

Species of leafy liverworts in protected forest of simancik 1, regency of deli serdang, north sumatera

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Abstract. Data and information of leafy liverworts diversity in Sumatera, especially North Sumatera, are still less reported. Research is conducted in order to invent and describe the morphological character of leafy liverworts in Protected Forest of Simancik I, regency of Deli Serdang, North Sumatera. Samples were collected along the hiking tracks of study site. Twenty two species belonging to 12 genera and 6 families were found. They were only one species of *Frullaniaceae*, eleven species of *Lejeuneaceae*, two species of *Lepidoziaceae*, two species of *Lophocoleaceae*, four species of *Plagiochilaceae* and two species of *Radulaceae*. Those species were found as epiphyte on the tree trunk and some on the decaying wood. The highest diversity of leafy liverworts was from *Lejeuneaceae* which consisted of two subfamilies: *Lejeuneoideae* and *Ptychanthoideae* and seven genera which are *Lejeunea*, *Archilejeunea*, *Lopholejeunea*, *Dendrolejeunea*, *Ptychantus*, *Mastigolejeunea* and *Thysananthus* while the lowest diversity was from *Frullaniaceae*.

Keywords: Bryophyte, *Lejeuneaceae*, *Lepidoziaceae*, Liverwort, *Plagiochilaceae*, *Radulaceae*, Sumatera

1. Introduction

Bryophytes are non-vascular plants which belongs to the second largest group after Angiospermae and has a very wide geographic spread. There are about 15,000-25,000 species of bryophytes in the world [1,2]. The most diverse bryophytes are found in subtropical and tropical regions especially in tropical rainforest areas [3,4]. Bryophytes are divided into three groups namely liverworts, mosses, and hornworts [4]. Bryophytes generally grow attached to various types of substrates i.e trees, decayed wood, litter, soil and even rocks with humid environment conditions and adequate sunlight.

Liverworts may grow as epiphytes, erect upward, dangle down, attach or lay down on the surface of the substrate [5], epiphytes in trunks and tree branches while some may also grow by attaching to the leaves epiphyll in lowland rainforests [6]. Bryophytes have an important role in the forest ecosystem, which maintain moisture and contribute in nutrient cycles, especially the carbon cycle [7]. Bryophytes also have potential utilization in the health field, since certain species contained a number of active ingredients, including anti-fungal, antibacterial, antitumor [8,9] and potential source of antioxidants in cosmetics, health, and food supplement industries [10]. Study of bryophytes in Indonesia is still less reported.

Data of liverworts biodiversity is still focused on Java origins, while in Sumatra, especially in North Sumatra is still scarce. Protected Forest of Simancik I or *Taman Hutan Raya* (TAHURA) Bukit



Barisan is located in Deli Serdang, District of North Sumatra. We assumed that the forest might be suitable habitat to find various species of liverworts. Until now, collections and information of leafy liverworts in Simancik 1 have not ever been reported yet, based on specimen collections in Herbarium MEDANESE without any records on bryophytes especially leafy liverworts. Therefore, the study will be the first attempt in collecting and describing leafy liverworts species based on morphological characters that inhabit Simancik Forest.

2. Methods

2.1. Study Site Description

The field study was conducted during five months of field observation at Protected Forest of Simancik 1 (098° 38' E, 03° 05' N, 250-1100 m asl), Taman Hutan Raya (TAHURA) Bukit Barisan, North Sumatra which covers an area of 9.800 ha. The area has a relative flat topography. The average range of annual rainfall, humidity and temperature were 2000-2500 mm, 80-90%, and 13-29 °C respectively. Commonly found vegetation were species such as: *Pinus mercurii*, *Altingia exelsa*, *Podocarpus imbricatus*, *Toona sureni*, *Casuarina*, *Eucalyptus*, *Cupressus*, *Agathis* and members of *Dipterocarpaceae*, *Moraceae*, *Arecaceae*, *Melastomataceae* and *Lauraceae*.

Collected samples were brought and identified at Laboratory of Plant Systematics, Faculty of Mathematics and Natural Sciences, University of North Sumatra, Medan. Forest area administratively located at Rambai Village, Sinembah sub-district of Tanjung Muda Hilir, Regency of Deli Serdang, North Sumatra, Indonesia.

2.2. Field Methodology

Leafy liverworts were sampled by surveying through accessible tracks. Each species found during survey is assessed by looking for its spot characters. For species growing as epiphytes on trees or trunks, a pocket knife is used to dissect samples from its substrate. Samples were then stored in paper envelope and written down local information such as: coordinates, altitude, temperature, humidity, light intensity and soil pH using standard analytical instruments.

