MOSSES OF MARAI PARAI TRAIL, MOUNT KINABALU

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ABSTRACT

A total of 109 species and three varieties in 62 genera and 26 families of mosses were collected along the Marai Parai Trail, northwestern part of Mount Kinabalu during a three-day survey in October 2023. This represents about 16% and 14% of mosses reported from Sabah and Borneo, respectively. The families with the highest number of species were Sematophyllaceae, followed by Leucobryaceae and Dicranaceae. Among the 112 taxa of mosses, six species are new records for Mount Kinabalu. In addition, several species are rarely collected in Borneo and restricted to Mount Kinabalu, showing the significant importance of the area within the Kinabalu Park.

Keywords: Borneo, moss flora, Kinabalu Park, Sabah.

INTRODUCTION

Marai Parai is located in the northwestern part of Mount Kinabalu and can be accessed via Kampung Kiau Nuluh in the Ranau District of Sabah, Malaysian Borneo. The Marai Parai-Gurkha Hut Scientific Expedition 2023 was organized by Sabah Parks from 7th to 20th October 2023 to collect scientific data on flora and fauna, as well as identifying eco-tourism features and potentials, along the Marai Parai-West Gurkha Hut route within the Kinabalu Park. Marai Parai and its adjacent areas has been less explored by researchers compared to other parts of Mount Kinabalu. Nonetheless, five previous scientific expeditions were conducted in Marai Parai from 1983 to 1993 by various group of researchers. It has been 30 years since the last expedition; the 2023 expedition is timely and vital before this route is developed and open to the public.

Mount Kinabalu has recorded 413 species of mosses belonging to 49 families and 161 genera (Frahm et al., 1990; Mohamed, 1998; Akiyama et al., 2001; Higuchi et al., 2008). This mountain has recorded the highest number of species of mosses in Borneo due to its high elevational range and various forest types, from lowland dipterocarp forest to subalpine forest. There are no specific publications of mosses from Marai Parai area in particular, except for several online records of specimens housed in various herbaria (GBIF.org, 2024). Thus, the objective of this study is to carry out an inventory of mosses along the Marai Parai-Gurkha Hut route to assist the park authority in formulating its management strategy for the development of the new climbing route to Mount Kinabalu summit.

METHODOLOGY

Opportunistic sampling of mosses was carried out along the Marai Parai-Gurkha Hut route (1,300–2,000 m a.s.l) within Kinabalu Park from 10th to 12th October 2023 (Table 1). Specimens outside the park's boundaries were not collected. Common substrates of mosses were surveyed, such as tree trunks, lianas, branches, rotten logs, humus, soils, rocks and boulders. The collected specimens were curated and identified at the BORNEENSIS Herbarium (BORH) of Universiti Malaysia Sabah. The classification of moss families and genera is based on Goffinet and Buck (2020), while species names and authority were based on the Tropicos (Tropicos.org., 2024) and World Flora Online (WFO, 2024) databases. The specimens were deposited at the Sabah Parks Herbarium (SNP) and a set of duplicates in BORH. The geographic distribution of the new records of mosses was based on occurrence data from Global Biodiversity and Information Facility (GBIF.org, 2024) and related references.

Table 1. Collection details of mosses from Marai Parai Trail, Mount Kinabalu.

Collection number	Collection details
7014–7120	Nunuk Camp to Marai Parai; N6°4'2.60", E116°30'25.33" to
	N6°4'54.84", E116°31'13.52", 10 October 2023.
7121–7165	Marai Parai to Kobuturan Camp; N6°4'54.84", E116°31'13.52" to
	N6° 4'44.50", E116°32'9.78", 11 October 2023.
7164–7184	Marai Parai to Nunuk Camp; N6°4'54.84", E116°31'13.52" to
	N6°4'2.60", E116°31'1.78", 12 October 2023.

RESULTS AND DISCUSSION

A total of 167 specimens of mosses were collected and examined in this study. Out of these, 109 species and three varieties belonging to 62 genera and 26 families of mosses were identified (Table 2, Appendix 1). This number represents ca. 16% of the 671 taxa of mosses reported for Sabah and ca. 14% of the 784 taxa of mosses reported for Borneo (Andi & Suleiman, 2020; Suleiman & Anwar, 2020; Suleiman et al., 2022; Suleiman et al., 2024). The most dominant family of mosses in this area is Sematophyllaceae with 17 taxa, followed by Leucobryaceae with 12 taxa and Dicranaceae with 10 taxa. These three families are commonly rich with species in montane forests in Borneo.

