

## New Philippine moss records and additions to the Luzon moss flora

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### Abstract

Four new Philippine moss records and five additions for the Luzon moss flora are presented. *Anomodontopsis rugelii* (Müll. Hal.) Ignatov & Fedosov; *Chaetomitrium horridulum* Bosch & Sande Lac.; *Chaetomitrium vrieseanum* Bosch & Sande Lac.; and *Dicranoloma deplanchei* (Duby) Par. are new country moss records while *Anomodon pseudotristis* (Müll. Hal.) Kindb.; *Bescherellia elegantissima* Duby; *Claopodium assurgens* (Sull. & Lesq.) Cardot; *Pseudoparaphysanthus moutieri* (Broth. & Paris) S.Olsson, Enroth, Huttunen & D.Quandt and *Racopilum magnirete* E.B.Bartram are new additions to the Luzon moss flora. *Anomodontopsis* Ignatov & Fedosov is a new genus record for the Philippines. This report of new records for the Philippine and Luzon's moss flora has once again highlighted the importance of continued bryological studies in the archipelago. In this respect, field collecting in the country's intervening islands and understudied areas is still necessary to further improve of knowledge of Philippine moss flora.

### Introduction

The author's review of bryophyte collections kept at the Philippine National Herbarium (code, PNH) and his expeditions to under-studied areas of the country have yielded four species of mosses new to the country and five new records for the Luzon moss flora. Among these new Philippine records, *Anomodontopsis rugelii* (Müll. Hal.) Ignatov & Fedosov; *Chaetomitrium vrieseanum* Bosch & Sande Lac.; and *Dicranoloma deplanchei* (Duby) Par. are also new records for Luzon while *Chaetomitrium horridulum* Bosch & Sande Lac. is reported here for the first time for Mindoro island. *Chaetomitrium horridulum*, *C. vrieseanum* and *D. deplanchei* are rather restricted in distribution, at least in Southeast Asia while *A. rugelii* is rather widespread in the temperate northern hemisphere. *Anomodontopsis* Ignatov & Fedosov is a new genus record for the Philippines.

In the case of the mosses added to the Luzon's moss flora, these are rather significant. *Bescherellia elegantissima* Duby, *Claopodium assurgens* (Sull. & Lesq.) Cardot and *Racopilum magnirete* E.B.Bartram are previously known in the Philippines only in Mindanao island. *Anomodon pseudotristis* (Müll. Hal.) Kindb., on the other hand, has only been recorded in Leyte and Mindoro islands while *Pseudoparaphysanthus moutieri* (Broth. & Paris) S.Olsson, Enroth, Huttunen & D.Quandt has been reported from a single locality in Samar island. Interestingly, the new Luzon materials of *A. pseudotristis*, *B. elegantissima*, *C. assurgens* and *R. magnirete* are author's collections from Mingan Mountains in the Sierra Madre Mountain Range while the single *P. moutieri* collection that has been kept in the PNH came from Mount Isarog. Both localities now represent

the northernmost stations in the archipelago for *A. pseudotristsis*, *B. elegantissima* and *R. magnirete*, except *C. assurgens* which was earlier reported by Tan and Iwatsuki (1983) in the small island of Batan found in the far northern end of the country. Likewise, these Mingan Mountains and Mount Isarog records also foretell the likely presence of these species in other parts of Luzon.

Identification of the abovementioned mosses followed Akiyama and Suleiman 2001; Bartram 1944; Enroth 1990; Fife 2014; Fleischer 1906–1908; Granzow-de la Cerda 1997; Noguchi *et al.* 1991; Pursell and Reese 1982; Sastre-De Jesús 1987; Suleiman and Anwar 2021; Tan 1987; Tan and Iwatsuki 1983; Touw 1972; Touw and Ochyra 1987; and van Zanten 2006. Their status, on the other hand, has been verified from floristic studies (Akiyama and Suleiman 2001; Ariyanti *et al.* 2009; Azuelo *et al.* 2015; Fife 2014; Fleischer 1915–1922; Granzow-de la Cerda 1997; Klazenga 1999; Linis 2004, 2006, 2009, 2010, 2014, 2018, 2019a, b; Linis and Tan 2008, 2010, 2013; Lubos 2010; Noguchi *et al.* 1991; Pócs 1969; Shevock and Yorong 2018; Suleiman and Akiyama 2014; Tan 1987; Tan and Iwatsuki 1983, 91; Tan and Robinson 1990; Tan and Shevock 2014, 2015; and Tan *et al.* 2000, 2015; Thin 1997; Thouvenot and Bardat 2013; Wu *et al.* 2002, 2011; van Zanten 2006). In addition, several type and Asian specimens lodged in BM, CAHP, PNH and SIN are examined to confirm their identities. Classification system of the identified species presented is adopted from Goffinet *et al.* (2009) while species authority name abbreviations are based on Brummitt and Powell (1992). Vouchered moss specimens are lodged in the PNH. The new Philippine and Luzon moss records are listed in alphabetical order.

### New Philippine moss records

***Anomodontopsis rugelii*** (Müll. Hal.) Ignatov & Fedosov, *Arctoa* 28(1): 90. 2019. (Anomodontaceae)

The recent molecular phylogenetic analysis of the genus *Anomodon* proposed the segregation of *Anomodon rugelii* (Müll. Hal.) Keissl. after finding it to be distant from the core *Anomodon* clade (Ignatov *et al.* 2019). This led to the transferring of *A. rugelii* into a new genus *Anomodontopsis* Ignatov & Fedosov within the Anomodontaceae. Despite lacking an obvious morphological synapomorphy, however, the author has accepted this proposal and named the Philippine specimen of *Anomodon rugelii* as *Anomodontopsis rugelii* (Müll. Hal.) Ignatov & Fedosov.

Distinctively slender in rusty brownish dense mats, the Philippine *A. rugelii* plant (Fig. 1) is essentially distinguishable in the field by its dry, incurving leaves, reddish costa and the conspicuous auricles found at the bases of its leaves (Granzow-de la Cerda 1997). Under the microscope, the leaf costa in *A. rugelii* are smooth abaxially with highly raised papillose-mamillose cells on the basal leaf margins and on the auricles. The presence of foliose uniseriate pseudoparaphyllia, which are absent in *Anomodon* species, is also helpful in distinguishing *A. rugelii*.

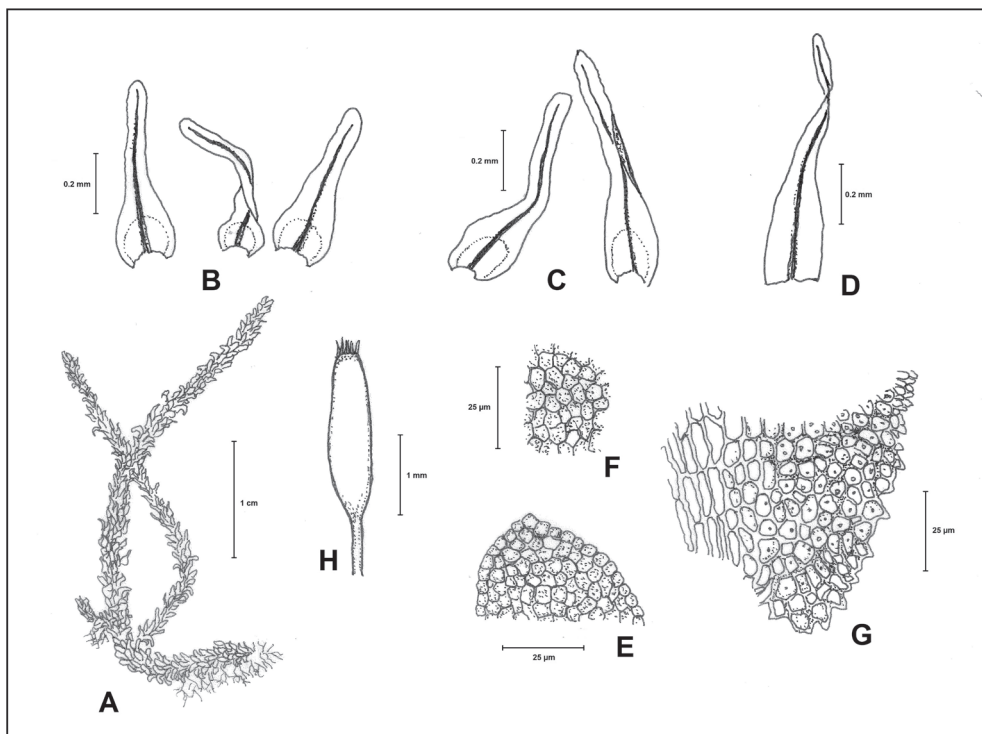
**Extra-Philippine Distribution:** Mainly circumboreal in Asia, eastern North America, and Central Europe (Granzow-de la Cerda 1997). **Intra-Philippine Distribution:** New to the Philippines. **Specimen examined:** Imelda Park, Baguio City, Benguet Province, Luzon Island, Philippines, on branches, 11 July 1987, *R. Magill*, *P. Redfearn* and *M. Crosby* 8087 as *Anomodon rugelii* (Müll. Hal.) Keissl. det. *P. Redfearn* (PNH180043).

