

# A Checklist of Lycophytes and Ferns from Tenompok Forest Reserve, Sabah, with Four Additions to Borneo

Andi Maryani A Mustapeng<sup>#</sup>, John B Sugau

Forest Research Centre, Sabah Forestry Department, PO Box 1407, 90715 Sandakan, Sabah, MALAYSIA.  
<sup>#</sup> Corresponding author. E-Mail: andimaryani.mustapeng@gmail.com; Tel: +6089-536382; Fax: +6089-531068.

**ABSTRACT** A three days botanical survey for lycophytes and ferns study was carried out between 6<sup>th</sup> to 8<sup>th</sup> September 2016 in Tenompok Forest Reserve, Ranau, Sabah. Tenompok Forest Reserve is a Class I Protection Forest Reserve under the jurisdiction of Ranau District Forestry Office of Sabah Forestry Department. This forest reserve is located in the western part of Sabah with an area of 1,984 ha. During the survey, matured specimens were collected along the existing trails, along a drainage, as well as off the trails within the forest reserve. A total of 53 specimens were collected, some common species were also sighted and recorded, but not collected. This checklist also incorporated with previous surveys within the reserve obtained from BRAHMS database system. As a result, 19 families were identified, comprising of 41 genera with 68 species and infraspecific taxa. Among the findings, four species are new records for Borneo, namely *Asplenium steerei* (Aspleniaceae), *Hymenophyllum caudiculatum* var. *productum* (Hymenophyllaceae), *Lindsaea malayensis* (Lindsaeaceae), and *Polystichum prolificans* (Dryopteridaceae). Six species of Bornean endemics were also collected in this survey, including three hyper-endemics to Mt. Kinabalu and surrounding areas, and seven species of ferns are rare and restricted to two or three locality regions. Despite the low number of taxa as compared to Mt. Kinabalu (Kinabalu Park), Tenompok Forest Reserve is an important habitat for rare and endemic lycophytes and ferns of Borneo. Further study should be conducted within this reserve to explore more areas, and to find possibly new records of lycophytes and ferns.

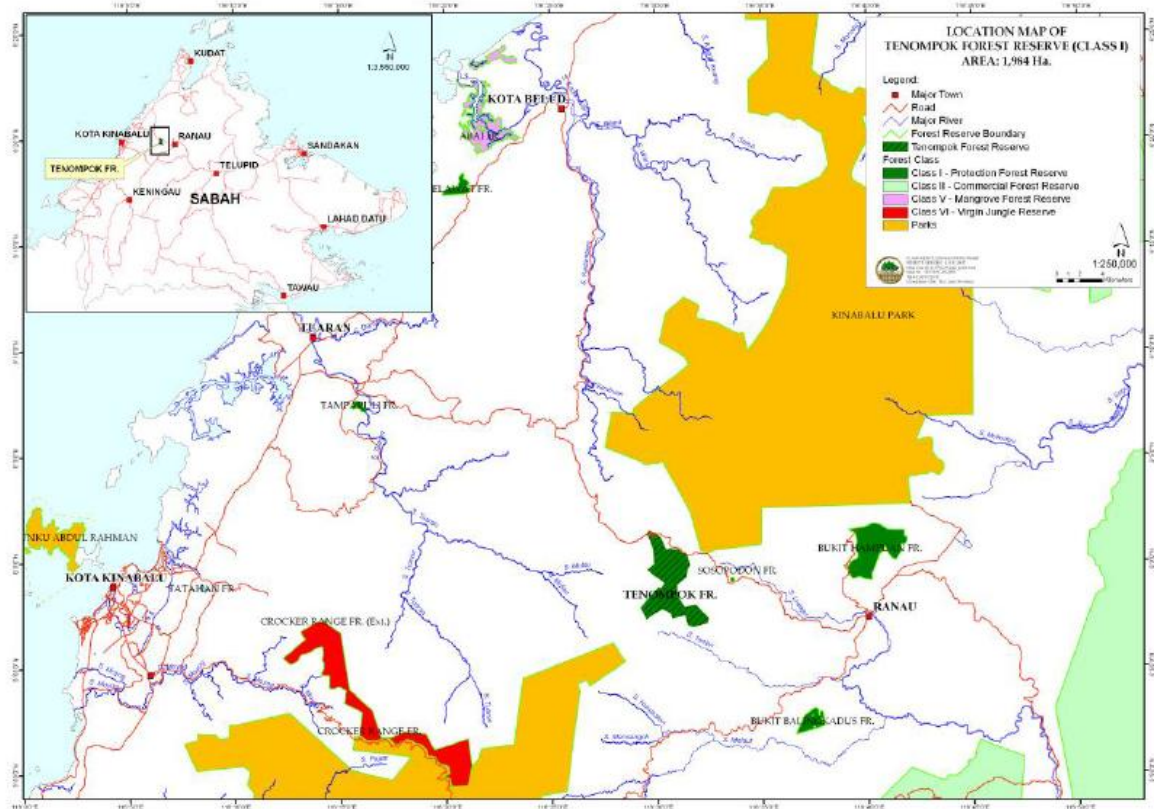
**KEYWORDS:** Borneo, endemic, new records, pteridophyte, Sandakan Herbarium.

