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Macrofungi Diversity in Mount Gede Pangrango National Park

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Abstract

Macrofungi are easily observed biodiversity. Mount Gede Pangrango National Park is a complex research location for inventorying macroscopic macrofungi. The rainy season is a strategic time for abundant macrofungi research. The purpose of this study was to inventory macrofungi and their relationship to the role of macrofungi through literature studies. The method used in this study was the free roaming method with sampling using the purposive sampling technique. Observations were made when macrofungi were found on the path to the Cibeureum waterfall at an altitude of 1,625 m above sea level. Information about the role of macrofungi with comparative studies with literature. The results of the study of macrofungi identification was using the determination key on various applications of macrofungi. The result found 5 orders, 10 families, 15 genera and 19 species. The role of macroscopic fungi associated with macroscopic for consumption (*Phillipsia*, *Laetiporus*, and *Lentinus*), macroscopic herbal fungi (*Microporus*, *Tatraea*, *Ganoderma*, and *Trametes*), macroscopic pathogenic fungi (*Phellinus*), macroscopic wood-destroying fungi (*Phellinus*) and macroscopic bioluminescent fungi (*Picipes* and *Mycena*). It can be concluded that the most dominant order found is Polyporales, and the most dominant family is Polyperaceae. The role of macroscopic fungi in study site are for consumption, macroscopic herbal fungi, macroscopic pathogenic fungi, macroscopic wood-destroying fungi, and macroscopic bioluminescent fungi.

Keywords: diversity; exploration; macrofungi; Mount Gede Pangrango National Park; polyperaceae

INTRODUCTION

Indonesia has high biodiversity and its naturalness is still maintained. Forests that are still naturally maintained are supported by diverse and varied ecosystem components. The components of the ecosystem are divided into 2, namely abiotic components consisting of soil, light, temperature, water and biotic components consisting of producers, consumers, and decomposers (Masriana *et al.*, 2023; Safitri *et al.*, 2023; Maritsa *et al.*, 2024). Decomposers play a role in ecosystem balance because they can help break down nutrients so that they can be utilized by other plants. One of the decomposers is macrofungi. Macrofungi have large fruiting bodies and most of them come from the Ascomycota division. Macrofungi have characteristics that are eukaryotic, unicellular or multicellular, produce spores, and cell walls in the form of chitin and macrofungi are heterotrophic organisms, namely taking nutrients from where the fungi live. Macrofungi can be found in damp places such as rotten wood, leaf litter, soil or rocks. In addition to having a role in the ecosystem, macrofungi can be utilized in various fields such as industry, agriculture, sources of medicine, food, textiles, and bioremediation agents (Mahardika *et al.*, 2021; Diharjo & Nurmiyati, 2022; Anjella *et al.*, 2023).

One of suitable habitat for macrofungi is Mount Gede Pangrango National Park. It has an important role in the history of conservation in Indonesia. It was established as a national park in 1980.

With an area of 22,851.03 hectares, the National Park is covered by mountainous tropical rainforest. Mount Gede Pangrango National Park consists of two main mountains, Mount Gede and Mount Pangrango, as well as a number of other peaks such as Mount Putri, Mount Kendang and Mount Taman. These two main mountains have an altitude of 2,958 m above sea level and 3,019 m above sea level respectively. In addition, there are also several beautiful waterfalls and lakes in the national park, such as Cibeureum, Cikahuripan and Situ Gunung. Gede Pangrango is one of the wettest parts of Java with a mean annual rainfall between 3,000 and 4,000 mm and with, even in the four driest consecutive months of the year, still more than 40 rainy days. The wettest season is from October to May, coinciding with the North West moonsoon, with more than 200 mm of rain every month and over 400 mm per month between December and March. Relative humidity is likewise high, espesially in the forest at night. However, during the dry season humidity on the peaks swings from a night- time low of 30% to an afternoom high of over 90%. These variations have a marked effect on plant communities (Geocities, 2024).

