of rural communities in many developing countries (Wani et al., 2010; Alam et al., 2022). Nutritionally, wild edible mushrooms are rich in protein and minerals, with comparatively low-fat content (Barros et al., 2008;

Alam et al., 2022). Globally, more than 12,000 species of macrofungi have been documented, including nearly 1,200 species reported in the following orders: Agaricales, Russulales, and Boletales (Deshmukh, 2004; Rai et al., 2005). However, many forest ecosystems in India remain poorly explored for macro-fungal diversity.

The *Amrabad* Tiger Reserve is a part of Nallamala hills of Eastern Ghats, has rich biodiversity and is an ecologically important region where systematic studies on macrofungi are lacking. Despite supporting diverse forest habitats favourable for fungal growth, no comprehensive taxonomic assessment of wild mushrooms has been conducted in the reserve. Therefore, the present study documented the Taxonomic inventory of macrofungi from Amrabad Tiger Reserve, Eastern Ghats, India, identified the species based on morphological characteristics, and assessed their distribution and ecological significance.

2. MATERIALS AND METHODS

2.1. Study Area

Amrabad Tiger Reserve is located in Nallamala hills of Eastern Ghats, Telangana, India (Fig. 1), and encompasses a total area of about 2,611 km², comprising a core zone of 2,166 km² and a buffer zone of 445 km². It is one of the largest tiger reserves in India. The reserve forms part of a broader landscape of nearly 6,000 km² in the Nallamala region, which is bisected by the Krishna River and includes the adjoining Nagarjunasagar–Srisailam Tiger Reserve, one of the largest Tiger Reserve in the country. The area is classified under Southern Tropical Dry Deciduous Forests and represents one of the largest contiguous savannah-like forest tracts in India (Champion and Seth, 1968), comprising species like *Terminalia tomentosa*, *Anogeisuss latifolia*, *Adina cordifolia*, *Hardwickia binata*, *Chloroxylon swietenia*, *Acacia sundra*, *Aegle marmelos*, *Dalbergia latifolia*, *Madhuca longifolia*, among others, with patches of bamboo *Bambusa arundinacea*, *Dendrocalamus strictus*, with the forest thinning out to shrub savannas and grasslands. The natural vegetation is interspersed with forestry plantations of teak *Tectona grandis* (Murthy et al., 2008).

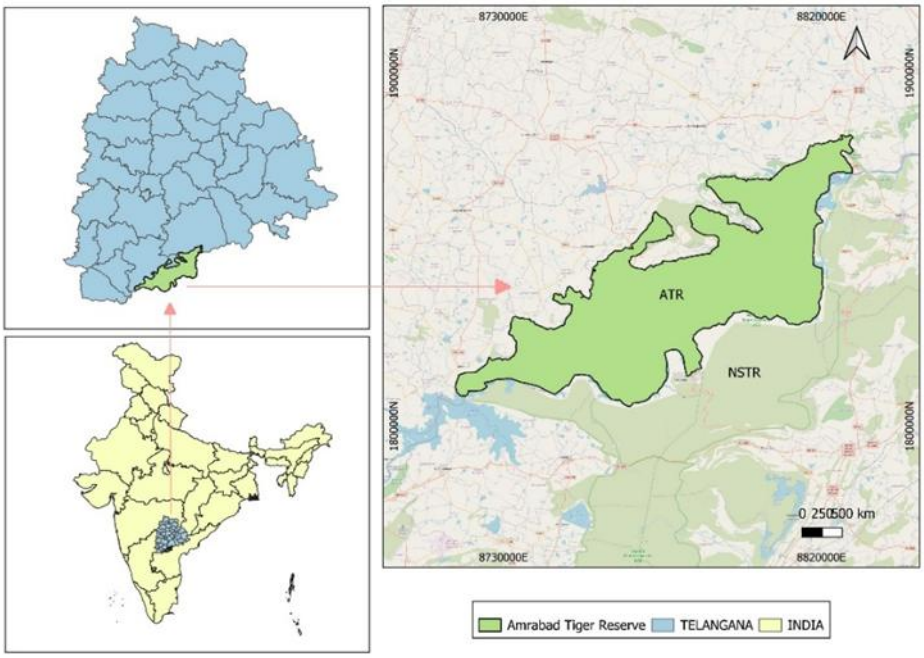


Figure 1. Map showing the Amrabad Tiger Reserve

2.2. Collection of Samples

Macrofungal diversity in the study area was examined through an opportunistic sampling approach, an accepted practice for recording fungal diversity given their periodic and irregular fruiting bodies (Lodge et al., 2004; Mueller et al., 2007). Field sampling was conducted from July to October 2025, including the monsoon and post-monsoon seasons, when environmental conditions are conducive to macrofungi fruiting. A field survey was conducted twice a day, in the morning and evening, to maximize detection of fresh fruiting bodies under suitable moisture and temperature conditions (Chang, 1999; Chang and Miles, 2004; Webster and Weber, 2007). Sampling was conducted from moisture-rich

areas, including bamboo patches, shaded areas within forests, leaf litter, dead and decaying wood, soil, and areas adjacent to seasonal and perennial water sources.

2.3. Identification Procedure

Each species of macrofungi was observed at ground level its morphological features and substrate type (dead wood, living trees, soil, leaf litter, bamboo litter, or area near water sources). Further, noted geo-coordinates. Species identification up to genus level, and few findings to the species level, based on morphological characteristic features including macroscopic features at generic level (pileus shape, colour, texture, lamellae, stipe morphology, odour, habitat and substrate) and also observed at microscopic characteristic features at species level (spore, morphology, basidia, cystidia, hyphal system and clamp connections) following standard taxonomic keys and past literature (Arora et al., 1986; Phillips, 2010; Buba et al., 2024: Elkhateeb et al., 2021; Karun et al.,2015; Liu et al., 2022; Pradeep et al., 2022; Putra et al., 2023; Semwal et al., 2018; Stokland et al., 2012; Wani et al., 2010). Family-level diagnostic characteristics were noted for about 36 families documented in this study. Specimens were not collected for this present survey to avoid disturbing fungal colonies, and the actual distribution of species within the study period remains undetermined.

2.4. Statistical Analysis

Species richness and substrate associations were summarized using descriptive statistics in Microsoft Excel. This methodology provided a baseline assessment of macrofungal diversity, habitat preference and ecological distribution.

