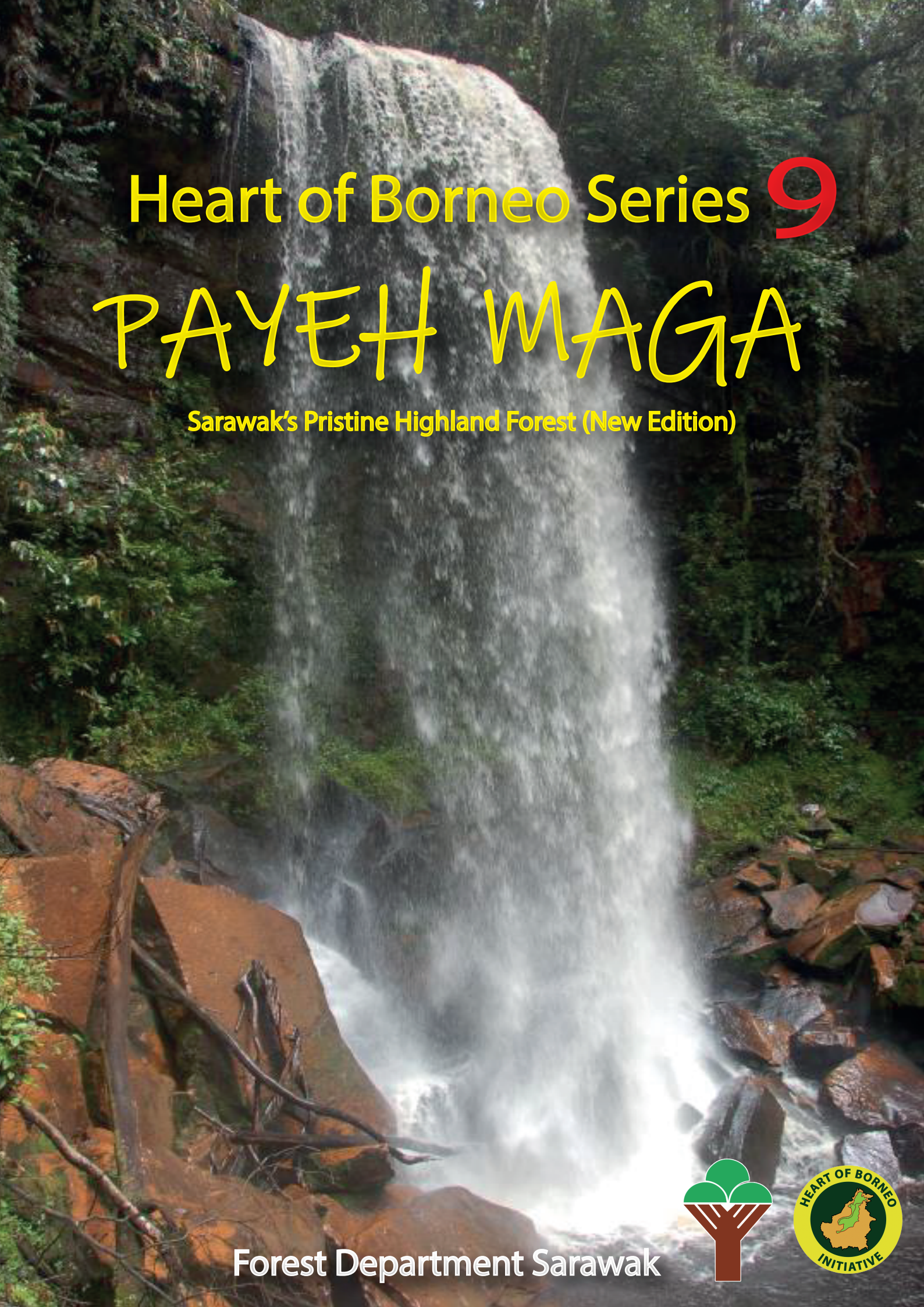


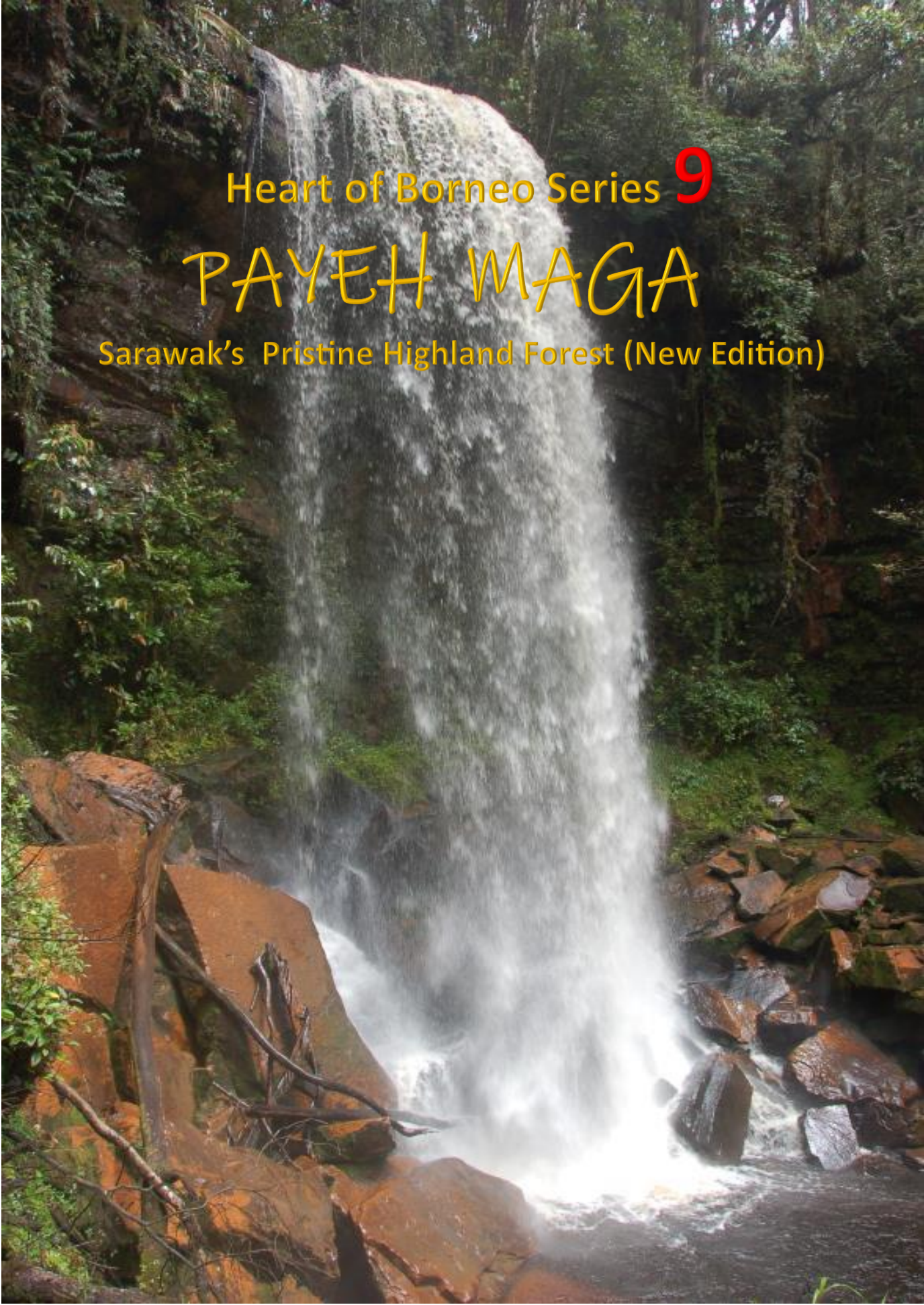
Heart of Borneo Series 9

PAYEH MAGA

Sarawak's Pristine Highland Forest (New Edition)

Forest Department Sarawak

HEART OF BORNEO INITIATIVE


Heart of Borneo Series 9
PAYEH MAGA
Sarawak's Pristine Highland Forest (New Edition)

HEART OF BORNEO SERIES 9

Payeh Maga

Sarawak's Pristine Highland Forest (New Edition)

A PUBLICATION
PROJECT HEART OF BORNEO INITIATIVE FOR SARAWAK

2021



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MESSAGE

Bismillahir-Rahmannir-Rahim, Selawat dan Salam Ke Atas Nabi Muhammad SAW

Assalamualaikum Warahmatullahi-wabarakatuh

I am honoured to be given privilege of writing the message for this publication, *Heart of Borneo Series 2: Payeh Maga – Sarawak's Pristine Highland Forest (New Edition).* I should, first of all congratulates the International Affair Division for their effort to republish (new edition) of this book.

The committee and editorial team deserve much credit for the time and effort put in the success of this book published. Special appreciations go to all the valued contributors who have been courteous to provide paper and photos which concluded into meaningful publication.

Datu Hamden Bin Haji Mohammad
Pengarah Hutan
Jabatan Hutan Sarawak



Forward

Payeh Maga Scientific Expedition: Sarawak's Pristine Highland Forest, was held from 28 September to 12 October 20101 with participation of over 80 researchers and scientists from various government institutions, universities and local NGOs and also participants from Brunei Darussalam and Indonesia. It was conceived as an activity to illustrate and provide invaluable insight to the mystery of Payeh Maga Forest. The expedition was jointly organized by the Forest Department Sarawak and Sarawak Forestry Corporation and mainly funded and supported by the Ministry of Natural Resources and Environment Malaysia and State Government of Sarawak as a continuation project under the Heart of Borneo (HoB) initiative. Payeh Maga Scientific Expedition, in fact is a second scientific expedition conducted in the project that revealed the diverseness of floras and faunas in the State.

I am privileged and honored to write the foreword for this book of very important scientific observations and discoveries on Payeh Maga Forest which ranks as among the superb wilderness areas, not only in Sarawak, but in Malaysia. The book entitled, "The Heart of Borneo Series 9: Payeh Maga – Sarawak's Pristine Highland Forest" is mainly a collection of provisional results that were presented by the participants during the expedition and as well as field observations from the authors.

It is my fervent hope that this publication on the Payeh Maga Forest would provide readers, especially its stakeholders, researchers and the public at large, with extensive references into the Payeh Maga's rich natural resources and its vast scientific potential.

