



The Liverworts Family *Plagiochilaceae* In Bukit Barisan Forest Park, North Sumatra

Christian Hadinata Sembiring, Etti Sartina Siregar*

Department of Biology, Faculty of Mathematics and Natural Sciences, Universitas Sumatera Utara, Indonesia. Jl. Bioteknologi No.1 Kampus USU Padang Bulan, Medan Indonesia

*Corresponding Author: etti1@usu.ac.id

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ABSTRACT

Bukit Barisan Forest Park at Karo Regency, North Sumatra is a habitat for many species of liverworts, one of them is *Plagiochilaceae*. However little information about species of *Plagiochilaceae* reported from the area. This study aims to identify the species of *Plagiochilaceae* and describe their morphology. The research was conducted from July 2021 to February 2022. All species of the *Plagiochilaceae* were collected using the explorative method, by tracking along the research area. Nine species of *Plagiochilaceae* were found belonging to one genera *Plagiochila*. The species found were *P. arbuscula*, *P. bantamensis*, *P. dendroides*, *P. denticulata*, *P. obtusa*, *P. salacensis*, *P. sciophila*, *P. sumatrana*, *P. Ungarangana*.

Keyword: Bukit Barisan Forest Park, Liverworts, North Sumatra, *Plagiochilaceae*

ABSTRAK

. Taman Hutan Raya Bukit Barisan di Kabupaten Karo, Sumatera Utara, merupakan habitat bagi banyak spesies lumut hati, salah satunya adalah *Plagiochilaceae*. Namun, informasi mengenai spesies *Plagiochilaceae* yang dilaporkan dari daerah tersebut masih sangat sedikit. Penelitian ini bertujuan untuk mengidentifikasi spesies *Plagiochilaceae* dan mendeskripsikan morfologinya. Penelitian dilakukan dari Juli 2021 hingga Februari 2022. Semua spesies *Plagiochilaceae* dikumpulkan menggunakan metode eksplorasi, dengan cara melacak di sepanjang area penelitian. Sembilan spesies *Plagiochilaceae* ditemukan yang termasuk dalam satu genus, yaitu *Plagiochila*. Spesies-spesies yang ditemukan adalah *P. arbuscula*, *P. bantamensis*, *P. dendroides*, *P. denticulata*, *P. obtusa*, *P. salacensis*, *P. sciophila*, *P. sumatrana*, dan *P. Ungarangana*.

Keyword: Taman Hutan Raya Bukit Barisan, Lumut Hati, Sumatera Utara, *Plagiochilaceae*



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1. Introduction

Bryophyte is a group of low plants that can grow attached to various substrates in nature, including trees, dead wood, rotten wood, litter, soil, and rocks. Bryophyte plants are reported to be the second largest group of plants after spermatophyte plants, it is estimated that there are almost 15,000 species and more than 1,000 genera spread throughout the world [4]. The highest diversity is found in subtropical and tropical areas, especially in tropical rain forest areas. Bryophytes are divided into three groups, namely hornworts (Anthocerotophyta), mosses (Bryophyta) and liverworts (Marchantiophyta). Liverworts are divided into two groups, namely leafy liverworts and thalloid liverworts.

One of the family of leafy liverworts that is commonly found in the forest is the *Plagiochilaceae* family. *Plagiochila* is the largest genus of the family *Plagiochilaceae*, which is known to have more than 1.600 species [6]. *Plagiochilaceae* is usually found in lowland forests and can grow on various substrates such as tree trunks, tree branches, rocks, or rotten logs [5, 8]. Asia and the Neotropics region is the center of the distribution of the genus *Plagiochila*, estimated that almost 450 taxa are known on the Asian continent [16]. Specific characteristics of this genus are medium to large size, decurrent leaf base, and with serrate leaf

margins. Research related to *Plagiochilaceae* in North Sumatra has been carried out before, but the data obtained are not sufficient. Several studies have been conducted on liverworts of the *Plagiochilaceae* family that have been reported in North Sumatra, namely 21 species in the Sibayak forest [11], 18 species in the Dolok nature reserve forest. Lubuk Raya [12], and 16 species in the Natural Tourist Park Eden 100 Gardens forest [13], 10 species in Batang Toru Forest [3]. However, information of *Plagiochilaceae* from Bukit Barisan National Park at Karo Regency, North Sumatra has never been reported. Therefore, it is necessary to identify the species of *Plagiochilaceae* in In Bukit Barisan Forest Park, North Sumatra and map their distribution.

