Report

The Bryophyte flora of Kinabalu National Park (Sabah, Malaysia), based on the collections by Japan-Malaysia collaborative expeditions in 1997

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Abstract

Bryophytes of Kinabalu National Park (including Poring) are reported here based on collections made by two Japan-Malaysia collaborative expeditions held in 1997. Although our research centered mainly on moss flora, some hepatics were also collected. A total of 40 families, 111 genera and 203 species of mosses, as well as 18 families, 25 genera and 31 species of hepatics were found among our collections. Twenty-five species were new to Kinabalu National Park or Sabah, 17 of which were new to Borneo Island.

Key words: Borneo, bryophytes, flora, hepatics, Kinabalu, mosses, Poring, Sabah

Introduction

Kinabalu National Park (Sabah, Malaysia) is situated at the northernmost part of Borneo Island, the second-largest island in the world. In the park, the various habitats include tropical rain forest (Poring) at the lower elevations, and alpine rocky area of Mt. Kinabalu (ca. 4000 m alt.). Moreover, park areas have been protected from human activities by the State Government, thus forming well-preserved natural forests, especially above 1500 m. These conditions certainly serve the rich bryophyte flora found in the park (Frahm et al., 1990; Tan and Iwatsuki, 1999).

Mt. Kinabalu, in the center of the park, and its vicinities are the areas that have been most intensively botanized by bryologists (Touw, 1978). In addition, systematic surveys, known as BRYOTROP, have been undertaken and a number of botanical samples accumulated by the project. Using these data, a number of learned papers have been published, along with a smart booklet that includes a revised list of the bryophytes of Kinabalu National Park (Frahm et al., 1990). The park encompasses a very large area, including a wide range of habitats for plant species. Several places exist that are difficult to access, further leading us to believe that a number of species will be found in the area.

In January and December 1997, we had a chance to visit Kinabalu National Park and were able to botanize there. Although our main focus was almost entirely on mosses, we were still able to collect more than 2000 specimens during the two surveys. These include 40 families, 111 genera and 203 species of mosses, and 18 families, 25 genera and 31 species of hepatics. Among the 234 total species reported in the following list, 25 species were newly reported from Kinabalu National Park or Sabah, with 17 among them also new to Borneo Island. In the following list, species newly found in Borneo are marked with double asterisks (**), while those that were first reported in Kinabalu or Sabah are marked with a single asterisk (*). These judgments are based on a previous checklist of Borneo mosses (Touw,

1978) and of mosses and hepatics of Kinabalu National Park (Frahm et al., 1990). For species new to Borneo, their previous distributions are shown in the following list. Moreover, *Distichophyllum scabrisetum* H. Akiy. & T. Yamag. and *Polytrichadelphus archboldii* Bartr. var. *kinabaluensis* H. Akiy. & T. Yamag. were reported based on our collections.

Additional notes for the conservation of invaluable species

We would like to give some comments learned during our surveys from the point of plant conservation. As shown in the list below, most rich and unique bryophyte flora are found: 1) around the Paka Cave (ca. 3000 m alt.) and its vicinities, and 2) along the Liwagu trail. At the Paka Cave, we found several species of tropical elements that usually grow in lowlands, including *Chaetomitrium* cf. *papillifolium* and *Himantocladium* sp. On the other hand, temperate elements such as *Andreaea subulata* and *Brachythecium plumosum* are also growing there. The most important point from a plant science perspective is that *Takakia lepidozioides*, one of the most primitive mosses, was growing on wet boulder and soils along the stream near the cave. This species has been found in the exceptionally cool-temperate zone in the Northern Hemisphere. The population at Paka Cave is the sole location in the tropics and is widely disjunctive from all other previously known populations. More than 40 years have passed since the first report of this species from Paka Cave. Although *T. lepidozioides* seems to maintain excellent condition according to our field observation, continuous attention should be paid to safeguard this plant.

On the Liwagu trail, there are well-moistened, primitive montane forests, which provide ideal habitats for bryophytes. In fact, on the Liwagu trail we found primitive thalloid liverworts, *Treubia insignis* subsp. *insignis*, which had not been recorded from Borneo Island before. Other examples included *Neolindbergia cladommoides* , *Acrophyllum javense*, and triploid plants of *Dumortiera hirsuta*.

We consider that these two are the most valuable places that afford irreplaceable habitats to bryophyte diversity and that have important value not only to bryology but also to general plant conservation. Though these locations are well preserved nowadays by the Sabah Park, we hope that continued attention be paid to avoid any disturbance.

Acknowledgements

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List of Bryophytes

The following list contains all the species collected from Mt. Kinabalu and Poring Spring during our two field works (January and December in 1997). Since our collection is restricted in number and places that we visited, this is not intended to be a complete list. This is especially true for the hepatics, since our efforts had been concentrated on collecting mosses.

All specimens cited here are deposited at the Museum of Nature and Human Activities (HYO); Hiroshima University (HIRO); Herbarium of the Universiti Malaysia Sabah (UMS); and Herbarium of Kinabalu National Park. Collector names (*H. Akiyama, T. Yamaguchi, A. Beyan, and H. Tsubota*) have been omitted to save space. Information about the altitude and habitat of each specimen is shown in parentheses following the specimen number. For the exact location of each specimen collected, refer to the Appendix at the end of this report. Most hepatic specimens were collected by Dr. Yamaguchi and filed with his private collection numbers. Therefore, in the list below, these specimens are indicated by five-digit numbers, with the collection sites indicated in parentheses after each specimen number. Those specimens are deposited at HIRO and UMS.

Musci

Takakiaceae

***Takakia lepidozioides* Hatt. & Inoue**

170 (3470 m, wet soil in a streamlet, shaded), 214 (3000 m, on thin soil layer on rock in a streambed), 215 (ibid.).

Paka Cave is the southernmost extent of this species. It grows vigorously and we found more than ten patches there.

We conducted population-based sampling of the

Paka Cave population to better understand its genetic structure. One of the most interesting results is that the Paka Cave population showed only slight genetic differentiation from three populations collected in Central Japan. For further information, see Akiyama (1999).

Andraeaceae

***Andreaea rupestris* Hedw. var. *rubicunda* (Bartr.) Iwats.**

181 (3440 m, wet rock along stream), 492 (3550 m, exposed rock at sunny site).

***Andreaea subulata* Harv.**

218 (3000 m, on wet boulder, partially submerged)

It grows abundantly on wet boulder at streambed beside the Paka Cave.

Sphagnaceae

***Sphagnum sericeum* C.Muell.**

126 (2000 m, on wet humus along a trail), 146 (2800 m, on wet along a trail), 236 (3000 m, on seepaging cliff in a forest).

***Sphagnum cuspidatum* C.Muell.**

137 (2070 m, on wet humus along a trail), 246 (3300 m, in small bog beside a hut).

***Sphagnum junghuhnianum* Dozy & Molk.**

158 (2800 m, on wet humus along a trail), 249 (2950 m, on humus in elfin forest).

Diphysciaceae

***Diphyscium granulosum* Chen**

200 (3470 m, wet rock under elfin shurb).

***Diphyscium involutum* Mitt.**

86 (1500 m, on wet pebble), 528 (1400 m, on wet rock in a stream), 532 (700 m, on sandstone beside a stream).

Polytrichaceae

***Dawsonia beccarii* Broth. & Geh.**

165 (2000 m, on soil), 455 (2840 m, on soil), 461 (2500 m, on soil).

This species prefers more sunny and open habitats than *D. longifolia*.

***Dawsonia longifolia* (Bosch & Sande Lac.) Zant. var. *superba* (Grev.) Zant.**

105 (1600 m, on soil in deep forest).

****Oligotrichum hercynicum* (Hedw.) Lam. & Cand.**

199 (3700 m, in boulder crevice).

This is the first report of this species from southeast Asia (Touw, 1978).

Distirbution: Widely distributed in subalpine zones in northern Hemisphere.

***Oligotrichum javanicum* (Hampe) Dozy & Molk.**

468 (3350 m, on moist soil), 474 (3450 m, on soil).

***Pogonatum cirratum* (Sw.) Brid.**

90 (1500 m, on soil), 422 (1600 m, on soil).

Among the two specimens collected, *Akiyama et al. 90* differs from the typical plants in its entire leaf shoulder.

***Pogonatum flexicaule* Mitt.**

212 (Paka Cave, 3000 m, on soil), 271 (1950 m, on moist cliff at Carson's Fall).

Iwatsuki and Noguchi (1975) collected *Pogonaum fuscatum* Mitt. around Paka Cave. Eddy (1988: 192) suspected that their report was based on *P. flexicaule*. The plants we collected at Paka Cave fully agree with *P. flexicaule* as well.