No	Families	Genera	Species	
1	Sematophyllaceae	8	16 + 1 var.	
2	Leucobryaceae	4	11 + 1 var.	
3	Dicranaceae	5	10	
4	Daltoniaceae	4	8	
5	Pylaisiadelphaceae	4	7 + 1 var.	
6	Fissidentaceae	1	7	
7	Orthotrichaceae	2	6	
8	Meteoriaceae	4	4	
9	Ptychomniaceae	1	4	
10	Calymperaceae	2	4	
11	Pterobryaceae	4	4	
12	Hypnaceae	1	3	
13	Pottiaceae	3	3	
14	Hypnodendraceae	3	3	
15	Polytrichaceae	2	3	
16	Rhizogoniaceae	2	3	
17	Bryaceae	2	2	
18	Bartramiaceae	2	2	
19	Symphyodontaceae	1	2	
20	Thuidiaceae	1	1	
21	Hookeriaceae	1	1	
22	Neckeraceae	1	1	
23	Racopilaceae	1	1	
24	Trachylomataceae	1	1	
25	Hylocomiaceae	1	1	
26	Sphagnaceae	1	1	
	Total	62	109 + 3 var.	

 Table 2. Summary of mosses collected from Marai Parai Trail, Mount Kinabalu in descending order of species number.

Out of the 112 taxa of mosses collected, remarkably six species are newly recorded for Mount Kinabalu, namely *Chaetomitrium horridulum* Bosch & Sande Lac., *Garovaglia baeuerlenii* (Geh.) Paris, *Papillidiopsis ramulina* (Thwaites & Mitt.) W.R. Buck & B.C. Tan, *Radulina borbonica* (Bél.) W.R. Buck var. *borbonica, Syrrhopodon mammillosus* Müll. Hal. and *Trachycladiella sparsa* (Mitt.) M. Menzel (Appendix 1). Mount Kinabalu is the

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most bryologically explored site in Borneo, yet new records of mosses are still being reported showing that we are still far from knowing the true diversity of bryophytes from this mountain.

Plate 1. Some of the mosses collected along the Marai Parai Trail of Mount Kinabalu. a. Bryobrothera tambuyukonensis, b. Braunfelsia plicata, c. Schistomitrium mucronifolium, d. Trachypus bicolor, e. Schlotheimia wallisii, f. Dawsonia longifolia, g. Garovaglia plicata ssp. plicata and h. Chaetomitrium horridulum.

Some of the species collected from the study area are either rare or restricted to Mount Kinabalu. An example is *Distichophyllum kinabaluense* Nog. & Z. Iwats. which is rarely recorded, and only found in Borneo and the Philippines (GBIF.org, 2024). Another species is *Syrrhopodon mammillosus* which is a rare species and known only from New Caledonia (type locality), Peninsular Malaysia, Cambodia, Borneo and the Philippines (Ellis, 2004, 2007;

GBIF.org, 2024). There are only two records of this species in Sabah, both of which were from Mount Silam in the eastern part of Sabah (Reese, 1996; Tan & Suleiman, 2022). Notably, several populations of *Schlotheimia wallisii* Müll. Hal. was observed in Marai Parai area between 1,400 m to 1,600 m above sea level (a.s.l.). Although this species is common in New Guinea, Indonesia and the Philippines, it is rarely recorded in Borneo and only restricted to Mount Kinabalu (Ramirez et al., 2024).

CONCLUSION

The three-day exploration resulted in a relatively high number of mosses with six new records for Mount Kinabalu and several rare species. Collection of specimens above 2,000 m a.s.l was not possible due to unfavourable weather and limited time during the expedition; undoubtedly, the total number of species would have been much higher if collections from the upper montane forests, along the Gurkha Hut Trail, were included. This area has a similar species richness with other parts of Mount Kinabalu.

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APPENDIX

Appendix 1. Checklist of mosses from Marai Parai Trail, Kinabalu Park.

The families, genera and species of mosses were arranged in alphabetical order. Species reported for the first time for Mount Kinabalu is marked with '*'. MS – Monica Suleiman; IA – Irmah Anwar.