3. RESULTS AND DISCUSSION

The recorded macrofungal species in the present study were distributed across a wide range of substrate within the Amrabad Tiger Reserve (Fig.2.). Among the observed substrates, dead wood supported the highest number of species with 35 records (40.2%), followed by soil with 16 records (18.4%), on trees with 15 records (17.2%), and leaf litter with 14 records (16.1%). Comparatively lower occurrences were observed on bamboo stumps (3 records, 3.4%) and animal pellets (2 records, 2.3%), while insect hosts and termite mounds each supported only 1 record (1.1%).

The dominance of fungi on dead and decaying wood indicates the ecological importance of woody debris as a major substrate for macrofungal growth and nutrient recycling in the dry deciduous forest ecosystem. Leaf litter and soil also provided favourable microhabitats for several agaric and gasteroid fungi, owing to higher moisture retention and greater organic matter accumulation. Wood-inhabiting taxa belonging to families such as Polyporaceae, Xylariaceae, and Ganodermataceae were frequently observed on fallen logs and standing trees, reflecting active decomposition processes within the reserve. The occurrence of fungi on specialized substrates such as termite mounds, insect hosts, bamboo stumps and animal pellets further highlight the ecological adaptability and substrate specificity of macrofungi in the Amrabad Tiger Reserve.

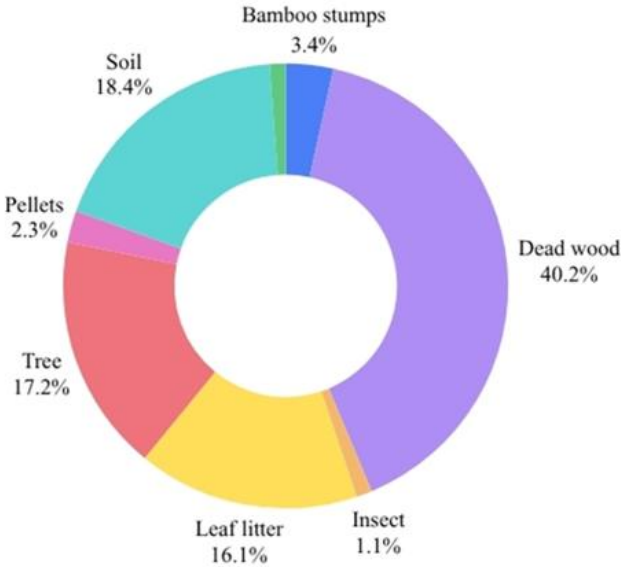


Figure 2. Pie chart showing the substrate utilization pattern by various macrofungi in Amrabad Tiger Reserve

Various ecologically significant fungi were also recorded during the survey, including entomopathogenic species such as *Cordyceps* sp., which grew on insect hosts. Moreover, termite-associated fungi like *Podaxis* sp. were found near termite mounds, highlighting interactions between fungi and termites within the forest environment. The presence of *Termitomyces* species proves the ecological linkage between fungi and termites. This association plays a crucial role in organic matter decomposition, nutrient cycling, and the maintenance of soil structure in forest ecosystems.

Table 1. Macrofungal taxa recoded in Amrabad Tiger Reserve

No.	Phylum	Class	Order	Family	Species and Genera	Substrate	Lat.	Long.
1	Basidiomycota	Agaricomycetes	Agaricales	Agaricaceae	*Agaricus* sp.	Soil	16.31530	78.75553
2	Basidiomycota	Agaricomycetes	Agaricales	Agaricaceae	*Agaricus trisul-phuratus*	Leaf litter	16.31410	78.75646
3	Basidiomycota	Agaricomycetes	Agaricales	Agaricaceae	*Calvatia* sp.	Bam-boo stumps	16.30776	78.72713
4	Basidiomycota	Agaricomycetes	Agaricales	Agaricaceae	*Chlorophyllum* sp.	Dead wood	16.30919	78.72713
5	Basidiomycota	Agaricomycetes	Agaricales	Agaricaceae	*Heimiomyces* sp.	Soil	16.30707	78.71362
6	Basidiomycota	Agaricomycetes	Agaricales	Agaricaceae	*Lepiota* sp.	Leaf litter	16.21011	78.72800
7	Basidiomycota	Agaricomycetes	Agaricales	Agaricaceae	*Lycoperdon* sp.	Soil	16.25651	78.72800
8	Basidiomycota	Agaricomycetes	Agaricales	Agaricaceae	*Lycoperdon* sp.	On tree	16.25429	78.72800
9	Basidiomycota	Agaricomycetes	Agaricales	Agaricaceae	*Podaxis* sp.	Soil	16.24422	78.72729
10	Basidiomycota	Agaricomycetes	Agaricales	Bolbitiaceae	*Panaeolus* sp.	Soil	16.16948	78.72729
11	Basidiomycota	Agaricomycetes	Agaricales	Crepidotaceae	*Crepidotus* sp.	Dead wood	16.33664	78.77222
12	Basidiomycota	Agaricomycetes	Agaricales	Crepidotaceae	*Crepidotus* sp.	Dead wood	16.33408	78.77222
13	Basidiomycota	Agaricomycetes	Agaricales	Entolomataceae	*Entoloma albidosimu-lans*	Dead wood	16.31686	78.77170
14	Basidiomycota	Agaricomycetes	Agaricales	Entolomataceae	*Entoloma panniculus*	Soil	16.31690	78.77165
15	Basidiomycota	Agaricomycetes	Agaricales	Entolomataceae	*Entoloma* sp.	Leaf litter	16.32884	78.77115
16	Basidiomycota	Agaricomycetes	Agaricales	Entolomataceae	*Entoloma* sp.	Soil	16.26283	78.74331
17	Basidiomycota	Agaricomycetes	Agaricales	Hydnangiaceae	*Hygrocybe miniata*	Soil	16.30817	78.74818
18	Basidiomycota	Agaricomycetes	Agaricales	Hydnangiaceae	*Hygrocybe pellucida*	Leaf litter	16.30816	78.75481
19	Basidiomycota	Agaricomycetes	Agaricales	Hydnangiaceae	*Hygrocybe* sp.	Leaf litter	16.30801	78.75481
20	Basidiomycota	Agaricomycetes	Agaricales	Hydnangiaceae	*Laccaria fraterna*	Leaf litter	16.22341	78.75480
21	Basidiomycota	Agaricomycetes	Agaricales	Hymenogastraceae	*Psilocybe* sp.	Leaf litter	16.33469	78.75491
22	Basidiomycota	Agaricomycetes	Agaricales	Marasmiaceae	*Marasmiellus* sp.	On tree	16.25390	78.74737
23	Basidiomycota	Agaricomycetes	Agaricales	Marasmiaceae	*Marasmiellus* sp.	On tree	16.25369	78.71876
24	Basidiomycota	Agaricomycetes	Agaricales	Marasmiaceae	*Marasmius haemato-cephalus*	Leaf litter	16.20266	78.71771
25	Basidiomycota	Agaricomycetes	Agaricales	Marasmiaceae	*Marasmius* sp.	Dead wood	16.18552	78.72045
26	Basidiomycota	Agaricomycetes	Agaricales	Marasmiaceae	*Roridomyces* sp.	On tree	16.18154	78.72007
27	Basidiomycota	Agaricomycetes	Agaricales	Mycenaceae	*Favolaschia* sp.	On tree	16.26278	78.72014
28	Basidiomycota	Agaricomycetes	Agaricales	Mycenaceae	*Mycena* sp.	Pellets	16.31343	78.72023