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## INTRODUCTION

Tenompok Forest Reserve (Tenompok FR) is a Class I Protection Forest Reserve, located in the western part of Sabah (Figure 1). With an area of 1,984 ha, the forest reserve is under the jurisdiction of Ranau District Forestry Office. The area has never experienced timber extraction activity in the past but was encroached in some parts, e.g. north western and south eastern. The reserve is currently dominated by montane forest with secondary growth especially along the peripheral of the reserve.

The Tenompok FR is located within the Ranau Forestry District and is accessible from the Tamparuli-Ranau road. Ranau district is the nearest town where the key government administrative offices are located. Tenompok FR is surrounded by state land, and the topography is mostly hilly with very steep slope. The highest point is about 1,660 m above sea level in the north with natural vegetation is made up of lower montane forests. The aim of this study is to come out with a latest checklist of lycophytes and ferns from Tenompok FR.



**Figure 1.** Location of Tenompok Forest Reserve in Sabah (Sabah Forestry Department, 2015).

## METHODOLOGY

The Heart of Borneo (HoB) Scientific Expedition organized by the Sabah Forestry Department was conducted from 5<sup>th</sup> to 10<sup>th</sup> September, 2016. During the expedition, botanical survey for lycophytes and ferns was carried out between 6<sup>th</sup> to 8<sup>th</sup> September, 2016 in Tenompok FR, Ranau, Sabah.

A random collection of lycophytes and ferns were carried out where matured specimens were collected along the existing trails, along a drainage, as well as off the trails within the forest reserve. Some common species were sighted and recorded, but not collected. These common species were identified to species level in the field by means of their distinctive field characteristics. For those that could not be readily identified, voucher specimens were collected for subsequent determination at Sandakan Herbarium (SAN). The voucher specimen collections were oven-dried to 55°C for several days before proceeding with the identification process. All specimens were sorted according to morphospecies and attempted for identification to species level by cross-referencing with the existing specimens in the herbarium and related flora references (e.g., Beaman & Edwards, 2007; Chao *et al.*, 2014; Chen *et al.*, 2017; Holttum, 1987, 1991; and etc.). Records of species from BRAHMS database system were also incorporated with the current study.

Plants classification of the lycophyte and fern groups was based on Christenhusz *et al.*, 2011 with additional modification based on World of Ferns (April 2018) and Catalogue of Life (29<sup>th</sup> November 2018) websites.

## RESULTS AND DISCUSSION

From the collections of lycophytes and ferns of Tenompok FR, a total of 68 species and infra-specific taxa were identified from the reserve (Appendix 1). These represented by two lycophytes and 17 ferns families, with three and 38 respective genera (Table 1). Some of the pictures from the collections are as depicted in Appendix 2.