2. Methods

This research was carried out in the field and laboratory. Field research was carried out in July 2021 in the Bukit Barisan Forest Park Area, Karo Regency. Morphological observations and identification were carried out from August 2021 to February 2022 at the Plant Systematics Laboratory, Biology Department, Faculty of Mathematics and Natural Sciences, Universitas Sumatera Utara, Medan, North Sumatra.

Sample of *Plagiochilaceae* were collected using the explorative method, by tracking along the Bukit Barisan Forest Park Collection Block path. The important characters of species were recorded, including substrate and color. Before collecting, the samples were photographed, recorded the date and the number of collection. The collected samples were put in to specimen envelopes separately. Measurement of physical factors is carried out every 100 m distance, including coordinates using a GPS (Global Positioning System), altitude with altimeter, air, temperature with a thermometer, air moist with hygrometer, and light intensity with luxmeter.

Identification of species were carried out based on morphological characters. Morphological observations were carried out using binocular microscope. Some of the references used in the identification include [1], [2], [3], [5], [6], [7], [12], [13], [14], and [15]. The data of *Plagiochilaceae* species are presented in the form of identification keys and morphological descriptions of species which are accompanied by photos of each species.

3. Result and Discussion

Based on research that has been carried out at the Bukit Barisan Forest Park, Karo Regency, North Sumatra, 9 species of liverworts from the *Plagiochilaceae* family were identified, which belong to one genus *Plagiochila*. The number of *Plagiochila* species reported in this study tends to be less than previously studies reported, such as [11, 12] with 18 species, and [13] with 16 species of *Plagiochilaceae* family. The difference in the number of *Plagiochilaceae* species obtained in these studies may be due to several factors, such as the environmental conditions at the study site, or the difference of their area sizes.

3.1 Key to species of Liverworts family *Plagiochilaceae* in Bukit Barisan Forest Park

- | | | |
|----------|--|-------------------------|
| 3.1.1 a. | A tree-like stature with lots of branching | 3 <i>P. dendroides</i> |
| b. | A stature with little branching | 2 |
| 3.1.2 a. | Pinnate branching like a fan | 1 <i>P. arbuscula</i> |
| b. | Pinnate branching..... | 3 |
| 3.1.3 a. | Stem with <i>paraphyllia</i> | 5 <i>P. obtusa</i> |
| b. | Stem without <i>paraphyllia</i> | 4 |
| 3.1.4 a. | Leaf shape oblong | 6 <i>P. salacensis</i> |
| b. | Leaf shape oval..... | 5 |
| 3.1.5 a. | Leaf margins are long ciliated | 7 <i>P. sciophila</i> |
| b. | Leaf margins are toothed..... | 6 |
| 3.1.6 a. | Margin of leaf apex with blunt and short toothed..... | 9 <i>P. ungarangana</i> |
| b. | Margin of leaf apex with sharp and long toothed..... | 7 |
| 3.1.7 a. | The ventral base of lateral leaves with tubular sac..... | 2 <i>P. bantamensis</i> |
| b. | The ventral base of lateral leaves without tubular sac | 8 |
| 3.1.8 a. | Teeth of leaf margin 9-14 cells long..... | 4 <i>P. denticulata</i> |
| b. | Teeth of leaf margin 1-4 cells long..... | 8 <i>P. sumatrana</i> |

3.2 Description of Liverworts Family *Plagiochilaceae*

3.2.1 *Plagiochila arbuscula* (Brid ex Lehm et Lindenbg) Lindenbg.

