



LEJEUNEACEAE (SUBFAMILY: LEJEUNEOIDEAE) OF MOUNT SIBUATAN, NORTH SUMATRA, INDONESIA

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ABSTRAK

Ferdinand Susilo, Nursahara Pasaribu, Syamsuardi, Etti Sartina Siregar 2023. Lejeuneaceae (sub suku: Lejeuneoideae) di Gunung Sibuanan Sumatera Utara Indonesia. *Floribunda* 7(2): 92–106 — Lejeuneaceae (sub suku: Lejeuneoideae) di Gunung Sibuanan, Sumatera Utara Indonesia. Informasi terkait keanekaragaman jenis sub suku *Lejeuneoideae* di Sumatera Utara, Indonesia masih sedikit dilaporkan, khususnya di Gunung Sibuanan belum pernah dilaporkan. Penelitian bertujuan untuk mengumpulkan, mengeksplorasi dan mendeskripsikan karakter morfologi serta memperoleh keanekaragaman subfamili *Lejeuneoideae* di kawasan hutan Gunung Sibuanan, Sumatera Utara. Sembilan belas jenis dari sub suku ini dilaporkan yang terdiri dari delapan marga: *Cheilolejeunea*, *Cololejeunea*, *Colura*, *Diplasiolejeunea*, *Drepanolejeunea*, *Lejeunea*, *Metalejeunea*, dan *Pycnolejeunea*. Satu jenis di antaranya yaitu *Drepanolejeunea pentadactyla* dilaporkan sebagai catatan baru untuk pulau Sumatera. Identifikasi kunci spesies dan gambar spesies disajikan dalam artikel ini.

Kata kunci: Lejeuneaceae, *Lejeuneoideae*, Gunung Sibuanan, catatan baru.

Ferdinand Susilo, Nursahara Pasaribu, Syamsuardi, Etti Sartina Siregar 2023. Lejeuneaceae (Subfamily: Lejeuneoideae) of Mount Sibuanan, North Sumatra, Indonesia. *Floribunda* 7(2): 92–106 — Lejeuneaceae (Subfamily: Lejeuneoideae) of Mount Sibuanan, North Sumatra, Indonesia. Information on the local diversity of the subfamily *Lejeuneoideae* in North Sumatra, Indonesia, is still less reported, especially in Mount Sibuanan. This study aimed to collect, explore and describe the morphological characters and obtain the diversity of the subfamily *Lejeuneoideae* in the Mount Sibuanan forest area, North Sumatra. Nineteen species of this subfamily are reported, comprising eight genera: *Cheilolejeunea*, *Cololejeunea*, *Colura*, *Diplasiolejeunea*, *Drepanolejeunea*, *Lejeunea*, *Metalejeunea*, and *Pycnolejeunea*. One species, namely *Drepanolejeunea pentadactyla*, is reported as new record for Sumatra. Identification key to species and pictures of species newly recorded is provided.

Key words: Lejeuneaceae, *Lejeuneoideae*, Mount Sibuanan, new record.

INTRODUCTION

The liverwort family of Lejeuneaceae is a large group comprising over one thousand species and about 69 accepted genera, making it one of the largest families within the liverwort group (Wang et al. 2016). The members of this family exhibit a range of colors from black, brown, green, yellowish to whitish, and vary in size from small to

robust. The branches are *Lejeunea*-type, sometimes with *Frullania*-type branches. The leaves are arranged in an incubous manner, with lateral leaves divided into lobes and lobules, the latter being attached to the lobe along a keel. The leaf cells contain small oil bodies, which can be granular or homogeneous. Underleaves are typically present, except in *Cololejeunea*, and may be divided or undivided. The gynoecia usually contain only one

archegonium, with the perianth having a beak; the capsule is rounded with a 2-layered wall, and the spores are multicellular and either isodiametrical or elongate (Gradstein, 2011; 2013).

Lejeuneaceae typically grow in humid tropical rainforests and prefer moist, semi-shaded to shaded areas in lowland and submontane rainforests or in secondary vegetation. However, some species can also be found in open and disturbed areas, such as suburban areas and cultivated plant regions. Most of the species within this family are epiphytes, growing on tree trunks, branches of trees or shrubs, living leaves, and occasionally on rotten logs (Gradstein et al., 2001; Lee & Gradstein 2013). The number of genera and species of Ptychanthoideae is less than Lejeuneoideae (He & Zhu, 2011). Lejeuneaceae possess oil bodies within their cells, which vary in number and shape and produce a characteristic scent when fresh (Haerida, 2009). Within some types of Lejeuneaceae, there are specialized cells on the leaves known as ocelli, which lack of chloroplasts and contain one large oil body. These cells are typically light gray, brown, or red in color and are larger than other cells on the leaf (Damayanti, 2006).

Data on liverworts diversity, in specific of the subfamily *Lejeuneoideae* in North Sumatra, is still limited. Previous records of Sumatran liverworts, specifically the Lejeuneaceae were reported by Verdoorn (1933), and followed by documentation of liverworts by Herzog (1943) with the results of 72 species described from specimens in Padang, West Sumatra, Indonesia. Recent reports on North Sumatra liverworts generally published by Schafer -Verwimp (2006) followed by other researchers across localities. The study and investigation of liverworts, specifically the Lejeuneaceae family in North Sumatra, are relatively limited. In Sibayak Forest, Siregar et al. (2014) found 16 species of Lejeuneaceae subfamily Ptychanthoideae; Dewi (2016) reported 12 species of Lejeuneaceae in Telagah Forest, Gunung Leuser National Park; Siregar et al. (2017) recorded 29 species in Sicikcike Natural Park, including 9 newly discovered species (previously unreported in Sumatra but found in another island); Siregar et al. (2020) identified 31 species of Lejeuneaceae in Taman Eden Natural Park, and 37 species of Lejeuneaceae in Mount Lubuk Raya.

Furthermore, data and information on the liverwort family of Lejeuneaceae in Mount Sibuan have not been reported until now, so exploration to collect North Sumatra's liverworts specimens, especially the *Lejeuneoideae* family is needed. This research is expected to provide information on the global and national diversity of liverworts and is expected to report some new records or even new species especially for the members of

Sumatran *Lejeuneoideae*. A dichotomous key to species identification among members is provided.

MATERIAL AND METHODS

The research site is located at Mount Sibuan forest area, Karo regency, North Sumatra, with ± 86 km from Medan city. The forest has an altitude of 2,346 m asl. with mean annual rainfall of 2000–2500 mm per year, and the air temperature in this region ranges from 13–25 °C with mean humidity percentage of 95%. Specimens were collected during exploratory surveys along accessible climbing paths and tracks. The liverwort specimens obtained were observed and differentiated morphologically through microscopy technique. The pieces of specimens were soaked in water, the base part is pinned with pointed tweezers, then one leaf was taken. The leaves were placed on an object glass, covered with a glass cover, and observed under a light-compound microscope. Important characteristics observed included: stature height, stature width, lobes (shape, edge, tip, base, trigonose cells), lobules (shape, edge, edge), ventral leaves (arrangement, shape, edge, edge) and jewelry (perianth). The collected specimens were morphologically identified using several identification keys and type descriptions from various available literatures: Gradstein (2011) and other publications on Malesiana and Asian liverworts such as Mizutani (1961), Yamada (1979), Inoue (1984), Bischler-Causse (1989), Gradstein et al. (2002), Zhu & Gradstein (2005). Identification is carried out at the Laboratory of Plant Taxonomy, Universitas Sumatera Utara. All of the newly acquired specimens are deposited at Herbarium Medanense (MEDA), Departement of Biology Faculty of Mathematics and Natural Sciences, Universitas Sumatera Utara, Medan, Indonesia.

RESULT AND DISCUSSION

A total of 19 species of Lejeuneaceae subfamily Lejeuneoideae were identified belonging to 8 genera, namely: *Cheilolejeunea*, *Cololejeunea*, *Colura*, *Diplasiolejeunea*, *Drepanolejeunea*, *Lejeunea*, *Metalejeunea*, and *Pycnolejeunea*. These species were distributed at altitude of 1531-2432 m. The check listed of Lejeuneaceae subfamily lejeuneoidea collected from study area was described below, alphabetically arranged. New record species for Sumatra was indicated by an asterisk (*) behind the species name.

