Species richness of mosses in selo hiking trails mount merbabu national park

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Abstract. Bryophyte are a group of low vascular plants that are not vascular, small, can grow in several substrates and tend to have a humid habitat. Mount Merbabu National Park (TNGMb) is a forest area located in the Mount Merbabu area, which is located in three districts, namely Magelang Regency, Boyolali Regency and Semarang Regency (Central Java Province). The purpose of this study was to analyze the species richness of bryophyte along the Merbabu climbing track through Selo, Boyolali. The method used is the exploration or exploration method. The results of bryophyte that were successfully recorded and identified were 11 families and 15 species, namely Marchantia emarginata, Marchantia polymorpha, Marchantia inflexa, Asterella limbata, Bryum capillare, Rhodobryum ontariense, Brachytecium runtabulum, Barbula indica, Lagiommium succulentum, Pseudosleropendodium purum flabellatum, Ectropothecium dealbatum, Funaria hygrometrica, Leucobryum javaness.

The Bryophytes that are often encountered are Bryopsida and Marchantiaceae

1. Introduction

Mount Merbabu National Park (TNGMb) is a forest area located in the Mount Merbabu area, which is located in three districts, namely Magelang Regency, Boyolali Regency and Semarang Regency (Central Java Province) [1]. Mount Merbabu National Park is mostly mountainous with hilly topography and steep ravines and cliffs, has a type B climate with rainfall 2000-3000 mm and temperatures throughout the year 17-30 ° C [2]. Geographically, the TNGMb area is at 7 ° 27'13 '' South Latitude and 110 ° 26'22 '' East Longitude. The National Park is a nature conservation area that has an original ecosystem, managed by a zoning system that is used for research, science, education, cultivation support, tourism, and recreation purposes.

The TNGMb area is a source of water for the life of the surrounding society, as a protected flora and fauna habitat, has the potential for interesting natural and cultural tourism. One of the climbing tracks for Merbabu is in Selo, Boyolali, Central Java Province. The natural beauty, diversity of flora and fauna in Selo, which are still beautiful. In addition, the diversity of flora species found is still quite large, such as diversity of ferns [3], diversity of orchids [4], diversity of medicinal plants [5] and...
many more. An environment with dominance of higher plants such as trees and high humidity is an ideal habitat for the growth of lower plants such as bryophyte.

_Bryophyte_ includes a group of lower vascular plants, are small, can grow in several substrates [6]. In addition, bryophyte is called as pioneering plants because they are able to grow in an environment where other plants are unable to live [7]. Bryophyte lives in colonies and rarely found which live individually, these bryophyte colonies can grow in various habitats. The habitat of _Bryophyte_ is able to live on rocks, soil, weathered logs and is able to stick to the surface of tree trunks (epiphytes). However, some types of _Bryophytes_ that grow are limited to special environments, for instance Musci species that can only grow on soil types that have an acidic or alkaline pH only [8].

_Bryophyte_ plants can grow optimally in the temperature range of 15 ° C - 25 ° C [9]. This increase in altitude can be related to a decrease in ambient temperature. Every 100 m increase generally causes a temperature drop of 0.4 ° C-0.7 ° C [10]. In the life of bryophytes, environmental factors are very influential, namely the microclimate affects the growth and development of _Bryophytes_ rather than macro factors [10].

In the area of Merbabu Mountain National Park there was research about _Bryophyte_, thus research on the hiking trail through Selo Boyolali has not been carried out yet. Previous research conducted on the downhill of Merbabu Mountain specifically in the Kragilan area, Magelang. Therefore, it is necessary to explore and identify the richness of _Bryophyte_ species in Mount Merbabu National Park so that it can be used as a reference for several parties such as management, education and research. This study aimed to analysis the species richness of _Bryophyte_ that exist along the hiking track of the Mount Merbabu National Park through Selo, Boyolali, Central Java Province

2. Research methods

This research was conducted in January - July 2020, which is located in the Mount Merbabu National Park through the Selo Climbing track, Boyolali, Central Java Province. Specimens were collected along the climbing track, starting from the Reporting Post to the Sabana. Samples were put on paper envelopes and there were also plastic.

This research was conducted by using the roaming method, namely visiting a location that is often traversed by climbers, then paying attention to the right and left of the climbing route that can be reached by the researcher. All types of _Bryophytes_ that have been collected in the form of samples and photos. After that, researcher identified based on their morphology.

The technique of analyzing _Bryophyte_ plant data was carried out in a quantitative descriptive manner using identification books, namely: (1) _A Handbook of Malesian Mosses Vol 1 Sphagnales to Dicranales_ (Eddy, 1988); (2) _Handbook of Malesian Mosses Vol 2 Leucobryaceae to Bubaumnaceae_ (Eddy, 1990); (3) _Handbook of Malesian Mosses Vol 3 Splachnobryaceae to Leptomataceae_ (Eddy, 1996); (4) _Guide to the Liverworts and Hornworts of Java_. Jenice Glime (2007) and Mengenal Tumbuhan Lumut (Bryophyta) Lukitasari (2018).