29	Basidiomycota	Agaricomycetes	Agaricales	Mycenaceae	*Tetrapyrgos nigripes*	Dead wood	16.25969	78.72770
30	Basidiomycota	Agaricomycetes	Agaricales	Nidulariaceae	*Cyathus* sp.	On tree	16.26221	78.72770
31	Basidiomycota	Agaricomycetes	Agaricales	Omphalotaceae	*Collybiopsis* sp.	Leaf litter	16.33336	78.72768
32	Basidiomycota	Agaricomycetes	Agaricales	Omphalotaceae	*Gymnopus* sp.	Soil	16.28563	78.73673
33	Basidiomycota	Agaricomycetes	Agaricales	Omphalotaceae	*Gymnopus* sp.	Leaf litter	16.32308	78.72854
34	Basidiomycota	Agaricomycetes	Agaricales	Omphalotaceae	*Omphalotus* sp.	Soil	16.31100	78.72665
35	Basidiomycota	Agaricomycetes	Agaricales	Physalacriaceae	*Oudemansiella* sp.	Dead wood	16.31016	78.75658
36	Basidiomycota	Agaricomycetes	Agaricales	Pluteaceae	*Volvariella bombycina*	On tree	16.29019	78.75675
37	Basidiomycota	Agaricomycetes	Agaricales	Pluteaceae	*Volvariella* sp.	Dead wood	16.26440	78.75674
38	Basidiomycota	Agaricomycetes	Agaricales	Psathyrellaceae	*Candolleomyces* sp.	Soil	16.30780	78.72595
39	Basidiomycota	Agaricomycetes	Agaricales	Psathyrellaceae	*Coprinopsis* sp.	Pellets	16.33336	78.72560
40	Basidiomycota	Agaricomycetes	Agaricales	Psathyrellaceae	*Parasola* sp.	Dead wood	16.16368	78.72604
41	Basidiomycota	Agaricomycetes	Agaricales	Psathyrellaceae	*Psathyrella corrugis*	Dead wood	16.22292	78.67085
42	Basidiomycota	Agaricomycetes	Agaricales	Pterulaceae	*Pterula* sp.	Bamboo stumps	16.31006	78.67087
43	Basidiomycota	Agaricomycetes	Agaricales	Pterulaceae	*Pterula subulata*	Dead wood	16.18759	78.67951
44	Basidiomycota	Agaricomycetes	Agaricales	Strophariaceae	*Gymnopilus* sp.	Bamboo stumps	16.28575	78.65627
45	Basidiomycota	Agaricomycetes	Agaricales	Strophariaceae	*Gymnopilus* sp.	Dead wood	16.28571	78.65311
46	Basidiomycota	Agaricomycetes	Agaricales	Tricholomataceae	*Collybia ocior*	Leaf litter	16.30918	78.63991
47	Basidiomycota	Agaricomycetes	Agaricales	Tricholomataceae	*Lepista tarda*	Leaf litter	16.21021	78.69843
48	Basidiomycota	Agaricomycetes	Auriculariales	Auriculariaceae	*Auricularia* sp.	Dead wood	16.30454	78.72720
49	Basidiomycota	Agaricomycetes	Boletales	Hygrophoropsidaceae	*Hygrophoropsis* sp.	Soil	16.30880	78.72719
50	Basidiomycota	Agaricomycetes	Boletales	Serpulaceae	*Serpula* sp.	Dead wood	16.25970	78.72695
51	Basidiomycota	Agaricomycetes	Geastrales	Geastraceae	*Geastrum triplex*	On tree	16.26461	78.65866
52	Basidiomycota	Agaricomycetes	Gomphales	Gomphaceae	*Phaeoclavulina* sp.	Dead wood	16.16909	78.66589
53	Basidiomycota	Agaricomycetes	Gomphales	Lentariaceae	*Lentaria byssiseda*	Leaf litter	16.24108	78.69392
54	Basidiomycota	Agaricomycetes	Hymenochaetales	Hymenochaetaceae	*Phellinus* sp.	On tree	16.16909	78.76531
55	Basidiomycota	Agaricomycetes	Hymenochaetales	Hymenochaetaceae	*Porodaedalea pini*	Termite mound	16.22290	78.76493
56	Basidiomycota	Agaricomycetes	Phallales	Phallaceae	*Mutinus bambusinus*	Dead wood	16.31344	78.77834
57	Basidiomycota	Agaricomycetes	Polyporales	Fomitopsidaceae	*Fomitopsis* sp.	On tree	16.26410	78.77934
58	Basidiomycota	Agaricomycetes	Polyporales	Fomitopsidaceae	*Ischnoderma* sp.	Soil	16.22338	78.44567
59	Basidiomycota	Agaricomycetes	Polyporales	Fomitopsidaceae	*Pycnoporellus* sp.	On tree	16.18901	78.44477

