

## Diversity of macrofungi (Ascomycota and Basidiomycota) in the Banyak Mountain Forest Area, Sragen District, Indonesia

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**Abstract.** Nurzahra VY, Muzazzinah, Indrowati M. 2025. Diversity of macrofungi (Ascomycota and Basidiomycota) in the Banyak Mountain Forest Area, Sragen District, Indonesia. *Nusantara Bioscience* 16: 39-48. Macroscopic fungi are high-value forest components that play an essential functional role in forest ecosystems. However, studies focusing on the diversity of macroscopic fungi in Indonesian forests are still limited and underexplored. The forest located in Banyak Mountain is one example of a forest area in Indonesia that has significant macroscopic fungal diversity. This study aims to examine the diversity of macroscopic fungi species in the Banyak Mountain Forest Area, Sragen District. The research employed an exploratory method by establishing 2×2 m plots using purposive sampling techniques and conducting descriptive analyses of the collected data. The results of the study in the Banyak Mountain Forest Area identified 33 species of macroscopic fungi from two divisions, namely Basidiomycota and Ascomycota, which are classified into four classes, six orders, twelve families, and twenty-two genera. Most macroscopic fungi found were substrate-dependent on decayed wood, with fewer species located on the soil. The environmental factors influencing their growth include air temperatures ranging from 28 to 32°C, air humidity between 67 and 80%, and soil pH levels of approximately 6.0 to 7.5, which are highly conducive to fungal proliferation. These findings provide a valuable checklist for future research on fungal distribution in tropical regions and contribute significantly to biodiversity conservation efforts.

**Keywords:** Ascomycota, Banyak Mountain Sragen, Basidiomycota, diversity, macrofungi

### INTRODUCTION

Indonesia is a country with vast tropical rainforests that boast remarkable species diversity, including macroscopic fungi. The diversity of fungi is one of the most crucial indicators of forest health and biodiversity (Rakić et al. 2023). The presence of various macrofungi species indicates a rich and complex ecosystem where each organism plays a unique role in maintaining the overall balance and functioning of the forest. Macroscopic fungi are fungi with large fruiting bodies visible to the naked eye without requiring a microscope, encompassing members of the divisions Basidiomycota and Ascomycota (Roda et al. 2010). These fungi display a wide range of colors, including white, yellow, orange, light or dark brown, pink, yellowish white, and black. The fruiting bodies of macrofungi take on various forms, such as trumpet-shaped, fan-shaped, umbrella-shaped, kidney-shaped, and semicircular (Norfajrina et al. 2021).

Ecologically, macroscopic fungi can be classified into three groups: saprophytic, parasitic, and symbiotic species (mycorrhiza) (Kutszegi et al. 2015). Most terrestrial macroscopic fungi are either saprophytic or mycorrhizal symbionts, although some are plant pathogens or parasitic fungi. Fungi thrive in moist environments with limited sunlight due to their negative phototropism, which demonstrates their tendency to grow in darkness (Rahma et al. 2019). The habitats of Ascomycota and Basidiomycota fungi in forests typically include decayed or dead tree

trunks, soil, and leaf litter, which provide various organic materials as nutrients for the fungi (Lailiyah et al. 2019). Fungal diversity depends on the variety of organisms present in an environment, such as plants and other animals (biotic factors), as well as pH levels, humidity, temperature, salinity, and climatic conditions (abiotic factors) (López-Bucio et al. 2015). Fungal diversity results from complex interactions between biotic and abiotic factors. For instance, optimal humidity and temperature can support plant growth, which in turn enhances fungal diversity (Tedersoo et al. 2014). Conversely, extreme climate change can disrupt these interactions and reduce fungal diversity (Hawksworth and Lücking 2017).

Fungi are among the elements that enrich biodiversity. In terms of utilization, fungi have been widely studied in the fields of industry, agriculture, medicine, food, textiles, and bioremediation (Hawksworth et al. 2017). Macroscopic fungi are consumed as food, supplements, and medicines, while also participating in nutrient cycling, carbon sequestration, pollution degradation, and ecosystem restoration (Tie et al. 2023). Additionally, macroscopic fungi are used as bioindicators of environmental quality (Alem et al. 2021). Some macroscopic fungi can accumulate heavy metals and other hazardous compounds, making them useful for monitoring pollution levels in the environment (Ediriweera et al. 2022). Mycorrhizal fungi, for example, are used to assess soil health and environmental pollution levels (Smith 2008). Additionally, decomposer fungi such as *Pleurotus ostreatus* (Jacq.)

P.Kumm. can be utilized to evaluate organic matter quality and decomposition processes within ecosystems (Chang and Lee 2004). These fungi produce composite enzymes capable of degrading environmental pollutants (Uddin et al. 2020). Furthermore, they generate organic compounds that bind soil particles, enhancing soil formation, structure, and nutrient absorption (Oregon State University Extension Service 2021).

