



## Variety of Bryophytes in Sultan Adam Mandiangin Grand Forest Park Area

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### Abstract

Moss plants can live well in areas that have high humidity. The Dutch Guesthouse which is located in the Sultan Adam Mandiangin Forest Park area has quite high humidity because the area has lots of dense plants, so it is a suitable habitat for the living nature of moss plants. This study aims to describe and identify the types of moss found. Data collection was carried out using the total roaming method, which was then followed by determining and identifying each sample of the moss plants found. Data analysis was carried out descriptively and identifying species with reference to the literature. The results of the study found 10 species of mosses belonging to 7 different families, both found in tree, rock and soil habitats. The species found were: *Calymperes tenerum*, *Calymperes afzelii*, *Hyophila apiculata*, *Hyophila involuta* (Hook.) A. Jaeger, *Ectropothecium falciforme*, *Octoblepharum albidum*, *Philonotis hastata*, *Acroporium secundum*, *Lejeunea lamacerina*, and *Thysananthus sp.* The results of this study are expected to provide information about the variety and biodiversity of mosses in South Kalimantan.

Keywords : Habitat, Bryophytes, Determination of Bryophytes, Various types of Bryophytes, Forest Park Sultan Adam Mandiangin

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### 1. Introduction

Moss plants (Bryophyta) belong to the division of lower plants. Occupying the second position after flowering plants in the plantae kingdom. Globally, there are approximately 18,000 species of moss, with around 1,500 species found in Indonesia. Which, being a tropical rain-forest area, provides optimal humidity for moss habitat [1].

Mosses thrive in diverse habitats, including the ground, rocks, large trees, and weathered wood. Their habitat necessitates moist and wet environmental conditions [2], making them well-suited for areas with high humidity. This resilience qualifies moss plants as pioneer plants, as they can initiate life in arid regions, paving the way for the establishment of various other plant species in the area [3].

The moss plant plays a crucial role in the tropical mountain forest ecosystem, aiding in maintaining water balance and nutrient cycles in the forest [4]. Additionally, moss serves as a bioindicator of environmental pollution [4] due to its sensitivity to changes in the environment [6].

Sultan Adam Grand Forest Park (Tahura) is located in the area of Mandiangin Timur Village, Karang Intan District, Banjar Regency, South Kalimantan. Tahura is one of the educational forests inhabited by various types of plants. Tahura is a highland area, it has a high humidity, creating an optimal environment for the biodiversity of flora and fauna.

Based on the research on biodiversity in the Sultan Adam Mandiangin Forest Park (Tahura) area by [7], 15 species of fern plants, both epiphytic and terrestrial. In another research by [8], 6 species of orchids and 4 species of pteridophytes were found. However, the question remains what types of moss plants are present in the Sultan Adam Grand Forest Park (Tahura) area. Therefore, research was conducted to explore the variety of moss plant species in that region.

This research aims to describe and identify the various moss species found in the Sultan Adam Grand Forest Park area. The results of this research are expected to provide information about the biodiversity of moss plants in South Kalimantan.

### 2. Materials and Methods

Samples were observed in the form of moss plants

found in the Dutch Reservation area of the Sultan Adam Mandiangin Forest Park. For sampling use a scraper. Camera for documentation, and detailed observation microscope and photomicroscope.

The research was conducted from January to June 2023 in the Dutch Pesanggarahan located in the Sultan Adam Mandiangin Forest Park. Moss sampling was carried out using the total exploration method, namely by exploring the paths around the Dutch Pe-sanggarahan area in Tahura Mandiangin. Samples taken include moss plants found attached to the soil, rocks, and trees taking complete moss parts. Before the samples were taken, the moss plants were photographed in their habitat. Then the moss was brought to the laboratory. In the laboratory, the moss

plants were observed morphologically and microscopically regarding the shape and structure of the thallus, phylloid shape, and reproductive organs, then described identified, and classified to the family level. The identification of bryophytes refers to the identification key and literature from the books [9], [10] and [11] as well as several journals.