***Pogonatum gymnophyllum* Mitt.**

153 (2860 m, on sandstone), 265 (2700 m, on soil).

Iwatsuki and Noguchi (1975) and Eddy (1988) already reported this species from Mt. Kinabalu as *P. proliferum* (Griff.) Mitt.

***Pogonatum iwatsukii* Touw**

527 (1400 m, on wet rock in a streambed in a forest).

We found only one population of this species, where it grows intermingled with *P. piliferum*. Judging from our field observation, *P. iwatsukii* seems to prefer wetter habitats than does *P. piliferum*.

***Pogonatum macrophyllum* Dozy & Molk.**

67 (1500 m, on soil along a trail in deep forest), 100 (ibid.).

Aerial shoots of plants that bear sporophytes are well branched.

***Pogonatum neesii* (C.Muell.) Dozy**

48 (1500 m, on rock in a garden), 49 (ibid.), 152 (2860 m, on sandstone in elfin forest), 167 (2300 m, on rock), 288 (1800 m, on rock), 454 (2840 m, on soil), 458 (2940 m, on soil), 467 (3320 m, soil), 482 (3500 m, on soil at sunny and open place), 498 (3560 m, on soil).

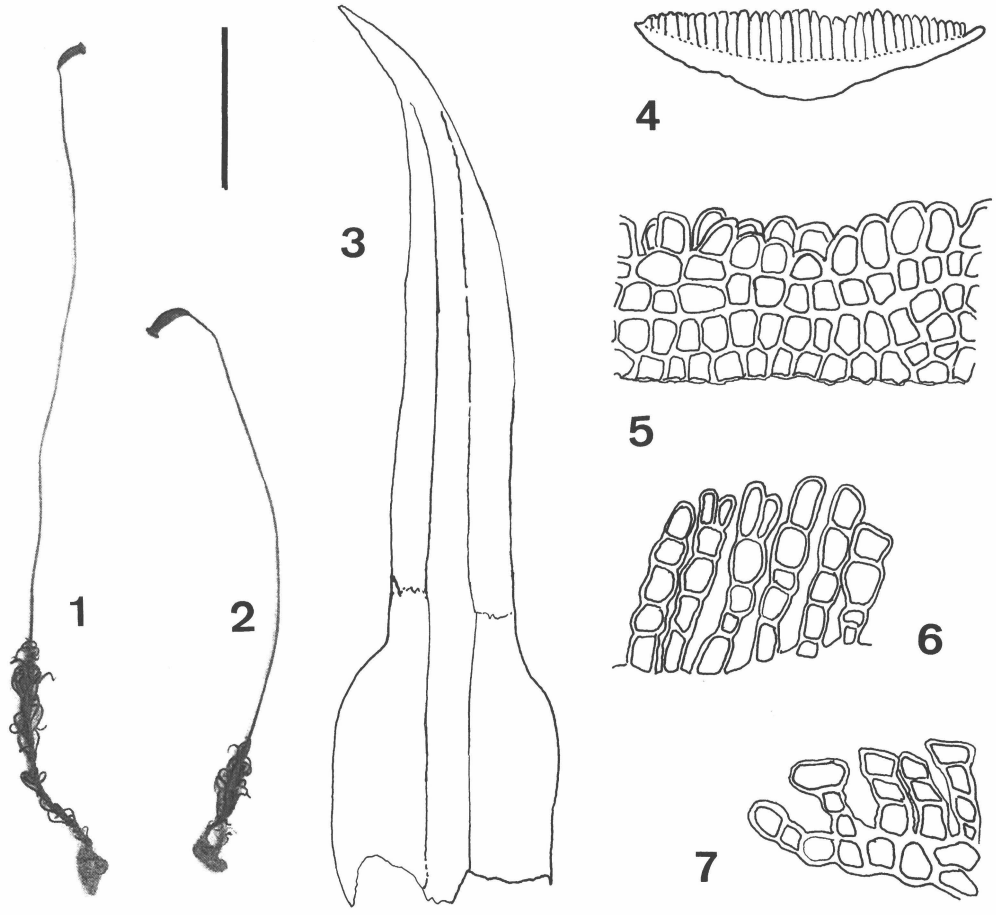
***Pogonatum* aff. *neesii* (C.Muell.) Dozy (Figs. 1-7)**

415 (1550-1900 m, on soil at sunny place).

Plants of our specimen show differences from the typical *P. neesii*. Some of the apical cells of lamella are divided in two. Contorted leaves in dry conditions also suggest discrepancies from typical plants.

** ***Pogonatum nudiusculum* Mitt.**

194 (3640 m, on wet or moist soil in boulder crevice), 484 (3520 m, in boulder crevice), 486 (3520 m, in boulder crevice).



Figs. 1-7. *Pogonatum aff. neesii* (C.Muell.) Dozy (*Akiyama et al. 415*)
1, 2: Plants (dry condition). Note the contorted leaves. **3:** Stem leaf. **4:** Transverse section of median part of stem leaf. **5:** Lateral view of lamella. **6:** Transverse section of lamellae (central part). **7:** ibid. (margin). Scale bar = 1 cm in Figs. 1, 2; 2 mm in Fig. 3; 200 μm in Fig. 4; 50 μm in Figs. 5 - 7.

These plants look like *Oligothrichum* species in the field because of their narrow lamella on the blade of leaves.

Distirbution: Widespread in Asia. Previously reported from Malay Peninsula and Philippines (Eddy, 1988).

***Pogonatum piliferum* (Dozy & Molk.) Touw**

88 (1500 m, on soil along a trail), 523 (1400 m, on soil, forming a large population at partially shaded place).

****Pogonatum rutteri* (Ther. & Dix.) Dix.**

301 (1640 m, on soil of trail bank).

This must be the lowest population so far known for this species (= *Pseudoracelopus armatus* Bartr.).

***Pogonatum submacrophyllum* Herz.**

164 (2300 m, on soil along a trail), 168 (ibid.).

***Pogonatum urnigerum* (Hedw.) P.Beauv.**

151 (2700 m, on rock), 189 (3550 m, on boulder), 457 (2870 m, on soil), 472 (3430 m, on humus and rock), 481 (3500 m, on soil), 500 (3570 m, on soil).

This species grows at rather sunny sites along a trail.

***Polytrichacdelphus archboldii* Bartr. var. *kinabaluensis* H.Akiy. & T.Yamag.**

185 (3560 m, forming dense and deep mat on soil along a trail at open site), 464 (3300 m, on soil), 485 (3500 m, on soil under huge boulder), 494 (3560 m, on soil).

For more details about this beautiful species, consult Akiyama et al. (1998). It was the first report of the genus from the Northern Hemisphere.

Fissidentaceae

***Fissidens areolatus* Griff.**

107 (1500 m, on soil, along a trail in a forest).

***Fissidens bryoides* Hedw.**

555 (600 m, trail bank in a forest).

***Fissidens javanicus* Dozy & Molk.**

298 (1650 m, trail bank in a forest).

***Fissidens nobilis* Griff.**

277 (1950 m, on dripping cliff), 329 (1600-1950 m, on rock at streambed), 426 (1550-1900 m, on soil beside a stream).

***Fissidens nymanii* Fleisch.**

447 (1500 m, trail bank in a forest).

****Fissidens wichurae* Broth. & Fleisch.**

87 (1500 m, on soil-covered trunk base), 286 (1600-1950 m, on wet rock), 446 (1500 m, on pebble along a trail).

Plants of all three specimens are autoicous and bear sporophytes that are situated at a terminal position on the stem. Leaves are linear and ca. 1.5 mm long. Perichaetial leaves develop wide borders at the margin of vaginant lamella.

Distribution: Unknown, but maybe widely distributed in Asia (Eddy, 1988).

***Fissidens zippelianum* Dozy & Molk.**

216 (3000 m, on wet rock at streambed), 217 (ibid.).

Ditrichaceae

***Ceratodon purpurens* (Hedw.) Brid.**

243 (3200 m, on soil at sunny site along a trail).

***Ditrichum difficile* (Duby) Fleisch.**

145 (2600 m, on dripping cliff), 150 (2300 m, on soil at sunny and open site), 271 (1950 m, on cliff near Carson Fall).

***Ditrichum flexicaule* (Schwaegr.) Hampe**

470 (3360 m, on soil overhanged by a huge boulder).

Kinabalu plants bear numerous sporophytes.

Dicranaceae

***Atractylocarpus comosus* Dix.**

128 (2500 m, on moist soil in elfin forest), 136 (2700 m, on humus at open site), 139 (ibid.), 210 (3100 m, on rotten log forming a large patch).

This species has been reported from Borneo Island by Eddy (1988).

***Braunfelsia edentula* (Mitt.) Wijk & Marg.**

197 (3470 m, on tree trunk in low elfin forest), 466 (3300 m, pendulous from rotten log).

