Fungi in Selo hiking trail of mount Merbabu national park
Central Java

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Abstract. Mount Merbabu National Park has the potential for abundant biodiversity in natural forest vegetation, including flora and fauna. The purpose of this study was to explore and identify fungi in Mount Merbabu National Park on Selo Climbing Lane, Boyolali, Central Java. The research was conducted in January until April 2020 on Selo Climbing Lane, Boyolali. This research was exploratory by using Cruise Methods, which explored the hiking trail at 1800-2571 meters altitude. Sampling was carried out every time the fungi were identified, and it was done when the same fungi were found. Identification was made by recording morphological characteristics, habitus, and the substrate through qualitative descriptive. The results showed that the 52 identified species of fungi belonged to the 26 families of fungi. The most common fungi are the Polyporaceae family, which consists of 5 species, namely: Trametes versicolor, Trametes polyzona, Polyporus sp, Polyporus versicolor dan Ganoderma applanatum.

1. Introduction

Mount Merbabu National Park is a network of areas included in the network of conservation areas in Central Java [1]. One of the locations that is rich in biodiversity is natural forest vegetation in the area of Mount Merbabu National Park, located at an altitude of 1,200-3,142 meters altitude [2]. Mount Merbabu National Park has a natural conservation area, both land and water that have native ecosystems, managed by a zoning system that is used for research, science, education to support cultivation, culture, tourism and recreation [3]. Geographically, Mount Merbabu National Park is located at 7.5 ° S and 110.4 °E east longitude, mostly mountains with hilly topography and steep ravines and cliffs, has a type B climate with rainfall 2000-3000 mm and temperatures throughout the year 17-30ºC [4]. High rainfall with low light intensity so that the condition of the Mount Merbabu area becomes humid, so the area is found in many kinds of fungi [5]. Indonesia is a mega-biodiversity country, namely a country that has many species, genetic diversity, high ecosystems and abundant potential for biodiversity.

Fungi are one of the organisms that play an important role in the ecosystem, but fungi are often neglected during exploration and identification of fungi. There are 1.5 million species of fungi in the world and until 1996 only 69,000 species of fungi have been identified. As many as 200,000 species of the 1.5 million species of these fungi are estimated to be found in Indonesia, where until now there is no definite data on the number of these mushroom species, which have been identified used or which have become extinct due to human activity [6]. Fungi have saprophytic and parasitic properties, which live with their hosts. As a parasite, the fungus cannot produce its own food. Fungi need a host to obtain their food (lignin, hemicellulose, and cellulose) as an energy source [7]. Saprophytic fungi are
rotting fungi so that they can change the composition of dead organic substances. Saprophytic fungi live on dead organisms such as wood, twigs, leaf litter and fruit.

In the Mount Merbabu National Park area, no research has been conducted on the richness of mushroom species, previous research only examined the diversity of wood rot fungi. For this reason, it is necessary to explore and identify the richness of mushroom species, so that it will help complete mushroom identification data in Indonesia and can provide information about the wealth of mushrooms in the Mount Merbabu National Park area so that it can be used as a reference for various aspects of both the management, education and research. This study aims to determine the richness of mushroom species in the Mount Merbabu National Park, Central Java Via Selo Boyolali.

2. Method
This research is an exploratory research using cruise methods. This was done by exploring the area of the use zone, jungle zone and core zone in the National Park of Mount Merbabu Via Selo Boyolali from an altitude of 1800-2571 meters altitude. Sampling of mushrooms using puroasive sampling technique, namely sampling is carried out based on the presence of fungi that are considered to represent a particular sampling area, when sampling if the same type of fungus is found more than once, then the type of fungus is not taken because it is considered to represent the area. The data analysis used was descriptive qualitative. The characteristics of the fungi that were observed were: morphology, habitus, and substrate.

3. Results and Discussion
Based on the results of exploratory research and identification of mushrooms carried out in the National Park of Mount Merbabu Via Selo Boyolali by exploring the use zone, jungle zone and core zone from an altitude of 1800-2571 meters altitude, fungi were identified in (Table 1).

The results showed that there were 52 mushroom species richness consisting of 2 mushroom divisions, namely 5 Ascomycota mushroom species and 47 Basidiomycota mushroom species. The order agaricales is a group of fungi that dominates in the research location because the largest number of species is found, and the dominant division is the basidiomycota group. Tally sheet data for mushroom species richness in Mount Merbabu National Park, Central Java Via Selo Boyolali can be seen in the table 1.