### 3. Results and Discussion

The results of observations of moss plants found in the Dutch Pesanggrahan, Sultan Adam Mandiangin Forest Park obtained as many as 10 species belonging to 7 families as shown in Table 1.

**Table 1. Variety of bryophytes**

Class	Familia	Species	Habitat
Bryopsida	Calymperaceae	<i>Calymperes tenerum</i>	Tree
		<i>Calymperes afzelii</i>	Tree
	Pottiaceae	<i>Hyophila apiculata</i>	Tree, soil
		<i>Hyophila involute</i> (Hook.) A. Jaeger	Rocks
	Hypnaceae	<i>Ectropothecium falciforme</i>	Tree
	Octoblepharaceae	<i>Octoblepharum albidum</i>	Tree
Hepaticopsida	Bartramiaceae	<i>Philonotis hastata</i>	Rocks
	Sematophyllaceae	<i>Acroporium secundum</i>	Tree
	Lejeuneaceae	<i>Lejeunea lamacerina</i>	Tree
		<i>Thysananthus</i> sp.	Soil

The characteristics of the Moss (Bryophytes) studied in the Salian Adam Mandiangin Forest Park Area and observations with a microscope at the Biology Laboratory of the FKIP, University of Lambung Mangkurat, showed a clear morphological difference. These characteristics can be seen from the morphology and structure of the thallus

of the moss plant, its phylloid form, its reproductive organs, and its habitat. The results showed that there were 8 types of mosses belonging to the Bryopsida group, and 2 types of leafy liverworts (Leafy hepaticae) belonging to the Hepaticopsida mosses.

#### Variety of Bryophytes in the Forest Park Area of Sultan Adam Mandiangin

##### 1. *Calymperes tenerum*

Bryophytes found in the Sultan Adam Mandiangin Forest Park area are as follows

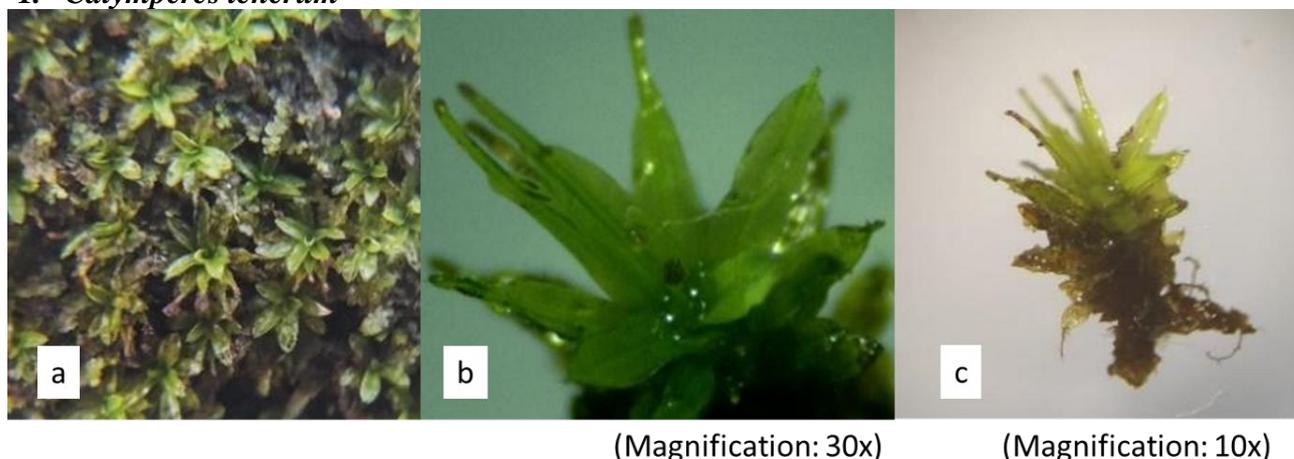


Figure 1: Observations of *Calymperes tenerum*: (a) habitus (b) leaves (c) stems and rhizoids

Based on the observation, the gametophyte phase of this moss is found in the form of leaves, stems, and

roots. The leaf morphology is dark green, lance-shaped, with a smooth edge and a pointed tip. The stem is not visible. This moss type has rhizoids that resemble threads. During the study, no sporophyte phase was found, and there were no Gemmae observed at the tip of the leaves. This moss is found attached to the surface of trees.