BARTRAMIACEAE

Breutelia arundinifolia (Duby) M. Fleisch.

On humus and boulder, in open area and partially shaded areas, 1400–1600m, MS & IA 7043, 7174.

In Borneo, this species has only been recorded from Mount Kinabalu and Mount Trusmadi.

Philonotis secunda (Dozy & Molk.) Bosch & Sande Lac.

On rock, in open area, 1400 m, MS & IA 7180.

BRYACEAE *Bryum apiculatum* Schwägr. On charcoal, in open area, 1600 m, MS & IA 7173.

Brachymenium nepalense Hook.

On fallen trunk, in partially shaded area, 1300 m, MS & IA 7034.

CALYMPERACEAE

Calymperes fasciculatum Dozy & Molk.

On treelet trunks, in partially shaded area, 1400 m, MS & IA 7086, 7097.

Syrrhopodon albidus Thwaites & Mitt.

On tree base, in partially shaded area, 1700 m, MS & IA 7135a.

*Syrrhopodon mammillosus Müll. Hal.

On tree base, in partially shaded area, 1700 m, MS & IA 7135b.

Syrrhopodon tristichus Nees ex Schwägr.

On treelet trunk, fully shaded, slope area, 1700 m, MS & IA 7127.

DALTONIACEAE

Bryobrothera tambuyukonensis H. Akiyama & Suleiman (Plate 1a)

On liana and treelet trunk, by a stream, partially shaded area, 1400–1500 m, MS & IA 7102, 7069.

Quite abundant within the elevation of 1500–1600 m.

Calyptrochaeta remotifolia (Müll. Hal.) Z. Iwats., B.C. Tan & Touw

On fallen log, in partially shaded area, 1400 m, MS & IA 7070.

Distichophyllum kinabaluense Nog. & Z. Iwats.

On soil and rotten twig, 1400 m, MS & IA 7067, 7083.

Distichophyllum mittenii Bosch & Sande Lac.

On boulder, in partially shaded area, 1700 m, MS & IA 7145b.

Distichophyllum nigricaule var. cirratum (Renauld & Cardot) M. Fleisch.

On boulder, by a stream, 1800 m, MS & IA 7152.

Distichophyllum osterwaldii M. Fleisch.

On boulders, by a river, in partially shaded area, 1400–1700 m, MS & IA 7076, 7145a.

Distichophyllum malayense Damanhuri & Mohamed

On rotten log, in partially shaded area, 1800 m, MS & IA 7153.

Ephemeropsis tjibodensis K.I. Goebel

On palm leaf, by a river, partially shaded area, 1400 m, MS & IA 7178.

DICRANACEAE

Braunfelsia dicranoides (Dozy & Molk.) Broth.

On rotten stump, in partially shaded area, 1300 m, MS & IA 7042.

Braunfelsia edentula (Mitt.) Wijk & Margad.

On humus in partially shaded area, 1400 m, MS & IA 7051.

Braunfelsia enervis (Dozy & Molk.) Paris

On fallen branch and tree trunks, 1300 m, MS & IA 7018, 7030, 7036.

Braunfelsia plicata (Sande Lac.) Broth. (Plate 1b)

On humus, boulder and tree trunk, in open to partially shaded areas, 1600–1700 m, MS & IA 7114, 7122, 7175.

This species was first reported from Mount Kinabalu by Bartram (1936). The second report was from Crocker Range Park (Suleiman et al., 2017). It is considered locally rare compared to *B. edentula* and *B. enervis* (GBIF.org, 2024).

Cryptodicranum armitii (Müll. Hal.) E.B. Bartram

On shrub branch, in partially shaded area, 1800 m, MS & IA 7156.

Dicranodontium uncinatum (Harv.) A. Jaeger

On tree trunk, in partially shaded area, 2000 m, MS & IA 7161.

Dicranoloma blumei (Nees) Broth. ex Renauld

On tree trunks, in partially shaded areas, 1300-1500 m, MS & IA 7041, 7106.

Dicranoloma brevisetum (Dozy & Molk.) Paris

On treelet trunk, in partially shaded area, 1400 m.

Dicranoloma braunii (Müll. Hal.) Paris

On tree root and trunk, in partially shaded area, 1300 m, MS & IA 7033, 7037.

Leucoloma molle (Müll. Hal.) Mitt.

