Habitat characteristics and utilization of edible wild mushrooms by local communities in the protected forest in Pinrang Regency, Indonesia

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Abstract. This study aims to determine the habitat characteristics and utilization of edible wild mushrooms by local communities in protected forest areas in Pinrang Regency, Indonesia. The study was conducted using observation, survey, interview, and questionnaire methods. The characteristics of the wild mushroom habitat are climate type B, with average rainfall is 2,780.2 mm/year, a temperature of 24-32°C, and relative humidity of 59-82%. In general, a wild mushroom grows on dead wood, especially candlenut (Aleurites moluccana) and mango (Mangifera indica), soil, and litter. There were 18 types of wild mushrooms found in the protected forest areas in Pinrang Regency, namely Termitomyces clypeatus, Pleurotus ostreatus, Pycnoporus sanguineus, Tyromyces chioneus, Trametes hirsute, Schizophyllum commune, Lepiota clypeolaria, Lepiota brunneoincarinata, Auricularia auricular, Psavinea, squarrosulus, Leucocoprins sp., Coprinellus micaceus, Ganoderma lucidum, Oudemansiella mucida. There were 5 types which include edible wild mushrooms that can be consumed by the community as a source of food and medicine, namely Termitomyces clypeatus, Pleurotus ostreatus, Schizophyllum commune, Auricularia auricular, and Pluteus cervinus, and 13 species include non-edible wild mushrooms and some of them are known as poisonous mushrooms.

1. Introduction
Fungi are one of the organisms that play an important role in the life cycle. The important role of fungi is to decompose complex organic materials that exist in nature into a very simple element so that it is easily absorbed and utilized by other organisms. Fungi are decomposers, parasitic and mutualistic organisms. Fungi, especially macroscopic fungi or macrofungi, are the main group of lignocellulose degrading organisms because they can produce lignocellulose degrading enzymes such as cellulase, ligninase, and hemicellulase. So that the cycle of matter in nature can continue. In addition, macroscopic fungal groups significantly affect forest food webs, survival or germination of tree saplings, tree growth, and overall forest health. Thus, the presence of macroscopic fungi is an important indicator of dynamic forest communities [1].

There are 200,000 species of 1.5 million species of 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, exploited, or have become extinct due to human activities. Several types of mushrooms can be used as a source of food and medicine, and others and some mushrooms can cause poisoning in a country that has extensive tropical rain forests with a high diversity of macroscopic fungal species. Macroscopic fungi play a special role in the decomposition of dead plants because fungi can utilize...
lignocellulosic materials. Fungal hyphae release a large number of extracellular enzymes that function to degrade various macromolecules, such as cellulose, hemicellulose, lignin, protein, into simple molecules, which are then absorbed by the fungal cells.

Pinrang Regency has the potential of various forest areas from lowland forest, and highland forest, which have long been used by the community as a source of non-timber forest products such as mushrooms, especially macroscopic mushrooms, these mushrooms are generally harvested by the community during the rainy season as a source of food and medicine, both for own consumption or sale. This study aims to determine the habitat characteristics and utilization of edible wild mushrooms by local communities in protected forest areas in Pinrang Regency, Indonesia.

2. Methods
2.1. Tools and materials
The tools used in this study were Global position system (GPS), hygrometer, camera, stationery, and mushroom identification books. The material used in this study was wild mushrooms.

2.2. Methods
The data used in this study include primary data and secondary data. Primary data is data obtained directly in the field or data that was first collected by researchers through field data collection using observation, survey, interview, and documentation methods. Secondary data is data that supports primary data, which is obtained from references that are relevant to this research in the form of the general state of the research area. The data collection techniques used by this research are:

2.2.1. Observation. Observation is a data collection technique that is carried out through direct observation of the object to be studied. This observation was carried out by researchers by direct observation of the characteristics and habitats of macroscopic fungi that exist around the forest area.

2.2.2. Survey. Habitat surveys are observations or observations that are carried out directly on the habitat or place of growth or the environment of a species. And measure the temperature and humidity by using a hygrometer. Purposive sampling method, based on the presence of microscopic fungi that are considered representative of the area, after which it is continued by recording the number of individuals. The fungi found in each plot were collected, and each species was taken for further identification using fungal identification books [2–5]. Then measurements were made on habitat conditions, including altitude, temperature, humidity, surrounding vegetation conditions, forest type, and type of place to grow. Measurement of habitat conditions, temperature, and humidity are measured using a hygrometer. A hygrometer is a tool for measuring air temperature and humidity, both indoors and outdoors. The condition of the surrounding vegetation, the type of forest, and the type of place to grow.