60	Basidiomycota	Agaricomycetes	Polyporales	Ganodermataceae	*Ganoderma* sp.	Dead wood	16.26315	78.44024
61	Basidiomycota	Agaricomycetes	Polyporales	Ganodermataceae	*Ganoderma* sp.	Dead wood	16.26351	78.44662
62	Basidiomycota	Agaricomycetes	Polyporales	Meruliaceae	*Byssomerulius* sp.	Dead wood	16.31976	78.44662
63	Basidiomycota	Agaricomycetes	Polyporales	Podoscyphaceae	*Podoscypha petalodes*	Dead wood	16.24424	78.44670
64	Basidiomycota	Agaricomycetes	Polyporales	Polyporaceae	*Cerioporus* sp.	Dead wood	16.30776	78.59446
65	Basidiomycota	Agaricomycetes	Polyporales	Polyporaceae	*Echinoporia hydnophora*	Dead wood	16.31685	78.59467
66	Basidiomycota	Agaricomycetes	Polyporales	Polyporaceae	*Hexagonia hydnoides*	Soil	16.31011	78.60817
67	Basidiomycota	Agaricomycetes	Polyporales	Polyporaceae	*Hexagonia* sp.	Dead wood	16.30819	78.61518
68	Basidiomycota	Agaricomycetes	Polyporales	Polyporaceae	*Lentinus* sp.	Dead wood	16.20682	78.61519
69	Basidiomycota	Agaricomycetes	Polyporales	Polyporaceae	*Microporus xanthopus*	Dead wood	16.25452	78.77156
70	Basidiomycota	Agaricomycetes	Polyporales	Polyporaceae	*Panus* sp.	Dead wood	16.16948	78.75419
71	Basidiomycota	Agaricomycetes	Polyporales	Polyporaceae	*Polyporaceae* sp.	On tree	16.24112	78.57443
72	Basidiomycota	Agaricomycetes	Polyporales	Polyporaceae	*Trametes* sp.	Dead wood	16.17202	78.57451
73	Basidiomycota	Agaricomycetes	Russulales	Bondarzewiaceae	*Amylosporus* sp.	Dead wood	16.30454	78.57398
74	Basidiomycota	Dacrymycetes	Dacrymycetales	Dacrymycetaceae	*Dacryopinax spathularia*	Dead wood	16.32853	78.68834
75	Basidiomycota	Tremellomycetes	Tremellales	Tremellaceae	*Tremella mesenterica*	Dead wood	16.17142	78.68832
76	Basidiomycota	Tremellomycetes	Tremellales	Tremellaceae	*Tremella* sp.	Dead wood	16.23913	78.58075
77	Ascomycota	Pezizomycetes	Pezizales	Sarcoscyphaceae	*Phillipsia* sp.	Dead wood	16.20726	78.58017
78	Ascomycota	Sordariomycetes	Hypocreales	Cordycipitaceae	*Cordyceps* sp.	Insect	16.33617	78.61069
79	Ascomycota	Sordariomycetes	Hypoxylales	Hypoxylaceae	*Hypoxylon cinnabarinum*	On tree	16.30801	78.71916
80	Ascomycota	Sordariomycetes	Xylariales	Xylariaceae	*Daldinia concentrica*	Dead wood	16.31685	78.69337
81	Ascomycota	Sordariomycetes	Xylariales	Xylariaceae	*Xylaria hypoxylon*	Leaf litter	16.26462	78.69268
82	Ascomycota	Sordariomycetes	Xylariales	Xylariaceae	*Xylaria longipes*	Soil	16.21346	78.50438
83	Ascomycota	Sordariomycetes	Xylariales	Xylariaceae	*Xylaria obovata*	Dead wood	16.45729	78.12201
84	Ascomycota	Sordariomycetes	Xylariales	Xylariaceae	*Xylaria* sp.	Soil	16.28773	78.71202
85	Ascomycota	Sordariomycetes	Xylariales	Xylariaceae	*Xylaria* sp.	Dead wood	16.23063	78.60199
86	Ascomycota	Sordariomycetes	Xylariales	Xylariaceae	*Xylaria* sp.	On tree	16.11799	78.47783
87	Ascomycota	Sordariomycetes	Xylariales	Xylariaceae	*Xylaria* sp.	On tree	16.11025	78.49402

Legend: * **sp.** – Indicates species, not identified to the exact species level within a genus, or cases where multiple species belong to the same genus. **Substrate** – Refers to the surface or material on which the fungal fruiting body was observed, including soil, leaf litter, dead wood, bamboo stumps, living trees, termite mounds, insect bodies, and animal pellets.

The present study represents 87 species of macrofungi belonging to 36 families from Amrabad Tiger Reserve, highlighting considerable fungal diversity in a tropical dry deciduous forest ecosystem. The dominance of Polypo-

raceae (9 species) reflects the ecological significance of wood-decaying fungi, which play a key role in lignin and cellulose degradation and nutrient cycling. Comparable dominance of Polypores was widely reported in forest ecosystems, where deadwood availability shapes macrofungal richness and composition (Lodge et al., 2004; Huhndorf et al., 2004; Stokland et al., 2012; Krah et al., 2018). The diversity documented suggests that habitat heterogeneity, seasonal variation, and substrate availability strongly influence macrofungal assemblies (Mueller et al., 2007).

The highest macrofungi occurrence on dead wood (40.2%) underscores the importance of woody substrates as primary niches for saprotrophic fungi. Deadwood serves as a nutrient-rich microhabitat that supports decomposition and cycling processes (Boddy et al., 2007; Pringle et al., 2011; Raisa et al., 2017). In contrast, the lowest occurrence of fungi on insect hosts (1%) indicates limited representation of highly specialized or host-specific fungi, which are often rare and less frequently found (Blackwell, 2011; Raja et al., 2017). These findings highlight the ecological significance of maintaining deadwood and structural complexity in forests to sustain fungal diversity and ecosystem functioning. Macrofungi belong mainly to the phyla Mycology (Basidiomycota) and Ascomycota. A total of 36 fungal families were identified based on important macroscopic and microscopic morphological characters. Distinguishing features such as fruiting body structure, hymenial type, spore morphology, ecological habitat, and substrate association were used to classify and identify the recorded macrofungal taxa.

3.1. Family - Agaricaceae:

Pileus fleshy, typically convex to umbonate, lamellae free, white to pinkish brown at maturity, stipe central with persistent annulus, spore print white, pink, brown, includes both saprotrophic and mycorrhizal forms gasteriod members (*Lycoperdon*, *Calvatia*, *Podaxis*) produce enclosed basidocarps (Puffballs) with powdery gleba at maturity. This family is predominantly saprotrophic in soil, dung, and decaying organic matter, though some members form ectomycorrhizal associations (Ainsworth, 2008; Hibbett et al., 2007; Alexopoulos et al., 1996). The collected mushrooms are *Agaricus* sp., *Agaricus trisulphuratus*, *Chlorophyllum* sp., *Lycoperdon* sp., *Calvatia* sp., *Lycoperdon umbrinum*, and *Lepiota* sp., as in Figure 3.

