Mycoheterotrophic plants of Tama Abu Protected Forest, Ulu Baram, Sarawak

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ABSTRACT A 10-day botanical survey was conducted during the Sarawak Heart of Borneo (HoB) Scientific Expedition in Tama Abu Protected Forest, Ulu Baram, Sarawak, from 15th to 25th August 2017. The scientific expedition was organized by Sarawak Forestry Department, which aim to document the variety of rich flora and fauna in Tama Abu Protected Forest. From the survey, four (4) families of mycoheterotrophic plants of angiosperms group were discovered, they are Burmanniaceae, Orchidaceae, Polygalaceae and Triuridaceae. These comprise of seven (7) genera and 12 species reported for this protected forest. Among the species, *Epirixanthes confusa* and *Gymnosiphon aphyllus* are recorded for the first time in Sarawak. Two species endemics to Bornean region, *Cystorchis saprophytica* and *Epirixanthes confusa*. Orchidaceae and Polygalaceae families are the most diverse families, with four recorded species for each. Most of the species recorded from pristine mixed dipterocarp forest with high humidity, except *Gymnosiphon aphyllus* and *Sciaphila winkleri*. These findings could be underrepresented the richness of mycoheterotrophic plants in Tama Abu, as this group of plant is easily over-looked due to their tiny size and dull colour that blend into the background colour of forest floor. The diversity of mycoheterotrophic plants in Borneo is expected to be high as the environment in Borneo is suitable for them to grow. However, most of the mycoheterotrophic plants are under-studied as they were rarely collected.

KEYWORDS: Mycoheterotroph, Heart of Borneo, endemic species, Borneo

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INTRODUCTION

The infamous Tama Abu Range is a stretch of mountainous range in Pulong Tau National Park, Ulu Baram, Sarawak, Borneo. The expedition site situated in Tama Abu Protected Forest at Southeastern part of Pulong Tau National Park, about N 03°18′37.1″, E 115°28″48.7″ (Figure 1).

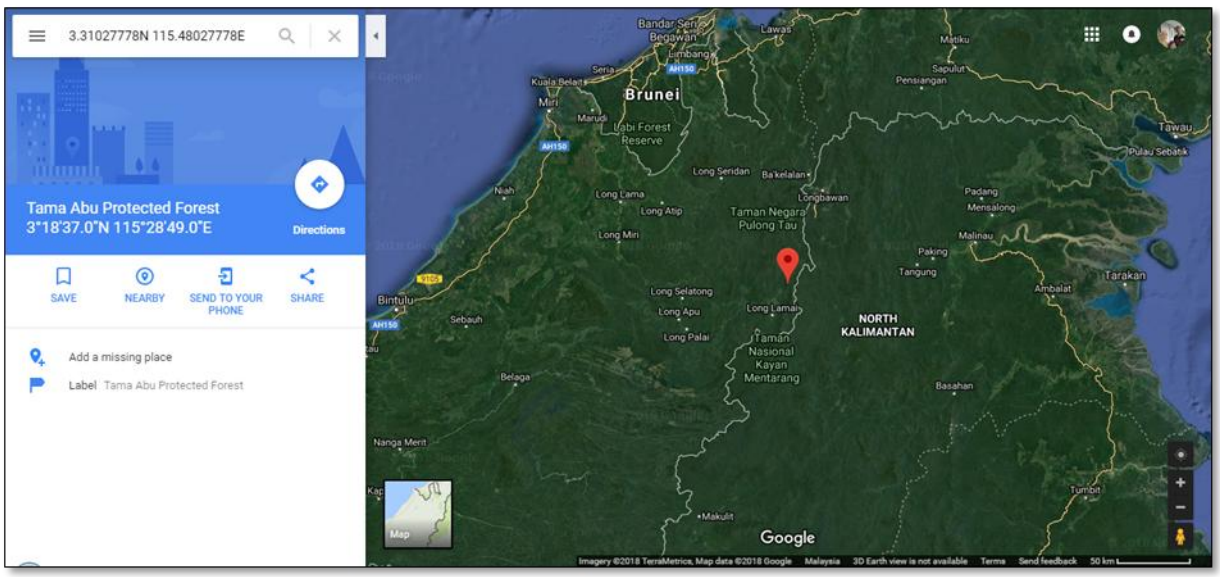

Figure 1. The location of Tama Abu Protected Forest at Southeastern part of Pulong Tau National Park (retrieved from Google Maps on 21st March, 2018)

The expedition site is mainly covered by lowland to hill mixed dipterocarp forest, ranging from 600 to 1,200 m a.s.l. Logging trails within the expedition site are the evident of logging activity in the past. The main river flowing in the expedition area is Sungai Baleh where riparian vegetation is found along the rivers and streams. Sub-montane mossy kerangas forest can be found along ridges on the highest peak. The expedition area is still considered pristine as many large dipterocarp trees above 60 cm diameter can be seen in the area.

