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Orthotrichaceae (Musci) of Palawan Island, with two species new to the Philippines

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Abstract

This paper provides an updated list of the Orthotrichaceae occurring in Palawan Island, the Philippines. Nine species are reported as new to the island. *Macromitrium clemensiae* E.B.Bartram and *M. megalocladon* M.Fleisch. are new country records, while the remaining seven species were previously reported in other islands of the Philippines. A key to the species of Orthotrichaceae in Palawan is provided. Descriptions and illustrations are provided for the two new country records. Notes and range extensions for each species reported are discussed.

Keywords: bryophytes, *Desmotheca*, *Groutiella*, *Macromitrium*, new records, range extensions, *Schlotheimia*.

Introduction

In the last published checklist of mosses of Palawan Island in the Philippines (Tan 1996), five species of Orthotrichaceae were recorded from the island: *Desmotheca apiculata* (Dozy & Molk.) Lindb. ex Cardot; *Macromitrium blumei* Nees ex Schwägr.; *Macromitrium cuspidatum* Hampe; *Macromitrium falcatulum* Müll.Hal.; and *Macromitrium salakanum* Müll.Hal. None of these species was exclusive to Palawan but also distributed on other islands in the Philippines (Tan and Iwatsuki 1991).

Previously undetermined collections of Orthotrichaceae from Palawan Island, mainly materials from previous expeditions of early field collectors from the Philippine National Herbarium (PNH), but also including collections from the authors now lodged in CAHUP, PPC, and VBGI, were studied as part of a broader floristic study of moss flora in Palawan Island. After being visited four times between 1987 and 1993 by B.C. Tan, the island was explored again in 2019–2022, which resulted in a significant number of collections. Several collections determined as either new country or island moss records from these recent expeditions have been published in an earlier paper (Linis and Logatoc 2023) with their collection details.

This paper reports nine additional orthotrichaceous species for the Palawan moss flora, with *Macromitrium clemensiae* E.B.Bartram and *M. megalocladon* M.Fleisch. representing the first report of these species for the country. *Groutiella tomentosa* (Hornsch.) Wijk & Margad., *Macromitrium angustifolium* Dozy & Molk., *M. fuscescens* Schwägr., *M. incurvifolium* (Hook. & Grev.) Schwägr., *M. longicaule* Müll.Hal., *M. zollingeri* Mitt. ex

Bosch & Sande Lac., and *Schlotheimia wallisii* Müll.Hal. were all reported previously from other islands of the Philippines and are here reported for the first time in Palawan Island.

Taxonomic Treatment

Key to genera of Orthotrichaceae known from Palawan Island

1. Branches strongly dimorphic in length, leaf shape and leaf arrangement; short branches with longer, irregularly arranged leaves; elongated branches pentastichous, with shorter leaves; capsules almost sessile, immersed, wide-mouthed, gymnostomous ..... ***Desmotheca***

1. Branches not clearly dimorphic; capsules various, never almost sessile, generally narrowed toward mouth, rarely gymnostomous 2

2. Leaf apices generally obtuse to truncate or retuse, often hair-pointed; basal leaf cells prorate; dioicous; calyptrae large, smooth, laciniate at the base (with 4–8 inflexed flaps); peristomes double, well developed ..... ***Schlotheimia***

2. Leaf apices variously shaped, generally acute to acuminate, if obtuse, never hair-pointed; basal leaf cells smooth or tuberculate, never prorate; dioicous or phyllodioicous; calyptrae plicate, hairy or not, small, never laciniate at base; peristomes lacking, single or, if double, rudimentary 3

3. Leaf apices subulate, fragile and brittle (all, except those of the youngest leaves usually broken off); upper leaf cells pluristratose; dioicous and isosporous; calyptrae covering only upper halves of the capsules ..... ***Groutiella***

3. Leaf apices rarely brittle; upper leaf cells unistratose; phyllodioicous and anisosporous; male plants dwarf; calyptrae fully covering capsules or nearly so ..... ***Macromitrium***

Desmotheca Lindb.

Desmotheca apiculata (Dozy & Molk.) Lindb. ex Cardot, *Ann. Jard. Bot. Buitenzorg, Suppl.* 1: 11. 1897. *Cryptocarpon apiculatum* Dozy & Molk., *Ann. Sci. Nat., Bot.*, sér. 3, 2: 302. 1844. *Type*: Indonesia, Kalimantan (Borneo), *P.W. Korthals s.n.* (holotype: L, not seen).

Descriptions: Fleischer (1904: 463–466), Bartram (1939: 186), Vitt *et al.* (1995: 87–91), Eddy (1996: 94).

Illustrations: Fleischer (1904: 464, fig. 86), Vitt *et al.* (1995: 89, fig. 38a–n), Eddy (1996: 95, fig. 394).

Notes: *Desmotheca apiculata* is readily distinguished from other species of Orthotrichaceae occurring in Palawan Island by its noticeably dimorphic branches, the fertile elongated branches having small, ranked, imbricate leaves terminated by several perichaetia with totally immersed, smooth capsules lacking peristomes. Other key features include creeping stems, dimorphic, apiculate leaves with tuberculate basal leaf cells and excurrent costa, short and hairy calyptrae, and immersed capsules (Vitt *et al.* 1995; Eddy 1996). *Desmotheca apiculata* is distributed in Southeast Asia, including the Andaman Islands, Papua New Guinea, and New Caledonia (Vitt 1990). In the Philippines, this species is recorded from the islands of Palawan (Tan 1996) and Mindanao (Tan and Iwatsuki 1991). *Desmotheca apiculata* is usually epiphytic, often growing on branch and tree trunks of open and disturbed forests, also in gardens and plantations across its range below 1600 m elev.

Specimen examined: Palawan Island: Narra Municipality, Mt Victoria, ridge, montane rainforest along the trail leading to the summit, ca 1602 m elev., N 09° 22' 17.56" E 118° 18' 20.38", on the branch of a tree, 23 December 2022, *Linis 5905-22a* (CAHUP, PPC, VBGI).

Groutiella Steere

Groutiella tomentosa (Hornsch.) Wijk & Margad., *Taxon* 9(2): 51. 1960. *Macromitrium tomentosum* Hornsch., *Fl. Bras.* 1(2): 21. 1840. *Type*: Brazil, in campis montevidensibus, *Sellow s.n.* (lectotype: H-BR 2726013, designated by Yu *et al.* 2011).

