Lejeuneaceae (Marchantiophyta) of Taman Eden 100 Natural Park North Sumatera Indonesia

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Abstract. Knowledge on the liverworts (Marchantiophyta) of Sumatera is still insufficiently reported including that of family Lejeuneaceae. This study was conducted to explore the diversity of Lejeuneaceae in Taman Eden Natural Park North Sumatera, Indonesia. Sample was collected along the hiking trails in the study site using the explorative survey method. Thirty one species of Lejeuneaceae were found in Taman Eden Natural Park, belonging to 13 genera, two of which are new record for Sumatera: Cololejeunea denticulata and Lejeunea albescens.

1. Introduction
Lejeuneaceae is the largest family in the liverworts (Marchantiophyta), represented by more than a thousand accepted species, in 69 genera [1]. The species of this family are generally as epiphyte, growth on tree trunk and branch, twigs and leaves. Some species growth on rotten logs. Growing on living leaves is one of special adaption from some species of family Lejeuneaceae such as genus Drepanolejeunea, Cololejeunea, and Leptolejeunea.

The member of Lejeuneaceae are yellowish green, dark green, pale yellow and blackish brown to black in color when in fresh samples. Lejeuneaceae can be recognized from the incubous leaves arrangements, the upper part of each leaf covering the base of the leaf above in dorsal view. It has three rows of leaves, two rows of lateral leaves and one row of ventral leaves, except in Cololejeunea (without ventral leaves). Lateral leaves consist of two two parts: lobe with bigger size and lobule with smaller size. Lobule attached to the lobe by a long keel (folded), cells contain oil bodies that can be observed in the fresh plant. The number and size of the oil body are important characters in identification [2].

The data and information of Lejeuneaceae is still a litte in North Sumatera. Some data was reported in Sumatera that about 49 species in Sibayak forest [3] [4], 29 species in Nature park of Sicike-cike [5], and 2 species in Lau Kawar of Karo districts [6]. The collection and information about liverworts family Lejeuneaceae in Taman Eden 100 Natural Park North Sumatera has never been reported until now. Taman Eden 100 is one of natural park which has a suitable habitat for liverworts because the condition of forest still natural. Therefore, this study is done to explore the diversity of Lejeuneaceae in Taman Eden 100 Natural Park North Sumatera. It is hoped that this study will complete data of Lejeuneaceae especially in North Sumatera and generally in Indonesia to be utilized in scientific and technologic progress in the future.
2. Methods

2.1. Study Site

The field study was conducted in Taman Eden 100 Natural Park, Sionggang Utara village, Lumban Julu district, and Toba Samosir regency, Sumatera Utara Province. The study area is located at 02° 39'00"- 02° 42'00" E and 099° 62'00"- 099° 64'00" N, which cover an area of 1000 ha. The topography of this study site is relative flat with altitude about 1.100 to 1.750 m asl, temperature 20.01°C, humidity is 96.64%, light intensity 1627.98 lux meters.

2.2. Field Methodology

The exploration was conducted through accessible tracks in the study site. Samples were collected from various substrates (tree trunks, rotten logs, and leaves), using a pocket knife. Samples were stored in paper envelope, as much as possible and written down some informations such as: collection number, date, collector name, location, and substrate. The physical factors also recorded from habitat: altitude, temperature, humidity, coordinates, and soil pH using standard analytical instruments.

2.3. Morphological observation and identification

The specimens collected were classified and identified based on morphological characters, using some literatures of Asian Lejeuneaceae. Some important characters for species identification are: leaf lobes (size, shape, margin, apex, trigone); lobules (size, shape, base, free margin, apex, keel); underleaves (size, shape, margin, apex); and perianth if present. Morphological characters were observed by using binocular microscope. The collected specimens are deposited at the Herbarium Medanense (MEDA), Department of Biology, Faculty of Mathematics and Natural Sciences, Universitas Sumatera Utara, Medan, Indonesia.

3. Results and discussions

The study found thirty-one species of Lejeuneaceae, belongong to thirteen genera: Acrolejeunea (two species), Cheilolejeunea (five species), Cololejeunea (two species), Colura (two species), Diplasiolejeunea (one species), Drepanolejeunea (three species), Lejeunea (seven species), Cololejeunea (two species), Lopholejeunea (three species), Metalejeunea (one species), Ptychanthus (one species), Schiffneriolejeunea (one species), and Thysananthus (one species). Two species of these are newly reported for Sumatera: Cololejeunea denticulata and Lejeunea albescens. Data are shown in Table 1.