Braunfelsia enervis* (Dozy & Molk.) Par.

317 (1900 m, on humus along a trail in montane forest).

In Borneo Island, this species is previously known from Sarawak (Touw, 1978).

***Bryohumbertia subcomosa* (Dix.) Frahm**

15161 (en route from Power Station to Laban Rata, 2750 m, on moist soil along a trail).

***Campylopus aureus* Bosch & Sande Lac.**

177 (3850 m, on wet cliff at sunny and open site).

***Campylopus comosus* (Schwaegr.) Bosch & Sande Lac.**

240 (3200 m, on soil-covered boulder).

There are flagellous gemmae at the tip of shoots. This is one of the distinguishing features of this species.

***Campylopus crispifolium* Bartr.**

155 (2800 m, on soil in elfin forest), 169 (2300 m, on humus), 213 (3000 m, on soil), 242 (3200 m, on soil in elfin forest), 253 (2950 m, on soil), 469-b (3350 m, on soil), 473 (3450 m, on soil).

This species has gemmae of reduced leaves.

***Campylopus exasperatus* (Nees & Blum.) Brid.**

142 (2280 m, on soil along a trail), 191 (3350 m, on soil at open and sunny site).

***Campylopus umbellatus* (Arn.) Par.**

47 (1500 m, on soil and rock), 53 (on rock, at sunny and open site).

***Campylopus zollingerians* (C.Muell.) Bosch & Sande Lac.**

247 (3300 m, on wet soil and rock).

This species grows in the small moor at open and sunny site near Laban Rata Hut.

***Dicranella setifera* (Mitt.) Jaeg.**

258 (2700 m, on wet soil), 537 (1400 m, on moist soil).

***Dicranodontium fleischerianum* Schultz-Mot.**

512 (2650 m, on tree trunk and trunk base).

Kinabalu plants have a number of deciduous leaves.

***Dicranodontium* sp.**

193 (3650 m, on soil in crevice of cliff), 198 (3500 m, on soil along a trail in elfin forest).

Our plants are characterized by their shiny gold plant color and number of deciduous leaves. Neither specimen has sporophytes, and the leaves might even act as asexual propagules. With other features, they resemble *D. fleischerianum* Schultze-Motel that is widespread at moderate to high altitudes in Malesia (Eddy, 1988)

***Dicranoloma assimile* (Hampe) Par.**

99 (1500 m, on tree trunk base).

***Dicranoloma billarderi* (Brid. ex Anon.) Par.**

166 (2300 m, on humus in mossy forest), 338 (1800 m, on humus along a trail in a forest).

***Dicranoloma blumii* (Nees) Par.**

250 (2950 m, oh humus and rotten log along a trail in elfin forest).

***Dicranoloma leucophyllum* (Hampe ex Sande Lac.)**

Par.

80 (1500 m, on humus along a trail).

***Leucoloma molle* (C.Muell.) Fleisch.**

14989 (around the Headquarter, 1500 m, on tree trunk at open site).

***Microdus brasiliensis* (Duby) Ther.**

536 (1400 m, on soil along a trail at open site in a forest).

****Microdus sumatranus* (Dix.) Eddy**

89 (1500 m, on soil along a trail at open site).

Kinabalu plants show the following features; setaceous stem leaves, yellow seta, and cylindrical capsules.

Distribution: Sumatra, Sulawesi, New Guinea.

***Wilsoniella decipiens* (Mitt.) Alston**

574 (680 m, on soil along a trail).

Leucobryaceae

***Leucobryum aduncum* Dozy & Molk. var. *teysmannianum* (Dozy & Molk.) T.Yamag.**

72 (1600 m, on rotten log along a trail in a forest).

***Leucobryum bowringii* Mitt.**

73 (1600 m, on soil along a trail in a forest).

***Leucobryum javense* (Brid. ex Schwaegr.) Mitt.**

75 (1600 m, on tree trunk in a forest), 256 (1950 m, on humus along a trail in a forest), 449 (ibid.).

***Leucobryum sanctum* (Brid.) Hampe**

332 (1500 m, pendulous among other mosses growing on trail bank in a forest).

Leucophanaceae

***Exostratum blumei* (Nees & Hampe) Ellis**

560 (600 m, on tree trunk in secondary forest).

***Leucophanes massartii* Ren. & Card.**

559 (600 m, on boulder along a trail, rather sunny site).

Schistomitriaceae

***Schistomitrium mucronifolium* (C.Muell.) Fleisch.**

74 (1500 m, on tree trunk at riverside).

Two columns of transparent cells at the median part of the leaves can be used to identify this species. However, it is still rather difficult to distinguish it from *S. apiculatum*. Frahm et al. (1990) has already reported this species from Mt. Kinabalu.

***Schistomitrium robustum* Dozy & Molk.**

15105 (around the Headquarter, 1500 m, on moist rotten log).

Pottiaceae

****Anoectangium aestivum* Hedw.**

262 (1950 m, on humus; with many propagules).

It is noteworthy that rhizoids appearing from leaf axils bear chloronema. These chloronema grow vigorously and form a dense, finely branching mat on the substrata that resembles filamentous algae to the naked eye.

Distribution: Cosmopolitan and widespread in Malesia.

***Barbula consanguinea* (Thw. & Mitt.) Jaeg.**

57 (1500 m, on soil-covered rock in a park garden).

Kinabalu plants show following features; seta 9-11mm long and peristome long, ca. 1/2 of capsule length, helically coiled.

***Hyophila involuta* (Hook.) Jaeg.**

567 (600 m, on rock in a field).

***Leptodontium flexifolium* (With.) Hampe**

465 (3300 m, on soil in elfin forest).

***Oxstegus cuspidatus* (Dozy & Molk.) Chen**

61 (1500 m, on tree trunk at streamside).

This is the same species of *Trichostomum perlongifolium* Froehl. that Frahm et al. (1990) reported from Mt. Kinabalu. Low plant height, strongly circinate and fragile leaves in dry conditions are characteristic to this species.

Calymperaceae

***Calymperes strictifolium* (Mitt.) Roth.**

556 (600 m, on soil along a trail in secondary forest).

***Calymperes porrectum* Mitt.**

557 (600 m, on trail bank in a secondary forest).

***Calymperes serratus* A.Brawn ex C.Muell.**

95 (1500 m, on shrub trunk in a forest).

***Calymperes taitense* (Sull.) Mitt.**

545 (600 m, on tree trunk in a secondary forest).

***Syrrhopodon gardneri* (Hook.) Schwaegr.**

85 (1500 m, on rotten log along a trail in a forest).

***Syrrhopodon japonicus* (Besch.) Broth.**

84 (1500 m, forming a large patch on tree trunk).

***Syrrhopodon spiculosus* Hook. & Grev.**

290 (1900 m, on root), 406 (1500 m, on rock), 507 (2100 m, on base of tree trunk).

Kinabalu plants bear many deciduous leaves. They might act as effective propagules.

***Syrrhopodon tristichus* Nees ex. Schwaegr.**

65 (1500 m, on rock covered with humus along a trail in a forest), 403 (ibid., on soil), 412 (1700 m, on soil along a trail in a forest), 15018 (1500 m, on tree trunk in a forest).

Grimmiaceae

***Grimmia affinis* Hornsch.**

173 (3610 m, in crevice of boulder at open site), 489 (3540 m, on boulder at sunny and open site), 493 (3550 m, in crevice of boulder at open site in elfin forest), 504 (3600 m, on boulder at open site).

***Grimmia* sp.**

178 (3740 m, on wet boulder at sunny and open site).

This is a much smaller species than *G. affinis*. It might be *G. ovalis* (Hedw.) Lindb.

***Racomitrium lanuginosum* (Hedw.) Brid.**

174 (4020 m, on soil among rocks).

***Racomitrium subsecundum* (Hook. & Grev.) Mitt.**

179 (3700 m, on wet soil among rocks), 201 (3780 m, among rocks), 229 (3000 m, on sand-covered rock beside a stream), 491 (3550 m, on soil under shrubbery).

Bryaceae

***Brachymenium nepalense* Hook.**

54 (1500 m, on rock and tree trunk in a garden).

***Bryum argenteum* Hedw.**

175 (4101m, on soil among rocks), 176 (4020 m, on soil among rocks), 499 (3570 m, in crevice of boulder at sunny and open site).

***Bryum billardieri* Schwaegr.**

219 (3100 m, on soil-covered rock at streambed).

This species is formerly reported as *Bryum wrightii* Sull. & Lesq. in Frahm et al (1990).

***Bryum clavatum* (Schimp.) C.Muell.**

483 (3520 m, in crevice of boulder).