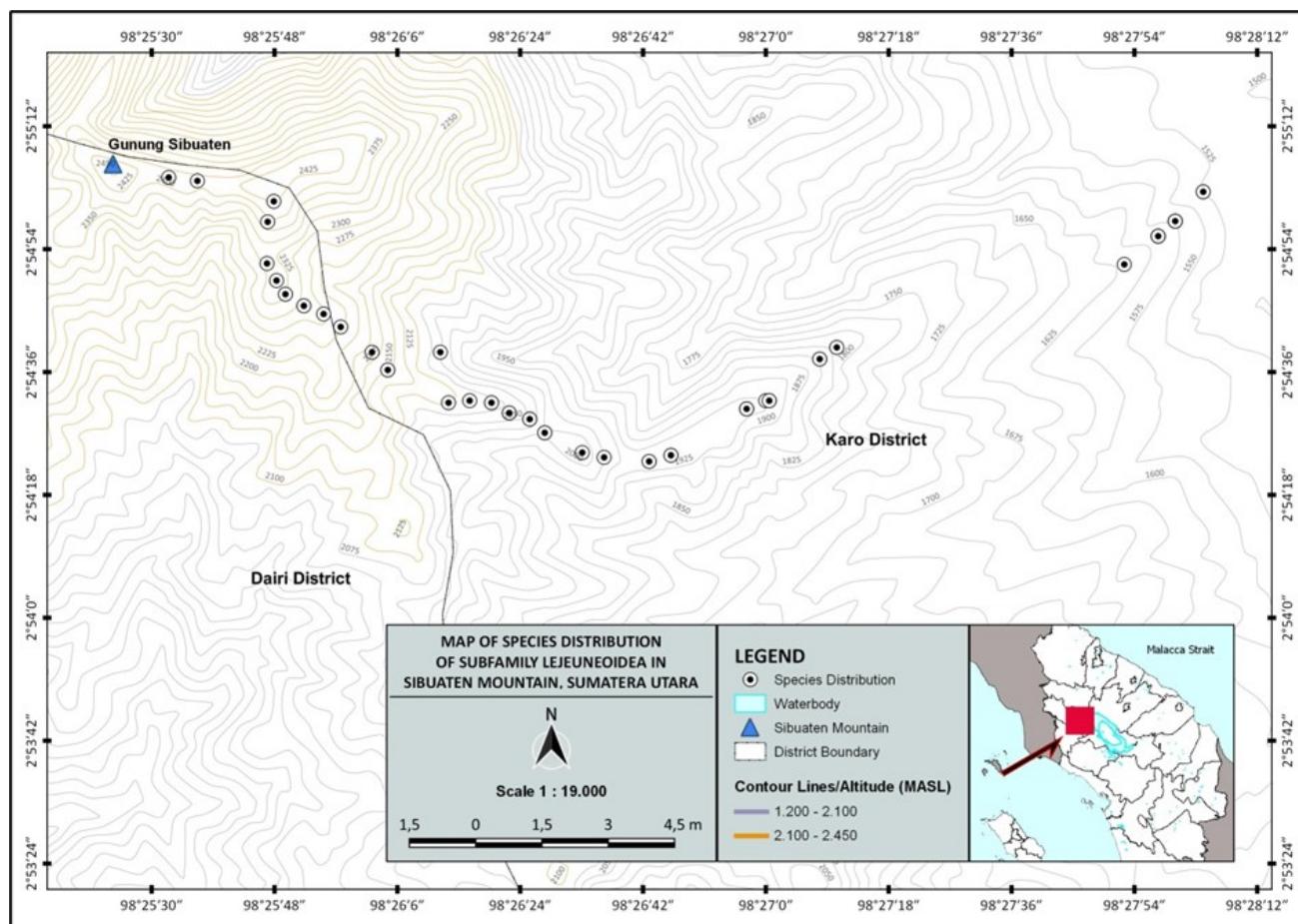


Figure. 1. Species distribution of subfamily Lejeuneoidea in Mount Sibuatan, North Sumatra Indonesia (Source: Great office of Conservation of Natural Resources of North Sumatra).

Key to species of *Lejeuneaceae* (subfamily: *Lejeuneoideae*) in Mount Sibuatan, North Sumatra, Indonesia.

- 1 a. Ventral leaves lacking 2
- b. Ventral leaves present 4
- 2 a. Leaf lobes with vitta 6. *Cololejeunea inflata*
- b. Leaf lobes lacking vitta 3
- 3 a. Lobe apex rounded and margin with dentate 5. *Cololejeunea denticulata*
- b. Lobe apex mucronulate and margin with acute teeth 7. *Cololejeunea haskarliana*
- 4 a. Leaves attached slightly parallel to stem 18. *Metalejeunea cucullata*
- b. Leaves attached perpendicular 5
- 5 a. Lateral leaves have an enlarge sac at the tip 8. *Colura acroloba*
- b. Leaves lacking sac 6
- 6 a. One ventral leaf in each leaf 9. *Diplasiolejeunea cavifolia*
- b. One ventral leaf in each pair of leaves 7
- 7 a. Ventral leaf positioned toward stem at 35-45° 8
- b. Ventral leaf positioned toward stem at 75-90° 16

Key to species of *Lejeuneaceae* (subfamily: *Lejeuneoideae*) in Mount Sibuanan, North Sumatra, Indonesia.

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- | | | |
|----|--|---|
| 8 | a. Leaf-lobules not reduced | 9 |
| | b. Leaf-lobules lateral, sometimes reduced to small | 13 |
| 9 | a. Leaf-lobules ovate | 19. <i>Pycnolejeunea nicobarica</i> |
| | b. Leaf-lobules rectangular longwise | 10 |
| 10 | a. Ventral leaves shallowly divided to $\frac{1}{7}$ – $\frac{1}{5}$ leaf-lobe length..... | 2. <i>Cheilolejeunea incisa</i> |
| | b. Ventral leaves deeply divided to $\frac{1}{4}$ – $\frac{1}{2}$ leaf-lobe length | 11 |
| 11 | a. Leaf-lobules tip with 2 teeth, 1 longer tooth curved toward ventral | 1. <i>Cheilolejeunea ceylanica</i> |
| | b. Leaf-lobules tip with 2 equally long teeth..... | 12 |
| 12 | a. Leaf-lobules $\frac{1}{2}$ leaf-lobe length | 3. <i>Cheilolejeunea longiloba</i> |
| | b. Leaf-lobules $\frac{1}{3}$ leaf-lobe length..... | 4. <i>Cheilolejeunea trapezia</i> |
| 13 | a. Merophyte of 2 cell rows | 14 |
| | b. Merophyte of 4 cell rows | 14. <i>Lejeunea dipterota</i> |
| 14 | a. Leaves with rounded tip | 15 |
| | b. Leaves with blunt tip..... | 16. <i>Lejeunea obscura</i> |
| 15 | a. Lateral leaf-lobules $\frac{1}{3}$ leaf-lobe length | 17. <i>Lejeunea tuberculosa</i> |
| | b. Lateral leaf-lobules blunt | <i>Lejeunea flava</i> |
| 16 | a. Ocelli present..... | 13. <i>Drepanolejeunea thwaitesiana</i> |
| | b. Ocelli lacking | 17 |
| 17 | a. Ventral leaves tip divided $\frac{1}{2}$ – $\frac{1}{3}$ leaf-lobe length | 12. <i>Drepanolejeunea ternatensis</i> |
| | b. Ventral leaves tip divided until leaf-lobe base..... | 18 |
| 18 | a. Ventral leaves 6 cell rows in length | 10. <i>Drepanolejeunea levicorma</i> |
| | b. Ventral leaves 8 cell rows in length | 11. <i>Drepanolejeunea pentadactyla</i> * |
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1. *Cheilolejeunea ceylanica* (Gottsche) R.M. Schust & Kachroo. in Kachroo & R.M. Schust., J. Linn. Soc., Bot. 56: 509. 1961; Mizut., J. Hattori Bot. Lab. 44: 121. 1978, 47: 324. 1980 & 51: 155. 1982; B.M. Thiers, Trop. Bryol. 5: 17. 1992; R.-L. Zhu et al., Nova Hedwigia 75: 393. 2002. (Fig. 2) Light green plants on specimens, width 0.7–1.3 mm. Irregular branching, ventral merophytes 2-3 cell lines. The lateral leaf arrangement is close together, flat adhesion; lobes are ovoid to elongated, 0.45 to 0.68 mm long, 0.34 to 0.45 mm wide, dorsal base flat, ventral base curved, flat edges, blunt to rounded edges; rectangular to rectangular leaf cell shape, width 0.11–0.20 mm, thick walls, smooth surface; trigones appears clear, triangular shape; rectangular lobules are elongated, 2/3 long from the base lobe flat, flat edges, flat edges with 2 teeth, 1 tooth longer and bend to ventral with second tooth length 7 cell lines, 1 cell line width, distance between teeth 1 cell line. Spaced ventral leaves, curved adhesions, almost rounded shapes, lengths 0.18–0.30 mm, widths

0.18–0.28 mm, rounded base, flat edges, ends split 1 / 3–1 / 2 from the length of the lobes.

Specimens examined: Sumatra: North Sumatra: Mt. Sibuanan, corticolous, epixyloous and epiphyllous, May 2020, alt. 1558–2065 m, T. 19.1–25.5 °C, H. 75–93%, F. Susilo 66, 101, 241, 248, 261, 271, 284, 295, 408, 492, 1100, 1101, 1508.

Distribution: Sri Lanka, Japan, Philippines, Thailand, Indonesia (Sumatra, Java, and Borneo).