The organizing committee deserves much credit for the time and effort put in for the success of the expedition. Special appreciation goes to all the esteemed writers and researchers who have been gracious to provide the data and photos which culminated into wonderful publication.

Former Director of Forests
Datu Haji Ali Yusop

Preface

This book gives us a glimpse of the findings of the Scientific Expedition to Payeh Maga made in 2010, which was jointly organized by the Forest Department Sarawak and Sarawak Forestry Corporation.

This book is one of the series of publications under the Heart of Borneo Project Initiative for Sarawak. It highlights the results of the 2010 expeditions with photographs and information on activities, the physical environments, flora, and fauna studies.

From the 14-day expedition, a tremendous amount of data was collected by researchers and scientists from various government departments, institutions, universities, and NGOs from Malaysia, Brunei Darussalam and Indonesia. The area covered in the expedition is relatively small, less than 20 percent of the Payeh Maga areas. The biodiversity recorded is exceptionally rich, many species of flora and fauna have been recorded and compiled. From the flora component, orchids and gingers are the two most diverse groups recorded in the Payeh Maga areas. Preliminary results indicate that the orchids with 45 genera consisting approx. 130 species and the gingers with 16 genera comprising more than 40 species have been recorded. Twelve species of Rhododendron were recorded in Payeh Maga which is possibly the highest number for a spot of Rhododendron in Sarawak. Apart from orchids, gingers, and rhododendrons, other plant species from the group of ferns, bryophytes, and fungi are found abundantly in the area. From those plant groups, many new records have been created. The fauna component is also exceptionally rich. Great numbers of mammals, birds, and insects have been recorded which are comparatively high as compared with those in the Lanjak Entimau Wildlife Sanctuary (LEWS).

Apart from the flora and fauna, the atmosphere of Payeh Maga itself is also unique with beautiful sceneries. Indeed, Payeh Maga area is probably the only highland area in Sarawak that is covered with peat swamp vegetation. Many waterfalls and seasoning rock streams with high aesthetic values for ecotourism spots are also found in this area.

Authors

Introduction

Sarawak is the largest component in Malaysia, lies between 0° 50' to 5° N latitude and 109° 30' to 115° 40' E longitude, occupying the northwestern part of Borneo. The coverage area is about equal size to all Peninsular Malaysia. Sarawak encompasses an area of about

12.4 million hectares and has a long-lying coastline approx. 725 km along the South China Sea and as well the widest inland boundary, about 300km long. Kuching is the capital city and also the main entrance for the State, located on the very west of Sarawak. While, Lawas is a small town located at the very end, eastern part of Sarawak, and is the main entrance to the State by land from Sabah.

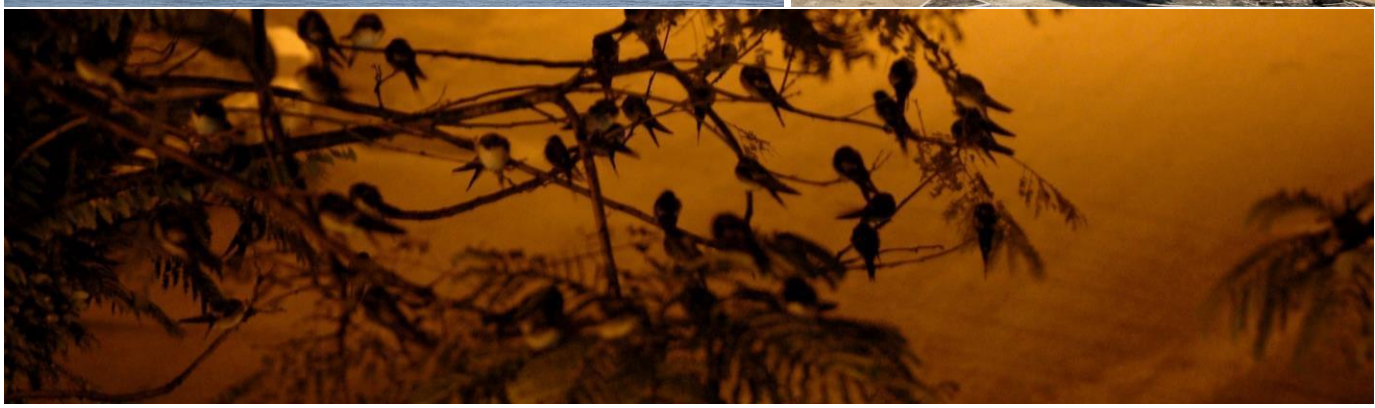


Lawas

The Lawas town is located about 1200km from the Kuching City and 200km from Kota Kinabalu, the capital city of Sabah. This small town, is linked by road to Sabah through the Merapok checkpoint and linked with Brunei Darussalam through the Mengkalap checkpoint.







What is the Heart of Borneo (HoB) Initiative?

Heart of Borneo (HoB) Initiative is a voluntary transboundary cooperation between Brunei, Indonesia and Malaysia to enable conservation and environment protection while enhancing sustainable development that improves

the welfare of those living on the island. The cooperation of the three ASEAN nations was officially launched in Brazil on 27 March 2006. On 12 February 2007, the Minister of Natural Resources and Environment, Malaysia; the Minister of Forestry, Republic of Indonesia and the Minister of Industry and Primary Resources, Brunei Darussalam signed

and jointly issued a Declaration in Bali, Indonesia.



Bali Declaration 2007

In view of the global concerns and controversies about the tropical

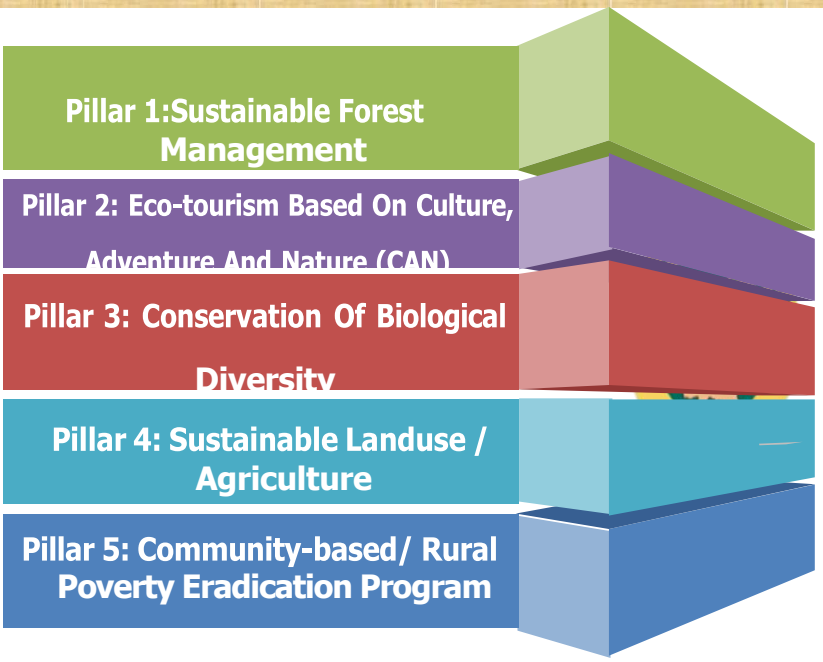
forest development, the long-term objective of the HoB Initiative, as enshrined in the Bali Declaration, is as follows:

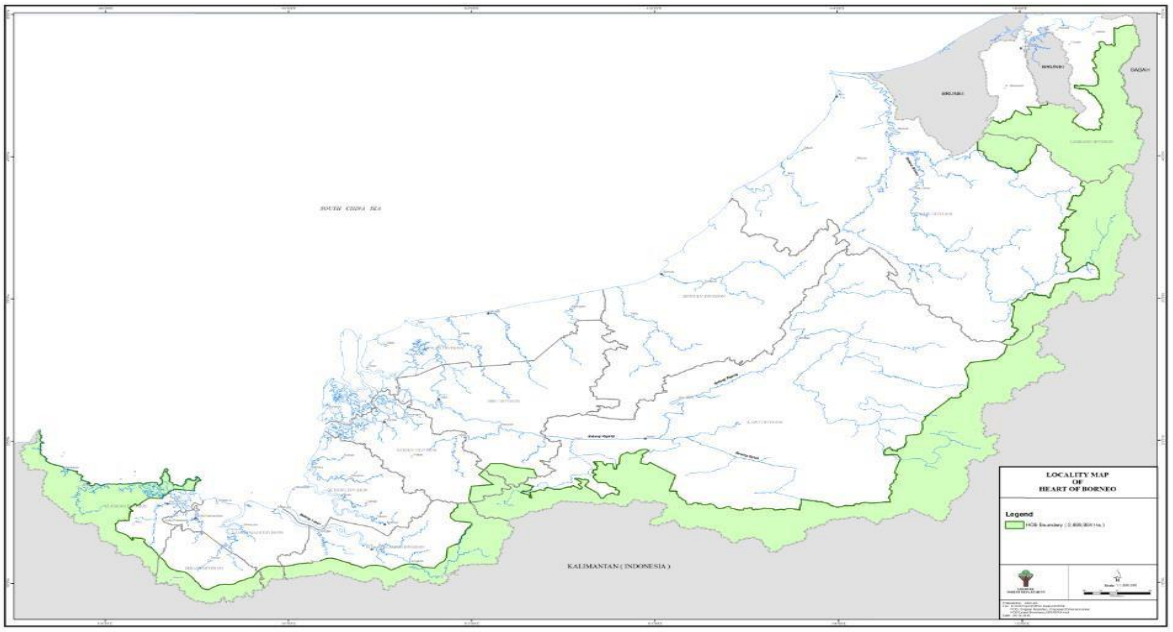
"With one conservation vision and with a view to promote peoples' welfare, we will cooperate in ensuring the effective management of forest resources and conservation of a network of protected areas, productive forests and other sustainable uses".



1	Represents the area designated as the Heart of Borneo area.
2	Represents the boundary of Heart of Borneo.
3	Represents the integrity of the forest which is crucially important. All in gold denoting under the good care of the 3 respective countries.
4	Represents the forest as the core element of the HoB initiative.
5	Represents the Global Earth
6	• Leaves representing the three pillars of sustainable development which are Economic, Social and Environmental requirements. • They are interlinked to represent the importance of forest connectivity for biodiversity conservation.