On the shrub trunk, in partially shaded area, 1300 m, MS & IA 7014.

FISSIDENTACEAE

Fissidens crassinervis Sande Lac. On cliff, in shaded area, 1700 m, MS & IA 7133.

Fissidens geminiflorus Dozy & Molk.

On boulder, by a river, 1400 m, MS & IA 7072a.

Fissidens laxitextus Broth. ex Gangulee

On boulder, in partially shaded area, 1800 m, MS & IA 7150.

Fissidens nobilis Griff.

On soil, by river, partially shaded area, 1400 m, MS & IA 7075.

Fissidens pallidus Hook. f. & Wilson

On rock, by a river in an open area 1400 m, MS & IA 7182.

Fissidens cf. perpellucidus Dixon

On tree trunk in partially shaded area, 1400 m, MA & IA 7084. Has all the characters of the species but its sporophytes are not terminal.

Fissidens taxifolius Hedw.

On boulder, by a river, 1400 m, MS & IA 7072b.

This is the second record of this species from Mount Kinabalu (Tan & Iwatsuki, 1989). This species was also found in Crocker Range Park (Suleiman et al., 2017). It could be locally common but overlooked due to its tiny size.

HOOKERIACEAE

Hookeria acutifolia Hook. & Grev. On boulder, by a river, in partially shaded area, 1400 m, MS & IA 7077.

HYLOCOMIACEAE

Macrothamnium macrocarpum (Reinw. & Hornsch.) M. Fleisch.

On boulder, by a river, 1400 m, MS & IA 7177.

HYPNACEAE

Ectropothecium buitenzorgi (Bél.) Mitt. On tree root, in partially shaded area, 1400 m, MS & IA 7079.

Ectropothecium elegantipinnatum (Müll. Hal.) A. Jaeger On treelet trunk, in open area, 1400 m, MS & IA 7052.

Ectropothecium dealbatum (Reinw. & Hornsch.) A. Jaeger On shrub trunk, in partially shaded area, 1300 m, MS & IA 7017.

HYPNODENDRACEAE

Dendro-hypnum beccarii Hampe On tree trunks, in partially shaded area, 1300–1400 m, MS & IA 7022, 7080.

Mniodendron dendroides (Brid.) Wijk & Margad.

On boulder, in partially shaded area, 1300 m, MS & IA 7026.

Touwiodendron diversifolium (Broth. & Geh.) N.E. Bell, A.E. Newton & D. Quandt

On boulders and tree trunk, in partially shaded area, 1400–1700 m, MS & IA 7081, 7082, 7144.

LEUCOBRYACEAE

Bryohumbertia sp.1

On humus, in open area, 1600 m, MS & IA 7168. This species is large for the *B. subcomosa* (Dixon) J.-P. Frahm, the only species of this genus in Malesian region.

Bryohumbertia subcomosa (Dixon) J.-P. Frahm

On humus, in open area, 1400 m, MS & IA 7045.

Campylopus comosus (Schwägr.) Bosch & Sande Lac.

On fallen branch, epiphytic in partially shaded area, 1700 m, MS & IA 7140.

Campylopus exasperatus (Nees & Blume) Brid.

On soil, in open area, 1600 m, MS & IA 7118.

Campylopus umbellatus (Arn.) Paris

On soil and boulder, in open area, 1400–1700 m, MS & IA 7049, 7121.

Leucobryum arfakianum Müll. Hal. ex Geh.

On tree trunks, partially shaded area, 1500–1700 m, MS & IA 7107, 7130.

Leucobryum bowringii Mitt.

On liana and rotten log, in open and partially shaded areas, 1400–1500 m, MS & IA 7100, 7179.

Leucobryum javense (Brid.) Mitt. var. javense

On treelet trunk, in partially shaded area, 1300 m, MS & IA 7028.

Leucobryum javense var. cyathifolium (Dixon) T. Yamag.

On rotten log in partially shaded area, 1400 m, MS & IA 7078a.

Leucobryum sumatranum Broth. ex M. Fleisch.

On humus in partially shaded area, 2000 m, MS & IA 7162.

Schistomitrium apiculatum (Dozy & Molk.) Dozy & Molk.

On treelet trunk in shaded area, 1500 m, MS & IA 7108.