It is difficult to distinguish *Bryum clavatum* from *B. apiculatum* Schwaegr., both of which had been reported from Mt. Kinabalu (Frahm et al. 1990). We tentatively follow the sense of Eddy (1996).

***Bryum russulum* Broth. & Geh.**

132 (2700 m, on moist humus along a trail in a forest), 456 (2850 m, on humus under shrubbery).

***Bryum* sp.**

58 (1480 m, on rock in a garden park)

Plants are reddish brown and small (up to 1 cm high). Stem leaves are ovate-lanceolate, somewhat concave, costa excurrent, margins plane, with 1-2 rows of narrow cells. Capsules are horizontal, with short necks much narrower than the urn. Peristome are similar to that of *Bryum clavatum*.

****Epipterygium tozeri* (Grev.) Lindb.**

341 (1800 m, on soil along a trail of Liwagu Trail).

Distribution: Widespread in temperate zones, but known only several localiteis, in Malesia, such as Taiwan, Luzon, Java, Bali, Flores, Papua New Guinea (Touw, 1992) .

***Orthodontium infratum* Dozy & Molk.**

223 (3000 m, on wet boulder beside a stream), 257 (2300 m, on the base of tree trunk), 511 (2650 m, on the base of tree trunk).

****Pohlia flexuosa* Hook. (Figs. 8-12)**

502 (3520 m, in crevice of boulder).

At first appearance, *Pohlia flexuosa* resembles *Bryum rubens* Mitt. But the long, vermicular, twisted propagules in the leaf axils are characteristic to the genus *Pohlia*. In addition, Kinabalu plants bear two kinds of asexual reproductive organ on the same stem, that is, ovoid gemmae (without leaf primordia) and propagules. The same condition has been reported by Andrew (1950) and Koponen and Norris (1985).

Distribution: Widespread and common in northern Hemisphere.

****Pohlia elongata* Hedw.**

192 (3420 m, on soil along a trail), 237 (3200 m, on soil), 238 (ibid.), 239 (ibid.).

This species formed a large population on soil along a trail.

Distribution: Widespread and common at higher altitudes in Malesia.

****Schizymenium javanicum* (Broth. ex Fleisch.) Shaw**

469 (3350 m, on trail bank), 477 (3470 m, on trial bank).

Kinabalu plants have much reduced peristome; exostome are vestigial and endostome are with low basal membrane and filamentous segments, the latter which are smooth above and indistinctly papillose blow. Leaves are narrow-lanceolate and borders do not develop at the margins. Costa do not reach apex or are shortly excurrent. Capsules are suberect, with long necks as long as the urn. These features are characteristic to the genus *Schizymenium* except for their long neck.

Distribution: Java (Eddy, 1996)

***Rhodobrym giganteum* (Schwaegr.) Par.**

62 (1500 m, on humus, tree trunk base and rotten log beside a stream), 423 (1700 m, on soil along a trail).

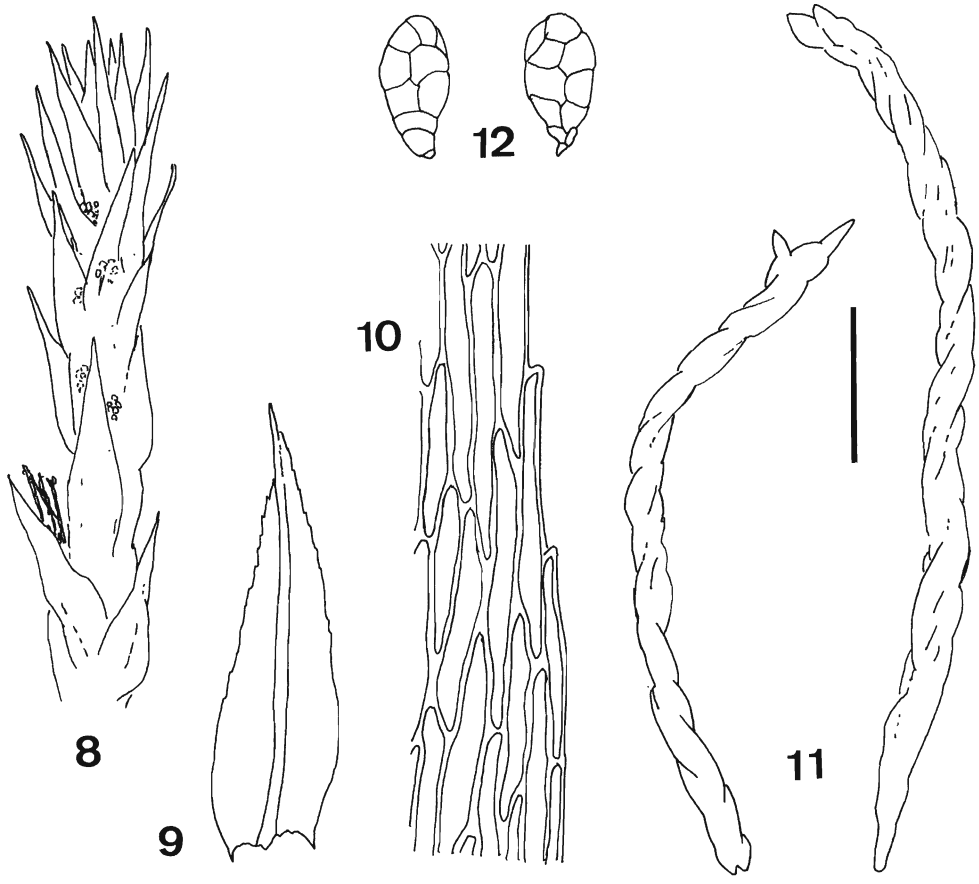
Mniaceae

***Plagiomnium rhynchophorum* (Hook.) Kop.**

273 (1930 m, at Carson's Fall, on wet soil-covered rock), 575 (730 m, on wet rock at streambed).

***Plagiomnium integrum* (Bosch & Sadne Lac.) Kop.**

333 (1800 m, on rock along a trail in a forest).



Figs. 8-12. *Pohlia flexuosa* Hook. (*Akiyama et al. 502*)
8: Upper part of plants. Note filamentous propagules (below) and ovoid gemmae (above) in the leaf axil. **9:** Stem leaf. **10:** Upper margin of stem leaf. **11:** Filamentous propagules. **12:** Ovoid gemmae. Scale bar = 1 mm in Fig. 8; 0.5 mm in Fig. 9; 50 μm in Fig. 10; 100 μm in Figs. 11, 12.

Leptostomataceae

***Hymenodontopsis streesemanii* Herz.**

451 (2430 m, on *Cyathea* trunk along a trail in elfin forest).

Funariaceae

***Entosthodon buseanus* Dozy & Molk.**

149 (2480 m, on moist soil at open site), 186 (3500 m, on soil at stream-side in shrubbery).

This species can be identified by the short apophysis, upright capsule, and short seta less than 2.5 cm long.

***Entosthodon mittenii* Dozy & Molk.**

172 (3680 m, on humus at alpine meadow), 221 (3000 m, on moist soil by a stream near Paka Cave), 495 (3560 m, on soil at open and sunny site), 496 (ibid.).

According to Touw (1978), another species of *Entostodon, E. borneensis* (Dix.) Iwats. (synonym of *E. wichurae* Fleisch.) was reported from Mt. Kinabalu.

Racopilaceae

***Racopilum cuspidigerum* (Schwaegr.) Mitt.**

519 (700 m, on rock along a trail in a disturbed thicket).

***Racopilum laxirete* Broth.**

546 (600 m, on rock along a trail in a disturbed thicket), 568 (on soil-covered rock in a field).

***Racopilum spectabile* Reinw. & Hornsch.**

66 (1500 m, on soil along a trail in a forest), 102 (ibid.), 104 (1500 m, on shrub), 111 (1500 m, on trunk base in a forest), 297 (1680 m, on shrub and litter), 302 (1600 m, on wet rock at streambed), 336 (1800 m, on rotten branch), 411 (1700 m, on rock at streambed), 439 (1600 m, on tree trunk), 558 (600 m, on rock by a stream).

Among our collections, there are no specimens corresponding to *Racopilum johanis-winkleri* Broth., which had been reported from Mt. Kinabalu (Iwatsuki and Noguchi, 1975). Akiyama and Zanten (2000) gave a brief note on all the *Racopilum* species found on Borneo Island.

Rhizogoniaceae

***Pyrrhobryum spiniforme* (Hedw.) Mitt.**

76 (1500 m, on tree trunk in a forest), 431 (1600 m, on tree trunk base along a trail in a forest).

***Rhizogonium graeffeanum* (C.Muell.) Jaeg.**

163 (2180 m, on humus in the cavity tree trunk base, shade), 264 (2700 m, on humus in the cavity of tree trunk base).