**Table 1.** Number of genera and taxa by plant groups and families from Tenompok FR.

Groups	Family	No. of Genera	No. of Taxa
Lycophytes	Lycopodiaceae	2	2
	Sellaginellaceae	1	3
Ferns	Aspleniaceae	1	4
	Athyriaceae	1	7
	Cyatheaceae	2	4
	Davalliaceae	1	1
	Dennstaedtiaceae	1	1
	Dicksoniaceae	1	1
	Dipteridaceae	2	2
	Dryopteridaceae	3	4
	Gleicheniaceae	2	2
	Hymenophyllaceae	3	5
	Lindsaeaceae	3	5
	Marattiaceae	1	2
	Nephrolepidaceae	1	2
	Polypodiaceae	6	7
	Pteridaceae	3	4
	Tectariaceae	2	3
Thelypteridaceae	5	9	
Sum		41	68

Of the 68 species and infra-specific taxa that been recorded, six species are endemic to Borneo. They are *Angiopteris ferox* (Marattiaceae), *Lindsaea crispa* (Lindsaeaceae), *Selaginella brevipes* (Selaginellaceae), and three species from Thelypteridaceae family: *Mesophlebion dulitense*, *Pronephrium firmulum*, and *Sphaerostephanos baramensis* (Appendix I). Out of these six endemics species, three are hyper-endemic to Mt. Kinabalu and surrounding areas including Tenompok FR, viz *Angiopteris ferox*, *Mesophlebion dulitense*, and *Selaginella brevipes*.

Among the species collected, four are new additions to Borneo: *Asplenium steerei* (Aspleniaceae), *Hymenophyllum caudiculatum* var. *productum* (Hymenophyllaceae), *Lindsaea malayensis* (Lindsaeaceae), and *Polystichum prolificans* (Dryopteridaceae). *Asplenium steerei* was previously reported from Moluccas, New Caledonia, New Guinea, the Philippines, Solomon Island, and Taiwan (Hassler, 2018). *Hymenophyllum caudiculatum* var. *productum* was first recorded from Argentina, Chile, and Juan Fdz. Isl (Hassler, 2018). *Lindsaea malayensis* was previously restricted in two localities, Peninsular Malaysia, and Thailand (Hassler, 2018). *Polystichum prolificans* was previously reported from Peninsular Malaysia, Sumatra, Thailand, and Moluccas (Hassler, 2018).

Other than that, seven species of ferns are restricted to two-three regions and considered as rare species worldwide. *Aenigmopteris dubia* is restricted to Borneo (Chen *et al.* 2017), and the Philippines; *Sphaeropteris trichodesma* is restricted to Borneo, and Peninsular Malaysia; *Diplopterygium bullatum* is restricted to Borneo, and New Guinea; *Alsophila commutata* and *Sphaerostephanos neotoppingii* are restricted to Borneo, Peninsular Malaysia, and Sumatra; *Diplazium porphyrorachis* is restricted to Borneo, Peninsular Malaysia, and Sulawesi; *Dicksonia mollis* is restricted to Borneo, the Philippines, and Sulawesi.

From the collections, the biggest family is Tectariaceae with nine taxa, followed by Athyriaceae and Polypodiaceae, with seven taxa reported for each. Three families reported only a single taxon, viz Davalliaceae, Dennstaedtiaceae, and Dicksoniaceae.

## CONCLUSION

The surveys recorded 68 species and infra-specific taxa from the reserve, of which six species of ferns are endemic to Borneo, including three hyper-endemic species to Mt. Kinabalu and surrounding areas, including Tenompok FR, Sabah. Although Tenompok FR has a relatively small area, four new Bornean records of ferns were collected during the short survey. This demonstrates that there is still incomplete knowledge of the fern richness in Borneo, specifically in Sabah state, which has diverse habitats. Thus, more explorations are needed in order to ascertain the richness and diversity of lycophytes and ferns in this region. The forests in Tenompok FR contain high conservation value plant species. Despite a low number of taxa as compared to Mt. Kinabalu (Kinabalu Park), Tenompok Forest Reserve is an important habitat for rare and endemic lycophytes and ferns in Borneo.

