

## Short Communications

# Fantastic Macrofungi in Poncokusumo District, Bromo Tengger Semeru National Park (TNBTS) Area and Their Habitat Characteristics

Aquinita Shinta Setya Amelia<sup>1</sup>, Rosita Fitrah Dewi<sup>1</sup>, Heni Setyawati<sup>1</sup>, Khalid Hafazallah<sup>2,4</sup>, Rahayu Fitriani Wangsa Putrie<sup>3</sup>, Husni Mubarok<sup>1\*</sup>

1) Tadris Biologi Study Program, UIN Kiai Haji Achmad Siddiq Jember, Jl. Mataram No.1 Mangli, Jember 68136, East Java, Indonesia

2) Yayasan Generasi Biologi Indonesia, Jl Swadaya Barat No.4, Semampir, Cerme, Gresik, East Java

3) Research Center for Applied Microbiology, National Research and Innovation Agency (BRIN), Jl. Raya Bogor Km. 46 Cibinong, Bogor 16911, West Java, Indonesia

4) Indonesian Mushroom Hunters Community (KPJI), Pekanbaru, Riau, Indonesia

\* Corresponding author, email: husnimubarok88@uinkhas.ac.id

### Keywords:

Ascomycota  
Basidiomycota  
Bromo Tengger Semeru  
Identification  
Macrofungi

### Submitted:

07 September 2023

### Accepted:

20 March 2024

### Published:

29 July 2024

### Editor:

Ardaning Nuriliani

### ABSTRACT

Bromo Tengger Semeru National Park (TNBTS) is a conservation area in East Java with an abundance of biodiversity, including macrofungi. This study aims to identify the macrofungal species existing in Poncokusumo district, TNBTS area, and their habitat characteristics for a further sustainable study of fungi. This study used a purposive sampling method by opportunistic exploration. Identification of macrofungi is conducted by morphological analysis and habitat characterization. The study identified 15 macrofungal species categorized as Ascomycota and Basidiomycota, that were distinct in their habitat characteristics. The 15 macrofungal species inhabited leaf litter, wood litter, soil, and bamboo.

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Macrofungi belong to the kingdom Fungi, which is notable for its crucial functions in ecosystems. Numerous species serve as essential decomposers and animal and human food sources (Tang et al. 2015). Most macrofungi produce fleshy, colloidal fruiting bodies that represent sexual reproductive structures. Fungi have an easy presence especially in places with sufficient humidity and in environments conducive for their growth. Some fungi even grow and associate with other organisms, whether it be through mutualism, antagonism, or parasitism. Macrofungi constitute a type of fungi as they are visible to the naked eye without the aid of a microscope and possess distinctive colorations and fruit body shapes. Macrofungi can be round like umbrellas, balls, bird's nests, and trumpets, with striking colors, that microfungi do not possess. Therefore, macrofungi are called fantastic and interesting to study.

A major number of macrofungi are members of Basidiomycota or Ascomycota, while a few are members of Zygomycota. Their fruiting bodies are located either above or below the ground (Mueller et al. 2007; Tang et al. 2015). Approximately 6,000 out of 100,000 fungi species in the world can produce visible fruiting bodies (Ainsworth 2008). Macro-

fungi have parasitic, symbiotic, or saprophytic lives. Symbiotic macrofungi cannot reproduce independently. Therefore, they need host partners to disperse and reproduce (Tang et al. 2015).

