



Variety of Bryophytes in Sultan Adam Mandiangin 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 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 various species of moss found in the area of study. Data collection was carried out using the exploring method, followed by determining and identifying each sample of the moss plants found in the laboratory. Data analysis was carried out descriptively and identifying species with reference to the relevant literatures. The results 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*, *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: Bryophytes, Habitat, Determination, Variety, Sultan Adam Mandiangin Forest Park

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1. INTRODUCTION

Moss plants (Bryophyta) are members of the division of lower plants. Mosses occupy the second place after flowering plants in the kingdom Plantae. The number of moss plants recorded in the world is approximately 18,000 species, and around 1,500 species of moss are found in Indonesia. Indonesia is a tropical rain forest area that has optimal humidity for moss habitat [1].

The habitat of mosses is quite diverse, they can be found on the ground, attached to rocks, on large trees, and are often found in weathered wood. Bryophytes habitat requires moist and wet environmental conditions [2]. Moss plants can live well in areas that have high humidity. This high ability to live is what makes moss plants often referred to as pioneer plants, because moss plants are able to start life in arid areas and then be followed

by various other plant species in the region [3].

Moss plants are one of the important components in tropical mountain forest areas that play a role in water balance and forest nutrient cycles [4]. In addition, moss plants also act as bio-indicators of environmental pollution [5]. This is because mosses are sensitive to environmental changes [6].

Sultan Adam Forest Park (Tahura) is located in the East Mandiangin Village area, Karang Intan District, Banjar Regency, South Kalimantan. Tahura is one of the areas that is used as an educational forest and is overgrown by various types of plants. Tahura is a highland area that has optimal humidity so it is very suitable as a habitat for moss to grow. However, the question is, what types of moss plants are found in the Sultan Adam Forest

Park (Tahura) area. Therefore, a study was conducted on the various types of moss plants in the region.

This study aims to describe and identify the types of moss found in the Forest Park

2. MATERIALS AND METHODS

The samples observed were moss plants that were found attached to the surface of trees, on rocks, or growing on the ground in the Sultan Adam Mandiangin Grand Forest Park area. For sampling using a scraper, cameras for documentation, and detailed observation using microscopes and photo microscopes.

The research was carried out from January to June 2023 at the Dutch Pesanggrahan which is in the Sultan Adam Mandiangin Forest Park area. Moss sampling was carried out using the exploration method, namely by exploring the paths around the Dutch Pesanggrahan area in Mandiangin Forest Park.

area. The results of this study are expected to provide information about the biodiversity of mosses in South Kalimantan.

When making observations, samples were documented in their habitat and then taken and brought to the laboratory. In the laboratory, the moss plants were observed morphologically and microscopically regarding the shape and structure of the thallus, phylloid form, and their reproductive organs, then they were described and identified and classified down to the family level.

3. RESULTS AND DISCUSSION

The results found 10 species belonging to 7 families of mosses in the Dutch Pesanggrahan, Sultan Adam Mandiangin Forest Park obtained as shown in table 1.

Table 1. Variety of bryophytes found

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

The characteristics of the Moss (Bryophytes) studied in the Sultan 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

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

1. *Calymperes tenerum*

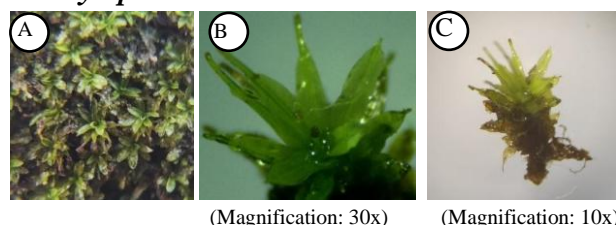


Figure 1. *Calymperes tenerum*: (A) habitus (B) leaves (C) stem and rhizoids

Based on the observations, it was found that the gametophyte phase consisted of leaves, stems and roots. The morphology of the leaves is dark green, the shape of the leaves is lanceolate, with flat edges and tapered ends. The stem is not clearly visible. This type of moss has thread-like rhizoids. At the time of the study there was no sporophyte phase and no gemmae were found at the tip of the leaf. This moss is found attached to the surface of the tree.

