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MOSSES OF MANTAILANG WITH NEW SPECIES RECORDS FOR CROCKER RANGE PARK, SABAH, MALAYSIAN BORNEO

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ABSTRACT
SULEIMAN, M., ANTHONY, F., REPIN, R. & ANWAR, I. 2025. Mosses of Mantailang with new species records for Crocker Range Park, Sabah, Malaysian Borneo. *Reinwardtia* 24(2): 145–159. — A two-day bryological survey was conducted in Mantailang of the Crocker Range Park (CRP), Sabah, East Malaysia, during the 2018 Mantailang scientific exploration. The survey aimed to carry out an inventory of mosses in the study area. A total of 89 species from 49 genera and 23 families were identified, with the family Calymperaceae being the most represented. Notably, 11 species were newly recorded for the CRP. Mantailang harbours rare and Bornean endemic species, highlighting the park's significance as a moss biodiversity hotspot and its importance for bryophyte conservation in Borneo.

Key words: Malaysia, moss flora, new records, Sabah.

ABSTRAK
SULEIMAN, M., ANTHONY, F., REPIN, R. & ANWAR, I. 2025. Lumut sejati dari Mantailang dengan catatan jenis baru di Crocker Range Park, Sabah, Malaysia Borneo. *Reinwardtia* 24(2): 145–159. — Survei briologi selama dua hari telah dilakukan di Mantailang di Crocker Range Park (CRP), Sabah, Malaysia Timur, pada saat eksplorasi ilmiah Mantailang 2018. Survei ini bertujuan untuk melakukan inventarisasi lumut sejati di kawasan tersebut. Sebanyak 89 jenis dari 49 marga dan 23 suku diidentifikasi, dengan suku Calymperaceae yang paling banyak terwakili. Sebanyak 11 jenis merupakan rekaman baru untuk CRP. Mantailang mempunyai jenis langka dan endemik di Borneo, mengutamakan pentingnya taman ini sebagai pusat keanekaragaman hayati lumut sejati dan pentingnya konservasi lumut di Borneo.

Kata kunci: Catatan baru, flora lumut sejati, Malaysia, Sabah.

INTRODUCTION

Mantailang is located in the Tenom District of southwestern Sabah, Malaysian Borneo (Fig. 1). It is located in the southernmost tip of the Crocker Range Park (CRP), the largest terrestrial national park in Sabah, with an area of 140,738 ha. This relatively remote area is about 6 km from Tenom Town, the capital of Tenom District, and 150 km South from Kota Kinabalu, the capital of Sabah State.

The moss flora of the CRP has been extensively studied in the last two decades (Suleiman & Akiyama, 2004; Suleiman & Jotan, 2015; Ellis *et al.*, 2016a, b; Suleiman *et al.*, 2017a, b). This park has recorded a total of 304 taxa of mosses belonging to 118 genera and 38 families, accounting to about 40% of the total number of mosses for Borneo. These studies have reported numerous new records of mosses for Sabah and Borneo, contributing significantly to the knowledge of moss diversity in this region. This park is also home to several Bornean endemic moss species and many rare mosses, cementing its importance as a protected area in Sabah.

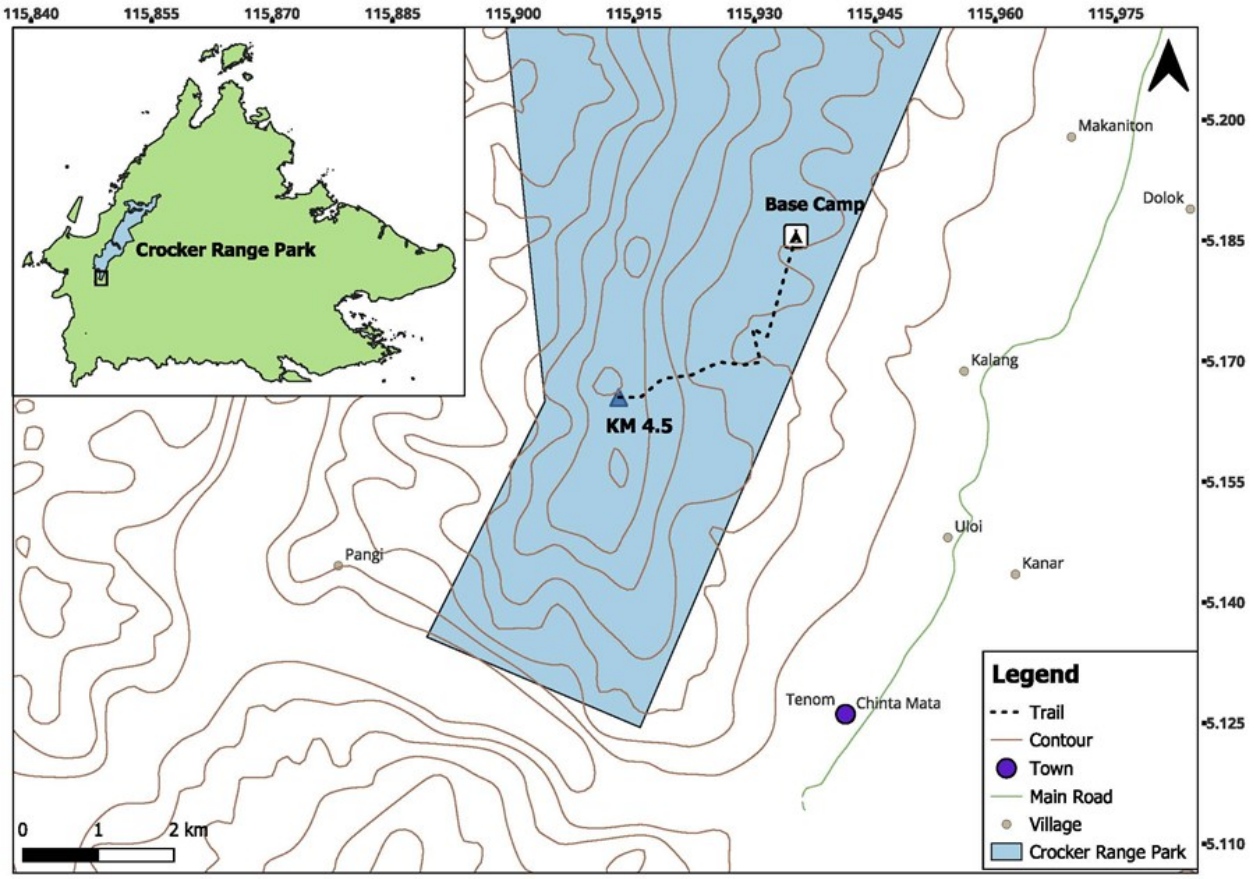

Fig. 1. Map of southern part of Crocker Range Park showing the study site. Insert is map of Sabah, Malaysian Borneo.