Despite their diverse functions and benefits, macroscopic fungi are threatened by various factors, including human activities. Rapid development and urbanization are considered the most harmful human actions, as they destroy macrofungi and their natural habitats. Scientists and conservationists have emphasized the importance of recognizing fungi as a key component of ecosystems and have called for targeted management actions to protect fungal species. These efforts include preserving old-growth forests, maintaining habitats to meet the specific needs of threatened fungal species, and allowing the decomposition of dead wood and leaf litter to enhance biodiversity (da Silva et al. 2019). One positive outcome of these conservation efforts is the increased awareness and understanding of fungi's critical roles in supporting the environment and biodiversity.

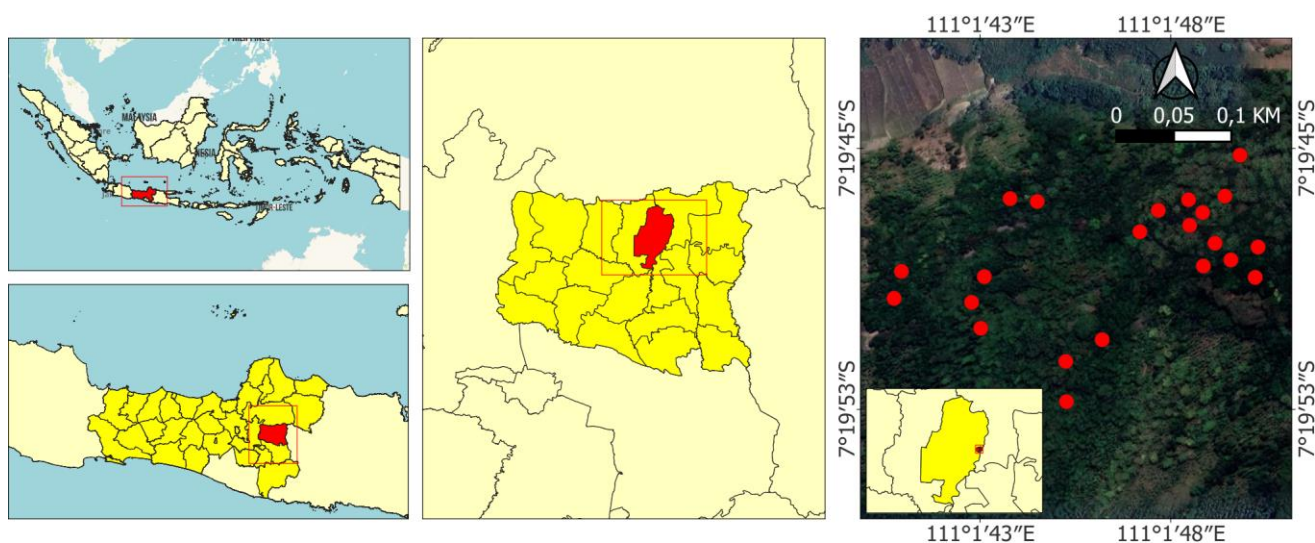
Fungi represent one of the most diverse groups of organisms on earth (Tedersoo et al. 2014). Tropical regions are known for their high biodiversity of flora and fauna. However, the total number of described fungal species remains very low and uncertain (Hawksworth et al. 2017). Fungal diversity in tropical regions, including Indonesia's protected forests, has not been fully explored and documented. To date, data and literature on macroscopic fungal diversity in Indonesia remain scarce. According to Cannon et al. (2018), more than 93% of fungal species worldwide are still unknown. In Indonesia, it is estimated that approximately 200,000 fungal species have been discovered (Roosheroe et al. 2006). Mueller et al. (2007) estimated that the number of macrofungal species in tropical Asia ranges between 10,000 and 25,000 species worldwide.

The forest area in Banyak Mountain is one example of a forest in Indonesia that harbors a significant diversity of macroscopic fungi. To date, no research has been conducted to identify the species of fungi in this forest area. Considering the essential role of macroscopic fungi in forest ecosystems, it is crucial to document the fungal diversity in this region as part of conservation efforts, ensuring the preservation of endangered species and their habitats. By exploring the diversity of macroscopic fungal species in Banyak Mountain, this study not only contributes to scientific knowledge but also provides valuable insights for conservation strategies and sustainable management. Additionally, information on the diversity of macroscopic fungi can serve as an educational resource for teaching biology concepts related to fungi. Considering the potential utilization of these fungi, it is necessary to conduct an inventory of fungal species. This study aims to identify the diversity of macroscopic fungal species present found in the forest area of Banyak Mountain.

## MATERIALS AND METHODS

### Study period and area

Sampling of macroscopic fungi was conducted from May to August 2024 in the Banyak Mountain Forest Area, located along the hillside road. Administratively, Banyak Mountain is situated in Gesi Sub-district, Sragen District, Central Java, Indonesia. The Banyak Mountain area spans a total of approximately 54.50 hectares, encompassing various land uses such as forests, fields, plantations, and rice paddies. This study focused on the dark green forested area, which is more relevant to fungal ecosystems, covering approximately 8.90 hectares. The forest in Banyak Mountain features gently sloping topography, latosol soil type, sandy clay soil texture with slight rocky elements, humus-rich soil structure, and moderate soil fertility. A map showing the research location is presented (Figure 1).