2.2.3. Questionnaire (Questionnaire). The questionnaire is a data collection technique by asking questions to be answered by respondents, in writing or not. This questionnaire is used by researchers to find out the perceptions or habits of residents or communities around forest areas regarding the use of macroscopic mushrooms found by the community.

2.2.4. Interview. The interview is a technique conducted by researchers by way of direct question and answer with respondents or informants to obtain information about macroscopic fungi to people who live around forest areas. This interview technique uses a structured technique where the questions have been prepared by the previous researcher.
2.2.5. Documentation study. Data collection is done indirectly on the object of research but through documents. The documents used can be in the form of research reports related to BPS data, habitats, and fungi at the research site, and other documents.

2.3. Data analysis
Primary data was collected through surveys and in-depth interviews with several respondents, while secondary data was obtained through document studies, literature studies, and scientific journals. The data of this study were analyzed descriptively qualitatively and presented in tabulated form.

3. Result and discussion
3.1. Habitat characteristics
According to Smith-Ferguson's climate classification, the climate type at the study site includes type B, which is wet with a dry and wet month ratio of 27.9%. The average rainfall is 2,780.2 mm/year, with an average of 9 wet months and 3 dry months. Rainfall occurs from December to June, with the highest rainfall occurring in March. The dry season occurs from June to December. At the research location, the air temperature range obtained was at 24-32°C, while the humidity was at 59-83%. Based on these conditions, it is very supportive of the growth of fungi, especially macroscopic fungi. This is because the fungus can grow with a relative humidity of 75-90%. Physical factors that are very influential on the life and place to grow mushrooms include temperature, humidity, altitude, and pH. According to Khosuma (2012), mushrooms can grow in the humidity range of 70-90%. While the temperature ranges from 22–27°C [6]. High irradiation intensity will inhibit the growth of fungal populations because it will inhibit the formation of structures of reproductive organs and fungal spores. Light, temperature, and water are ecologically important environmental factors in fungal growth.

The types of vegetation found by macroscopic fungi were forests, gardens, and settlements. The types of vegetation found were candlenut (Aleurites moluccana), mango (Mangifera indica), breadfruit (Artocarpus communis), kluwih (Artocarpus camansi), coconut (Cocos nucifera), banana (Musa paradisiaca), corn (Zea mays), salak (Salacca zalacca), grasses and litter. This macroscopic fungus or wild fungus is commonly found on forest floors, gardens, yards, and around rice fields, on dead wood trunks, soil, and litter.

| Mushroom Growing | Frequency | Percentage (%) |
|------------------|-----------|----------------|
| Soil             | 7         | 38.89          |
| Dead Wood        | 10        | 55.56          |
| Litter           | 1         | 5.56           |
| **Total**        | **18**    | **100.00**     |

Based on Table 1, the most fungus grows on dead wood stems, namely 10 species (55.56%), soil 7 types (38.89%) and litter 1 type (5.56%). Types of deadwood stem overgrown with fungus are candlenut (Aleurites moluccana), mango (Mangifera indica), breadfruit (Artocarpus communis), kluwih (Artocarpus camansi), coconut (Cocos nucifera), and dead banana (Musa paradisiaca).

3.2. Types and utilization of wild mushrooms
There are 18 types of fungi in the study area, all of which are in 1 Division Basidiomycota, Division Basidiomycota dominates the macroscopic fungal population in the study area including Termitomyces clypeatu, Pleurotus ostreatus, Pycnoporus sanguineus, Tyromyces chioneus, Trametes hirsute, Schneizolpita commune, Lepiota brunneoincarnata, Auricularia auricular, Psathyrella candelleana, Plateus cervinus, Parasola plicatilis, Parasola lectea, Lentinus squarrosulus, Leucocoprinus sp.,
Based on the survey results showed that the most abundant macroscopic fungi in each family were the Psathyrellaceae and Polyporaceae families having the highest percentage of 22.22%, and the Agaricaceae family of 16.67%, and the lowest percentages were Lyophyllaceae, Tricholomataceae, Schizophyllaceae, Auriculariaceae, Ganodermataceae, Physalacriaceae, and Pluteaceae which have a percentage of 5.56%.