***Chaetomitrium horridulum*** Bosch & Sande Lac. *Bryologia Javanica* 2: 46. 167. 1862. (Symphyodontaceae)

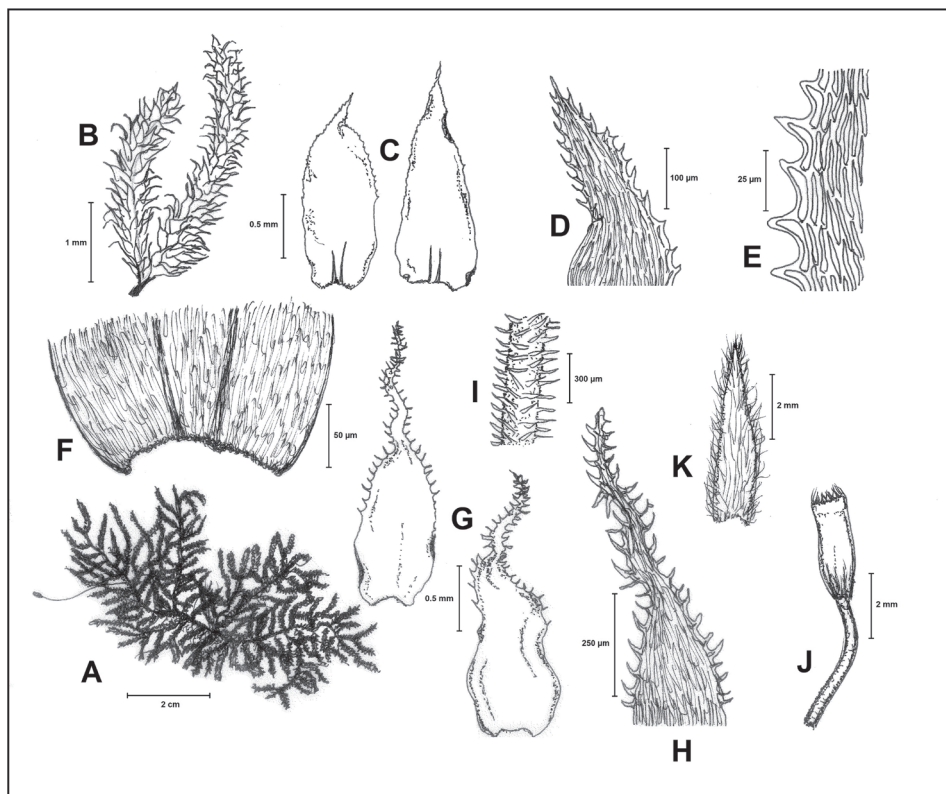
*Chaetomitrium horridulum* is a Malesian endemic reported here for the Philippines for the first time. The Philippine material identified as *C. horridulum* (Fig. 2) has setulose seta up to 3 cm long and has a plant size distinctly larger compared to other Philippine *Chaetomitrium* species. Other morphological characters of this material agree well with the original description provided by Fleischer (1906–1908), hence, can be recognised by its reddish-brown colouration, widely spreading lanceolate leaves, smooth lamina cells and cucullate calyptra which are hispid above and without cilia at the base.

Elsewhere, *C. horridulum* can only be confused with *C. ciliatum*, another Malesian endemic. Both species are similar in appearance but the latter has no reddish-coloration tinge and has much denser, spinose-prorate lamina cells on the abaxial surfaces of its leaves. According to Suleiman and Akiyama (2014), *C. ciliatum* could be a variant of *C. horridulum*.

**Extra-Philippine Distribution:** Borneo, Java, and Sumatra (Akiyama and Suleiman 2001; Suleiman and Akiyama 2014). **Intra-Philippine Distribution:** New to the Philippines. **Specimen examined:** Mount Ayniaban, Puerto Galera, Province of Mindoro Oriental, Mindoro Island, Philippines, on bark of trees, 5 March 1989, *J. R. Cabalquinto* and *B. O. van Zanten* 997 (PNH).



**Fig. 1.** *Anomodontopsis rugelii* (Müll. Hal.) Ignatov & Fedosov. (A) Habit. (B) Branch leaves. (C) Stem leaves. (D) Perichaetial leaf. (E) Apex of branch leaf. (F) Median laminal cells adjacent to margin of branch leaf. (G) Basal laminal cells near costa of leaf. (H) Capsule. (All from R. Magill, P. Redfearn and M. Crosby 8087 (PNH)).



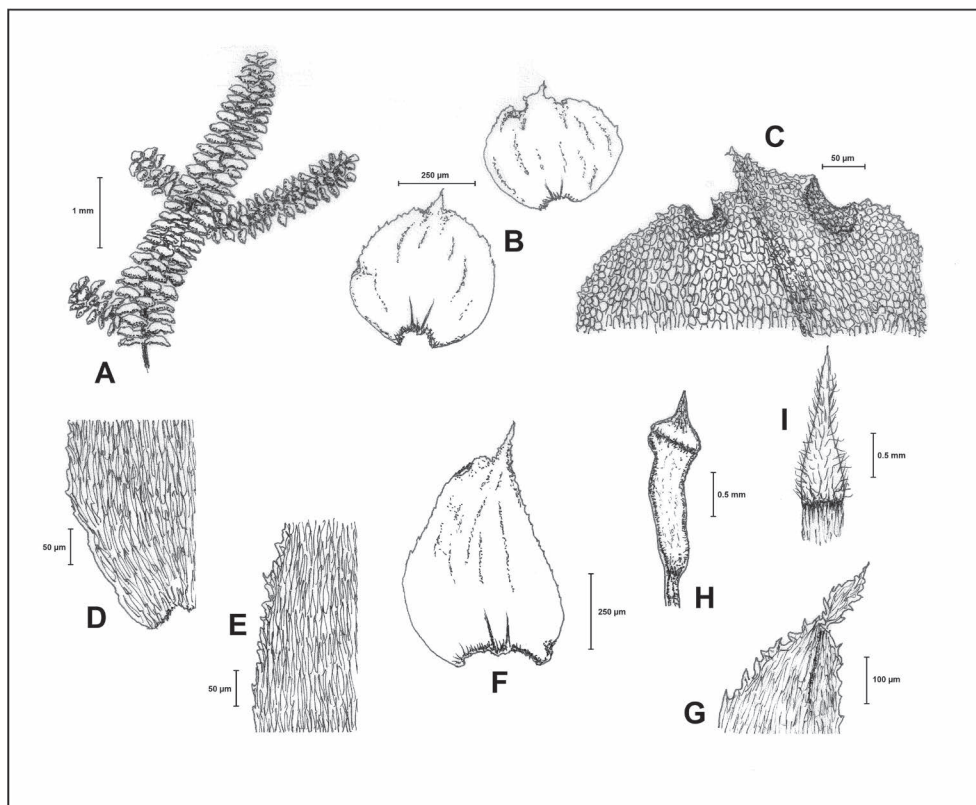
**Fig. 2.** *Chaetomitrium horridulum* Bosch & Sande Lac. (A) Habit. (B) Portion of shoot. (C) Branch leaves. (D) Apex of branch leaf. (E) Median laminal cells of branch leaf. (F) Basal laminal cells of branch leaf. (G) Inner perichaetial leaves. (H) Apex of perichaetial leaf. (I) Ornamentation on a seta. (J) Capsule. (K) Calyptra. (All from J. R. Cabalguinto and B. O. van Zanten 997 (PNH)).