A large part of CRP's remote and less accessible areas were not surveyed in previous studies, including Mantailang. Thus, the objective of this study was to carry out an inventory of mosses from Mantailang, Crocker Range Park.

MATERIALS AND METHODS

Mosses were collected along the trails from the exploration Base Camp (5º11'7.88"N, 115º56' 6.69"E) to km 4.5 (5º9'55.7"N, 115º54'47.3"E; Fig. 1) from 2nd to 3rd November 2018. The study area is characterized by mixed dipterocarp forest, ranging from 500 m to 1,200 m asl. It sits in a hilly and rugged terrain, from lowland mixed dipterocarp forest to lower montane forest; mossy forest starts to develop from 1,100 m asl. The area is largely considered to be a primary forest, except for the lowland areas adjacent to the base camp with signs of previous anthropogenic disturbances.

The collected specimens were curated and identified at the BORNEENSIS Herbarium (BORH) of the Universiti Malaysia Sabah. Taxonomic keys for Malesian mosses were used in species identification, such as Akiyama (2010), Eddy (1988, 1990, 1996), Menzel (1992), Mohamed & Robinson (1991), Noguchi (1976), Tan & Iwatsuki (1989), and Touw (2001). The classification of the moss families, genera and species names were based on the World Flora Online (WFO, 2025). The specimens were deposited at the Sabah Parks Herbarium (SNP) and a set of duplicates in BORH.

RESULTS AND DISCUSSION

A total of 103 specimens of mosses were collected during the survey and out of these, 89 species in 49 genera and 23 families of mosses were identified, including three uncertain taxa (Table 1; Fig. 2 –4; Appendix 1). This number represents *ca.* 13% of the mosses reported for Sabah and *ca.* 11% of the mosses reported for Borneo (Suleiman *et al.*, 2006; Suleiman *et al.*, 2024a, b). The Calymperaceae has the highest number of species with 11 species, followed by the Neckeraceae and Sematophyllaceae each with nine species, the Daltoniaceae with eight species, and the Fissidentaceae with six species (Table 1). These families are expected to be