Groutiella goniorrhyncha (Dozy & Molk.) E.B.Bartram, *Rev. Bryol. Lichénol.* 23: 250. 1954. *Micromitrium goniorrhynchum* (Dozy & Molk.) A.Jaeger, *Ber. Thätigk. St. Gallischen Naturwiss. Ges.* 1872–73: 157. 1874. *Macromitrium goniorrhynchum* (Dozy & Molk.) Mitt., *J. Proc. Linn. Soc., Bot., Suppl.* 1: 53. 1859. *Schlotheimia goniorrhyncha* Dozy & Molk., *Pl. Jungh.* 3: 338. 1854. *Type*: Indonesia, Java, Semarang (Samarang) Province, Mt Ungaran, *Junghuhn s.n.* (lectotype: L0623557, designated by Touw 2007).

Descriptions: Fleischer (1904: 456–459, as *Micromitrium goniorhynchum*), Bartram (1939: 183–184, as *Macromitrium goniorhynchum*), Vitt and Ramsay (1985: 431–434), Vitt *et al.* (1995: 85–86), Eddy (1996: 82–84).

Illustrations: Fleischer (1904: 457, fig. 84, as *Micromitrium goniorhynchum*), Vitt and Ramsay (1985: 432–433, figs. 333–340), Vitt *et al.* (1995: 87, fig. 37a–g), Eddy (1996: 83, fig. 386; 84, fig. 387).

Notes: Bartram (1939) first reported this species in the Philippines as *Macromitrium goniorhynchum* [sic], which he later treated as *Groutiella goniorhyncha* [sic] (Bartram, 1954). Yu *et al.* (2011) eventually placed the species in synonymy with the pantropical *Groutiella tomentosa*. This species is distinguished by its prostrate stems with short, erect branches and fragile, subulate leaves bordered in their lower portions by several rows of elongate, thick-walled cells that contrast sharply with the inner oblate to rounded basal cells.

In the Philippines, *Groutiella tomentosa* has a relatively broad distribution and is recorded from the islands of Luzon, Catanduanes, Mindoro, Panay, and Mindanao (Tan and Iwatsuki 1991; Linis 2009, 2014; Tan *et al.* 2015). Only one specimen, collected by the first author from Mt Victoria, has been identified from the central part of Palawan. This plant was collected from the upper tree trunk and branches of a tree in the montane forest over the mountain ridge. Across the country, *G. tomentosa* is a common plant usually found as an epiphyte, on tree trunks, branches, and twigs, rarely on rock, and has been observed from lowlands up to *ca* 1500 m elev. The species can be common in gardens and similar sites prone to desiccations for a considerable period.

Specimen examined: Palawan Island: Narra Municipality, Mt Victoria, ridge, montane rainforest along the trail leading to the summit, *ca* 1620 m, N 09° 22' 17.56"; E 118° 18' 20.38", on upper tree trunk and branches, 23 December 2022, *Linis 5919-22* (CAHUP, PPC, VBGI).

Macromitrium Brid.

Key to species of *Macromitrium* known from Palawan Island

1. Basal leaf cells elongate-rectangular, smooth, without tuberculae, not bulging 2
1: Basal leaf cells rounded oval to elongate rectangular, bulging, conic or at least some cells with tuberculae 7
2. Basal leaf cells with straight to shallow-sigmoid or somewhat curved lumen ..... *M. incurvifolium*
2: Basal leaf cells with distinctly curved or sigmoid lumen 3
3. Leaves long-cuspidate, > 3.5 mm long; costae long-excurrent ..... *M. cuspidatum*
3: Leaves obtuse, mucronate, acuminate-apiculate to long and slenderly acute, < 3.0 mm long; costae percurrent to short excurrent 4
4. Plants glaucous-green; transitions from basal leaf cells to upper leaf cells sharp (with 1–3 cell tiers); costae excurrent ..... *M. fuscescens*
4: Plants olive-green to reddish; transitions from leaf basal cells to upper leaf cells gradual (within 5–10 cell tiers); costae excurrent to percurrent 5
5. Perichaetium almost vestigial, with 1–4 bracts smaller than vegetative leaves, not concealing vaginula ..... *M. falcatulum*
5: Perichaetium not reduced, composed of perichaetial leaves concealing the vaginula 6
6. Perichaetial leaves obtuse, retuse, mucronate; costae excurrent ..... *M. salakanum*
6: Perichaetial leaves acute to acuminate; costae percurrent or excurrent ..... *M. angustifolium*
7. Seta smooth ..... *M. longicaule*
7: Seta papillose or scabrid 8
8. Plants small; branches less than 1.0 cm long; leaves less than 2.0 mm long 9
8: Plants moderately robust to robust; branches more than 1.0 cm long; leaves more than 2.0 mm long 10
9. Perichaetial leaves broadly pointed; costa short to moderately excurrent ..... *M. blumei*
9: Perichaetial leaves acuminate; costa strongly excurrent ..... *M. zollingeri*

10. Inner basal leaf cells short, strongly differentiated from *ca* 10 rows of elongated, smooth, outer marginal basal leaf cells ..... *M. clemensiae*

10: Inner basal leaf cells, elongate, more or less similar to elongate, outer marginal basal leaf cells..... *M. megalocladon*

Macromitrium angustifolium Dozy & Molk., *Musc. Frond. Archip. Ind*. 16. 1844. *Type*: Indonesia, Sumatra, Java, and Kalimantan (Borneo), *P.W. Korthals s.n.* (lectotype: L0060422, annotated by Vitt and published by Touw 2007).

Descriptions: Noguchi (1989: 616), Bartram (1939: 178–179), Vitt *et al.* (1995: 17–19), Eddy (1996: 46).

Illustrations: Noguchi (1989: 615, fig. 273, B), Vitt *et al.* (1995: 18, fig. 7a–k), Eddy (1996: 47, fig. 358).

Notes: *Macromitrium angustifolium* is the most common species of the genus on the island of Luzon in the Philippines. The lustrous yellowish green to olive-green colour, squarrose leaves when moist, percurrent costa, sharply and narrowly acute leaf apices, papillose upper leaf cells, elongate, curved-sigmoid, non-tuberculose basal cells, strongly differentiated outer and inner perichaetial leaves, narrowly elliptic smooth capsules, and sparsely hairy calyptrae are diagnostic for this species (Vitt *et al.* 1995). In some Philippine materials, the leaves are gradually narrowed to slenderly, acute leaf apices, and the costa ends 1–2 cells below the apex, similar to those in New Guinea (Vitt *et al.* 1995). In contrast, specimens with shortly acuminate leaf apices with excurrent costae can be confused with those of other Philippine *Macromitrium* species, such as *M. fuscescens* and *M. salakanum*. A thorough molecular investigation may reveal some cryptic diversity within this species, although until further data are available, we can continue with the broad species concept currently adopted.