***Chaetomitrium vrieseanum*** Bosch & Sande Lac., *Bryologia Javanica* 2: 54. 174. 1862. (Symphyodontaceae)

*Chaetomitrium vrieseanum* is one of the smaller members of the genus. Together with *C. acanthocarpum* Bosch & Sande Lac., *C. brassii* E.B.Bartram, *C. laevisetum* Dixon, *C. robbinsii* E.B.Bartram, and *C. roemeri* M.Fleisch., it belongs to a subgroup under *Chaetomitrium* that has orbicular to suborbicular branch leaves (Suleiman and Anwar 2021). Until recently, this subgroup has been known to be restricted in New Guinea and neighbouring islands. However, the reporting of *C. acanthocarpum* in Sulawesi by Ariyanti *et al.* (2009) and the recent discovery of *C. vrieseanum* in Borneo by Suleiman and Anwar (2021) have extended the geographical distribution of this subgroup to the West Malesian region.

*Chaetomitrium vrieseanum* (Fig. 3) is unlike other Philippine species of *Chaetomitrium*. Apart from its small size, it can be easily distinguished from other local congeners by its squarrose, orbicular branch leaves with margins that are strongly undulate above which end in rounded apices with sharp apiculus (Suleiman and Anwar 2021). The only other Philippine member of *Chaetomitrium* that comes close to it in terms of size is *C. leptopoma* (Schwägr.) Bosch & Sande Lac. However, the branch leaves of the latter, although shortly apiculate, are rather ovate and rigid which are erect or recurved at apices (Suleiman and Akiyama 2014).

**Extra-Philippine Distribution:** Borneo (Suleiman and Anwar 2021), New Guinea (Akiyama 1997) and Seram Island of the Maluku Islands, Indonesia (Akiyama and Suleiman 2014). **Intra-Philippine Distribution:** New to the Philippines. **Specimen examined:** North slope of Mount Isarog, Province of Camarines Sur, Luzon Island, Philippines, on branches, 18 May 1991, *J. R. Cabalguinto 2182* (PNH).



**Fig. 3.** *Chaetomitrium vrieseanum* Bosch & Sande Lac. (A) Portion of shoot. (B) Branch leaves. (C) Apex of branch leaf. (D) Basal laminal cells of branch leaf. (E) Median laminal cells of branch leaf. (F) Inner perichaetial leaf. (G) Apex of inner perichaetial leaf. (H) Capsule. (I) Calyptra. (All from *J. R. Cabalguinto 2182* (PNH)).

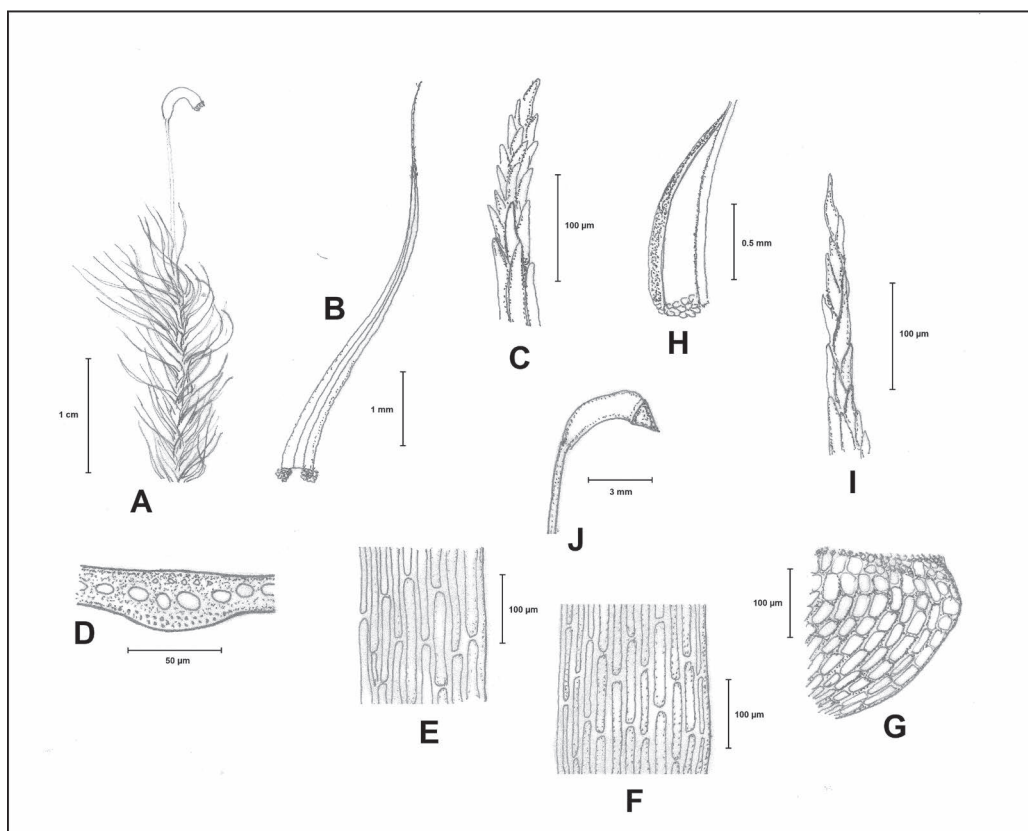
***Dicranoloma deplanchei*** (Duby) Par., *Index Bryologicus, editio secunda* 2: 25. 1904. (Dicranaceae)

Having been found on soil, the Philippine *Dicranoloma deplanchei* material (Fig. 4) resembles a diminutive form of *D. billardierii* (Brid.) Paris with elongate to linear, thick-walled upper lamina cells, serrated leaf margins, and a costa with scattered abaxial teeth. However, the morphological characters of this *D. deplanchei* material conform to that of Pursell and Reese (1982)'s description of the species with weaker serrulations along leaf margins, thinner-walled lamina cells, and fewer teeth on the abaxial surfaces of the costa. In *D. billardierii*, the leaves are generally secund, distinctly ventrally secund along with the shoots (Fife 2019), unlike

*D. deplanchei* leaves (Fig. 4A). The leaf shape in *D. deplanchei* is much different from *D. billardieri*, which is broader at the base than the more linear leaf shape of *D. deplanchei* (Fig. 4B). Also, the walls of alar cells in the *D. deplanchei* leaves are darker orange to brown in colour, somewhat thicker, and never with angular thickenings. Furthermore, the leaf costae in *D. deplanchei* are found to consist of more than three guide cells with at least two tiers of stereid bands above and below these cells (Fig. 4D) as in the case of leaf costae in *D. billardieri*, which consist of 2, rarely up to 3 guide cells which have only one tier of stereid band above and below these cells (Fife 2019).

In the meantime, the author will use the abovementioned morphological distinctions to keep *D. deplanchei* and *D. billardieri* apart. This treatment will remain until sufficient evidence become available to prove the two species inseparable.

**Extra-Philippine Distribution:** New Caledonia and New Guinea (Pursell and Reese 1982). **Intra-Philippine Distribution:** New to the Philippines. **Specimen examined:** Ating Tahanan, Baguio City, Benguet Province, Luzon Island, Philippines, on soil, May 13, 1991, *P. P. Lowry II* and *B. Suprin 3703* (PNH180033).