Figure 3. Fruiting bodies of Agaricaceae

3.2. Family - Auriculariaceae:

Defined by gelatinous to rubbery or cartilaginous basidiocarps that are typically ear shaped, discoid, irregularly lobed or bracket like and characteristically reddish brown to purplish brown in colour when fresh, becoming hard and shrunken upon desiccation but reviving upon re-hydration. Hyphae with clamp connections medullary tissue of loosely interwoven hyphae embedded in gelatinous matrix. Habitat: Wood rotting, on dead or living branches (Ainsworth, 2008; Hibbett et al., 2007; Alexopoulos et al., 1996). The collected mushroom is *Auricularia cf. cornea*, as in Figure 4.

3.3. Family - Bolbitiaceae:

Basidocarps small to medium, Gills adnate to adnexed or free, often crowded: colour changing from pale yellow or whitish to rusty brown or cinnamon brown as spores mature. Habitat: Coprophilous, grassy areas, compost or rich soils (Ainsworth, 2008; Alexopoulos et al., 1996). The collected mushroom is *Panaeolus foenisecii*, as in Figure 4.

3.4. Family - Bondarzewiaceae:

Basidiocarps large, polypore-like, stipitate to sessile, often forming rosette-like clusters of overlapping flabellate to fan-shaped caps. Pileus surface smooth to tomentose, cream to pale tan. Spore print white, hyphal system monomitic and generative hyphae with clamp connections. Habitat: Saprotrophic to weakly parasitic at tree bases (Ainsworth, 2008; Hibbett et al., 2007). The collected mushroom is *Amylosporus campbellii*, as in Figure 4.

3.5. Family - Cordycipitaceae:

Ascomata immersed in or on fleshy to fibrous stroma, often brightly coloured yellow, orange and white. Ascospores filiform, multi-separate, often fragmenting into part spores. Many species of entomopathogenic (parasitizing insects, spiders or other arthropods) and some target other fungi. Habitat: Parasitic on insect and other fungi (Ainsworth, 2008; Hibbett et al., 2007; Alexopoulos et al., 1996). The collected mushroom is *Cordyceps militaris*, as in Figure 4.

Figure 4. Some macrofungal fruiting bodies of Auriculariaceae, Bolbitiaceae, Bondarzewiaceae, and Cordycipitaceae

3.6. Family - Crepidotaceae:

Basidocarps small, pleurotoid (laterally attached) to sessile or with a very rudimentary stipe fan shaped or kidney shaped or shell. Pileus surface smooth to fibrillise, white, cream, orhre or brownish. Spore print brown to rusty brown or cinnamon brown. Habitat: Saprotrophic on decaying wood or bark, cosmopolitan (Ainsworth, 2008; Alexopoulos et al., 1996). The collected mushrooms from this family are *Crepidotus* sp., and *Crepidotus* sp., as in Figure 5.

3.7. Family - Dacrymycetaceae:

Basidiocarps gelatinous, rubbery or waxy, shape variable, cushion-like, club-shaped, branched, disc-like or pustulate. Typically, bright yellow to orange or orange-red and less commonly white or pale. Habitat: Saprotrophic on dead wood; cosmopolitan, especially common in moist temperate and tropical regions (Ainsworth, 2008; Hibbett et al., 2007; Alexopoulos et al., 1996). The collected mushroom from this family is *Dacryopinax spathularia*, as in Figure 5.

Figure 5. Some macrofungal fruiting bodies of Crepidotaceae, and Dacrymycetaceae

3.8. Family - Entolomataceae:

Basidiocarps agaricoid, occasionally secotioid or clitocyboid, pileus convex to umbonate, sometimes depressed, surface dry to viscid, silky or fibrillose. Gills adnate to sinuate or decurrent, initially pale after becoming distinctly pink as spores mature, one of the most reliable field characters and stipe central, fibrous. Spore print pink to salmon pink. Habitat: Mycorrhizal or saprotrophic, grasslands, woodlands, cosmopolitan and many species are toxic (Ainsworth, 2008; Hibbett et al., 2007; Alexopoulos et al., 1996). The collected mushrooms from this family are *Entoloma albidosimulans*, *Entoloma panniculus*, and *Entoloma* sp., as in Figure 6.

Figure 6. Some macrofungal fruiting bodies of Entolomataceae

3.9. Family - Fomitopsidaceae:

Basidiocarps bracket-shaped, hoof shaped or resupinate, perennial or annual, flesh firm, corky to woody. Hymenophore poroid; pores small, circular, cream to brown. Spores print white to pale yellow. Hyphal system dimitic or trimitic skeletal hyphae without clamp connections and generative hyphae with clamp connections. Habitat: Saprotrophic or weakly parasitic on hardwoods (Ainsworth, 2008; Hibbett et al., 2007; Alexopoulos et al., 1996). The collected mushrooms from this family are *Fomitopsis* sp., *Ischnoderma* sp., and *Pycnoporellus* sp., as in Figure 7.

Figure 7. Some macrofungal fruiting bodies of Fomitopsidaceae

3.10. Family - Ganodermataceae:

Basidicarps annual to perennial, bracket-shaped, fan-shaped. Hymenophore poroid; pores small, circular, white to cream, brushing brown and spore print brown. The hyphal system is trimitic, with generative hyphae bearing clamp connections. Habitat: Saprotrophic or parasitic on hardwoods (Ainsworth, 2008; Hibbett et al., 2007; Alexopoulos et al., 1996). The collected mushroom from this family is *Ganoderma* sp., as in Figure 8.

3.11. Family - Geastraceae:

Basidiocarps gasteroid (enclosed); young fruiting body hypogeous to epigeous, onion-shaped. Outer peridium splits stellately into 4-12 rays that recurve, forming a star-like base, the defining macroscopic features of earthstars. Basidiospores globes, ornamented and brown colour print. Habitat: Saprotrophic in soil, leaf litter and sandy soils (Ainsworth, 2008; Hibbett et al., 2007; Alexopoulos et al., 1996). The collected mushroom from this family is *Geastrum triplex*, as in Figure 8.