**Figure 1.** Map of the study area in Banyak Mountain Forest, Gesi Sub-district, Sragen District, Central Java Province, Indonesia

## Procedures

The research employed an exploratory survey method involving direct observation of macroscopic fungi in the Banyak Mountain Forest Area. Sampling was conducted using a purposive sampling technique, with plots measuring 2×2 m established in areas where macroscopic fungi were found within the study site. The macromorphological characteristics such as fruiting body shape, fruiting body color, fruiting body size, cap surface texture, type of hymenophore, and type of substrate (Putra 2021), habitat information, including humidity, temperature, soil pH, and fungal substrates such as wood, leaf litter, and soil, were observed on-site and recorded. Samples were photographed in their natural habitats using a digital camera for identification purposes. The collection site, date, specimen count, and habitat of each species were documented in a field diary.

## Data analysis

The data collected from the field were analyzed using a descriptive-explorative method and presented in tables and figures. The stages were as follows: data were gathered through exploration of the research area, and macroscopic fungi found were visually observed based on characteristics. The fungi were documented to facilitate the identification process. Whenever possible, objects were identified directly in the field; if not, they were collected for further observation. For collection purposes, fungi samples were carefully taken, especially those with soft fruiting bodies, to ensure intact specimens. The samples were then wrapped in newspaper or placed in jars/storage boxes, labeled, and stored in large plastic bags with harder and heavier fungi placed at the bottom. Next, to preserve macroscopic fungi during identification, a drying process was conducted. For optimal results, macroscopic fungi were dried using an oven and then observed for their macroscopic characteristics. The macroscopic characteristics observed included the dimensions and shapes of the fruiting bodies. Identification of macroscopic fungi was performed after their macroscopic characteristics had been thoroughly documented. This process utilized relevant literature such as McKnight (1998), Arora (1986), and Desjardin (1950), research journals focusing on macroscopic fungi, and several online mushroom databases, including [www.mushroomexper.com](http://www.mushroomexper.com) and <https://www.indexfungorum.org/Names/Names.asp>.

## RESULTS AND DISCUSSION

### Macroscopic fungi species in the Banyak Mountain Forest Area

A total of 33 species of macroscopic fungi were identified in the Banyak Mountain Forest Area, Tangen Sub-district, Sragen District. These fungi were classified into the phyla Ascomycota and Basidiomycota. In total, 22 genera of macroscopic fungi were identified, including *Daldinia* Ces. & De Not., 1863, *Xylaria* Hill ex Schrank, 1789, *Hypoxylon* Bull., 1791, *Dacryopinax* G.W.Martin, *Tremella* Pers., *Coprinellus* P.Karst., *Parasola* Redhead, Vilgalys & Hopple, *Schizophyllum* Fr., 1815, *Marasmius*

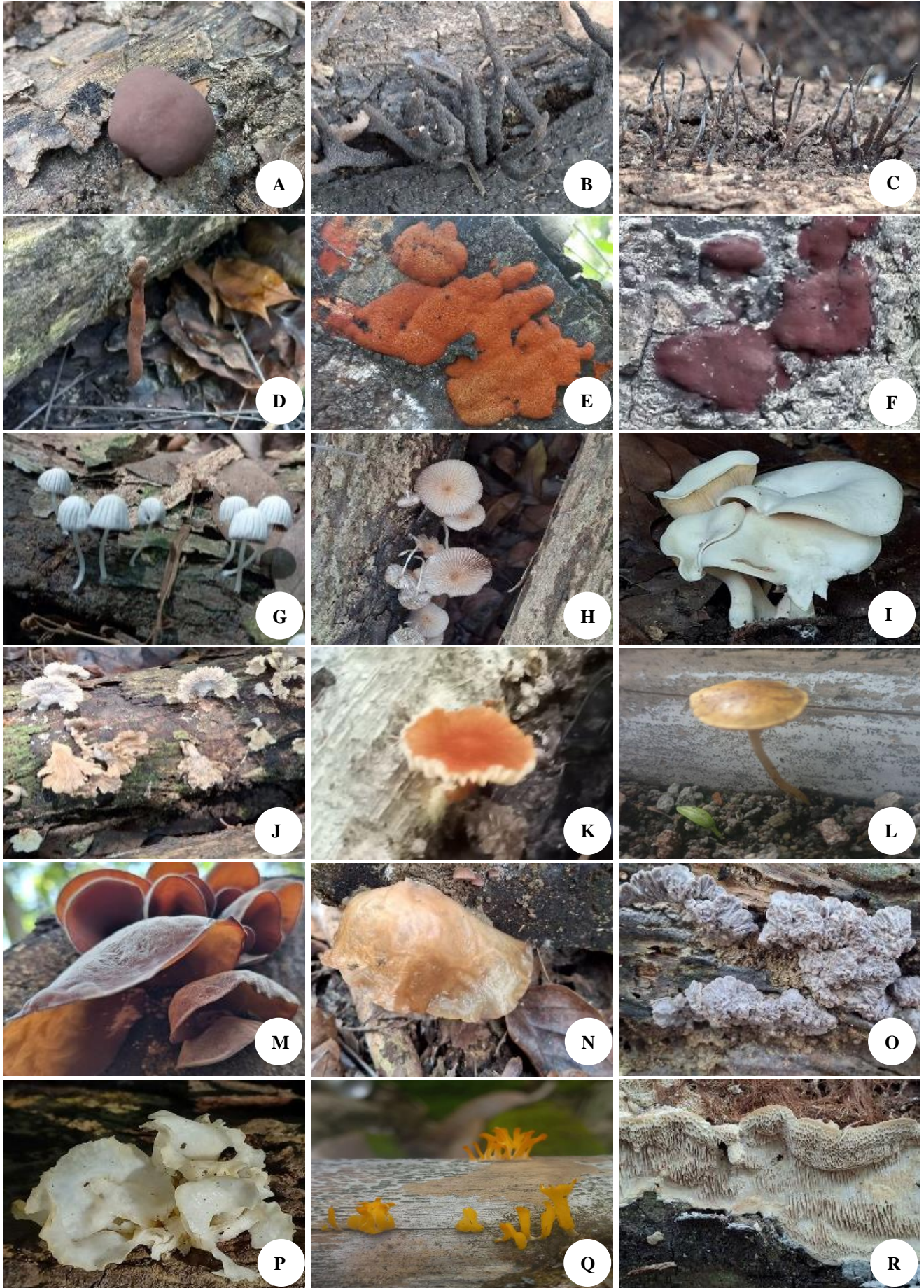
Fr., 1836, *Clitopilus* (Fr. ex Rabenh.) P.Kumm., *Tubaria* (W.G.Sm.) Gillet, *Auricularia* Bull., 1780, *Anurodia* P.Karst., *Fomitopsis* P.Karst., 1881, *Panus* C.J.Schoenherr, 1823, *Lentinus* Fr., *Polyporus* P.Micheli, 1729, *Trametes* Fr., 1836, *Hexagonia* Fr., *Tyromyces* P.Karst., *Earliella* Murrill, and *Ganoderma* P.Karst., 1881 (Figure 2). Most of the macroscopic fungi discovered were saprophytic species, often found growing in colonies (Table 1).