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**APPENDIX 1.** List of lycophytes and ferns species recorded from Tenompok Forest Reserve. The species are arranged by family in alphabetical order, and follows Christenhusz *et al.* (2011) with additional modification based on World of Ferns (April 2018) and Catalogue of Life (29<sup>th</sup> November 2018) websites. Remark: (#) Endemic to Borneo; (+) New record to Borneo.

Family	Genus	Species
<b>LYCOPHYTES</b>		
Lycopodiaceae	<i>Lycopodium</i>	<i>Lycopodium clavatum</i> L.
	<i>Palhinhaea</i>	<i>Palhinhaea cernua</i> (L.) Carv. Vasc. & Franco
Selaginellaceae	<i>Selaginella</i>	<i>Selaginella brevipes</i> A.Br.# <i>Selaginella intermedia</i> (Bl.) Spring <i>Selaginella plana</i> (Desv. ex Poir.) Hieron.
<b>FERNS</b>		
Aspleniaceae	<i>Asplenium</i>	<i>Asplenium nidus</i> L. <i>Asplenium scolopendrioides</i> J.Sm. <i>Asplenium steerei</i> Harr.+ <i>Asplenium unilaterale</i> Lam.
Athyriaceae	<i>Diplazium</i>	<i>Diplazium cordifolium</i> Bl. var. <i>cordifolium</i> <i>Diplazium cordifolium</i> Bl. var. <i>pariens</i> (Copel.) C.Chr. <i>Diplazium esculentum</i> (Retz.) Sw. <i>Diplazium porphyrorachis</i> (Bak.) Diels <i>Diplazium riparium</i> Holtt. <i>Diplazium sikkimense</i> (C.B.Cl.) C.Chr. <i>Diplazium tomentosum</i> Bl.
Cyatheaceae	<i>Alsophila</i>	<i>Alsophila borneensis</i> (Copel.) R.M.Tryon <i>Alsophila commutata</i> Mett.
	<i>Sphaeropteris</i>	<i>Sphaeropteris glauca</i> (Bl.) R.M.Tryon <i>Sphaeropteris trichodesma</i> (Scort. ex Bedd.) R.M.Tryon
Davalliaceae	<i>Davallia</i>	<i>Davallia hymenophylloides</i> (Bl.) Kuhn
Dennstaedtiaceae	<i>Microlepia</i>	<i>Microlepia hookeriana</i> (Wall.) Presl
Dicksoniaceae	<i>Dicksonia</i>	<i>Dicksonia mollis</i> Holtt.
Dipteridaceae	<i>Cheiropleuria</i>	<i>Cheiropleuria bicuspis</i> (Bl.) C.Presl
	<i>Dipteris</i>	<i>Dipteris conjugata</i> Reinw.
Dryopteridaceae	<i>Dryopteris</i>	<i>Dryopteris</i> cf. <i>subarborea</i> (Bak.) C.Chr.
	<i>Pleocnemia</i>	<i>Pleocnemia conjugata</i> (Bl.) C.C.Presl <i>Pleocnemia irregularis</i> (C.Presl) Holtt.
	<i>Polystichum</i>	<i>Polystichum prolificans</i> Alderw.+
Gleicheniaceae	<i>Diplopterygium</i>	<i>Diplopterygium bullatum</i> (T.Moore) Parris
	<i>Gleichenia</i>	<i>Gleichenia microphylla</i> R.Br.
Hymenophyllaceae	<i>Abrodictyum</i>	<i>Abrodictyum obscurum</i> (Bl.) Ebihara & K.Iwats. <i>Abrodictyum pluma</i> (Hook.) Ebihara & K.Iwats.
	<i>Cephalomanes</i>	<i>Cephalomanes singaporianum</i> v.d.Bosch
	<i>Hymenophyllum</i>	<i>Hymenophyllum caudiculatum</i> var. <i>productum</i> (C.Presl) C.Chr.+ <i>Hymenophyllum pilosissimum</i> C.Chr.