Plant robust, with width of 4.4-5 mm, dark green to yellowish in the specimen, The arrangement of leaves on the stem forms an angle of $<90^\circ$, branching pinnate with an arrangement like a fan shape. The arrangement of the leaves on the stem alternate, sparse and not attached to each other; oblong to oval shape, 2-2.5 mm long and 1.4-2 mm wide; lateral end rounded and serrated 6 with a length of 1-5 cells, lateral edge toothed overall from short to long serrations with a tooth length of 3-5 cells, tapered base; hexagon leaf cells, thin surface, triangle trigon, thin cell walls. Ventral leaves absent. Generative organs not found.

Specimen examined	: Bukit Barisan Forest Park, 27 July 2021, Christian 07
Distribution	: Indonesia (Sumatra, Java, Kalimantan), Malaysia, China, Philippines, Papua New Guinea, New Zealand, Japan, Samoa [11]
Ecology	: Epiphytes on tree trunks at an altitude of 1468.5 masl, humidity 70% and temperature 21°C .



Figure 1. *Plagiochila arbuscula* a. Habit, b. Lateral leaf, c. Lateral leaf cells

3.2.2 *Plagiochila bantamensis* (Reinw., Blume and Nees) Mont.

Plant has a fairly large habit, with a width of 4-6 mm, light green to yellowish in specimens, Pinnate branching. The arrangement of the leaves on the stem alternates, the leaves are tight, the attachment is flat.; oval to ovoid shape, 2.2-3 mm long, 1.3-2 mm wide; broad and toothed tip like cilia, lateral end has water sacs with an elongated shape and ciliated 3-6 cells, short toothed edge 2-5 cells long, base rounded, serrated 5 from short to long serrations 3-long 7 cells; hexagon leaf cells, thin surface, triangle trigon, thin cell walls. The ventral leaves are tightly packed, round, 1-1.5 mm long and 0.7-1 mm wide. Generative organs not found.

Specimen examined	: Bukit Barisan Forest Park, 27 July 2021, Christian 25
Distribution	: Indonesia (Sumatra, Java, Kalimantan), Malaysia, China, Philippines, Papua New Guinea, Taiwan, Thailand, Japanese, Vietnam [17].
Ecology	: Epiphytes on tree trunks at an altitude of 1447.4 masl, 84% humidity and a temperature of 19°C .

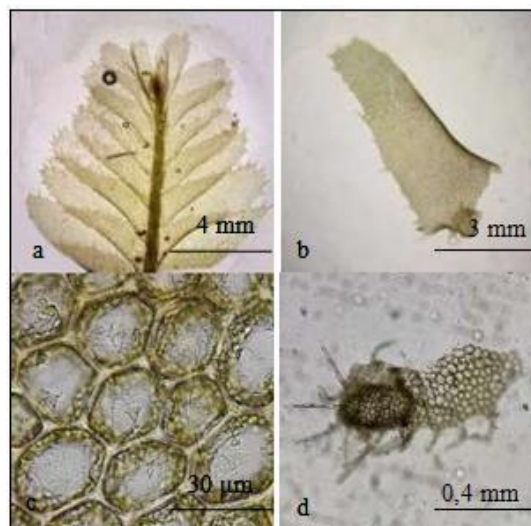


Figure 2. *Plagiochila bantamensis* a. Habit, Lateral leaf, c. Lateral leaf cells, d. Sac

3.2.3 *Plagiochila dendroides* (Nees.) Lindenbg.

Plant with small habit resembling a tree with many branches, width of 1.5-2 mm, yellow to brown in color in specimens, pinnate branching. The arrangement of the leaves on the stem alternates, the leaves are tight and attached to each other; oval to ovoid shape, 0.6-0.9 mm long, 0.4-0.7 mm wide; lateral end has two lobes protruding slightly inward and toothed 2-3 with a length of 4-6 cells, lateral edge flat, base rounded; rectangular leaf cells, thin surface, triangle trigon, thin cell walls. Ventral leaves absent. Generative organs not found.