*Calymperes tenerum* is found at the base of tree substrates and is also found in agricultural and rubber plantation areas. In addition to tree substrates, it can be found on rocks, soil, and decaying wood. The stem grows

upright and acrocarp [12]. The rhizoids when observed, appear as threads firmly attached to the substrate. When measured, the leaves are 1.4 mm long, green in color, lanceolate-shaped, and with a flat edge [1]. According to [13], the vegetative reproduction of this moss involves gemmae. Gemmae round in shape and spiny, are found at the tip of its leaves, which is a characteristic feature of this species.

## 2. *Calymperes afzelii*



Figure 2: Observations of *Calymperes afzelii*: (a) habitus (b) leaves (c) stems and rhizoids (d) adaxial shoots (gemmae)

Based on the observations, the gametophyte phase consists of phylloids and stems. The phylloids are yellowish green, lanceolate-shaped, with a flat edge and a pointed tip. It has an upright stem resembling a rhizome. During the study, no sporophyte phase was found to be growing, but there were adaxial buds found at the tip of the leaves. This moss is found attached to the surface of trees.

The Calymperaceae family generally grows in groups with upright stems, rarely found growing creeping, and usually found on tree trunks [14]. The rhizomes are red to yellowish brown [11]. The leaf edge is flat,

becoming thicker below the leaf tip, with a blunt leaf tip and the presence of gemmae. Gemmae are generally adaxial at the tips of the leaf, curling around the costa, and the base of the leaf is upright with yellowish-green leaf color [6]. Calymperaceae has two types of reproductive structures, generative reproductive structures in the form of spores and vegetative reproductive structures in the form of buds (gemmae) found at the tips of its leaves [15].

## 3. *Hyophila apiculata*

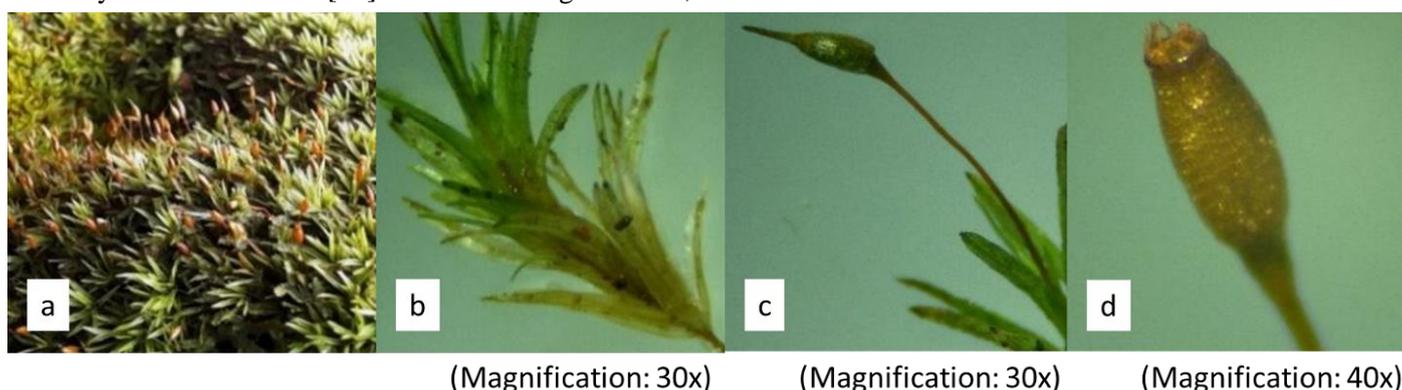


Figure 3: Observations of *Hyophila apiculata*: (a) habitus (b) leaves (c) capsule and seta (d) peristomal teeth

