

Mosses new for Mindanao Island, The Philippines, III

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Abstract Twenty moss species are reported to be new records of the Mindanao flora, of which five are new species records for the Philippine moss flora. *Metadistichophyllum* M.Fleisch. is a new generic record for the Philippine flora. Of the added species records, *Chaetomitrium ciliatum*, *Distichophyllum subcarinatum*, *Hampeella pallens* and *Metadistichophyllum rhizophorum* reveal the floristic connection of Mindanao Island with Borneo, Java and Australasia.

Key words : Philippine mosses, Mindanao flora, new species records, Wallacea.

Introduction

Mindanao is the southernmost island of the Philippines. At 104,630 km², Mindanao is only slightly smaller than the island of Luzon to the north at 109,965 km². However, bryophyte collection and inventory efforts have historically received much less attention in Mindanao as compared to Luzon. The number of mosses reported by Linis and Tan (2008) for these two island masses is in stark contrast with 613 mosses documented for Luzon but only 333 species for Mindanao. The state of under collection of the moss diversity in Mindanao is shown further by the outcome of a recently held joint month-long expedition conducted in April–May of 2014 by botanists of Central Mindanao University (CMUH) in the Philippines and the California Academy of Sciences (CAS) in United States. Two scientific articles based on the plant collections of this joint expedition have been published (Tan and Shevock, 2014; Azuelo *et al.*, 2015) which yielded 37 new moss records for the

island of Mindanao, of which 7 are also new species records for the country. A perusal of publications of Philippine moss flora shows that these new records of Mindanao mosses have long been reported from Luzon. Here in the third part of the series reporting on the newly collected Mindanao mosses, we add another 20 moss species new to the Mindanao flora, of which five species are new records for the Philippine moss flora. *Metadistichophyllum* M.Fleisch. is a new generic record for the Philippine moss flora. Other added species records, such as *Chaetomitrium ciliatum*, *Distichophyllum subcarinatum*, *Hampeella pallens* and *Metadistichophyllum rhizophorum*, reveal the strong floristic connection of Mindanao Island with Borneo, Java and Australasia. Certainly, more surveys of moss diversity of Mindanao Island in the years to come will bring the number of moss taxa up to near 600 species.

In the report below, the arrangement of the moss taxa is done alphabetically by the genus and species epithets. The family placement provided at the end of each species follows Goffinet

et al. (2009). The asterisk (*) indicates a new species record for the Philippine flora. Duplicates of the moss collections enumerated below are distributed to selected herbaria in Europe, North America and Asia, including TNS.

1. *Acroporium aciphyllum* Dixon [Sematophyllaceae]

This West Malesian endemic species is like a small version of the common *Acroporium stramineum* (Reinwardt & Hornschuch) M.Fleisch. with an abruptly aciphyllous leaf apex. See Tan (1994) for a good illustration of this leaf character. According to Tan (1994), its past records from the Philippines are all from Luzon. The same species is known also from Malay Peninsula (Dixon, 1924).

Specimen examined: North Cotabato Province, Kidapawan City, lower slopes of Mt. Apo National Park above EDC Geothermal Field, 1735 m, 29 Apr 2014, *Shevock 44905* (CAS, CMUH, TNS, UC).

2. *Acroporium convolutum* (Bosch & Sande Lac.) M.Fleisch. var. ***elatum*** (Dixon) B.C.Tan [Sematophyllaceae]

This West Malesian taxon is best recognized by its ovate-oblong and involute leaves with a long acuminate apex. Additionally, its leaf cells are occasionally unipapillose, a character not seen in many species of *Acroporium*. The taxon has an old Philippine specimen kept in Herb. Hampe with no locality of island indicated (see Tan, 1994). This taxon is also known from Borneo and Malay Peninsula (see Tan, 1994; Suleiman *et al.*, 2006; Yong *et al.*, 2013).

Specimens examined: Bukidnon Province, Malaybalay City, along ridge trail to summit of Mt. Kiamo from Kibalabag Village, on small diameter hardwood vine, 1580 m, 7 May 2014, *Shevock & Tan 45134* (CAS, CMUH, UC); North Cotabato Province, Kidapawan City, southwest slopes of Mt. Apo above Geothermal Production Field of EDC, 2230 m, 30 Apr 2014, *Shevock 44994* (CAS, CMUH, UC).

3. *Acroporium rigens (Broth. ex Dixon) Dixon [Sematophyllaceae]

Acroporium rigens is a less known Malesian endemic, recently reported from Papua New Guinea by Tan *et al.* (2007). Having a plant size with erect, setaceous leaves reaching 3 mm or longer, it looks like a large version of the widespread Malesian species, *A. johannis-winkleri* Broth. (Tan, 1994). The species is a new record both for the Mindanao and the Philippine floras.