Calymperes tenerum is found at the base of tree substrates and is found in agricultural areas and rubber forests. In addition to the tree substrate, it can be found in rocks, soil, and rotting wood. Stems grow upright and acrocarp [7]. Rhizoids when observed are like threads firmly attached to the substrate. The leaves when measured have a length of 1.4 mm, green color, lanceolate shape, and flat edges [1]. According to [8] vegetative propagation of this moss uses gamma. Gemmae has a round, thorn-like shape at the tip of the leaf, which is the hallmark of this type.

2. *Calymperes afzelii*



Figure 2. *Calymperes afzelii*: (A) habitus (B) leaves (C) stems and rhizoids (D) adaxial shoots (gemmae)

The results of observations found that the gametophyte phase consists of phylloid and stem. Phylloid are yellowish green in color with lanceolate shape, flat edges, and tapered ends. It has an upright stem resembling a rhizome. At the time of the study, there was no growing sporophyte phase but there were adaxial shoots at the tips of the leaves. This

moss is found attached to the surface of the tree.

The Calymperaceae family generally grows in groups with upright stems, is rarely found creeping and is usually found growing on tree trunks [9]. The rhizomes are red to yellowish brown [10]. Flat leaf edge, in the thick part ending under the leaf tip, blunt leaf tip and visible gemma. Gemma is generally adaxial at the tip of the leaf tip rolled hugging the costa, the base of the leaf is upright with a yellowish-green leaf color [6]. Calymperaceae has two types of propagation tools, namely generative propagation tools in the form of spores and vegetative propagation tools in the form of buds (gemmae) which are found at the tips of the leaves [11].

3. *Hyophila apiculata*

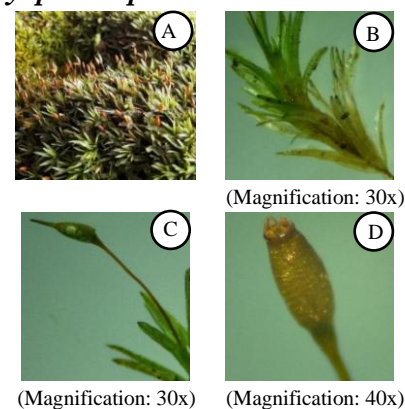


Figure 3. *Hyophila apiculata*: (A) habitus (B) leaves (C) capsule and setae (D) peristomal teeth

Observation results of *Hyophila apiculata* moss found that the gametophyte phase in the form of stems, leaves and rhizoids was also found in the sporophyte phase in the form of seta and capsules. The morphology of the leaves is light green, lanceolate in shape with flat edges and tapering ends. Moss stems and roots are covered with piles of leaves. Seta are reddish brown, the capsule is located at the end of the seta, the capsule with peristome teeth is brownish while the capsule with calyptra is light green. This moss is found on the ground and is also attached to weathered trees.

This moss can be found attached to soil substrates, rocks, and dead wood substrates [10]. *Hyophila apiculata* moss has a light green color, the arrangement of the leaves is

alternate with flat leaf edges, the tips of the leaves are tapered and curved [12]. This species has an oval-shaped sporangium. The stems of this moss are very short and covered in leaves so they are not visible [4].

4. *Hyophila involuta*



Figure 4. *Hyophila involuta*: (A) habitus (B) leaves (C) stem

The results of the observations found that the gametophyte phase consisted of leaves and stems. The leaves are yellowish green, oval in shape with flat edges and tapering ends. The stems of this moss are very short and covered with piles of leaves. No sporophytes were found at the time of observation. This moss is found on the surface of rocks and lives in groups.

Hyophila involuta is found on rock substrates in agricultural areas and grows in groups. The light green leaves spread when moist and curl when dry [10]. The phase found is only the gametophyte. Rhizoids are like threads attached to the substrate. The stem is almost invisible because it is covered with leaves. The leaves are light green, oval in shape, flat at the edges, and tapered at the ends [1]. In the *Hyophila* genus, the upper stem is green and the lower part is red to reddish brown or dark green [6].