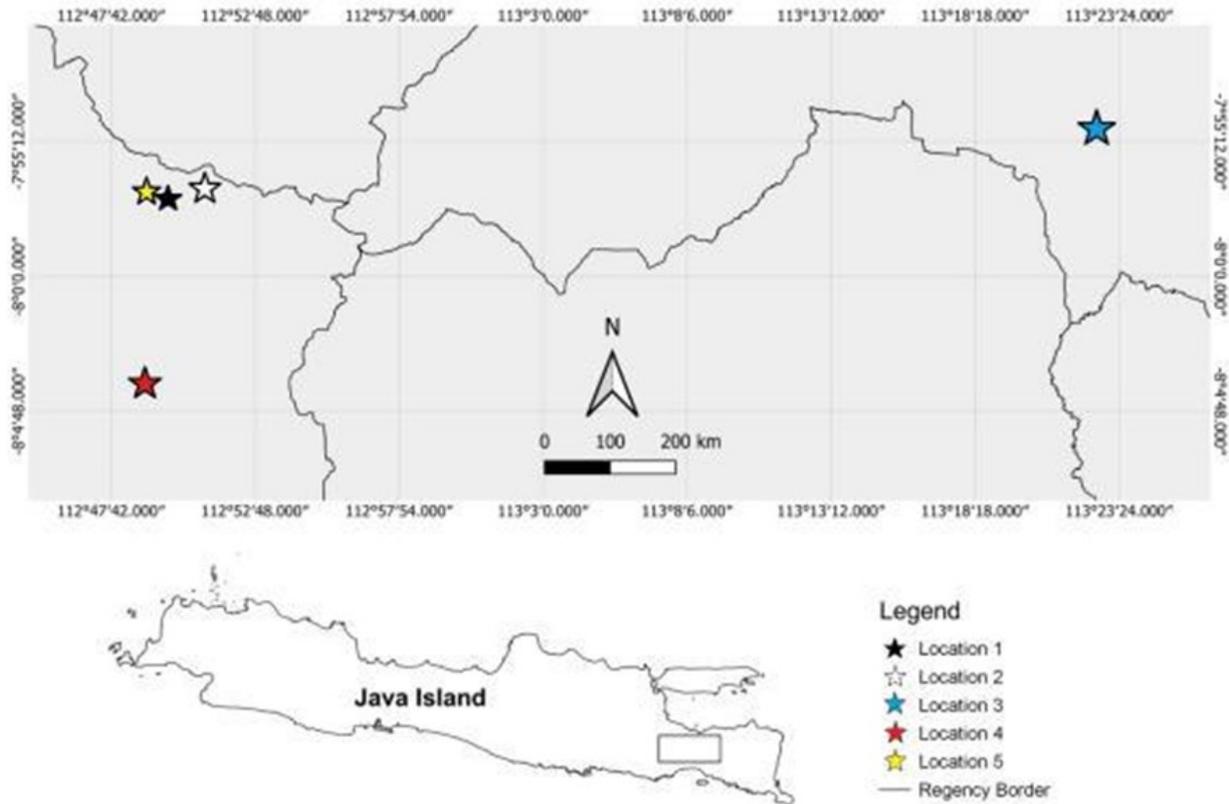
Bromo Tengger Semeru National Park (TNBTS) is a conservation area spanning four different regencies in East Java Province, namely Probolinggo, Pasuruan, Malang, and Lumajang Regencies. This area has at least three ecosystem types, namely montane, sub-montane, and sub-alpine ecosystems (Anesta et al. 2020). These ecosystems provide perfect habitats for macrofungi to live, some being rare macrofungi (Anesta et al. 2020; Majumdar et al. 2022). Previous studies showed that changes in the number of species and conveyance extension of species separately, includes in specific changes in macrofungal communities due to climate change (Gong et al. 2012; Zotti & Pautasso 2013). Some other factors such as precipitation, CO<sub>2</sub> level, air temperature, soil pH, and habitat are known to affect the existence of macrofungi (Ferris et al. 2000; Lindblad 2001; Salerni et al. 2001; Chen et al. 2018; Rudolph et al. 2018; Taniguchi et al. 2018; Kotowski et al. 2021; Rakić et al. 2022; Song et al. 2022).

Fungi have a huge biodiversity, which is growing in databases with the increasing sensitivity of identification tools used by scientists. Hawksworth and Cowell (1991) reported that there are 1,500,000 types of fungi in the world and still counting. About 80% of fungi are of microscopic types, while the remaining 20% are macroscopic fungi. In Indonesia, macroscopic fungi make up only 0.15% of the total fungi worldwide (Retnowati et al. 2019).

The exploration of macrofungal species in the TNBTS area is still limited. Several studies have only focused on their use and relation to ethnobotany (Haryati & Azrianingsih 2012; Indriyani et al. 2012). Numerous macrofungi have been identified in several forests and national parks in Indonesia, including Bukit Danau Forest. Five orders, 13 families, and 17 genera of macrofungi have been documented in this location (Salmiah et al. 2020). In another national park, Danau Sentarum National Park, 23 species from 7 orders and 12 families were discovered, with the Polyporaceae family being the most abundant (Juarsih et al. 2023). Given this limitation, this study aims to conduct macrofungal species identification and habitat characterization. The data generated from this study are expected to serve as basic data for further studies of fungi in this area.