After doing research, exploration and identification of mushrooms in the area of Mount Merbabu National Park Via Selo Boyolali obtained data on the species richness of mushrooms totaling 52 species from 2 mushroom divisions. The fungal divisions found were Basidiomycota and Ascomycota, the basidiomycota division of the largest mushroom group with 47 species and Ascomycota division of 5 species.

According to Novarita (2019) research, generally fungi found in both forest environments are included in the Basidiomycota division which is better known as a fungus or fungus. while the Ascomycota division is generally microscopic and only a large part of it is macroscopic [8].

The Agariales Order is the order most commonly found in Mount Merbabu National Park which consists of 29 species of mushrooms. The Order of Agariales from the Basidiomycetes class is a group of fungi that have many species of morphological forms such as umbrellas and have a soft texture and are often found because these fungi grow in damp places [9].

There are 26 families of fungi found in Mount Merbabu National Park, namely Agaricaceae, Bolbitiaceae, Hydnangiaceae, Hygrophiaceae, Hymenogastraceae, Inocybaceae, Lyophyllaceae, Marasmiaceae, Mycenaceae, Pluteaceae, Pleurotaceae, Psathyrellaceae, Schizophyllaceae, Strophariaceae, Dompeastmycetaceae, Strophariaceae, Geastraceae Hymenochaetaceae, Fomitopsidaceae, Polyporaceae, Albatrellaceae, Tremellaceae. The polyporaceae family is the largest species found, namely 5 species of fungi including Trametes versicolor, Trametes polyzona, Polyporus sp, Polyporus versicolor and Ganoderma applanatum.
### Table 1. Tally Sheet The Richness of Mushroom Types in Mount Merbabu National Park Via Selo Boyolali, Central Java

| Division   | Order      | Familia         | No. | Species                      |
|------------|------------|-----------------|-----|------------------------------|
| Ascomycota | Peltigerales| Peltigeraceae    | 1   | *Peltigera canina*           |
|            | Peziza     | Pezizaceae      | 2   | *Peziza violacea*            |
|            | Peziza     | Pezizaceae      | 3   | *Peziza Badia*               |
|            | Xylaria    | Xylariaceae     | 4   | *Xylaria sp1*                |
|            | Xylaria    | Xylariaceae     | 5   | *Xylaria sp2*                |
| Basidiomycota | Agaricales | Agaricaceae     | 6   | *Lepiota sp*                 |
|            |            |                 | 7   | *Bovista pila*               |
|            |            |                 | 8   | *Lycoperdon Umbrinum*        |
|            |            | Bolbitiaceae    | 9   | *Conocybe sp 1*              |
|            |            |                 | 10  | *Pholiota rugosa*            |
|            |            |                 | 11  | *Conocybe tenera*            |
|            |            |                 | 12  | *Conocybe pubescene*         |
|            |            | Hydnangiaceae   | 13  | *Laccaria bicolor*           |
|            |            |                 | 14  | *Laccaria fraterna*          |
|            |            | Hygrophoraceae  | 15  | *Hygrocybe cupida*           |
|            |            |                 | 16  | *Hygrocybe miniata*          |
|            |            |                 | 17  | *Hygrophorus Goetzii*        |
|            |            | Hymenogastraceae| 18  | *Galerina Vittiformis*       |
|            |            | Inocybaceae     | 19  | *Crepidotus mollis*          |
|            |            | Lyophyllaceae   | 20  | *Termomyces*                 |
|            |            | Marasmiaceae    | 21  | *Xeromphalina campanella*    |
|            |            |                 | 22  | *Marasmius calhouniae*       |
|            |            |                 | 23  | *Marasmius sp*               |
|            |            | Mycenaceae      | 24  | *Mycena sp 1*                |
|            |            |                 | 25  | *Mycena tenerrima*           |
|            |            |                 | 26  | *Mycena acicula*             |
|            |            |                 | 27  | *Mycena aff-Mamaku*          |
|            | Pluteaceae |                 | 28  | *Pluteus sp*                 |
|            | Pleurotaceae|                 | 29  | *Pleurotus sp1*              |
|            |            |                 | 30  | *Pleurotus sp 2*             |
|            | Psathyrellaceae|             | 31  | *Coprinellus sp*             |
|            |            |                 | 32  | *Coprinellus disseminatus*    |
|            | Schizophyllaceae|               | 33  | *Schizophyllum commune*      |
|            | Strophariaceae|              | 34  | *Hypholoma sp*               |
|            | Dacrymycetales|                | 35  | *Calocera cornea*            |
|            |            |                 | 36  | *Calocera furcata*           |
|            | Geastrales | Geastraceae     | 37  | *Geastrum coronatum*         |
|            |            |                 | 38  | *Geastrum saccatum*          |
|            | Gomphales  | Gomphaceae      | 39  | *Ramaria myceliosa*          |
|            | Helotiaceae| Helotiaceae     | 40  | *Ascochorine sarcoides*      |
|            | Hymenochaetales |            | 41  | *Coltricia cinnamomea*       |
|            | Polyporalears|                 | 42  | *Coltricia perennis*         |
|            |            |                 | 43  | *Coltricia sp1*              |
|            | Fomitopsisidaceae|           | 44  | *Laetiporus conifericola*    |
|            | Polyporaceae|                 | 45  | *Trametes versicolor*        |
|            |            |                 | 46  | *Trametes polyzona*          |
|            |            |                 | 47  | *Polyporus sp*               |
|            |            |                 | 48  | *Polyporus versicolor*       |
|            |            |                 | 49  | *Ganoderma applanatum*       |
|            | Rusulalears| Albatrellaceae   | 50  | *Albatrellus confluens*      |
|            | Tremellales| Tremellaceae    | 51  | *Tremella fuciformis*        |
|            |            |                 | 52  | *Tremella aurantia*          |
The study of wood rot fungi in 2017 in Mount Merbabu National Park found 23 species of wood rot fungi belonging to 13 families, the Polyporaceae family has the largest number of species compared to other families, namely 9 species, namely: *Ganoderma aplanatum*, *Polyporus cinnabarinus*, *Polyporus squamosus*, *Meripilus giganteus*, *Laetiporus sulphureus*, *Hapalopilus rutilans*, *Fomitopsis pinicola*, *Fomes fomentarius*, *Trichaptum biforme* [10].