2. *Cheilolejeunea incisa* (Gottsche) R.M.Schust & Kachroo, J. Linn. Soc. Bot. 56: 509. 1960. *Lejeunea incisa* Gottsche, Syn. Hepat. 360. 1845. *Pycnolejeunea incisa* (Gottsche) Step., Sp. Hepat. 5: 624.1914. (Fig. 3)

Light green plants on the specimen, 1–1.5 mm wide. Irregular branching, ventral merophytes of 3 cell lines. The lateral leaf arrangement is close together, flat adhesion; lobes are ovoid, 0.5–0.75 mm long, 0.35–0.53 mm wide, dorsal base flat, ventral base flat, flat edges, flat ends and curved inward on the ventral side; rectangular leaf cell

shape, width 0.21–0.25 mm, thick wall, smooth surface; trigones appears clear, triangular shape; the lobules are rectangular in shape, 1/2 in length from the lobe, base flat, flat edge, flat edge. Adjacent ventral leaves, curved adhesions, oval shape, lengths 0.25–0.38 mm, width 0.4–0.5 mm, base flat, edges flat, ends split slightly 1/5–1 / 7 from lobe length.

Specimens examined: Sumatra: North Sumatra: Mt. Sibuanan, corticolous and epiphyllous, May 2020, alt. 1950–2131 m, T. 17.2–18.5 °C, H. 93–96%, F. Susilo 751, 773, 1282, 1308, 1391, 1395, 1396, 1656.

Distribution: Australia, Indonesia (Sumatra and Java), Papua New Guinea (Thiers, 1992).

3. *Cheilolejeunea longiloba* (Steph. Ex G.Hoffm.). Kachroo & R.M. Schust. ex J.J. Engel & B.C. Tan. *J. Hattori Bot. Lab.* 60: 294 1986. *Pycnolejeunea longiloba* Stephani ex G. Hoffm. Ann. Bryol. 8:114. 1935. (Fig. 4)

Light green plants on the specimen, 0.8–1.5 mm wide. Irregular branching. Ventral merophytes of 2 cell lines. The lateral leaf arrangement is close together, flat adhesion; lobes are ovate to elongated, 0.46–0.78 mm long, 0.34–0.52 mm wide, dorsal base flat, ventral base flat, flat edges, rounded tip, rectangular leaf cell shape, 0.07–0.11 mm wide, thick wall, smooth surface; trigones large, marginal cells of leaf lobe rectangular to elongated, ½ in length from the base, flat edges with 2 teeth, Ventral leaves are distant, curvedly intact, nearly ovale in shape, 0.19–0.26 mm long, 0.19–0.25 mm wide, rounded base, flat edge, apex divided to ¼ of lobe length.

Specimens examined: Sumatra: North Sumatra: Mt. Sibuanan, corticolous and epiphyllous, May 2020, alt. 1950–2180 m, T. 15.9–19.7 °C, H. 92–94%, F. Susilo 708, 719, 745, 762, 773, 796, 799, 811, 827, 920, 1028, 1122, 1125, 1155, 1147, 1508, 1577, 1587, 1589, 1750.

Distribution: Sri Lanka, India, China, Philippines, Thailand, Vietnam, Cambodia, Malaysia, Indonesia (Sumatra, Java and Borneo), Papua New Guinea, Australia.

4. *Cheilolejeunea trapezia* (Nees) Kachroo & R.M.Schust., [J. Linn. Soc., Bot. 56: 509. Feb. 1961, comb. invalid.] ex Mizut. var. *ceylanica* A.E.D. Daniels & K.C. Kariyappa comb. & stat. nov. *Jungermannia trapezia* Nees, Enum. Pl. Crypt. Jav. 41. 1830. (Fig. 5)

Light green plants on specimens, 0.5–1.5 mm wide. Irregular branching, ventral merophytes 4 cell lines. The lateral leaf arrangement is close together, flat adhesion; ovoid lobe, 0.5–0.75 mm long, 0.4–0.6 mm wide, dorsal base flat, ventral base flat, flat edge, rounded tip; six-square leaf cell shape, width 0.12–0.18 mm, thick walls, smooth

surface; trigones appears clear, triangular shape; elongated lobules, length 1/3 of lobes, base base, flat edges, flat ends with 2 teeth, small second teeth length 2 cell lines and width 1 cell row, distance between the two 8 cell line teeth. Spaced ventral leaves, curved adhesions, round shapes, 0.2 –0.3 mm long, 0.3–0.35 mm wide, rounded base, flat edges, 1/2 split ends of lobe length.

Specimens examined: Sumatra: North Sumatra: Mt. Sibuanan, corticolous, May 2020, alt. 1558 m, T. 25.5°C, H. 75, F. Susilo 99.

Distribution: Cosmopolitan in tropical and subtropical Asia and Oceania.

5. *Cololejeunea denticulata* (Horik.) S. Hatt. *Bull. Tokyo Sci. Mus.* 11: 99 1944. (Fig. 6)

Plants are light green to brown in the specimen, 1.0 –1.8 mm wide. Irregular branching, ventral merophytes 2 cell lines. The lateral leaf arrangement is close together, flat adhesion; breech ovoid lobe, length 0.6–0.9 mm, width 0.32–0.5 mm, flat dorsal base, flat ventral base, toothed edge, rounded tip; rectangular leaf cell shape, 0.14 mm wide, thin walls, smooth surface; trigones appears clear, triangular shape; lobules are elongated to ovoid, 1 / 4–1 / 2 long from lobes, base flat, flat edges, flat edges; don't have vitta. Has no ventral leaves.

Specimens examined: North Sumatra: Mt. Sibuanan, epiphyllous, May 2020, alt. 1531–2065 m, T. 19.1–22.3°C, H. 75–89%, F. Susilo 14, 397, 676, 749, 751, 752, 769, 770, 831, 857, 859, 861, 915, 923, 932, 939, 945, 946, 967, 974, 1005, 1007, 1048, 1115, 1125, 1222, 1244, 1271, 1352, 1498, 1507, 1508, 1511, 1539, 1576, 1582, 1584, 1601, 1638.

Distribution: Indonesia (Sumatra and Java; Gede Pangrango Mountain, Haerida, 2010) Japan, and Taiwan.

6. *Cololejeunea haskarliana* (Lehm. & Lindenb.) Schiffin. *Hedwigia* 29: 72 1890. (Fig. 7)

Plants are light green to brown in the specimen, 0.5 –1.1 mm wide. Irregular branching, ventral merophytes 1 cell line. Lateral lateral leaf arrangement, flat attachment; lobes are ovoid, 0.30 –0.50 mm long, 0.22–0.40 mm wide, dorsal base flat, ventral base flat, jagged edge, rounded tip, not hyaline; rectangular cell shape, 0.12 mm wide, thin walls, smooth surface; trigones appears clear, triangular shape; ovular lobules, 1/3 of the lobes long, flat base, flat edges, flat ends with 2 teeth; Vitta absent. Ventral leaves absent.

Specimens examined: North Sumatra: Mt. Sibuanan, epiphyllous, May 2020, alt. 1978 m, T. 18°C, H. 94%, F. Susilo 1180, 1300.

Distribution: India, Bhutan, Sri Lanka, China, Indonesia, Japan, Malaysia, Cambodia, New Caledonia, Philippines, Vietnam, Afrika (Pande &

Misra, 1943; Onraedt, 1981; Tixier, 1985; Mizutani, 1986; Tan & Engel, 1986; Long & Grolle, 1990; Piippo, 1990; Grolle, 1995; Zhu, 1995; Zhu & So, 2001; Asthana & Srivastava, 2003; Yamada & Iwatsuki, 2006).

7. *Cololejeunea inflata* Steph. *Hedwigia* 34: 249 1895. (Fig. 8)

Plants are light green to brown in the specimen, 0.8–1.4 mm wide. Irregular branching, ventral merophytes 2 cell lines. Lateral leaf arrangement, flat attachment; ovoid lobes, lengths 0.47–0.60 mm, width 0.37–0.50 mm, dorsal base flat, ventral base flat, flat edges, rounded edges, hyaline; round leaf cell shape, 0.12 mm wide, thin wall, smooth surface; trigones appears clear, triangular shape; oval lobules, 1/2 length of lobe, flat base, flat edge, flat tip with 2 teeth, second tooth 2 long cell lines, 1 broad cell; has vitta 2–3 cell lines, vitta length of 6 cell lines. Has no ventral leaves.

Specimens examined: North Sumatra: Mt. Sibutan, epiphyllous, May 2020, alt. 1840–2432 m, T. 16.0–17.8°C, H. 85–94%, F. Susilo 478, 480, 482, 548, 576, 748, 750, 751, 768, 771, 773, 775, 777, 782, 783, 787, 788, 797, 801, 802, 805, 811, 812, 818, 821, 823, 824, 825, 827, 832, 838, 842, 1042, 1163, 1212, 1281, 1293, 1297, 1303, 1305, 1309, 1381, 1383, 1390, 1397, 1405, 1593, 1594, 1927.

Distribution: China, Japan, Malaysia, Philippines, New Caledonia, Thailand, Cambodia, Vietnam, Borneo, Sulawesi, Java, Sumatra, Malaka (Zhu 1995).