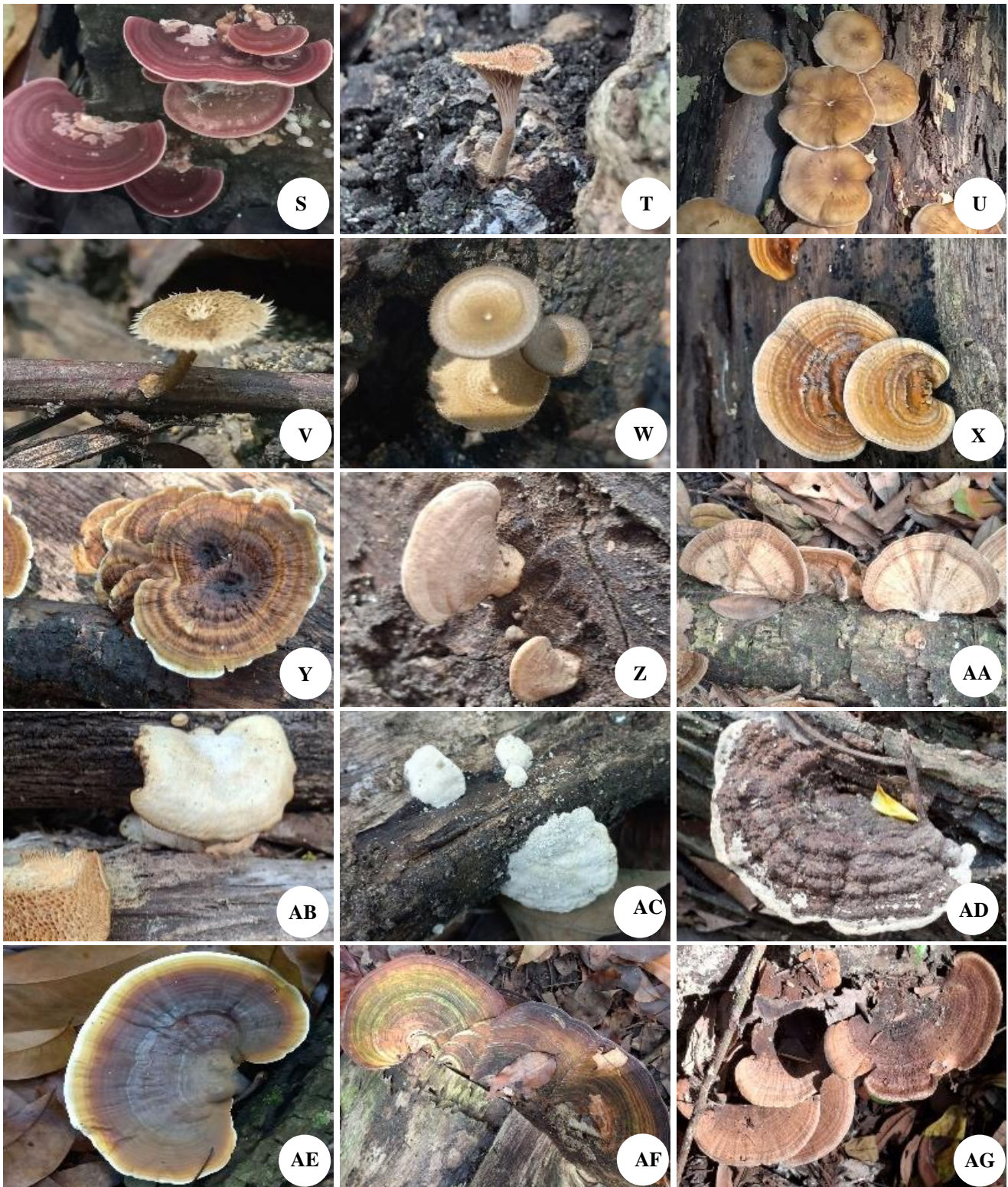
The results of this study revealed 27 species belonging to the division Basidiomycota and only 6 species classified under the division Ascomycota. Basidiomycota fungi were more frequently encountered than Ascomycota fungi, suggesting that the environmental conditions in the study area were more conducive to the proliferation of Basidiomycota species (Widyastuti and Yeni 2022). The population distribution of Basidiomycota fungi is strongly associated with the abundance of trees and leaf litter, which serve as substrates, along with high levels of moisture and water that promote the growth of macroscopic fungi (Rudawska et al. 2022).