Specimen examined: Bukidnon Province, Malaybalay City, along ridge trail to summit of Mt. Kiamo from Kibalabag Village, on hardwood trunk, 1680 m, 7 May 2014, *Shevock & Tan 45157* (CAS, CMUH, UC).

4. *Acroporium rufum* (Reinw. & Hornsch.) M.Fleisch. [Sematophyllaceae]

Acroporium rufum is a small plant that has somewhat falcate leaves with oblong lanceolate leaves and acuminate leaf apices. It is better known in literature and in the region by its synonym, *A. braunii* Müll.Hal. For the differences between this species and related species, see Tan (1994). *Acroporium rufum* is widely reported across tropical SE Asia.

Specimens examined: Bukidnon Province, Malaybalay City, along ridge trail to Mt. Kiamo from Kibalabag Village, 1520 m, 7 May 2014, *Shevock & Tan 45179* (CAS, CMUH, MO, NY, TNS, UC); Lantapan Municipality, Mt. Kitanglad Range Natural Park, Along route to Mt. Dulang-Dulang from Sitio Bul-ogan, 1775 m, 20 Apr 2014, *Shevock 44682* (CAS, CMUH).

5. *Aerobryidium crispifolium* (Broth. & Geh.) M.Fleisch. [Meteoriaceae]

A new species record for Mindanao, *Aerobryidium crispifolium* is a rather large and showy pendulous species on hardwood branches. It has very crispate undulate and rugose leaf apices, like *Aerobryidium filamentosum* (Hooker) M. Fleisch., but the length of narrow leaf apices in *Aerobryidium crispifolium* is shorter than that of the latter. This taxon is mainly a Malesian species. Its records in Yunnan Province of China

(see Wu and Pei, 2011) need confirmation.

Specimen examined: Bukidnon Province, Lantapan Municipality, Mt. Kitanglad Range Natural Park, along trail about 4.5 km above Sitio Bulogan, toward Mt. Dulang-Dulang, 2000 m, 20 Apr 2014, *Shevock 44709* (CAS, CMUH, H, MO, NY, PNH, PTBG, TAIE, TNS, UC).

***6. *Chaetomitrium ciliatum* Bosch & Sande Lac.** [Symphyodontaceae]

This is a medium sized plant in the genus with long creeping stem and many lateral branches reaching 10 mm long. The undulate leaves with long dorsal spines make this species distinctive in appearance. Suleiman and Akiyama (2014) provided a good description and illustration of the diagnostic characters for this species. The only species of *Chaetomitrium* in Mindanao that will be confused with this species is *C. orthorhynchum* (Dozy & Molk.) Bosch & Sande Lac. But the latter differs in having a smaller plant size, less undulate leaves, acute to short acuminate, but not long, acuminate leaf apices, and less spinose dorsal leaf cells. *Chaetomitrium ciliatum* is new to Mindanao and the Philippines. Its previous records are from Java of Indonesia. Its distribution suggests a Wallacea biogeographical pattern (see Vane-Wright, 1990).

Specimen examined: Bukidnon Province, Malaybalay City, along ridge trail to Mt. Kiamo accessed from Kibalabag Village, on podocarp shrub branches, 1580 m, 7 May 2014, *Shevock & Tan 45139* (CAS, CMUH, UC).

7. *Chaetomitrium lanceolatum* Bosch & Sande Lac. [Symphyodontaceae]

The leaf morphology of this species is close in many respects to *C. papillifolium* Bosch & Sande Lac., another species found in Mindanao. Both species share ovate-lanceolate and concave leaves that become abruptly contracted to an acuminate and toothed leaf apex. But the former differs from the latter in having cucullate calyptra that is not ciliate at base and a more densely setose seta (Bartram, 1939). Fleischer (1900–1923) presented a good illustration of *C. lanceo-*

latum. Known already from Luzon (Tan and Iwatsuki, 1991), Borneo (Suleiman *et al.*, 2006) and Java (Fleischer, 1900–1923), the presence of *C. lanceolatum* in Mindanao is not unexpected.

Specimen examined: Bukidnon Province, Lantapan Municipality, Mt. Kitanglad Range Natural Park, lower slopes of Dulang-Dulang above Sitio Bulogan, on shrub branches, 1775 m, 20 Apr 2014, *Shevock 44686* (CAS, CMUH, UC).