***Rhizogonium lamii* Reim.**

263 (2500 m, on humus in the cavity of tree trunk base), 342 (1830 m, on rotten log), 513 (2650 m, on tree trunk base).

Bartramiaceae

***Breutelia arundinifolia* (Duby) Fleisch.**

130 (2390 m, on moist soil along a trail), 162 (2500 m, on wet rock along a trail), 260 (1900 m, on moist soil along a trail at rather open site), 463 (2500 m, on moist soil along a trail).

This species is vigorously growing on trailside soil between 1900 m and 2500 m in altitude. Among our collections, there is no specimen corresponding better to *Breutelia kinabaluensis* Dix. that has more or less smaller plant size than *B. arundinifolia*. We cannot find any differences between these two species regarding other features.

Hypnodendraceae

***Hypnodendron beccarii* (Hampe) Jaeg.**

117 (1600 m, on tree trunk and trunk base), 287 (1700 m, on tree trunk).

This species resembles small plants of *Trachyloma indicum* in the branching manner of ascending shoots and can easily be mistaken in the field.

***Hypnodendron dendroides* (Brid.) Touw**

70 (1500 m, on soil in a forest), 101 (1600 m, on rotten log in a forest), 204 (3100 m, on rotten log along a trail in elfin forest), 259 (2850 m, on rotten log and rock in elfin forest), 310 (1850 m, on rotten log), 315 (1650 m, on tree trunk and trunk base), 420 (1600 m, on rotten log).

This is the commonest species for the genus in the Kinabalu Park, and bears sporophytes abundantly.

***Hypnodendron divrsifolium* Broth. & Geh.**

96 (1600 m, on soil along a trial in a forest), 443 (ibid.).

Hypnodendron fusco-mucronatum* (C.Muell.) Jaeg. subsp. *fusco-mucronatum

548 (600 m, on wet boulder at streambed).

***Hypnodendron milnei* Mitt. ssp. *korthalsi* (Par.) Touw**

550 (600 m on wet boulder at streambed).

This species grew intermingled with *H. fusco-mucronatum*.

***Hypnodendron reinwardtii* (Schwaegr.) Jaeg. ssp. *caducifolium* (Herz.) Touw**

283 (1640 m, on rock).

****Hypnodendron subspininervium* (C.Muell.) Jaeg.**

15011 (around the Headquarter, 1500 m, on tree trunk).

***Hypnodendron vitiense* Mitt.**

400 (1500 m, on wet rock in the streambed along Silau-silau trail).

This species is a good example of typical rheophytes among mosses. In the field, it resembles *Thamnobryum* species.

Spiridentaceae

***Spiridens reinwardtii* Nees**

267 (2400 m, on trunk of *Cyathea* sp.), 462 (ibid.).

These two specimens were collected from the same *Cyathea* tree. For habitat preference of this species, refer the note given by Akiyama (1989).

Orthtrichaceae

***Macromitrium aspericuspis* Dix.**

480 (3470 m, on tree trunk in elfin mossy forest).

Setae of this species are around 11mm long and calyptra is almost naked.

***Macromitrium ochraceum* (Dozy & Molk.) C.Muell.**

183 (3450 m, on tree trunk in elfin forest).

***Schlotheimia rubiginosa* Wright**

251 (2900 m, on tree trunk in elfin forest).

*****Zygodon intermedius* Bruch & Schimp.**

202 (3100 m, on tree trunk along a trail in elfin forest).

Distribution: Widespread in Malesia.

***Zygodon reinwardtii* (Hornsch.) A.Braun**

244 (3200-3300 m, on tree trunk along a trail in elfin forest).

Rhacocarpaceae

***Rhacocarpus alpinus* (Wright.) Par.**

182 (3600 m, forming dense mat on wet cliff surface at open site), 184 (3700 m, on tree trunk base at open site), 506 (3600 m, on boulder at open site).

This is one of the most common bryophytes on rock faces over 3600m in altitude.

Pterobryaceae *sense lat.*

***Garovaglia elegans* (Dozy & Molk.) Bosch & Sande**

Lac.

81 (1500 m, on shrub branch at streamside).

***Neolindbergia rigida* (Bosch & Sande Lac.) Fleisch.**

116 (1600 m, on tree trunk at streamside), 535 (700 m, on tree trunk in secondary forest).

***Neolindbergia cladomnioides* H.Akiy.**

324 (1600 m, on fallen trunk in a forest).

Neolindbergia cladomnioides is a rare species endemic to Borneo Island. This is the second report of this species from Mt. Kinabalu, and the third report for this species (Akiyama, 1991, 1992).

***Pterobryopsis gedehensis* Fleisch.**

326 (1600 m, on tree trunk in a forest).

***Symphysodontella attenuatulla* Fleisch**

526 (700 m, on tree trunk in rather dry forest), 547 (ibid.).

***Symphysodontella cylindracea* (Mont.) Fleisch.**

106 (1500 m, on tree trunk along a trail in a forest), 304 (1600 m, on fallen trunk in a forest), 323 (ibid.).

Myuriaceae

***Myurium rufescens* (Reinw. & Hornsch.) Fleisch.**

188 (3470 m, on tree trunk base in elfin forest), 222 (3000 m, on wet soil along a trail in elfin forest), 230 (3000 m, on moist rock along a trail in elfin forest).

Meteoriaceae

***Aerobrydium crispifolium* (Broth. & Geh.) Broth.**

79 (1500 m, on rotten log in a forest), 325 (1600 m, on fallen tree trunk in a forest).

***Barbella compressiramea* (Ren. & Card.) Fleisch.**

530 (1400 m, hanging from shrub branch in a forest).

***Floribundaria floridunda* (Dozy & Molk.) Fleisch.**

292 (1800 m, on shrub branch in a forest), 402 (1500 m, on shrub branch in a forest).

***Floribundaria thuidioides* Fleisch.**

554 (600 m, on boulder along a trail in secondary forest).

Meterorium miquelianum* (C.Muell.) Broth. ssp. *miquelianum

441 (1700 m, pendulous from shrub branch in a forest).

***Papillaria fuscescens* (Hook.) Jaeg.**

261 (1950 m, on humus at sunny site).

Trachypodaceae

***Trachypus bicolor* Reinw. & Hornsch.**

129 (2280 m, on fallen trunk in a forest), 187 (3500 m, on fallen trunk in elfin forest).

***Trachypodopsis serrulata* (P.Beauv.) Fleisch.**

515 (3000 m, on tree trunk base in mossy forest).

Trachylomataceae

***Trachyloma indicum* Mitt.**

195 (3400 m, on rock in elfin forest), 337 (1800 m, on rotten log; with gemmae in leaf axil).

Neckeraceae

***Calyptothecium urvilleanum* (C.Muell.) Broth.**

94 (1600 m, on tree trunk and trunk base in a forest), 525 (700 m, hanging from shrub branch in secondary forest).

***Cryptogonium phyllogonioides* (Sull.) Isov.**

562 (600 m, on tree trunk at slope of secondary forest).

***Himantocladium cyclophyllum* (C.Muell.) Fleisch**

78 (1600 m, on tree trunk and trunk base in a forest), 305 (1600 m, on fallen trunk in a forest).

Kinabalu plants are dioicous in sexuality (or bear male and female sexual organs on different shoots), and thus we identified them as *Himantocladium cyclophyllum*.

***Himantocladium plumula* (Nees) Fleisch.**

553 (600 m, on rock and tree trunk base beside a stream).

***Himantocladium* sp. (Figs. 13 - 17)**

225 (3000 m, on rocky cliff beside a small waterfall).