3.12. Family - Gomphaceae:

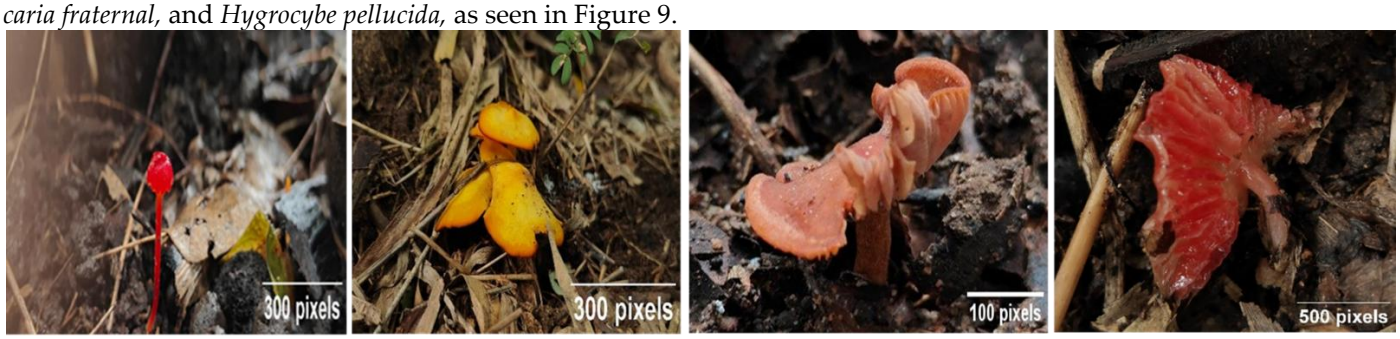
Basidicarps club-shaped, top-shaped, or irregularly branched. Hymenophore wrinkled, ridged or veined on the outer surface and no true gills or pores. Spore print ochraceous, yellowish brown or rusty brown and hyphal system monomitic. Habitat: Ectomycorrhizal with conifers and hardwoods and temperate to tropical (Ainsworth, 2008; Hibbett et al., 2007; Alexopoulos et al., 1996). The collected mushroom from this family is *Phaeoclavulina* sp., as in Figure 8.

Ganoderma sp. *Ganoderma* sp. *Geastrum triplex* *Phaeoclavulina* sp.

Figure 8. Some macrofungal fruiting bodies of Ganodermataceae, Geastraceae, and Gomphaceae

3.13. Family - Hydnangiaceae:

Basidiocarps agaricoid, small to medium, pileus convex to umbonate or plane and surface smooth to fibrillose, dry. Gills deeply decurrent to adnate, thick, well-spaced, waxy in texture, giving a greasy feel like Hygrophoraceae, stipe central, solid and spore print white. Basidiospores are ellipsoid, smooth, thin-walled, dextrinoid, and have clamp connections. Habitat: Saprotrophic in coniferous and mixed forests, often in deep litter and widely distributed (Ainsworth, 2008; Hibbett et al., 2007). The collected mushrooms from this family are *Hygrocybe* sp., *Hygrocybe ceracea, Laccaria fraternal,* and *Hygrocybe pellucida,* as seen in Figure 9.



Hygrocybe sp. *Hygrocybe ceracea* *Laccaria fraternal* *Hygrocybe pellucida*

Figure 9. Some macrofungal fruiting bodies of Hydnangiaceae

3.14. Family - Hygrophoropsidaceae:

Basidiocarps agaricoid, resembling chanterelles (Cantharellus) pileus convex, becoming deeply funnel-shaped or infundibuliform surface dry to slightly tomentose, bright or orange to orange yellow. Gills deeply decurrent, crowded, repeatedly forking, orange superficially similar to Cantharellus, but gill blades are not forked, ridged, stipes are central, slender, concolorus with cap and the spore print is white. Habitat: Saprotrophic in coniferous and mixed forests, often in deep litter and widely distributed (Ainsworth, 2008; Hibbett et al., 2007; Alexopoulos et al., 1996). The collected mushroom from this family is *Hygrophorosis* sp., as seen in Figure 10.

3.15. Family - Hymenochaetaceae:

Basidiocarps bracket-shaped, effused, reflexed, annual or perennial, flesh corky to woody, typically rust brown to dark brown and Hymenophore poroid, toothed or smooth, pores small, round to angular. Basidiospores are small, ellipsoid to cylindrical, smooth, thin-walled and hyphae without clamp connections. Habitat: Saprotrophic or parasitic on hardwoods and conifers (Ainsworth, 2008; Hibbett et al., 2007; Alexopoulos et al., 1996). The collected mushrooms from this family are *Porodaedalea pini*, and *Phellinus alni*, as seen in Figure 10.

3.16. Family - Hymenogastraceae:

Basidiocarps agaricoid, cortinarioid or occasionally secotioid, pileus convex to umbonate. Gills adnate to sinuate, brownish to rusty brown at maturity. Gills adnate to sinuate, brownish to rusty brown at maturity. Spore print: rusty brown to tobacco brown; clamp connections present. Habitat: Mycorrhizal or saprotrophic and temperate woodland (Ainsworth, 2008; Hibbett et al., 2007; Alexopoulos et al., 1996). The collected mushroom from this family is *Psilocybe* sp., as seen in Figure 10.

3.17. Family - Hypoxylaceae:

Stromata well developed, typically hard, carbonaceous or fleshy when fresh, darkening on drying, surface often covered with KOH extractable pigments (Dull purple, reddish, grey or black). Ascospores are brown to dark at maturity, unicellular, ellipsoid to fusiform, smooth with a germ slit. Habitat: Saprotrophic on deadwood and endophytic in living plants (Ainsworth, 2008; Hibbett et al., 2007; Alexopoulos et al., 1996). The collected mushroom from this family is *Hypoxylon cinnabarinum*, as seen in Figure 10.

3.18. Family - Lentariaceae:

Basidiocarps coral-like to club-shaped, small, slender, branched, flesh brittle to firm and surface smooth, white to pale cream or tan. Spore print white; clamp connections present; hyphal system monomitic. Habitat: Saprotrophic on decaying wood or woody litter in forests (Ainsworth, 2008; Hibbett et al., 2007). The collected mushroom from this family is *Lentaria byssiseda*, as seen in Figure 10.

Figure 10. Some macrofungal fruiting bodies of different families

3.19. Family - Marasmiaceae:

Basidiocarps resupinate, effused-reflexed, annual, flesh soft, waxy, gelatinous to fibrous. Hymenophore typically merulioid (wrinkled, poroid or labyrinthiform with shallow irregular pores or ridges and spore print white. Hyphal system monomitic generative hyphae with clamp connection. Habitat: Saprotrophic on dead wood (Ainsworth, 2008;

Hibbett et al., 2007; Alexopoulos et al., 1996). The collected mushrooms from this family are *Marasmius cf. hematocephalus*, *Roridomyces* sp., *Marasmiellus* sp., and *Marasimus* sp., as seen in Figure 10.