This study was conducted in five locations in Poncokusumo District, Malang Regency (part of the buffer zone of the TNBTS area), from October to December 2022 (Figure 1, Table 1). Poncokusumo District houses a typical lowland forest at an elevation of less than 1,000 meters above sea level. This area is typically hilly and mountainous. The average annual precipitation and temperature are about 2,300 mm and 21.7 °C, respectively. The highest precipitation is about 423 mm during the wet season in December, and the relative humidity of this area is about 82% (Santikayasa et al. 2017).

Sample collection was performed using the field survey method, involving surveying the forest area directly (Firdausi & Basah 2018). The samples obtained were photographed and identified based on their morphological characteristics. Species identification was conducted based on Suryani and Cahyanto (2022), involving the use of expert validation, Khalid Hafazallah, from Generasi Biologi Indonesia. Morphological identification was also carried out by observing such characteristics as cap color, shape and size of the cap and stipe, cap edge, and stipe height (Putra & Dwi 2022). We also recorded and measured the habitat conditions and such factors as temperature and humidity, light intensity, an soil pH using a thermo-hygrometer, a Lux meter, and a soil tester, respectively.



**Figure 1.** Location of the study area.  
(the focus of study area is in the rectangle, Taman Nasional Bromo Tengger Semeru)

A total of 15 macrofungal species were discovered across five locations in Poncokusumo, TNBTS area, including 14 Basidiomycota species and a species of Ascomycota, as listed in Table 2. Notably, eight species were found inhabiting wood litter, while the rest were observed in leaf litter, soil, and bamboo (Table 3).

According to the data presented in Table 2, there were four species of macrofungi found in Sampling Location 1, namely *Lepista sordida* (Schumach.) Singer, *Lactocollybia* cf. *epia* (Berk. & Broome) Pegler, *Leucocoprinus fragilissimus* (Ravenel ex Berk. & M.A. Curtis) Pat., and *Dacryopinax* (Fr.) McNabb. Meanwhile, four species were found in Sampling Location 2, namely *Collybiopsis* aff. *ramealis* (Bull.) Millsp., *Trametes* cf. *villosa* (Sw.) Kreisel, *Pseudocolus fusiformis* (E. Fisch.) Lloyd, and *Morchella* cf. *galilaea* Masaphy & Clowez. Only two species were discovered in Sampling Location 3, namely *Ganoderma aplanatum* (Pers.) Pat. and *Auricularia nigricans* (Sw.) Birkebak, Looney & Sánchez-García. Another two species were discovered in Sampling Location 4, namely *Trametes hirsute* (Wulfen) Lloyd and *Lentinus arcularius* (Batsch) Zmitr. Three species were found in Sampling Location 5, namely *Schizophyllum commune* Fr.:Fr, *Coprinopsis* cf. *kubickae* (Pilát & Svrček) Redhead, Vilgalys & Moncalvo, and *Coprinellus disseminatus* (Pers.) J.E. Lange.

The habitat of each macrofungal species is presented in Table 3. The macrofungi live in a habitat with temperatures ranging from 25 to 31 °C and neutral to acidic pH conditions (Table 4). The greatest diameter was found in *Ganoderma aplanatum* (Pers.) Pat., and the smallest was found in *Leucocoprinus fragilissimus* (Ravenel ex Berk. & M.A. Curtis) Pat., *Coprinopsis* cf. *kubickae* (Pilát & Svrček) Redhead, Vilgalys & Moncalvo, and *Dacryopinax aurantiaca* (Fr.) McNabb. The diameter of *Pseudocolus*

**Table 1.** Sampling location and habitat type of macrofungal in TNBTS area.

Location	Coordinate	Habitat Type	
Loc-1	-8°02'48.0"S 112°49'33.8"E	Bamboo forest, far from settlements and close to cliffs	
Loc-2	-8°03'03.2"S 112°49'08.5"E	Natural forest, dominated by shady big trees and far from settlements	
Loc-3	-8°05'15.10"S 112°81'85.1"E	Natural forest, dominated by shady big trees and close to PDAM water channels	
Loc-4	-8°03'20.4"S 112°48'43.9"E	Pine forest and close to the stream	
Loc-5	-8°03'03.2"S 112°49'08.5"E	Plantation, dominated by <i>Hibiscus tiliaceus</i> , <i>Melia azedarach</i> , <i>Paraserianthes falcataria</i> , and <i>Samanea saman</i> trees, near settlements	