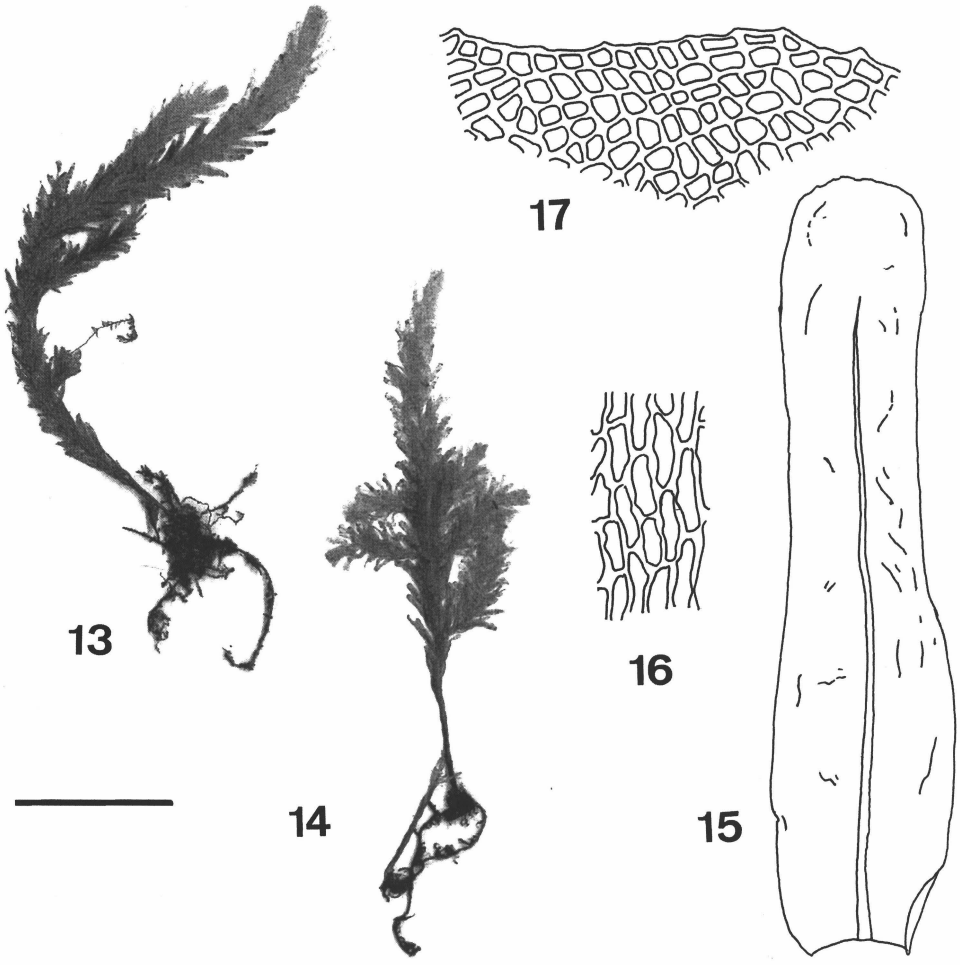
This curious plant was collected on a rocky cliff beside a stream near the Paka Cave. It has rather large shoots, bearing only several lateral branches. Sparse branching may be induced by the unusual habitat condition of higher altitude for the family. Judging from the shape of the stem leaves, this plant resembles to *Himantocladium plumula* (Nees.) Fleisch., but the plant size of the latter is much smaller than the present species. It also resembles an undeveloped form of *Homaliodendron flabellatum* (Sm.) Fleisch. that bears few or no branches. But its well serrate margin at leaf apex is different from the weakly crenulate ones of the present species. Unfortunately, there are no sexual organs, thus it is difficult to know to which genera it really belongs.

***Homaliodendron flabellatum* (Sm.) Fleisch.**

437 (1700 m, on tree trunk in a forest), 460 (3040 m, on boulder in elfin forest).

***Homaliodendron microdendron* (Mont.) Fleisch.**

83 (1500 m, on tree trunk and trunk base in a forest), 542 (600 m, on tree trunk base in secondary forest), 573 (ibid.).



Figs. 13-17. *Himantocladium* sp. (*Akiyama et al. 225*)
13, 14: Plants (dry condition). **15:** Stem leaf. **16:** Median lamina cells of stem leaf. **17:** Truncate apex of stem leaf. Note the truncate apex. Scale bar = 2 cm in Figs. 13, 14; 1 mm in Fig. 15; 50 μm in Figs. 16, 17.

***Neckeropsis lepineana* (Mont.) Fleisch.**
552 (600 m, on tree trunk in a secondary forest).
***Pinnatella ambigua* (Bosch & Sande Lac.) Fleisch.**
299 (1600 m, on tree trunk in a forest).
***Pinnatella kuehliana* (Bosch & Sande Lac.) Fleisch.**
564 (600 m, on tree trunk base beside a stream).
***Pinnatella mucronata* (Bosch & Sande Lac.) Fleisch.**
563 (600 m, on tree trunk beside a stream).

Thamnobryaceae
***Thamnobryum ellipticum* (Bosch & Sande Lac.) Nog. & Iwats.**
276 (1950 m, on wet boulder at Carson's Fall), 561 (600 m, on wet boulder at streamside).

Daltoniaceae
***Ephemeropsis tjibodensis* Goeb.**
335 (1800 m, on leaf along a trail in a forest).
***Daltonia angustifolia* Dozy & Molk.**
433 (1700 m, on leaf along a trail in a forest).
***Distichophyllum scabrisetum* H.Akiy. & T.Yamag.**
539 (1400 m, on rotten log in a forest).
There have been several *Distichophyllum* species reported to have acuminate leaves (Noguchi & Iwatsuki, 1972). This species also has long acuminate leaves. For more details, see Akiyama and Yamaguchi (1999).
***Distichophyllum cuspidatum* Dozy & Molk.**
308 (1850 m, on shrub branch and leaf tip in a forest), 409 (1500 m, on shrub branch in a forest).
***Distichophyllum mittenii* Bosch & Sande Lac.**
306 (1830 m, on wet rotten log in a streamlet in a forest), 534 (1400 m, on wet rotten log beside a stream in a forest).
***Distchophyllum osterwardii* Fleisch.**
343 (1800 m, on moist rock along a trail in a forest), 425 (1600 m, on wet soil in streamlet in a forest).
***Distichophyllum tortile* Bosch & Sande Lac.**
524 (1400 m, on wet rotten log along a trail in a

forest).

Hypopterygiaceae

***Cyathophorum spinosum* (C.Muell.) Fleisch.**

303 (1600 m, on fallen tree trunk in a forest).

***Hypopterygium tenellum* C.Muell.**

121 (1500 m, on *Cyathea* trunk at open site), 565 (600 m, on rock at streambed in a forest).

***Hypopterygium vriesei* Bosch & Sande Lac.**

549 (600 m, on rock at streamside in secondary forest), 569 (640 m, on tree trunk base along a trail at forest slope).

***Lopidium struthiopteris* (Brid.) Fleisch.**

231 (3000 m, on moist rock and soil-covered rock at half-shaded site).

***Lopidium trichocladon* (Bosch & Sande Lac.) Fleisch.**

418 (1700 m, on tree trunk along a trail in a forest).

Hookeriaceae

***Acrophyllum javense* (Froehl.) Iwats. et al.**

300 (1650 m, on moist soil covered by grasses along a trail in a forest), 349-bis (on wet boulder near the Carson's Fall), 438 (1650 m, on moist soil along a trail in a forest).

***Actinodontium rhaphidostegum* (C.Muell.) Bosch & Sande Lac.**

50 (1500 m, on bamboo trunk at sunny site in a park garden), 122 (1500 m, on tree fern trunk in a park garden)

***Callicostella papillata* (Mont.) Mitt.**

540 (1400 m, on wet rotten log at streambed in a forest).

***Callicostella probaktiata* Bosch & Sande Lac.**

543 (600 m, on wet metal water-pipe).

***Calyptrochaeta rotundifolia* (Nog. & Iwats.) Touw**

232 (3000 m, on wet rock beside a stream).

We collected it at the Paka Cave, type locality of the species.

***Chaetomitrium leptopoma* (Schwaegr.) Bosch & Sande Lac.**

404 (1500 m, on shrub branch at riverside).

***Chaetomitrium papillifolium* Bosch & Sande Lac.**

209 (3000 m, on shrub branches in a mossy forest).

Kinabalu plant grows at much higher altitude than typical habitat of this species.

****Chaetomitrium orthorrhynchum* (Dozy & Molk.) Bosch & Sand Lac.**

296 (1700 m, on shrub branch in a forest), 311 (1850 m, on shrub branch in a forest), 442 (1550-1900 m, on shrub branch in a forest).

***Hookeria acutifolia* Hook. & Grev.**

46 (1500 m, on moist rock and soil at streamside in a forest), 113 (ibid.), 171 (3470 m, on wet soil in a streamlet under low elfin thicket).

***Hookeriopsis* sp.**

328 (1650 m, on soil covered rock along a trail in montane forest).

Plants are small, flaccid, pale yellowish green, and sparsely branched. Stems are ca. 3 cm long. Stem leaves are strongly shrunken in dry conditions, lanceolate, 0.5 mm wide and 2 mm long. Lamina cells are nearly transparent, linear, ca. 100 μm long, and shorter at the upper part. Leaf margins are differentiated by their larger cells and form distinctive serration. Judging only by description, this species most resembles *Hookeriopsis wichurae* Fleisch. reported from Java.

Thuidiaceae

***Pelekium velatum* Mitt.**

517 (700 m, on rotten log in a disturbed thicket).

***Thuidium glaucinum* (Mitt.) Bosch & Sande Lac.**

570 (650 m, on rock in a secondary forest).

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

203 (3100m, on rotten log, rocks and soil in mossy forest), 255 (1950m, on soil along a trail in montane forest).