8. *Colura acroloba* (Month. Ex Steph.) Jovet-Ast., Rev. bryol. Lichenol. 22: 297. 1953. *Lejeunea acroloba* Prantl, *Hedwigia* 29: xiv. 1980. (Fig. 9)
Light green plants on the specimen, 1.5–2.0 mm wide. Irregular branching. Ventral merophytes of 3 cell lines. The lateral leaf arrangement is close together, flat adhesion; lobes are elongated to obovate, 0.5–1.0 mm long, 0.4–0.9 mm wide, dorsal base flat, ventral base flat, flat edges, rounded tip, Leaf cell shape round to polygonous, 0.22–0.34 mm wide, thick wall, smooth surface; trigoneses large, nodulous, marginal cells of leaf lobe linearis to lanceolate, long, flat base and curved inwards on lateral side, apex rounded; contain sac; sac edge less than 16 papilla cells, apex acute. Ventral leaf distant, slightly curved intact, V-shaped, 0.2–0.4 mm long, 0.4–0.5 mm wide, flat base, flat edge, apex divided to 1/3 of lobe length; lobes linearis to lanceolate, apex acuminate, 5–8 cell lines long, 3–4 cell lines wide.

Specimens examined: North Sumatra: Mt. Sibutan, epiphyllous, May 2020, alt. 1558–2422 m, T. 19.7–25.5°C, H. 75–92%, F. Susilo 116, 751, 764, 768, 920, 937, 940, 941, 1027, 1267, 1277, 1309, 1384, 1575, 1576, 1577, 1583, 1584, 1593, 1594,

1713, 1993.

Distribution: Australia, Cambodia, China, India, Indonesia (Java, Sumatra), Malaysia, New Caledonia, New Guinea, Philippines, Samoa, Salomo Is., Sri Langka, Thailand, Vietnam (Zhu and So, 2001).

9. *Diplasiolejeunea cavifolia* Steph. Sp. Hepat. 5: 918. *Diplasiolejeunea brachyclada* A. Evans. *Bull. Torrey Bot. Club* 39: 216 1912; *Diplasiolejeunea ocellata* Stephani. *Sp. Hepat.* 5: 920 1916. (Fig. 10)

Plants are brownish green on the specimen, 1.5–1.8 mm wide. Irregular branching, Ventral merophytes of 3 cell lines. The lateral leaf arrangement is close together, slightly curved intact; lobes are ovate to curved, 0.66–0.83 mm long, 0.56–0.70 mm wide, dorsal base curved, ventral base flat, flat edges, rounded tip, hexagonal leaf cell shape, 0.12–0.20 mm wide, thin wall, rough surface; trigoneses large, triangular, marginal cells of leaf lobe ovate, $\frac{1}{3}$ – $\frac{1}{2}$ in length from the base, flat edges with 3 teeth, 2nd tooth 3 cell lines long, 2 cell lines wide, distance between tooth 4 cell lines. Ventral leaves are distant on each segment, nearly curvedly intact, cuneatus, 0.25–0.30 mm long, 0.20–0.25 mm wide, rounded base, flat edge, apex divided to $\frac{2}{3}$ of lobe length. Lobes triangular, apex acuminate, 16 cell lines long, 8 cell lines wide.

Specimens examined: North Sumatra: Mt. Sibutan, epiphyllous, May 2020, alt. 1950–2100 m, T. 19.0–19.7°C, H. 90–92%, F. Susilo 751, 761, 764, 771, 799, 910, 939, 941, 1120, 1172, 1236, 1267, 1281, 1311, 1351, 1353, 1399, 1466, 1498, 1507, 1512, 1544, 1577, 1584, 1585.

Distribution: Pantropic, Asia: Cambodia, China (Hainan), Java, Sumatra, Luzon, Malaysia, Sri Lanka, Taiwan, New Caledonia (Schafer-Verwimp 2006).

10. *Drepanolejeunea levicornua* Steph., Sp. Hepat. 5: 347. 1913. (Fig. 11)

Plants are dark green to brown in the specimen, width 0.75–1.5 mm. Irregular branching, ventral merophytes of 3 cell lines. Lateral leaf arrangement is distant, flat attachment; ovoid lobe, length 0.37–0.75 mm, width 0.34–0.52 mm, dorsal base flat, flat ventral base, jagged edge, tapered tip; rectangular leaf cell shape, width 0.15–0.19 mm, thick walls, smooth surface; trigones is less obvious, triangular shape; lobules are elongated, 1/4–1/3 in length from lobe, base flat, flat edge, flat edge. The ventral leaves are spaced, the attachment is slightly curved, the shape of the horn, length 0.23–0.26 mm, width 0.19–0.21 mm, base flat, edge flat, tip split to the base of the lobe; lobes are linear to lanceolate, pointed ends, 6 cell lines long, 2 cell lines wide.

Specimens examined: North Sumatra: Mt. Sibu-

atan, epiphyllous, May 2020, alt. 1840–2351 m, T. 17.8–18.5°C, H. 91–94%, F. Susilo 464, 682, 690, 694, 695, 696, 709, 713, 719, 726, 729, 745, 747, 748, 750, 754, 758, 760, 761, 762, 763, 764, 765, 768, 771, 772, 773, 782, 783, 796, 799, 801, 805, 811, 821, 827, 833, 857, 908, 909, 910, 917, 920, 922, 924, 935, 937, 938, 940, 941, 946, 958, 959, 960, 965, 976, 995, 997, 998, 1005, 1027, 1028, 1034, 1036, 1042, 1044, 1046, 1048, 1063, 1067, 1071, 1081, 1089, 1090, 1103, 1119, 1120, 1130, 1180, 1222, 1236, 1244, 1245, 1267, 1278, 1351, 1382, 1430, 1486, 1353, 1508, 1544, 1575, 1576, 1577, 1582, 1587, 1648, 1750, 1802, 1804, 1816, 1817, 1837, 1839, 1858.

Distribution: Cina, Indonesia (Borneo, Java, Seram, Celebes, Sumatra), Malaysia, Papua New Guinea (Zhu and So, 2001).

11. *Drepanolejeunea pentadactyla* (Mont.) Steph. Sp. Hepat. 5:357 1913. *Lejeunea pentadactyla* Mont. Ann. Sci. Nat., Bot., sér. 3, 10: 113. (Fig. 12)

Plants dark green to brown in the specimen, width 0.28–0.50 mm. Irregular branching, ventral merophytes of 3 cell lines. Lateral leaf arrangement is distant, flat attachment; lobes are ovoid, length 0.17–0.30 mm, width 0.11–0.16 mm, flat dorsal base, flat ventral base, 2–5 toothed upper edge, pointed tip; six-square leaf cell shape, width 0.12–0.18 mm, thick walls, smooth surface; trigones is less obvious, triangular shape; lobules are elongated, 1/2 in length from lobe, flat base, flat edge, flat edge. The ventral leaves are spaced, the attachment is slightly curved, the shape of the horn, length 0.20–0.25 mm, width 0.18–0.20 mm, base flat, edge flat, tip split to the base of the lobe; lobes are linear to lanceolate, pointed ends, 8 cell lines long, 2 cell lines wide.

Specimens examined: North Sumatra: Mt. Sibutan, epiphyllous, May 2020, alt. 1531–2304 m, T. 20.3–22.3°C, H. 86–89%, F. Susilo 1531–2304 mdpl, Mei 2017, Ferdinand Susilo 33, 643, 682, 690, 694, 695, 696, 709, 713, 715, 726, 729, 747, 749, 754, 760, 763, 764, 765, 771, 772, 782, 783, 799, 800, 801, 802, 831, 833, 848, 909, 917, 921, 922, 924, 935, 938, 940, 946, 958, 959, 960, 965, 976, 995, 997, 998, 1034, 1036, 1042, 1044, 1046, 1062, 1063, 1071, 1081, 1089, 1090, 1103, 1122, 1128, 1154, 1174, 1180, 1245, 1302, 1314, 1342, 1461, 1486, 1499, 1508, 1539, 1576, 1587, 1591, 1594, 1637, 1654, 1709, 1731, 1760, 1786.

Distribution: India, China, Taiwan, Cambodia, Hawaii, Malaysia, Indonesia (Seram Is., West Irian, Sumatra- new record based on recent study), Philippines, Thailand, Vietnam, Madagascar, New Caledonia, Samoa Is., Tahiti, Australia (Tan & Engel 1986, Zhu & So 2001, McCarthy 2006, Dey et al. 2008, Asthana & Shukla 2009, Söderström et al. 2010, Chuah-Petiot 2011, Wang et al. 2011).

12. *Drepanolejeunea ternatensis* (Gottsche) Schiffn. Spec. Hepat. 5: 353 (1913). *Lejeunea ternatensis* Gott. in Gott., Lindenb. & Nees, Synop. Hepat. 346 (1845). *Drepanolejeunea unidentata* Horik. Bot. Mag. Tokyo, 49: 589, f. 23 (1935). (Fig. 13)

Plants are brownish green in the specimen, width 0.24–0.42 mm. Irregular branching, ventral merophytes of 3 cell lines. Lateral leaf arrangement is distant, flat attachment; ovoid lobe, length 0.21–0.34 mm, width 0.15–0.20 mm, flat dorsal base, ventral base curved, wavy edge, tapered tip; six-square leaf cell shape, width 0.14–0.18 mm, thick walls, smooth surface; trigones appears clear, triangular shape; oval lobules, 1/2 length of lobe, flat base, wavy edge, flat tip. The ventral leaves are spaced, the attachments are slightly curved, the shape is V, the length is 0.20–0.24 mm, the width is 0.14–0.20 mm, the base is flat, the edge is flat, the tip is split 1/2–1/3 of the length of the lobe; lobes are linear, pointed end 3 cell lines long, 1 cell wide.