5. *Ectropothecium falciforme*

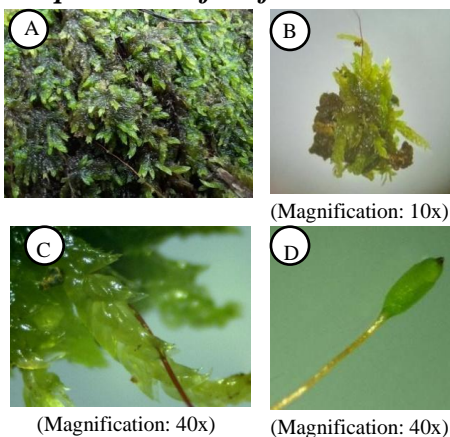


Figure 5. *Ectropothecium falciforme*: (A) habitus (B) stem (C) leaves (D) capsules and setae

The results of observations of *Ectropothecium falciforme* moss found gametophyte and sporophyte phases. In the gametophyte phase found parts in the form of leaves and stems, while in the sporophyte phase found seta and capsules. The leaves are yellowish green, oval in shape, flat edge and tapered tip. The stems are very short and branched, spreading on the substrate and covered with leaves. Setae are reddish in color. The capsule is located at the end of the seta, oval in shape with a light green color with a calyptra at the end. This moss was found creeping on rotting dead trees.

Ectropothecium falciforme moss grows spreading in a dense arrangement forming like a woven braid. The leaves are stacked small, oval in shape, the layout of the leaves alternates around the branches [6]. The leaves are oval in shape with a pointed tip. The stems are almost invisible because they are covered with a mass of leaves and creep on the surface of the substrate. Rhizoids are shaped like threads [1]. The capsule is located at the end of the seta, slightly curved oval with calyptra at the end [13].

6. *Octoblepharum albidum*

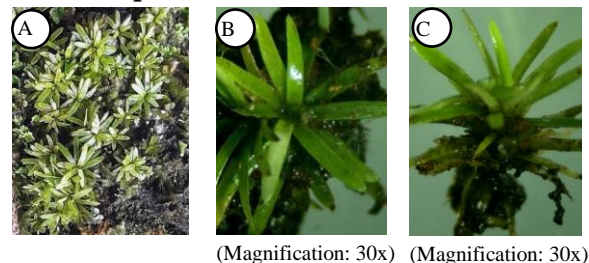


Figure 6. *Octoblepharum albidum*. (A) habitus (B) leaves (C) stems and rhizoids

Observation results only found the gametophyte phase in the form of leaves and stems. Leaves are pale green, striped with flat edges and tapering ends. Very short stem. Rhizoids are not visible during observation because they are covered by leaves. No sporophytes were found at the time of observation. This moss lives in groups and is found attached to the surface of tree trunks. When

found this moss grows with other types of moss colonies side by side.

Octoblepharum albidum is a lichen that lives attached to trees. According to [14] which states that the leaves on this moss look thick and shiny. This moss has a light green color to tend to pale green, the leaf arrangement spreads in a line shape [15]. The stem is not visible because it is covered with leaves. Rhizoids have a thread-like shape and are firmly attached to the substrate [1]. The phase found in the field was only the sporophyte but according to [10] that in *Octoblepharum albidum* moss it has long setae and ovoid capsules, shiny brown when ripe.

7. *Philonotis hastata*

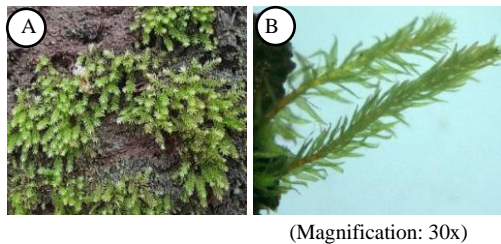
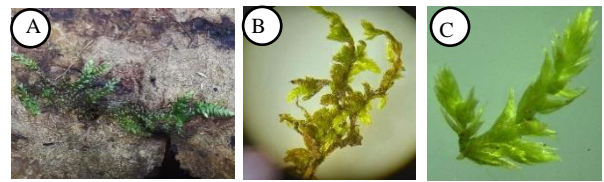


Figure 7. *Philonotis hastata*: (A) habitus (B) leaves and stems

The results of the morphological observations of this moss, namely, found parts in the form of leaves and stems. The leaves are yellowish green, lanceolate in shape, flat at the edges and tapering at the ends. The stem is straight and not branched. No sporophytes were found at the time of observation. This moss is found attached to moist rocks.