## APPENDIX 1 (cont)

Lindsaeaceae	<i>Lindsaea</i>	<i>Lindsaea crispa</i> Bak.# <i>Lindsaea malayensis</i> Holtt.+ <i>Lindsaea pectinata</i> Bl.
	<i>Odontosoria</i>	<i>Odontosoria chinensis</i>
	<i>Tapeinidium</i>	<i>Tapeinidium biserratum</i> (Bl.) Alderw.
Marattiaceae	<i>Angiopteris</i>	<i>Angiopteris evecta</i> (Forst.) Hoffm. <i>Angiopteris ferox</i> Copel.#
Nephrolepidaceae	<i>Nephrolepis</i>	<i>Nephrolepis davallioides</i> (Sw.) Kunze <i>Nephrolepis hirsutula</i> (G.Forst.) Presl
Polypodiaceae	<i>Aglaomorpha</i>	<i>Aglaomorpha drynarioides</i> (Hook.) M.C.Roos
	<i>Goniophlebium</i>	<i>Goniophlebium percussum</i> (Cav.) Wagner & Grether <i>Goniophlebium subauriculatum</i> (Bl.) Presl
	<i>Lepisorus</i>	<i>Lepisorus mucronatus</i> (Fee) Li Wang
	<i>Microsorium</i>	<i>Microsorium heterocarpum</i> (Bl.) Ching
	<i>Phymatosorus</i>	<i>Phymatosorus membranifolius</i> (R.Br.) S.G.Lu
	<i>Selliguea</i>	<i>Selliguea taeniata</i> (Sw.) Parris
Pteridaceae	<i>Adiantum</i>	<i>Adiantum</i> sp.
	<i>Pityrogramma</i>	<i>Pityrogramma calomelanos</i> (L.) Link
	<i>Pteris</i>	<i>Pteris vittata</i> L. <i>Pteris wallichiana</i> Agardh
Tectariaceae	<i>Aenigmopteris</i>	<i>Aenigmopteris dubia</i> (Copel.) Holtt.
	<i>Tectaria</i>	<i>Tectaria decurrens</i> (Presl) Copel. <i>Tectaria pleiosora</i> (Alderw.) C.Chr.
Thelypteridaceae	<i>Coryphopteris</i>	<i>Coryphopteris gymnopoda</i> (Bak.) Holtt.
	<i>Mesophlebion</i>	<i>Mesophlebion dulitense</i> Holtt.#
	<i>Pneumatopteris</i>	<i>Pneumatopteris truncata</i> (Poir.) Holtt.
	<i>Pronephrium</i>	<i>Pronephrium firmulum</i> (Bak.) Holtt.# <i>Pronephrium menisciicarpon</i> (Bl.) Holtt. <i>Pronephrium nitidum</i> Holtt.
	<i>Sphaerostephanos</i>	<i>Sphaerostephanos baramensis</i> (C.Chr.) Holtt.# <i>Sphaerostephanos heterocarpus</i> (Bl.) Holtt. <i>Sphaerostephanos neotoppingii</i> Holtt.

**APPENDIX 2.** Lycophytes and Ferns of Tenompok FR. a. *Aenigmopteris dubia* (Tectariaceae); b. *Diplazium cordifolium* Bl. var. *pariens* (Athuriaceae); c. *Sphaerostephanos neotoppingii* (Thelypteridaceae); d. *Selaginella plana* (Selaginellaceae); e. *Microlepia hookeriana* (Dennstaedtiaceae).