Based on the observation, the moss *Hyophila apiculata* found parts of the gametophyte phase including stems, leaves, and rhizoids. Additionally, the sporophyte phase includes seta and capsules. The leaf morphology of this moss is light green, lanceolate-shaped, with flat edges and a pointed tip. The stems and roots of the moss are

covered by a pile of leaves. The seta is reddish-brown, and the capsule is located at the end of the seta. The capsule has brownish peristome teeth, while the calyptra is light green. This moss is found on the soil surface and can also be attached to weathered trees.

This moss can be found attached to soil substrates,

rocks, and dead wood substrates [11]. The moss *Hyophila apiculata* has a light green color, and its leaves are arranged alternately with flat leaf edges. The leaf tips are tapered and curved [16]. This species has an oval-shaped sporangium. The stem of this moss is very short and cov-

ered by its leaves, making it not visible [4].

#### 4. *Hyophila involute* (Hook.) A. Jaeger

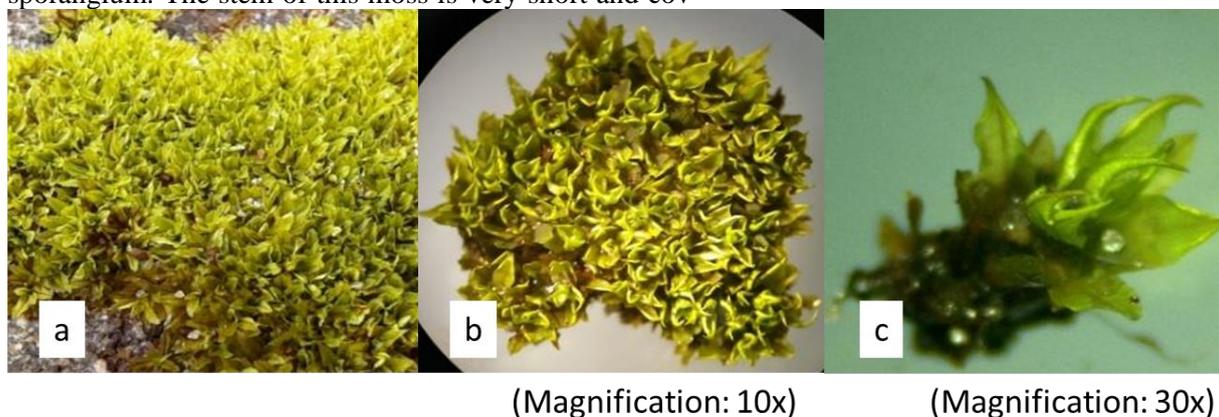


Figure 4: Observations of *Hyophila involute* (Hook.) A. Jaeger: (a) habitus (b) leaves (c) stem

The observation found parts of the gametophyte phase in the form of leaves and stems. The leaves are yellowish green, oval-shaped with flat edges and tapered tips. The stems are very short and covered by a pile of leaves. No sporophyte was found during the observation. This moss is found on the surface of rocks and grows in groups.

*Hyophila involute* is found on rock substrates in agricultural areas and grows in groups. The leaves are

light green, spreading when moist, and curling when dry [11]. Only the gametophyte phase was found. Thread-like rhizoids are attached to the substrate. The stem is almost invisible as it is covered by leaves. The leaves are light green, oval-shaped, with flat edges, and tapered tips [1]. In the *Hyophila* genus, the upper part of the stem is green, and the lower part is red to reddish-brown or dark green [6].