Mycoheterotroph plant are sometimes mistakenly called as saprophyte, only fungi are true saprophyte as they can utilize dead organic material directly. Mycoheterotroph plants are partly or entirely non-photosynthesis plants that obtain food from mycorrhiza fungi that grow on its roots (Merckx et al. 2009). They parasitise fungi at their roots for energy and nutrient. These interesting plants are tiny, short-lived, above ground and thrive well in lowland primary rainforest, mainly near water sources. The flora of Borneo is very diverse in mycoheterotrophic plant species due to its rich vegetation, high precipitation and high temperature. The expedition site is close to river and stream, and it is suitable for mycoheterotroph plants.

METHODOLOGY

The 10-day field surveys were conducted along the transect that accessible and prepared by the organizer. Each transect is about 2–4 km long, cutting through forests and streams. Collection of plants were made following standard Herbarium Collection Method. Each collected specimen is placed at Botanical Research Centre (BRC) collection room, and a duplicate is distributed to Sarawak Herbarium (SAR). For small plants, spirit collection method was used. The spirit collections are placed at BRC collection room. Identification of the plants based on published paper (Cheek & Burgt 2010; Dancak et al. 2017; Dang Van Son et al. 2015; Tsukaya et al. 2016 and etc.), and collaborative work with experts.

RESULT

Twelve species of mycoheterotrophic plants from family Burmanniaceae, Orchidaceae, Polygalaceae and Triuridaceae were recorded from the expedition site. Brief information and pictures of each species is provided below according to their respective family.

1. BURMANNIACEAE

1.1 *Burmannia championii* Thwaites

Small plant, about 10 cm tall (Fig. 2). Whole plant white, inflorescence arranged at apex of stem, 8-flowered. Only one specimen found, on riparian forest along Sg. Baleh at 686 m a.s.l. Species were reported from Brunei, Sabah, Sarawak and Kalimantan within Bornean region.

Global distribution: Borneo, China southeast, India, Japan, Java, Korea, Peninsular Malaysia, Maluku, Nansei-shoto, New Guinea, Nicobar Island, Sri Lanka, Sumatra, Taiwan, Thailand and Vietnam.

1.2 B*urmannia lutescens* Becc.

Slender plants grow in solitary or in clumps, about 9–15 cm tall, sometime branching (Fig. 3). Inflorescence 1–4-flowered, whitish with yellowish outer tepals. Growing abundantly when it was found, mostly on pristine mixed dipterocarp forests with high humidity at 700-800 m a.s.l. Species is widely distributed within Bornean region.

Global distribution: Bismarck Archipelago, Borneo, Java, Peninsular Malaysia, New Guinea, Sulawesi and Sumatra.

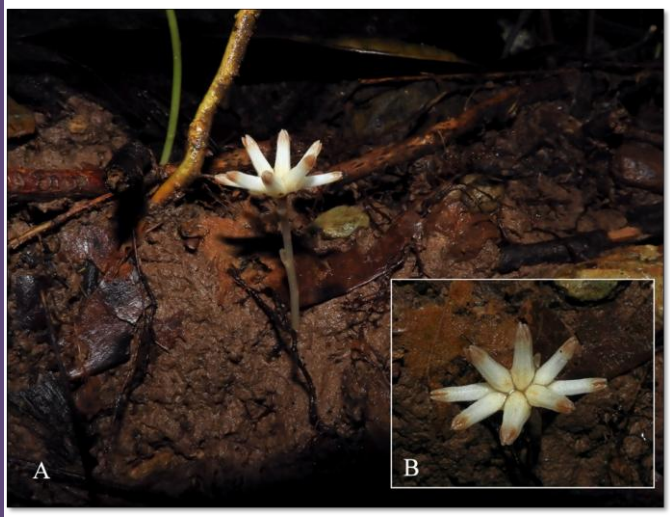

Figure 2. A. Habit; B. Close-up of inflorescence. Photos of SFC8434 by Ling Chea Yiing.