Specimens examined: North Sumatra: Mt. Sibutan, corticolous, saxicolous, epixyloous and epiphyllous, May 2020, alt. 1558–2342 m, T. 22.9–25.5°C, H. 75–81%, F. Susilo 46, 157, 165, 451, 488, 492, 539, 644, 751, 762, 767, 769, 802, 848, 908, 937, 959, 962, 1027, 1028, 1067, 1071, 1119, 1130, 1278, 1382, 1384, 1396, 1430, 1531, 1533, 1656, 1711, 1816.

Distribution: Australia, Caroline Is., China, Fiji, India, Indonesia (Java, Moluccas, Seram Is., Sumatra), Japan, Malaysia, Micronesia, Papua New Guinea, Philippines, Samoa Is., Seychelles, Sri Langka (Zhu and So, 2001).

13. *Drepanolejeunea thwaitesiana* (Mitt.) Steph. Sp. Hepat. 5: 350 1913. *Lejeunea thwaitesiana* Mitt. Proc. Linn. Soc. Lond. 5: 117 1861. (Fig. 14)

Plants are dark green to brownish green in the specimen, 1.2–1.5 mm wide. Irregular branching, ventral merophytes of 3 cell lines. The lateral leaf arrangement is close together, flat adhesion; lobes are ovoid, 0.54–0.72 mm long, 0.35–0.45 mm wide, dorsal base flat, ventral base curved, toothed edge, tapered tip; rectangular leaf cell shape, width 0.14–0.20 mm, thick walls, smooth surface; trigones appears clear, triangular shape; ovular lobules, 1/3 of the lobes long, flat base, flat edges, flat ends. The ventral leaves are spaced, the attachment is slightly curved, the shape of the horn, length 0.22–0.25 mm, width 0.18–0.20 mm, base flat, edge flat, tip split to the base of the lobe; lobes are linear to lanceolate, pointed ends 6–7 cell lines long, 2 cell lines wide.

Specimens examined: North Sumatra: Mt. Sibutan, epiphyllous, May 2020, alt. 1950–21100 m, T. 19.0–19.7°C, H. 90–92%, F. Susilo 802, 1486, 1584.

Distribution: Cambodia, China, India, Indonesia (Borneo, Java, Seram Is., and Sumatra), Sri Lanka, Thailand, Peninsular Malaysia, Papua New Guinea (Mizutani, 1990; Zhu and So, 2001; Gradstein, 2011).

14. *Lejeunea dipterota* (Eifrig) G.E.Lee. *Taxilejeunea dipterota* Eifrig. *Ann. Bryol.* 9:96.1937. (Fig. 15)

Plants are light green on the specimen, 1.0–1.5 mm wide. Irregular branching, Ventral merophytes of 4 cell lines. The lateral leaf arrangement is close together, evenly intact; lobes ovate, 0.70–0.90 mm long, 0.50–0.70 mm wide, dorsal base curved, ventral base curved, apex rounded, leaf cells pentagonal to round, 0.21–0.26 mm wide, thick wall, smooth surface; trigones large, triangular, marginal cells of leaf lobe ovate, $\frac{1}{3}$ in length from the base, flat base, flat edges, apex truncated with 2 teeth, 2nd tooth 2 cell lines long, 1 cell lines wide, distance between tooth 2 cell lines. Ventral leaves intact, nearly curvedly intact, ovate, 0.40–0.50 mm long, 0.60–0.70 mm wide, flat base curvedly inwards, flat edge, apex divided to $\frac{1}{3}$ of lobe length.

Specimens examined: North Sumatra: Mt. Sibutan, corticolous and epifit on liana, May 2020, alt. 1558–22033 m, T. 18.5–25.5°C, H. 75–92%, F. Susilo 59, 81, 157, 169, 173, 178, 202, 268, 449, 1416.

Distribution: Indonesia (Sumatra; Lubuk Raya and Sibuan Mount., and Java), Malaysia (Lee 2013; Siregar et al., 2017).

15. *Lejeunea flava* (Sw.) Ness. Naturgesch. Eur. Leberrm. 3: 277. 1838. *Jungermannia flava* Swartz, Prodr. 144. 1788. (Fig. 16)

Plants are dark green on the specimen, 1.3–1.6 mm wide. Irregular branching, Ventral merophytes of 2 cell lines. The lateral leaf arrangement is distant, evenly intact; lobes ovate to oblongous, 0.70–0.85 mm long, 0.45–0.55 mm wide, dorsal base flat, ventral base flat, apex rounded, hexagonal leaf cells, 0.15–0.17 mm wide, thick wall, smooth surface; trigones large, triangular, marginal cells of leaf lobe ovate to triangular, $\frac{1}{4}$ in length from the base, flat base, flat edges, apex truncated. Ventral leaves distant, curvedly intact, ovate, 0.40–0.60 mm long, 0.45–0.60 mm wide, flat base, flat edge, apex divided to $\frac{1}{2}$ of lobe length.

Specimens examined: North Sumatra: Mt. Sibutan, corticolous and epifit on root, May 2020, alt. 1531–2180 m, T. 15.9–22.3°C, H. 89–94%, F. Susilo 15, 19, 25, 28, 32, 36, 53, 54, 72, 75, 103, 104, 106, 112, 182, 183, 368, 410, 424, 433, 434, 439, 877, 1112, 1197, 1754.

Distribution: India, Andaman and Nicobar Is., Nepal, Bhutan, Sri Lanka, China, Indonesia, Philippines, Thailand, Japan, Korea, New Zealand,

Jamaika, North and South America, Europe, Africa, Australia (Mizutani, 1971; Schuster, 1980; Onraedt, 1981; Tan & Engel, 1986; Piippo, 1990; Long & Grolle, 1990; Grolle, 1995; Wigginton & Grolle, 1996; Joshi, 2001; Singh & Singh, 2004; McCarthy, 2006; Yamada & Iwatsuki, 2006; Song & Yamada, 2006; Singh & Nath, 2007; Verma & Srivastava, 2008; Singh et al., 2008; Lai et al., 2008; Dey et al., 2009).

16. *Lejeunea obscura* Mitt. J. Proc. Linn. Soc., Bot.5: 112.1861. (Fig. 17)

Plants are dark green on the specimen, 1.0–1.8 mm wide. Irregular branching, Ventral merophytes of 2 cell lines. The lateral leaf arrangement is closely intact, evenly intact; lobes ovate, 0.52–0.76 mm long, 0.62–0.82 mm wide, dorsal base flat, ventral base flat, apex truncated; hexagonal leaf cells, 0.22–0.28 mm wide, thick wall, smooth surface; trigones large, triangular, marginal cells of leaf lobe ovate to triangular, $\frac{1}{5}$ in length from the base, flat base, flat edges, apex truncated, lobes reduced to minute size. Ventral leaves distant, curvedly intact, ovate, 0.27–0.41 mm long, 0.23–0.33 mm wide, flat base, flat edge, apex divided to $\frac{1}{2}$ of lobe length.

Specimens examined: North Sumatra: Mt. Sibutan, terricolous, May 2020, alt. 1558 m, T. 25.5°C, H. 75%, F. Susilo 47, 93.

Distribution: China, India, Indonesia (Java and Sumatra), Nepal, Sri Langka (Zhu and So, 2001).

17. *Lejeunea tuberculosa* Steph. Sp. Hepat. 5: 790. 1915. (Fig. 18)

Light green plants on the specimen, width 0.50–0.78 mm. Irregular branching, ventral merophytes 2 cell lines. Lateral lateral leaf arrangement, curved attachment; lobes are ovoid, length 0.30–0.40 mm, width 0.22–0.31 mm, dorsal base curved, flat ventral base, flat edge, rounded tip; the shape of round to polygonal leaf cells, width 0.12–0.24 mm, thick walls, smooth surface; trigones appears clear, triangular shape; ovular lobules, $\frac{1}{3}$ length of lobe, flat base, flat and curved edges, flat ends with 2 teeth, second tooth length 2 cell lines, width of 1 cell line, distance between teeth 2–3 cell lines. Spaced ventral leaves, curved attachment, almost rounded shape, flat base, flat edge, split edge 1/2 of lobe length.

Specimens examined: North Sumatra: Mt. Sibutan, corticolous, epixyloous and epiphyllous, May 2020, alt. 1558–2065 m, T. 19.1–25.5°C, H. 75–93%, F. Susilo 35, 47, 128, 153, 171, 172, 180, 184, 275, 295, 304, 308, 386, 488, 495, 751, 1528.

Distribution: Butan, Cina, India, Indonesia (Java and Sumatra), Nepal, Filipina (Zhu & So, 2001; Verma & Srivastava, 2011).