3. Results and discussion

Based on the results of the study that 15 species of _Bryophytes_ were recorded, belonging to 11 families (Table 1). The families of _Marchantiaceae_ and _Bryaceae_ are a group of mosses that dominate the research location because of the highest number of species and are often found. The classes of bryophytes found are _Marchantiopsida_ and _Bryopsida_. _Marchantiopsida_ found 1 family while _Bryopsida_ found 10 families.

Merbabu is one of the mountains on the island of Java. Merbabu has an altitude of ± 3142 masl, humidity reaches 75% RH in the savanna, temperatures between 16 ° C-23 ° C on the Selo hiking track, Boyolali Regency, Central Java Province.

Merbabu on the Selo hiking tracks has humidity and temperature suitable for moss growth. This is supported by Van Steenis (Lipi, 2006) who states that moss plants found in the Java Mountains tend to be found at altitudes ranging from 1600-4500 masl, or so-called starting from the mountainous zone to Sub Alpin, because _Bryophyte_ can grow at humidity more than 70%, and temperatures of 10 ° C-30 ° C [11].

_Bryophyte_ can be found in various substrates including: trees, weathered wood, soil, and rocks. The results of the analysis showed that most of the _Bryopsis_ grew on tree branches and trunks and only a few species grew on the ground. _Marchantiopsida_ are mostly found growing in soil and humid
places. This is consistent with Mundir (2013) that *Marchantopsida* are often seen in very humid and wet places, for example along rivers, mountains or hills that have cold temperatures.

Table 1. Thally Sheat species richness of *Bryophyte* in Merbabu Mountain National Park  Selo hiking track, Boyolali, Central Java

| Familii       | No | Species                  | Substrat                    |
|---------------|----|--------------------------|-----------------------------|
| Marchantiaceae| 1  | *Marchantia emarginata*  | Stone, Soil,                |
|               | 2  | *Marchantia polymorpha*  | Stone, Soil,                |
|               | 3  | *Marchantia inflexa*     | Stone, Soil,                |
| Aytoniaceae   | 4  | *Asterella limbata*      | Soil                        |
| Bryaceae      | 5  | *Bryum capillare*        | Tree                        |
|               | 6  | *Rhodobryum ontariense*  | Tree, Weathered Wood        |
| Pottiaceae    | 7  | *Brachytrichum rufatum*  | Soil, Tree                  |
|               | 8  | *Barbula indica*         | Batuan                      |
| Mniaceae      | 9  | *Plagiomnium succulentum*| Tanah, Tree                 |
| Brachytheciaceae| 10 | *Pseudoscleroepodium purum* | Tree                      |
| Meteoriaceae  | 11 | *Barbella pendula* (Sull.) Fleisch | Twigs            |
| Neckeraeae    | 12 | *Homaliiodendrom filabellatum* | Tree                      |
| Pylasiae      | 13 | *Ectropothecium dealbatum* | Tree, Weathered Wood        |
| Funnariaceae  | 14 | *Funaria hygrometrica*   | Tree                        |
| Leucobryaceae Schimp | 15  | *Leucobryum javaness*    | Tree (Cemara Gunung)        |

11 Family 15 Species

Some types of bryophytes are cosmopolitan, which can be found everywhere. Each species of *Bryophytes* has a limited distribution area or substrate [15]. *Bryophyte* that grow on trees such as *Barbula indica* have benefits for the surrounding environment, namely as an indicator of pollution. This can be seen if an area is polluted such as pollution and is overgrown by *Barbula indica*, the average leaf height and moss height will decrease. This is because lichens are very tolerant and can last for weeks or even months at a moisture content of less than 5% [16].

The moss plant of the *Meteoriaceae* family is a smooth and long hanging *Bryophyte* like a meteor so it is called Meteoridae. The *Bryophyte* that hangs like a beard, but is quite rough like coconut husk, is usually used by residents as a pillow filling for cotton. The following plants found on the Selo hiking track, Mount Merbabu Selo Boyolali, Central Java are shown in Figure 1. *Bryophyte* species richness in the Mount Merbabu National Park, Selo Hiking Route, Boyolali Regency dominated by *Bryophyte* whose habitat is trees and rotten woods. Environmental conditions around the ascent of Mount Merbabu Selo Route are quite supportive for spore germination, growth and development of *Bryophyte*, especially in trunks of tree. According to Bates (2008), a substrate with a rough surface is a good place for moss growth, while a smooth and slippery surface cannot be overgrown with *Bryophyte*.