Specimen examined : Bukit Barisan Forest Park, 27 July 2021, Christian 17 Distribution : Indonesia (Sumatra, Java, Kalimantan), Malaysia, China, Cambodia, Philippines, Taiwan, Thailand, Japan, Vietnam [11].

Ecology : Epiphytes on tree trunks at an altitude of 1457.2 masl, humidity 76% and temperature 20°C.

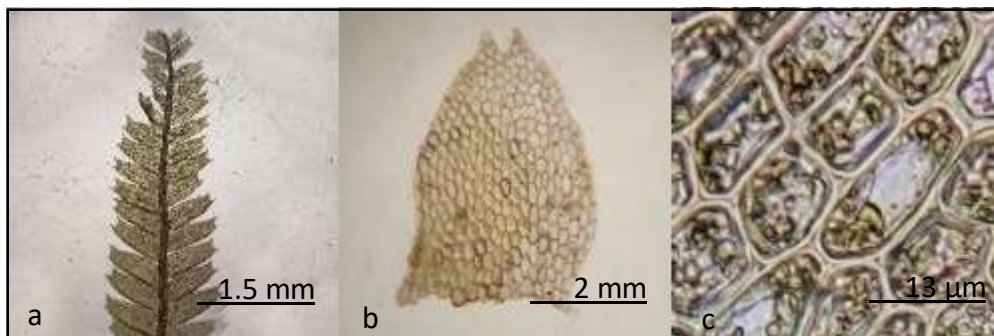


Figure 3. *Plagiochila dendroides* a. Habit, b. Lateral leaf, c. Lateral leaf cells

3.2.4 *Plagiochila denticulata* Mitten, J. Proc. Linn. Bot.,

Plant with medium habit, 3-3.2 mm wide, light green to yellowish in specimens, pinnate branching. The arrangement of the leaves on the stem alternates, the leaves are tight and attached to each other; oval to ovoid shape, 1.2-1.7 mm long, 0.7-1.3 mm wide; broad lateral end, long dorsal and lateral edges with ciliated serrations 9-14 cells long, broad base; ovate leaf cells, thin surface, trigon bulging triangle, thin cell walls. Reduced ventral leaves. Generative organs not found.

Specimen examined : Bukit Barisan Forest Park, 27 July 2021, Christian 16, 23.

Distribution : Indonesia (Sumatra), China, Thailand, India, Nepal [9].

Ecology : Epiphytes on tree trunks at an altitude of 1415.8-1447 masl, humidity 77-92% and temperature 23.4-24° C.

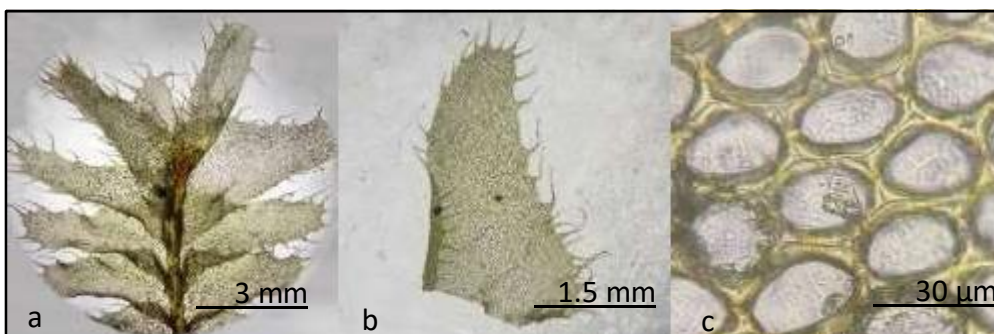


Figure 4. *Plagiochila denticulata* a. Habit, b. Lateral leaf, c. Lateral leaf cells

3.2.5 *Plagiochila obtusa* Lindenbg.