**Fig. 4.** *Dicranoloma deplanchei* (Duby) Par. (A) Portion of shoot. (B) Leaf. (C) Apex of leaf. (D) Cross-section of leaf through the costa just above the alar patches. (E) Median laminal cells of leaf. (F) Basal laminal cells of leaf. (G) Alar cells. (H) Lower part of an inner perichaetial leaf. (I) Apex of inner perichaetial leaf. (J) Capsule. (All from *P. P. Lowry II* and *B. Suprin 3703* (PNH180033)).

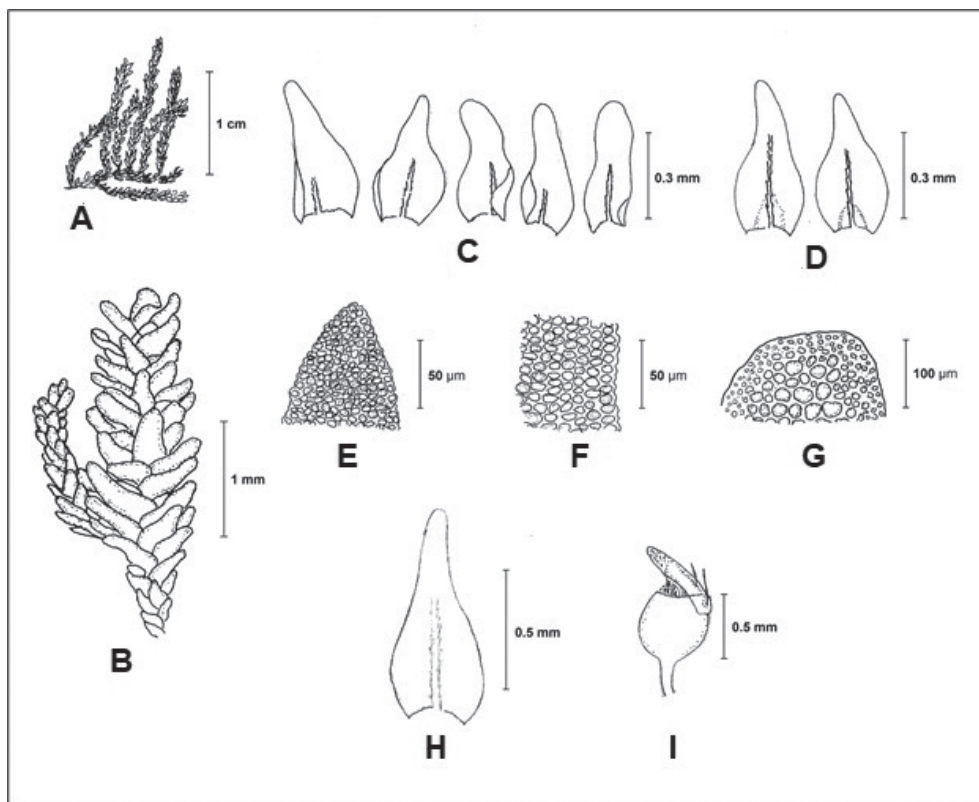
### Additions to Luzon moss flora

*Anomodon pseudotristis* (Müll. Hal.) Kindb., *Enumeratio Bryinearum Exoticarum, Supplementum Secundum* 97. 1891. (Anomodontaceae)

The Mingan plant identified as *A. pseudotristis* (Fig. 5) is very similar to other Asian *A. pseudotristis* plant materials examined by the author (Mount Ma-Tou, Jiangsu Province, China, *M. C. Ji 12700* (SIN); Tosashimizushi, Shikoku, Japan, *H. Deguchi s.n.* (SIN); Mount Pangasugan, Baybay City, Leyte Province, Leyte Island, Philippines, *B.C. Tan, M. Navarez and L. Raros 84-230* (CAHP); Mount Baco, Mindoro Occidental Province, Mindoro Island, Philippines, *V. C. Linis 1289-05* (PNH)) except the Mingan plant is much smaller, barely exceeding 1.4 cm in length.

In the Philippines, *A. pseudotrlistis* is readily distinguishable from its local congener *A. viticulosus* (Hedw.) Hook. & Taylor (Linis and Tan 2010). However, *A. viticulosus* is a larger plant (ca. 6–9 cm long) in dense mats with lingulate branch leaves (up to 3 mm long) that gradually taper to narrow lingulate smooth apices whereas *A. pseudotrlistis* is a much smaller plant in thin mats with tiny lingulate branch leaves (under 0.5 mm long) that end in rounded, obtuse to broadly acute leaf apices which are crenulate throughout due to prominent papillae. Furthermore, *A. viticulosus* is generally observed growing on calcareous soils (Noguchi *et al.* 1991; Linis and Tan 2010) whereas *A. pseudotrlistis* is entirely epiphytic on dicotyledonous trees (Tan 1987; Noguchi *et al.* 1991; Linis 2009; Fife 2014).

**Extra-Philippine Distribution:** Widely distributed in regions around Indian Ocean and Southwest Pacific and is one of the few in the genus to reach the Southern Hemisphere (Noguchi *et al.* 1991; Granzow-de la Cerda 1997; Thouvenot and Bardat 2013; Fife 2014). **Intra-Philippine Distribution:** Leyte (Tan 1987; Tan and Iwatsuki 1991) and Mindoro islands (Linis 2009). **Specimen examined:** So. Siete, Mangan Mountains, Gabaldon, Nueva Ecija Province, Luzon Island, Philippines, on trunk of Aymit (*Ficus* sp.) tree, November 3, 2007, 460 m a.s.l., 15° 29.00' 21.58" N 121° 20.00' 48.79" E, V. C. Linis 2737-07 (PNH).



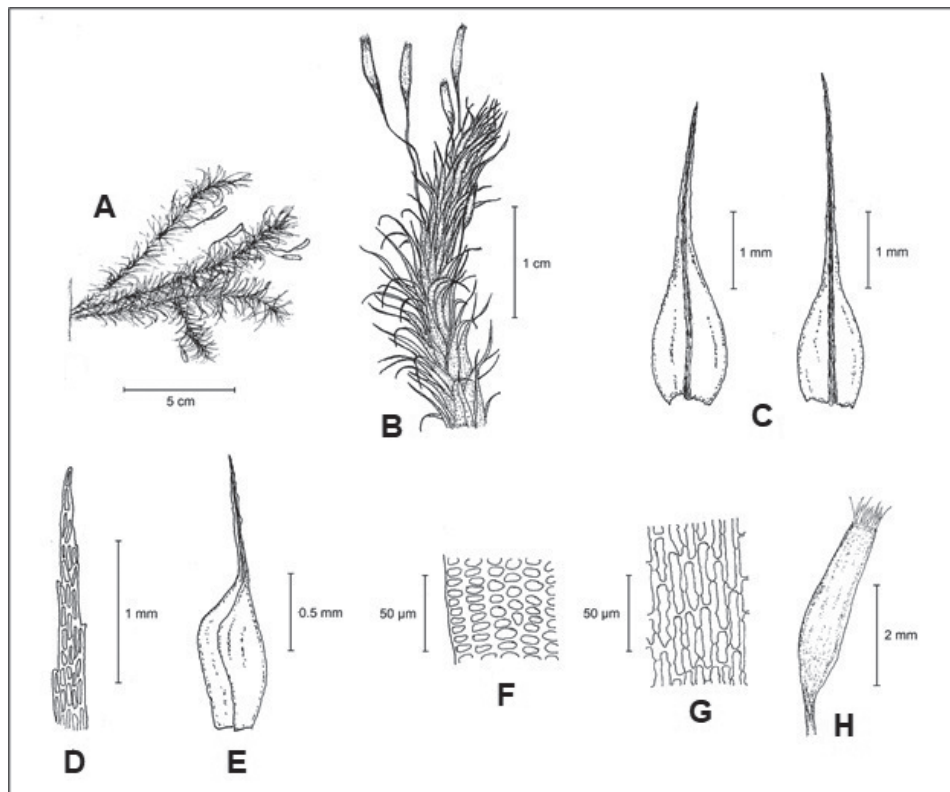
**Fig. 5.** *Anomodon pseudotrlistis* (Müll. Hal.) Kindb. (A) Habit. (B) Portion of shoot. (C) Branch leaves. (D) Stem leaves. (E) Apex of branch leaf. (F) Median laminal cells adjacent to margin of branch leaf. (G) Cross section of stem. (H) Inner perichaetial leaf. (I) Capsule. (All from Linis 2737-07 (PNH)).