Based on interviews, there were 5 species (27.78%) which include edible wild mushrooms that can be consumed by the community as a source of food and medicine, namely Termitomyces clypeatus, Pleurotus ostreatus, Schizophyllum commune, Auricularia auricular, and Pluteus cervinus, and 13 species (72.22%) include non-edible wild mushrooms and some of them are known as poisonous mushrooms. Several species of macroscopic mushrooms have been widely used by local communities as food ingredients and sources of traditional medicines. Mushrooms can be used as food ingredients because they have a delicious taste and are used as traditional medicines. Communities consume wild mushrooms because they have a delicious and savory taste, and most people say that macroscopic mushrooms or wild mushrooms found are generally used only for consumption as side dishes, made as snacks such as mushroom chips. According to some people, if they find a lot of mushrooms, usually some are consumed and also sold. People usually sell mushrooms in the form of processed foods such as mushrooms that have been mixed with vegetables or also stir-fried mushrooms. Several species of macroscopic mushrooms have been widely used by local communities as food ingredients and sources of traditional medicines. Mushrooms can be used as food ingredients because they have a delicious taste and are used as traditional medicines. People consume wild mushrooms because they have a delicious and savory taste, and most people say that macroscopic mushrooms or

| Local name | Scientific name | Family | Mushroom | Growing | Utilization |
|------------|-----------------|--------|----------|---------|-------------|
| Basi loka  | *Termitomyces clypeatus* | Lyophyllaceae | Soil | Edible |
| Basi       | *Pleurotus ostreatus* | Tricholomataceae | Deadwood | Edible |
| Tambatang  | *Pycnoporus sanguineus* | Polyporaceae | Deadwood | Non-edible |
| Ki’ddi     | *Schizophyllum commune* | Schizophyllaceae | Deadwood | Edible |
| Tambatang  | *Trametes hirsute* | Polyporaceae | Deadwood | Non-edible |
| Basi       | *Lepiota clypeolaria* | Agaricaceae | Soil | Non-edible |
| Basi       | *Lepiota brunneoincarnata* | Agaricaceae | Soil | Non-edible |
| Basi       | *Lentinus squarrosulus* | Polyporaceae | Deadwood | Non-edible |
| Basi       | *Auricularia auricular* | Auriculariaceae | Deadwood | Edible |
| Basi       | *Psathyrella conglobata* | Psathyrellaceae | Soil | Non-edible |
| Basi       | *Coprinellus disseminatus* | Psathyrellaceae | Soil | Non-edible |
| Basi       | *Parasola plicatilis* | Psathyrellaceae | Deadwood | Non-edible |
| Basi       | *Parasola lacteal* | Psathyrellaceae | Soil | Non-edible |
| Basi       | *Leucocoprinus sp.* | Agaricaceae | Soil | Non-edible |
| Tambatang  | *Tyromyces chioneus* | Polyporaceae | Deadwood | Non-edible |
| Basi       | *Pluteus cervinus* | Pluteaceae | Litter | Edible |
| Tambatang  | *Ganoderma lucidum* | Ganodermataceae | Deadwood | Non-edible |
| Basi       | *Oudemansiella mucida* | Physalacriaceae | Deadwood | Non-edible |

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Mushrooms from the Basidiomycota division that are often used and found by local communities are *Pleurotus ostreatus*, *Termitomyces clypeatus*, *Schizophyllum commune* (ki’ikki), *Auricularia auricular* (ear mushroom), and *Pluteus cervinus* (basi loka). *Auricularia auricular* (Ear mushroom) from the genus Auricularia have a shape like an ear, dark brown. Many grow wild in clusters attached to dead trees, fallen trees, piles of wood, or fence posts around the house, which is often used as a food source by the community because it has a delicious taste. This is following the very high content of ear mushrooms, with the composition: water 89.1%, protein 4.2%, fat 5.3% carbohydrates 2.8%, fiber 19.8%, and calories 351 mg [3]. *Auricularia auricular* is a species of wood fungus from the heterobasidiomycetes class which has high nutritional content and economic value. The nutritional content of ear mushrooms are protein, fat, carbohydrates, riboflavin, niacin, Ca, K, P, Na, and Fe. Ear mushrooms in terms of appearance are very unattractive but have very good nutritional content. In addition to these types of mushrooms, people do not dare to consume other mushrooms because of their ignorance of information about the content contained in these mushrooms.