Plant has a fairly large habit, 4-5.4 mm wide, yellowish green in specimens. Stem with paraphyllia, pinnate branching. The arrangement of the leaves on the stem alternates, the leaves are tight and attached to each other; ovoid shape, 2.2-2.8 mm long, 1.5-2.2 mm wide; tapered lateral end, lateral edge toothed overall from long and pointed to short serrations with a length of 2 cells, base rounded,

toothed 6 and short toothed and pointed cells 1-4 cells; hexagon leaf cells, thin surface, triangle trigon, thin cell walls. Ventral leaves absent. Generative organs not found.

Specimen examined : Bukit Barisan Forest Park, 27 July 2021, Christian 6, 20

Distribution : Indonesia (Sumatra, Java, Kalimantan), Taiwan [11].

Habitat and Ecology : Epiphytes on tree trunks at an altitude of 1429.6-1492 masl, humidity 67-77% and temperature 20-21°C.

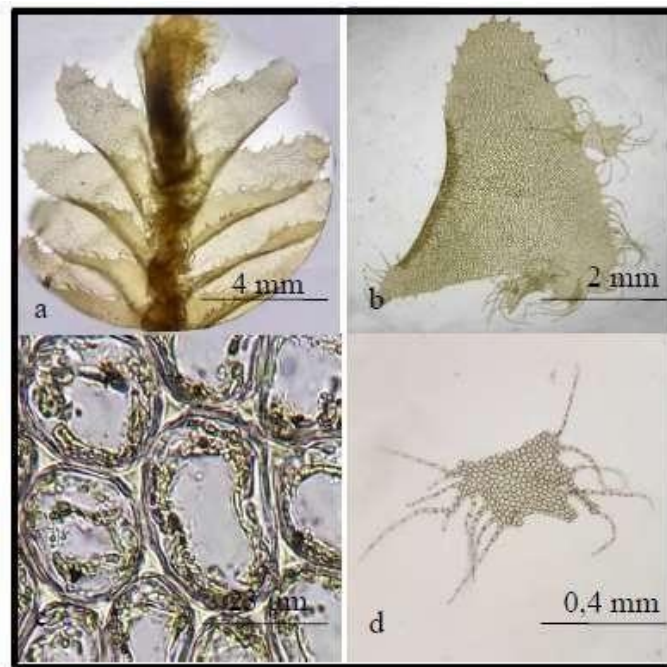


Figure 5. *Plagiochila obtusa* a. Habit, b. Lateral leaf, c. Lateral leaf cells, d. *Paraphyllia*

3.2.6 *Plagiochila salacensis* Gott.

Plant with small habit, 2.3-3 mm wide, light green to yellowish in specimen, pinnate branching. The arrangement of the leaves on the stem alternates, the leaves are rather tight and attached to each other; elongated shape, 1-1.8 mm long, 0.7-1.2 mm wide; lateral end wide, lateraledge with sharp teeth from base to tip, with two teeth that are always dominant and form a sinus, tooth length 4-24 cells, base rounded; round leaf cells, thin surface, triangle trigon, thin cell walls. Ventral leaves absent. Generative organs not found.

Specimen examined : Bukit Barisan Forest Park, 27 July 2021, Christian 5

Distribution : Indonesia (Sumatra, Java, Kalimantan), Malaysia, China, Philippines, Taiwan, India [11].

Ecology : Epiphytes on tree trunks at an altitude of 1450 masl, 81% humidity and a temperature of 23° C.

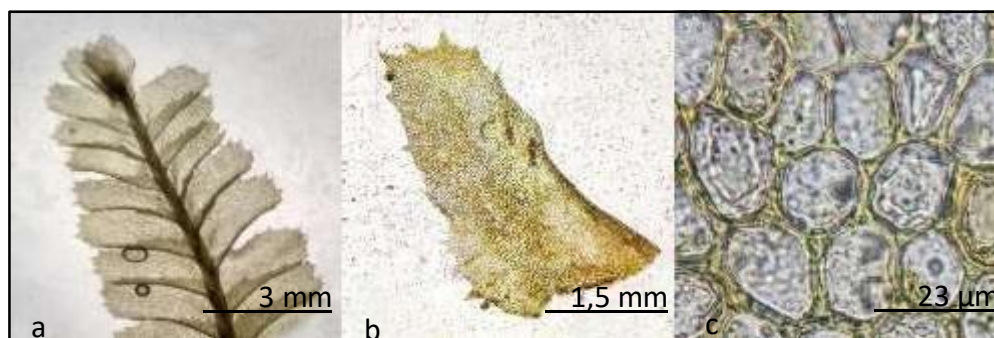


Figure 6. *Plagiochila salacensis* a. Habit, b. Lateral leaf, c. Lateral leaf cells

3.2.7 *Plagiochila sciophila* Nees.