Macrofungi are easily observed biodiversity. Fruit bodies that have various colors and their roles in daily life, both beneficial and detrimental, are very interesting to reveal and study further. Mount Gede Pangrango National Park is a very large conservation area. This area is a complete source of biodiversity in terms of species variation, food chains, populations of living things, and the biosphere. Macrofungi really like humid and wet habitat areas. In the rainy season, its habitat is very suitable for mushroom growth (Wahyudi & Azwin, 2016; Prapitasari *et al.*, 2020; Supratman, 2023). Mount Gede Pangrango National Park is a conservation area that has great potential for macrofungal research. Several studies on macrofungi that have been conducted are: 19 species and 14 genera were found, dominated by *Ganoderma* and *Microporus*, which are strongly suspected of having the potential as food and medicine (Putra *et al.*, 2019) and research on mycorrhizal soil macrofungi to support specific forest growth (Lekatompessy & Sukiman, 2015). Some of these findings are contained in unscientific articles, so that the diversity of macrofungi in Mount Gede Pangrango National Park is relatively small. The purpose of this study is to inventerize the macrofungi in the Mount Gede Pangrango National Park area. With this study, it is hoped that it can add information about the very large macrofungal inventory so that it can be used as pre-research material for macrofungal researchers to conduct in vitro research in the laboratory.

METHOD

This study was conducted on the Cibeureum waterfall hiking trail. The method used in this study is the free roaming method with sampling using the purposive sampling technique, following the predetermined route (Muspiah *et al.*, 2016; AJ *et al.*, 2024; Nisa *et al.*, 2024). Observations were made along the path area to Cibeureum Waterfall at an altitude of 1620 meters above sea level. Observations of fungi were carried out at a distance of 1-2 m to the left and right of the travel route. Sampling was carried out by paying attention to the area around the research route that was overgrown with fungi, both on the soil, leaf litter and rotten wood or living tree trunks. Data collection was carried out by making a brief description and filling in a list on a tally sheet about the morphology of macroscopic fungi. The macroscopic fungi found were then photographed while still attached to the substrate. Furthermore, it was taken by removing the fruit body intact for macroscopic observation and description which included the shape and color of the cap, the surface of the cap, the type of cap, the diameter of the cap, the shape of the stalk, the length and diameter of the stalk, the presence or absence of lamellae. The macroscopic fungi found were identified using various fungal applications and key determination Rahmawati et al. 2018. The map of data collection locations can be seen in Figure 1.