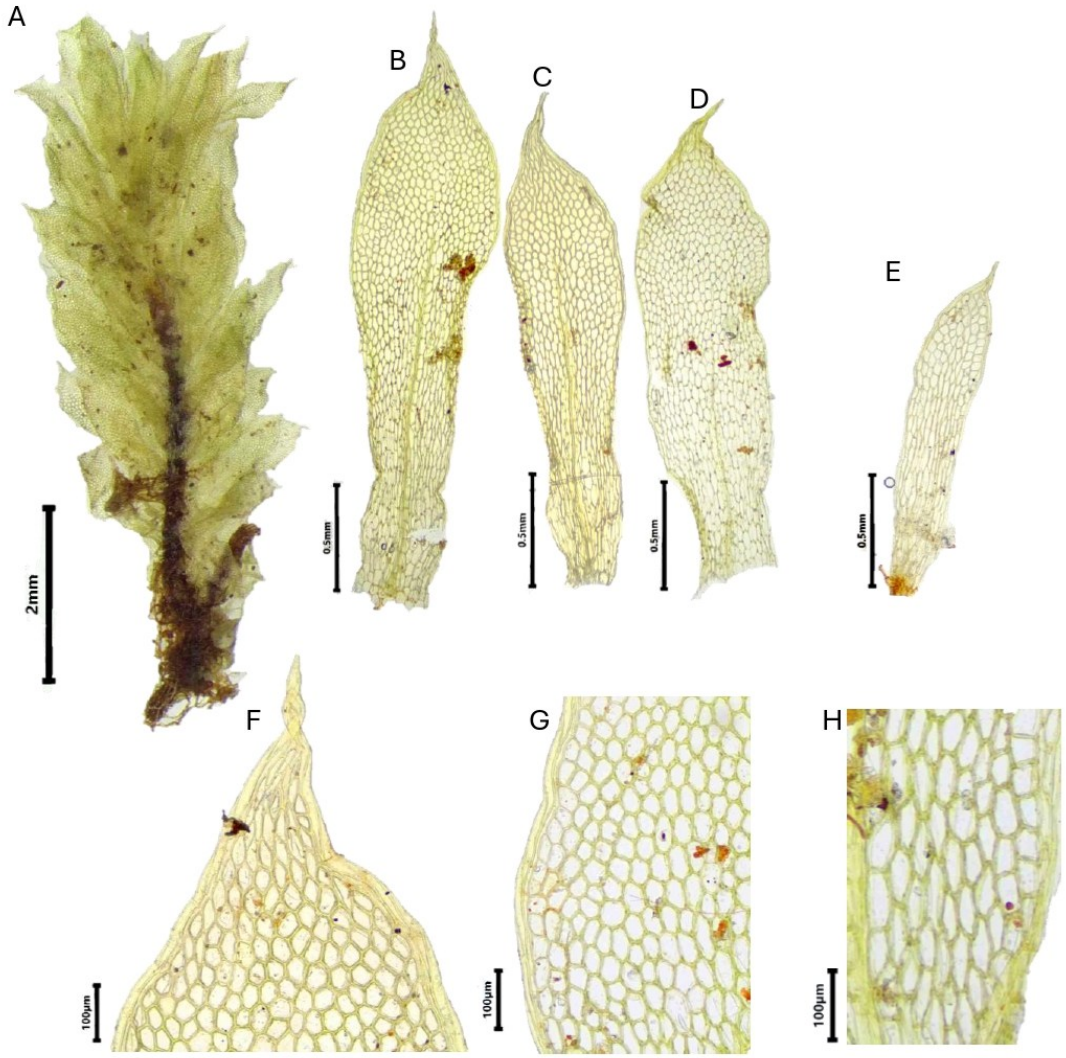

Fig. 2. *Distichophyllum* cf. *angustifolium* Dixon. A. Plant. B–D. Leaves. E. Perichaetial leaf. F. Leaf apex. G. Mid-lamina cells. H. Basal cells. (A–H from *M. Suleiman & I. Anwar 6593*). Photos by Irmah Anwar.

rich in species in lowland areas of the CRP. Previous studies have identified the five dominant moss families in the CRP as Calymperaceae, Sematophyllaceae, Pylaisiadelphaceae, Dicranaceae, and Daltoniaceae (Suleiman *et al.*, 2017a). Notably, the highest peak in the CRP, Mount Minduk Sirung (2,076 m asl), was surveyed in earlier research. However, the current study focused on elevations from 500 m to 1,200 m asl, resulting in a limited representation of montane families such as the Dicranaceae and Leucobryaceae (Appendix 1). The extensive survey of several streams near the camp site and along the trail yielded a significant number of species of Neckeraceae, Daltoniaceae, and Fissidentaceae.

Among the 89 species of mosses collected from the study area, 11 are new records for the CRP (Appendix 1). This addition is notably high for a two-day survey in only 4.5 km long trail. The findings increase the total moss taxa count in CRP to 315, accounting for approximately 47% of Sabah's mosses and 40% of Borneo's moss flora. This has highlighted the park as one of the hotspots for moss diversity in Borneo.

Borneo has only about 25 species (*ca.* 3%) of endemic moss species. Low endemism in bryophytes is due to their efficient spore dispersal and ecological versatility, allowing them to colonise diverse habitats across large areas (Glime, 2017; Vanderpoorten & Goffinet, 2009). These factors contribute to their widespread distribution, reducing species confinement to specific regions. One species of Bornean endemic species was collected from Mantailang which is *Racopilum laxirete*

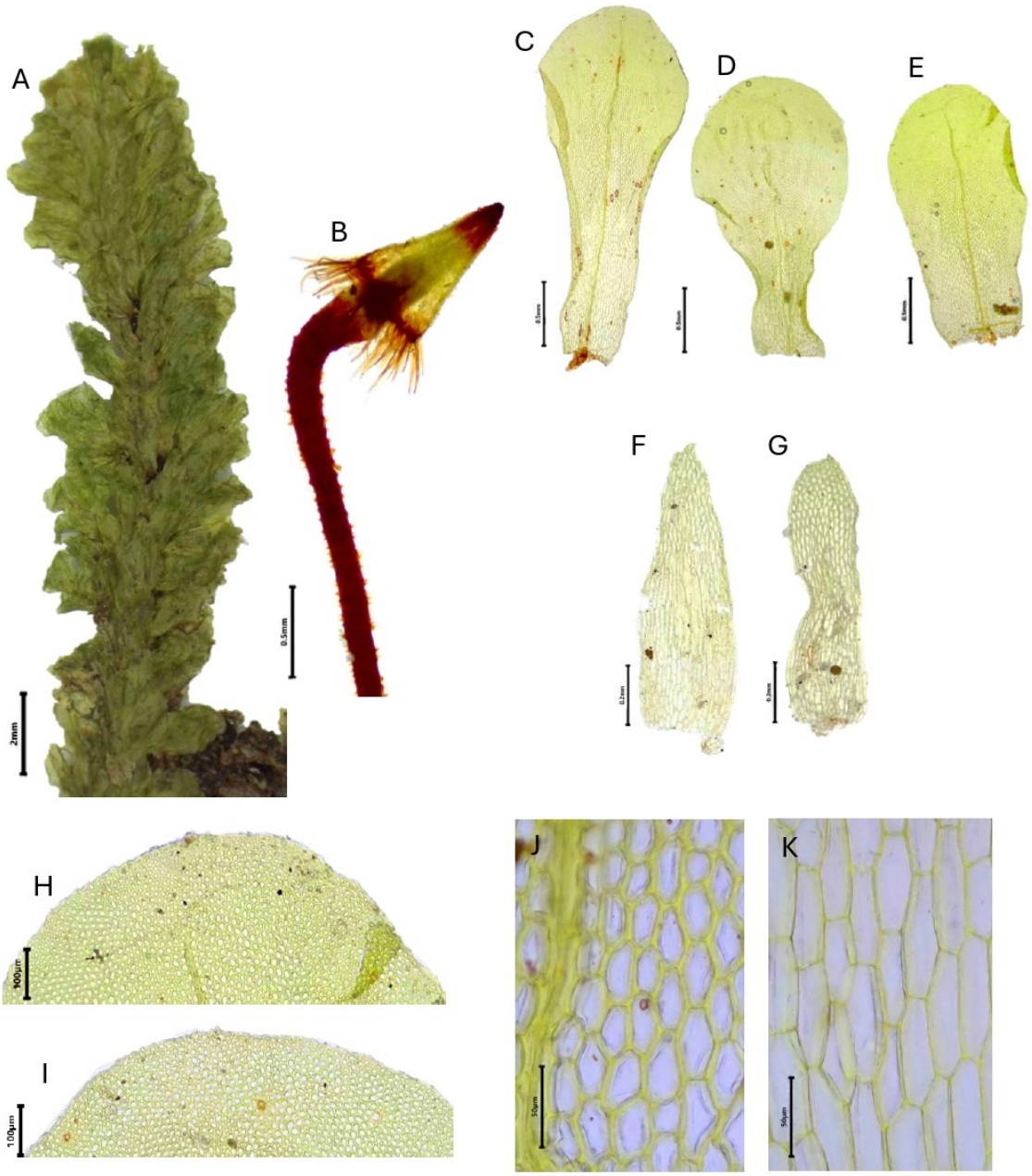

Fig. 3. *Distichophyllum* cf. *undulatum* Dozy & Molk. ex Bosch & Sande Lac. A. Plant. B. Sporophyte. C–E. Leaves. F–G. Perichaetial leaves. H–I. Leaf apices. J. Mid-lamina cells. K. Basal cells. (A–K from *M. Suleiman & I. Anwar 6647*). Photos by Irmah Anwar.