Plant with medium habit, 2.7-3.4 mm wide, yellowish-green in specimens, pinnate branching. The arrangement of the leaves on the stem alternates, the leaves are rather tight and attached to each other; oval to ovoid shape, 1.2-2.2 mm long, 0.7-0.9 mm wide; lateral tip wide, lateral edge sharply serrated with 2 sharp teeth at leaf tip, tooth length 4-10 cells, base rounded; ovate leaf cells, thin surface, triangle triangle, thick cell walls. Ventral leaves reduce. Generative organs not found.

Specimen examined : Bukit Barisan Forest Park, 27 July 2021, Christian 8

Distribution : Indonesia (Sumatra, Java, Kalimantan), Malaysia, China, Philippines, Taiwan, India [11].

Ecology : Epiphytes on tree trunks at an altitude of 1473 masl, humidity 68% and temperature 20° C.

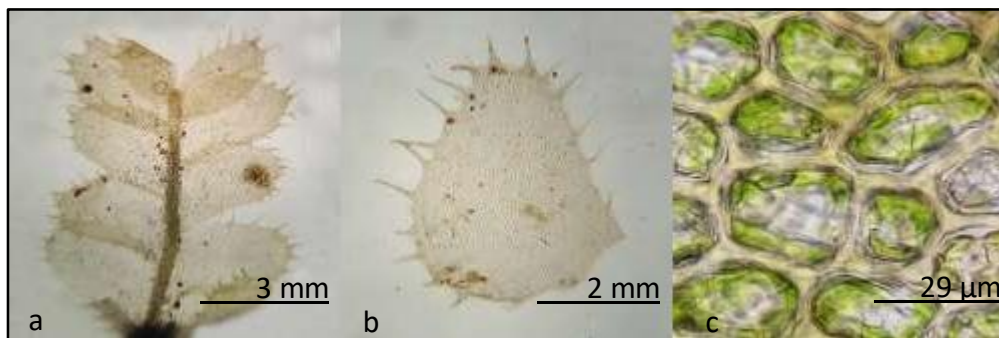


Figure 7. *Plagiochila sciophila* a. Habit, b. Lateral leaf, c. Lateral leaf cells

3.2.8 *Plagiochila sumatrana* Schiff.

Plant with fairly large habit, 4.3-5.2 mm wide, brownish yellow in specimens, pinnate branching. The arrangement of the leaves on the stem alternates, the leaves are tight and attached to each other; oval to ovoid in shape, 1.8-2.4 mm long, 1.7-2 mm wide; lateral end rounded, lateral edge toothed overall from short to pointed serrations with a cell length of 1-4 cells, pointed base, rounded and curved inward; ovate leaf cells, thin surface, trigon bulging triangle, thin cell walls. Ventral leaves absent. Generative organs not found.

Specimen examined : Bukit Barisan Forest Park, 27 July 2021, Christian 2, 10, 11, 14.

Distribution : Indonesia (Sumatra, Java, Kalimantan), Philippines, China [15].

Ecology : Epiphytes on tree trunks at an altitude of 1417-1536.6 masl, humidity 77-92% and temperature 19.1-24° C.