**Table 2.** List of macrofungi species found in the TNBTS area.

No.	Species	Genus	Family	Ordo	Division	Number found
1.	<i>Leucocoprinus fragilissimus</i> (Ravenel ex Berk. & M.A. Curtis) Pat.	<i>Leucocoprinus</i>	Agariceae	Agaricales	Basidiomycota	2
2.	<i>Schizophyllum commune</i> Fr.:Fr	<i>Schizophyllum</i>	Schizophyl- laceae	Agaricales	Basidiomycota	52
3.	<i>Lactocollybia</i> cf. <i>epia</i> (Berk. & Broome) Peg- ler	<i>Lactocol- lybia</i>	Marasmiceae	Agaricales	Basidiomycota	3
4.	<i>Coprinopsis</i> cf. <i>kubickae</i> (Pilát & Svrček) Red- head, Vilgalys & Mon- calvo	<i>Coprinopsis</i>	Psathyrellace- ae	Agaricales	Basidiomycota	47
5.	<i>Coprinellus disseminatus</i> (Pers.) J.E. Lange	<i>Coprinellus</i>	Psathyrellace- ae	Agaricales	Basidiomycota	19
6.	<i>Lepista sordida</i> (Schumach.) Singer	<i>Lepista</i>	Tricholoma- taceae	Agaricales	Basidiomycota	2
7.	<i>Collybiopsis</i> aff. <i>ramealis</i> (Bull.) Millsp.	<i>Collybiopsis</i>	Omphalotaceae	Agaricales	Basidiomycota	5
8.	<i>Pseudocolus fusiformis</i> (E. Fisch.) Lloyd	<i>Pseudocolus</i>	Phallaceae	Phallales	Basidiomycota	3
9.	<i>Dacryopinax aurantiaca</i> (Fr.) McNabb	<i>Dacryopinax</i>	Dacrimyceta- ceae	Dacrymy- cetales	Basidiomycota	1
10.	<i>Trametes hirsuta</i> (Wulfen) Lloyd	<i>Trametes</i>	Polyporaceae	Polyporales	Basidiomycota	4
11.	<i>Lentinus arcularius</i> (Batsch) Zmitr.	<i>Lentinus</i>	Polyporaceae	Polyporales	Basidiomycota	2
12.	<i>Trametes</i> cf. <i>villosa</i> (Sw.) Kreisel	<i>Trametes</i>	Polyporaceae	Polyporales	Basidiomycota	2
13.	<i>Ganoderma applanatum</i> (Pers.) Pat.	<i>Ganoderma</i>	Ganoderma- taceae	Polyporales	Basidiomycota	8
14.	<i>Auricularia nigricans</i> (Sw.) Birkebak, Loon- ey & Sánchez-García	<i>Auricularia</i>	Auriculariaceae	Auricularial- es	Basidiomycota	67
15.	<i>Morchella</i> cf. <i>galilaea</i> Masaphy & Clowez	<i>Morchella</i>	Morchellaceae	Pezizales	Ascomycota	1