5 PILLARS OF THE HEART OF BORNEO



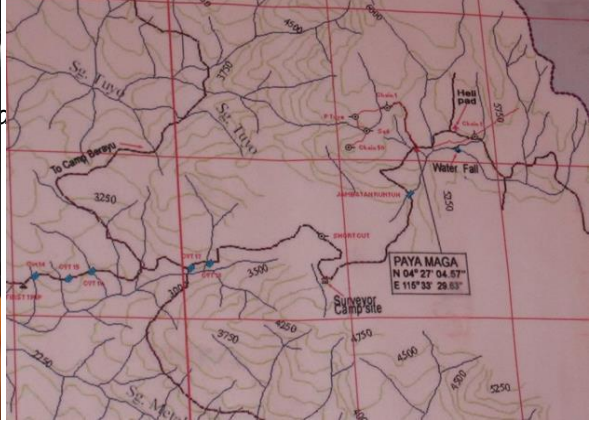


In Sarawak, the HoB covers 2.7 million ha over a contiguous block

along Sarawak's boundaries with Kalimantan and with Sabah and Brunei. The HoB is fully in line with existing policies by both state and federal government.

HoB Sarawak started with a total area of 2.1 million hectares is divided into three regions namely Northern, Central and Southern Regions. In 2018, the HoB areas was extended to 2.7 million hectares and approved by the State Cabinet. The expansion involves the area from Batang Ai to the western region of Sarawak. This covers the Kelingkang Range, Gunung Apeng National Park, Bungo Range National Park, Gunung Pueh National Park, Kubah National Park, Gunung Gading National Park, Samunsam Wildlife Sanctuary, Matang Wildlife Centre, Kuching Wetland National Park, Bako National Park, Sampadi National Park, Santubong National Park and Tanjung Datu National Park.





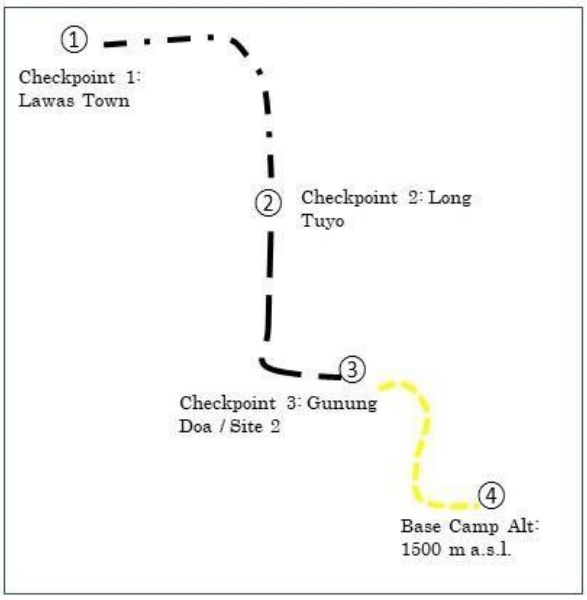


Scientific Expedition to Payeh Maga 2010

The scientific Expedition to Payeh Maga 2010 was organized by the Forest Department Sarawak and Sarawak Forestry Corporation. It was the second expedition made under the Heart of Borneo (HoB) Initiative Project for Sarawak. More than 80 researchers and supporting staffs from various government agencies, institutions, NGOs and local universities involved in this expedition






①
Checkpoint 1:
Lawas Town
②
Checkpoint 2: Long
Tuyo
③
Checkpoint 3: Gunung
Doa / Site 2
④
Base Camp Alt:
1500 m a.s.l.







The Journey

It began from the Lawas town through a dusty logging road and reached checkpoint one at Long Tuyo village, after one and a half hours. Then, the journey continued through the slippery and muddy road to checkpoint three, Gunung Doa. Finally, the journey end at Base camp after 4-5 hours hike.








TOYOTA
QME3655


TOYOTA
QME3655


QSG 1980









The Expedition – Camping Sites

The Base Camp was located on N04° 27' 4.57" and E115° 33' 29.53" at the altitude of 1500 m above sea level. The average temperatures at daytime was 16-22°C and 10-13°C at night. The humidity was above 80%.













2010/09/30



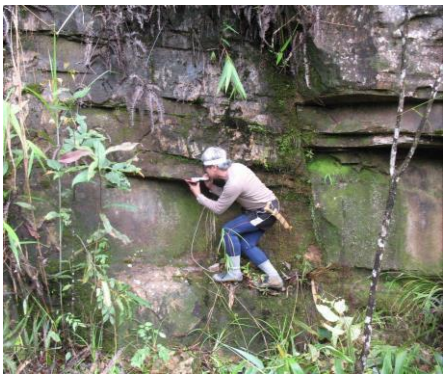






Sampling, collecting and preserving samples are crucial. The methods used varied depending on the type of studies and specimens, i.e. flora and fauna. The collected specimens need to be preserved properly according to the methods, and well taken care of as they are the evidence of the studies.







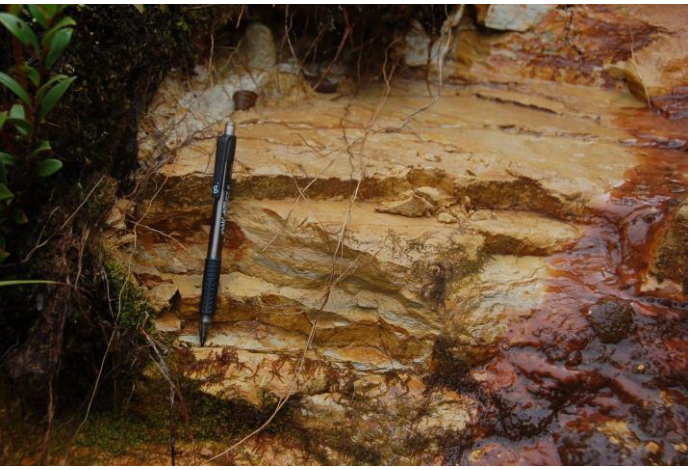




Topography and Geology

The topography of Payeh Maga is rugged throughout the areas with its most strongly dissected terrain located in the east and west sides. Elevation ranges from 500m to 1828m (the summit of Gunung Matalan). There are three major peaks in the area; Gunung Doa at 570m (the lowest peak), Gunung Tuyo (1752m) and Gunung Matalan (1828m).

Basically the Payeh Maga areas are covered with various types of cross-bedded sandstone facies (e.g. Amalgamated sandstone, Fine-grained white sandstone, Sandstone with coal facies and Carbonaceous mudstone), coal and shale.