Total species of Lejeuneaceae found in this study are considered higher than previous reports at Sicike-cike Natural Park North Sumatera which reported by [5]. Who published 29 species of liverworts family Lejeuneaceae which belonged to 10 genera. But, this result obtained lower than the research of Siregar 2015 that identified amount 49 species of liverworts family Lejeuneaceae in Sibayak forest which consist of 18 genera. The differences of total species found in each of these districts was due variations physical factor in each location. The survey intensity, the length of sampling time is might also impressed the differences in total species found in each area [7].

Differences of total species and genus found was due to height difference in each location. Sibayak forest is lowland forest until lower mountain forest with an altitude of 870-12050m dpl. Eden park 100 is the forest about 1.100 to 1.750m asl, Sicike cike nature park is lower mountain forest with an altitude of 1250-1400 m dpl. According to [8] elevation increase was effect to increas moss species wealth. The other factors which involved the small of total species found because there are the different between collection intensity and enviromental factor.

The most total species found in this study is Lejeunea genus it is about 7 species. Lejeunea is the biggest genus in Lejeuneaceae family with total about three hundred currently accepted species [9] (Lee et al., 2014). Lejeunea had spread central in humid lowlands and lower montane sites of the tropics regions, and it spread was lower in temperate region [11]. Besides growing in humid and
closed tropical rain forests, the Lejeunea genus can also grow in opened environment and disturbed area such as garden and suburbs [10].

Besides physical factor, moss growth supported by substrate. Lejeuneaceae family of liverworts species were found growing on tree and leaf of substrate. Species of Lejeuneaceae in the study were dominantly found attached to barks are 22 species, the rest of it are 9 species were growing on leaf. The genera was usually live in living leaves are, Cololejeunea, Colura, Drepanolejeunea and Leptolejeunea. According to [12] There are Lejeuneaceae substrate eventhought epiphyte which growth on barks, twigs and living leaves. [8] told that tree basalts were the suitable substrate for moss because it has high humidity and is a transition zoning between the forest soil and tree trunks. The moss who lived on tree will effected by tree bark surfaced structure, or its place must be humid with high light intensity [13].

Table 1. Species of liverworts family Lejeuneaceae at Taman Eden 100 Natural Park.

| No. | Genera         | Species               | Substrates |
|-----|----------------|-----------------------|------------|
| 1.  | Acrolejeunea   | Acrolejeunea pycnoclada | Bark       |
| 2.  | Acrolejeunea   | Acrolejeunea tjibodensis | Bark       |
| 3.  | Cheilolejeunea | Cheilolejeunea ceylanica | Bark       |
| 4.  | Cheilolejeunea | Cheilolejeunea longiloba | Bark       |
| 5.  | Cheilolejeunea | Cheilolejeunea trapezia | Bark       |
| 6.  | Cheilolejeunea | Cheilolejeunea sp1.   | Bark       |
| 7.  | Cheilolejeunea | Cheilolejeunea sp2.   | Bark       |
| 8.  | Cololejeunea   | Cololejeunea denticulata* | Leaf       |
| 9.  | Cololejeunea   | Cololejeunea falcata  | Leaf       |
| 10. | Colura         | Colura acrolba        | Leaf       |
| 11. | Colura         | Colura vitiensis      | Leaf       |
| 12. | Diplasiolejeunea | Diplasiolejeunea cavifolia | Bark       |
| 13. | Drepanolejeunea | Drepanolejeunea levicornua | Leaf       |
| 14. | Drepanolejeunea | Drepanolejeunea ternatensis | Leaf       |
| 15. | D. thwaitesiana | D. thwaitesiana      | Leaf       |
| 16. | Lejeunea       | Lejeunea albescens*  | Bark       |
| 17. | Lejeunea       | Lejeunea dipterota   | Bark       |
| 18. | Lejeunea       | Lejeunea eifrigii    | Bark       |
| 19. | Lejeunea       | Lejeunea flava       | Bark       |
| 20. | Lejeunea       | Lejeunea obscura     | Bark       |
| 21. | Lejeunea       | Lejeunea sordida     | Bark       |
| 22. | Lejeunea       | Lejeunea tuberculosa | Bark       |
| 23. | Leptolejeunea  | Leptolejeunea maculata  | Leaf       |
| 24. | Leptolejeunea  | Leptolejeunea vitrea  | Leaf       |
| 25. | Lopholejeunea  | Lopholejeunea herzogiana | Bark       |
| 26. | Lopholejeunea  | Lopholejeunea nigricans | Bark      |
| 27. | Lopholejeunea  | Lopholejeunea subfusca | Bark       |
| 28. | Metalejeunea   | Metalejeunea cucullata  | Bark       |
| 29. | Ptychanthus    | Ptychanthus striatus  | Bar       |
| 30. | Schiffnerolejeunea | Schiffnerolejeunea pulopenangensis | Bark     |
| 32. | Thysananthus   | Thysananthus spathulistipus | Bark       |