***Bescherellia elegantissima*** Duby, *Bulletin de la Société Botanique de France* 20: 130. 1. 1873. (Hypnodendraceae)

Examination of the type material of *B. philippinensis* (Zamboanga, Mindanao Philippines, E. D. Merrill 8354 (BM000986837)) and the Mangan plant materials has shown that both are morphologically similar except the leaves in Mangan plants are slightly longer (ca. 3.0–7.0 mm long) with more abruptly narrowed lamina, longer subula and serrated margins (Fig. 6). Therefore, the author is maintaining them as one species until definitive evidence is available to prove otherwise.

The discovery of *B. elegantissima* in Mangan Mountains more than 80 years after its first collection by Merrill from Zamboanga province in Mindanao island (Bartram, 1939) reveals a significant extension of its extant Philippine range from the western Mindanao bordering the South China Sea to the eastern coast of Luzon island alongside the Pacific Ocean.

**Extra-Philippine Distribution:** Australia, New Guinea, New Zealand, and Sulawesi (Sastre-De Jesús 1987; Enroth 1990). **Intra-Philippine Distribution:** Mindanao (Bartram 1939; Tan and Iwatsuki 1991). **Specimens examined:** Mt. Hugis Balanga, Mingan Mountains, Aurora Province, Luzon Island, Philippines, on tree trunk, lowland forest, November 4, 2007, 1000 m a.s.l., 15° 33.00' 12.18" N 121° 25.00' 21.85" E, V. C. *Linis* 2881-07 (PNH); Mt. Hugis Balanga, Mingan Mountains, Aurora Province, Luzon Island, Philippines, on tree trunk, montane forest, November 25, 2007, 1300 m a.s.l., 15° 33.00' 18.00" N 121° 25.00' 46.30" E, V. C. *Linis* 2911-07 (PNH); Mt. Hugis Balanga, Mingan Mountains, Aurora Province, Luzon Island, Philippines, on tree trunk, montane forest, November 25, 2007, 1300 m a.s.l., 15° 33.00' 18.00" N 121° 25.00' 46.30" E, V. C. *Linis* 2942-07 (PNH); Mt. Hugis Balanga, Mingan Mountains, Aurora Province, Luzon Island, Philippines, on tree trunk, montane forest, November 25, 2007, 1300 m a.s.l., 15° 33.00' 18.00" N 121° 25.00' 46.30" E, V. C. *Linis* 2943-07 (PNH).

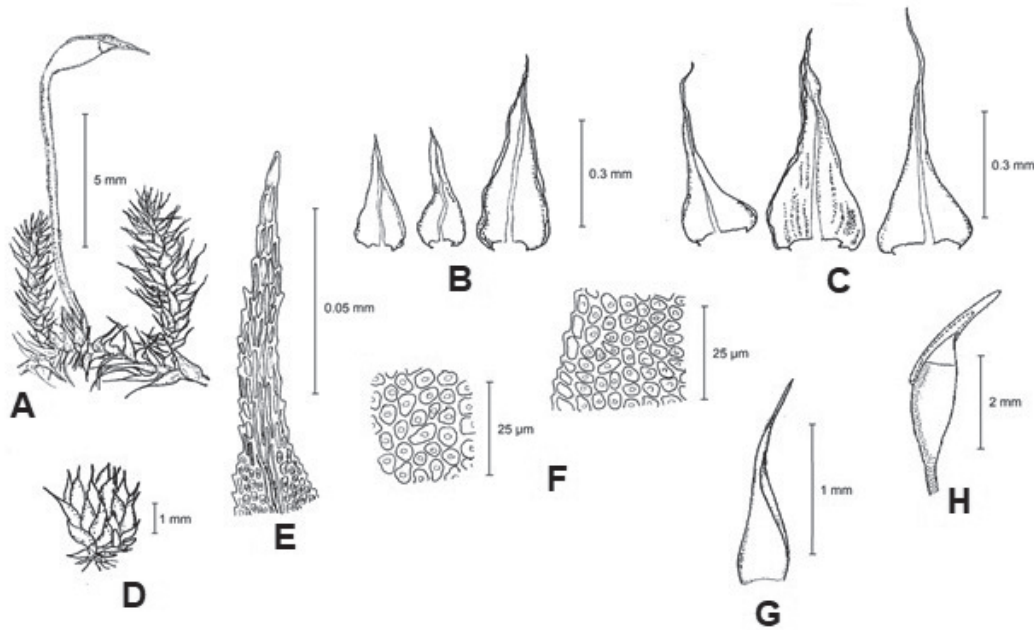


**Fig. 6.** *Bescherellia elegantissima* Duby. (A) Habit. (B) Portion of dry shoot. (C) Stem leaves. (D) Apex of leaf. (E) Inner perichaetial leaf. (F) Median laminal cells adjacent to margin of leaf. (G) Basal laminal cells near costa of leaf. (H) Capsule. (All from *Linis* 2942-07 (PNH)).

*Claopodium assurgens* (Sull. & Lesq.) Cardot, *Bulletin de la Société Botanique de Genève* 3: 283. 1911. (Leskeaceae)

The moss identified as *C. assurgens* in Mingan Mountains (Fig. 7) is morphologically similar to other Asian materials examined (Gunung Halimun National Park, Java Island, Indonesia, *B. C. Ho* 05314 (SIN); Mount Apo, North Cotabato Province, Mindanao Island, Philippines, *F. Schumm* and *U. Schwarz* 4993 (SIN); Mount Iraya, Batan Island, Batanes Province, Philippines, *M. Suzuki* 1794-*b* (CAHP); Vŭ Quang National Park, North Central Coast, Vietnam, *B. C. Tan* 02-208 (SIN)). It is also superficially similar to its local congener, *C. prionophyllum*, but the latter is a larger plant (up to 10 cm long) bearing non-revolute stem leaves with tips abruptly narrowing into linear, slightly twisting acumen. The stem leaves found in *C. assurgens* are almost similar in shape but differ from *C. prionophyllum* in having revolute margins in the upper half with tips ending into non-twisting acumen. In *C. prionophyllum*, almost all leaf cells in its branch leaves except at the acumen bear papillae. These papillae are absent along the margins of branch leaves in *C. assurgens*.

**Extra-Philippine Distribution:** East Asia (Noguchi *et al.* 1991; Thin 1997; Wu *et al.* 2002) and in the island of Java, Indonesia (Fleischer 1915–1922). **Intra-Philippine Distribution:** Documented in Batan island (Tan and Iwatsuki 1983, 1991) and Mount Apo in Mindanao island (Tan *et al.* 2000). **Specimen examined:** Mt. Hugis Balanga, Mingan Mountains, Aurora Province, Luzon Island, Philippines, on wet rocks, montane forest, November 25, 2007, 1300 m a.s.l., 15° 33.00' 18.00" N 121° 25.00' 46.30" E, V. C. *Linis* 2922-07 (PNH).



**Fig. 7.** *Claopodium assurgens* (Sull. & Lesq.) Cardot. (A) Portion of shoot. (B) Branch leaves. (C) Stem leaves. (D) Dwarf male plant. (E) Apex of branch leaf. (F) Median laminal cells of branch leaf. (G) Inner perichaetial leaf. (H) Capsule. (All from Linis 2922-07 (PNH)).