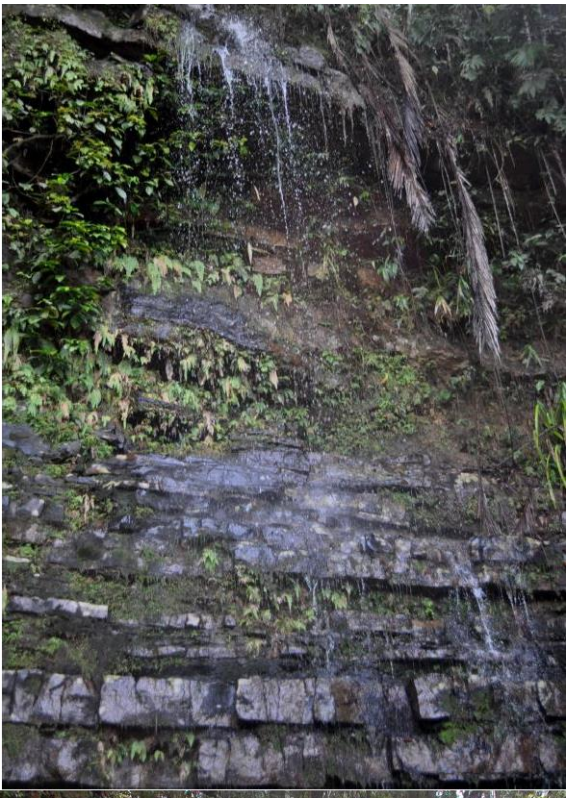


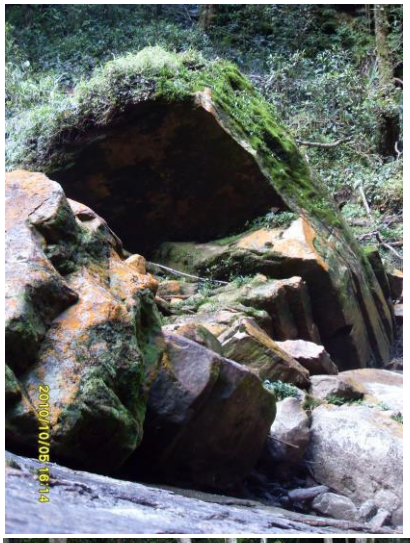




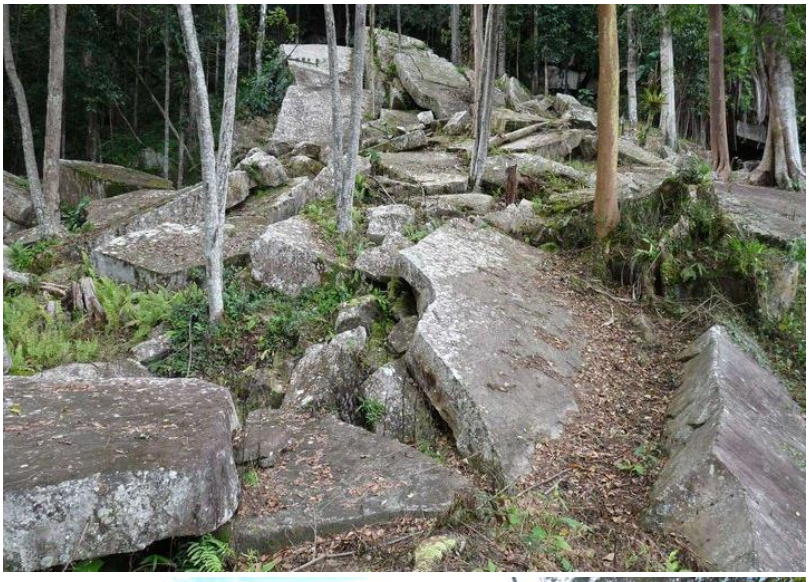


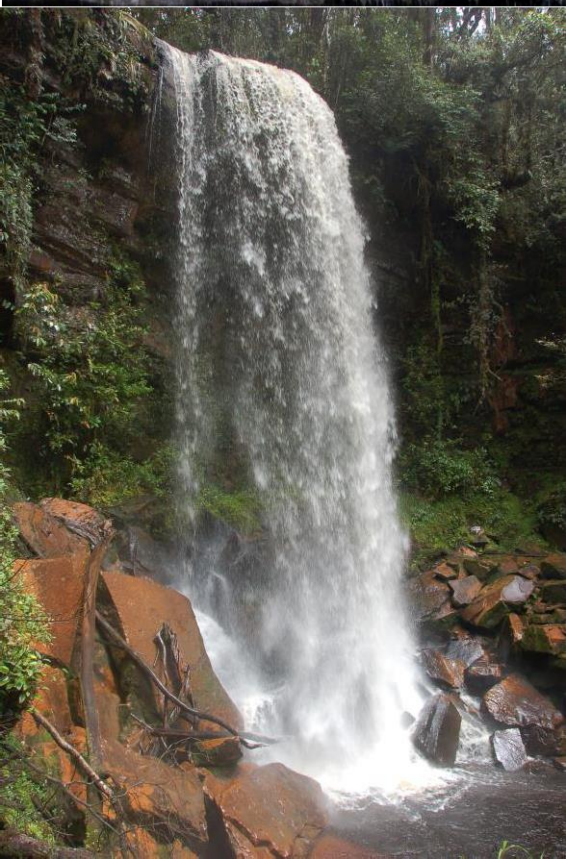
Geographical features of Payeh Maga













The Forests

The Payeh Maga area is part of Murud complexes located on the north-east toward the Lawas town. The areas are including two main peaks, Tuyo peak and Matalan peak with a coverage area of up to few hundreds square meters. The areas consist of four major vegetations, namely hill mixed dipterocarp forest (MDF), peat swamp forest (PSF), sub-montane forest and mossy forest.

Hill MDF is found on the foothill of the Payeh Maga, that includes Gunung Doa, one of the expedition sites. The vegetation is dominated by large and tall dipterocarp trees. The density of herbaceous plants also exceptionally rich particularly the aroids, gingers, gesneriads and ferns. As well as diversity of fauna showed a tremendous diversity, particularly the insects, mammals and birds.



Further up laying another three vegetation; sub-montane forest,

mossy forest and PSF. The sub–montane and mossy forest are dependent on the local climate, which is affected by the distance to

the sea, the exposition and the altitude between 500-4000m. The two vegetation are characterized based on the flora types that is influenced by the frequent or seasonal low-level of cloud cover that usually at the canopy level. Here, the annual rainfall can range from 500-1000mm per year with temperature between 8-25ºC.







The PSF in Payeh Maga area is probably the highest altitude PSF in Sarawak that lay between 1400- 1600m. Preliminary surveys revealed that the tree species occurring here are almost similar to the lowland peat forest (e.g. Copaifera palustris, Goniothalamus andersonii, Macaranga pruinosa, Stemonurus scorpioides etc.).



The Gymnosperm

The gymnosperm is always regarded as a group of natural plant that bears naked seeds with the origin in the late Carboniferous period. Conifers are the largest group of living gymnosperms, mostly are woody plants and evergreens. Among the conifers families that occurred in Payeh Maga are Araucariaceae, Cupressaceae and Podocarpaceae.



The Peeling Bark Tree

The Myrtaceae is the third largest family after Dipterocarpaceae and Euphorbiaceae that dominated the Bornean forests. Most of the members in this family are having important economic and environmental values, e.g. Syzygium.

The peeling bark tree or Selunsur belongs to the genus Tristaniopsis. In Borneo, 11 species with eight subspecies have been recorded. The Selunsur sometimes also known as Melaban or Terkoyong-koyong are easily recognized in the forest because of its peeling bark characteristic.







The Oak Tree

The family Fagaceae is one of important families that are common constituents of the understory, main canopy and rarely emergent layers of the lowland to montane forests in Borneo. Four genera that comprise 100 species were recorded in Borneo with 49 species are endemic to the island and 17 species are restricted to Sabah and Sarawak (Soepadmo et al. 2000). During the expedition, three genera with 7-8 spp. were recorded.







The Magnolias

The Magnolias belong to the Magnoliaceae family. Unlike most angiosperms, whose flower parts are in ring, the Magnolias have their stamens and pistils in spiral on a conical receptacle. The family has approximately 225 species in seven genera. In Payeh Maga, only one species was recorded during the expedition.



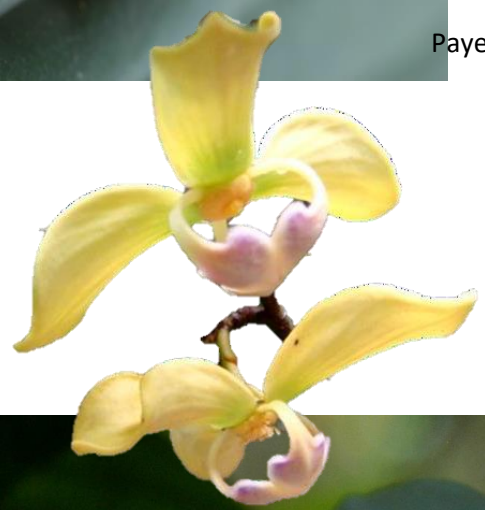




The Soursop Tree Family

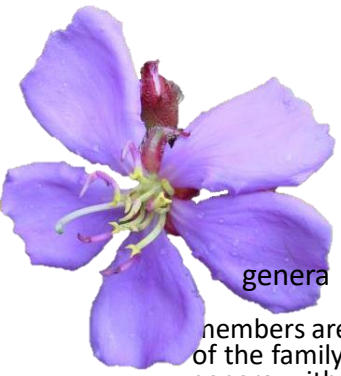
The Annonaceae or also known as "custard apple family" is the largest family in the order Magnoliales with more than 230 genera that consist of 2300-2500 species throughout the world. The members of this family normally are trees, shrubs and rarely lianas.

In Payeh Maga, Goniothalamus and Polyalthia are the two most specious genera within Annonaceae with three species recorded for each genus. The density of individuals for both genera can be found abundantly from the foothill of Payeh Maga towards an altitude 1400m, mostly shrubs or small trees.









The Senduduk Family

The family Melastomataceae comprising some 200 with 4500 genera species distributed mostly in the tropics. The members are annual, perennial, herbs, shrubs, small trees or climbers. The diversity of the family Melastomataceae in Payeh Maga is exceptionally rich with at least 10 genera with more than 30 species have been sighted and recorded. Among the genera are Marumia, Medinilla, Melastoma, Phyllagathis and Sonerila.

Medinilla sp.









Sonerila sp.

Marumia sp.



Melastoma beccarianum

Melastoma

The genus Melastoma or Senduduk or Kemunting is commonly found occupied in young secondary forests or open-spaced. They are mostly shrubs or treelets up to 5 m tall. There are about 50 species distributed around Southeast Asia, India and Australia. At least

oma species have been collected and sighted and collected in Payeh Maga area.

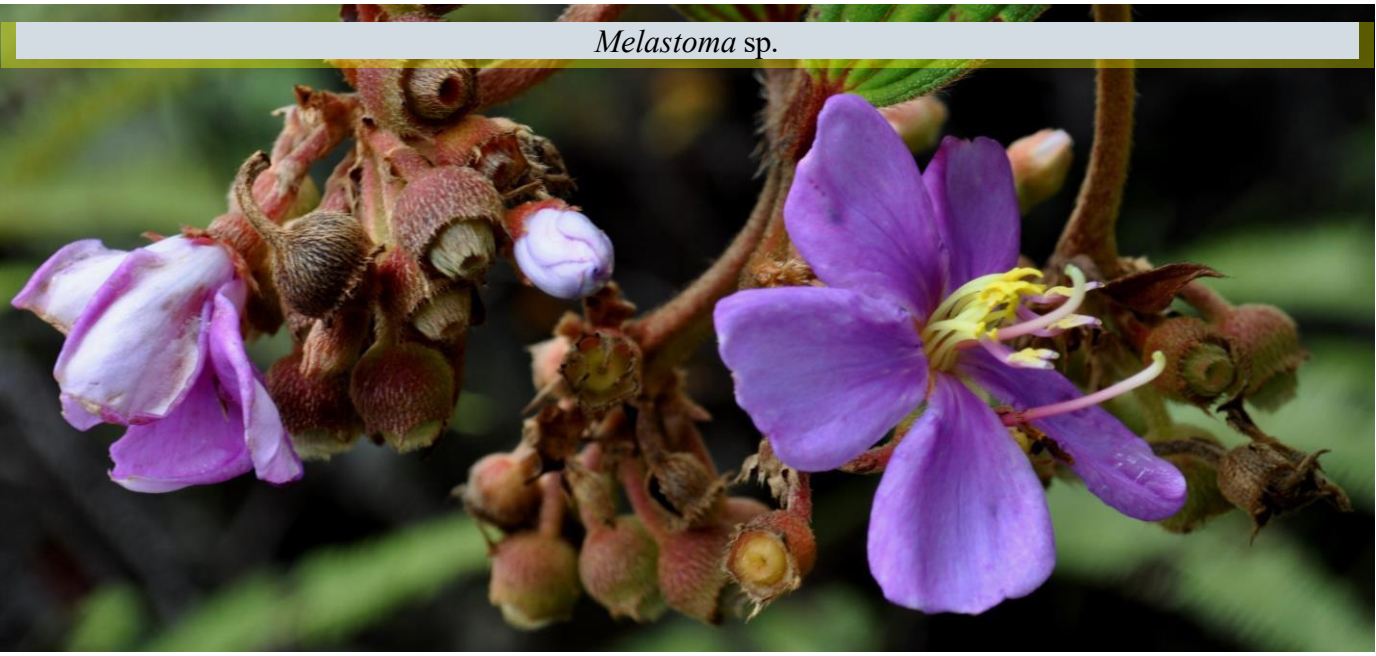


Melastoma barioensis



Melastoma malabathricum

Melastoma sp.