18. *Metalejeunea cucullata* (Reinw. Et al.) Grolle. Bryophyt. Biblioth. 48: 100, 1995. *Jungermannia cucullata* Reinw., Blume et Nees, Nova Acta Phys.-Med. Acad. Caes. Leop.-Carol. Nat. Cur. 12 (1): 227. 1825. (Fig. 19)

The plants are light green to yellowish in the specimen, 0.5 mm wide. Irregular branching, ventral merophytes 2 cell lines. The lateral leaf arrangement is spaced, the leaves are perpendicular to almost parallel to the stem, flat attachment; lobes are ovoid to elongated, 0.20–0.25 mm long, 0.10–0.15 mm wide, dorsal base flat, ventral base curved, jagged edges, rounded ends; four to rectangular leaf cell shapes, 0.10–0.12 mm wide, thick walls, rough surfaces; trigones appears clear, triangular shape; ovular lobules, 1 / 2–1 / 4 in length from lobe, flat base, flat edge with 10 mamilose cells, flat tip with 2 teeth. Spaced ventral leaves, curved attachment, round shape, length 0.75–0.12 mm, width 0.5–0.18 mm, rounded base, flat edge, split edge 1/3–1 / 4 of lobe length.

Specimens examined: North Sumatra: Mt. Sibutan, corticolous, epixyloous and epiphyllous, May 2020, alt. 1558–1978 m, T. 18.0–23.3°C, H. 81–93%, F. Susilo 96, 235, 271, 333, 386, 413, 490, 767, 800, 913, 933, 1107, 1394, 1575, 1583, 1819.

Distribution: common in Pantropics.

19. *Pycnolejeunea nicobarica* Steph. *Hedwigia* 35: 126 1896. *Lepidolejeunea bidentula* (J.B. Jack & Stephani) R.M. Schust.; *Phytologia* 45: 425 1980. (Fig. 20)

The plants are light green in the specimens, 0.9–1.2 mm wide. Irregular branching type, ventral merophytes 2 cell lines. Adjacent lateral leaf arrangement, flat leaf adhesion; ovoid lobe, length 0.5–0.65 mm, width 0.3–0.45 mm, flat dorsal base, ventral base curved, flat edge, rounded tip; rectangular leaf cell shape, width 0.15–0.23 mm, thick cell wall, smooth cell surface; trigones appears clear, triangular shape; oval lobules to triangles, flat bases, flat edges, split ends with 2 teeth distance between teeth 1 cell line. Spaced ventral leaves, curved leaf attachment, round shape, length 0.25–0.38 mm, width 0.28–0.45 mm, rounded base, flat edge, split edge 1/3 of the length of the ventral leaf. Androecium lacking; perianth lacking.

Specimens examined: North Sumatra: Mt. Sibutan, corticolous and epiphyllous, May 2020, alt. 1558–1978 m, T. 18.0–23.3°C, H. 75–94%, F. Susilo 64, 165, 275, 284, 361, 1197.

Distribution: Nicobar, South Indochina, Cambodia (Tixier 1985), Philippines, Vietnam, Indonesia (Sumatra and Borneo).

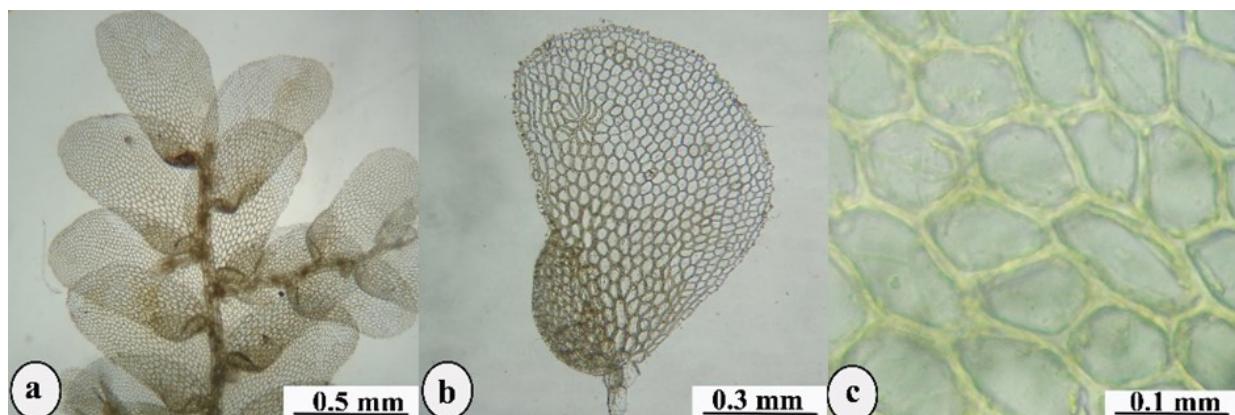


Figure 2. *Cololejeunea denticulata* a. Habit b. Lateral leaves c. Cells of Lateral leaves

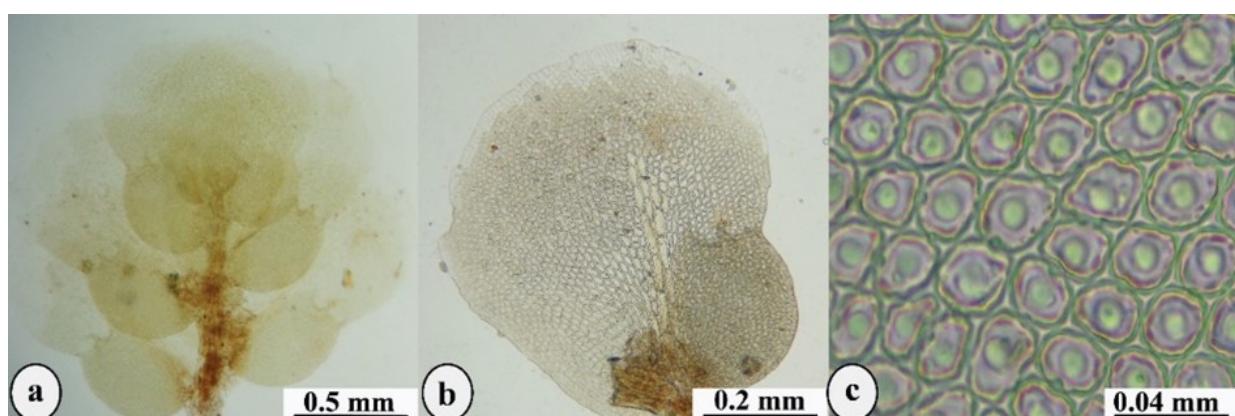


Figure 3. *Cololejeunea inflata* a. Habit b. Lateral leaves c. Cells of Lateral leaves

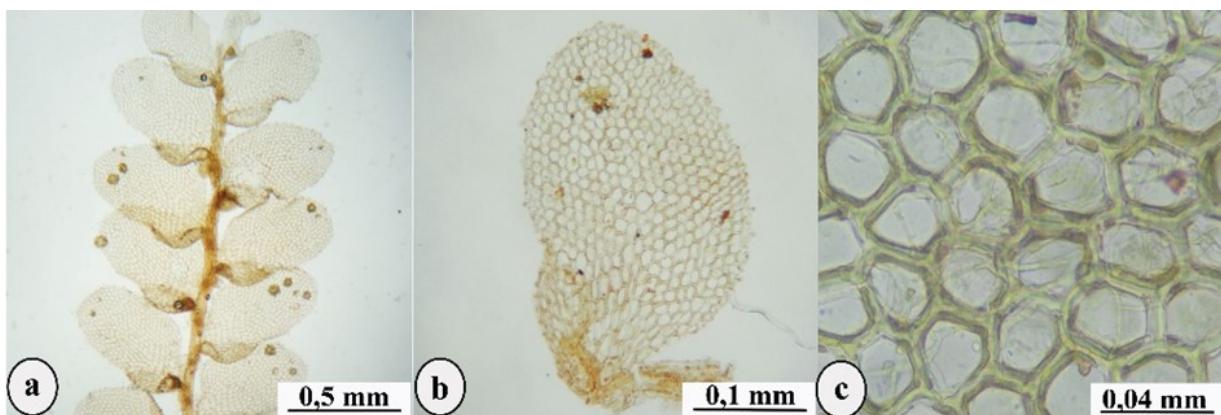


Figure 4 *Cololejeunea haskarliana* a. Habit b. Lateral leaves c. Cells of Lateral leaves

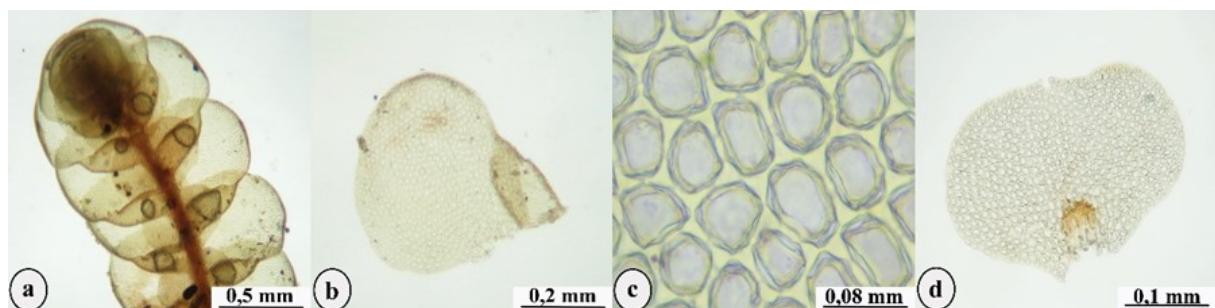


Figure 5 *Cheilolejeunea incisa* a. Habit b. Lateral leaves c. Cells of Lateral leaves d. Ventral leaves.