Plagiotheciaceae

***Plagiothecium neckeroideum* Bruch & Shimp.**

254 (3130 m, on soil overhanged by a boulder in elfin forest), 459 (ibid.).

No gemmae are observed in Kinabalu plants of our collections. In addition, their leaves scarcely undulate comparing with typical *P. neckeroideum*. The upper most lamina cells slightly differentiated from lower ones, however, can serve to know their identity.

Brachytheciaceae

***Brachythecium plumosum* (Hedw.) Bruch & Schimp.**

220 (3000 m, on moist to wet boulder at streambed at open site near Paka Cave).

***Rhynchostegiella vriesei* (Dozy & Molk.) Broth.**

285 (1640 m, on shrub leaf at rather sunny site).

Entodontaceae

*****Campylodontium flavescens* (Hook.) Bosch & Sande Lac.**

120 (1500 m, on stonewall near the Headquarter office), 278 (ibid.), 544 (600 m, on tree trunk base in

secondary forest).

Distribution: Java, Sumatra, Sulawesi.

***Entodon bandongiae* (C.Muell.) Jaeg.**

571 (670 m, on boulder at Bat Cave).

****Entodon plicatus* C.Muell.**

124 (1500 m, on stonewall near the Headquarter office).

Distribution: Widespread in temperate zones, and known from Sri Lanka in the tropics.

Sematophyllaceae

***Acroporium diminutum* (Brid.) Fleisch.**

109 (1500 m, on tree trunk in a forest), 346 (1830 m, on tree trunk base in a forest), 435 (1600 m, on shrub branch in a forest).

***Acroporium johannis-winkleri* Broth.**

291 (1900 m, on soil along a trail in wet forest), 541-b (600 m, on soil along a trail in secondary forest).

***Acroporium lamprophyllum* Mitt.**

60 (1500 m, on tree trunk at streamside in a forest), 226 (3000 m, on wet rock at streambed in a forest).

***Acroporium aff. longicaule* (Sande Lac.) Fleisch.**

417 (1600 m, on tree trunk in a forest).

Plants of our specimen differ from the typical ones in wider leaf shape.

***Acroporium stramenium* (Reinw. & Hornsch) Flesich. var. *turgidum* (Mitt.) B.C.Tan**

327 (1630 m, on rotten log in a forest).

***Brotherella falcata* (Dozy & Molk.) Fleisch.**

228 (3000 m, on boulder at streambed in a forest).

***Clastobryella* sp.**

115 (1500 m, on tree trunk at sunny and open site).

Leaves are distinctly serrate and propagules are papillose.

***Isocladiella flagellifera* (Sak.) Lin**

429 (1600 m, on shrub branch), 529 (700 m, on shrub branch).

***Mastopoma uncinifolium* (Broth.) Broth.**

82 (1500 m, on wet rotten log in a forest), 108 (1500 m, on soil along a trail in a forest), 114 (1500 m, on rotten log along a trail by a stream), 275 (1950 m, Carson's Fall, on wet wood balcony), 295-a (1750 m, on rotten log in a forest) 320 (1800 m, on stump in a forest), 401 (1500 m, on soil along a trail by a river), 440 (1500 m, on shrub branch in a forest).

****Meiothecium microcarpum* (Hook.) Mitt.**

56 (1500 m, on bamboo trunk, moist, at open site), 566 (600 m, on rock in a filed).

This is the first report of this species from Kinabalu National Park (Frahm et al., 1990).

*****Sematophyllum tristictulum* (Mitt.) Fleisch.**

51 (1480 m, on bamboo trunk at open site), 572 (600 m, on tree trunk at forest slope).

This species grows on the nodes of bamboo trunks.

Distribution: Widespread in Malesia.

***Taxithelium alare* Broth.**

59 (1500 m, on climber at streamside in a forest), 98 (on fallen rotten log in a forest), 279 (1800 m, on shrub branch and leaves in a forest), 293 (1900 m, on shrub branch in a forest), 434 (1600 m, on leaves in a forest), 435 (1600 m, on shrub branch in a forest), 444 (1600 m, on shrub leaves at riverbed in a forest).

***Taxithelium* sp.**

207 (3100 m, on rock in a mossy forest).

This plant totally lacks papillae in its lamina cells. More or less scalariform, pale-colored alar regions, however, indicate its affinity to the genus.

****Trichosteleum boschii* (Dozy & Molk.) Jaeg.**

227 (3000 m, on wet rock at streambed), 428 (1600 m, on shrub branch).

Kinabalu plants have the following features; unipapillose lamina cells, smooth setae and cucullate, glabrous calyptrae.

Distribution: Widespread in Malesia.

***Trichosteleum hamatum* (Dozy & Molk.) Fleisch.**

69 (1500 m, on rotten log along a trail in a forest), 91 (1600 m, on rotten log along a trail in a forest), 97 (1600 m, on wet rock covered with soil along a trail in a forest), 284 (1800 m, on shrub branch in a forest; with numerous gemmae in leaf axils), 347 (1830 m, on rotten log along a trail in a forest).

***Trismegistia calderensis* (Sull.) Broth.**

319 (1850 m, on rotten log and pendulous from shrub branches along a trail in a forest), 419 (ibid.).

Trismegistia calderensis is characterized by sparse branching and long, narrow, and somewhat curled upper lamina of both stem and branch leaves.

Among our collections, one specimen (*Akiyama et al. 131*, collected on moist humus along a trail in a upper montane forest at 2300 m alt.) is different from above two specimens in the presence of stipes and differentiation of lamina cells at leaf borders. It should be recognized a *"subintegrifolia"*-type of the species. This type resembles *T. gracilicaulis* in general appearance, but its plant size is much larger of the latter species.

***Trismegistia gracilicaulis* Dix. & Herz.**

63 (1500 m, on soil and tree trunk base; forming dense and flat mat on a ground), 118 (1500 m, on rotten log along a trail in a forest), 405 (1500 m, on tree trunk

in a forest), 413 (1800 m, on rotten log along a trail in a forest), 533 (700 m, on rotten log in a disturbed thicket along a river).

Our identification of the *Trismegistia* specimens is based on a whole taxonomic revision of the genus by the senior author of this report. *Trismegistia gracilicaulis* is characterized (1) by well-developed, upright stipes with somewhat recurved leaves, and (2) by stem and branch leaves abruptly narrowed into long acumen from round bases.

***Trismegistia panduriformis* (Wright) Broth.**

64 (1500 m, on soil along a trail in a forest), 314 (1650 m, on tree trunk base in a forest), 416 (1700 m, on tree trunk base and rotten log forming a dense mat in a forest).

Trismegistia panduriformis can be easily identified by its large plant size, ligulate, deeply dentate leaves with small upper lamina cells.

***Warburgiella* cf. *cupressinoides* C.Muell.**

281 (1800 m, on rotten log along a trail in a forest).

This species has the following features: leaves are circinate to falcate when dry, gradually narrowed into long acumen, coarsely serrate; lamina cells are smooth; seta are up to 20 mm long; calyptrae are mitrate.

***Warburgiella leptocarpa* (Schwaegr.) Flesich.**

71 (1500 m, on rotten log at rather shaded site), 208 (3000 m, on rotten log in a mossy forest).

One of our specimens (no. 208) was collected at much higher place than typical habitat of this species.

Hypnaceae

***Ectropothecium* spp.**

Though there are a number of *Ectropothecium* species among our collections, we could not identify them.

***Isopterygium* sp.**

134 (2500 m, on soil along a trail in montane forest), 234 (3000 m, on shrub trunk base beside a stream).

This plants have filamentaous propagules and naked lateral buds surrounded by filamentous pseudoparaphyllia.

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

180 (3500 m, in a wet shallow hole of boulder in elfin forest).

****Pseudotaxiphyllum pohliaecarpum* (Sull. & Lesq.) Iwats.**

148 (2500 m, on soil along a trail), 160 (2520 m, on moist soil along a trail in a forest), 471 (3360 m, on rather dry soil under huge boulder).

Distribution: Unknown, but maybe common in Malesia.

***Taxiphyllum arcuatum* (Bosch & Sande Lac.) He**

312 (1850 m, on shaded, moist humus in a hole of tree trunks in a forest).

Hepaticae

Herbertaceae

***Herbertus arminatus* (Steph.) H.A.Miller**

15295 (Paka Cave, 3000 m, on moist sandy soil beside a stream in a forest), 15296 (ibid. on tree root by a stream), 15364 (ibid. on moist boulder by a stream).

Pseudolepicoleaceae

***Blepharostoma trichophyllum* (L.) Dum.**

15278a (Paka Cave, 3000 m, on moist rotten log), 15375 (around Paka Cave, 3100 m, on moist rotten log along a trail in a mossy forest), 15381 (ibid.).