This study identified 5 species of fungi with soft, jelly-like fruiting bodies. Surprisingly, these five fungi originated from three different orders. *Auricularia auricula* (L.) Underw. (Figure 2.M), *A. delicata* (Mont. ex Fr.) Henn. (Figure 2.N), and *A. mesenterica* (Dicks.) Pers. (Figure 2.O) belong to the order Auriculariales, characterized by gelatinous fruiting bodies that are generally stalkless or have short stalks (Wu et al. 2021). *Tremella fuciformis* Berk. (Figure 2.P), also known as the "snow fungus," has a jelly-like, white fruiting body (Kuo et al. 2023). *Tremella fuciformis* has been utilized as a food source, a medicinal ingredient, and a raw material for cosmetics (Ma et al. 2021) and *Dacrymyces spathularia* (Schwein.) G.W.Martin (Figure 2.Q) from Dacarymycetales order. The mushroom *D. spathularia* has fruiting bodies shaped like spatulas and features a jelly-like texture with yellow or orange coloration. Its surface texture is smooth and elastic, but as it ages, this mushroom becomes very fragile and easily disintegrates (Rahma et al. 2018).

### Number of macrofungal Orders in the Banyak Mountain Forest Area

The exploration in this study revealed that fungi belonging to the order Polyporales (Figure 2.R-AG) were the most abundant, accounting for 48.5% of the total fungi identified (Figure 3). This indicates that the order Polyporales is well-adapted to the environmental conditions of the Banyak Mountain Forest. This finding aligns with the study by Arif (2020), which reported that Polyporales generally exhibit a high level of adaptability. Their adaptability is attributed to their robust and firm fruiting bodies, which make them more resistant to climate fluctuations and weather conditions. Polyporales are also the most frequently found macroscopic fungi in other forest areas in Indonesia, such as the Rawa Bento peat swamp forest (Sayuti et al. 2023), the lowland forest of Bukit Wangkang (Zulpitasari et al. 2019), and the highland forest of Lore Lindu National Park in Central Sulawesi (Yusran et al. 2021).





**Figure 2.** Macroscopic fungi identified in the Banyak Mountain Forest Area, Sragen District, Indonesia. A. *D. concentrica*; B. *X. primorskensis*; C. *X. apiculata*; D. *X. telfairii*; E. *H. haematostroma*; F. *H. griseobrunneum*; G. *C. disseminatus*; H. *P. plicatilis*, I. *C. prunulus*; J. *S. commune*; K. *Marasmius* sp.; L. *T. furfuracea*; M. *A. auricula*; N. *A. delicata*; O. *A. mesenterica*; P. *T. fuciformis*; Q. *D. spathularia*; R. *A. albida*, S. *F. feei*; T. *P. lecontei*; U. *L. brumalis*; V. *L. crinitus*; W. *P. arcularius*; X. *T. hirsuta*; Y. *T. versicolor*; Z. *T. pubescens*; AA. *H. tenuis*; AB. *P. alveolaris*; AC. *T. chioneus*; AD. *E. scabrosa*; AE. *G. lucidum*; AF. *G. applanatum*; AG. *G. boninense*