3.20. Family - Meruliaceae:

Basidiocarps resupinate, effused, reflexed or bracket-like, annual, flesh soft, waxy and gelatinous to fibrous. Hymenophore typically merulioid (wrinkled, poroid or labyrinthiform with shallow irregular pores or ridges), surface colour variable, cream, pinkish, orange or brown, spore print white and hyphae with clamp connections. Habitat: Saprotrophic on dead wood (Ainsworth, 2008; Hibbett et al., 2007; Alexopoulos et al., 1996). The collected mushroom from this family is *Byssomerulius corium*, as seen in Figure 10.

3.21. Family - Mycenaceae:

Basidiocarps small, fragile, agaricoid pileus typically conical to bell-shaped to convex, often striate, surface smooth, dry to slightly viscid. Gills adnate to adnexed, narrow, well-spaced, white to greyish or pinkish and spore print white. Habitat: Saprotrophic on leaf litter, dead wood or bark (Ainsworth, 2008; Hibbett et al., 2007; Alexopoulos et al., 1996). The collected mushrooms from this family are *Favolaschia* sp., *Mycen* sp., and *Tetrapyrgos nigripes*, as seen in Figure 11.

3.22. Family - Nidulariaceae:

Basidiocarps are small, gasteriod, cup or nest shaped (Bird nest fungi), outer surface smooth to hairy. Glebal masses enclosed in lens-shaped peridioles (egg-like structures) sitting inside the cup, one of the most distinctive macroscopic features among all fungi and spore print white. Basidiospores are large, ellipsoid to globose, smooth, hyaline and thick-walled. Habitat: Saprotrophic on dead wood, dung and plant debris (Ainsworth, 2008; Hibbett et al., 2007; Alexopoulos et al., 1996). The collected mushroom from this family is *Cyathus* sp., as seen in Figure 11.

3.23. Family - Omphalotaceae:

Basidiocarps small to medium, pileus convex to depressed or funnel-shaped, surface dry, often with radial fibris or smooth. Gills deeply decurrent to adnate, forking or simple, often orange, yellow or cream and spore print white to pale cream. Some species are bioluminescent (glow in the dark), including Omphalotus sp., a notable biological feature. Clamps are present. Habitat: Saprotrophic on roots, buried wood or at the base of trees (Ainsworth, 2008; Hibbett et al., 2007; Alexopoulos et al., 1996). The collected mushrooms from this family are *Collybiopsis* sp., *Gymnopus* sp., *Omphalotus* sp., and *Gymnopus* sp., as seen in Figure 11.

Figure 11. Some macrofungal fruiting bodies of different families

3.24. Family - Phallaceae:

Basidiocarps initially egg-shaped, hypogeous or at soil surface, outer peridium white, smooth interior gelatinous. At maturity, the peridium ruptures and the spongy, hollow stipe elongates rapidly, bearing a cap covered with dark green to olive, fetid, slimy gleba stinkhorns. Basidiospores are small, oblong, smooth, and hyaline to pale green. Habitat: Saprotrophic in soil, wood chips, leaf litter and pantropical to temperate (Ainsworth, 2008; Hibbett et al., 2007; Alexopoulos et al., 1996). The collected mushroom from this family is *Mutinus bambusinus,* as seen in Figure 12.

3.25. Family - Physalacriaceae:

Basidiocarps small to medium, agaricoid pileus convex to umbonate or plane, surface smooth to dry to slightly viscid, often honey brown to whitish and gills adnate to decurrent, white to cream. Basidiospore broadly ellipsoid to ovoid, smooth, hyaline, inamyloid, spore print white and clamp connection present. Habitat: Saprotrophic to parasitic on woody substrates, and some (Armillaria) cause serious root rot of trees (Ainsworth, 2008; Hibbett et al., 2007; Alexopoulos et al., 1996). The collected mushroom from this family is *Oudemansiella* sp., as seen in Figure 12.

3.26. Family - Pluteaceae:

Basidiocarps agaricoid, pileus convex to bell-shaped or plane surface smooth fibrillose dry to viscid, gills free, not attached to the stipe, a key macroscopic feature initially white, becoming pink as spores develop. Basidiospores broadly ellipsoid, smooth, hyaline to pinkish under the microscope, spore print pink to salmon pink and clamp connections present or absent. Habitat: Pluteus saprotrophic on wood, Volvariella on soil, dung or wood (Ainsworth, 2008; Hibbett et al., 2007; Alexopoulos et al., 1996). The collected mushrooms from this family are *Volvariella bombycina*, and *Volvariella* sp., as seen in Figure 12.

Mutinus bambusinus *Oudemansiella* sp. *Volvariella bombycina* *Volvariella* sp.

Figure 12. Some macrofungal fruiting bodies of Phallaceae, Physalacriaceae, and Pluteaceae families

3.27. Family - Podoscyphaceae:

Basidiocarps stipitate to sub-stipitate, fan-shaped to infundibuliform (funnel-shaped) or multiple fused caps. Hymenophores are smooth to wrinkled or veined on the underside, with no true gills or pores. Basidiospores ellipsoid to cylindrical, smooth, hyaline, inamyloid or weakly amyloid and hyphal system monomitic to dimitic generative hyphae with clamp connections. Habitat: Saprotrophic on dead hardwood or at the base of living trees (Ainsworth, 2008; Hibbett et al., 2007; Alexopoulos et al., 1996). The collected mushroom from this family is *Podoscypha petalodes*, as seen in Figure 13.

3.28. Family - Polyporaceae:

Basidiocarps typically bracket-shaped, fan-shaped, or with a distinct lateral to central stipe, annual flesh corky, leathery or fleshy. Hymenophores strictly poroid, pores small to large, pileus surface smooth, white, cream, tan, brown or brightly coloured. Basidiospores are cylindrical to ellipsoid, smooth, hyaline, thin-walled, with a spore print white to pale yellowish. Hyphal system dimitic or trimitic, with skeletal and binding hyphae present with clamp connections on generative hyphae. Habitat: Saprotrophic or parasitic on dead wood (Ainsworth, 2008; Hibbett et al., 2007; Alexopoulos et al., 1996). The collected mushrooms from this family are *Cerioporus* sp., *Echinoporia hydnophora*, *Hexagonia hydnoides*, *Hexagonia* sp., *Lentinus* sp., *Microporus xanthopus*, *Panus* sp., *Polypore* sp., and *Trametes* sp., as seen in Figure 13.