#### 5. *Ectropothecium falciforme*

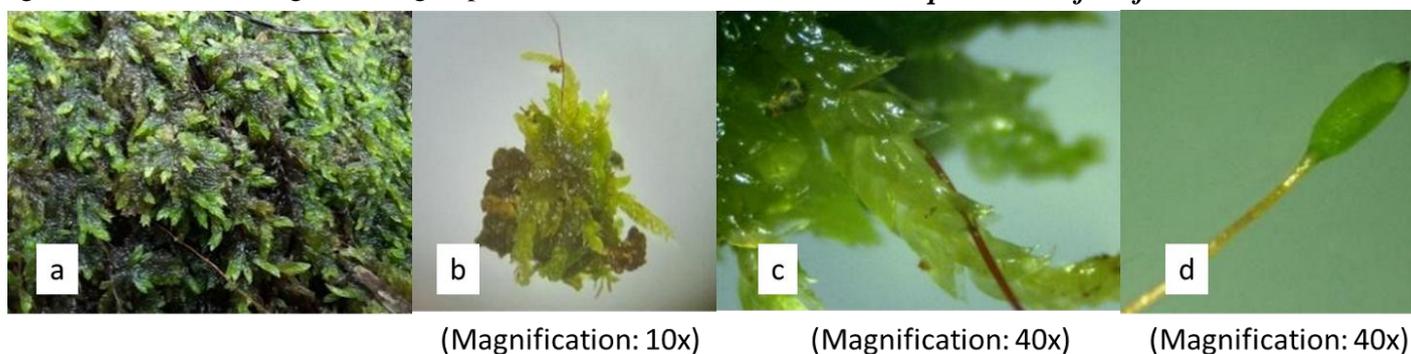


Figure 5: Observations of *Ectropothecium falciforme*: (a) habitus (b) stem (c) leaves (d) capsules and setae

The observation results of *Ectropothecium falciforme* found the gametophyte and sporophyte phases. In the gametophyte phase, parts of leaves and stems were found, while in the sporophyte phase, setae and capsules were identified. The leaves are yellowish-green, oval-shaped, with flat edges and tapered tips. The stem is very short, branching and crawling on the substrate, covered by leaves. The setae are reddish. The capsule is located at the tip of the seta, oval-shaped, light green, with a calyptra at its end. This moss was found creeping on decaying dead trees.

*Ectropothecium falciforme* moss grows in a creeping arrangement, forming a dense weave-like structure. Its small leaves are stacked, oval-shaped, and arranged alternately around the branches [6]. The leaves are oval-shaped with tapered ends. The stem is almost invisible as it is covered by a mass of leaves and creeps on the surface of the substrate. The rhizoids are thread-like in shape [1]. The capsule is located at the tip of the setae, slightly curved oval with a calyptra at the end [17].

## 6. *Octoblepharum albidum* Hedw

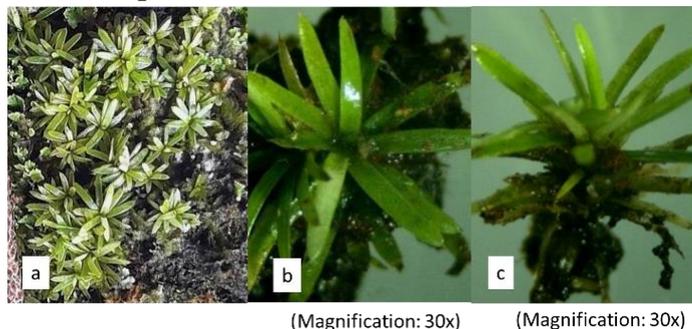


Figure 6: Observations of *Octoblepharum albidum* Hedw: (a) habitus (b) leaves (c) stems and rhizoids

Observations found only the gametophyte phase in the form of leaves and stems. Leaves are pale green, line-shaped with flat edges and tapered ends. The rhizoid is not visible during observation because it is covered by leaves. No sporophytes were found during observation. This moss lives in groups and is found attached to the surface of tree trunks. When discovered this moss grows with other types of moss colonies side by side.