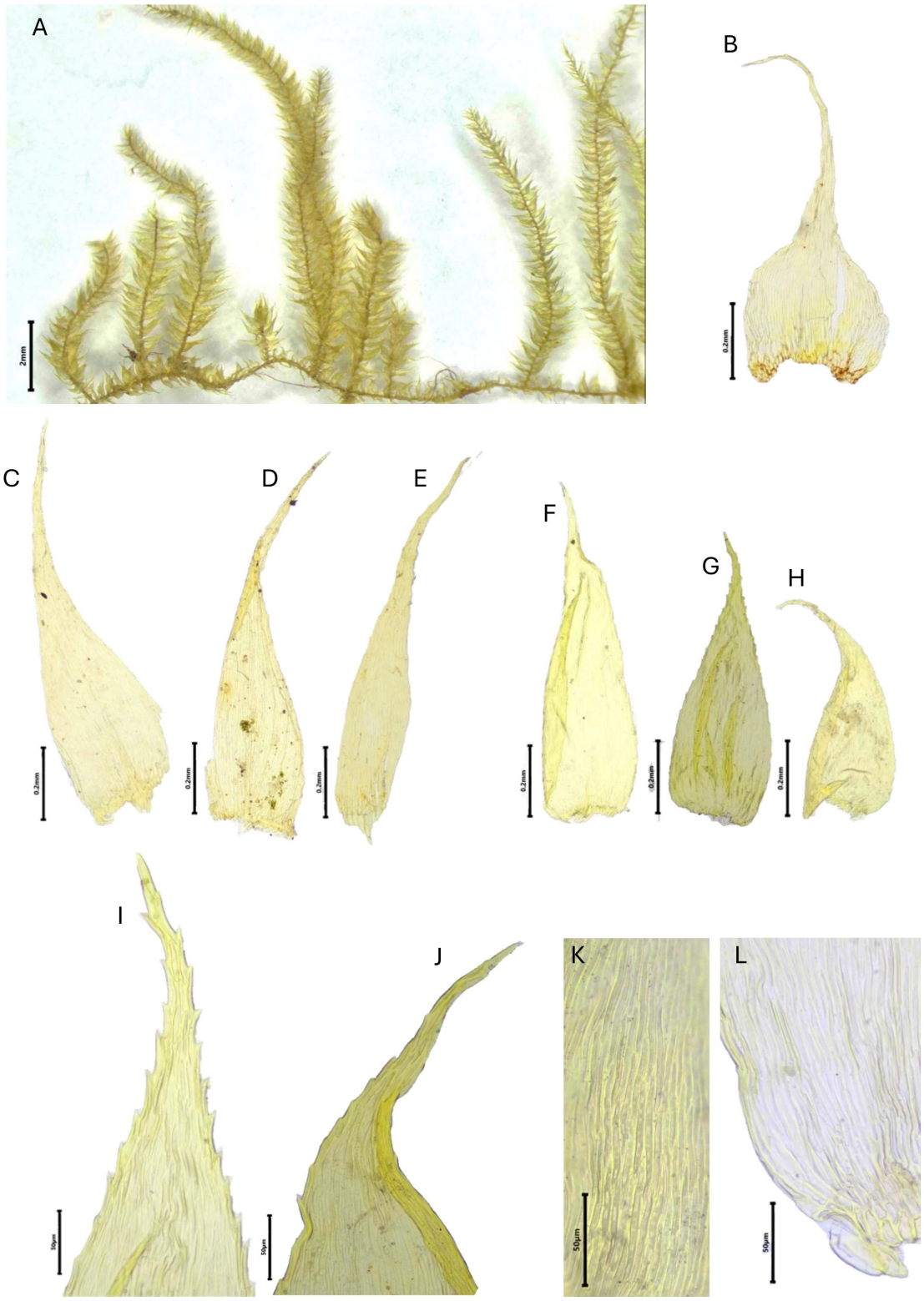

Fig. 4. *Ectropothecium* sp. A. Plant. B. Perichaetial leaf. C–E. Branch leaves. F–H. Stem leaves. I–J. Leaf apices. K. Mid-lamina cells. L. Basal cells. (A–L from *M. Suleiman & I. Anwar 6644*). Photos by Irmah Anwar.

Table 1. Summary of mosses collected from Mantailang, Crocker Range Park, in descending order of species number.

No	Families	Genera	Species
1	Calymperaceae	6	11
2	Neckeraceae	7	9
3	Sematophyllaceae	4	9
4	Daltoniaceae	3	8
5	Fissidentaceae	1	6
6	Leucobryaceae	1	5
7	Pylaisiadelphaceae	4	5
8	Hypnaceae	1	4
9	Spiridentaceae	2	4
10	Thuidiaceae	2	4
11	Dicranaceae	2	3
12	Polytrichaceae	1	3
13	Meteoriaceae	3	3
14	Orthotrichaceae	1	2
15	Ptychomniaceae	1	2
16	Racopilaceae	1	2
17	Hypopterygiaceae	2	2
18	Pterobryaceae	2	2
19	Brachytheciaceae	1	1
20	Callicostaceae	1	1
21	Calomniaceae	1	1
22	Diphysciaceae	1	1
23	Myuriaceae	1	1
	Total	**49**	**89**

Broth. This species has been reported in Sabah, Sarawak and Kalimantan (Akiyama & van Zanten, 1999; van Zanten, 2006; GBIF, 2025). With this addition, the CRP now has four Bornean endemic species (Suleiman *et al.*, 2017a), adding value to this park.