**Table 1.** List of fungi found in the Banyak Mountain Forest Area, Sragen District, Indonesia

Divisio	Ordo	Familia	Species	
Ascomycota	Xylariales	Xylariaceae	<i>Daldinia concentrica</i> (Bolton) Ces. & De Not. <i>Xylaria primorskensis</i> Y.M.Ju, H.M.Hsieh, Lar.N.Vassiljeva & Akulov <i>Xylaria apiculata</i> Cooke <i>Xylaria telfairii</i> (Berk.) Sacc. <i>Hypoxyton haematostroma</i> Mont. <i>Hypoxyton griseobrunneum</i> (B.S.Mehrotra) J.Fourn., Kuhnert & M.Stadler	
Basidiomycota	Agaricales	Psathyrellaceae	<i>Coprinellus disseminatus</i> (Pers.) J.E.Lange <i>Parasola plicatilis</i> (Curtis) Redhead, Vilgalys & Hopple	
		Schizophyllaceae	<i>Schizophyllum commune</i> Fr.	
		Marasmiaceae	<i>Marasmius</i> sp. Fr.	
		Entolomataceae	<i>Clitopilus prunulus</i> (Scop.) P.Kumm.	
		Agaricomycetes	<i>Tubaria furfuracea</i> (Pers.) Gillet	
	Auriculariales	Auriculariaceae	<i>Auricularia auricula</i> (L.) Underw. <i>Auricularia delicata</i> (Mont. ex Fr.) Henn. <i>Auricularia mesenterica</i> (Dicks.) Pers.	
		Polyporales	Fomitopsidaceae	<i>Antrodia albida</i> (Fr.) Donk <i>Fomitopsis feei</i> (Fr.) Kreisel
			Polyporaceae	<i>Panus lecomtei</i> (Fr.) Corner <i>Lentinus brumalis</i> (Pers.) Zmitr <i>Lentinus crinitus</i> (L.) Fr. <i>Polyporus arcularius</i> (Batsch) Fr. <i>Polyporus alveolaris</i> (DC.) Bondartsev & Singer <i>Trametes hirsuta</i> (Wulfen) Lloyd <i>Trametes versicolor</i> (L.) Lloyd <i>Trametes pubescens</i> (Schumach.) Pilát <i>Hexagonia tenuis</i> (Fr.) Fr. <i>Tyromyces chioneus</i> (Fr.) P.Karst <i>Earliella scabrosa</i> (Pers.) Gilb. & Ryvarden
	Tremellales	Tremellaceae	<i>Ganoderma lucidum</i> (Curtis) P.Karst. <i>Ganoderma applanatum</i> (Pers.) Pat. <i>Ganoderma boninense</i> Pat.	
		Dacrymycetales	Dacrymycetaceae	<i>Tremella fuciformis</i> Berk. <i>Dacrymyces spathularia</i> (Schwein.) G.W.Martin

Fungi from the order Xylariales were the second most commonly found (Figure 2.A-F), comprising 18.2% of the total fungi and representing the only macroscopic fungal order from the division Ascomycota identified in Banyak Mountain. Members of the genus *Xylaria* are characterized by dense, finger- or club-shaped fruiting bodies. These fungi can be found on decaying wood, leaves, fruits, seeds, animal droppings, soil, and termite nests (Wangsawat et al. 2021). The secondary metabolites and bioactivities of fungi in the genus *Xylaria* continue to be explored due to their potential benefits, particularly in the field of health (Lin et al. 2016). The number of orders can be seen in Table 2.

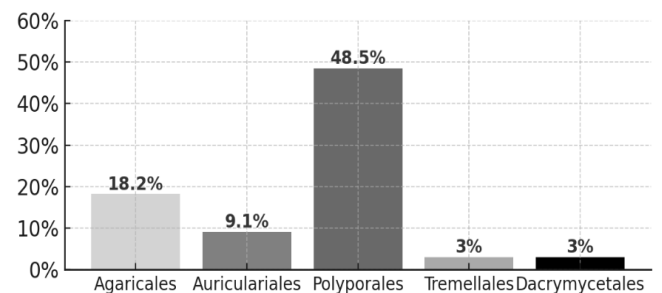
The percentage of the number of macroscopic fungi species in each order in the Banyak Mountain Forest Area is presented in Figure 3.

#### Distribution of macrofungal species across families

The research findings revealed the presence of 33 species of fungi belonging to 12 families. The most dominant family was Polyporaceae, comprising 11 species, indicating that this family had the highest number of species in the research area. The fungi from the Polyporaceae family typically grow on wooden substrates, including both decayed/dead wood and living wood, classifying them as wood fungi.

**Table 2.** Number of Orders of macroscopic fungi in the Banyak Mountain Forest Area, Sragen District, Indonesia

Ordo	Number of families	Number of species
Agaricales	5	6
Auriculariales	1	3
Polyporales	3	16
Tremellales	1	1
Dacrymycetales	1	1
Xylariales	1	6
Grand total	12	33

**Figure 3.** Percentage of the number of macroscopic fungi species in each order

The percentage of the number of macroscopic fungi species in each family in the Banyak Mountain Forest Area is presented in Figure 4.

The study found that the family Polyporaceae was the most diverse among all documented macroscopic fungi in the Banyak Mountain Forest Area, with a total of 11 species. This was followed by the family Xylariaceae with 6 species, Auriculariaceae and Ganodermataceae with 3 species each, Psathyrellaceae and Fomitopsidaceae with 2 species each, and 6 other families represented by only one species, as shown in Table 3. Among the identified macrofungal families, Xylariaceae was the only family classified under the division Ascomycota.