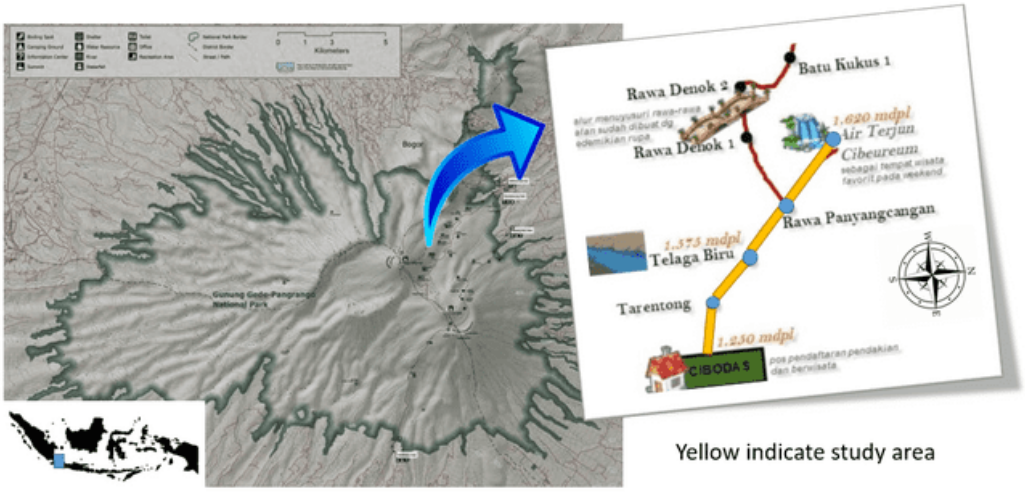

Figure 1. Location of research data collection

RESULT AND DISCUSSION

Based on the research results, fungi were found to be classified into 2 Classes (Agaricomycetes and Leotiomycetes), 5 Orders (Pezizales, Heliotales, Polyporales, Agaricales, and Russulales), 10 Families (Agaricaceae, polyperaceae, Sarcoscyphaceae, fomitopsidaceae, ganodermataceae, mycenaceae, russuluaceae, hymenochaetaceae, crepidotaceae, and sthrophariaceae) and 15 Genus (*Microporus, Tatraea, Ganoderma, Picipes, Tyromyces, Trametes, Pleurotus, Phillipsia, Laetiporus, Phellinus, Crepidotus, Pholiota, Phellinopsis, Earliella* and *Mycena*). The fungal substrates obtained were almost all found on fallen tree trunks and some fungi grew on soil containing litter. Fallen trees generally still have nutrients needed by fungi, in addition to their water content is quite high. Given the high rainfall, fallen trees are thought to be the most strategic substrate for fungi to thrive.

The maximum growth of most macroscopic fungi members of the Basidiomycota phylum ranges from 50-70% water content. Soil that contains a lot of litter has organic compounds that undergo decomposition which can then be absorbed by fungi for growth (Noverita, 2017). The litter comes from fallen leaves, flowers, seeds, and twigs. Nutrients such as glucose from the decomposition of leaf litter will be converted by fungi into mannitol compounds to be absorbed and used for the metabolism of hyphal tissue. Other nutrients such as alkaloids and lignin or other carbohydrate polymers are needed by fungi (Hasanuddin, 2018; Putra *et al.*, 2019; Tristina *et al.*, 2022). The diversity of fungi is dominated by the orders polyporales and agarycales, the families polyporaceae and agarycaceae. The characteristic of Polyporaceae is a woody fungus that lives in forests with a dominant substrate in the form of living or decayed plant stems. The National Park area is a very abundant source of plant life, so it is a very strong reason for agarycaceae and polyporaceae to dominate. The research results data can be seen in table 1.

Table 1. Macrofungi diversity at Mount Gede Pangrango National Park

Phylum	Class	Ordo	Famili	Genus	*Species*
Ascomycota	Agaricomycetes	Pezizales	Sarcoscyphaceae	*Phillipsia*	*Phillipsia* sp.
	Leotiomycetes	Helotiales	Helotiaceae	*Tatraea*	*Tatraea* sp.
Basidomycota	Agaricomycetes	Polyporales	Polyporaceae	*Microporus*	*Microporus* sp1
					Microporus sp2
				Picipes	*Picipes* sp.
				Tyromyces	*Tyromyces* sp.
				Polyporus	*Polyporus* sp.
				Earliella	*Earliella* sp.
				Trametes	*Trametes* sp1.
					Trametes sp2.
			Fomitopsidaceae	*Laetiporus*	*Laetiporus* sp.
			Russulaceae	*Russula*	*Russula* sp1.
					Russula sp2.
			Ganodermataceae	*Ganoderma*	*Ganoderma* sp.
		Agaricales	Mycenaceae	*Mycena*	*Mycena* sp.
			Crepidotaceae	*Crepidotus*	*Crepidotus* sp.
			Strophariaceae	*Pholiota*	*Pholiota* sp.
		Hymenochaetales	Hymenochaetaceae	*Phellinopsis*	*Phellinopsis* sp.