***Pseudoparaphysanthus moutieri*** (Broth. & Paris) S.Olsson, Enroth, Huttunen & D.Quandt. *Bryophyte Diversity and Evolution* 38(2): 64. 2016. (Neckeraceae)

Touw and Ochyra (1987) and Ochyra and Enroth (1989) placed *Neckeropsis moutieri* (Broth. & Paris) M.Fleisch. in *Neckeropsis* sect. *Pseudoparaphysanthus* based on morphological characters. Later, Olsson *et al.* (2016) transferred *N. moutieri* and several other species of *Neckeropsis* in the genus *Pseudoparaphysanthus* (Broth.) S.Olsson, Enroth, Huttunen & D.Quandt based on the molecular data used in their analysis. Based on this evidence, the author followed Olsson *et al.* (2016) in transferring *N. moutieri* to genus *Pseudoparaphysanthus*.

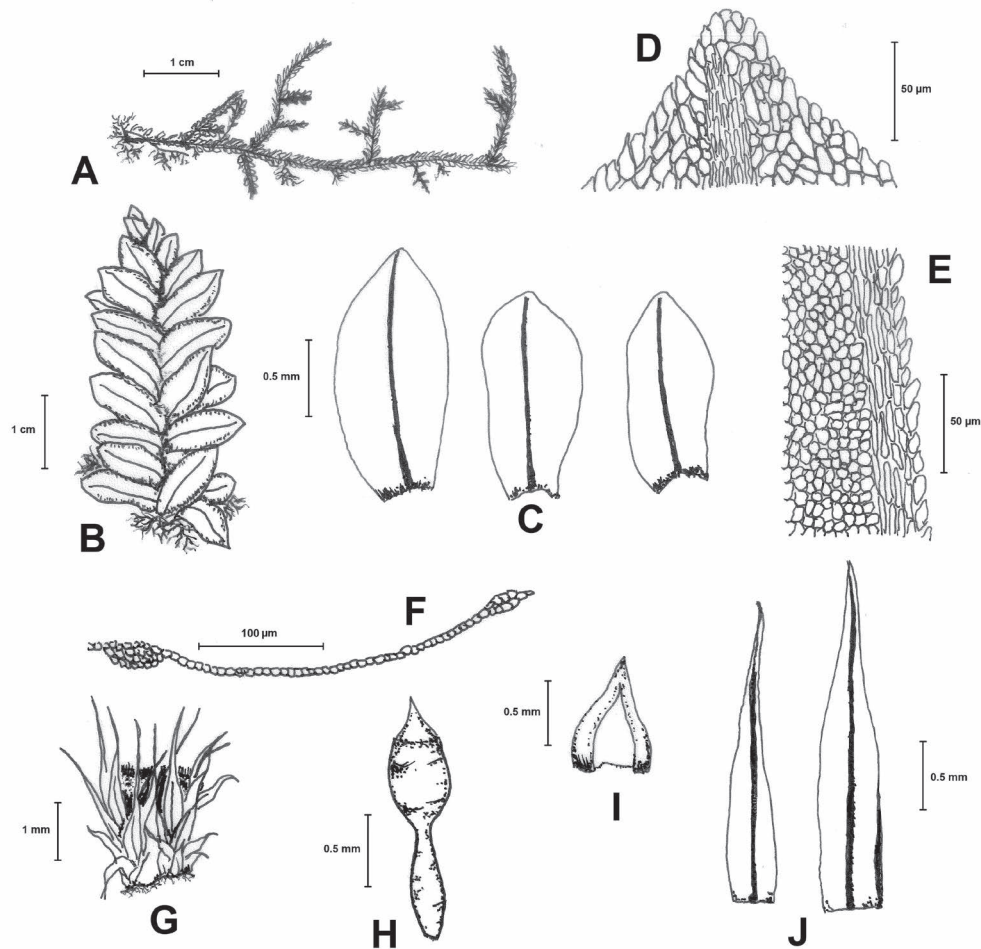
The Luzon material of *P. moutieri* has a very distinct and sharply demarcated limbidia along both leaf margins consisting of elongated, thick-walled cells reaching to leaf apex or nearly so which sets it apart from members of *Neckeropsis* (Fig. 8). In addition, the leaves of *P. moutieri* have either broadly acute or obtuse leaf apices, a very strong costa reaching to leaf apex or ending just a few cells below it and lack basal auricles. In the Philippines, *P. moutieri* can be confused with a similar rheophytic species *P. bonianus* (Besch.) S.Olsson, Enroth, Huttunen & D.Quandt. However, the latter species has limbidia consisting only of one layer of cells while that of *P. moutieri* consisted of 2 layers. Furthermore, the leaf margins of *P. moutieri* are densely denticulate to dentate throughout while the leaf margins of *P. bonianus* are denticulate only in the narrowed part of leaf apices or entirely absent.

**Extra-Philippine Distribution:** North Vietnam (Pócs 1969; Wu *et al.* 2011), southern China (Wu *et al.* 2011).

**Intra-Philippine Distribution:** Mount Purog in Samar island (Touw 1972; Tan and Iwatsuki 1991). **Specimen**

**examined:** North slope of Mount Isarog, Province of Camarines Sur, Luzon Island, Philippines, on stone beside a creek, May 13, 1991, J. R. Cabalguinto 2107 (PNH).



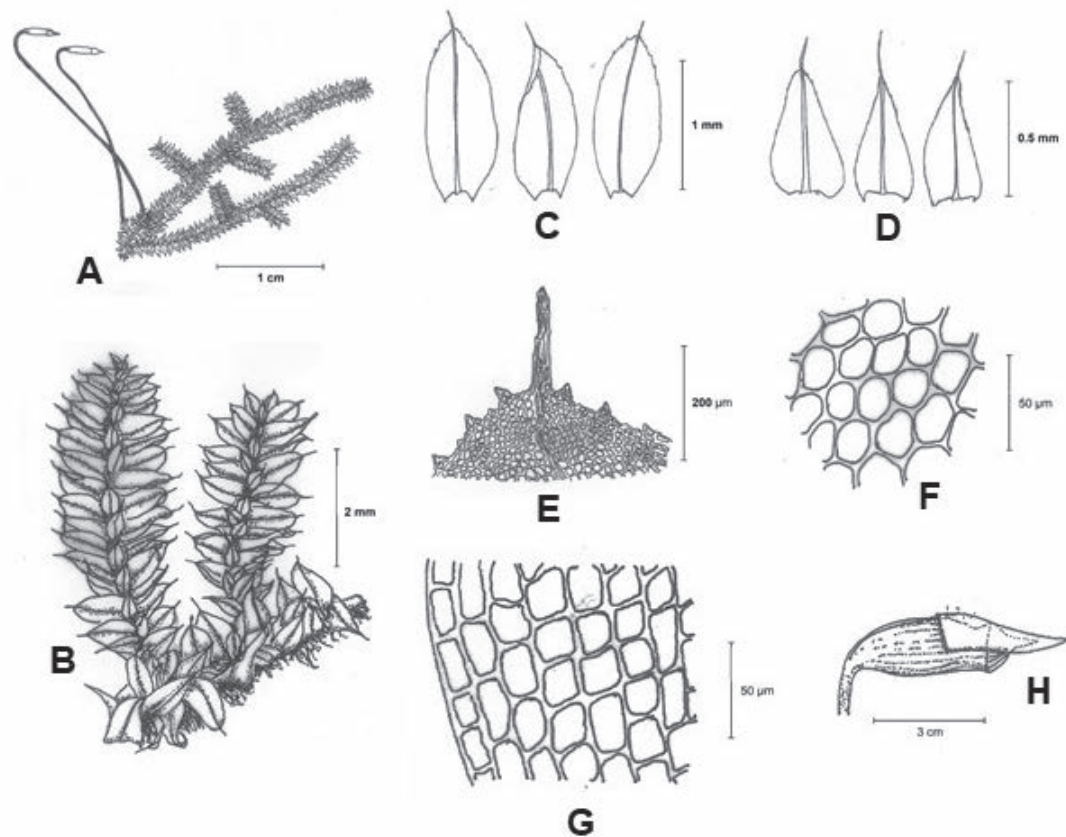


**Fig. 8.** *Pseudoparaphysanthus moutieri* (Broth. & Paris) S.Olsson, Enroth, Huttunen & D.Quandt. (A) Habit. (B) Portion of shoot. (C) Branch leaves. (D) Apex of branch leaf. (E) Margin of branch leaf showing the limbidium and lamina cells. (F) Cross-section of a branch leaf. (G) Perichaetium. (H) Capsule. (I) Calyptra. (J) Outer perichaetial leaves. All from J. R. Cabalguinto 2107 (PNH).