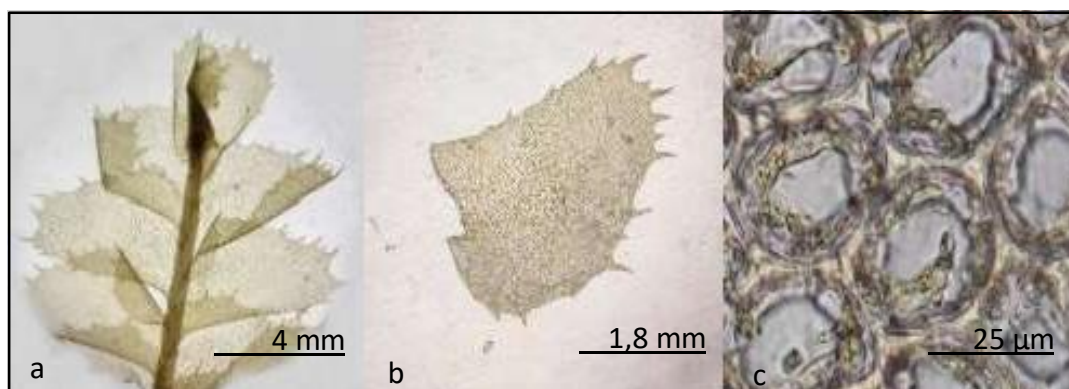


Figure 8. *Plagiochila sumatrana* a. Habit, b. Lateral leaf, c. Lateral leaf cells

3.2.9 *Plagiochila ungarangana* S. Lac.

Plant with medium habit, 2.5-3 mm wide, dark green to brownish on specimens, pinnate branching. The arrangement of the leaves on the stem alternates, the leaves are tight and attached to each other; oval to ovoid shape, 1-1.6 mm long, 0.7-0.9 mm wide; broad end, serrated lateral edge 3 of the

serrations short and pointed, serrations 2-4 cells long, base rounded; ovate leaf cells, thin surface, triangle trigon, thin cell walls. Ventral leaves absent. Generative organs not found.

Specimen examined : Bukit Barisan Forest Park, 27 July 2021, Christian 22

Distribution : Indonesia (Sumatra, Java, Kalimantan), Malaysia, China, Philippines [12].

Ecology : Epiphytes on tree trunks at an altitude of 1448.2 masl, 84% humidity and a temperature of 20°C.

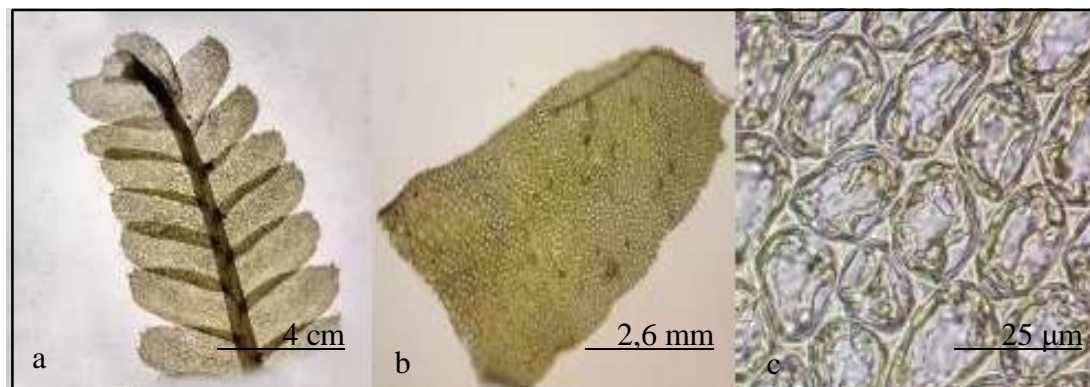


Figure 9. *Plagiochila ungarangana* a. Habits, b. Lateral leaf, c. Lateral leaf cells

3. Conclusions

Based on the research that has been carried out in the Bukit Barisan Forest Park, North Sumatra, it was found as many as 9 species of liverworts family *Plagiochilaceae*, namely *P. arbuscula*, *P. bantamensis*, *P. dendroides*, *P. denticulata*, *P. obtusa*, *P. salacensis*, *P. sciophila*, *P. sumatrana*, and *P. ungarangana*.

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