Figure 3. A. Habit; B. Close-up of flowers showing the tepals. Photos of SFC8420 by Ling Chea Yiing.

1.3 *Gymnosiphon aphyllus* Blume

Small plant about 9.5 cm tall, stem red-brown (Fig. 4). Inflorescence on top of the plant, flowers red-brown, 5–7 mm tall. Only one specimen, found at kerangas forest above 1,000 m a.s.l. Species usually having white to pale yellow stems, and found growing at the lower altitude forest. In Borneo, species is recorded in Brunei, Sabah, Kalimantan, and a new record for Sarawak.

Global distribution: Borneo, Caroline Island, Java, Lesser Sunda Island, Peninsular Malaysia, New Guinea, Sulawesi, Sumatra, Taiwan and Thailand.

Figure 4. Inflorescence of SFC8495 by Ling Chea Yiing.

2. ORCHIDACEAE

2.1 *Aphyllorchis montana* Rchb.f.

A tall plant, more than 1 m tall, grow on solitary, rarely in clump (Fig. 5). Stem whitish with purple stripes. Inflorescence with over 30 flowers, about 10 flowers open at time, flowering in succession. Flower about 2.5 cm wide when open, white with purple marked and stripes on sepals and petals. It can be found mainly on mixed dipterocarp forest along the transect of Sg. Baleh. In Borneo, species was previously reported from Sabah, Sarawak and Brunei.

Global distribution: Assam, Borneo, Cambodia, China, East Himalaya, India, Japan, New Guinea, Peninsular Malaysia, Philippines, Sri Lanka, Sumatra, Taiwan, Thailand and Vietnam.

2.2 ***Aphyllorchis pallida*** **Blume**

A small plant, usually grow in clumps, can grow more than 30 cm tall (Fig. 6). Inflorescence on top of the plant, more than 20 flowers, 1–3 flowers open at a time, flower in succession. Flower about 5 mm wide when open, white with purplish stripes on sepals and petals. This species can be found growing abundantly along ridges and gully below huge trees around the study area. Species is widely distributed within Borneo.

Global distribution: Borneo, Java, Peninsular Malaysia, Philippines, Sumatra, Thailand and Vietnam.

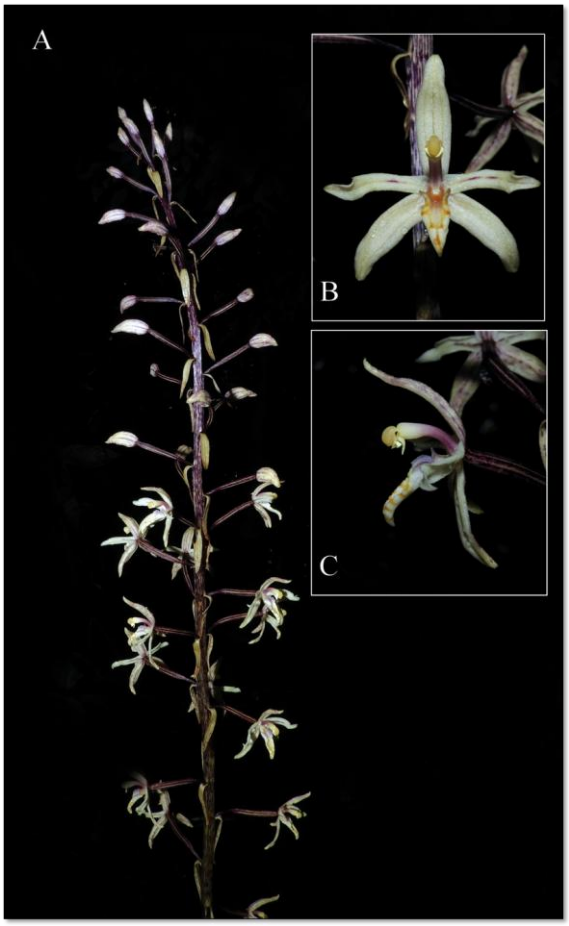

Figure 5. A. Habit; B–C. Close-up of flower. Photos of SFC8462 by Ling Chea Yiing.