Macromitrium angustifolium is a widespread tropical Asian species that occurs in Mainland China, Sumatra, Java, Borneo, Sulawesi, the Philippines, New Guinea, and the Solomon Islands (Vitt *et al.* 1995; Guo *et al.* 2012). It is reported here as new to Palawan Island, extending its current Philippine range to the south from Luzon, Mindoro and Camiguin (Bartram 1939; Tan and Iwatsuki 1991; Linis 2009, 2014). This species was collected in the tropical lower montane rainforest of Mt Salakot and the tropical subalpine forest in the summit area of Mt Mantalingahan. Across the country, *M. angustifolium* is mainly a sub-canopy epiphyte occurring on tree branches, trunks, and logs in disturbed or secondary forests.

Specimens examined: Palawan Island: Puerto Princesa City, Mt Salakot, mossy rainforest along the trail above the small helicopter landing site, *ca* 1100 m, on a tree trunk, 05 May 1979, *Wm. Sm. Gruèzo WM6449* (personal herbarium of W.S. Gruèzo; VBGI); Rizal Municipality, Mt Mantalingahan, tropical subalpine forest near the summit, 2068 m elev., on the trunk of a hardwood tree, 09 January 2020, *E.L.R. Logatoc 20-0127* (CAHUP, VBGI), tropical subalpine forest, *ca* 1900 m elev., on top of a boulder, 09 January 2020, *E.L.R. Logatoc 20-0132* (CAHUP, PPC, VBGI).

Macromitrium blumei Nees ex Schwägr., *Sp. Musc. Frond., Suppl*. 4: 316. 1842. *Type*: Indonesia, Java, *Blume s.n.* (holotype: BM, not seen; isotype: H-BR, not seen).

Macromitrium copelandii Broth., *Philipp. J. Sci., C*. 3: 16. 1908. *Type*: Philippines, Bataan Province, Mt Mariveles, *E.B. Copeland s.n.* (isotype: NY, not seen).

Descriptions: Fleischer (1904: 424–428), Bartram (1939: 175–176), Eddy (1996: 74–76), Guo *et al.* (2012: 348–450).

Illustrations: Fleischer (1904: 425), Eddy (1996: 75, fig. 382), Guo *et al.* (2006: 477; 2012: 349, figs. 56–65).

Notes: *Macromitrium blumei* are small mat-forming plants that can be distinguished from other Philippine species of the genus by: small branch leaves, densely coiled around the stem, forming "rope-like" shoots; isodiametric, bulging to mammillate upper leaf cells; elongate, pellucid, incrassate lower leaf cells with distinct papillae or tubercles; seta up to 16 mm long; urceolate smooth capsule with the short cylindrical mouth; double peristomes; and naked calyptrae (Guo *et al.* 2012). This species is closely related to *M. zollingeri* Mitt. ex Bosch & Sande Lac. (Guo *et al.* 2006), another species in the genus reported here as new for Palawan. The taxonomic status here adopted and the distinction between these two mosses is discussed under the latter.

Macromitrium blumei is a tropical Asian species reported from Hainan, Sumatra, Java, Borneo, Lombok, and the Philippines (Eddy 1996). In the Philippines, *M. blumei* was reported in Luzon, Mindoro, Palawan, Negros, and Mindanao (Tan and Iwatsuki 1991; Tan 1996; Linis 2009). In Palawan, this species was collected on tree trunks and fallen branches in the tropical lower and tropical upper montane rainforests. Across its range in the Philippines, *M. blumei* is usually found as an epiphyte on tree trunks and twigs and has been observed from lowlands up to ca 1600 m.

Specimens examined: Palawan Island: Rizal Municipality, Mt Mantalingahan, tropical upper montane rainforest-over-ultramafic substrate, *ca* 1600 m elev., on the trunk of a hardwood tree, 27 July 2019, *E.L.R. Logatoc 19-0337* (CAHUP, PPC, VBGI), on the trunk of a hardwood tree, 09 January 2020, *E.L.R. Logatoc 20-0152*, *20-0153* (CAHUP, VBGI); Brooke's Point Municipality, Mt Mantalingahan, tropical lower montane rainforest-over-ultramafic substrate, *ca* 1300 m elev., on a fallen branch, *E.L.R. Logatoc 20-0100*, *20-0101* (CAHUP, VBGI).

Macromitrium clemensiae E.B.Bartram, *Philipp. J. Sci*. 61: 242. 1936. *Type*: Malaysia, Borneo, Mt Kinabalu, Penibukan, *J. Clemens & M.S. Clemens 40531* (holotype: FH00213595, not seen).

Description: Plants fairly robust; young shoots yellowish green, gradually turning to reddish brown at mature portions. Stems creeping, covered with tomentum, stem leaves inconspicuous; branches erect, up to 2.0 cm tall. Branch leaves narrowly lanceolate, loosely erect and crisped when dry, arcuate patent to almost squarrose when moist, 2.5–3.0 mm long and 0.4–0.5 mm wide across the weakly developed shoulders, carinate; margins plane; apices narrowly acuminate, irregularly dentate; costa percurrent to short-excurrent. Upper leaf cells quadrate to short-rectangular, up to 10 µm wide, evenly incrassate, internal walls slightly thickened, densely pluripapillose and obscure. Basal leaf cells dimorphic; interior cells uniformly elongate, up to 20 µm long, evenly incrassate, mostly conspicuously tuberculate; marginal cells narrow and smooth, forming a strongly differentiated pellucid band of cells along lower margins, up to 1/3 length of the leaves. Perichaetial leaves narrowly lanceolate, conspicuously erect, longer than branch leaves, up to 3.5 mm long. Seta 8.0–9.0 mm long, papillose, twisted. Capsule ovoid, up to 2.0 mm long and 1.0 mm wide; peristome teeth fused, forming a continuous membrane, up to 50 µm long. Calyptra mitrate, plicate, hairy, up to 4.0 mm long.