Philonotis hastata habitat in moist and wet soil, as well as rocks. The sporophyte consists of a leg, seta and capsule. The capsule is pyriform, horizontal, slightly hanging [16]. This moss has slender, upright stems. Leaves curl to stem evaporation when dry, lanceolate shape, leaf tips pointed, leaves have flat edges. The arrangement of the leaves is a very tight spiral [4]. Leaves are green when young and yellowish when old. Rhizoid like threads attached to the substrate [1].

8. *Acroporium secundum*



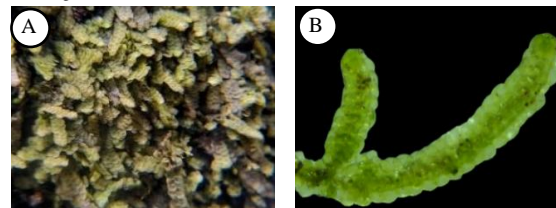
(Magnification: 10x) (Magnification: 30x)

Figure 8. *Acroporium secundum*: (A) habitus (B) stem (C) leaves

The results of observations of the morphology of this moss, namely, found parts of the leaves. The leaves are light green, lanceolate in shape, flat edge and pointed at the end. The rhizoids and stems were not clearly visible at the time of observation because they were covered with leaves. No sporophytes were found at the time of observation. During the research, this species was found growing 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 [17]. *Acroporium secundum* has glossy green or yellowish green leaves, ovate to lanceolate in shape. Rhizoids are shaped like brown threads attached to the substrate [18], stems brown, almost invisible because they are covered with leaves, and grow creeping. According to [1] *Acroporium secundum* elongated seta is brownish green. The capsule is elongated and green in color.

9. *Lejeunea lamacerina*



(Magnification: 30x)

Figure 9. *Lejeunea lamacerina*: (A) habitus (B) leaves

The results of observations of the morphology of this moss, namely, found only parts of the leaves. The leaves are pale green, oval in shape like fish scales, flat edge and rounded tip. Stems and rhizoids are not visible at the time of observation because they are covered by leaves. The sporophyte phase was not found during observation. During the research, this species was found growing on the surface of tree bark.

Lejeunea lamacerina is a liverwort plant from the Lejeuneaceae family. *Lejeunea lamacerina* is commonly found on rocks and trees in areas around rivers, as well as forest areas in hilly areas. This moss plant is an epiphytic plant that grows attached to tree trunks [19].

Lejeunea lamacerina has the characteristics of stems that grow creeping and have lobes that function as water pockets for absorption, water storage, and to reduce the risk of drought so that they can survive well [20]. Rhizoids are fine brown hairs that stick firmly to the substrate. Stems creep on the substrate and are covered by an arrangement of leaves. The leaves are pale green, the leaf arrangement is neat, the shape is oval, the edges are flat, and the tip is blunt [1].

10. *Thysananthus* sp

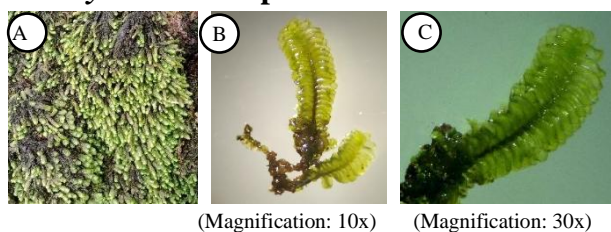


Figure 10. *Thysananthus* sp: (A) habitus (B) stem (C) leaves

The results of morphological observations on this leafy liverwort were found only the

leaves. The leaves are light green, ovoid in shape, flat edge and rounded tip. The leaves are stacked parallel. Rhizoids and stems were not observed at the time of observation because they were covered with leaves. No sporophytes were found at the time of observation. During the research, this species was found growing on the surface of tree bark.