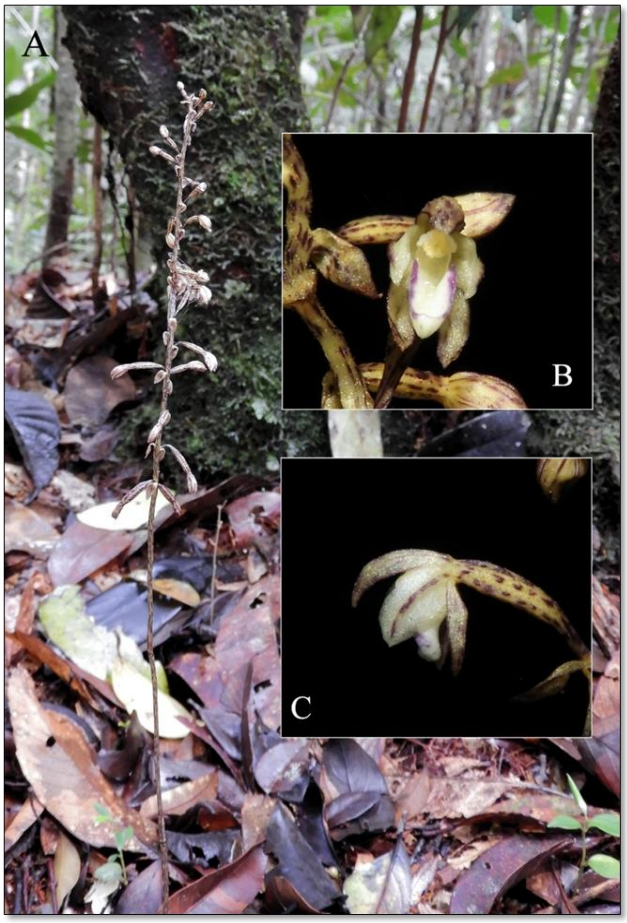

Figure 6. A. Habit; B. Close-up of flower. Photos of SFC8425 by Ling Chea Yiing.

2.3 ***Cystorchis aphylla*** **Ridl.**

This species is about 10 cm tall, with brownish stem (Fig. 7). Inflorescence closely arranged on top of the plant, 4-flowered, open at the same time. Flowers less than 1 cm long, brownish and yellowish. It can be found on forest floor in mixed dipterocarp forest, but not abundant. In Borneo, species was previously found in Sabah, Sarawak and Kalimantan.

Global distribution: Borneo, Java, Peninsular Malaysia, Maluku, Philippines, Sumatra and Thailand.

2.4 ***Lecanorchis multiflora*** **J.J.Sm.**

This species can grow more than 50 cm tall, very slender black stem and branching (Fig. 8). Inflorescence on upper part of the stem, few to many flowers, flowering in succession. Flowers about 1 cm wide when open, with white and hairy lip, other parts brownish. This species found growing on forest floor near riparian and mixed dipterocarp forest. Species was reported previously in Sabah, Sarawak, Brunei and Kalimantan within Borneo.

Global distribution: Borneo, China, Java, Peninsular Malaysia, Sumatra and Thailand.

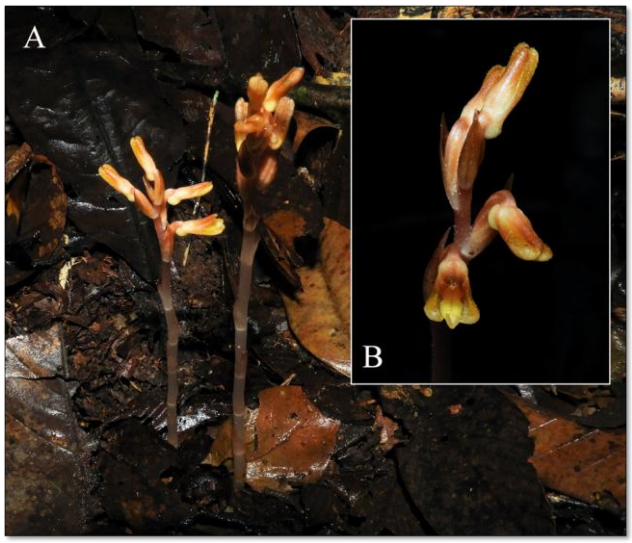

Figure 7. A. Habit; B. Close-up of inflorescence. Photos of SFC8423 by Ling Chea Yiing

Figure 8. A. Habit; B–C. Close-up flower. Photos of SFC8424 by Ling Chea Yiing.