Illustration: Fig. 1; Eddy (1996: 45, fig. 357).

Notes: Several Philippine species of *Macromitrium* have tuberculate basal cells; however, the markedly differentiated broad bands of pellucid cells along the lower leaf margins easily distinguish *M. clemensiae* from others. Outside the Philippines, *M. clemensiae* is similar to the New Guinea endemic *M. norrisianum* Vitt having similar bordered lower leaf margins. However, the larger *M. norrisianum* has rounded to rounded-quadrate bulging upper leaf cells with firm walls (Vitt *et al.* 1995). In contrast, similar cells of *M. clemensiae* are quadrate, densely pluripapillose, and obscure, with less thickened cell walls. *Macromitrium clemensiae* without sporophytes can be mistaken for a species of *Groutiella*. The persistent, unistratose, and dentate leaf apices of *M. clemensiae* affords an alternative to distinguish it from this genus (Eddy 1996).

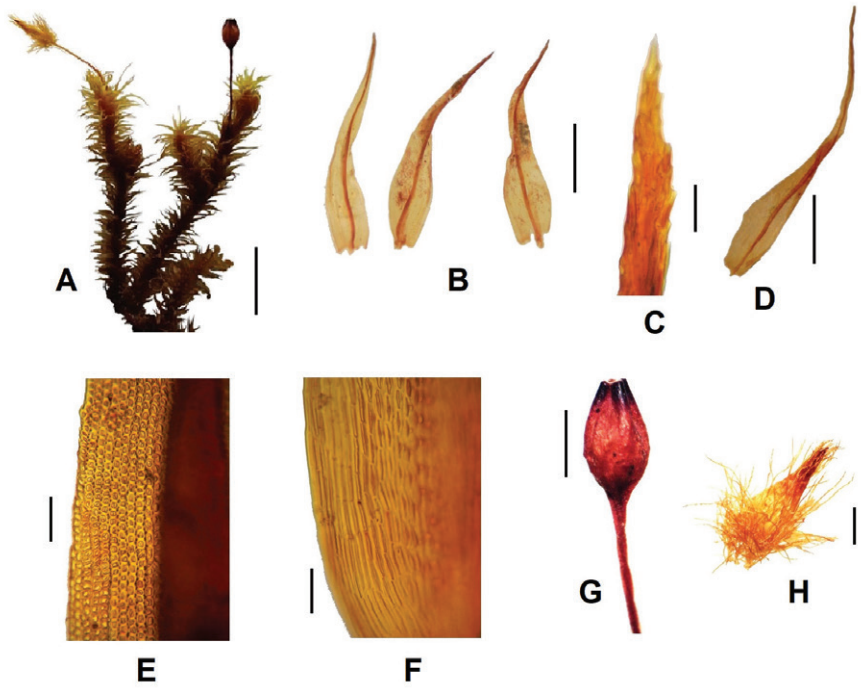

Fig. 1. *Macromitrium clemensiae* Bartram. **A**: Habit of plant, moist. **B**: Leaves, adaxial view. **C:** Leaf apex, adaxial view. **D:** Perichaetial leaf, adaxial view. **E.** Median leaf cells. **F.** Basal leaf cells near margin. **G:** Capsule. **H.** Calyptra. All from *E.L.R. Logatoc 20-0145* (CAHUP). Scale bars: A = 5 mm; B, D, G = 1 mm; C = 20 µm; E, F = 40 µm; H = 2 mm.

Macromitrium clemensiae is only known from Borneo (Bartram 1936; Higuchi *et al*. 2006) until now. Reported here for the first time in the Philippines, it appears to be a rare plant, being the specimen *E.L.R. Logatoc 20-0145* the fifth published record of this species. *Macromitrium clemensiae* is usually found as an epiphyte on branches and twigs of trees, fallen branches and tree trunks.

Specimen examined: Palawan Island: Rizal Municipality, Mt Mantalingahan, tropical upper montane rainforest-over-ultramafic substrate, *ca* 1700 m elev., on a fallen branch, 09 January 2020, *E.L.R. Logatoc 20-0145* (CAHUP, PPC, VBGI).

Macromitrium cuspidatum Hampe, *Icon. Musc*. (*Hampe*): pl. 20. 1844. *Type*: Indonesia, Java, *Junghuhn s.n.* (lectotype: BM, designated by Vitt *et al.* 1995).

Descriptions: Bartram (1939: 180), Vitt *et al.* (1995: 27–29), Eddy (1996: 49–50), Guo *et al*. (2012: 342).

Illustrations: Vitt *et al.* (1995: 28, fig. 12a–j), Eddy (1996: 50, fig. 361), Guo *et al*. (2012: 343).

Notes: *Macromitrium cuspidatum* are robust yellowish-green plants forming mats or cushions. The broad, loosely erect leaves and the ovoid capsules on short setae can distinguish this species from its congeners in the field. Under the microscope, the species is readily identified by the long cuspidate leaves with a long-excurrent solid costa and the smooth, asymmetrically thickened cells with curved-sigmoid narrow lumina restricted to the basal leaf area (Vitt *et al.* 1995; Eddy 1996).

Macromitrium cuspidatum is another example of a widespread tropical Asian *Macromitrium* species, having been reported from China and the northern and western parts of Malesia, reaching Papua New Guinea (Vitt *et al.* 1995; Eddy 1996; Guo *et al*. 2012). Locally, it is reported from Luzon, Mindoro, Palawan, Panay, and Mindanao (Tan and Iwatsuki 1991; Tan 1996; Linis 2009; Tan and Shevock 2015). In the Philippines, *M. cuspidatum* was collected on tree trunks and branches in semi-open areas of tropical lowland forests up to *ca* 1600 m.

Specimen examined: Palawan Island: Narra Municipality, Mt Victoria, ridge, montane rainforest along the trail leading to the summit, *ca* 1602 m elev., N 09° 22' 17.56" E 118° 18' 20.38", on a branch of an understory tree, 23 December 2022, *Linis 5893-22* (CAHUP, PPC, VBGI).

Macromitrium falcatulum Müll.Hal., *Linnaea* 38: 558. 1874. *Type*: Philippines, *H. Cuming 2212* (lectotype: NY, designated by Vitt *et al.* 1995; isotype: BM, not seen).

Macromitrium merrillii Broth., *Öfvers. Finska Vetensk.-Soc. Förh*. 47(14): 4. 1905. *Type*: Philippines, Luzon, Tarlac Province, *Merrill 3590* (holotype: H-BR, not seen).