Notes: *new record species for Sumatera

Descriptions of two new species record for Sumatera

1) **Cololejeunea denticulata** (Horik.) S. Hatt.
Plant light green to brownish in the dry specimen, about 1,0-1,5 mm wide. Irregularly branching, ventral merophytes two cells wide. Lateral leaves contiguous; lobe obovate, 0.5-0.9 mm long x 0.38-
0.6 mm wide, dorsal and ventral base plane, margin denticulate, apex rounded; cells hexagonal, thin-walled, cuticle smooth, trigones distinct, triangular; lobules oblong, 0.2-0.3 mm long, free margin straight, apex with two teeth, the first tooth is two cells long and four cells wide, the second tooth is shorter. Ventral leaves absent.

Specimens examined : ES 3560, 3568, 3479, 3714, 3643, 3459; KH 313.

Distribution : Bangladesh, China, Taiwan, Japan, Korea, Indonesia (Sumatera: new record)

Ecology : Found on living leaves at 1445-1600 m asl.

Figure 1. *Cololejeunea denticulata* a. Habit b. Lateral leaf c. Leaf cells

2) *Lejeunea albescens* (Steph.) Mizut

Plant light green in the dry specimens, about 0.9-1.5 mm wide. Irregularly branching, ventral merophyte with two cell rows. Lateral leaves imbricate; lobes ovate, 0.6-0.8 mm long x 0.4-0.5 mm wide, dorsal base plane, ventral base curved, margin entire, apex rounded; cells hexagonal to rounded, 0.23-0.26 mm wide, thick-walled, cuticle smooth; trigones distinct, triangular; lobules ovate, 0.1-0.4 mm long, margin entire, apex with two teeth. Ventral leaves imbricate, Daun ventral rapat, reniform, 0.5-0.6 mm long, 0.6-0.8 mm, margin entire, apex divided to $\frac{1}{4}$ of underleaf length.

Specimen examined : ES 3153.

Distribution : Philippines, Malaysia, Indonesia (Sumatera: new record, Java), Papua New Guinea.

Ecology : Found on bark at 1300 m asl.
4. Conclusions
A total of 31 species of liverworts family Lejeuneaceae were recorded from Taman Eden 100 Natural Park, North Sumatera, including in 13 genera: *Acrojeunea* (two species), *Cheilolejeunea* (five species), *Cololejeunea* (two species), *Colura* (two species), *Diplasiolejeunea* (one species), *Drepanolejeunea* (three species), *Lejeunea* (seven species), *Leptolejeunea* (two species), *Lopholejeunea* (three species), *Metalejeunea* (one species), *Ptychanthus* (one species), *Schiffneriolejeunea* (one species), and *Thysananthus* (one species). The largest genus in the study is *Lejeunea*. Two species of these are newly reported for Sumatera: *Cololejeunea denticulata* and *Lejeunea albescens*.

Acknowledgements
The authors gratefully acknowledge that the research is supported by Ministry of Research and Technology and Higher Education Republic of Indonesia. The support is under the research grant TALENTA USU of year 2018 with contract number: 2590/UN5.1.R/PPM/2018 TANGGAL 16 Maret 2018”. The authors would also like to thank the tim work of specimen.

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