**Table 3.** Species of macrofungal found in different characteristics of habitat in TNBTS area.

Name of species	Divison	Place of live characteristics	Locality				
			1	2	3	4	5
<i>Collybiopsis</i> aff. <i>ramealis</i> (Bull.) Millsp.	Basidiomycota	Leaf litter		+			
<i>Pseudocolus fusiformis</i> (E. Fisch.) Lloyd	Basidiomycota	Leaf litter		+			
<i>Lepista sordida</i> (Schumach.) Singer	Basidiomycota	Leaf litter	+				
<i>Trametes hirsuta</i> (Wulfen) Lloyd	Basidiomycota	Wood litter					+
<i>Ganoderma aplanatum</i> (Pers.) Pat.	Basidiomycota	Wood litter				+	
<i>Auricularia nigricans</i> (Sw.) Birkebak, Looney & Sánchez-García	Basidiomycota	Wood litter				+	
<i>Lentinus arcularius</i> (Batsch) Zmitr.	Basidiomycota	Wood litter					+
<i>Trametes</i> cf. <i>villosa</i> (Sw.) Kreisel	Basidiomycota	Wood litter		+			
<i>Schizophyllum commune</i> Fr.:Fr	Basidiomycota	Wood litter					+
<i>Coprinopsis</i> cf. <i>kubickae</i> (Pilát & Svrček) Redhead, Vilgalys & Moncalvo.	Basidiomycota	Wood litter					+
<i>Lactocollybia</i> cf. <i>epia</i> (Berk. & Broome) Pegler.	Basidiomycota	Wood litter	+				
<i>Coprinellus disseminatus</i> (Pers.) J.E. Lange	Basidiomycota	Soil					+
<i>Morchella</i> cf. <i>galilaea</i> Masaphy & Clowez.	Ascomycota	Soil		+			
<i>Leucocoprinus fragilissimus</i> (Ravenel ex Berk. & M.A. Curtis) Pat.	Basidiomycota	Soil	+				
<i>Dacryopinax</i> (Fr.) McNabb	Basidiomycota	Bamboo	+				

Note: Bamboo forest (1), natural forest and far from settlements (2), natural forest and close to PDAM water channels (3), pine forest (4), and plantation (5).

*fusiformis* (E. Fisch.) Lloyd was immeasurable because of the fungus' irregular shape. As for the color of the macrofungi, variations were observed between species (Table 4).

The macrofungal species found in Poncokusumo, TNBTS area, are described in detail as follows:

***Collybiopsis* aff. *ramealis* (Bull.) Millsp.** This species was observed in leaf litter under specific environmental conditions (Figure 2A). These conditions include a temperature of 26 °C, acidic pH, low light intensity, and a humidity level between 50 and 65%. This species has a white stipe that remains the same size from its base to tip, growing up to 3 cm in height. Its umbrella-shaped cap starts white with a brownish center and widens as it matures. The surface of the cap is smooth and has split edges, revealing its tight gills and rings. The diameter of the cap spans roughly 2.5–3 cm. *Collybiopsis* aff. *ramealis* (Bull.) Millsp. is a notable species that exhibits a unique characteristic of thriving independently on wooden branches with firmly anchored roots. This distinctive behavior sets it apart from other species (Amin et al. 2019).

***Pseudocolus fusiformis* (E. Fisch.) Lloyd.** This species was observed in leaf litter at a temperature of 26 °C, with a preference for neutral soil pH, low light intensity, and humidity levels ranging from 50 to 65%. This species can also be found in soil substrates, grasslands, and bushes (Pasaylyuk et al. 2018). The fruiting body of this species is both loose and stiff, featuring a soft tip that ultimately ruptures to become the thallus. The thallus resembles an octopus tentacle, featuring a rough surface and greyish-brown mucus that emits a pungent odor; therefore, this mushroom is often called devil's finger (Pasaylyuk et al. 2018). With three arms and an orange hue, the thallus can grow up to 8 cm in height, while the mycelium is white, smooth, and unassuming (Figure 2B).

**Table 4.** Species name, abiotic factors, and morphological characteristics of macrofungal.

No.	Species	Temperature (°C)	pH	Diameter (cm)	Colour
1.	<i>Leucocoprinus fragilissimus</i> (Ravenel ex Berk. & M.A. Curtis) Pat.	26	Acidic	2	White
2.	<i>Schizophyllum commune</i> Fr.:Fr	31	Neutral	2.5	Brownish-grey
3.	<i>Lactocollybia</i> cf. <i>epia</i> (Berk. & Broome) Pegler	30	Neutral	3	White
4.	<i>Coprinopsis</i> cf. <i>kubickae</i> (Pilát & Svrček) Redhead, Vilgalys & Moncalvo	27	Neutral	2	White-brown
5.	<i>Coprinellus disseminatus</i> (Pers.) J.E. Lange	27	Acidic	3	White
6.	<i>Lepista sordida</i> (Schumach.) Singer	25	Neutral	6	Purple
7.	<i>Collybiopsis</i> aff. <i>ramealis</i> (Bull.) Millsp.	26	Acidic	2.5	White with brownish center
8.	<i>Pseudocolus fusiformis</i> (E. Fisch.) Lloyd	26	Neutral	Immeasurable	Orange
9.	<i>Dacryopinax aurantiaca</i> (Fr.) McNabb	26	Neutral	2	Orange
10.	<i>Trametes hirsuta</i> (Wulfen) Lloyd	26	Acidic	3	Cream to brown
11.	<i>Lentinus arcularius</i> (Batsch) Zmitr.	27	Acidic	4	Dark brown and light brown
12.	<i>Trametes</i> cf. <i>villosa</i> (Sw.) Kreisel	30	Neutral	3	Brown center
13.	<i>Ganoderma aplanatum</i> (Pers.) Pat.	30	Neutral	34	Brown
14.	<i>Auricularia nigricans</i> (Sw.) Birkebak, Looney & Sánchez-García	26	Neutral	7	Reddish-brown
15.	<i>Morchella</i> cf. <i>galilaea</i> Masaphy & Clowez	25	Acidic	3	Brown