The Ordo Polyporales of the Basidiomycetes class grows on leaf litter, twigs and wood substrates in the forest. The flesh of the Ordo Polyporales fruiting bodies varies from soft to hard. Most of the members of this family have hymenium (fertile layer) in vertical pores at the bottom of the lid [11].

Environmental conditions at the research location along the hiking trail of Mount Merbabu National Park Via Selo Boyolali, Central Java at an altitude of 1,800 meters altitude to 2,100 meters altitude, have a range of air temperatures reaching 18 °C - 23 °C with air humidity of 60 - 70%. So it is suitable for fungal growth, as well as the availability of organic materials that support the growth of fungi from Agaricales species.

Basically, mushrooms will grow well in conditions of high humidity. Macro fungi can grow optimally at a temperature of 20-30 °C and the ideal humidity is between 80-90 °C [12]. Humidity and temperature factors also affect the growth of macroscopic fungi with humidity ranging from 80-91%, while temperatures range from 22-27% [13].

The optimum temperature for fungal growth is in the range of 20˚C – 35˚C, and humidity of 70% - 100%, and the range of light intensity is between 380-720 Lux. Light intensity greatly affects the reproduction of fungi [14]. In forest areas with high humidity and low air temperatures tend to be dominated by macro fungi with wet and soft flesh such as the Agaricus group, on the other hand, in forest areas with low humidity, low intervention and high temperatures tend to be dominated by hard and porous macrophages such as the polyporales group [15].

**Figure 1.** Some of the richness of mushroom species found in the Mount Merbabu National Park area Via Selo Boyolali. (A). *Peziza badia*; (B). *Tremella aurantina*; (C). *Ramaria myceliosa*; (D). *Xeromphlina Campanella*; (E). *Albatrellus confusus*; (F). *Coltricia cinnamomea*; (G). *Trametes vericolor*; (H). *Mycenna tenerrima*; (I). *Calocera cornea*; (J). *Hygrocybe cuspidate*; (K). *Coprinellus disseminatus*; (L). *Geastrum saccatum*. 
The results of several studies on the biodiversity of fungi in Indonesia show that species from the order Agaricales are the most dominant compared to other species. Research on the diversity of fungi in the Mekarsari Tourism Park, West Java, there are 20 types of macro fungi, 18 types of fungi included in the Agaricales, 1 species of the order Polyporales and 1 type of the order Xylariales [16]. The results of the research on mushrooms in the Kasepuhan Cisungsang area, Banten. The most commonly found mushrooms are from the Agaricales order as many as 18 species from 34 species of basidiomycota fungi [17]. The types of mushrooms found in the Mountain National Park in Figure 1.