3. POLYGALACEAE

3.1 *Epirixanthes confusa* Tsukaya, M. Suleiman & H.Okada

The species is easily mistakenly identified as *E. elongata* and it differs from the other members of Epirixanthes in having persistent bracts even after fruit maturation, no bracteole, and pointed inflorescence apices. It is a leafless tiny plant, can grow more than 15 cm tall, stem purple and branching (Fig. 9). Flowers minute, about 1 mm wide when open. This species can be found from more than one site from Tama Abu, which is surprisingly one of the most abundant species in the group. It is found mainly on riparian forest along Sg. Baleh with large boulders and steep slopes. Species is endemic to Borneo and was first described from Imbak Canyon Conservation Area of Sabah, and newly recorded for Sarawak.

Global distribution: Borneo.

Figure 9. A. Habit; B. Close-up of inflorescence. Photos of SFC8470 by Ling Chea Yiing.

3.2 *Epirixanthes kinabaluensis* T.Wendt

A tiny plant, about 10 cm tall above ground, with branching stem (Fig. 10). Inflorescence a compact imbricate, with yellow-brown bracts and white flowers. Flowers less than 1 mm wide when open.

This species can be found growing next to *E. confusa* on the forest floor. Species was previously recorded from Sabah and Sarawak within Borneo.
Global distribution: Borneo and Sumatra.

3.3 *Epirixanthes elongata* Bl.

This species is about 15 cm tall above ground, with purple stem, branching. Inflorescence a compact imbricate on top of the plant (Fig. 11). Floral bracts cauducous, it dropped when flowers turn into fruits. Flower is about 2 mm long when open, white in colour. It is found growing abundantly at one locality from the expedition site, on steep slopes of mixed dipterocarp forest. Within Borneo, species occur in Sabah, Sarawak and Kalimantan.
Global distribution: Borneo, China, India, Java, Laos, Moluccas, Peninsular Malaysia, Sumatra, Thailand and Vietnam.

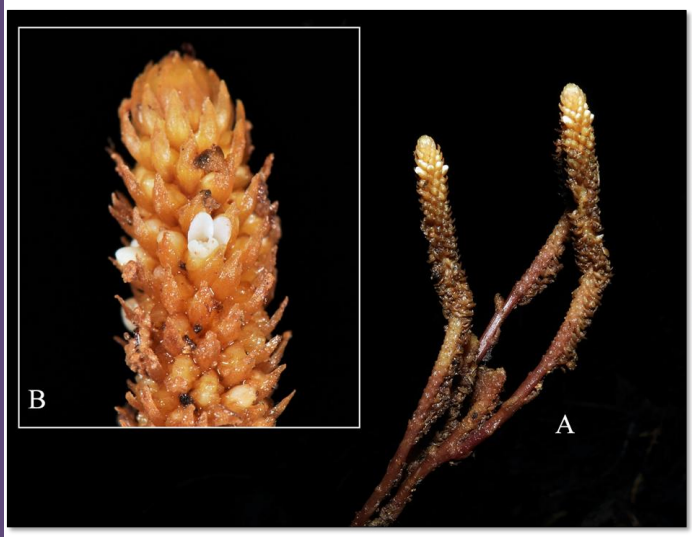

Figure 10. A. Habit; B. Close-up of inflorescence. Photos of SFC8306 by Ling Chea Yiing.

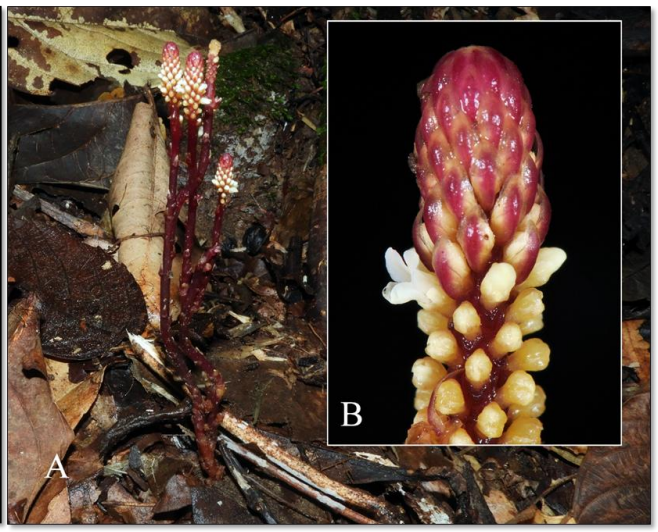

Figure 11: A. Habit; B. Close-up of inflorescence. Photos of SFC8309 by Ling Chea Yiing.