**Figure 2.** Macrofungi species (Basidiomycota) observed in leaf litter. **A.** *Marasmius collybiopsis* aff. *ramealis* (Bull.) Millsp., **B.** *Pseudocolus fusiformis* (E. Fisch.) Lloyd, **C, D.** *Lepista sordida* (Schumach.) Singer.

***Lepista sordida* (Schumach.) Singer.** This species is a type of macrofungi that boasts a striking purple hue. It is typically found in leaf litter. Its stipe is both stiff and loosely striped (fibrillose), its cap is wide and smooth, and its lamellae are branched to the edges (stipe margins) (Figure 2C). The cap edge is notched (umbonate) (Figure 2D). This species was observed in environments with a temperature of 25 °C, a humidity level of 85%, and a neutral pH value of 6. The stipe diameter is 6–10 cm. This species possesses a mycelium. This species is distributed in Indonesia (especially Java Island), Sri Lanka, Thailand, America, and Switzerland. It is often found in compost soil, grass, and gardens (Retnowati 2019).

***Trametes hirsuta* (Wulfen) Lloyd.** This species was observed in weathered wood with a habitat temperature of 26 °C, acidic soil pH of 5, moderate light intensity, and 70% humidity. This species forms semi-fan-shaped fruiting bodies with irregular brackets, which lack a cup (Figure 3A). As the fruiting body ages, its color changes from cream to brown, and it has a rough surface with long hair (villose). The fruiting body is directly attached to the substrate with a pseudo-root type, and its back is porous.

***Trametes cf. villosa* (Sw.) Kreisel.** This particular species is a *Trametes* species found in a habitat with a temperature of 30 °C, neutral pH of 6, moderate light intensity, and 75% humidity. The fruiting body of this macrofungus is semi-fan-shaped with irregular brackets, and it lacks a pileus. It has a brown center and cream-colored edges, with a firm texture and a rough surface (Figure 3B). The fruiting body has dimensions of 3 cm in height and 5 cm in diameter, with a slightly grooved edge that is directly attached to the substrate and porous in the back (Figure 3C). The *Trametes* species can be found living in groups, overlapping each other in soil habitats, in weathered wood colonies, or even growing solitarily (Norfajrina et al. 2021).

***Ganoderma applanatum* (Pers.) Pat.** This macrofungal species was observed in wood at a habitat temperature of approximately 30 °C. This species exhibits a fruiting body with a distinctive fan-shaped appearance, boasting a rough and grooved surface with a hard texture (Figure 3D). With a diameter of approximately 34 cm and a height of 19.4 cm, the body is brown in coloration, devoid of any visible cap or gills, and possessing a slightly curved edge. Notably, the lower portion of the body is white and features a fine porous texture (Figure 3E).

***Auricularia nigricans* (Sw.) Birkebak, Looney & Sánchez-García.** This species typically thrives in woodland environments characterized by moderate intensity of light and air humidity at approximately 80%. The fruiting body of this mushroom possesses a soft, rubbery, or chewy texture and features a lobe-like shape with a smooth surface and dense, fuzzy hair. Typically, this reddish-brown macrofungus lacks a stipe and is directly attached to the substrate (Figure 3F). It measures between 5 and 12 cm in diameter and between 3 and 7 cm in height. This species also thrives in colonies distinguished by a pseudo-rhizoid root type. In addition, this species is well known as the ear mushroom due to its fruiting body's resemblance to a human ear. It is included as an edible mushroom. It can also serve as a heartburn remedy and a means of reducing pain associated with internal injuries (Norfajrina et al. 2021).