Macromitrium winkleri Broth., *Bot. Jahrb. Syst*. 49: 350. 1912. *Type*: Indonesia, Kalimantan (Borneo), Hayup, *Winkler n. 2117* (lectotype: H-BR, designated by Vitt *et al.* 1995).

Descriptions: Bartram (1939: 174–175), Vitt *et al.* (1995: 32–33), Eddy (1996: 38–40).

Illustrations: Vitt *et al.* (1995: 33, fig. 14a–j), Eddy (1996: 40, fig. 352).

Notes: *Macromitrium falcatulum* are short, small plants distinguished by the tightly inrolled leaves, densely papillose upper leaf cells, rounded-tuberculate basal leaf cells, tiny perichaetial leaves with exposed vaginula, and densely hairy calyptrae (Vitt *et al.* 1995). When dry, plants of this species can be mistaken as *M. tylostomum* Mitt. ex Bosch & Sande Lac. However, the latter is a larger species with smooth, bulging upper leaf cells and long-acuminate perichaetial leaves. This species is also similar in appearance to *M. nepalense* (Hook. & Grev.) Schwägr.; however, the latter has tuberculate basal cells in the lower half of the leaves, and the capsules are fusiform, not short ovoid, as in *M. falcatulum* (Eddy 1996).

Macromitrium falcatulum has been reported from Indochina, Peninsular Malaysia, Borneo, the Philippines, and New Guinea (Tan and Iwatsuki 1993; Vitt *et al*. 1995). It is reported from the Philippine islands of Batan, Luzon, Palawan, and Mindanao (Tan and Iwatsuki 1991; Tan 1996). This species is mainly corticolous in open and relatively dry situations, particularly in disturbed secondary lowland forests.

Specimen examined: Palawan Island: Narra Municipality, Barangay Princess Urduja, secondary lowland rainforest beside the trail along Buhawi River from Base Camp leading to the summit, *ca* 1200 m elev., N 09° 21' 13.14" E 118° 18' 25.20", on the trunk of a tree, associated with *Calymperes porrectum*, 22 December 2022, *Linis 5867-22b* (CAHUP, PPC, VBGI).

Macromitrium fuscescens Schwägr., *Sp. Musc. Frond., Suppl*. 2, 2(2): 129. 1827. *Type*: Marianas, in insulis Marianis, *Gaudichaud s.n.* (lectotype: G, designated by Vitt *et al.* 1995; isotype: G, not seen).

Macromitrium semipellucidum Dozy & Molk., *Musc. Frond. Archip. Ind*. 17. 1844. *Type*: Indonesia, Kalimantan (Borneo) and Java (lectotype: L, designated by Vitt *et al.* 1995).

Descriptions: Bartram (1939: 178, as *M. semipellucidum*), Vitt *et al*. (1995: 33–36), Eddy (1996: 52, as *M. semipellucidum*).

Illustrations: Vitt *et al*. (1995: 34, fig. 15a–i), Eddy (1996: 52–53, fig. 365, as *M. semipellucidum*).

Notes: *Macromitrium fuscescens* are small to medium-sized, whitish green plants characterised by the squarrose-spreading leaves when moist, often inflexed leaf apices, excurrent costae, very small and obscure upper leaf cells, elongate and transparent basal leaf cells with sigmoid lumens, 16 irregular peristome teeth, and hairy calyptrae (Vitt *et al.* 1995). This species can be distinguished from other members of the "*M. gracile*" group (Vitt and Ramsay 1985) found in Palawan by the broader, acuminate, and longer mucronate apices versus the gradually narrowed, slenderly acute apices of *M. angustifolium* and the somewhat broader, acuminate, and longer mucronate apices of *M. salakanum* (Vitt *et al.* 1995).

This low-elevation species is somewhat widespread in Southeast Asia up to the Pacific Islands (Vitt *et al.* 1995). In the Philippines, *M. fuscescens* was reported in Luzon, Panay, and Mindanao (Tan and Iwatsuki 1991 as *M. semipellucidum*), mainly at lower elevations up to 1000 m. In Palawan, the species was collected on a fallen branch in the tropical lower montane rainforest of Mt Mantalingahan, representing a new record for the island.

Specimen examined: Palawan Island: Brooke's Point Municipality, Mt Mantalingahan, tropical lower montane rainforest, *ca* 900 m elev., on a fallen branch, 05 January 2020, *E.L.R. Logatoc 20-0042* (CAHUP, PPC, VBGI).

Macromitrium incurvifolium (Hook. & Grev.) Schwägr., *Sp. Musc. Frond., Suppl*. 2, 2(2): 144. 1827. *Orthotrichum incurvifolium* Hook. & Grev., *Edinburgh J. Sci*. 1: 117. 1824. *Type*: Indonesia, Ternate Island and in King Georges Sound, *s.coll.* (lectotype: E-Greville, designated by Vitt and Ramsay 1985).

Macromitrium subtile Schwägr., Sp. Musc. Frond., Suppl. 2, 2(2): 140. 1827. *Type*: Society Islands, Tahiti, in insula Otaheite, *A. Menzies s.n.* (lectotype: G-Schwägrichen, designated by Vitt and Ramsay 1985).

Macromitrium subuligerum Bosch & Sande Lac., Bryol. Jav. 1: 124. 1860. *Type*: Indonesia, Java, Mts Gede and Salak, *Teysmann s.n.* (lectotype: L, designated by Vitt *et al.* 1995).

Macromitrium planocespitosum Müll. Hal., Linnaea 38: 560. 1874. *Type*: Philippines, Luzon, Majayjay (Mahahai), *Wallis 1871* (lectotype: H-BR, designated by Vitt *et al.* 1995).

Macromitrium foxworthyi Broth., Philipp. J. Sci., C. 3: 16. 1908. *Type*: Philippines, Luzon, Pampanga Province, Mt Abu, *Foxworthy 1932* (holotype: H-BR, not seen).

Descriptions: Bartram (1939: 177 as *M. foxworthyi*; 177–178 as *M. subuligerum*), Vitt and Ramsay (1985: 415–419), Vitt *et al*. (1995: 36–39), Eddy (1996: 46–47; 49 as *M. subtile*).