*Octoblepharum albidum* is a leafy moss that lives attached to trees. According to [18], the leaves of this moss appear thick and shiny. The moss has a light green to pale green color, and the arrangement of the leaves is spread in a linear shape [19]. The stem is not visible as it is covered by leaves. The rhizoids have a thread-like shape and strongly attach to the substrate [1]. In the field, only the sporophyte phase was found, but according to [11], *Octoblepharum albidum* moss has a long setae and oval-shaped capsule that becomes shiny brown when ripe.

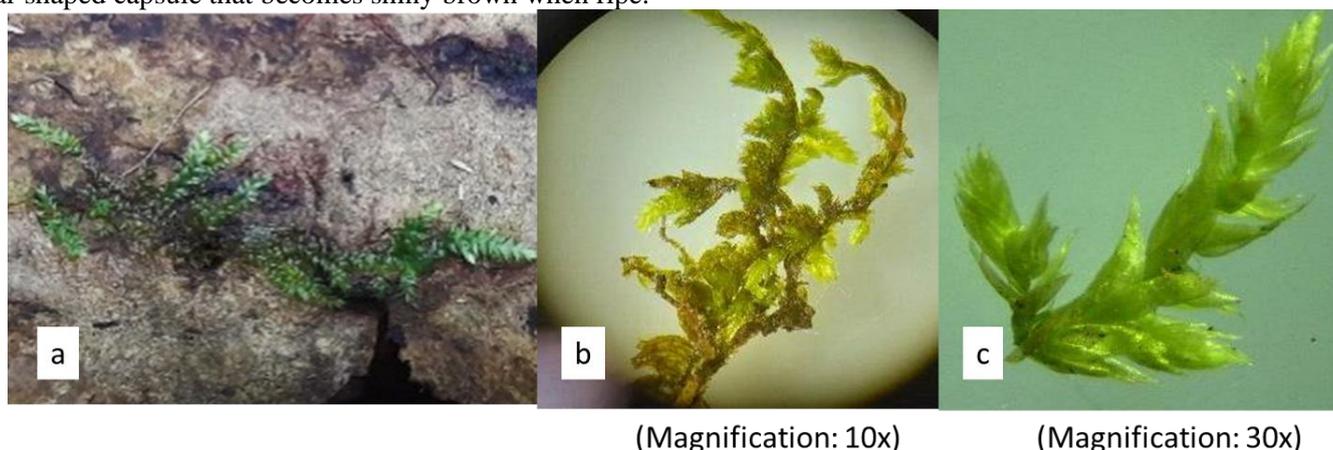


Figure 8: Observations of *Acroporium secundum*: (a) habitus (b) stem (c) leaves

The results of morphological observations of this moss are found in the leaves. The leaves are light green, lanceolate-shaped, with flat edges, and pointed tips. Rhizoids and stems are not visible during observation due to leaf coverage. No sporophyte was found during the obser-

## 7. *Philonotis hastata*



Figure 7: Observations of *Philonotis hastata*: (a) habitus (b) leaves and stems

The results of morphological observations of this moss are found in the form of leaves and stems. The leaves are yellowish green, lanceolate-shape, with flat edges, and tapered ends. The stem is straight and unbranched. No sporophytes were found during observation. This moss is found attached to moist rocks.

The habitat of *Philonotis hastata* includes moist and wet soil, as well as rocks. The sporophyte consists of a seta and capsule. The capsule is pyriform, horizontal, and slightly hanging [20]. This moss is slender with an upright stem. Its leaves will curl to reduce evaporation when dry, lanceolate-shaped with pointed tips, and flat edges. The arrangement of the leaves is tightly spiraled [4]. The leaves are green when young and turn yellowish as they age. Thread-like rhizoids attached to the substrate [1].

## 8. *Acroporium secundum*

This species was observed to grow creeping on weathered tree trunks.