Fungi can live saprophytic and generally macroscopic fungi grow on weathered wood, litter / soil, leaves, and animal dung, and some also grow on rotting fungi [18]. Fungi can grow well on rotting wood compared to fungi that live in soil [19].

The richness of mushroom species in the area of Mount Merbabu National Park Via Selo Boyolali is dominated by fungus living on wood, namely (52%), this percentage is higher than fungi that live on the soil (42%) and fungi that live on leaf litter (6%). Several species of fungi found can be seen in (Figure 2).

The high diversity of fungal species that grows on wood, is due to the fact that many woody plants fall and experience weathering, besides that wood can provide enough nutrients for macrofungal fungi [20].

Wood fungus under favorable conditions will develop very rapidly in wood with the growth of hyphae. Hyphae secrete enzymes to decompose the components of the wood cell wall. So that it can degrade the insoluble components of wood into soluble products, and finally into simple chemical compounds which are then included in the metabolism of fungi as a source of food and energy [21].

The potential mushrooms can be used as food ingredients because they have a delicious and delicious taste, and are also used as medicines, decomposers and mycorrhizal fungi in plant roots. Ascomycota and Basidiomycota mushrooms, some are edible and many are not edible. More than 10,000 species of mushrooms worldwide and about 2000 of them are considered edible [22].

Basidiomycetes class mushrooms which are used as food mushrooms include the Pleurotus sp. This fungus grows on the wood of Diospyros pseudonimalbarica, the ear fungus Auricularia auricula is found growing on the wood of Sagagulang (Blumeodendron tokbrai Bl) [23]. The nutritional content of Auricularia auricula mushrooms is 3.6% ash, 12.5% protein, 1.7% fat and 66.1% total carbohydrates [24].

Fungi that can be used as medicine are Coprinellus disseminatus, Calvatia craniiformis, Collybia confluens, Scleroderma citrinum, Lenzites betulina, Polyporus aranciarius, Microporus flabelliformis, Coriolus versicolor, Mikroporus xanthopus, Ganoderma, Russula sanguinea, dan Albaretellus confluens. The results show that Microporus flabelliformis contains active anti-bacteria. The results of the macro mushroom extract experiment against bacteria showed that the Ganoderma and Microporus flabelliformis extracts were the most effective in suppressing the growth of Xanthomonas oryzae pv. Oryzae, Ralstonia solanacearum dan Pectobacterium carotovorum [25].

Fungi have the potential as mycorrhizae, which have enormous benefits, namely helping to overcome the problem of lack of water and other nutrients. Fungi have the potential as mycorrhizae, including Amanita spp., Geastrum spp., Lycoperdon sp., dan Hygroporus sp. Jenis jamur yang berpotensi sebagai dekomposer, antara lain Lepiota spp, Marasmius spp., Leucocoprinus sp.,

Figure 2. Percentage of mushroom growing habitat in the Mount Merbabu National Park area Via Selo Boyolali.
Auricularia sp., Coprinus spp., Clavulina sp., Entoloma spp., Mycena spp., Daldinea spp., Polyporus spp. and Xylaria spp [26].

4. Conclusion

The results showed that in the area of Mount Merbabu National Park Via Sel Boyolali found 52 species of mushrooms consisting of two divisions of Ascomycota and Basidiomycota fungi. Ascomycota mushrooms consist of three orders, namely: Peltigerales, Pezizales and Xylariales, three families and five species. Basidiomycota mushrooms consist of nine orders, namely: Agariales, Polyporales, Hymenochaetales, Dacrymycetales, Tremellales, Geastrales, Gomphales, Rusulales and Helotiaceae, there are 26 families and 47 species of fungi. Exploration and identification of fungal growing habitats were dominated by fungi that live on wood, namely (52%), this percentage is higher than that of fungi that live in soil (42%) and fungi that live on leaf litter (6%). The potential for mushrooms in the Mount Merbabu National Park area Via Sel Boyolali, has the potential as a decomposer, medicine, food, and mycorrhizae.

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