***8. *Distichophyllum subcarinatum* A.Nog. & Z.Iwats.** [Daltoniaceae]

This is a small to medium sized plant of *Distichophyllum* with distinctive carinate leaves that end with a short cuspidate apices. Noguchi and Iwatsuki (1972) provided an excellent line drawing of this species based on the type specimen collected from Mt. Kinabalu of Borneo. *Distichophyllum subcarinatum* has been proposed a synonym of *D. subcuspidatum* A.Nog. & Z.Iwats. by Akiyama and Yamaguchi (1999). But the former differs from the latter in having a carinate leaf base and non-collenchymatous leaf cells (see Noguchi and Iwatsuki, 1972). On the other hand, the suggested synonymy of *Distichophyllum subcarinatum* and *D. brevicuspes* M.Fleisch. in Tan and Robinson (1990) still awaits confirmation. As is, *Distichophyllum subcarinatum* is a new species record for both the Mindanao and Philippine moss floras. It is an example of Bornean-Philippine (Mindanao) endemic.

Specimen examined: Bukidnon Province, Lantapan Municipality, Mt. Kitanglad Range Natural Park, summit ridge of Dulang-Dulang, on trunk of tree fern in open site, 2945 m, 24 Apr 2014, *Shevock, Fritsch & Opiso 44888* (CAS, CMUH, TNS, UC).

9. *Groutiella tomentosa* (Hornsch.) Wijk & Margad. [Orthotrichaceae]

The genus is easily distinguished in the family Orthotrichaceae by the presence of a well differentiated basal leaf border. The oblong and smooth capsule coupled with a short, smooth and mitrate calyptra is equally diagnostic. The species is widespread in all three tropical regions

and reaching Australasia. It is known more popularly in Malesia by its synonym, *G. goniorrhyncha* (Dozy & Molk.) Wijk & Margadant. In the Philippines, this species is common in rainforests in Luzon and Visayas Island groups. Its presence in Mindanao is a late discovery.

Specimen examined: Bukidnon Province, Malaybalay City, along beginning of trail to Mt. Kiamo accessed from Kibalabag Village, disturbed secondary forest, on large hardwood trunk, 1210m, 7 May 2014, *Shevock & Tan 45181* (CAS, CMUH, MO, NY, PNH, TAIE, TNS, UC).

10. *Hampeella pallens* (Sande Lac.) M.Fleisch. [Ptychomniaceae]

Hampeella pallens is a distinctive species to recognize in the field. The complanate plant habit with the somewhat curved leaves are diagnostic among the species of mosses in the Philippines. It can be mistaken for a member of the Plagiotechiaceae, but its erect, oblong and 8-ribbed dry capsule, when present, will place it in Ptychomniaceae. Fleischer (1900–1923) illustrated accurately this species. *Hampeella pallens* is one of the Australasian mosses that reaches the Philippines and also Taiwan (see Enroth, 1991).

Specimen examined: North Cotabato Province, Kidapawan City, lower slopes of Mt. Apo National Park above EDC Geothermal Field, 1875m, 29 Apr 2014, *Shevock 44940* (CAS, CMUH, TNS, UC).

***11. *Homalothecium laevisetum* Sande Lac.** [syns. *H. appressifolium* (R.S.Williams) Broth., *Homalothecium celebesiae* (Müll.Hal.) Broth.] [Brachytheciaceae]

In the Philippines, this genus has, thus far, only one species represented. *Homalothecium laevisetum* is identified by the terete branches with plicate leaves that have a band of short rounded cells extending across the leaf base (Bartram, 1939). The present report is a new record of the genus for Mindanao Island. Tan and Iwatsuki (1991) reported this taxon from Luzon and Panay as a local endemic under its synonym,

H. appressifolium. Enroth (1993) reduced *Homalothecium appressifolium* to a synonym of *H. celebesiae*, while Hofmann (1998) considered both taxa to be synonyms of the widespread continental Asiatic species, *H. laevisetum*, thus, expanding its range from Russia, Japan, Korea, China and Taiwan, Indonesia, Philippines to Papua New Guinea (Hoffman, 1998). Few moss species in Asia, like *H. laevisetum*, have such a broad latitudinal range of distribution encompassing boreal, temperate and tropical regions.

Specimen examined: Bukidnon Province, Malaybalay City, along ridge trail to Mt. Kiamo accessed from Kibalabag Village, disturbed secondary forest, on large hardwood branch, 1195m, 7 May 2014, *Shevock & Tan 45106* (CAS, CMUH, UC).