Several of the species collected in the study area are rarely reported in Sabah or Borneo. Examples are *Claopodium prionophyllum* (Müll. Hal.) Broth., *Distichophyllum jungermannioides* (Müll. Hal.) Bosch & Sande Lac., *D. osterwaldii* M. Fleisch., *Ectropothecium penzigianum* var. *rigens* M. Fleisch., *Macromitrium blumei* var. *zollingeri* (Mitt. *ex* Bosch & Sande Lac.) S.L. Guo, B.C. Tan & Virtanen, and *Neolindbergia cladomnioides* H. Akiyama. Some of these species could be widely distributed in Borneo but overlooked because of their small size or misidentified because of the lack of revised keys of certain genera in the Malesian region, such as *Distichophyllum* and *Ectropothecium*.

CONCLUSION

This study expands the known species richness of mosses in the Crocker Range Park, adding new records of 11 species for the park. The presence of rare and endemic species further emphasises the park's importance as a hotspot for bryophyte diversity. Future exploration of other remote areas within the park may yield further discoveries, underscoring the need for continued research and protection of the area.

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APPENDIX

Preliminary checklist of mosses from Mantailang, Crocker Range Park.

The families, genera, and species of mosses were arranged alphabetically. Species reported for the first time for Crocker Range Park is marked with "*" and "+" for species endemic to Borneo. MS – Monica Suleiman; IA – Irmah Anwar.

BRACHYTHECIACEAE

***Claopodium prionophyllum* (Müll. Hal.) Broth.**
On rock, partially shaded, 500 m asl, *MS & IA 6566.*

CALLICOSTACEAE
***Callicostella papillata* (Mont.) Mitt.**
On rock, by stream, partially shaded, 500 m asl, *MS & IA 6577, 6578b.*

CALOMNIACEAE
***Pyrrhobryum spiniforme* (Hedw.) Mitt.**
On rotten log, partially shaded, 850 m asl, *MS & IA 6594.*

CALYMPERACEAE
***Arthrocormus schimperi* (Dozy & Molk.) Dozy & Molk.**
On tree trunk, partially shaded, 600 m asl, *MS & IA 6582.*

***Calymperes afzelii* Sw.**
On tree trunk, by stream, partially shaded, 500 m asl, *MS & IA 6573.*

***Calymperes lonchophyllum* Schwägr.**
On tree trunk, partially shaded, 600 m asl, *MS & IA 6585.*

***Leucophanes octoblepharioides* Brid.**
On tree and shrub trunks, open and partially shaded areas, 600–1,100 m asl, *MS & IA 6579, 6634.*

***Exostratum blumei* (Nees ex Hampe) L.T. Ellis**
On tree trunk, by stream, partially shaded area, 500 m asl, *MS & IA 6570.*

****Mitthyridium jungqulianum* (Mitt. ex Dozy & Molk.) H. Rob.**
On treelet trunk, partially shaded, 1,000 m asl, *MS & IA 6622.*

Note: Leaves 2.2–2.7 × 0.5–0.6 mm with dentate margin. This species can be distinguished from the more common *Mitthyridium undulatum* (Dozy & Molk.) H. Rob. from its much shorter cancellinae which is only 1/4–1/6 of leaf length, and the leaf is linear-lanceolate with less undulate margins.

Illustrations: Eddy, 1990: 137, Fig. 253.

***Mitthyridium undulatum* (Dozy & Molk.) H. Rob.**
On tree trunk, partially shaded, 600 m asl, *MS & IA 6580.*

***Syrrhopodon albovaginatus* Schwägr.**
On tree stump and rotten log, partially shaded, 600–700 m asl, *MS & IA 6583, 6587.*

***Syrrhopodon confertus* Sande Lac.**
On climber, partially shaded, 1,100 m asl, *MS & IA 6631.*

***Syrrhopodon muelleri* (Dozy & Molk.) Sande Lac.**
On tree trunk, by stream, partially shaded, 500 m asl, *MS & IA 6569.*

***Syrrhopodon tristichus* Nees ex Schwägr.**

On climber, partially shaded, 1,100 m asl, *MS & IA 6629.*

DALTONIACEAE
***Calyptrochaeta remotifolia* (Müll. Hal.) Z. Iwats., B.C. Tan & Touw**
On leaf and shrub branch, partially shaded, 1,200 m asl, *MS & IA 6654, 6651.*

***Distichophyllum cuspidatum* (Dozy & Molk.) Dozy & Molk.**
On treelet trunk, partially shaded, 1,200 m asl, *MS & IA 6649.*

****Distichophyllum jungermannioides* (Müll. Hal.) Bosch & Sande Lac.**
On tree trunk, partially shaded, 1,200 m asl, *MS & IA 6653.*

Note: Leaves 1.24–1.49 mm × 0.77–0.85 mm, obovate with narrowed base, apex obtuse and cuspidate with short apiculus of *ca.* 80 μm. The easily detached leaves of this species aids in its identification. This is the second record for Sabah and the third for Borneo (Noguchi & Iwatsuki, 1972; GBIF, 2025).

Illustrations: Mohamed & Robinson, 1991: 23, Fig. 58-64.

***Distichophyllum* cf. *angustifolium* Dixon** (Fig. 2)
On rotten log, partially shaded, 800 m asl, MS & IA 6593.

Note: Leaves up to 2.73 × 0.69 mm, oblanceolate to lingulate-spathulate from long and narrowed base. The leaf cells are large, lax, thin-walled, and more or less uniform in size above, 39–53 μm × 29–39 μm, but much larger below, reaching to 110 × 25 μm. This taxon has all the species characters except for the longer leaf subula (98–147 μm). It also resembles *D. malayense* Damanhuri & Mohamed but the latter has weak costa which is only up to 0.4 of the leaf length and leaf apices are more obtuse with longer subula, reaching 450 μm (Damanhuri & Mohamed, 1986; Ho *et al.*, 2010).