***Racopilum magnirete*** E.B.Bartram, *Farlowia* 1: 506, figs 11–14. 1944. (Racopilaceae)

The morphological characters of Luzon materials identified as *R. magnirete* (Fig. 9) agree well with van Zanten's (2006) description of the species based on the type material collected by Bartram (1944). Close examinations of Mangan specimens identified as *R. cuspidigerum* (Schwägr.) Ångstr. including a type of material (Hawaiian Islands, U.S.A., *C. Gaudichaud-Beaupré s.n.* (BM001109833)) revealed that *R. magnirete* is a small epiphytic plant with loosely inserted lateral leaves that spread sideway whereas for the slightly larger *R. cuspidigerum*, the lateral leaves are more closely inserted. In *R. magnirete*, the ovate lateral leaves have undulating lamina with margins becoming coarsely toothed toward the base of the costa. Similar leaves in *R. cuspidigerum* are more narrowly ovate in shape with margins either entire or serrated toward the leaf apices. If serrated, the teeth in *R. cuspidigerum* are composed mainly of single cells compared to the 2 or 3 cellular teeth in *R. magnirete* (van Zanten 2006). Given these circumstances, *R. magnirete* is treated here as a separate species apart from *R. cuspidigerum* for the time being, until a definite conclusion become available.

**Extra-Philippine Distribution:** British Solomon Islands (van Zanten 2006). **Intra-Philippine Distribution:** Mindanao (Bartram 1944; Tan and Iwatsuki 1991). **Specimen examined:** So. Siete, Mangan Mountains, Gabaldon, Nueva Ecija Province, Luzon Island, Philippines, on trunk of Aymit (*Ficus* sp.) tree, November 3, 2007, 460 m a.s.l., 15° 29.00' 21.58" N 121° 20.00' 48.79" E, V. C. *Linis* 2734-07 (PNH); So. Siete, Mangan Mountains, Gabaldon, Nueva Ecija Province, Luzon Island, Philippines, on tree trunk, November 3, 2007, 460 m a.s.l., 15° 29.00' 21.58" N 121° 20.00' 48.79" E, V. C. *Linis* 2738-07 (PNH); So. Siete, Mangan Mountains, Gabaldon, Nueva Ecija Province, Luzon Island, Philippines, on tree trunk, November 3, 2007, 460 m a.s.l., 15° 29.00' 21.58" N 121° 20.00' 48.79" E, V. C. *Linis* 2746-07 (PNH); Brgy. Pantoc, Gabaldon, Nueva Ecija Province, Luzon Island, Philippines, on tree trunk, November 3, 2007, 615 m a.s.l., 15° 28.00' 27.63" N 121° 21.00' 49.76" E, V. C. *Linis* 2750-07 (PNH).



**Fig. 9.** *Racopilum magnirete* E.B.Bartram. (A) Habit. (B) Portion of shoot. (C) Lateral leaves. (D) Dorsal leaves. (E) Apex of lateral leaf. (F) Median laminal cells of lateral leaf. (G) Basal laminal cells adjacent to margin of lateral leaf. (H) Capsule. (All from Linis 2746-07 (PNH)).

### Conclusions

The updated distributional patterns exhibited by the nine reported Philippine mosses are significant and useful to the phytogeographical studies of Philippine moss flora. For instance, the additions of *Chaetomitrium horridulum*, *Chaetomitrium vrieseanum*, and *Dicranoloma deplanchei* for the Philippine moss flora further fortify its current relationship with neighbouring areas in the Malesian region whereas the report of *Anomodontopsis rugelii* is an addition to the growing country list of widespread northern latitude mosses, albeit, restricted to the high mountains of Luzon. The addition of previously unreported four Philippine mosses: *Anomodon pseudotrlistis*, *Bescherellia elegantissima*, *Claopodium assurgens*, and *Racopilum magnirete* to Luzon island, on the other hand, only goes to show that some Philippine moss species displaying disjunctive distributions within the archipelago could likely be a result of under-sampling in the intervening islands. These could also imply that species displaying similar distributions may eventually turn out to be Philippine-wide in distribution.

### Acknowledgments

The author is most grateful to the British Museum of Natural History, National Museum of the Philippines, Singapore Botanic Gardens, and the University of the Philippines Los Baños for providing access to the bryological collections. The author would also like to thank the Biology Department of De La Salle University (DLSU) for accessing the laboratories and equipment necessary for the execution of this study. This study received financial support from the University Research Coordination Office of DLSU.

## References

- Akiyama H (1997) Taxonomic studies of mosses of Seram and Ambon (Moluccas, East Malesia) collected by Indonesian–Japanese Botanical Expeditions VIII. Meteoriaceae, Hookeriaceae, and Trachypodaceae. *Natural Human Activity* 2: 9–31.
- Akiyama H, Suleiman M (2001) Taxonomical notes on the genus *Chaetomitrium* (Hookeriaceae, Musci). *Hikobia* 13: 491–509.
- Ariyanti NS, Gradstein SR, Sporn SG, Angelika R, Tan BC (2009) Catalogue of the bryophytes of Sulawesi, supplement 1: new species records. *Blumea* 54: 287–289. <https://doi.org/10.3767/000651909X476300>
- Azuelo AG, Tan BC, Shevock JR, Manual A, Yorong A, Sariana L (2015) Mosses new for Mindanao Island, Republic of the Philippines. *Proceedings of the California Academy of Sciences* 62(4): 127–134.
- Bartram EB (1939) Mosses of the Philippines. *Philippine Journal of Science* 68(1–4): 1–437.
- Bartram EB (1944) New and noteworthy Philippine mosses. *Farlowia* 1(4): 503–513. <https://doi.org/10.5962/p.315993>
- Brummitt RK, Powell CE (1992) *A list of authors of scientific names of plants, with recommended standard forms of their names, including abbreviations*. Kew: Royal Botanic Gardens.
- Enroth J (1990) Bryophyte flora of the Huon Peninsula, Papua New Guinea. XXXVIII. Cyrtopodaceae and Cryphaeaceae (Musci). *Annales Botanici Fennici* 27: 177–188.
- Fife AJ (2014) Anomodontaceae. In: Heenan PB, Breitwieser I, Wilton AD, editors. *Flora of New Zealand - Mosses*. Fascicle 9. Lincoln: Manaaki Whenua Press. (5 August 2014) [accessed 2019 December 11]. <http://dx.doi.org/10.7931/J2JW8BS5>
- Fife AJ (2019) Dicranaceae. In: Smitsen R, Wilton AD, editors. *Flora of New Zealand - Mosses*. Fascicle 42. Edition 2. Lincoln: Manaaki Whenua Press. (21 February 2019 Second edition) [accessed 2021 October 21]. <http://dx.doi.org/10.7931/B1Y026.2>
- Fleischer M (1906–1908) *Die Musci der Flora von Buitenzorg*. Vol. 3. Leiden: EJ Brill.
- Fleischer M (1915–1922) *Die Musci der Flora von Buitenzorg*. Vol. 4. Leiden: EJ Brill.
- Goffinet B, Buck WR, Shaw AJ (2009) Morphology, anatomy, and classification of the Bryophyta. In: Goffinet B, Shaw AJ, editors. *Bryophyte Biology*. Cambridge: Cambridge University Press; pp. 55–138.
- Granzow-de la Cerda Í (1997) Revision and phylogeny of *Anomodon* and *Herpetineuron* (Anomodontaceae, Musci). *Contributions from the University of Michigan Herbarium* 21: 205–275.
- Ignatov MS, Fedorova AV, Fedosov VE (2019) On the taxonomy of Anomodontaceae and *Heterocladium* (Bryophyta). *Arctoa* 28(1): 75–102. <https://doi.org/10.15298/arctoa.28.08>
- Klazenga N (1999) A revision of the Malesian species of *Dicranoloma* (Dicranaceae, Musci). *Journal of the Hattori Botanical Laboratory* 87: 1–130.
- Linis VC (2004) A checklist of Mosses in Mt. Arayat, Pampanga, Philippines. *Journal of Tropical Biology* 3: 2–6.
- Linis VC (2006) A review of intra-Philippine distribution pattern of Philippine mosses based on recent evidence of tectonic evolution of the archipelago: insights and problems. *Banwa* 3(1&2): 31–64.
- Linis VC (2009) Biogeography of Mindoro mosses. *Blumea* 54: 290–296. <https://doi.org/10.3767/000651909X476319>
- Linis VC (2010) The moss flora of Camiguin Island, Philippines, and their floristic relations to adjacent islands in the archipelago. *Telopea* 12(4): 525–542. <https://doi.org/10.7751/telopea20105844>
- Linis VC (2014) Biogeographical notes on the moss floras of Bicol Peninsula in Luzon and the Catanduanes Islands, The Philippines. *Philippine Journal of Science, Special Issue* 142: 119–133.
- Linis VC (2018) A new country record and additions to the moss floras of Luzon and Mindanao islands, Philippines. *Telopea* 21: 91–99. <https://doi.org/10.7751/telopea12512>
- Linis VC (2019a) Notes on the diversity and floristic affinity of mosses (Musci, Bryophyta) from Zambales Mountain Range, Luzon island, Philippines. *Phytotaxa* 388(1): 69–97. <https://doi.org/10.11646/phytotaxa.388.1.3>
- Linis VC (2019b) New Philippine moss records for Luzon and Mindanao islands. *Journal of Bryology* 41(1): 48–58. <https://doi.org/10.1080/03736687.2018.1560542>
- Linis VC, Tan BC (2008) Progress of studies on phytogeography and biodiversity of Philippine moss flora from 1991 to 2006. In: Mohamed MAH, Baki BB, Nasrulhaq-Boyce A, Lee PKY, editors. *Bryology in the New Millennium*. Kuala Lumpur: University of Malaya; p. 13–22.
- Linis VC, Tan BC (2010) Eleven new records of Philippine mosses. *Acta Bryolichenologica Asiatica* 3: 95–100.
- Linis VC, Tan BC (2013) Eight additional new records of Philippine mosses. *Telopea* 15: 45–49. <https://doi.org/10.7751/telopea2013006>
- Lubos, L (2010) Species richness, distribution, and status of mosses in selected mountains in Mindanao, Philippines. *Asian Journal of Biodiversity* 1(1): 72–90. <https://doi.org/10.7828/ajob.v1i1.103>
- Noguchi A, Iwatsuki, Z, Yamaguchi T (1991) *Illustrated moss flora of Japan*. 4. Nichinan, Miyazaki, Japan: Hattori Botanical Laboratory; pp. 743–1012.