3.29. Family - Psathyrellaceae:

Basidiocarps small to medium, agaricoid pileus often conical to bell-shaped, typically fragile, surface smooth to fibrillose, often hygrophanus and striate. Gills adnate to adnexed, crowded, stipe slender, hollow, fragile. Basidiospore ellipsoid to ovoid, smooth, dark purplish brown to blackish with prominent germ, common and clamp connections present. Habitat: Saprotrophic or parasitic on dung, compost, wood or rich soil (Ainsworth, 2008; Hibbett et al., 2007; Alexopoulos et al., 1996). The collected mushrooms from this family are *Candolleomyces* sp., *Corprinopsis* sp., *Parasola* sp., and *Psathyrella corrugis*, as seen in Figure 13.

3.30. Family - Pterulaceae:

Basidiocarps coral like ramariod, club-shaped or thread-like, slender, often hair-like, sometimes forming tufts. Hymenophore smooth, covering the outer surface of branches and basidiospores ellipsoid to cylindrical, smooth, hyaline, inamyloid, spore print white and some species are parasitic on other fungi (mycoparasites on Termitomyces gardens) or on plant material. Habitat: Saprotrophic or parasitic, leaf litter and woody debris (Ainsworth, 2008; Hibbett et al., 2007). The collected mushrooms from this family are *Pterula subulata*, and *Pterula* sp., as seen in Figure 13.

Figure 13. Some macrofungal fruiting bodies of Podoscyphaceae, Polyporaceae, Psathyrellaceae, and Pterulaceae

3.31. Family - Sacroscyphaceae:

Ascomata(apothecia) cup-shaped to discoid, stipitate or sessile, often brightly coloured, vivid scarlet, red or orange inside, outer surface typically whitish or paler. Ascospores are large, ellipsoid to fusiform, smooth to ornamented (warty or reticulate), often with prominent oil droplets, typically 8-spored. Paraphyses filiform, often with coloured contents and Excipulum (cup wall) composed of interwoven hyphae, with an outer surface that is thick-walled, like excipular hairs. Habitat: Saprotrophic on moist soil, woody debris or buried wood, temperate to subtropical and often appearing in spring (Ainsworth, 2008; Hibbett et al., 2007; Alexopoulos et al., 1996). The collected mushroom from this family is *Phillipsia* sp., as seen in Figure 14.

3.32. Family - Serpulaceae:

Basidiocarps resupinate, flat on substrate to weakly reflexed, annual to short-lived, surface waxy to membranous. Hymenophore poroid to merulioid (irregular shallow pores or folds), colour cream, yellowish brown to rust brown. Basidiospores ellipsoid to cylindrical, smooth, yellowish brown, thin-walled and dextrinoid, spore print yellowish to rusty brown. Hyphal system monomitic, hyphae with clamp connections. Habitat: Saprotrophic on timber, temperate regions and including indoor environments (Ainsworth, 2008; Hibbett et al., 2007; Alexopoulos et al., 1996). The collected mushroom from this family is *Serpula similis*, as seen in Figure 14.

3.33. Family - Strophariaceae:

Basidiocarps agaricoid, small to large pileus convex to plane, often viscid to slimy when moist, surface smooth yellowish, orange-brown or reddish, gills adnate to sinuate, becoming dark purple brown as spores develop. Basidiospores are large, ellipsoid, smooth, dark brown with a distinct germ pore, thick wall and spore print dark purple brown to blackish brown; clamp connections are present. Habitat: Saprotrophic on dung, soil, wood chips or wood (Ainsworth, 2008; Hibbett et al., 2007; Alexopoulos et al., 1996). The collected mushrooms from this family are *Gymnopilus* sp., and *Gymnopilus* sp., as seen in Figure 14.

3.34. Family - Tremellaceae:

Basidiocarps gelatinous, rubbery to waxy, shaped, lobed. Each cell produces one sterigma with basidiospores that are globose to ellipsoid, smooth, hyaline, thin-walled, often yeast-like in germination, and a monomitic hyphal system, with haustorial branches and clamp connections. Habitat: Mostly mycoparasitic on other Basidiomycota on dead wood (Ainsworth, 2008; Hibbett et al., 2007; Alexopoulos et al., 1996). The collected mushrooms from this family are *Tremella mesenterica,* and *Tremella* sp., as seen in Figure 14.

3.35. Family - Tricholomataceae:

Basidiocarps agaricoid pileus convex to umbonate, plan or depressed surface to viscid smooth to fibrillose and gills sinuate to adnate or adnexed, stipe central, stout, fleshy, no ring or volva in most genera. Basidiospores are ellipsoid to globular, smooth, with clamp connections present in most genera and ectomycorrhizal with trees, often fruiting in association with specific tree species. Habitat: Soil in forests (ectomycorrhizal) (Ainsworth, 2008; Hibbett et al., 2007; Alexopoulos et al., 1996). The collected mushrooms from this family are *Collybia ocior*, and *Lepista cf. tarda*, as seen in Figure 14.

3.36. Family - Xylariaceae:

Stromata erect, cushion-like, club-shaped, branched or effused surface typically black and carbonaceous at maturity, often with a coloured granular pigment layer beneath the surface. Ascospores unicellular, brown to dark brown, ellipsoid to bean-shaped, smooth, typically with a straight to curved germ slit, a highly diagnostic feature and paraphyses filiform. Anamorphs produce conidia in a peripheral layer of immature stromata (often white, cream or coloured powder). Habitat: Saprotrophic on dead wood, causing white rot, some endophytic, pantropical to temperate (Ainsworth, 2008; Hibbett et al., 2007; Alexopoulos et al., 1996). The collected mushrooms from this family are *Daldinia concentrica,* and different species of *Xylaria* sp., like *Xylaria hypoxylon*, *Xylaria longipes*, and *Xylaria obovate*, as seen in Figure 14.

Figure 14. Some macrofungal fruiting bodies of different families

4. CONCLUSION

This study provides the first baseline information on macrofungal diversity in Amrabad Tiger Reserve. The abundance of wood-decaying and saprophytic fungi highlights their crucial role in decomposition, nutrient recycling and carbon sequestration in dry deciduous forests. The presence of mycorrhizal fungi and mushrooms in bamboo-dominated habitats further highlights their significant roles in soil fertility and maintenance, as well as in supporting vegetation. These findings underscore the importance of incorporating fungal diversity into biodiversity assessment and conservation for effective ecosystem-based management in Amrabad Tiger Reserve. Long-term documentation and ecological studies of Macrofungi will be essential for improving our understanding of forest ecosystem processes and ensuring the sustainable conservation of fungal biodiversity in Amrabad Tiger Reserve.

Ethical Statement

Not Applicable.

Conflicts of Interest

The authors declare no competing interests.

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