Illustrations: Vitt and Ramsay (1985: 416–417, figs. 275–284), Vitt *et al*. (1995: 37, fig. 16a–j), Eddy (1996: 48, fig. 359; 50–51, fig. 363 as *M. subtile*).

Notes: *Macromitrium incurvifolium* are medium-sized plants, with olive-green shoots eventually turning rusty-brown in older parts. In Palawan Island, *M. incurvifolium* can appear somewhat like a miniature version of *M. angustifolium* and, at times, can be confused with *M. fuscescens* and *M. salakanum*. *Macromitrium incurvifolium* is distinguished from those as mentioned above by the: erect-incurved leaves when moist; acuminate-mucronate leaf apices; short excurrent costa; densely papillose upper leaf cells; short and wide-lumened transitional cells; short-rectangular, curved to straight, non-tuberculate basal cells; very short, non-sheathing, ovate-acuminate perichaetial leaves; and the hairy calyptrae (Vitt *et al*. 1995). Vitt and Ramsay (1985) provided a detailed discussion on the difference of this species from related species found in Australasia.

Commonly found at low elevations in relatively open and disturbed habitats, *Macromitrium incurvifolium* occurs in East Asia, Malesia, northern Australia, and Oceania (Vitt *et al.* 1995; Eddy 1996). In the Philippines, the species was reported in several localities from Luzon and once each from Mindoro, Panay, and Mindanao [Tan and Iwatsuki 1991 as *M. subtile* var. *subuligerum* (Bosch & Sande Lac.) M.Fleisch.]. Our single collection of *M. incurvifolium* from Palawan represents a new record of this species for the island.

Specimen examined: Palawan Island: Narra Municipality, Mt Victoria, ridge, montane rainforest along the trail leading to the summit, *ca* 1602 m elev., N 09° 22' 17.56"; E 118° 18' 20.38", on a tree branch, mixed with *Macromitrium blumei*, 23 December 2022, *Linis 5906-22b* (CAHUP, PPC, VBGI).

Macromitrium longicaule Müll.Hal., *Syn. Musc. Frond*. 1: 742. 1849. *Type*: Indonesia, Java, *Miquel s.n.* (lectotype: L, designated by Vitt *et al.* 1995).

Descriptions: Fleischer (1904: 451–453), Vitt *et al*. (1995: 39–42), Eddy (1996: 64–66).

Illustrations: Fleischer (1904: 452, fig. 83), Vitt *et al*. (1995: 40, fig. 17a–k), Eddy (1996: 64–65, fig. 374).

Notes: *Macromitrium longicaule* are moderately sized, olive-green plants forming loose to dense spreading mats. This species is distinguished from its congeners by the: sheathing leaf bases; short, densely papillose upper leaf cells; relatively longer tuberculate basal leaf cells; short setae, which are often double in a perichaetium; and the non-sheathing perichaetial leaves with long-flexuose acumen, giving a bristle-like appearance when dry (Vitt *et al*. 1995).

Macromitrium longicaule is widespread in Malesia, and has been reported to occur in the Philippines, Borneo, Java, and New Guinea (Tan and Iwatsuki 1991; Eddy 1996). According to Vitt *et al*. (1995), this species has a broad ecological and elevation range in Papua New Guinea, occurring as an epiphyte in primary and secondary lowland rainforests, montane rainforests, scrub vegetation, and gardens from 600–2850 m elev. In the Philippines, this species was reported from Luzon and Mindanao (Tan and Iwatsuki 1991), mainly on tree trunks and branches in the upper canopies of montane rainforests. In Palawan, this species was collected on the base of a tree growing in ultramafic outcrops at *ca* 1600 m elev. representing a new record for the island.

Specimen examined: Palawan Island: Rizal Municipality, Mt Mantalingahan, montane heath-over-ultramafic rocks, *ca* 1600 m elev., on the base of a hardwood tree, 26 July 2019, *E.L.R. Logatoc 19-0294* (CAHUP, PPC, VBGI).

Macromitrium megalocladon M.Fleisch., *Hedwigia* 50: 282. 1911. *Type*: Indonesia, West Irian, Jayawijaya, *Römer 718* (lectotype: FH, designated by Vitt *et al.* 1995).

Description: Plants large and stiff, rigidly branched; young shoots golden, yellowish green to olive-green, gradually turning reddish brown at mature portions; in loose mats. Stems creeping, poorly differentiated; branches erect, up to 5.0 cm long. Stem and branch leaves ovate-lanceolate to lanceolate, contorted and wide-spreading from an erect base when dry, stiffly wide-spreading to squarrose-recurved and in 5 distinct ranks when moist, 2.0–3.5 mm long and 0.4–0.5 mm wide; margins plane to reflexed; apices narrowly acute, strongly keeled above, with projecting papillae; costa percurrent. Upper leaf cells rounded to rounded short-elliptic, up to 14 μm wide, evenly incrassate, strongly convex, unipapillose to highly tuberculate, papilla tall and acute, clear, marginal cells somewhat smaller. Median leaf cells rounded-rhombic to short-elliptic, 10–20 μm long and 9–12 μm wide, convex, unipapillose. Basal leaf cells near insertion elongate-rectangular, 20–60 μm long and 7–10 μm wide, irregularly incrassate, straight, flat, smooth, clear; cells above elliptic-rectangular, 20–30 μm long and 9–11 μm wide, irregularly incrassate, nearly flat, unipapillose. Sporophyte not seen.

Illustrations: Fig. 2; Vitt *et al.* (1995: 46, fig. 19a–i; 47, fig. 20a–c), Eddy (1996: 39, fig. 351).

Notes: In the field, plants of *Macromitrium megalocladon* may be confused with species of *Trachypodopsis* M.Fleisch. due to the robust and stiff habit (Eddy 1996). On the other hand, this species can be distinguished from other Philippine *Macromitrium* species with tuberculate upper and lower leaf cells by the: robust and stiff habit; squarrose leaves in distinct ranks when moist; strongly convex upper leaf cells with tall and acute papilla; large tuberculae; prorate seta; and densely hairy calyptrae (Vitt *et al.* 1995). According to Eddy (1996), *Macromitrium megalocladon* is most similar to *M. ochraceum* (Dozy & Molk.) Müll.Hal. However, the unipapillose to tuberculate upper leaf cells and the elimbate leaf margin distinguishes *M. megalocladon* from the latter.