3.4 *Epirixanthes papuana* J.J.Smith

A tiny plant with yellow-brown stem, branching on top, about 10 cm above ground (Fig. 12). Inflorescence a short compact imbricate, 0.5–1 cm long. Flower bracts caducous, yellow-brown, with tiny white flowers. This species was recorded one time from mixed-dipterocarp forest, a tiny species which is easily over-looked. The species was reported previously from Sarawak and Kalimantan within Borneo.
Global distribution: Borneo, Java, Moluccas, New Guinea, Philippines (Luzon), Sumatra and Solomon Island.

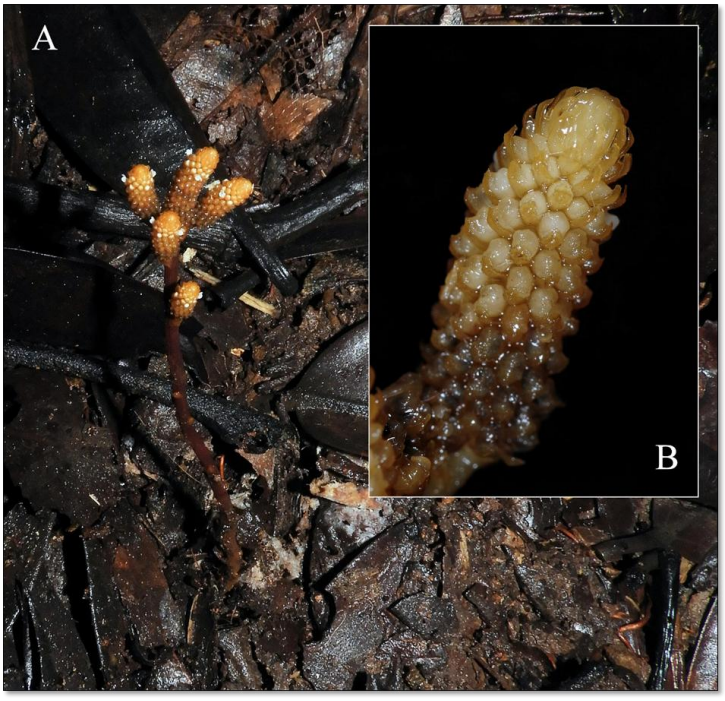

Figure 12. A. Habit; B. Close-up of inflorescence. Photos of SFC8411 by Ling Chea Yiing.

4. TRIURIDACEAE

4.1 *Sciaphila winkleri* Schltr.

This plant is about 12 cm above ground, with purplish stem, branching on top (Fig. 13). Inflorescence on top of the stem, with purplish female flowers below and male flowers at apex. Female flower carpel about 2–3 mm wide, with 6 purplish tepals. Male flower smaller, with three anthers. Fruits about 4 mm wide, berry-like, pinkish in colour. It is recorded from mossy kerangas forest from only one locality. In Borneo, species was reported previously in Sarawak and Kalimantan.

Global distribution: Borneo and New Guinea.

Figure 13. A. Habit of SFC8456 by Ling Chea Yiing.

CONCLUSION

From the 10 days of field survey, 12 species of mycoheterotroph plants of angiosperms group were identified from seven (7) genera and four (4) families. Orchidaceae and Polygalaceae families are the most diverse families, with four (4) recorded species for each. Most of the species recorded from pristine mixed dipterocarp forest with high humidity, except *Gymnosiphon aphyllus* and *Sciaphila winkleri*. Among the species, *Gymnosiphon aphyllus* and *Epirixanthes confusa* are new records for Sarawak. Two (2) species endemics to Bornean region, *Cystorchis saprophytica* and *Epirixanthes confusa*. There were also some species which only restricted to two-three regions which can consider them as a rare species. This number could be under-represented the richness of mycoheterotroph plants in Tama Abu, as this group of plant is easily over-looked due to their tiny size and dull colour that blend into the background colour of forest floor. The diversity of mycoheterotrophic plants in Borneo is expected to be high as the environment in Borneo is suitable for them to grow. This plant group is usually tiny and are less collected by researchers or collectors. As such it is important for researchers to collect them during field works in order to study them. Collaboration with other researchers or experts also important in order to fully understand the diversity of mycoheterotrophic plants in Borneo.

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