Schistomitrium mucronifolium (A. Braun *ex* Müll. Hal.) M. Fleisch. (Plate 1c) On shrub trunk, partially shaded, 1400 m, MS & IA 7056.

METEORIACEAE

Cryptopapillaria fuscescens (Hook.) M. Menzel

On twigs, in partially shaded area, 1400 m, MS & IA 7088.

Pseudotrachypus wallichii (Brid.) W.R. Buck

On shrub branch, in partially shaded area, 1300 m, MS & IA 7015.

This species was recently reported from the former Manut Copper Mine (Suleiman et al. 2024). It was also previously reported from Mount Lumaku (Suleiman et al., 2011) and Mount Tambuyukon (Suleiman et al., 2022). This is the second record for Mount Kinabalu.

*Trachycladiella sparsa (Mitt.) M. Menzel

On shrub, in partially shaded area, 1800 m, MS & IA 7147.

This species was recently recorded from Mount Trusmadi as new to Borneo (Andi & Suleiman, 2020). It is widely distributed in Asia from India to Taiwan and Papua New Guinea (GBIF.org, 2024). Mount Kinabalu is the second locality of this species in Borneo.

Trachypus bicolor Reinw. & Hornsch. (Plate 1d)

On treelet trunk, in partially shaded area, 1700 m, MS & IA 7134.

NECKERACEAE

Homaliodendron flabellatum (Sm.) M. Fleisch.

On fallen log, in partially shaded area, 1400 m, MS & IA 7092.

ORTHOTRICHACEAE

Macromitrium angustifolium Dozy & Molk.

On treelet and shrub trunks and fallen log, 1500–1700 m, MS & IA 7105, 7116, 7124, 7131. This species is restricted to Southeast Asia, except for one record in China. In Borneo, it is recorded on Mount Kinabalu and Mount Tambuyukon, and in South Kalimantan (GBIF.org, 2024; Suleiman et al., 2022).

Macromitrium blumei Nees ex Schwägr.

On treelet trunks, fallen branch, rotten log and boulder, 1300–1400 m, MS & IA 7027, 7048, 7050, 7054, 7055, 7095.

Macromitrium clemensiae E.B. Bartram

On fallen log and shrub trunk, in partially shaded area, 1400–1500 m, MS & IA 7058, 7110. This species was an endemic to Borneo but has been recorded recently from Palawan Island of the Philippines (Linis et al., 2023).

Macromitrium ochraceum (Dozy & Molk.) Müll. Hal.

On fallen log, shrub trunk or fallen from tree canopy, 1400–1600 m, MS & IA 7094, 7099, 7167.

Macromitrium zollingeri Mitt. ex Bosch & Sande Lac.

On shrub and tree trunks and fallen branch, in open and partially shaded area, 1300–1600 m, MS & IA 7035, 7119, 7166, 7169.

This species is distributed in Sri Lanka, Indonesia, Cambodia, Thailand, Peninsula Malaysia and Borneo. Based on GBIF.org (2024), only one specimen collected from Borneo; although

without coordinates, the locality was stated as "Maraiparai Borneo" at an elevation of 1524 m (Orrell, 2024).

Schlotheimia wallisii Müll. Hal. (Plate 1e)

On tree base and trunks, open and partially shaded area, 1400–1600 m, MS & IA 7053, 7109, 7120.

POLYTRICHACEAE *Dawsonia longifolia* (Bruch & Schimp.) Zanten (Plate 1f) On soil, partially shaded area, 1950 m, MS & IA 7162.

Pogonatum cirratum subsp. macrophyllum (Dozy & Molk.) Hyvönen

On soil, in partially shaded area, 1400 m, MS & IA 7064.

Pogonatum rutteri (Thér. & Dixon) Dixon

On boulder, in partially shaded area, 1800 m, MS & IA 7149.

POTTIACEAE

Barbula pseudoehrenbergii M. Fleisch.

On soil and boulder, in open area, 1400–1700 m, MS & IA 7071, 7123.

Chionoloma bombayense (Müll. Hal.) P. Sollman

On cliff and boulders in open and partially shaded areas, 1400–1700 m, MS & IA 7047, 7117, 7132, 7164.

Trichostomum brachydontium Bruch

On boulder, in open area, 1400 m, MS & IA 7044. This species was recently reported as new to Borneo (Suleiman et al., 2024). This is the second record of this species in this island.