Thysananthus sp is part of the Lejeuneaceae family, this plant is characterized by convex leaves, with rolled lobule edges [21]. It has leaves that are light brownish green, lobes rounded to oval, edges flat, ends rounded to tapered, in the center there are several rows of cells resembling leaf veins (vittae) [22]. This moss plant is epifit by attaching to tree trunks that are still alive or dead. Tropical lowland rain forest areas are the right areas for this moss to grow [23].

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 in accordance with 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 ranged from 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 masl and temperature air 27-29°C.

The existence of moss (Bryophyta) 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 [24]. Moss plants

will grow optimally at air temperatures of 10-30°C, air humidity in the range of 70-98%, optimum soil moisture for moss growth of 50-80% [25]. Soil pH ranges from 4.3-8.3 [26], and elevation below 1000m [10]. Lower soil temperature can help average water evaporation and root growth, while altitude can affect climate [24].

Based on the results of environmental parameter measurements, it is known that the Sultan Adam Mandiangin Grand Forest Park

has 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 Forest Park area, can be concluded 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 involuta*, *Ectropothecium falciforme*, *Octoblepharum albidum*, *Philonotis hastata*, *Acroporium secundum*, *Lejeunea lamacerina*, and *Thysananthus* sp.

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REFERENCES

- [1] Riyana, Y., Sari, S. G., & Gunawan, G. (2020). Bryophyta di Sekitar Kawasan Bandar Udara Internasional Syamsudin Noor Kalimantan Selatan: Bryophyta in the vicinity of Syamsudin Noor International Airport, South Kalimantan. *Jurnal Jejaring Matematika dan Sains*, 2(2), 36-40.
- [2] Maisyura, N., Ajizah, A., & Amintarti, S. (2021). The validity of learning media on the form of booklet types of Bryophytes in the riverbanks of Wisata Alam Sungai Kembang for Senior High School Student grade X. *BIO-INOVED: Jurnal Biologi-Inovasi Pendidikan*, 3(2), 66-71.
- [3] Lukitasari, M. (2019). *Mengenal Tumbuhan Lumut (Bryophyta): Deskripsi, Klasifikasi, Potensi dan Cara Mempelajarinya*. CV. AE MEDIA GRAFIKA.
- [4] Raihan, C., Nurasih, N., & Zahara, N. (2019, January). Keanekaragaman Tumbuhan Lumut (Bryophyta) di Air Terjun Peucari Bueng Jantho Kabupaten Aceh Besar. In *Prosiding Seminar Nasional Biotik* (Vol. 6, No. 1).
- [5] Damayanti, L. (2006). Koleksi Bryophyta Taman Lumut Kebun Raya Cibodas Vol II No. 4. *Cianjur: LIPI UPT Balai Konservasi Tumbuhan Kebun Raya Cibodas*.
- [6] Endang, T. (2020). Inventarisasi Jenis-Jenis Lumut (Bryophyta) di Daerah Aliran Sungai Kabura-Burana Kecamatan Batauga Kabupaten Buton Selatan. *Jurnal Biologi Tropis*, 20(2), 161-172.
- [7] Fajriah, R. (2018). *Keanekaragaman Lumut (Bryophytes) pada Berbagai Substrat di Kawasan Sungai Pucok Krueng Raba Kecamatan Lhoknga Kabupaten Aceh Besar sebagai Referensi Praktikum Ekologi Tumbuhan* (Doctoral dissertation, UIN Ar-Raniry Banda Aceh).
- [8] Fitria, N. (2020). *Keanekaragaman Tumbuhan Lumut (Bryophyta) Di Kawasan Tahura Pocut Meurah Intan Kabupaten Aceh Besar Sebagai Sub Materi Pendukung Pembelajaran Bryophyta Di SMAN 1 Lembah Seulawah* (Doctoral dissertation, UIN AR-RANIRY).
- [9] Bartram, E. B. (1939). Mosses of the Philippines. *Philippine J. Sci.*, 68, 1-473.
- [10] Eddy, A. (1988). Handbook of Malesian mosses.
- [11] Afriyansyah, B., Juairiah, L., & Windadri, F. I. (2019). Keanekaragaman dan rekaman baru jenis lumut di Pulau Sumatra. *Floribunda Jurnal*, 6(3).
- [12] Zahara, M. (2019). *Jenis-jenis Tumbuhan Lumut (Bryophyta) di Stasiun Penelitian Soraya Kawasan Ekosistem Leuser sebagai Referensi Mata Kuliah Botani Tumbuhan Rendah* (Doctoral dissertation, UIN Ar-Raniry Banda Aceh).
- [13] Rahimah. Inventarisasi Tumbuhan Lumut (Bryophyta) Di Kawasan Ekowisata Taman Hutan Raya (Tahura) Sultan Adam Kalimantan Selatan.
- [14] Windadri, F. I. (2010). Keanekaragaman Lumut Ditaman Nasional Bukit Barisan Selatan, Provinsi Lampung. *Berita Biologi*, 10(2), 159-165.
- [15] Febrianti, G. N. (2015). Identifikasi Tumbuhan Lumut (Bryophyta) di Lingkungan Universitas Jember Serta Pemanafaatannya Sebagai Buku Nonteks.
- [16] Amalia, N. N., & Sujadmiko, H. (2022). Diversity of Bryophytes in Plaosan