***Distichophyllum spathulatum* (Dozy & Molk.) Dozy & Molk.**
On rotten log, partially shaded, 1,200 m asl, *MS & IA 6655.*

***Distichophyllum* cf. *undulatum* Dozy & Molk. ex Bosch & Sande Lac**. (Fig. 3)
On shrub branch, partially shaded, 1,200 m asl, *MS & IA 6647.*

Note: Leaves obovate to spathulate, up to 2.5 × 1.1 mm, recurved below, slightly rugose above, and margin bordered by elongated cells from the base (1–2 cell rows) to the apices (single cell row). The leaf apices are broadly obtuse with minute apiculus, at most 12 μm tall, and the margin is weak and irregularly denticulate. Leaf cells are more or less homogenous ⅓ above, 12–22 (–26) μm in diameter, becoming gradually bigger below, paracostal cells are 22–41 μm in mid-lamina, and up to 98 × 27 μm at the base. Its costa is strong, reaching ¾ to ⅘ of the leaf length. Calyptra fringed at base with long hairs and the surface scabrous with some short hairs, 12–24 μm long. Perichaetial leaves small, oblong-ovate, apex of the inner ones is short acuminate but outer one are short acute to obtuse. Seta is about 5 mm long and spinose to the base.

This taxon has all the characteristics of the species except for the apex of the outer perichaetial leaves that are not acuminate as illustrated by Dozy & Molkenboer (1855–1870). It can be confused with *Distichophyllum mittenii* Bosch & Sande Lac. but its denticulate margin will separate it from the latter species. *Distichophyllum undulatum* has been reported in Borneo (Dixon, 1935), the Philippines (Shevock & Yorong, 2018), Java, Micronesia, Papua New Guinea, Sumatra and Vietnam (GBIF, 2025).

***Distichophyllum osterwaldii* M. Fleisch.**
On boulder, by stream, partially shaded, 900 m asl, *MS & IA 6598.*

***Ephemeropsis tjibodensis* K.I. Goebel**
On tree trunk, partially shaded, 1,200 m asl, *MS & IA 6650.*

DICRANACEAE
***Dicranoloma assimile* (Hampe) Broth. ex Renauld**
On tree trunk, partially shaded, 1,200 m asl, *MS & IA 6646.*

***Dicranoloma brevisetum* (Dozy & Molk.) Paris**
On rotten log and shrub trunk, partially shaded, 1,105–1,100 m asl, *MS & IA 6633, 6639.*

***Leucoloma molle* (Müll. Hal.) Mitt.**
On rotten log, partially shaded, 1,000 m asl, *MS & IA 6618.*

DIPHYSCIACEAE
***Diphyscium mucronifolium* Mitt. ex Dozy & Molk.**
On rock, partially shaded, 800 m asl, *MS & IA 6592.*

FISSIDENTACEAE
***Fissidens crassinervis* Sande Lac.**
On soil, partially shaded, 1,000 m asl, *MS & IA 6617.*

Fissidens crispulus* Brid. var. *crispulus
On rock and soil, by stream, partially shaded, 500–850 m asl, *MS & IA 6578a, 6599.*

***Fissidens hollianus* Dozy & Molk.**
On tree root, partially shaded, 850 m asl, *MS & IA 6595.*

***Fissidens javanicus* Dozy & Molk.**
On rock, partially shaded, 800 m asl, *MS & IA 6591.*

***Fissidens pallidus* Hook. f. & Wilson**
On rock, partially shaded, 1,100 m asl, *MS & IA 6625.*

****Fissidens guangdongensis* Z. Iwats. & Z.-H. Li**
On termite mount, partially shaded, 1,100 m asl, *MS & IA 6637.*

Note: Leaves up to 1.49 × 0.45 mm, ovate-lanceolate and apices broadly acute to apiculate. The costa which is ceasing 7–8 cells below apex can separate it from *F. pellucidus* Hornsch. which has percurrent apex.

Illustrations: Suzuki, T. & Iwatsuki, Z., 1999: 261, Fig. 1.

HYPNACEAE

****Ectropothecium penzigianum* var. *rigens* M. Fleisch.**
On treelet branch, partially shaded, 1200 m asl, *MS & IA 6660.*

Note: Large plants with stems to 15 cm long and regularly but remotely branched. Stem leaves triangular-lanceolate, slightly cordate and widest at insertion, *ca.* 1.4 × 0.6 mm, and apex falcate and gradually acuminate. Branch leaves are smaller and different in outline, about *ca.* 1.1 × 0.4 mm ovate below and apex more strongly falcate. This is the second record of the species for Borneo (Suleiman *et al.*, 2006).

Illustrations: He, S., 2005; 113, Fig. 640.

***Ectropothecium striatulum* Dixon**
On shrub branch, partially shaded, 1,100 m asl, *MS & IA 6640.*

****Ectropothecium zollingeri* (Müll. Hal.) A. Jaeger**
On rock, by stream, partially shaded, 500 m asl, *MS & IA 6575.*

Note: Plant irregularly pinnate and complanate. Leaves slightly falcate, margin sharply serrulate above and cells are clearly prolulose throughout the leaf.

Illustrations: He, S., 2005; 116, Fig. 642.

***Ectropothecium* sp.** (Fig. 4)
On tree trunk, partially shaded, 1,200 m asl, MS & IA 6644.

Note: The plant habit of this soft-textured moss is similar to the genus *Floribundaria*, which is laxly branched and forming elongated fronds. The stem leaves are very lax, ovate-lanceolate, 0.99 × 0.3 mm, asymmetrical, falcate above with finely acuminate apices and the margin is serrate half above. The branch leaves are *ca.* 0.77 × 0.3 mm, not falcate, very variable in shape, from ovate-lanceolate to narrowly lanceolate, finely acuminate and more sharply serrate.