The family Polyporaceae, a frequent sight in diverse environments, including decaying wood and soil, is a subject of extensive research. The findings, as highlighted in the research by Lestari (2018), provide a wealth of knowledge about the prominent characteristics of Polyporaceae members, including their relatively large and robust fruiting bodies attached to decaying wood. These fungi's ability to survive in dry conditions, enabling them to flourish in environments with varying altitudes and moisture levels, is a testament to their adaptability. The prevalence of bracket and conk fungi, particularly those from the family Polyporaceae, in forest habitats further underscores their adaptability and resilience (Cababan et al. 2021).

### Habitat distribution of macrofungi in the Banyak Mountain Forest

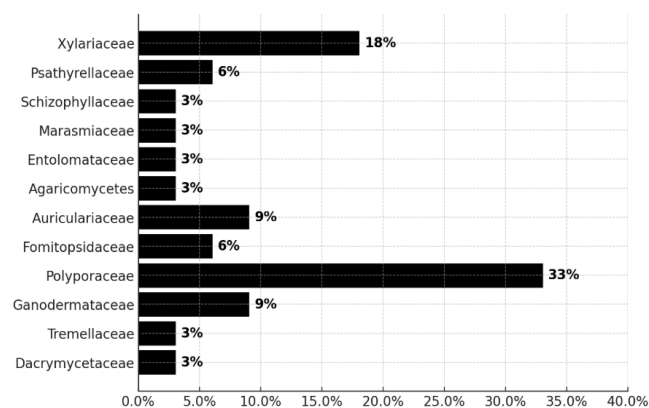
Climate is known to be a key factor in the formation of fruiting bodies, and seasonal changes have been linked to variations in the phenology, abundance, and distribution of fungal species (Sutjaritvorakul et al. 2017). The habitats of the macrofungi identified in this study are predominantly found in habitats such as moist soil and, notably, decayed wood (Figure 5). This latter habitat significantly influences the composition of macrofungal species in this survey. All species from the orders Polyporales, Auriculariales, and

Tremellales were found exclusively on decayed wood, while some species from the order Agaricales and Xylariales were observed growing on soil. Decayed wood was identified as the primary habitat for macrofungi, harboring 29 species (88%), while 4 species (12%) were found on soil substrates. Deadwood, a rich source of nutrients and shelter, is a key habitat for saprophytic organisms, particularly macrofungi. Most macrofungi found in the Banyak Mountain Forest Area are decomposers of leaf litter and wood, contributing to the acceleration of the nutrient cycling process in forest ecosystems (Niego et al. 2023).

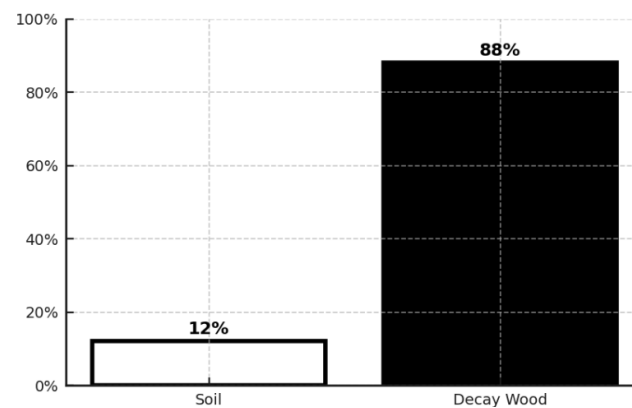
Macrofungi typically thrive on decayed wood and soil due to the substrates ability to provide an optimal environment for growth. Substrates serve as growth media and the primary source of nutrients for these fungi (Darmawanti et al. 2023). In the Banyak Mountain forest, the majority of Basidiomycota species identified were wood-decomposing fungi, as they flourish on rotting wood. This observation suggests that most fungal species identified in this study serve as decomposers within the forest ecosystem.

**Table 3.** Number of Families of macroscopic fungi in the Banyak Mountain Forest, Sragen District, Indonesia

Families	Number of species
Xylariaceae	6
Psathyrellaceae	2
Schizophyllaceae	1
Marasmiaceae	1
Entolomataceae	1
Agaricomycetes	1
Auriculariaceae	3
Fomitopsidaceae	2
Polyporaceae	11
Ganodermataceae	3
Tremellaceae	1
Dacrymycetaceae	1
Grand total	33



**Figure 4.** Percentage of the number of macroscopic fungi species based on families in the Banyak Mountain Forest, Sragen District, Indonesia



**Figure 5.** Distribution of macrofungal species across substrates

Fungi that inhabit decayed trunks and branches are classified as saprophytic fungi, playing a crucial role in recycling materials and nutrients within forest ecosystems. While most fungi can degrade and utilize carbohydrates such as cellulose, only wood-decomposing fungi can break down and utilize the carbohydrate complexes found in lignin-cellulose-hemicellulose structures within the cell walls of woody plants (Riley et al. 2014). Fungi growing on living plants are likely parasitic or pathogenic, whereas those on soil may belong to the mycorrhizal fungi group. These mycorrhizal fungi are microscopic and can colonize plant roots or live in the soil surrounding root systems (Rao et al. 2010). Most macrofungi in this study inhabited decayed wood, highlighting their predominantly saprophytic nature (Tadosa et al. 2021). The role of macrofungi in nutrient recycling is significant, as evidenced by the species observed growing on soil substrates, including *Parasola plicatilis* (Curtis) Redhead, Vilgalys & Hopple, *Clitopilus prunulus*, *Tubaria furfuracea* (Pers.) Gillet, and *Xylaria telfairii* (Berk.) Sacc. Macrofungi can either live in colonies (clusters) or as solitary individuals. In the Banyak Mountain Forest Area, most of the identified macrofungal species were observed living in colonies.