Rhododendron

The genus Rhododendron or locally known as Tassak by the Iban is an attractive group of plants that have large and showy beautiful flowers. There are about 900 species in the world with majority are native to the highland of Himalayan Region from northern India through Nepal into Western China

t 150 species are recorded from the

y about 50 species are recorded in Borneo with Sabah 35 species recorded (Argent et al. 1989).



Rhododendron crassifolium



Rhododendron himantodes



Rhododendron lanceolatum

Rhododendrons exhibit an enormous diversity of size and shape, from prostrate ground covers growing no more than a few centimeters in height to trees of more than 30 m tall. Mostly the flowers are white, red, pink or yellow, but sometimes blue, purple, magenta, orange, and in various shades and mixtures of most of these colours.



Rhododendron bogobonum



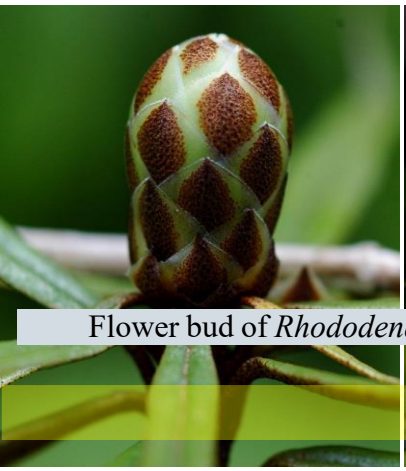
Rhododendron rogosum



Rhododendron orbiculatum



Rhododendron suaveolens





Flower bud of *Rhododendron himantodes*

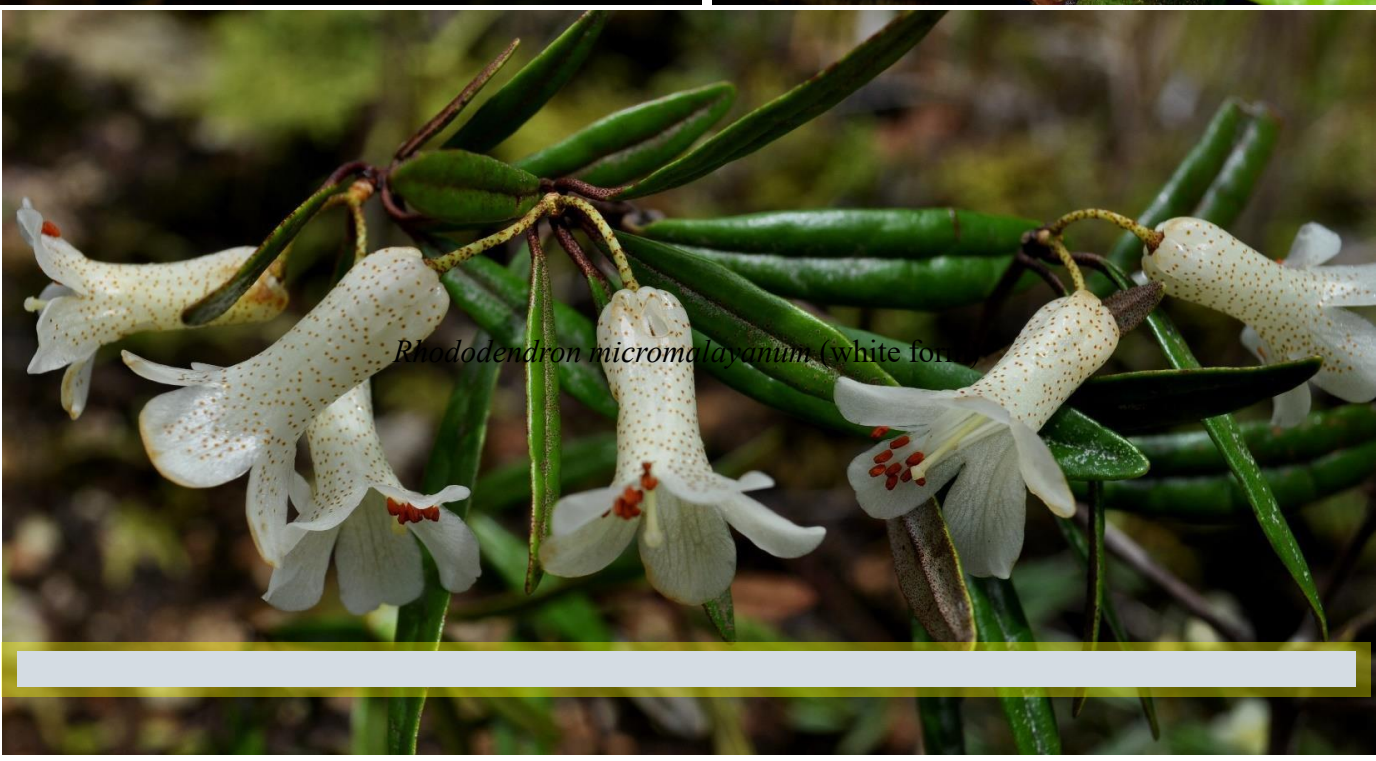
Rhododendrons are among the most popular planted shrubs for ornamental decorations besides the orchids.



Rhododendron micromalayanum (pink form)



Flower bud of *Rhododendron cf. crassifolium*



Rhododendron micromalayanum (white form)

Balanophora

The genus Balanophora is a holoparasitic flowering plant that commonly parasitizes the roots of a wide variety of plant species. Species of Balanophora are among the most bizarre of all flowering plants having inflorescence that emerges from warty tubers that are attached to their host plant. There are 15 recognized species throughout temperate and tropical areas.



Balanophora reflexa

Mycoheterotrophic Plant

Non-photosynthetic mycoheterotrophic plants are among the most intriguing species of angiosperms, yet they remain poorly understood. The mycoheterotrophic plants obtain their organic carbon, partly or even exclusively, by digestion of fungal hyphae (Leake, 1994, 2004). Majority of them, are associated with

arbuscular mycorrhizal fungi and ''steal'' carbon and other nutrients indirectly from green plants by hooking themselves into the mycorrhizal networks that linked to adjacent autotrophic plants (Imhof, 1999a, b, 2001; Leake, 2004; Franke, 2006).



Epirixanthes sp.



Thismia

Thismia is a small, poorly-known genus that had been treated as a member of the tribe Thismieae of the family Burmanniaceae (Jonker 1938, 1948, Stone 1980, Jarvie 1996, Saunders 1996, Yang et al. 2002, APG 2003, Tsukaya and Okada 2005). Recent molecular phylogenetic study suggested that Thismia is sister to the Dioscorea clade, not the Burmannia clade, therefore supporting recognition of the Thismiaceae (Merckx et al. 2006). The genus consists of c. 35 species and is concentrated mainly in Peninsular Malaysia and tropical South America. All species of the genus are mycoheterotrophic, leafless herbs, growing typically amongst leaf litter on shady wet forest floor.



Thismia goodii



Thismia coronata







Arisaema filiformis

Yam Family

The yam or Araceae family is astonishingly diverse with c. 105 genera consisting of thousands of species that are distributed throughout the world. They are recognized by the presence of a fleshy thickened spike bearing flowers called spadix which is generally surrounded or

partly surrounded and protected by a large leafy bract known as spathe. About 27 genera are native to Borneo with more than 300 species recorded.

The Cobra Lilies

The genus Arisaema or known as Cobra lilies, comprising about 150-170 species that majority occur in the Himalayas and the mainland Asia.

Arisaema is notorious for

its interannual "sex change" and

is the only

ew angiosperms that has

awak, however, only one species has been
mis.





Alocasia sp.

Genus *Alocasia*

The genus Alocasia consists of terrestrial herbs thriving on the forest floor, leaf litter, humus, deposits on rocks, usually in deep shade or sometimes in exposed areas of secondary forests. The members of Alocasia are medium-sized to rarely arborescent and gigantic herb. There are about 60-70 species distributed in Asia, Australasia, Malay Archipelago and Melanesia. During the expedition, at

a are sighted and recorded. Among the species are
i, A. longiloba and a gigantic

atha comprises of small to medium sized evergreen herb. Most of them are rheophytic along streams and by waterfalls in lowland to lower montane forests. There are 11 recognized species of Piptospatha that distributed from southern Thailand to West Malesia and six of them are recorded in Sarawak including a new record,

Piptospatha kinabaluensis that

was discovered in Payeh Maga area.







Genus *Scindapsus*

The genus Scindapsus is an evergreen climbing herbs, sometimes very robust and sometimes producing flagelliform shoots. Occasionally found climbing hemi-

es and also creeping over rocks. This genus
t 36 species that are
Archipelago, Melanesia

species of Scindapsus



have been recorded in Payeh Maga.

Genus *Homalomena*

The genus Homalomena consists of terrestrial herbs that are mostly found in Southern Asia and Southwestern Pacific. There are about 80-150 species recorded. Many of the species in this genus produce a strong scent of anise. The flowers are small without petals that are enclosed by the spathe. There are about 8- 10 species recorded in Payeh Maga.

One of the species is Homalomena humilis, a miniature species that found as lithophytes or rheophytes at the lower



altitude near Gunung Doa.



Homalomena cf. humilis





Begonia

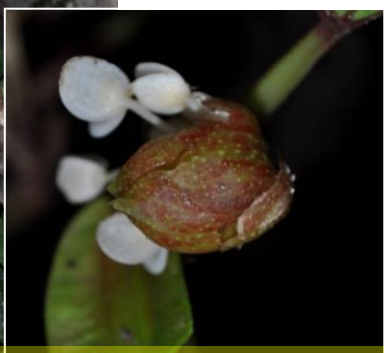
The genus Begonia L. is one of the largest genera of flowering plants with c. 1600 species have been described and has a complicated taxonomic history. Generic concepts in the family Begoniaceae have been changed much with more than 50 genus names having been put into synonyms with Begonia. However, today only two genera were recognized; Begonia and Hillebrandia. The Begonia species are grouped into 78 sections (Doorenbos et al. 1998; Smith et al. 1986). While, Hillebrandia is a monotypic genus that is represented by a single species, a Hawaiian endemic, Hillebrandia sandwicensis Oliver. Each section in the genus Begonia is restricted to a single continent except section Begonia which has wide distribution, American-Asian (de Lange & Bouman, 1992; 1999).