The following are the morphological characteristics of macrofungi found in Mount Gede Pangrango National Park: (1) *Microporus* sp1, has the morphological characteristics of brown upper thallus color, white lower thallus color, hard thallus texture, rough upper thallus surface, rough lower thallus surface, flat thallus edge, no aroma, size 1.5 cm x 2 cm, no stem, rhizoid substrate attached to fallen tree trunks. The morphology of *Microcopus* sp 1. It can be seen in attachment 1. (2) *Microporus* sp2, has the morphological characteristics of brown upper thallus color, white lower thallus color, hard thallus texture, rough upper thallus surface, rough lower thallus surface, serrated thallus edge, size 5 cm x 5.5 cm, orange thallus stem color, thallus stem size 2.5 cm, hard thallus stem texture, smooth thallus stem surface, strong thallus stem, rhizoid substrate attached to leaf litter. Morphology of *Microcopus* sp. 2. It can be seen in attachment 2. (3) *Tatraea* sp., has morphological characteristics of light brown upper thallus color, light brown lower thallus color, moist thallus texture, smooth upper thallus surface, smooth lower thallus surface, flat thallus edge, size 3 cm x 1.8 cm, no stem, rhizoid substrate attached to tree trunk. Morphology of *Tatraea* sp. can be seen in attachment 3. (4) *Ganoderma* sp., has morphological characteristics of red upper thallus color, white lower thallus color, hard thallus texture, smooth upper thallus surface, smooth lower thallus surface, flat thallus edge, size 5 cm x 5.5 cm, no stem, rhizoid substrate attached to living tree trunk. Morphology of *Ganoderma* sp. It can be seen in attachment 4. (5) *Picipes* sp., has morphological characteristics The upper thallus color is dark brown to black, the lower thallus color is orange, the thallus texture is hard, the upper thallus surface is smooth, the lower thallus surface is smooth, the thallus edge is serrated, size 3.5 cm x 3 cm, the thallus color is orange, the thallus stem size is 1.5 cm, the thallus stem texture is hard, the rhizoid substrate is attached to the fallen tree trunk. The morphology of *Picipes* sp. It can be seen in attachment 5.

(6) *Russula* sp1., has morphological characteristics: The upper thallus color is white with a pinkish tinge, the lower thallus color is white, the upper thallus surface is smooth, the lower thallus surface is smooth and serrated, the thallus edge is serrated, odorless, size 5.5 cm x 5.5 cm, the thallus stem color is white, the thallus stem size is 4.5 cm, the thallus stem is fragile, the rhizoid substrate is attached to leaf litter. Morphology of *Rusulla* sp 1. It can be seen in attachment 6. (7) *Russula* sp2., has morphological characteristics of purple upper thallus color, white lower thallus color, moist thallus texture, smooth upper thallus surface, smooth lower thallus surface with serrations, even thallus edge, size 6 cm x 6.2 cm, white thallus stem color, thallus stem size 5.5 cm, hard thallus stem texture, rough thallus stem surface, strong thallus stem, rhizoid substrate attached to leaf litter. Morphology of

Russula sp2. It can be seen in attachment 7. (8) *Phillipsia* sp., has the following morphological characteristics: Purple upper thallus color, White lower thallus color, Moist thallus texture, Smooth upper thallus surface, Smooth wavy lower thallus surface, Flat thallus edge, No aroma, Size 4 cm x 3.5 cm, No stem, Rhizoid substrate attached to fallen tree trunks. The morphology of *Phillipsia* sp. can be seen in attachment 8. (9) *Laetiporus* sp., has the following morphological characteristics: Orange upper thallus color, Cream lower thallus color, Hard thallus texture, Rough upper thallus surface, Rough lower thallus surface, Serrated thallus edge, Size 10 cm x 10 cm, Orange thallus stem color, 7 cm thallus stem size, Rough thallus stem texture, Strong thallus stem, Lives in colonies, Rhizoid substrate attached to tree trunks. Morphology of *Laetiporus* sp. Can be seen in attachment 9. (10) *Phellinus* sp., has morphological characteristics of upper thallus color brown, lower thallus color light brown, hard thallus texture, upper thallus surface rough, lower thallus surface smooth, wavy thallus edge, pungent aroma, thallus size 4.3 cm x 3.3 cm, no stem, rhizoid substrate attached to fallen tree trunk. *Phellinus* sp. morphology can be seen in attachment 10.