PTEROBRYACEAE

Oedicladium rufescens (Reinw. & Hornsch.) Mitt.

On shrub trunk, in partially shaded area, 2000 m, MS & IA 7160.

Pterobryopsis crassicaulis (Müll. Hal.) M. Fleisch.

On treelet trunk, in partially shaded area, 1400 m, MS & IA 7066. Only two records of this species from Borneo, and both are from the Crocker Range (Noguchi & Iwatsuki, 1972; Suleiman et al., 2017).

Symphysodon neckeroides Dozy & Molk. var. neckeroides

On boulder, in partially shaded area, 1300 m, MS & IA 7023.

Symphysodontella cylindracea (Mont.) M. Fleisch.

On shrub and treelet trunks, in partially shaded area, 1400–1900 m, MS & IA 7062, 7098, 7159.

PTYCHOMNIACEAE

Garovaglia angustifolia Mitt. var. angustifolia

On rotten log, in partially shaded area, 1500 m, MS & IA 7113.

*Garovaglia baeuerlenii (Geh.) Paris

On treelet trunk, in partially shaded area, 1300 m, MS & IA 7032. This species was recently reported from Mount Tambuyukon as new to Sabah (Suleiman et al., 2022). It has a limited distribution; reported only in Papua New Guinea, Borneo (Type is from Sarawak) and Solomon Islands (GBIF.org, 2024).

Garovaglia elegans (Dozy & Molk.) Hampe ex Bosch & Sande Lac.

On treelet trunk, in partially shaded area, 1400 m, MS & IA 7096.

Garovaglia plicata (Brid.) Bosch & Sande Lac. subsp. plicata (Plate 1g)

On shrub stem, in partially shaded area, 1700 m, MS & IA 7137. The leaves are very concave, apices constricted and margin smooth except for the apical margin which is only remotely denticulate.

PYLAISIADELPHACEAE

Clastobryum scalare (A. Jaeger) Tixier

On treelet trunks and shrub stem, in partially shaded area, 1300–1700 m, MS & IA 7040, 7139, 7141.

Mastopoma armitii var. uncinifolium (Broth.) B.C. Tan, T.J. Kop. & D.H. Norris

On shrub stem, in partially shaded area, 1800 m, MS & IA 7155.

Mastopoma subrobustum Dixon

On shrub leaves, in partially shaded area, 1400 m, MS & IA 7087.

Taxithelium lindbergii (A. Jaeger) Renauld & Cardot

On shrub trunk, in partially shaded area, 1400 m, MS & IA 7057.

Taxithelium vernieri (Duby) Besch.

On twigs, in partially shaded area, 1400 m, MS & IA 7091.

Trismegistia calderensis (Sull.) Broth. var. calderensis

On twigs, in partially shaded area, 1400 m, MS & IA 7089.

Trismegistia calderensis var. *convoluta* (Bosch & Sande Lac.) K.T. Yong, B.C. Tan & B.C. Ho

On rotten wood and tree root, in partially shaded area, 1400 m, MS & IA 7059, 7060.

Trismegistia panduriformis (C.H. Wright) Broth.

On tree root, in partially shaded area, 1700 m, MS & IA 7142. This robust species is very common on 1800 m elevation along the trail to Kobuturan Camp.

RACOPILACEAE

Racopilum spectabile var. subisophyllum Herzog

On boulder, in partially shaded area, 1900 m, MS & IA 7163.

RHIZOGONIACEAE

Pyrrhobryum spiniforme (Hedw.) Mitt.

On rotten log and tree root and buttress, in partially shaded area, 1300–1800 m, MS & IA 7024, 7061, 7158.

Rhizogonium graeffeanum (Müll. Hal.) A. Jaeger

On tree buttress, in partially shaded area, 1800 m, MS & IA 7151.

Rhizogonium lamii Reimers On rotten log, fully shaded, 1800 m, MS & IA 7157. SEMATOPHYLLACEAE *Acroporium convolutum* var. *elatum* (Dixon) B.C. Tan On twigs, in open area, 1600 m, MS & IA 7170.

Acroporium diminutum (Brid.) M. Fleisch.

On rotten log in partially shaded area, 1400 m, MS & IA 7078b.

Acroporium hyalinum (Reinw. ex Schwägr.) Mitt. var. hyalinum

On treelet trunk, by river, in open area, 1600 m, MS & IA 7176.