12. *Macromitrium cuspidatum* Hampe [Orthotrichaceae]

This Malesian species of *Macromitrium* has the unique leaf feature of having rectangular upper laminal cells and linear, curved basal laminal cells that are smooth throughout, in addition to a long excurrent costa (Bartram, 1939). It is a distinctive species not likely to be confused with any of its local congeners. In the Philippines, the species is known from several localities in Luzon, Mindoro and Palawan (Tan and Iwatsuki, 1991).

Specimen examined: Bukidnon Province, Malaybalay City, along the summit ridge of Mt. Kiamo from Kibalabag Village, 1775m, 7 May 2014, *Shevock & Tan 45169* (CAS, CMUH, MO, UC).

13. *Macrothamnium javense* M.Fleisch. [syn. *M. hylocomioides* M.Fleisch.] [Hylocomiaceae]

In the Philippine archipelago, *Macrothamnium* M.Fleisch. is a genus commonly found on ground in moist mossy forest at high elevations. Of the two species reported from the country, *M. javense* is less commonly encountered than *M. macrocarpum* (Reinwardt & Hornsch.) M.Fleisch. The former is distinguished from the latter by its strongly serrated leaf margins and a decurrent leaf base.

Specimen examined: Bukidnon Province, Lan-

tapan Municipality, Mt. Kitanglad Range Natural Park, mid-slope of Dulang-Dulang at Alanib River. On rocks seasonally submerged, 2190 m, 22 Apr 2014, *Shevock 44774* (CAS, CMUH, KRAM, MO, NY, PNH, TNS, UC).

14. *Metadistichophyllum rhizophorum (M. Fleisch.) A.Nog. & Z.Iwats. [Daltoniaceae]

The genus *Metadistichophyllum* was created by Noguchi and Iwatsuki (1972) to accommodate a distinctive, *Distichophyllum*-like species that produces numerous long and stiff rhizoidal filaments that bear gemmae at the tip. Fleischer (1900–1923) illustrated nicely the gametophyte of this species under its synonym, *Distichophyllidium rhizophorum* M.Fleisch. The species is known from Java, Borneo, and now the Philippines (Mindanao). Its preferred habitat growing on trunk of tree fern in montane mossy forest is also unique for the genus. The population of this species on Mt. Kitanglad is the second locality next to Mt. Malindang in Mindanao. An earlier mention of this moss from Mt. Malindang was included in an unpublished report of a study project on the vegetation and biodiversity of Mt. Malindang National Park prepared by one of us (VA).

Specimens examined: Misamis Occidental Province, Don Victoriano Municipality, Mt. Malindang National Park, in CMU plot #200–250, on trunk of tree fern, 26 Dec 2001, *BC Tan 2001-2000* (CMUH, UC); Bukidnon Province, Lantapan Municipality, Mt. Kitanglad Range Natural Park, alternate ridge route to Dulang-Dulang, on tree fern trunk, 2945 m, 23 Apr 2014, *Shevock 44829* (BOL, CAS, CMUH, KRAM, KUN, MO, NY, PNH, TNS, UC).

15. *Meteoriopsis reclinata* (Müll.Hal.) M.Fleisch. in Broth. [Meteoriaceae]

Having a long creeping stem with distinctive rows of squarrose leaves on branches, this is one of the easiest species to identify in the family Meteoriaceae. A widespread taxon in Asia, it is a common moss in many rain forests in Luzon and the Visayan island groups in the Philippines. The discovery of its presence in Mindanao is long overdue.

Specimens examined: Bukidnon Province, Lantapan Municipality, Mt. Kitanglad Range Natural Park, lower slopes of Dulang-Dulang above Sitio Bul-ogan, on rock wall with litter, 1350 m, 20 Apr 2014, *Shevock 44675* (CAS, CMUH, MO, NY, PNH); Malaybalay City, lower slopes along trail to Mt. Kiamo from Kibalabag Village, 1195 m, 7 May 2014, *Shevock & Tan 45109* (CAS, CMUH, TNS).

16. *Pelekium versicolor* (Hornsch. ex Müll.Hal.) Touw [Thuidiaceae]

In the Philippines, this is a small moss known before from Luzon Island by its synonym, *Thuidium tamariscellum* Müller Hal. (Bartram, 1939). Touw (2001) moved the species to *Pelekium* after redefining the genus and provided a key to the species of *Pelekium* known from Tropical Asia, Western Pacific and Hawaii. *Pelekium versicolor* is a widespread African-Asian species and is a moss of disturbed habitats in open forests in Malesia (Touw, 2001). A new record for Mindanao, *Pelekium versicolor* is best identified among its congeners in the Philippines by its muticous stem leaves and smooth setae.

Specimen examined: Bukidnon Province, Malaybalay City, along trail to Mt. Kiamo from Kibalabag Village, 1210 m, 7 May 2014, *Shevock & Tan 45183* (CAS, CMUH, UC).