Schizophyllum commune (ki’ikki) is a fungus that naturally grows on wood and can be consumed by humans [7]. The Schizophyllum commune can survive in dry conditions and can generally be found growing on dead tissue from wood with minimal water capacity. *Schizophyllum commune* mushroom (ki’ikki) is for personal consumption but some are sold to traditional markets in the form of mixed vegetables. The habit of consuming this mushroom has long been practiced by the community, this is because the taste of the mushroom is very delicious. The Schizophyllum commune (ki’ikki) mushroom contains many types of vitamins.

The *Pleurotus ostreatus* mushroom (Oyster mushrooms) has a white color. Oyster mushrooms contain high vitamins, amino acids, and minerals. This oyster mushroom is one type of mushroom that is very popular and is very popular among the Indonesian people. At this time oyster mushroom cultivation in Indonesia is growing very rapidly with the emergence of oyster mushroom farmers in several regions in Indonesia, and there are also several oyster mushroom farmers around the research location. *Pleurotus ostreatus* or Oyster mushroom is very easy to find in traditional and modern markets. Oyster mushrooms have a delicious taste and are also full of nutrients, high in protein, and low in fat. The shelf life of oyster mushrooms itself is easily damaged after being harvested. This is because oyster mushrooms have a fairly high water content of 86.6%. According to Ohiro (1990), dried oyster mushrooms have a higher protein content than wet oyster mushrooms, which is between 10.5-30.4% compared to the initial protein content of about 7.04% [8]. So that dried oyster mushrooms are better than other protein sources from soybeans and nuts. Egar., et al 2018, stated that every 100 grams of oyster mushrooms contain 19-35% protein with 9 kinds of amino acids; 1.7-2.2% fat consists of 72% unsaturated fatty acids, mushroom carbohydrates Thiamine, riboflavin, and niacin are the main B vitamins in oyster mushrooms besides vitamins D and C, minerals consist of K, P, Na, Ca, Mg, as well as Zn, Fe, Mn, Co, and Pb. Metallic microelements are very low, so they are safe for daily consumption.

Termitomyces clypeatus includes mushrooms that can be consumed; these mushrooms are very rarely found in very large quantities. Communities use Termitomyces mushrooms as food for consumption. Among the Termitomyces species, some species have medicinal properties, for example, to treat low blood pressure, rheumatism, kwashiorkor, and purgatives. Basi loka or *Pluteus cervinus*, is also one of the edible mushrooms that is generally found growing on litter; according to the community this mushroom has a delicious taste and is often used as an additional vegetable as an additional side dish at the community dining table, but this mushroom is very rare. found because only 1 or 2 mushrooms grow in 1 banana stem or litter. Several types of macro mushrooms are edible and have the potential to be developed in the form of cultivation, one of which is *Pluteus cervinus* [9].

Other macroscopic mushrooms that people find apart from those they know for consumption, they leave alone or ignore it because, according to residents, these mushrooms cannot be consumed or used.
From the results of interviews, people who use macroscopic mushrooms also said that they only eat mushrooms that have been passed down for generations to be consumed by their ancestors or their previous parents. This indicates that there is a lack of knowledge and understanding of the community about macroscopic mushrooms that can be consumed and also the use or manufacture of wild mushrooms as traditional medicines or other uses.

4. Conclusions
The characteristics of the wild mushroom habitat are climate type B, with average rainfall is 2,780.2 mm/year, a temperature of 24-32 °C, and relative humidity of 59-82%. In general, a wild mushroom grows on dead wood, especially candlenut (Aleurites moluccana) and mango (Mangifera indica), soil, and litter. There were 18 types of wild mushrooms found in the protected forest areas in Pinrang Regency, namely Termitomyces clypeatu, Pleurotus ostreatus, Pycnoporus sanguineus, Tyromyces chioneus, Trametes hirsute, Schizophyllum commune, Lepiota clypeolaria, Lepiota brunneoincarnata, Auricularia auricular, Psavinea, squarrosulus, Leucocoprinus sp., Coprinellus micaceus, Ganoderma lucidum, Oudemansiella mucida. There were 5 types which include edible wild mushrooms that can be consumed by the community as a source of food and medicine, namely Termitomyces clypeatus, Pleurotus ostreatus, Schizophyllum commune, Auricularia auricular, and Pluteus cervinus, and 13 species include non-edible wild mushrooms, and some of them are known as poisonous mushrooms.

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