Acroporium hyalinum var. hamulatum (M. Fleisch.) M.S. Chua & B.C. Ho

On tree trunks, in partially and fully shaded area, 1300–1700 m, MS & IA 7029, 7125.

Acroporium johannis-winkleri Broth.

On tree trunk, liana, boulder and rotten trunks, in full and partially shaded area, 1300–1700 m, MS & IA 7019, 7039, 7068, 7112, 7126, 7128, 7171.

Acroporium rigens (Broth. ex Dixon) Dixon

On boulder and humus, in partially shaded area, 1300–1500 m, MS & IA 7038, 7111.

Acroporium rufum (Reinw. & Hornsch.) M. Fleisch.

On tree trunk, in partially shaded area, 1700 m, MS & IA 7139.

Acroporium secundum (Reinw. & Hornsch.) M. Fleisch.

On tree trunks, in partially shaded area, 1300 m, MS & IA 7016, 7031.

Acroporium strepsiphyllum (Mont.) B.C. Tan var. strepsiphyllum

On boulders and tree trunks, in open and partially shaded area, 1300–1500 m, MS & IA 7020, 7025, 7065, 7165.

Isocladiella surcularis (Dixon) B.C. Tan & Mohamed

On shrub stem, in partially shaded area, 1300 m, MS & IA 7021.

Macrohymenium mitratum var. *strictum* (Bosch & Sande Lac.) B.C. Tan, T.J. Kop. & D.H. Norris

On tree root, in open and sunny area, 1400 m, MS & IA 7046.

The holotype of this species was collected from Mount Kinabalu by Hugh Low (Suleiman et al., 2006). Rarely collected in Borneo since then.

Papillidiopsis koponenii B.C. Tan

On shrub twigs, in partially shaded area, 1400–1800 m, MS & IA 7090, 7154.

*Papillidiopsis ramulina (Thwaites & Mitt.) W.R. Buck & B.C. Tan

On rock by a river, open area, 1400 m, MS & IA 7181.

This species is widely distributed in Asia and Oceana, extending from China to Australia (GBIF.org, 2024). However, it is relatively rare in Sabah with only one previous record in Sabah (Suleiman et al., 2017). Mount Kinabalu is its new locality in Sabah.

*Radulina borbonica (Bél.) W.R. Buck var. borbonica

On rotten log, in partially shaded area, 1500 m, MS & IA 7085.

This species is almost cosmopolitan (GBIF.org, 2024). Probably common locally but only one record ever reported in Borneo (Suleiman et al., 2017). This is the first record for Mount Kinabalu.

Rhaphidostichum piliferum (Broth.) Broth.

On tree buttress, in partially shaded area, 1400 m, MS & IA 7063.

Trichosteleum boschii (Dozy & Molk.) A. Jaeger

On rotten log, in partially shaded area, 1600 m, MS & IA 7172.

Warburgiella leptocarpa (Schwägr.) M. Fleisch.

On rotten stump, in partially shaded area, 1700 m, MS & IA 7138.

SPHAGNACEAE

Sphagnum sericeum Müll. Hal.

On humus, partially shaded area, 1500–1700 m, MS & IA 7103, 7129.

SYMPHYODONTACEAE

Chaetomitrium orthorrhynchum (Dozy & Molk.) Bosch & Sande Lac.

On twigs, in partially shaded area, 1400 m, MS & IA 7093.

The leaf apices are widely acute and not constricted but considering that this species is very variable, it can be accepted here.

*Chaetomitrium horridulum Bosch & Sande Lac. (Plate 1h)

On treelet trunks and shrub stems, by stream, in open and partially shaded area, 1500–1700 m, MS & IA 7101, 7104, 7115, 7143.

This species has limited records; distributed only in Vietnam, Sumatra, Java, Borneo and the Philippines (GBIF.org, 2024; Tropicos.org., 2024). There is only one previous record in Borneo which was from Maliau Basin Conservation Area (Mohamed et al., 2010).

THUIDIACEAE *Thuidium cymbifolium* (Dozy & Molk.) Dozy & Molk.

On boulder and log, by a river, in partially shaded area, 1400 m, MS & IA 7073, 7074.

TRACHYLOMATACEAE

Trachyloma indicum Mitt.

On boulder, in partially shaded area, 1700 m, MS & IA 7146.