Macromitrium megalocladon was previously known in New Guinea and Sulawesi (Vitt *et al.* 1995; Eddy 1996). It is recorded here in the Philippines for the first time, from Palawan Island. In New Guinea and Sulawesi, specimens have been observed from *ca* 1800 m to over 3000 m elev., and although *M. megalocladon* plants are known as epiphytic and photophilic, many have been collected from rotting wood, tree bases, shrubs, and stumps; these plants are also known to occur on rocks and soil occasionally (Vitt *et al.* 1995). According to Vitt *et al.* (1995), the type specimen was labelled as occurring "terrestrial". Coincidentally, the Philippine materials were collected on a "litter-covered boulder".

Specimens examined: Palawan Island: Rizal Municipality, Mt Mantalingahan, montane heath-over-ultramafic rocks, *ca* 1600 m elev., on a litter-covered boulder, 26 July 2019, *E.L.R. Logatoc 19-0292* (CAHUP, PPC, VBGI), tropical subalpine forest, *ca* 1900 m elev., on a litter-covered boulder, 09 January 2020, *E.L.R. Logatoc 20-0133* (CAHUP, VBGI).

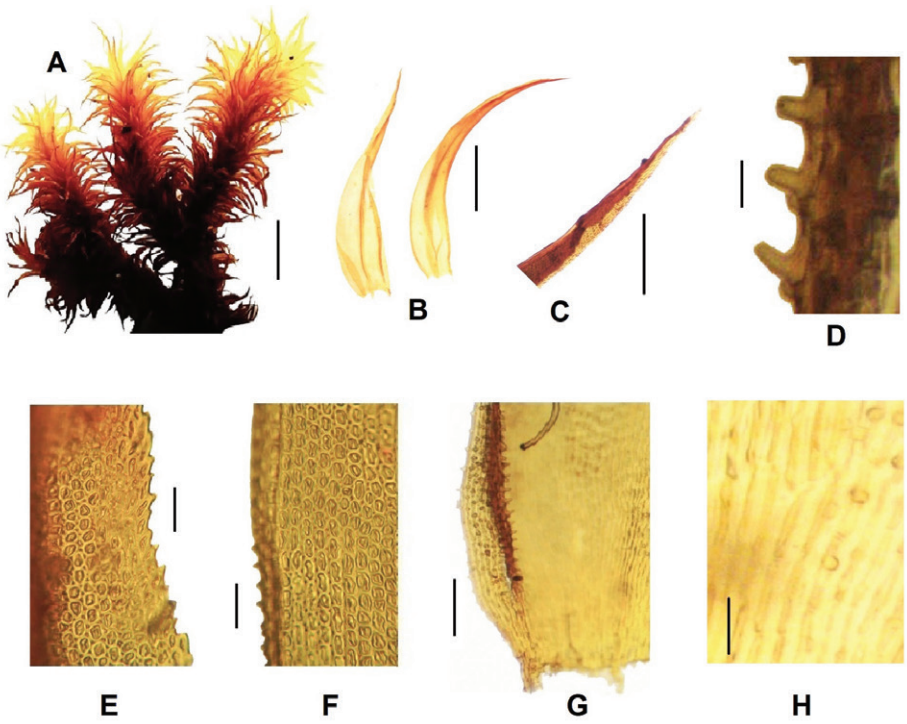

Fig. 2. *Macromitrium megalocladon* M.Fleisch. **A**: Habit of plant, moist. **B**: Leaves, adaxial view. **C:** Leaf apex, adaxial view. **D:** Papillae of leaf cells near the alar region. **E.** Upper leaf cells. **F.** Median leaf cells. **G:** Basal-marginal and alar region. **H.** Basal leaf cells. All from *E.L.R. Logatoc 20-0133* (CAHUP). Scale bars: A = 5 mm; B = 1 mm; C = 0.5 mm; D = 6 µm; E, F = 40 µm; G = 0.2 mm; H = 30 µm.

Macromitrium salakanum Müll.Hal., *Syn. Musc. Frond*. 2: 646. 1851. *Type*: Indonesia, Java, Mt Salak, *Zollinger 1426* (lectotype: L, designated by Vitt *et al.* 1995).

Macromitrium reflexifolium Sande Lac., *Verh. Kon. Akad. Wetensch., Afd. Natuurk*. 13: 8. 1872, *nom. illeg. Macromitrium celebense* Paris, *Index Bryol*. 773. 1897. *Macromitrium salakanum* subsp. *celebense* (Paris) M.Fleisch., *Musci Buitenzorg* 2: 446. 1908. *Macromitrium salakanum* var. *reflexifolium* M.Fleisch. ex E.B.Bartram, *Philipp. J. Sci*. 68: 179. 1939. *Type*: Indonesia, Sulawesi, Menado, *de Vriese s.n.* (lectotype: L, designated by Vitt *et al.* 1995).

Macromitrium salakanum var. *reflexifolium* M.Fleisch. *Die Musci der Flora von Buitenzorg* 2: 447. 1904, *nom. inval.*

Descriptions: Fleischer (1904: 442–445), Bartram (1939: 179), Vitt *et al.* (1995: 65–68), Eddy (1996: 52).

Illustrations: Fleischer (1904: 443, fig. 82), Vitt *et al.* (1995: 66, fig. 29a–j), Eddy (1996: 50–51, fig. 362).

Notes: *Macromitrium salakanum* are small, mat-forming plants characterised by the: narrowly lanceolate, squarrose-recurved leaves; branch leaves ending in either narrow apices or as short mucro with excurrent costa; smooth sigmoid-elongate basal cells gradually grading to obscure upper leaf cells; obtuse perichaetial leaves; and hairy calyptrae (Vitt *et al.* 1995). The species belongs to the *salakanum-angustifolium-incurvifolium* group, with the three species sharing the small habit, non-tuberculate basal cells, and obscure papillose upper leaf cells. *Macromitrium salakanum* is distinguished from the others by combining the squarrose-recurved leaves and obtuse perichaetial leaves about the same size as vegetative leaves.

The species is widely scattered in Malesia, having been recorded from the Philippines, Java, Sulawesi, and New Guinea, reaching New Caledonia and the Solomon Islands (Vitt *et al.* 1995; Eddy 1996). In the Philippines, *M. salakanum* was reported from Luzon, Mindoro, Palawan, Leyte, Camiguin, and Mindanao (Tan and Iwatsuki 1991; Tan 1996; Linis 2009).