Sands (2000) estimated about 160 Begonia species in Borneo. To date, about 60 species are recorded in Sarawak which are grouped into five major sections viz. Diploclinium, Ignota, Petermannia, Reichenhemia and Spenanthera. Section Petermannia is the largest section with nearly two-third of the species in Sarawak are in this section. The study of Begonia in Sarawak however is still insufficient as very limited data is available.









Begonia murudensis in natural habitat in Payeh Mage

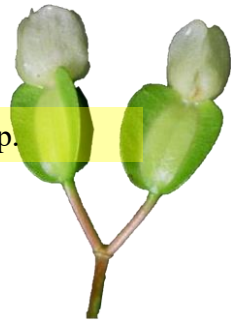


Begonia baramensis

Begonia baramensis. This cane-like begonia is one of the common species in Borneo. This species distributed from the central part of Sarawak toward the western part of Sabah and is also recorded in west Kalimantan. B. baramensis probably is the tallest begonia species in Borneo that reached more than 300 cm tall!

The section *Petermannia*

The section Petermannia is one of the largest sections of the genus in Southeast Asia with more than 190 described species and probably dozens of species are still waiting for description, particularly in Borneo and New Guinea. Among the species recorded from the Payeh Maga were, B. adenostygia, B. baramensis, B. borneensis, B. murudensis, B. pleioclada and three species are yet to be identified.



Unidentified *Begonia* sp.





Begonia hidiri



Begonia pleioclada



The Section *Spenanthera*

The members of these sections are mainly distributed in mainland Asia. Most of the species in this section are terrestrial, perennial rhizomatous or with upright stems with absent tubers. In Sarawak, this section was represented by a single species; Begonia chlorocarpa. This highland species was originally discovered and described from Mount Kinabalu, Sabah. Begonia chlorocarpa is one of the five species are recorded in Borneo.

This species thrived well at the damp and wet place near to the streams. Frequently as lithophytes on the rocks surface under deep shade of canopy and also encountered in the interior of forest, the areas that are exposed to the morning sunlight. Easily recognized by large and showy flowers and fleshy fruits. Only a few plants were recorded in Payeh Maga at altitude 1000 - 1400 m above sea level.



Begonia chlorocarpa

The Setawar Family - Genus *Hellenia*

Hellenia is one of the genera in the Costaceae family, locally called as Setawar hutan by the Malay. All members of the genus Hellenia previously are placed in the genus Costus. Based on the phylogeny study, Specht (2006) has segregated all the Asian Costus (including C. englarianus from Africa) into their own genera; Cheilocostus and Paracostus. The genus Hellenia, however is the valid name used for the Asian species.



Hellenia globosa var. *velutinus*



Hellenia globosa var. *globosa*



Hellenia speciosa

Genus *Paracostus*

The subgenus Paracostus now has been upgraded as a new genus in the family Costaceae based on molecular evidence (Specht, 2006). Previously, only two species have been placed into this genus, P. paradoxus, an endemic species to Borneo and P. englarianus is endemic to tropical Africa. Meekiong et al. (2006) have added three more species from Sarawak, P. bullatus and P. eburneus, two limestone specialist from northern west of Sarawak and P. muluensis from northern east of Sarawak.





The Banana Family

The family Musaceae consists of large to gigantic herbs with pseudostems and leaf sheaths. The inflorescence springs from the rhizomes and emerges at the top of the stem, either erect, horizontal or pendulous as a unit of cymose. Previously, this family was represented by three genera, viz. Ensete, Musella and Musa. The genus Musella, however, is now sunken into the genus Ensete based on molecular evidences.

There are about 50 species of wild Musa in the world that distributed in India, Indo-China, Southeast Asia, New Guinea, northern part of Australia and probably southern part of Japan. Southeast Asia and New Guinea are the centre of distributions with two-third of the species are recorded here. About 18 species were recorded in Borneo and 14 of them were recorded in Sarawak (Meekiong and Tawan, 2010).





Musa lokok



Musa lokok Geri and Ng

This small statue wild banana with only 1-2.5m tall, so far was recorded only from the highland areas of Limbang and Lawas districts at 1100-1400maltitude. The epithet name of this species derived from the locally name, pisang lokok by the Kelabit people.

The young rolled leaf was reported being used as traditional cigarette.

Musa sakaiana Meekiong, Ipor and Tawan

Musa sakaiana is closed to M. lokok by having pendulous fruit bunch, but the plants are more robust and taller, with 3-4m tall. In additional, the male flowers of

M. sakaiana are arranged in two tiers and the flowers are creamy in colour. Compared with M. lokok, this species has more fruits, 8-10 fruits per hand that are arranged almost parallel to the stalk. The epithet name of this species was given in honour to the late Dr Judson Sakai Tagal, one of the young minister of the Sarawak State, who represented the Ba'kelalan area, adjacent to the Paya Maga.





Gesneriads

The Asiatic Gesneriaceae with about 70 genera except the Chinese Titanotrichum belong to the subfamily Cyrtandroideae (Mendum and Atkins, 2004). The genus Cyrtandra J.R. & G. Frost is the largest genus containing about 600 species distributed from the Nicobar Island in the Indian Ocean, to Southern Thailand, through Malesia to Taiwan, the southern Ryukyu Islands, southeast to Queensland and the Loyalty Islands and Hawaii (Bramley et al. 2004). The centre for species diversity are Borneo, New Guinea and the Pacific Islands.











Agalmyla borneensis

Genus *Agalmyla*

The genus Agalmyla with 97 species that are divided into three sections based on their geographical distribution. The section Agalmyla with

d Dicrotrichum with 19 and 54 species respectively.
e only species recorded in Payeh Maga.

Genus *Aeschynanthus*

The genus Aeschynanthus is a tropical herb that usually trailing epiphytes with bright coloured flowers. Vernacularly

known as "monkey lipstick flower" or lipstick plants which referred to the appearance of developing buds in some species. Three Aeschynanthus species were discovered during the expedition, with all of them were epiphytic on the tree trunks or branches thrived well in the shaded areas near to the streams.





Pitcher Plant

The pitcher plants comprise seven genera, which are distributed throughout parts of Americas, Asia and Australia (Clarke, 1997). The seven genera are representing four families; Catapsis and Brocchinia are from family Bromeliaceae; Heliamphora, Sarracenia and Darlingtonia (family Sarraceniaceae); Cephalotus (family Cephalotaceae) and the largest genus of pitcher plants, Nepenthes from the family Nepenthaceae.

The genus Nepenthes is distributed from as far as the Seychelles, Madagascar and New Caledonia toward the east, India, Sri Lanka, Indo-China and up to southern China, South-east Asia, New Guinea and down to northern Australia. The vast majority occur on the islands of Borneo and Sumatra, and Borneo s considered as the centre of Nepenthes biodiversity with



31 species have been recorded. Out of that number, 24 species are reported to be endemic to the island.



Nepenthes chaniana

Nepenthes chaniana is considered as a highland species, recorded at 1500- 2000m altitude. Normally found as epiphytic on the tree trunks or branches in the mossy forest or highland kerangas forest or submontane forest. Sometimes also as terrestrial in a rosette formed but seldom seen climbing as it is not a strong

nd to drape over.

This species was named after K.G.K. Reinwardt, the founder of the Bogor Botanic Gardens in Java. This species grows in a variety of habitats from sea level up to

2000m altitude. Commonly seen as epiphytic on the tree canopy or on the tree trunks and branches in the exposed areas. This species easily distinguished from other species by having glabrous slender pitcher, without fringed wings and the presence of two glandular spots inside the pitchers.



Nepenthes reinwardtiana



Nepenthes lowii

This species is one of most striking species in Sarawak. The upper pitchers are very different from other species with strongly constricted in the middle and with greatly reduced peristome. The lid is leaped with inner surface covered with bristle and reflexed from the mouth. The pitchers of N. lowii are very hard and rigid compare to any other species. This species also considered as a

highland species that recorded from 1600-2400m altitude.



Nepenthes gracilis

Nepenthes gracilis

This species is the most widespread and commonly species in South-east Asia. Distributed from the sea level up to 800m altitude and frequently found in many roadside ditches regardless of soil types. In Sarawak, this species easily recognized as has the smallest pitcher among all the species and narrowly cylindrical pitchers.



Nepenthes stenophylla

Nepenthes stenophylla or the narrow-leaves pitcher plant is endemic to Borneo. This species produces attractive funnel-shaped pitchers up to 25cm long. The epithet name is derived from combination of two Greek words, steno mean narrow and phylla mean leaves that refer to the shape of lamina







Nepenthes tentaculata

Nepenthes tentaculata or the Fringed Pitcher-plant is native to Borneo and Sulawesi. This species occasionally found in the highland areas at elevation from 400-2500m altitudes. The epithet name is derived from Latin word, tentacula means tentacles are referring to multicellular appendages on the upper surface of the pitcher lid. This species typically inhibits mossy forests and ridge-top vegetation on mountain summits.





Nepenthes fusca

Nepenthes
"Dusky Pitcher Plant
species has wide alt
and is typically fou
altitudes. The epithe
fuscus means dark b
colour of the pitcher.

Plectocomia

The genus Plectocomia belongs to the palm family is one of many genera found in Sarawak. This genus is relatively small with only two species recorded in Sarawak; P. mulleri and P. mira. Both species are normally thriving in opened space or secondary forest that emerging on the very top of canopy. Plectocomia mulleri or known as Wi tibu by the Iban is common in the Payeh Maga area.





Plectocomia mulleri



Orchids

Sarawak is a state exceptionally rich in natural resources, mainly her forests, plants and animals. One of the most elegant examples of the wealth is in the diversity of the orchid flora. The Sarawak orchid flora have been better known over a century ago from Beccari's collections, Hugh Low and Ridley, but likewise were never systematically reported. Current enumeration by Beaman et al. (2001) reported about 1000 orchid species from Sarawak.