2.3. Laboratory Identification

All specimens were air-dried to prevent excessive humid and fungal contamination. Specimens were identified using following guides to bryophyte and liverworts: A Revision of Japanese *Lejeuneaceae*. *The journal of the Hattori Botanical Laboratory* [11], The Genus *Plagiochilla* (Dum.) Dum. In Southeast Asia [12], Systematic Botany Monographs [13], Guide to the Bryophyte of Tropical Amerika, Vol 86 [1], Mengenal *Bryophyta* (Lumut) Taman Nasional Gunung Gede Pangrango Volume 1 [6], Guide to the Liverwort and Hornworts of Java [7]. Morphological characters were examined by using light-compound microscope. Essential characters following species identification are: length, width, lobes, lobules, and perianths.

3. Results and Discussions

The study found twenty-two species of leafy liverworts belonging to twelve genera and six families: *Frullaniaceae* (1 species), *Lejeuneaceae* (11 species), *Lepidoziaceae* (2 species), *Lophocoleaceae* (2 species), *Plagiochillaceae* (4 species), and *Radullaceae* (2 species). Data are shown in Table 1.

Table 1. Species of Leafy Liverworts at Protected Forest of Simancik 1

N	Families	Species	Substrates
1.	<i>Frullaniaceae</i>	<i>Frullania apiculata</i>	Trunk
2.	<i>Lejeuneaceae</i>	<i>Lejeunea rotundistipula</i>	Trunk
3.		<i>Archilejeunea planiuscula</i>	Trunk
4.		<i>Dendrolejeunea fruticosa</i>	Trunk
5.		<i>Lopholejeunea acutifolia</i>	Trunk
6.		<i>Lopholejeunea eulopha</i>	Trunk dan Wood log
7.		<i>Lopholejeunea nigricans</i>	Trunks

8.		<i>Lopholejeunea subfusca</i>	Trunks
9.		<i>Mastigolejeunea replata</i>	Trunks
10.		<i>Mastigolejeunea virens</i>	Trunks
11.		<i>Ptychantus stratus</i>	Trunks
12.		<i>Thysananthus spathulistipus</i>	Trunks
13.	<i>Lepidoziaceae</i>	<i>Bazzania japonica</i>	Trunks
14.		<i>Bazzania vittata</i>	Trunk and Twig
15.	<i>Lophocoleaceae</i>	<i>Heteroscyphus argutus</i>	Trunk and Wood log
16.		<i>Heteroscyphus coalitus</i>	Trunk and Wood log
17.	<i>Plagiochilaceae</i>	<i>Plagiochila gracilis</i>	Trunk and Twig
18.		<i>Plagiochila teysmannii</i>	Twig
19.		<i>Plagiochila spathulifolia</i>	Twig
20.		<i>Pedinophyllum interruptum</i>	Trunk and Twig
21.	<i>Radulaceae</i>	<i>Radula javanica</i>	Trunk and Wood log
22.		<i>Radula retroflexa</i>	Trunk

Total leafy liverworts species found in this study are considered lower than previous reports at Sibayak Forest, North Sumatera. Previous study found 163 species of liverworts which belonged to 53 genera and 22 families. Numerous species of liverworts found in Sibayak were due to the wide spread of bryophytes across habitat [14]. The forest was known to ranging from sub-alpine to low alpine forest while in our study, Simancik was only known for its lowland-type forest (600 m asl). Intensity of survey, sampling period and macro-/microclimate variation may also cause difference in finding bryophytes in each area [15].

Members of *Lejeuneaceae* were mostly found in our study. *Lejeuneaceae* was the speciose of leafy liverworts in the tropics and estimated about 90 genera with 1600 species. The family was commonly found in montane forest in contrary with our results from from lowland forest [1,16]. Only a small portion of species from *Lejeuneaceae* that were revealed in our study. Previous studies have reported a number of species from *Lejeuneaceae* in Java (160 species) and North Sumatera (49 species) [7,14,17].

Measurement of physico-chemical parameters at Simancik 1 was conducted although data not shown. The average temperature, humidity and light intensity was 25-29 °C, 48-50%, and 13-123 lux respectively which was assumed to be suitable for growth of certain bryophyte species [4,18,19]. Elevation is also a limiting factor of finding bryophytes. An increase of elevation will cause a drop of temperature, especially humidity and wind flow [2,20,21]. Other factors that support bryophyte existence in habitat are their growth substrates. Species of leafy liverworts were dominantly found attached to tree trunks followed by twigs and wood logs in our study. The specific term is given as *Corticolous* (epiphyte at trunks) and *Ramicolous* (epiphyte at twigs) [3,22].

4. Conclusions

Leafy liverworts found in this study are still in a small portion of total species in the tropics. Our results are the first report in revealing species richness of leafy liverworts in lowland forest of Simancik 1, North Sumatera. Attempt to collect more specimens is needed to give a precise number of leafy liverworts from North Sumatera. Alternative study site and sampling intensity must be considered in future study.

References

- [1] Gradstein SR, SP Churchill and N Salazar-Allen (2001) *Guide to the Bryophytes of Tropical America*. New York: The New York Botanical Garden Comp.
- [2] Glime JM (2007) *Bryophyte Ecology Volume 1. Physiological Ecology*. Michigan Technological University and the International Association of Bryologists.