HYPOPTERYGIACEAE
***Hypopterygium vriesei* Bosch & Sande Lac.**
On rock, by stream, partially shaded, 500–900 m asl, *MS & IA 6576, 6604.*

***Lopidium struthiopteris* (Brid.) M. Fleisch.**
On tree trunk, by stream, open area, 900 m asl, *MS & IA 6607.*

LEUCOBRYACEAE
Leucobryum aduncum* Dozy & Molk. var. *aduncum
On rotten tree, partially shaded, 700 m asl, *MS & IA 6586.*

***Leucobryum arfakianum* Müll. Hal. ex Geh.**
On treelet trunk, partially shaded, 1,100 m asl, *MS & IA 6643.*

***Leucobryum chlorophyllosum* Müll. Hal.**
On rotten log, partially shaded, 1,100 m asl, *MS & IA 6627.*

Leucobryum javense* (Brid.) Mitt. var. *javense
On tree trunk, partially shaded, 1,100 m asl, *MS & IA 6662.*

***Leucobryum sanctum* (Nees ex Schwägr.) Hampe**
On rotten log, partially shaded, 900 m asl, *MS & IA 6616.*

METEORIACEAE
***Cryptopapillaria fuscescens* (Hook.) M. Menzel**
On treelet branch, partially shaded, 1,200 m asl, *MS & IA 6658.*

***Floribundaria intermedia* Thér.**
On rock, partially shaded, 500 m asl, *MS & IA 6574.*

****Pseudotrachypus wallichii* (Brid.) W.R. Buck.**
On treelet trunk, by stream, partially shaded, 900 m asl, *MS & IA 6609.*

Note: This species is very variable in terms of habit, size and colouration. In general, this species has complanate and widely spreading leaves with strongly undulate margins. The stem leaves are *ca.* 1.98 × 0.67 mm while branch leaves are slightly bigger, *ca.* 2.9 × 0.62 mm. The seta is 18 mm long, scabrous almost to the base.

Illustrations: Noguchi, 1976: 297–298, Fig. 26–27.

MYURIACEAE
***Oedicladium rufescens* (Reinw. & Hornsch.) Mitt.**
On tree trunk, partially shaded, 1,100 m asl, *MS & IA 6628.*

NECKERACEAE
***Circulifolium exiguum* (Bosch & Sande Lac.) S. Olsson, Enroth & D. Quandt**
On liana, partially shade, 500 m asl, *MS & IA 6572.*

***Circulifolium microdendron* (Mont.) S. Olsson, Enroth & D. Quandt**
On tree root, partially shaded, 500 m asl, *MS & IA 6562.*

***Himantocladium plumula* (Nees) M. Fleisch.**
On tree trunk, open area, by stream, 900 m asl, *MS & IA 6605.*

***Neckeromnion gracilentum* (Bosch & Sande Lac.) S. Olsson, Enroth, Huttunen & D. Quandt**
On treelet trunk, partially shaded, at ridge, 600 m asl, *MS & IA 6584.*

***Neckeromnion lepineanum* (Mont.) S. Olsson, Enroth, Huttunen & D. Quandt**
On liana, partially shaded, 900 m asl, *MS & IA 6613.*

***Neckeropsis cyclophylla* (Müll. Hal.) S. Olsson, Enroth & D. Quandt.**
On tree root, partially shaded, 500 m asl, *MS & IA 6563.*

***Pinnatella kuehliana* (Bosch & Sande Lac.) M. Fleisch.**
On tree root, partially shaded, by stream, 900 m asl, *MS & IA 6610.*

***Taiwanobryum mucronatum* (Bosch & Sande Lac.) S. Olsson, Enroth & D. Quandt**
On rock, by stream, partially shaded, 500 m asl, *MS & IA 6568.*

***Touwia elliptica* (Bosch & Sande Lac.) S. Olsson, Enroth & D. Quandt**
On rock, by stream, partially shaded, 900 m asl, *MS & IA 6603.*

ORTHOTRICHACEAE
****Macromitrium blumei* var. *zollingeri* (Mitt. ex Bosch & Sande Lac.) S.L. Guo, B.C. Tan & Virtanen**
Canopy epiphyte, partially shaded, 800 m asl, *MS & IA 6590.*

Note: Leaves *ca.* 1.4 × 0.3 mm, lingulate, apex broadly obtuse with a short excurrent costa, awn *ca.* 150 µm. Seta is very short, only ca.7 mm long and smooth. This variety is rarely collected in Borneo and thus far only found on Crocker Range (Suleiman *et al.*, 2024a, b).

Illustrations: Eddy, 1996: 77, Fig. 384. (as *Macromitrium zollingeri* Mitt. ex Bosch & Sande Lac.)

***Macromitrium orthostichum* Nees ex Schwägr.**
On fallen branch, partially shaded, 600 m asl, *MS & IA 6581.*

POLYTRICHACEAE
***Pogonatum cirratum* subsp. *fuscatum* (Mitt.) Hyvönen**
On soil, partially shaded, 1,100 m asl, *MS & IA 6624.*

***Pogonatum iwatsukii* Touw**
On soil, open area, by stream, 900 m asl, *MS & IA 6608.*

***Pogonatum piliferum* (Dozy & Molk.) Touw**
On rock, partially shaded, 700 m asl, *MS & IA 6588.*

PTEROBRYACEAE
****Neolindbergia cladomnioides* H. Akiyama**
On tree trunk, by stream, partially shaded, 900 m asl, *MS & IA 6606.*

Note: Secondary stems erect, up to 4 cm tall, terete and not branched. Leaves *ca.* 3.0 × 1.2 mm, strongly plicate, and apex acute and widely recurved on one side. Leaf margins coarsely serrate, costa not reaching the apex and keeled ⅓ below the apex. The type specimen of this species was collected from Mount Kinabalu in 1961 (Suleiman *et al.*, 2006). This species is also recorded in East Kalimantan (Akiyama, 1992) and the Mindanao Island of the Philippines (Lubos, 2007). This is the third record of this species for Borneo.