Pholidota sp.



Spathoglottis microchilina



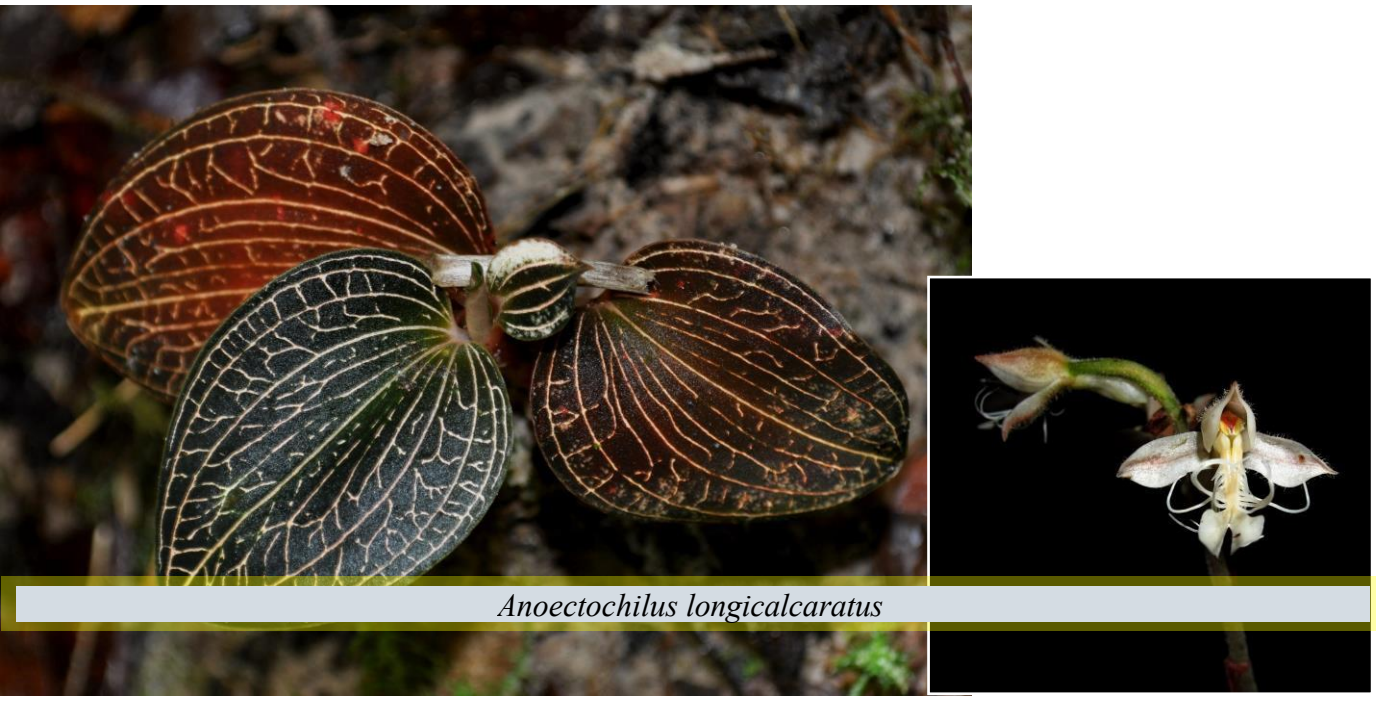
Nervilia cf. plicata

Jewel Orchids

The jewel orchids are mostly from the subfamily Orchidoideae, in subtribe Goodyerinae and Acianthinae. Majority of the jewel orchids are terrestrial, forest dwelling, thriving in damp, shady places where they grow among the rich accumulations of leaf litter. They are so-called jewel orchids because most of them have attractive leaves with either zones of variegation of coloured venation. Among the genera of jewel orchids that found in Sarawak are Anoectochilus, Corybas, Cystorchis, Dossinia, Goodyera, Macodes, Vrydagzynea and Zeuxine (Beaman et al. 2001).

Genus *Anoectochilus*

The genus Anoectochilus is a terrestrial orchid with green leaves, or with colourful silvery or reddish venations. There are about 40 species recognized in the world. However, in Sarawak only one species has been recorded, Anoectochilus longicalcaratus.



Anoectochilus longicalcaratus

Genus Corybas

The genus Corybas or 'helmet orchids' is a small or dwarf orchid; terrestrial, lithophytes and rarely epiphytic that arise from small tuberoids. This one-leaf orchid with size about 50-cent is bearing only one-flowered at a time, and the flower is helmet- shaped. During the expedition, C. pictus was discovered on the trail to Tuyoh peak and considered

as a new record for Sarawak.

Genus Macodes

Macodes is a small genus with about 10 species that distributed from Malaysia to the Pacific islands. All species in this genus are terrestrial with creeping fleshy rhizomes. The leaves are rather fleshy, brownish with golden coloured or silvery veins on the upper surface of the leaf. Flowers are small and not resupinate. Macodes petola is the only species recorded in Sarawak. This species grows on the wet cliffs, gullies or deep shade in old secondary forest to lower montane forest at elevation from 200-1200m.



Macodes petola

Genus *Paphiopedilum*

Paphiopedilum or commonly known as 'Lady's Slipper' is one of the members of the Slipper orchids groups. Other members in the group are Selenipedium, Phragmipedium, Mexipedium and Cypripedium. The slipper orchids are the most spectacular and instantly recognizable plants in Borneo. There are 12 species of Paphiopedilum recorded in Borneo and half of the number can be found in Sarawak. During the expedition, only one species was recorded. This species with tessellated leaves, morphologically was close to P. bullenianum. However, it was unable to be clarified as no flowering plants were encountered during the expedition.



Paphiopedilum cf. bullenianum

Mycoheterotrophy Orchids

Many saprophytes have short life cycles and are often overlooked due to their inconspicuous colouring. Most of the saprophytic orchids thrive very well in deep shaded areas on the forest floor where they are well inconspicuous against the leaf litter. Eleven genera of saprophytic orchids have been recorded in Sarawak. Two genera were recorded during the expedition; Cystorchis and Epipogium.

Genus *Cystorchis*

This genus is a terrestrial herb; stem with a few leaves or saprophytic, replaced by brown scales-leaves. About 20 species distributed in China, India, Malaysia,

Indonesia, the Philippines, New Guinea and Vanuatu. Six species in Borneo and four of them recorded in Sarawak.

Cystorchis aphylla

Leafless saprophytic herb. Rhizome tuberous with erect stem. Inflorescence terminal, with lax flowers, 3-5 flowers; flowers are small and resupinate. This species is normally found in lowland area at 100-400m altitude and sometimes on limestone hills.



Cystorchis aphylla

Genus Epipogium

The genus Epipogum was introduced by J.G. Gmelin in 1747 but only accepted as a valid name after it was published by R. Brown in 1810 as Epipogium. This genus is perhaps very well known in European and northern Asian Ghost Orchid or Spurred Coral-root which is particularly inconsistent in appearance.



Epipogium roseum

Epipogium roseum

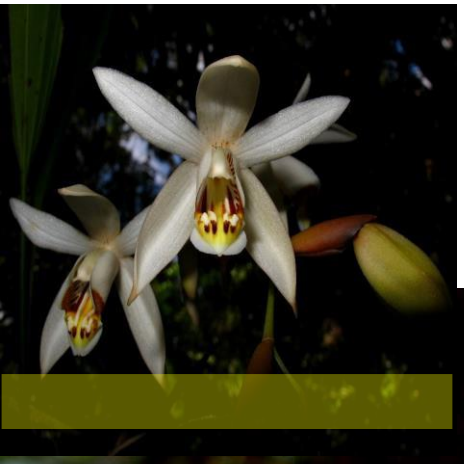
Leafless saprophytic herbs. Rhizome tuberous with erect flesh stem. Inflorescence terminal, racemose, non- resupinate. Flower white. This species widely distributed from Africa, mainland Asia, eastward through Peninsular Malaysia, Indonesia and New Guinea to Australia and Solomon Islands. This is the second record of this species in Sarawak after the first record from Batu Laga Plateau in Belaga District.