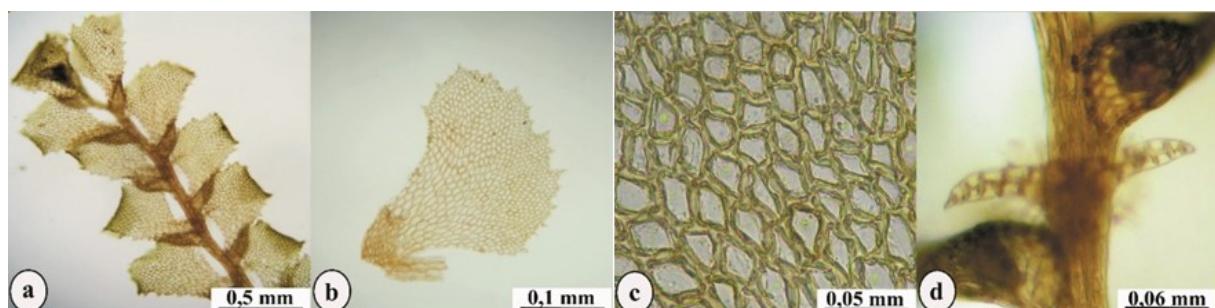


Figure 6. *Drepanolejeunea levicornua* a. Habit b. Lateral leaves c. Cells of Lateral leaves d. Ventral leaves.

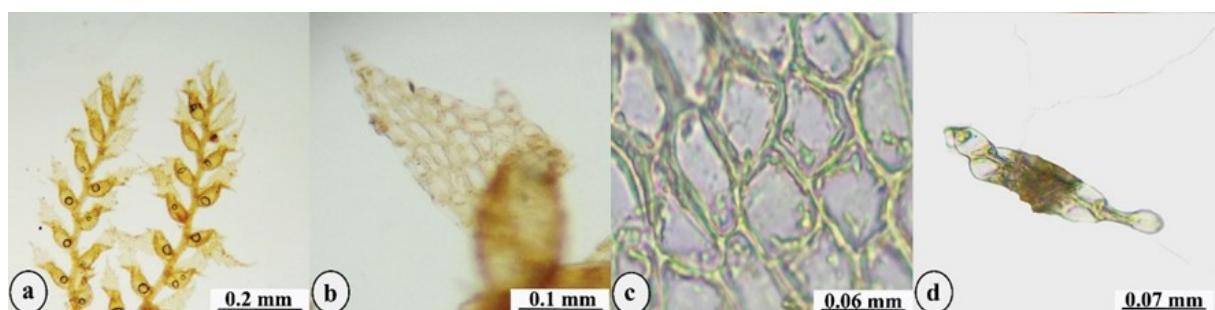


Figure 7. *Drepanolejeunea pentadactyla* a. Habit b. Lateral leaves c. Cells of Lateral leaves d. Ventral leaves.

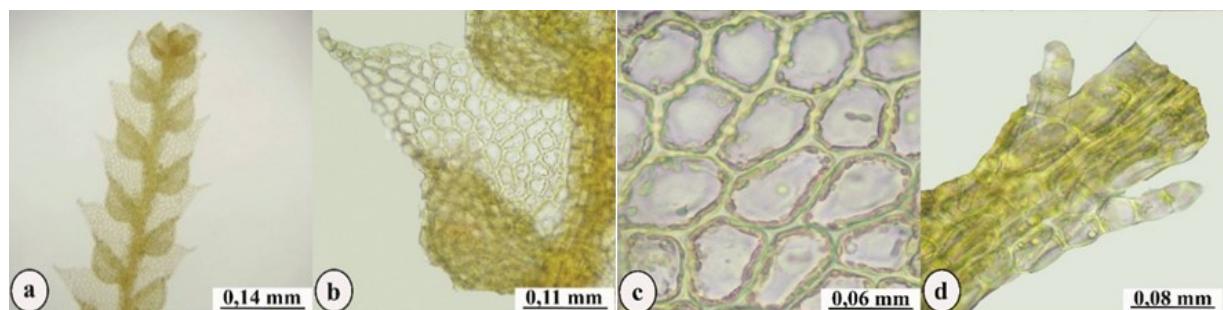


Figure 8. *Drepanolejeunea ternatensis* a. Habit b. Lateral leaves c. Cells of Lateral leaves d. Ventral leaves.

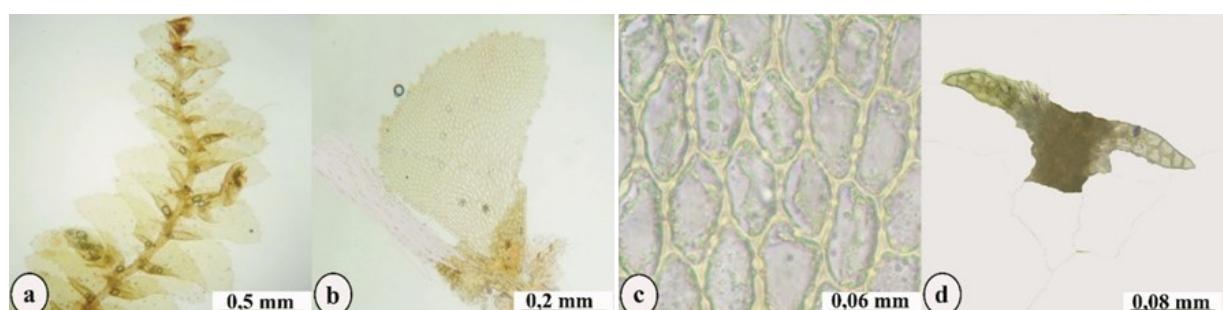


Figure 9. *Drepanolejeunea thwaitesiana* a. Habit b. Lateral leaves c. Cells of Lateral leaves d. Ventral leaves.

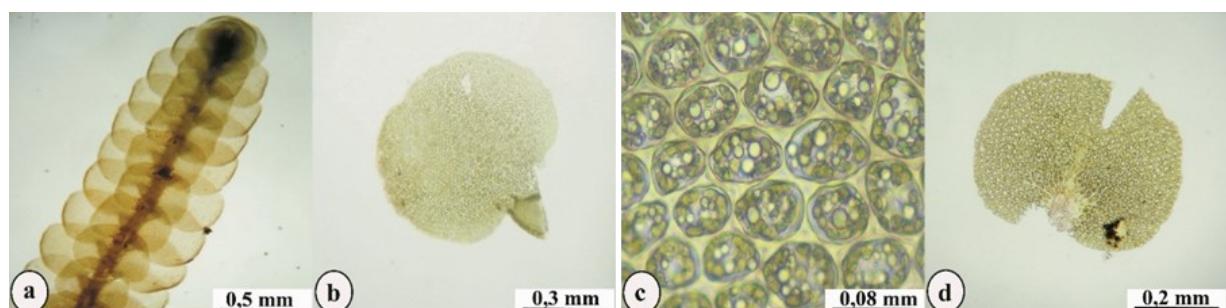


Figure 10 *Lejeunea dipterota* a. Habit b. Lateral leaves c. Cells of Lateral leaves d. Ventral leaves.

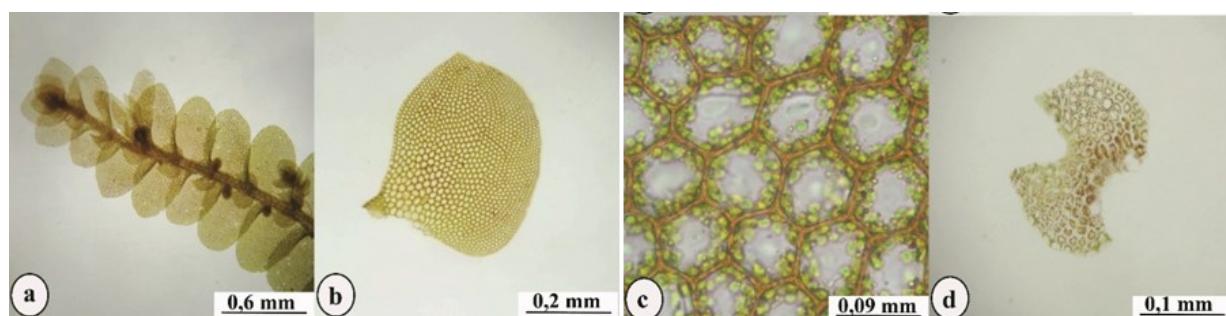


Figure 11. *Lejeunea obscura* a. Habit b. Lateral leaves c. Cells of Lateral leaves d. Ventral leaves.