Trichocoleaceae

***Trichocolea merillana* Steph.**

15073 (around Headquarter, 1500 m, on moist rotten log in a forest).

***Trichocolea pluma* (Reinw. et al.) Dum.**

15076 (around Headquarter, 1500 m, on moist soil along a trail in a forest), 15379 (en route from Laban Rata to Paka Cave, 3140 m, on moist rock along a trail in a forest).

Lepidoziaceae

***Lepidozia cladorhiza* (Reinw. et al.) Gott. et al.**

15113 (en route from Power Station to Laban Rata, 2080 m, on moist bank along a trail in a forest).

***Lepidozia supradecomposita* Lindenb.**

15144 (en route from Power Station to Laban Rata, 2430 m, on moist rock along a trail in a forest).

***Kurzia gonyotricha* (Sande Lac.) Grolle**

15057 (around Headquarter, 1500 m, on moist soil along a trail in a forest).

***Kurzia borneensis* Mitt.**

15409 (en route from Laban Rata to Power Station, 2900 m, on moist bank along a trail in a forest).

***Psiloclada clandestina* Mitt.**

15024 (around Headquarter, 1500 m, on moist rock covered with soil along a trail in a forest).

***Telaranea neesii* (Lindenb.) Fulf.**

15061 (around Headquarter, 1500 m, on moist rotten log along a trail in a forest), 15065 (ibid.).

Lepicoleaceae

***Lepicolea yakusimensis* (Hatt.) Hatt.**

15301 (Paka Cave, 3000 m, on moist boulder covered with sandy soil by a stream in a forest).

Geocalycaceae

***Heteroscyphus diestianus* (Sande Lac.) Piippo**

15036 (around Headquarter, 1500 m, on moist soil along a trail in a forest).

***Heteroscyphus splendens* (Lehm. & Lindenb.) Grolle**

14992 (around Headquarter, 1500 m, on moist soil along a trail in a forest).

***Lophocolea costata* (Nees) Gott.**

15094 (around Headquarter, 1500 m, on moist rock with soil along a trail in a forest).

Scapaniaceae

***Scapania lepida* Mitt.**

154 (2800 m, on humus at a slope of elfin forest), 252 (2950 m, on moist humus in elfin forest).

Gymnomitriaceae

***Marsupella revoluta* (Nees) Dum.**

15298 (Paka Cave, 3000 m, on moist rock covered with sandy soil by a stream in a forest).

Jungermanniaceae

***Chandonanthus hirtellus* (Web.) Mitt.**

15152 (en route from Power Station to Laban Rata, 2570 m, on moist rock along a trail in a forest).

***Denotarisia linguifolia* (De Not.) Grolle**

15118 (en route from Power Station to Laban Rata, 2100 m, on moist soil along a trail at open site), 15288 (in the vicinity of Paka Cave, 3000 m, on tree trunk in a mossy forest).

***Jamesoniella autumnalis* (DC.) Steph.**

15396 (en route from Paka Cave to Laban Rata, 3260 m, on tree trunk along a trail in upper montane forest).

Plagiochilaceae

***Plagiochila dendroides* (Nees) Lindenb.**

15263 (in the vicinity of Paka Cave, 3000 m, on tree trunk in a mossy forest).

***Plagiochilion braunianum* (Nees) Hatt.**

15386 (en route from Laban Rata to Paka Cave, 3160 m, on moist rock covered with soil along a trail in elfin forest).

Cephaloziaceae

***Nowellia borneensis* Grolle**

15276 (in the vicinity of Paka Cave, 3000n, on moist rotten log in a mossy forest), 15277 (ibid.), 15278b (ibid.), 15420 (en route from Laban Rata to Power Station, 2340 m, on moist rotten log along a trail in a forest).

Pleuroziaceae

***Pleurozia gigantea* (Web.) Lindb.**

15149 (en route from Power Station to Laban Rata, 2515m, on tree trunk along a trail at open site), 15164 (ibid., 2825m, on moist rock along a trail in a forest), 15165 (ibid.).

***Pleurozia conchifolia* (Hook. & Arn.) Aust.**

15167 (en route from Power Station to Laban Rata, 2915m, on tree trunk along a trail in a montane forest).

***Pleurozia johannis-winkleri* Herz.**

15422 (en route from Power Station to Laban Rata, 2170 m, on moist rock along a trail in a forest).

Lejeuneaceae

***Lopholejeunea wiltensii* Steph.**

15297 (Paka Cave, 3000 m, on tree root by a stream in a forest).

***Metzgeriopsis pusilla* Goeb.**

309 (1700 m, on shrub leaf in a forest).

Metzgeriaceae

***Apometzgeria pubescens* (Schrunk) Kuwah. var. *kinabaluensis* Kuwah.**

15373 (en route from Laban Rata to Paka Cave, 3140 m, on tree trunk along a trail in montane forest).

Pallaviciniaceae

***Jensenia decipiens* (Mitt.) Grolle**

140 (2400 m, on moist humus along a trail in a forest), 143 (2500 m, on moist humus, forming a large population along a trail in a forest), 450 (2400 m, on moist soil along a trail in elfin forest), 452 (2800 m, on moist soil along a trail in elfin forest), 453 (ibid.; male plants), 15142 (en route from Power Station to Laban Rata, 2370 m, on moist bank along a trail in a forest).

Treubiaceae

****Treubia insignis* Goebel ssp. *insignis***

280 (1600 m, Liwagu trail; on moist soil along a trail), 430 (ibid.).

This is the first report of this genus from Borneo Island (Schuster and Scott, 1969; Frahm et al., 1990).

Distribution: Sumatra, Java, Luzon, New Guinea.

(Schuster and Scott, 1969).

Marchantiaceae

***Dumortiera hirsuta* (Sw.) Reinw. et al. (monoploid)**

541-a (600 m, on soil along a trail in secondary forest), 576 (ibid.).

All monoploid plants were collected at Poring.

***Dumortiera hirsuta* (Sw.) Reinw. et al. (diploid)**

274 (1700-1500 m, on soil along a trail in a forest), 410 (ibid.), 448a (1500 m, on boulder covered with soil at streambed).

Diploid plants grew vigorously on moist soil along a trail of the Liwagu Trail and around Carson's Fall.

****Dumortiera hirsuta* (Swartz) Reinw. et al. (triploid)**

448-b (1500 m, on boulder covered with soil at streambed).

This is the second report of the triploid plants of *Dumortiera hirsuta* from Southeast Asia (Fritsch, 1991; the first one being from Taiwan). We collected triploid plants on wet rocks from the riverbed along the Liwagu trail. Triploid plants differ from diploid plants nearby in the naked upper part of the carpocepalum.

We also found triploid plants at Genting Highland on the Malay Peninsula. But they differ from Kinabalu plants in their total lack of papillae on the surface of the thallus. According to our preliminary research using allozyme variations, Kinabalu triploids show greater genetic difference than those in other localities.

Wiesnerellaceae

***Wiesnerella denudata* (Mitt.) Steph.**

414 (1800 m, on soil along a trail in a forest).

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Appendix. List of collection sites. Numerical numbers mean collection numbers of each specimens.

46-71	Jan. 13.	Around Headquarter and secondary forest nearby, ca. 1500 m alt.
72-125	Jan. 14.	In a moist reserved forest below the Headquater, 1500-1600 m alt.
126-169	Jan. 15.	Along a trail between Power Station to Laban Rata, 1900-3300 m alt.
170-201	Jan. 16.	Along a trail between Laban Rata to the top of Mt. Kinabalu, 3300-4100 m alt.
202-213	Jan. 17.	In a mossy forest around Paka Cave, 3000 m alt.
214-247	Jan. 17.	Paka Cave and along a stream nearby, 3000 m alt.
248-278	Jan. 18.	Along a trail between Laban Rata to Power Station, 1900-2900 m alt.
279-380	Jan. 19.	Along a Liwagu trail (well moist montane forest developed along a ravine), 1600-1900 m alt.
400-408	Dec. 20.	Along a Silau-silau trail (moist montane forest), 1450-1500 m alt.
409-448	Dec. 21.	Along a Liwagu trail, 1550-1900 m alt.
449-463	Dec. 22.	Along a trail in elfin forest slope between Power Station and Laban Rata, 1900-3300 m alt.
464-507	Dec. 23.	Along a trail between Laban Rata to Sayan-sayan Hut, 3300-3570 m alt.
508-516	Dec. 24.	Along a trail between Laban Rata to Power Station, 2000-3000 m alt.
517-540	Dec. 25.	Disturbed forest n the vicinity of Kiau, foot of Mt. Kinabalu, ca. 700 m alt.
541-577	Dec. 26.	Reserved forest of Poring, 600-700 m alt.