- [3] Gradstein SR and T Pocs (1989) *Bryophyte*. Book Chapter: Lieth, H and MJA Werger. 1989. *Tropical a Forest Ecosystems*. Amsterdam. Elsevier Science Publisher B.V. Pages 314-315.
- [4] Sporn SG, MM Bos, Hoffstatter-Muncheberg, M Kessler and SR Gradstein (2009) Microclimate Determines Community Composition but not Richness of Epiphytic Understorey Bryophytes of Rainforest and Cacao Agroforests Indonesia. *Funct Plant Biol.* **36(2)**:171-179.
- [5] Damayanti L (2006) Koleksi Bryophyta Taman Lumut Kebun Raya Cibodas. Volume II No.4. UPT Balai Konservasi Tumbuhan Kebun Raya Cibodas. Sindanglaya. Cianjur.
- [6] Hasan M and Ariyanti N (2004) Mengenal Bryophyta (Lumut) di Taman Nasional Gunung Gede Pangrango Volume 1. Cetakan pertama. Taman Nasional Gunung Gede Pangrango.
- [7] Gradstein SR (2011) Guide to the Liverworts and Hornworts of Java. Bogor. Seameo Biotrop.
- [8] Shi YQ, CJ Zhu, BQ Yuan, BQ Li, J Gao XJ Qu, B Sun, YN Cheng, S Li, X Li and HX Lou (2009) Marchantin C, a Novel Microtubule Inhibitor from Liverwort with Anti-Tumor Activity Both *In Vivo* and *In Vitro*. *Cancer Lett.* **276(2)**: 160-170.
- [9] Veljić M, A Cirić, M Soković, P Janačković and PD Marin (2010) Antibacterial and Antifungal Activity of the Liverwort (*Ptilidium Pulcherrimum*) Methanol Extract. *Arch Biol Sci Belgrade.* **62(2)**: 381-395.
- [10] Dey A, and JN De (2012) Antioxidative Potential of Bryophytes: Streaa Tolerance and Commercial Perspective: A review. *Pharmacologia.* **3(6)**: 151-159.
- [11] Mizutani M (1961) A revision of Japanese Lejeuneaceae. *Journal of the Hattori Botanical Laboratory* **24**: 116-180.
- [12] Inoue H (1989) The genus *Plagiochila* (Dum.) Dum. In Southeast Asia. Tokyo. Academia Scientific Book Inc.
- [13] So ML (2001) Systematic Botany Monographs of *Plagiochilla* (*Hepaticeae, Plagiochillaceae*) in China. *Journal of the Hattori Botanical Laboratory* **60**: 207.
- [14] Siregar ES, NS Ariyanti, and SS Tjitrosoedirdjo (2014) *Lejeuneaceae* Anak Suku *Ptychanthoideae* di Hutan Sibayak Sumatera Utara. *Floribunda* **4(8)**: 218-225.
- [15] Gradstein SR, NM Nadkarni, T Kromer, I Holz, and N Noske. (2003) A Protocol and Representative Sampling of Vascular and Non-vascular Epiphyte Diversity of Tropical Rain Forests. *Selbyana* **24(1)**:105-111.
- [16] Gradstein SR, and H Culmsee (2010) Bryophyte Diversity on Tree trunk in Montane Forest of Central Sulawesi, Indonesia. *Tropical Bryology* **31**:95–105.
- [17] Söderström L, SR Gradstein, and A Hagborg (2010) Checklist of the Hornworts and Liverworts of Java. *J Phytotaxa* **9**:53–149.
- [18] Friedel A, GV Oheimb, J Dengler, and W Härdtle (2006) Species Diversity and Species Composition of Epiphytic Bryophytes and Lichens A Comparison of Managed and Unmanaged Beech Forests in NE Germany. *Feddes Repert.* **117**:1-2, 172-185
- [19] Ariyanti NS, MB Merijin, K Kuswata, ST Sri, E Gunahardja, and SR Gradstein (2008) Bryophytes on Tree Trunks in Natural Forest, Selectively Logged Forest and Cacao Agroforests in Central Sulawesi, Indonesia. *Biol conserv.* **141**: 2516-2527.
- [20] Whitmore TC (1984) *Tropical Rain Forest of the Far East*. Oxford (DE). Clarendon press.
- [21] Enroth J (1990) Altitudinal Zonation of Bryophytes on the Huon Peninsula, Papua New Guinea, A Floristic Approach, with Phytogeographic Considerations. *Trop Bryol.* **2(2)**:61-90.
- [22] Gonzales-Mancebo JM, A Losada-Lima and S McAlister (2004) Host Specificity of Epiphytic Bryophyte Communities of Laurel Forest in Tenerife (Canary Island, Spain). *The Bryologist.* **106(3)**; 383-384.