*Acroporium secundum* belongs to the Sematophyllaceae family which can grow in moist forests, bark, and is rarely found on rocks [21]. *Acroporium secundum* has

shiny green or yellowish-green leaves, ranging from oval-shaped to lanceolate. The rhizoids are thread-like and brown, attaching to the substrate [22]. The brown stem is almost invisible as it is covered by leaves and grows in a creeping manner. According to [1], the setae of *Acroporium secundum* elongates and brownish-green in color. The capsule is elongated and green in color.

### 9. *Lejeunea lamacerina*

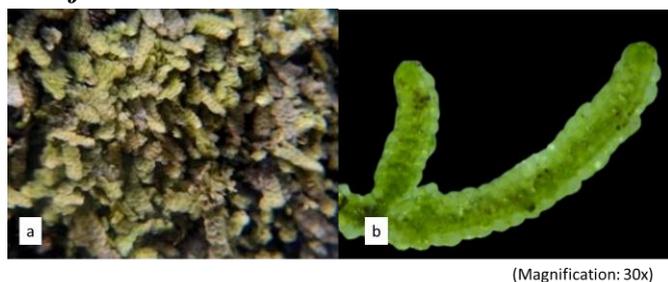


Figure 9: Observations of *Lejeunea lamacerina*: (a) habitus (b) leaves

The morphological observation results of this moss indicate the presence of only leaf parts. The leaves

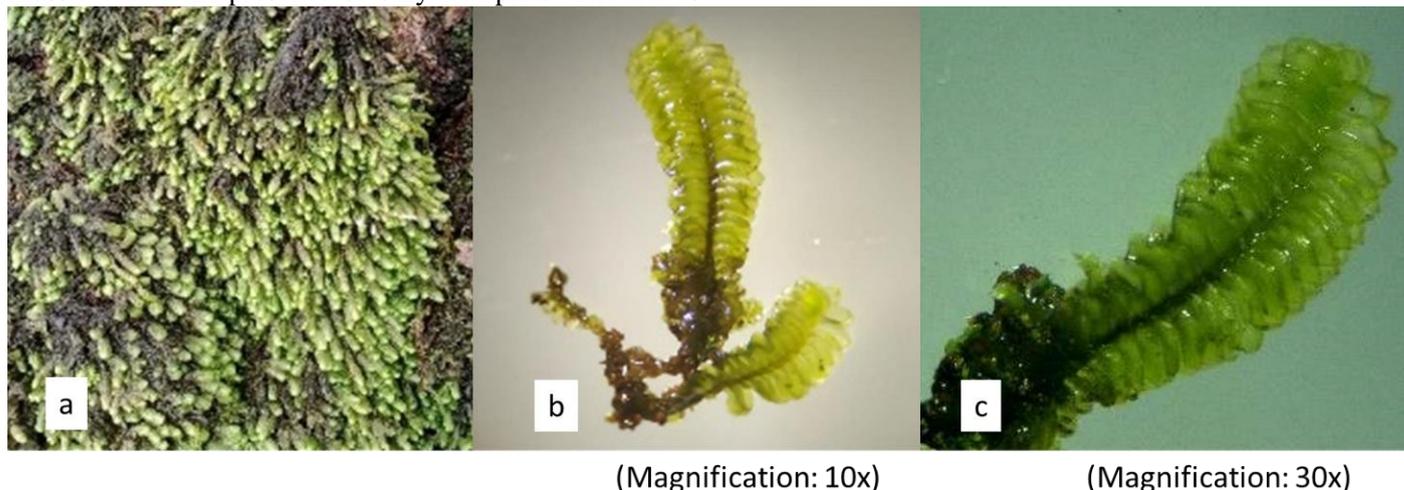


Figure 10: Observations and literature on *Thysananthus* sp: (a) habitus (b) stem (c) leaves

The morphological observation results of this leafy liverwort are found only in the leaves. The leaves are light green, oval-shaped, with flat edges and rounded tips. The arrangement of the leaves is stacked in parallel. Rhizoids and stems were not observed during the observation as they were covered by leaves. No sporophyte was found during the observation. This species was observed to grow on the surface of tree bark.