***Lentinus arcularius* (Batsch) Zmitr.** This species was found in woodlands with a habitat temperature of 27 °C, acidic pH, moderate light intensity, and 82% humidity. It possesses a rigid, brown stipe that is hollow and rough in texture, standing 3.5 cm tall (Figure 3G). The stipe is centrally located and narrows at both the base and apex. The cap is dark

brown along the edges and light brown in the center, with a wide, flat-stipe shape, a densely hairy (pubescent) surface, and a diameter of 4 cm. The lamellae are crossed (anastomosed), attached to the stipe's mycelium, devoid of rings, and possess crossed hymenophores (Figure 3H). The Polyporales in this study, i.e., *Trametes hirsuta*, *Lentinus arcularius*, *Trametes cf. villosa*, and *Ganoderma aplanatum*, are known to have similar characteristics as saprophytes on weathered wood and as parasites on living wood (Rahma 2018).

***Schizophyllum commune* Fr.:Fr.** This species was found in wood habitats with a temperature of 31 °C, neutral pH of 6.2, and low light intensity. Its fruiting body is fan-shaped, elastic, covered in tightly packed velutinous hairs, and brownish-grey in surface appearance (Figure 3I). With a diameter of 2.5 cm and a height of 2 cm, this macrofungus lacks a stalk and has a flat, rimose edge. Additionally, it does not possess any gills or lamellae, but it has a flat regular bar. This species grows independently on wooden substrates, and its propagation occurs through the lumen of various vessels, xylem strings, fibers, and tracks (Fuziyanti et al. 2022). It is known by various local names in Indonesian regions, including Java, Sulawesi, Tidore, and Halmahera (Fitri et al. 2022). *S. commune* is an edible mushroom that can be eaten as a traditional food and a medicinal mushroom as an anti-inflammatory (Dewi et al. 2022). It can be cultivated on sawdust of jackfruit wood, *ketapang* (*Terminalia catappa*) wood, and *rambutan* (*Nephelium lappaceum*) wood (Mahardhika et al. 2022). According to a previous study, *S. commune* grows in 92 species of wood as its substrates (Yusran et al. 2023), including *H. tiliaceus*, *M. azedarach*, *P. falcataria*, and *S. saman* that were found in the fifth location of this study.

***Coprinopsis cf. kubickae* (Pilát & Svrček) Redhead, Vilgalys & Moncalvo.** This white-brown species is commonly found as colonies in wooded areas with a temperature of 27 °C, neutral soil pH of 6.3, high light intensity, and 77% humidity. This macrofungus has a stipe texture that is not hard, has a smooth surface, and can reach a height of up to 5 cm. The cap is minute, convex, and half-round, with undulating edges and a diameter of approximately 2 cm (Figure 3J, Figure 3K). Unlike some others, this species does not have any gills but instead has a mycelium. In addition, some *Coprinopsis* species are known to have the potential as food ingredients (Vantamuri & Kaliwal 2017).

***Lactocollybia cf. epia* (Berk. & Broome) Pegler.** This species was observed in a habitat characterized by a temperature of 30 °C, neutral soil pH (6.6), and moderate light intensity, such as weathered wood (Figure 3L). It displays a stiff, loosely attached stipe that maintains an equal shape from base to tip, situated in the center of the growth. The stipe surface is smooth, reaching 4 cm in height. It has a white convex-shaped cap 3 cm in diameter with a smooth surface texture but notched or umbonate at the edge (Figure 3M). Moreover, this species possesses a mycelium with no ring, and the gynophore is packed with regular lamellae. This species of mushroom boasts a unique aroma and is highly coveted for its nutritional benefits (Norfajrina et al. 2021). It is a popular choice for community cultivation due to its rich concentration of amino acids, vitamins, and minerals (Susan & Retnowati 2018).