17. *Pseudotaxiphyllum arquifolium* (Bosch & Sande Lac.) Z.Iwats. [Hypnaceae]

Pseudotaxiphyllum arquifolium is similar to *Taxiphyllum arcuatum* (Bosch & Sande Lac.) S. He in having a complanate plant habit and with arcuate leaves. The two genera differ, however, in the absence of pseudoparaphyllia in *Pseudotaxiphyllum* and presence in *Taxiphyllum* (Noguchi, 1994). The leaf apices of *Pseudotaxiphyllum arquifolium* ranges from narrowly acute to acuminate. The stem cross section of the Mindanao specimen shows a small differentiated central strand surrounded by large and thin-walled cortical and 1–2 layers of small thick-walled epidermal cells. This species is collected by us from clayey volcanic soil. The other known locality of

this species in the country is Lamao River in Bataan Province of Luzon Island (see Tan and Iwatsuki, 1991).

Specimen examined: Bukidnon Province, Lantapan Municipality, Mt. Kitanglad Range Natural Park, upper slopes of Dulang-Dulang along alternative ridge route to Mt. Dulang-Dulang, 2240 m, 23 Apr 2014, *Shevock 44830* (CAS, CMUH, TNS, UC).

18. *Pterobryopsis crassicaulis* (Cardot) Broth. [Pterobryaceae]

In the family, the long and slender creeping primary stem coupled with several erect and little branched, secondary stems identify *Pterobryopsis* from other genera. Two species are known, from the Philippines. *P. crassicaulis* is differentiated from *P. gedehensis* M.Fleisch. by the presence of single costa which is absent in the leaves of the latter. Both species are very well illustrated in Fleischer (1900–1923). *P. crassicaulis* is a widespread Malesian moss already known from the Philippines from several localities in Luzon and Visayan Island groups (Hyvönen, 1989; Tan and Iwatsuki, 1991).

Specimens examined: Bukidnon Province, Malaybalay City, along trail to Mt. Kiamo from Kibalabag Village, 1680 m, 7 May 2014, *Shevock & Tan 45165* (CAS, CMUH), 1500 m, 7 May 2014, *Shevock & Tan 45115* (CAS, CMUH) and *Shevock & Tan 45111* (CAS), *Shevock & Tan 45169A* (CAS, TNS).

19. *Sinskea flammea* (Mitt.) W.R.Buck [Meteoriaceae]

Long known from the country's moss flora by its synonym, *Chrysocladium flammeum* (Mitt.) M.Fleisch., populations of *S. flammea* exhibits in the field an orange-reddish cast in addition to form pendulous mats. It is a widespread continental Asiatic species. In the Philippines, it is well known from the northern highland of Luzon, and now, with a confirmed southward extension of range to the highland in Mindanao.

Specimens examined: Bukidnon Province, Lantapan Municipality, Mt. Kitanglad Range

Natural Park, upper slopes of Dulang-Dulang along main route to summit, 2615 m, 22 Apr 2014, *Shevock 44817* (CAS, CMUH, TNS) and 2675 m, 22 Apr 2014, *Shevock 44823* (CAS, CMUH, KRAM, PNH, PTBG, UC).

20. *Symphyodon perrottetii* Mont. [Symphyodontaceae]

The genus, *Symphyodon* Montagne, is easy to identify with its echinate capsule, but some species can be difficult to ascertain in the absence of a sporophyte. This is due to the overlapping variation of morphological characters seen in related species (see He and Snider, 2000). However, *S. perrottetii* can be identified, in the absence of a capsule, by its somewhat complanate and undulate leaves with irregularly toothed margins in the upper half of the blade. This species is known from Luzon and Mindoro (Bartram, 1939; Tan and Iwatsuki, 1991) in the Philippines. He and Snider (2000) indicated its presence in Mindanao in a distribution map but cited no definite specimen. Our report here is a confirmation of its range extension from Luzon to Mindanao.

S. perrottetii is the most widespread species in the genus in Asia ranging from Indian subcontinent, Indochina, China, Japan to SE Asia. Higuchi (2014) newly reported its presence in Hawaii and provided colored pictures of its leaf details for species identification.

Specimens examined: Bukidnon Province, Lantapan Municipality, Mt. Kitanglad Range Natural Park, upper slopes of Dulang-Dulang, 2200 m, 21 Apr 2014, *Shevock 44732* (CAS, CMUH, UC) and 2675 m, 22 Apr 2014, *Shevock 44824* (CAS, CMUH, MO, TNS, UC).

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