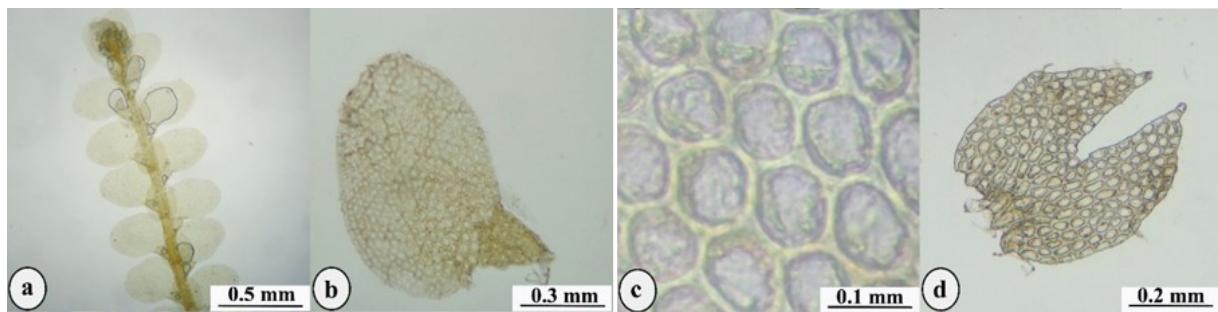


Figure 12. *Lejeunea flava* a. Habit b. Lateral leaves c. Cells of Lateral leaves d. Ventral leaves.

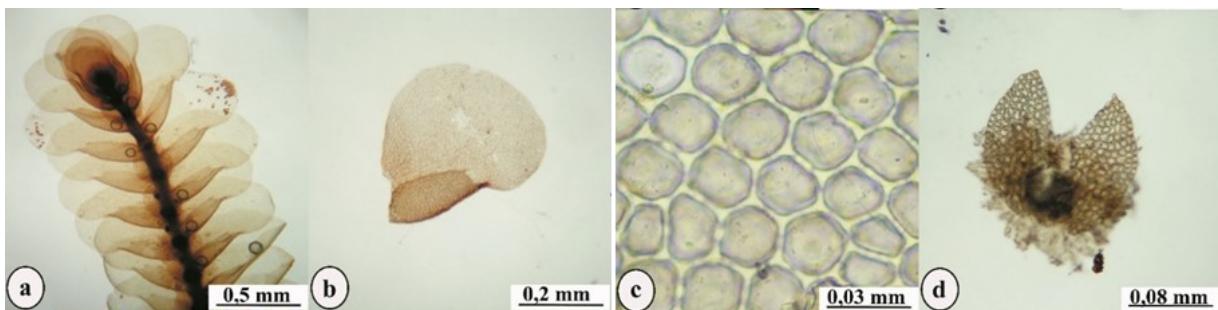


Figure 13. *Cheilolejeunea longiloba* a. Habit b. Lateral leaves c. Cells of Lateral leaves d. Ventral leaves.



Figure 14. *Colura acroloba* a. Habit b. Lateral leaves c. Cells of Lateral leaves



Figure 15. *Diplasiolejeunea cavifolia* a. Habit b. Lateral leaves c. Cells of Lateral leaves d. Ventral leaves.

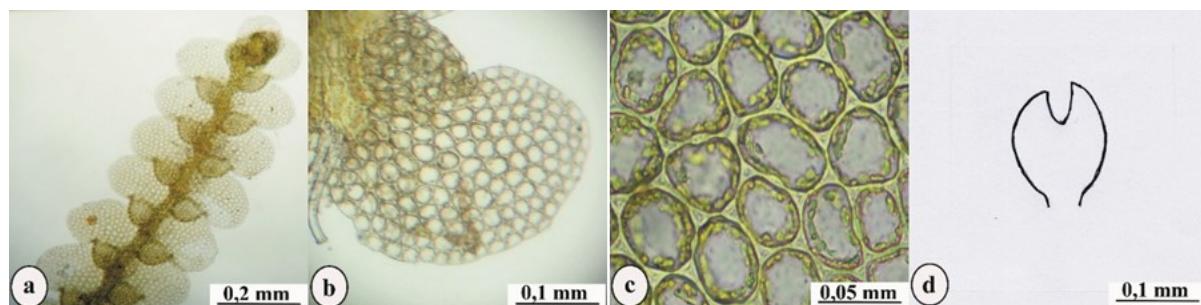


Figure 16. *Lejeunea tuberculosa* a. Habit b. Lateral leaves c. Cells of Lateral leaves d. Ventral leaves.

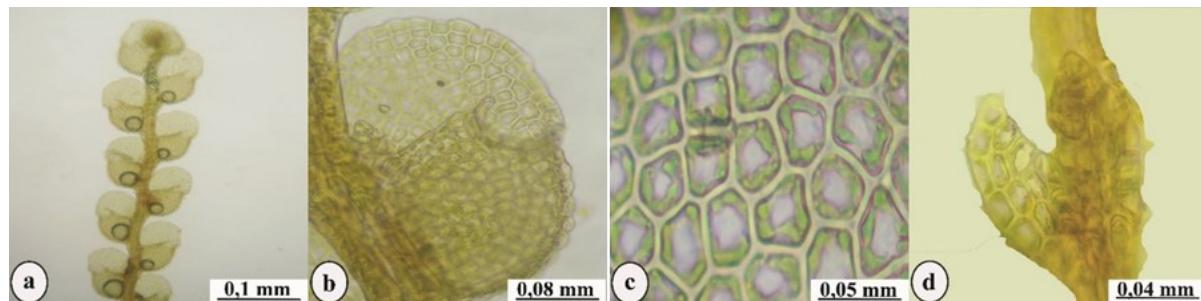


Figure 17. *Metalejeunea cucullata* a. Habit b. Lateral leaves c. Cells of Lateral leaves d. Ventral leaves.

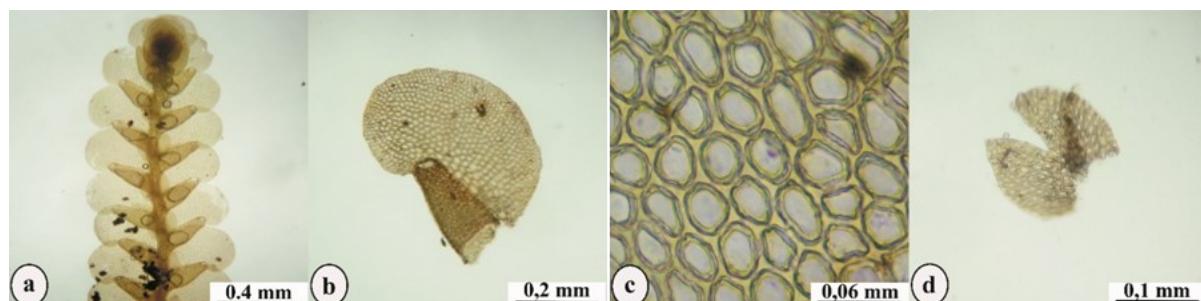


Figure 18 *Cheilolejeunea ceylanica* a. Habit b. Lateral leaves c. Cells of Lateral leaves d. Ventral leaves

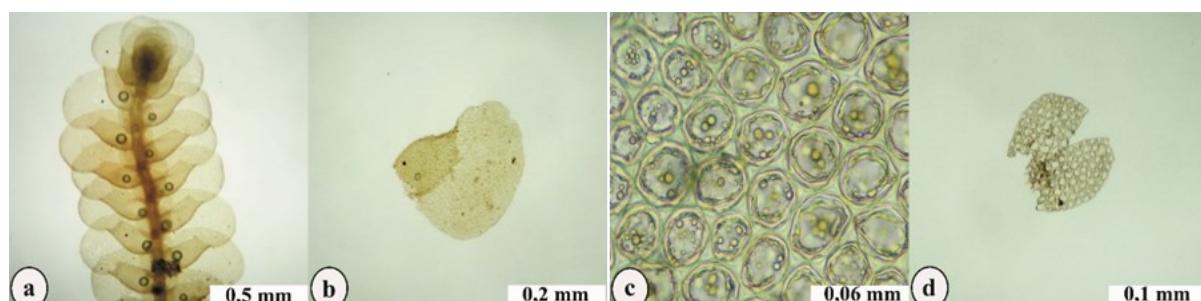


Figure 19. *Cheilolejeunea trapezia* a. Habit b. Lateral leaves c. Cells of Lateral leaves d. Ventral leaves.

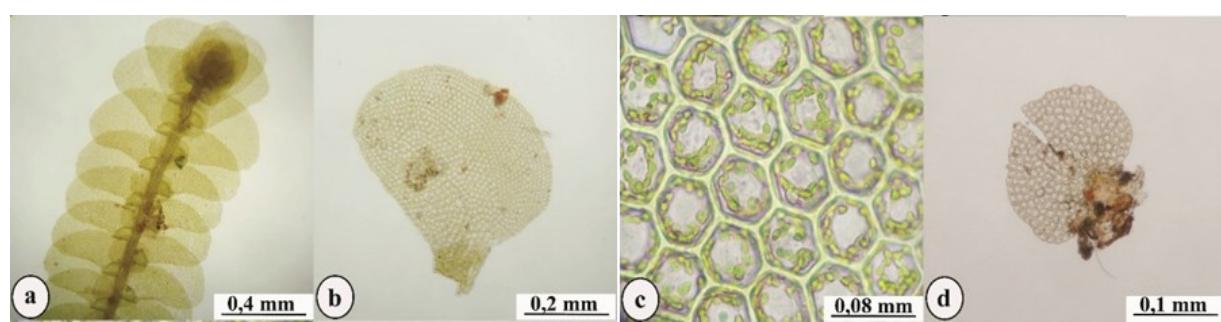


Figure 20. *Pycnolejeunea nicobarica* a. Habit b. Lateral leaves c. Cells of Lateral leaves d. Ventral leaves

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