- Temple, Central Java. *Berkala Ilmiah Biologi*, 13(3), 25-35.
- [17] Fanani, M., Afriyansyah, B., & Haerida, I. (2019). Keanekaragaman Jenis Lumut (Bryophyta) pada Berbagai Substrat di Bukit Muntai Kabupaten Bangka Selatan. *EKOTONIA: Jurnal Penelitian Biologi, Botani, Zoologi dan Mikrobiologi*, 4(2), 43-47.
- [18] Pollawatn, R. (2008). *Systematic treatment of Sematophyllaceae (Musci) in Thailand* (Doctoral dissertation, Bonn, Univ., Diss., 2008).
- [19] Van der Pluijm, A., Blok, D., & Robertus, I. (2015). *Lejeunea lamacerina* (gevleugeld tuitmos), een zuidelijk oceanisch levermos nieuw voor Nederland. *Buxbaumiella*, 103, 14-23.
- [20] Aristria, D., Perwati, L. K., & Wiryani, E. (2014). Keanekaragaman Marchantiophyta Epifit Zona Montana di Kawasan Gunung Ungaran, Jawa Tengah. *Bioma: Berkala Ilmiah Biologi*, 16(1), 26-32.
- [21] Siregar, E. S., Pasaribu, N., & Khairani, K. (2020). The liverwort family Lejeuneaceae (Marchantiophyta) of Mount Lubuk Raya, North Sumatra, Indonesia.
- [22] Haerida, I. (2009). Keanekaragaman Suku Lejeuneaceae (Hepaticae, Lumut Hati) di Daerah Sekitar PPKAB (Pusat Pendidikan dan Konservasi Alam Bodogol) Taman Nasional Gunung Gede-Pangrango, Jawa Barat. *Berita biologi*, 9(6), 683-691.
- [23] Sukkharak, P. (2015). A systematic monograph of the genus *Thysananthus* (Lejeuneaceae, Marchantiophyta). *Phytotaxa*, 193(1), 1-81.
- [24] Lestiani, A., Lestari, R. S. D., Rizkia, R. A., Pratiwi, A. M., Azrai, E. P., & Rini, D. S. (2021). Survei keberagaman lumut dan pohon inang di kawasan Kebun Raya Bogor. *Proceeding of Biology Education*, 4(1), 51-62.
- [25] Wati, T. K., Kiswardianta, B., & Sulistyarsi, A. (2016). Keanekaragaman Hayati Tanaman Lumut (Bryophitha) Di Hutan Sekitar Waduk Kedung Brubus Kecamatanpilang Keceng Kabupaten Madiun. *Florea: Jurnal Biologi Dan Pembelajarannya*, 3(1), 46-51.
- [26] Walidi, R. (2017). *Inventarisasi Lumut Di Kawasan Perkebunan Karet Ptpn 7 Desa Sabah Balau, Kabupaten Lampung Selatan, Lampung* (Doctoral dissertation, UIN Raden Intan Lampung).