- Ochyra R, Enroth J (1989) *Neckeropsis touwii* (Musci, Neckeraceae), new species from Papua New Guinea, with an evaluation of sect. *Pseudoparaphysanthus* of *Neckeropsis*. *Annales Botanici Fennici* 26: 127–132.
- Olsson S, Enroth J, Huttunen S, Quandt, D (2016) Phylogeny of *Neckeropsis* and *Himantocladium* (Neckeraceae, Bryophytina). *Bryophyte Diversity and Evolution* 38(2): 53–70. <https://doi.org/10.11646/bde.38.2.4>
- Pócs T (1969) Fifth contribution to the bryoflora of North Vietnam. *Botanikae Közlemények* 56: 139–147.
- Pursell, RA, Reese, WD (1982) The mosses reported from New Caledonia. *Journal of the Hattori Botanical Laboratory* 53: 449–482.
- Sastre-de Jesús I (1987) Revision of the Cyrtopodaceae and transfer of *Cyrtopodendron* to the Pterobryaceae. *Memoirs of The New York Botanical Garden* 45: 709–721.
- Shevock JR, Yorong AP (2018) New additions to the moss flora of Mindanao island, Republic of the Philippines. *Philippine Journal of Systematic Biology* 12: 68–72. <https://doi.org/10.26757/pjsb.2018a12004>
- Suleiman M, Akiyama H (2014) Malesian *Chaetomitrium* (Symphyodontaceae, Musci): type illustrations, taxonomical notes, and key to the species. *Humans and Nature* 25: 1–62. [https://doi.org/10.24713/hitotoshizen.25.0\\_1](https://doi.org/10.24713/hitotoshizen.25.0_1)
- Suleiman M, Anwar I (2021) *Chaetomitrium vrieseanum* Bosch & Sande Lac. (Symphyodontaceae), a noteworthy record of a moss from Borneo. *Check List* 17(1): 227–231.
- Tan BC (1987) New records of Philippine mosses. *Memoirs of The New York Botanical Garden* 45: 446–454. <https://doi.org/10.15560/17.1.227>
- Tan BC, Iwatsuki Z (1983) Nineteen new records of Philippine mosses. *Kalikasan, Philippine Journal of Biology* 12: 328–350.
- Tan BC, Iwatsuki Z (1991) A new annotated Philippine moss checklist. *Harvard Papers in Botany* 3: 1–63.
- Tan BC, Lubos L, Schwarz U (2000) New and biogeographically noteworthy records of Philippine mosses from Mindanao Island. *Tropical Bryology* 18: 27–37. <https://doi.org/10.11646/bde.18.1.5>
- Tan BC, Robinson H (1990) A review of the Philippine Hookeriaceae taxa (Musci). *Smithsonian Contribution to Botany* 75: 1–41. <https://doi.org/10.5479/si.0081024X.75>
- Tan BC, Shevock JR (2014) Noteworthy mosses collected from the 2014 expedition of CAS and CMU new to Mindanao Island of the Philippines. *Bryophyte Diversity & Evolution* 36: 22–30. <https://doi.org/10.11646/bde.36.1.2>
- Tan BC, Shevock JR (2015) Species of *Macromitrium* (Orthotrichaceae) new to the Mindanao region and the Philippines with one species new to science. *Proceedings of the California Academy of Sciences* 64: 541–549.
- Tan BC, Shevock JR, Coritico F, Amoroso V (2015) Mosses new for Mindanao Island, The Philippines III. *Bulletin of the National Museum of Nature and Science, Series B (Botany)*, Tokyo 41: 91–97.
- Thin, NN (1997) The vegetation of Cucphuong National Park, Vietnam. *Sida, Contributions to Botany* 17(4): 719–759.
- Thouvenot L, Bardat J (2013) Contribution to the bryophyte flora of New Caledonia. I. New taxa and amendments. *Cryptogamie, Bryologie* 34(1): 37–47. <https://doi.org/10.7872/cryb.v34.iss1.2013.37>
- Touw A (1972) Additional notes on *Neckeropsis*. *Lindbergia* 1: 184–188.
- Touw A, Ochyra R (1987) Additional notes on *Neckeropsis* 2. *Lindbergia* 13: 97–104.
- van Zanten BO (2006) A synoptic review of the Racopilaceae (Bryophyta, Musci). 1. Asian, Pacific, and Australasian species of the genus *Racopilum*. *Journal of the Hattori Botanical Laboratory* 100: 527–552.
- Wu P-C, Crosby MC, He S (2002) Hookeriaceae–Thuidiaceae. In: He S, editor. *Moss flora of China*. Vol. 6. Beijing, New York & St. Louis: Science Press & Missouri Botanical Garden.
- Wu P-C, Crosby MC, He S (2011) Erpodiaceae–Climaciaceae. In: He S, editor. *Moss flora of China*. Vol. 5. Beijing, New York & St. Louis: Science Press & Missouri Botanical Garden.

Received 1 September 2021, accepted 29 October 2021.