(11) *Tyromyces* sp., has morphological characteristics of upper thallus color bone white, lower thallus color bone white, moist thallus texture, upper thallus surface smooth, lower thallus surface smooth, flat thallus edge, no aroma, thallus size 3 cm, no stem, rhizoid substrate attached to fallen tree trunk. *Tyromyces* sp. morphology can be seen in attachment 11. (12) *Polyporus* sp., has morphological characteristics of brown upper thallus color, orange lower thallus color, rough thallus texture, rough upper thallus surface, rough lower thallus surface, wavy thallus edge, odorless, size 8 cm x 5 cm, thallus stem size 1.5 cm, rhizoid substrate attached to fallen tree trunk. *Polyporus* sp. morphology can be seen in attachment 12. (13) *Pholiota* sp., has morphological characteristics of brown upper thallus color, yellow lower thallus color, moist thallus texture, smooth upper thallus surface, smooth lower thallus surface serrated, even thallus edge, odorless, size 1.3 cm x 0.5 cm, yellow thallus stem color, thallus stem size 2.5 cm, moist thallus stem texture, smooth thallus stem surface, fragile thallus stem, rhizoid substrate attached to leaf litter. *Pholiota* morphology can be seen in attachment 13. (14) *Trametes* sp1., has morphological characteristics: The upper thallus color is cream, the lower thallus color is bone white, the thallus texture is hard, the upper thallus surface is rough, the lower thallus surface is rough and wavy, the thallus edge is wavy, has no aroma, measures 5 cm x 5 cm, has no stem, the rhizoid substrate is attached to the fallen tree trunk. The morphology of *Trametes* sp 1. It can be seen in attachment 14. (15) *Trametes* sp2., has morphological characteristics: The upper thallus color is pale yellow, the lower thallus color is bone white, the thallus texture is moist, the upper thallus surface is smooth, the lower thallus surface is smooth and serrated, the thallus edge is flat, measures 4.2 cm x 3.2 cm, has no stem, the rhizoid substrate is attached to the fallen tree trunk. The morphology of *Trametes* sp2. It can be seen in attachment 15.

(16) *Mycena* sp., has morphological characteristics: Upper thallus color is brown, Lower thallus color is light brown, Smooth thallus texture, Upper thallus surface is smooth, Lower thallus surface is serrated, Edge of thallus is wavy, Odorless, No stem, Rhizoid substrate attached to dead tree trunks. Morphology of *Mycena* sp. It can be seen in attachment 16. (17) *Crepidotus* sp., has morphological characteristics: Upper thallus color is white, Lower thallus color is bone white, Moist thallus texture, Upper thallus surface is smooth, Lower thallus surface is smooth, Edge of thallus is flat, Odorless, No stem, Rhizoid substrate attached to living tree trunks. Morphology of *Crepidotus* sp. Can be seen in attachment 17. (18) *Earliella* sp., has the following morphological characteristics: Orange upper thallus color, Brown lower thallus color, Hard thallus texture, Rough upper thallus surface, Smooth lower thallus surface, Wavy thallus edge, Odorless, No stem, Has fibrous roots, Rhizoid substrate attached to living tree trunks. *Earliella* sp. morphology can be seen in attachment 18. (19) *Phellinopsis* sp., has the following morphological characteristics: Brown upper thallus color, Brown lower thallus color, Moist thallus texture, Smooth upper thallus surface, Smooth lower thallus surface serrated, Flat thallus edge, No stem, Rhizoid substrate attached to fallen tree trunks. *Phellinopsis* sp. morphology can be seen in attachment 19.