Specimen examined: Palawan Island: Brooke's Point Municipality, Mt Mantalingahan, tropical lower montane rainforest-over-ultramafic substrate, *ca* 1000 m elev., on a fallen branch, 07 January 2020, *E.L.R. Logatoc 20-0071* (CAHUP, PPC, VBGI).

Macromitrium zollingeri Mitt. ex Bosch & Sande Lac., *Bryol. Jav*. 1: 113. 1859. *Type*: Indonesia, Java, *Zollinger 3716* (lectotype: L, *fide* Touw 2007).

Descriptions: Fleischer (1904: 422–424), Eddy (1996: 78), Guo *et al.* (2006: 476 as *M. blumei* var. *zollingeri*).

Illustrations: Fleischer (1904: 423, fig. 77), Eddy (1996: 77, fig. 384).

Notes: *Macromitrium zollingeri* are mat-forming plants that can be distinguished from other small to medium-sized Philippine *Macromitrium* species by: densely arranged, ligulate branch leaves with broadly-obtuse to rounded-truncate leaf apices; strongly and abruptly excurrent costa in branch leaves, forming a distinct awn; ovate-triangular and acuminate perichaetial leaves, with percurrent to excurrent costa; long seta; and naked calyptrae (Eddy 2006).

Guo *et al.* (2006) evaluated the taxonomic distinctness of *Macromitrium annamense* Broth. & Paris, *M. blumei*, and *M. zollingeri* based on statistical methods using the morphology of leaves and setae sampled from type specimens and other specimens. They suggested that *M. zollingeri* should be treated as *M. blumei* var. *zollingeri* (Mitt. ex Bosch & Sande Lac.) S.L.Guo, B.C.Tan & V.Virtanen. However, given the apparent cryptic diversity in the Orthotrichaceae, we treat this taxon as a distinct species until a thorough molecular investigation proves otherwise. *Macromitrium zollingeri* differs from *M. blumei* in having longer leaves with longer awns, ligulate leaf outlines with higher leaf length/width ratios, and acuminate perichaetial leaves.

Macromitrium zollingeri is a species widespread in Malesia (Eddy 1996), recorded from Indochina, the Malay Peninsula, Sumatra, Borneo, and Sulawesi (Tan and Iwatsuki 1993; Eddy 1996; Gradstein *et al.* 2005; Suleiman *et al.* 2006). Linis and Schwarz (2023) recently reported this species from the Philippines, particularly in Mt Apo, Mindanao Island.

Specimens examined: Palawan Island: Narra Municipality, Mt Victoria, mossy forest, on a branch of a hardwood tree, 19 February 2021, *M.D. delos Angeles s.n. [01]*, *M.D. delos Angeles s.n. [11]* (CAHUP).

Schlotheimia Brid.

Schlotheimia wallisii Müll.Hal., *Linnaea* 37: 173. 1873 [1872]. *Type*: Philippines, Insulae Philippinae regione montosa, *G. Wallis s.n.* (lectotype: NY, designated by Vitt *et al.* 1993).

Schlotheimia speciosissima Broth., *Philipp. J. Sci., C.* 3: 17. 1908. *Type*: Philippines, Mindanao, Misamis Province, Mt Malindang, *Mearns and Hutchinson For. Bur. 4798* (holotype: Forestry Bureau Manila Herbarium, destroyed).

Descriptions: Bartram (1939: 185–186), Vitt *et al.* (1993: 19–23), Eddy (1996: 88).

Illustrations: Vitt *et al.* (1993: 20, 8a–k), Eddy (1996: 86–87, fig. 389).

Notes: A common species throughout its range, *Schlotheimia wallisii* is a somewhat variable species that has been described under several names (Vitt *et al.* 1993). In Palawan, this species is distinguished from other species of Orthotrichaceae by: robust plants and leaves; erect-spreading and rugose leaves, when moist; leaves with intact long, flexuose arista; prorate basal leaf cells; long seta; smooth capsules; and very long calyptra (Vitt *et al.* 1993; Eddy 1996).

Schlotheimia wallisii is widely distributed in Malesia and adjacent areas (Vitt *et al.* 1993; Eddy 1996). In the Philippines, it is reported from Luzon, Mindoro, Negros, and Mindanao (Tan and Iwatsuki 1991; Tan and Mandia 2001). At Palawan, this species was collected on tree trunks and fallen branches in the tropical lower and tropical upper montane rainforests of Mt Mantalingahan, representing a new record for the island.

Specimens examined: Palawan Island: Rizal Municipality, Mt Mantalingahan, tropical upper montane rainforest-over-ultramafic substrate, *ca* 1600 m elev., on the trunk of a hardwood tree, 27 July 2019, *E.L.R. Logatoc 19-0310* (CAHUP, PPC, VBGI); Brooke's Point Municipality, Mt Mantalingahan, tropical lower montane rainforest-over-ultramafic substrate, *ca* 1200 m elev., on a fallen branch, 07 January 2020, *E.L.R. Logatoc 20-0080* (CAHUP, VBGI), *ca* 1300 m elev., on a fallen branch, 07 January 2020, *E.L.R. Logatoc 20-0099* (CAHUP, PPC, VBGI), tropical upper montane rainforest-over-ultramafic substrate, *ca* 1600 m elev., on the trunk of a hardwood tree, 08 January 2020, *E.L.R. Logatoc 20-0121* (CAHUP, VBGI).

Checklist of Orthotrichaceae from Palawan Island, the Philippines

List of 13 species of Orthotrichaceae currently known to occur in Palawan Island. An asterisk (*) indicates a new island record, while a double asterisk (**) indicates a new country record.

Desmotheca apiculata (Dozy & Molk.) Lindb. ex Cardot

**Groutiella tomentosa* (Hornsch.) Wijk & Margad.

**Macromitrium angustifolium* Dozy & Molk.

Macromitrium blumei Nees ex Schwägr.

***Macromitrium clemensiae* E.B.Bartram

Macromitrium cuspidatum Hampe

Macromitrium falcatulum Müll.Hal.

**Macromitrium fuscescens* Schwägr.

**Macromitrium incurvifolium* (Hook. & Grev.) Schwägr.

**Macromitrium longicaule* Müll.Hal.

***Macromitrium megalocladon* M.Fleisch.

Macromitrium salakanum Müll.Hal.

* *Macromitrium zollingeri* Mitt. ex Bosch & Sande Lac.

**Schlotheimia wallisii* Müll.Hal.

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