*Thysananthus* sp belongs to the family Lejeuneaceae. This plant is characterized by convex leaves with rolled lobule edges [25]. The leaves range in color from light green to brownish, with oval-shaped to elongated lobes, flat edges, rounded to tapered ends, and in the middle there are several rows of cells resembling leaf veins (vittae) [26]. This moss plant is epiphytic, attaching itself

are pale green, oval-shaped resembling fish scales, with flat edges and rounded tips. The stem and rhizoids are not visible during observation as they are covered by leaves. The sporophyte phase was not found during the observation. This species was observed to grow on the surface of tree bark.

*Lejeunea lamarcerina* is a liverwort from the Lejeuneaceae family. It is commonly found on rocks and trees in areas around rivers, as well as in hilly forest regions. This moss plant is an epiphytic organism that grows attached to tree trunks [23].

*Lejeunea lamarcerina* is characterized by its creeping stem with lobes that function as water pockets for absorption, water storage, and to reduce the risk of drought so that they can survive well [24]. The rhizoids are fine brown hairs that strongly attach to the substrate. The stem creeps on the substrate and is covered by an arrangement of leaves. The leaves are pale green, neatly arranged, oval-shaped, with flat edges, and blunt tips [1].

### 10. *Thysananthus* sp

to both living and dead tree trunks. Tropical lowland rainforests are suitable areas for the growth of this moss plant [27].

#### Abiotic Factors in the Sultan Adam Mandiangin Grand Forest Park Area

The survival of moss plants is influenced by the environmental conditions of the habitat by the adaptability of these plants. The following are the results of measuring environmental parameters in the Sultan Adam Mandiangin Forest Park area which can be seen in Table 2.

**Table 2: Table of environmental parameters**

No.	Parameter	Unit	Range
1.	Light intensity	Lux	Min Max 8450-8890 14.590-18.540
2.	Soil pH	-	6,4-6,5
3.	Soil moisture	%	76%-80%
4.	Air humidity	%	71%-77%
5.	Venue Altitude	Mdpl	315
6.	Air temperature	°C	27-29°C

Based on the measurement results, light intensity was obtained in the range of 8,450-18,540 lux, soil pH ranged from 6.4-6.5, soil moisture ranged from 76-80%, air humidity ranged from 71-77%, altitude 315 meters above sea level and air temperature 27-29°C.

The existence of moss (Bryophytes) is influenced by abiotic factors such as light intensity, where moss will grow optimally at a light intensity of 10,000 lux or 795 Cd to help the photosynthesis process [28]. Bryophytes will grow optimally at air temperatures of 10-30°C, the air humidity in the range of 70-98%, and optimum soil moisture for moss growth of 50-80% [29]. Soil pH ranges from 4.3-8.3 [30], and elevation below 1000m [11]. Lower soil temperature can help average water evaporation and root growth, while altitude can affect climate [28].

Based on the results of environmental parameter measurements, it is known that the Sultan Adam Mandiangin Grand Forest Park has a suitable habitat and supports moss growth.

## 4. Conclusion

From the results variety of Bryophytes found in the Dutch Pesanggrahan which is located in the Sultan Adam Mandiangin Grand Forest Park area, conclusions can be included that there are 10 species out of 7 familia, both in tree, rock, and soil habitats; that is, *Calymperes tenerum*, *Calymperes afzelii*, *Hyophila apiculata*, *Hyophila involute* (Hook.) A. Jaeger, *Ectropothecium falciforme*, *Octoblepharum albidum*, *Philonotis hastata*, *Acroporium secundum*, *Lejeunea lamacerina*, and *Thysananthus* sp.

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