However, this is not the case with bryophyte with soil or rock substrate on the forest floor. It is along the climbing track that is traversed by climbers, the presence of water flowing and some that is inundated by the forest floor, which affects the spores of *Bryophyte* that are released from their capsules (spore boxes). The size of the spore box which is very small and lightly carried by the water will easily be washed away, so that it will not be possible to grow on the forest floor in such conditions on the forest floor in the study location.

*Bryophyte* that can grow on trees are mostly found at the base of trees 0- 100 cm, rather than on the parts of trees that are 100-200 cm taller [13]. Lichens can only be found in that area because at the base of the tree there is a lot of humus or it is closer to the ground, so that the type of *Bryophyte* that grows on the ground can also grow at the base of the tree [15]. When viewed from the substrate for growth, *Bryophytes* generally grow on trees. This is because the surface of the tree or branch is generally uneven so that the spores of the *Bryophytes* are released from the spore box can be caught or remain attached to the cracked part of the trunk [2]. The root surface is cracked and supported by a
humid environment, sufficient sunlight, the Bryophyte buds and spores can germinate and then continue their life [14]. In the leaves of the trees, Bryophyte growth is found, especially on the coarse or hairy parts of the leaves in humid and shady environments.

**Figure 1.** Species richness of Bryophyte in Selo hiking track Mount Merbabu National Park (A). *Marchantia inflexa*, (B) *Marchantia emarginata*, (C) *Marchantia polymorpha*, (D) *Brachythecium rutabulum*, (E) *Leucobryum javanes*, (F) *Bryum capillare*, (G) *Floribundaria floribunda*, (H) *Rhodobryum ontanariense*, (I) *Campylopus spp.*, (J) *Plagiomnium succulentum*, (K) *Homaliodendrom flabellatum*, (L) *Pseudoscleropodium purum*, (M) *Barbula indica* (N) *Asterella limbata*, (O) *Barbella
The richness of Bryophyte species in the Mount Merbabu National Park area is dominated by the type of Bryophyte whose habitat is soil and trees or tree trunks, with a weathered wood substrate. Weathered wood is a good medium for Bryophyte because the wood has been weathered so that it is able to absorb and store quite a lot of water between the wood cells. So that bryophyte spores that fall on the substrate and are supported by sufficient light intensity can germinate, grow and develop into Bryophytes [14]. In line with Windadari (2010) states that weathered wood is a good place for Bryophyte growth because it provides water and the substances needed for moss growth. Bryophyte cannot be found growing on the rotten wood of Iwul trees, this is because the surface of the trunk is relatively smooth. Thus, it cannot be a substrate for Bryophyte growth. In addition to sticking to tree trunks of Bryophyte which are often found hanging on tree branches, this Bryophyte comes from the Meteoriaceae family which has dense leaves. This type of bryophyte is often found climbing on tree trunks because the substrate in this type is suitable and the tree or twig that is used as a place to stick and hang has a rough and not smooth bark structure so it is suitable for attaching spore boxes and germination and growth take place.

Bryophyte can grow on rocks because of the humidity generated by Bryophyte. Although Bryophyte biomass is small, if the water content of Bryophyte is high, the moisture in the rock will be high. The high humidity in the rock causes the minerals in the rock to degrade more. Hence, the weathering process by moisture can occur due to the hydration reaction of the mineral components making up the rock [20].

The Bryophytes found on the Selo Hiking Track, Boyolali, Mount Merbabu are dominated by various kinds of Bryopsida and Marchantiopsida. The farther from the forest, the type of Bryophyte found will decrease, bryophyte are more abundant if they are at higher altitudes [16]. The presence of Bryophyte such as epiphytic Bryophyte is influenced by climatic conditions, it is also influenced by the host tree species, the distribution and abundance of bryophytes can be influenced by the physical and chemical characters of the host tree [17]. It is such as the diameter of the stem, the texture of the bark, the water absorption and the acidity of the bark [18]. If bryophyte is not able to live in a certain place because it adapts to its reproductive system, the substrate is in the form of rocks or tree roots that have been dominated by algae (algae) growth [19].

The number of species and families from this study is less than the results of the study of Bryophyte in 2017 in the downhill of Mount Merbabu through the forest of Pinus Kragilan, Magelang Regency, Central Java Province, which recorded 11 families and 15 species. Bryophytes that are found and recorded are from the Bryopsida class or leaf lichens from the Anthoceratopsida class and Hepaticopsida class [11].

4. Conclusion
The results showed that the conditions in Mount Merbabu National Park through Selo climbing route, Boyolali, Central Java Province have a fairly good condition for bryophyte habitat. This can be seen from the richness of species of Bryophytes that were found, namely as many as 15 species.

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