The macro fungi found are very diverse, in terms of color they vary greatly. The color of the macro fungus thallus can determine whether the fungus is poisonous or not. Several characteristics of

poisonous macro fungi can be recognized: having a striking color, emitting an unpleasant odor, the thallus is easily destroyed when touched, the thallus has spots especially on the cap. Research at Mount Gede Pangrango National Park was conducted during the rainy season. This can affect the temperature around Mount Gede Pangrango National Park. The growth of macrofungi is greatly influenced by environmental factors that vary in each region. The most dominant environmental factors for macrofungi to grow and develop well are at a temperature of 16°C, 97% humidity and an optimum pH between 5 - 7.5. A temperature difference of 0.1^0C can affect the survival of fungi, in addition, other biotic and abiotic environments also greatly affect the life of macrofungi (Rahmawati *et al.* 2018; Mohammad *et al.*, 2024; Yudhistian *et al.*, 2024). In addition to temperature, other factors that affect the growth of macrofungi include acidity levels (pH), humidity, light, air, and growing media. Humans, fungi-eating animals, and thallus resistance also affect macrofungal resistance. The presence of macrofungi in conservation forests, plus the environmental conditions of Mount Gede Pangrango National Park are often passed by mountain climbers, so it is likely that humans use macrofungi for consumption or as medicine (Nasution *et al.*, 2018; Rahmawati *et al.*, 2018; Tristina *et al.*, 2022).

Macrofungi from the Basidiomyecetes class are widely used as food and medicinal ingredients, most of which are found in dead tree substrates. Food macrofungi have an important role in providing nutritious, quality food at affordable prices (Mahardika *et al.*, 2021; Bahar *et al.*, 2022; Ambarawati *et al.*, 2023). In addition to food based on the findings of macrofungi types in Mount Gede Pangrango National Park, many can be used for further research in the medical field. *Phellinus* mushroom extract has anticancer and antioxidant activities. *Russula* is the only genus from the Russulales order found in this study to isolate lectins and has the potential for antitumor, antimicrobial, and antioxidant activities (Konno *et al.*, 2015; Haryadi *et al.*, 2023; Gupta *et al.*, 2024). Besides Macrofungi, this study site also suitable for insect (Al Khairina *et al.*, 2024). This direct exploration is effective one not only on forest but also in lake,beach, and even laboratory (Pertiwi & Saputri, 2020; Laurenza *et al.*, 2023; Putri *et al.*, 2023). In terms of science, macrofungi are widely favored by researchers to conduct further research in the laboratory related to the potential of macrofungi that have the potential to have antioxidant, antibacterial, antifungal or anticancer substances. This is because many people who suffer from serious illnesses still use herbal medicine. Macro fungi are widely used by medical teams in certain countries that still use macro fungi to treat various diseases. In Mount Gede Pangrango National Park, *Mycena* is also a good decomposer. Several species of *Mycena* are a group of fungi that can fluoresce (Wahyudi *et al.*, 2016; Hasibuan, *et al.*, 2021; Maritsa *et al.*, 2024).

CONCLUSION

Based on the results of the Macrofungi Inventory study in the Gunung Gede Pangrango National Park area, 5 orders, 10 families, and 15 genera and 19 species were found. Identification of macrofungi was carried out using various macroscopic characters. The macrofungi are: *Phillipsia* sp., *Tatraea* sp., *Microporus* sp1., Microprorus sp2., *Trametes* sp., *Picipes* sp., *Tyromyces* sp., *Polyporus* sp., *Earliella* sp., *Trametes* sp1., *Trametes* sp2., *Laetiporus* sp., *Russula* sp1., *Russula* sp2., *Ganoderma* sp., *Mycena* sp., *Crepidotus* sp., *Pholiota* sp., *Phellinopsis* sp. Macrofungal substrates are widely found on tree trunks and litter containing soil. Various types of macrofungi can be used as food ingredients, as herbs, decomposers, and as bioluminescence agents. The diversity of fungi is dominated by the order polyporales and agarycales, the family polyporaceae and agarycaceae. This is because the Mount Gede Pangrango National Park area has rotten trees as an ideal stem substrate for the species. This research is beneficial for the nation, especially researchers because it can be used as pre-research material for macrofungi researchers to conduct in vitro research stages in the laboratory.

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