#### Environmental parameters at Banyak Mountain

Environmental parameters were measured to assess the habitat conditions for mushroom growth in the Banyak Mountain forest Area. The data from the measurement of abiotic environmental parameters, including temperature, humidity, and soil pH, are presented in Table 4.

The environment influences the abundance of macroscopic mushrooms. The soil in the Banyak Mountain forest Area has humus characteristics, with soil acidity values ranging from 6.0 to 7.5. According to Gunawan (2001), mushrooms generally thrive well at pH levels between 5.5 and 7.5. This indicates that the soil pH in the Banyak Mountain Forest Area is suitable for mushroom growth. The pH of the substrate is one of the factors that can influence mushroom growth because pH affects enzymatic activity within the cells.

The humidity measurements ranged from 67 to 80%. According to Zabel et al. (2020), mushrooms prefer humidity levels between 40 and 80%, which are essential for maintaining water content and nutrient transport within cells. The measurement results show that the air humidity in the Banyak Mountain Forest Area is suitable for the survival of mushrooms. The moist forest conditions ensure an adequate supply of water, thus meeting the water and other nutrient needs for mushroom growth.

**Table 4.** Result of microclimate variable measurement

Environmental factors	Measurement range
Temperature (°C)	28-32°C
Air humidity (%)	67-80%
Soil pH	6.0-7.5

Based on observations, the air temperature in the Banyak Mountain forest area ranged from 28 to 32°C. This data provides an accurate figure of the thermal conditions in the Banyak Mountain Forest Area, which is crucial for understanding the local environmental dynamics. Generally, mushrooms can grow optimally at temperatures ranging from 15 to 40°C (Zabel et al. 2020). This means that the air temperature in the Banyak Mountain Forest Area is optimal for mushroom growth. This season is conducive to mushroom production as the temperature and relative humidity levels are adequate to facilitate the breakdown of organic matter by mushrooms (Wang et al. 2022).

The survival abilities of macroscopic mushrooms in nature vary. According to Putra et al. (2019), mushrooms are cosmopolitan organisms, making them easy to find in various types of habitats. However, their growth in nature is influenced by many factors that affect their distribution. Each type of mushroom has different adaptive abilities to a particular habitat. Additionally, the substrate found at all locations supports the growth of these mushroom species. Decayed wood is the dominant substrate at all locations.

#### Discussion

A wide variety of naturally occurring macrofungi can be found in Banyak Mountain due to its supportive environmental conditions. Macrofungal diversity varies significantly as a result of environmental factors such as decaying logs, moist soil, sandy soil, humus, and leaf litter (Vishwakarma et al. 2017). Variations in macrofungal distribution can also be attributed to multiple factors, including rainfall, the availability of suitable substrates, moisture-retaining wood with consistently high humidity, and forest type (Hu et al. 2022). Geographically, Indonesia is located in the tropics, situated along the equatorial latitude, with two distinct seasons and a unique climatic environment. The months of May to July experience high rainfall, which supports fungal growth.

Various macroscopic fungi that grow naturally can be found in the forest area of Banyak Mountain due to its supportive environmental conditions. These include fungi from the divisions Ascomycota and Basidiomycota. Given the abundance of dead trees and tree trunks in the Banyak Mountain Forest Area, along with the high humidity and water content, polypores tend to thrive on substrates rich in cellulose in this environment (Gilbert et al. 2002). Macroscopic fungi are found seasonally worldwide in various habitats such as humus-rich soil, decaying plant litter, and logs in forests, as well as in grasslands and even sandy soils and other types of soil. Macroscopic fungi that inhabit decayed wood or dead trees are commonly found due to their ability to survive at higher temperatures and the fact that their toughness deters herbivorous animals (Couceiro and Couceiro 2022).

This study revealed that the species composition and forest structure influence the microhabitat conditions (soil humidity, soil pH, and temperature) in each forest community, with air temperatures ranging from 28-32°C, humidity from 67 to 80%, and pH from 6.0 to 7.5. These conditions are highly conducive to the growth and development of fungi, particularly macroscopic fungi. The

fungi found are known to play an important role as decomposers in the Banyak Mountain Forest Area, as they were predominantly found growing as saprophytes on decaying wood trunks and branches, with a smaller proportion associating with mycorrhizae.

In conclusion, 33 species of macroscopic fungi were found in the Banyak Mountain Forest Area, identified across 6 orders and 12 families, as reported in this study. The order Polyporales was the most dominant group at the study site. The Basidiomycota and Ascomycota fungi found generally live on decayed wood, with a smaller number living on soil. This study provides valuable information on the biodiversity of Basidiomycota and Ascomycota fungi in the Banyak Mountain Forest Area, Tangen Sub-district, Sragen District, Central Java, Indonesia.

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