***Coprinellus disseminatus* (Pers.) J.E. Lange.** This species can be found in soil with a habitat temperature of 27 °C, acidic pH of 5.6, moderate light intensity, and 62% humidity. It is characterized by a cylindrical stipe shape with a smooth white surface and a 6 cm height. Its cap shows an umbrella with a small parabolic shape (Figure 4A). This species boasts a soft texture and regular blade (translucent striate), with a stipe diame-



**Figure 3.** Macrofungi species (Basidiomycota) observed in wood litter. **A.** *Trametes hirsuta* (Wulfen) Lloyd, **B,C.** *Trametes* cf. *villosa* (Sw.) Kreisel, **D,E.** *Ganoderma aplanatum* (Pers.) Pat., **F.** *Auricularia nigricans* (Sw.) Birkebak, Looney & Sánchez-García, **G,H.** *Lentinus arcularius* (Batsch) Zmitr., **I.** *Schizophyllum commune* Fr. **J,K.** *Coprinopsis* cf. *kubickae* (Pilát & Svrček) Redhead, Vilgalys & Moncalvo., **L,M.** *Lactocollybia* cf. *epia* (Berk. & Broome) Pegler.

ter of 3 cm. Moreover, its lamellae exhibit luminophore properties. This species can live in a variety of substrates such as soil, dead tree trunks, leaf litter, and dirt. However, it is only safe to consume this species during its early stages of growth as mature ones contain dangerous toxins (Mahardika et al. 2021).

***Morchella* cf. *galilaea* Masaphy & Clowez.** It was found in soil with a temperature of 23 °C, high light intensity, 75% humidity, and pH of 5. The stipe is soft, round, hollow, and smooth, with a height of 10 cm and brown color. The cap is brown, wavy, and devoid of a ring (Figure 4B). *Morchella*, both wildy grown and cultivated, is edible and utilized as a food ingredient (Putra 2021).

***Leucocoprinus fragilissimus* (Ravenel ex Berk. & M.A. Curtis)**

**Pat.** This species was found in soil with acidic pH, low light intensity, and a temperature of 26 °C. It has a smooth, bone-white stipe that is the same size from base to tip, reaching a height of 5 cm. The wide umbrella-shaped cap is white with a yellow centre, 2 cm in diameter, and smooth in the surface with finely serrated edges. The blade sticks to the base (Figure 4C). In addition, it has a mycelium, rings, and a gynophore in the form of dense lamellae. This species is typically solitary or found in scattered groups. It is not edible and known for medical use (Priskila et al. 2018; Putra et al. 2022).

***Dacryopinax aurantiaca* (Fr.) McNabb.**

This species is commonly found in weathered bamboo with habitat temperatures ranging from 20 to 26 °C, neutral pH, low light intensity, and high humidity. Its fruit body takes the form of a thallus with a rubbery, jelly-like texture and an irregular shape. The surface is smooth, with no rings, hymanophores, or lamellae, and the thallus's color is orange. The fungus attaches directly to the substrate and can reach a height of 3–4 cm. *Dacryopinax* belongs to the Dacrymycetales family and is commonly found on dead wood and bamboo that has been exposed to sunlight. Due to its jelly-like texture, it is often referred to as the jelly mushroom (Norfajrina et al. 2021).



**Figure 4.** Macrofungi species observed in soil and bamboo. **A.** *Coprinellus disseminatus* (Pers.) J.E. Lange. (Basidiomycota), **B.** *Morchella* cf. *galilaea* Masaphy & Clowez. (Ascomycota), **C.** *Leucocoprinus fragilissimus* (Ravenel ex Berk. & M.A. Curtis) Pat. (Basidiomycota), **D.** *Dacryopinax aurantiaca* (Fr.) McNabb. (Basidiomycota)

In conclusion, Poncokusumo District of TNBS houses four different types of habitat characteristics, namely bamboo forest, natural forest, pine forest, and plantation area. A total of 15 macrofungal species were discovered across five locations in there, including 14 Basidiomycota species and a species of the Ascomycota division. Eight species were found inhabiting wood litter, while the rest were observed in leaf litter, soil, and bamboo. Microscopic and biochemical tests on the macrofungal samples obtained are needed for further study.

**AUTHOR CONTRIBUTION**

All authors contributed equally to writing the manuscript. A.S.S.A con-

ducted the research, including data collection, while H.M., R.F.D., and H.S supervised the study. K.H and R.F.W.P validated the species data.

### ACKNOWLEDGMENTS

We indebted to village government Poncokusumo, Malang Regency, East Java for giving the research permit.

### CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

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