Illustrations: Akiyama et al. 1991: 83, Fig. 4a–e.

Symphysodon neckeroides* Dozy & Molk. var. *neckeroides
On fallen branch, partially shaded, 1,000 m asl, *MS & IA 6619.*

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

On climber, partially shaded, 900–1,100 m asl, *MS & IA 6614, 6632.*

***Garovaglia angustifolia* Mitt.**
On treelet trunk, partially shaded, 1,000 m asl, *MS & IA 6623.*

PYLAISIADELPHACEAE
***Isocladiella surcularis* (Dixon) B.C. Tan & Mohamed**
On treelet trunk, partially shaded, 850 m asl, *MS & IA 6596.*

Mastopoma armitii* (Broth. & Geh.) Broth. var. *armitii
On shrub branch and treelet trunk, partially shaded, 1,200 m asl, *MS & IA 6645, 6652.*

***Taxithelium lindbergii* (A. Jaeger) Renauld & Cardot**
On shrub branch, partially shaded, 1,100 m asl, *MS & IA 6636.*

****Trismegistia calderensis* var. *convoluta* K.T. Yong, B.C. Tan & B.C. Ho**
On rock and rotten log, by stream, partially shaded, 900 m asl, *MS & IA 6597, 6615.*

Note: This variety is rigid in habit with well-developed stipes, *ca.* 1.5 cm tall. The stipe and stem leaves are 1.7–2.4 × 0.8–0.9 mm, and apex abruptly long acuminate and twisted. Seta 5 cm and smooth.

Illustrations: Akiyama, 2010: 47–50, Pl. 6–7 (as *T. calderensis* var. *rigida* (Reinw. & Hornsch.) H. Akiyama).

Trismegistia lancifolia* (Harv.) Broth. var. *lancifolia
On treelet trunk, partially shaded, 1,105 m asl, *MS & IA 6641.*

RACOPILACEAE
***+Racopilum laxirete* Broth.**
On boulder, by stream, partially shaded, 500 m asl, *MS & IA 6567.*

Racopilum spectabile* Reinw. & Hornsch. var. *spectabile
On tree trunk, partially shaded, 900 m asl, *MS & IA 6612.*

SEMATOPHYLLACEAE
***Acanthorrhynchium papillatum* (Harv.) M. Fleisch.**
On tree trunk, partially shaded, 900 m asl, *MS & IA 6611.*

Acroporium convolutum* (Sande Lac.) M. Fleisch var. *convolutum
On tree trunk, partially shaded, 1,100 m asl, *MS & IA 6630.*

***Acroporium diminutum* (Brid.) M. Fleisch.**
On treelet branch and liana, partially shaded, 1,200 m asl, *MS & IA 6648, 6657.*

Acroporium hyalinum* (Reinw. ex Schwägr.) Mitt. var. *hyalinum
On fallen branch, partially shaded, 1,200 m asl, *MS & IA 6626.*

Acroporium lamprophyllum* Mitt. var. *lamprophyllum
On fallen branch, partially shaded, 1,000 m asl, *MS & IA 6620.*

***Acroporium rigens* (Broth. ex Dixon) Dixon**
On rotten log, partially shaded, 1,150–1,200 m asl, *MS & IA 6638, 6656.*

****Rhaphidostichum bunodicarpum* (Müll. Hal.) M. Fleisch.**
On rock, by stream, partially shaded, 900 m asl, *MS & IA 6600.*

Note: Plants smaller than *Rhaphidostichum piliferum* (Broth.) Broth., leaves 2.9 × 0.9 mm and arista *ca.* 0.9 mm long. Seta 2 cm long, smooth but rough at extreme tip. Capsule 1.5 mm long and mamillose.

Illustration: Brotherus, 1908: 1123, Fig. 785 (as S*ematophyllum bunodicarpum* (Müll.Hal.) Broth.)

***Rhaphidostichum piliferum* (Broth.) Broth.**
On treelet branch, partially shaded, 1,200 m asl, *MS & IA 6659.*

***Trichosteleum mammosum* (Müll.Hal.) A. Jaeger**
On rock, partially shaded, 700 m asl, *MS & IA 6589.*

SPIRIDENTACEAE
***Dendro-hypnum beccarii* Hampe**
On treelet trunk, partially shaded, 1,100 m asl, *MS & IA 6635.*

***Dendro-hypnum milnei* subsp. *korthalsii (*Bosch & Sande Lac. ex Paris) N.E. Bell, A.E. Newton & D. Quandt**
On rock, by stream, partially shaded, 900 m asl, *MS & IA 6602.*

***Dendro-hypnum subspininervium* subsp. *arborescens* (Mitt.) N.E. Bell, A.E. Newton & D. Quandt**
On climber and treelet trunk, partially shaded, 1,000–1,200 m asl, *MS & IA 6621, 6661.*

***Mniodendron dendroides* (Brid.) Wijk & Margad.**
On tree trunk, partially shaded, 1,200 m asl, *MS & IA 6642.*

THUIDIACEAE
***Thuidium cymbifolium* (Dozy & Molk.) Dozy & Molk.**
On tree trunk and boulder, partially shaded, 500–900 m asl, *MS & IA 6564, 6601.*

Thuidium pristocalyx* (Müll.Hal.) A. Jaeger var. *pristocalyx
On rotten log, partially shaded, 1,200 m asl, *MS & IA 6663.*

***Pelekium velatum* Mitt.**
On liana, partially shaded, 500 m asl, *MS & IA 6565.*

******Pelekium bonianum* (Besch.) Touw**
On tree trunk, partially shaded, 500 m asl, *MS & IA 6571.*

Note: This species can be identified from its low mammillose seta, and the branch leaves are distant and incurved when dry and median leaf cells are clearly with 1–3 papillae. *Pelekium velatum* on the other hand has spinose calyptra and hispid-papillose seta (Touw, 2001). This is the third record of this species for Borneo (Suleiman *et al.*, 2006).

Illustration: Touw, 2001: 111, Fig. 35.