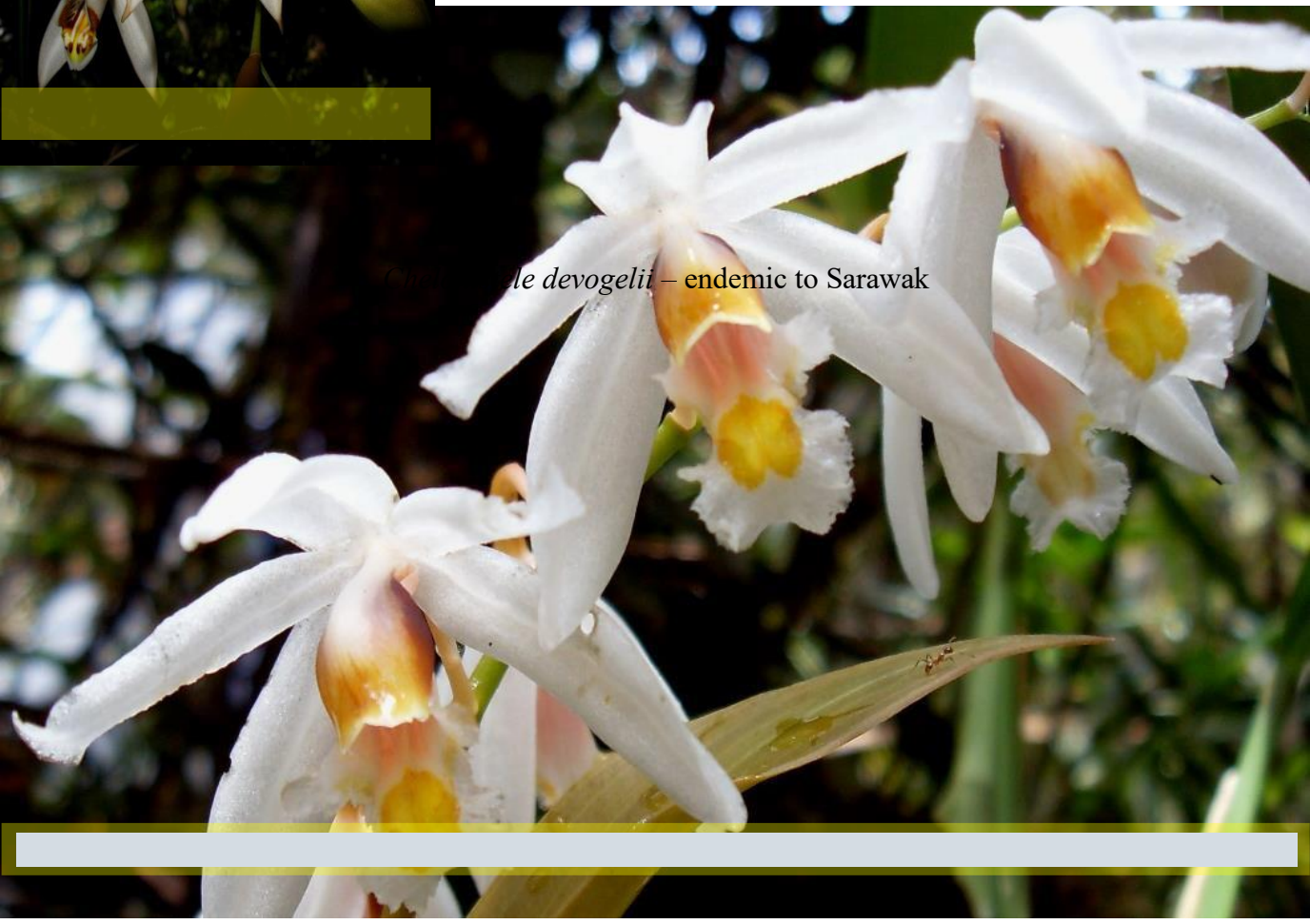
Genus Coelogyne

The genus Coelogyne was created by Lindl in 1821 comprising 160-200 species. Mostly the members of this genus are epiphytic, rarely lithophytes or terrestrial herbs. In Sarawak, 60 species have been recorded from various types of habitats. The number might increase as many specimens are yet to be identified particularly the specimens collected from central parts of Sarawak. In Payeh Maga areas, nine species were recognized.



Coelogyne radioferens
Coelogyne hirtella





Coelogyne devogelii – endemic to Sarawak



Dendrobium bifarium

Genus *Dendrobium*

The genus Dendrobium is one of the largest genera in the Orchidaceae family with approximately 1300-1400 species distributed throughout the world and the second largest genus in Southeast Asia. They are also probably the most diverse in terms of different habits and flower shapes.



Dendrobium piranha

This genus was established by Olof Swartz in 1799. The generic name was derived from the Greek words, Dendron mean tree and bios mean life with

ho lives on trees" or essentially epiphytes. About
during the expedition. Among the species are, D.
D. panduriferum, D. piranha and D. secundum.

Dendrobium sp. (section Aporum)



Dendrobium lancilobum



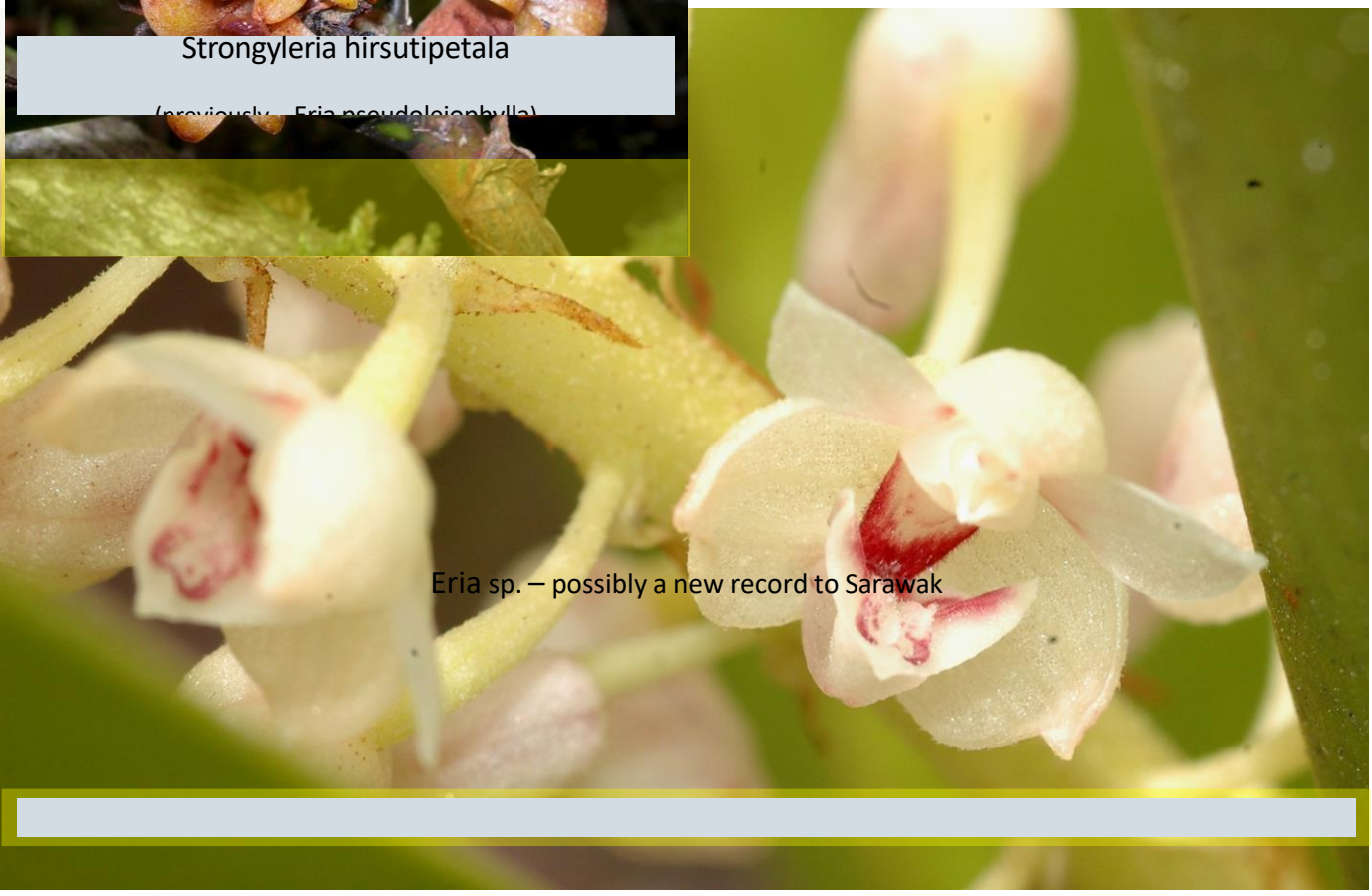
Genus *Eria*

Eria is a polyphyletic genus of some 370 species distributed widely in tropical Asia. Most of them are epiphytic, lithophytic or rarely as terrestrial herbs. The flowers are mostly small to medium size, rarely showy. There are 71 recognized species recorded in Sarawak with many in herbarium and in the wild are still unidentified. During the expedition, nine species were recognized and many specimens yet to be identified. Among the species recorded were E. cf. bicristata, E. crassipes, E. farinosa, E. floribunda, E. hyacinthoides, E. pseudoleiophylla, E. pulchella and E. robusta.



Strongyleria hirsutipetala

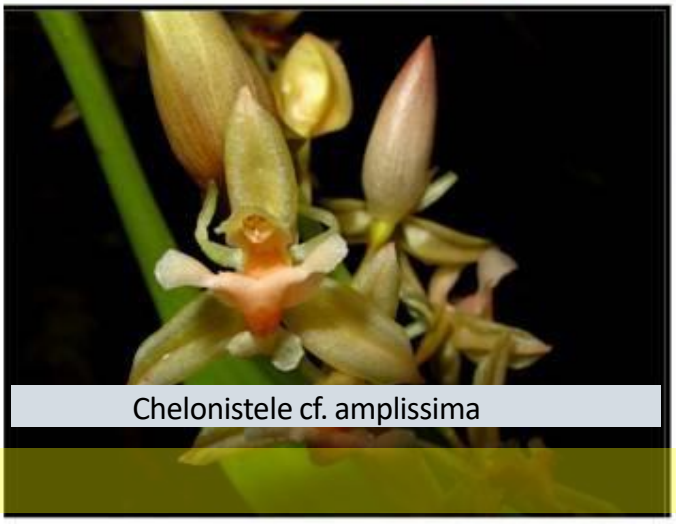
(previously Eria pseudoleiophylla)



Eria sp. – possibly a new record to Sarawak



Chelonistele sulphurea



Chelonistele cf. amplissima



Calanthe musa-amanii (new record)

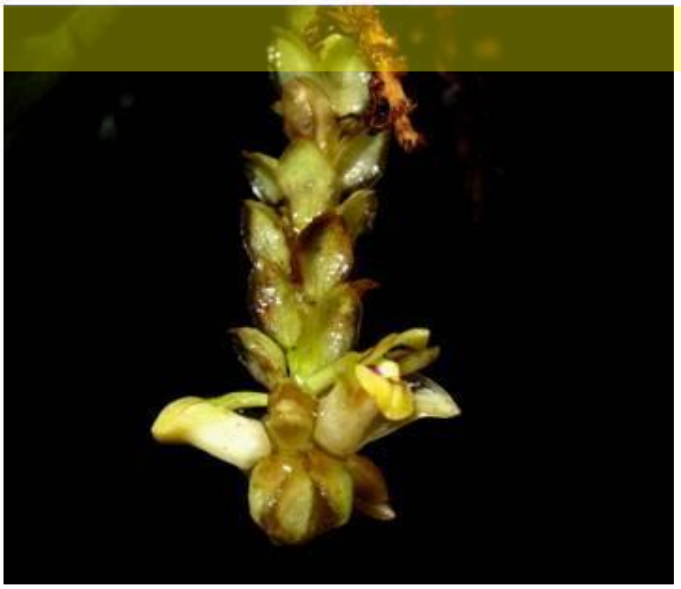


Bulbophyllum sp. (section Altisceptum)

Appendicula congesta



Appendicula pendula













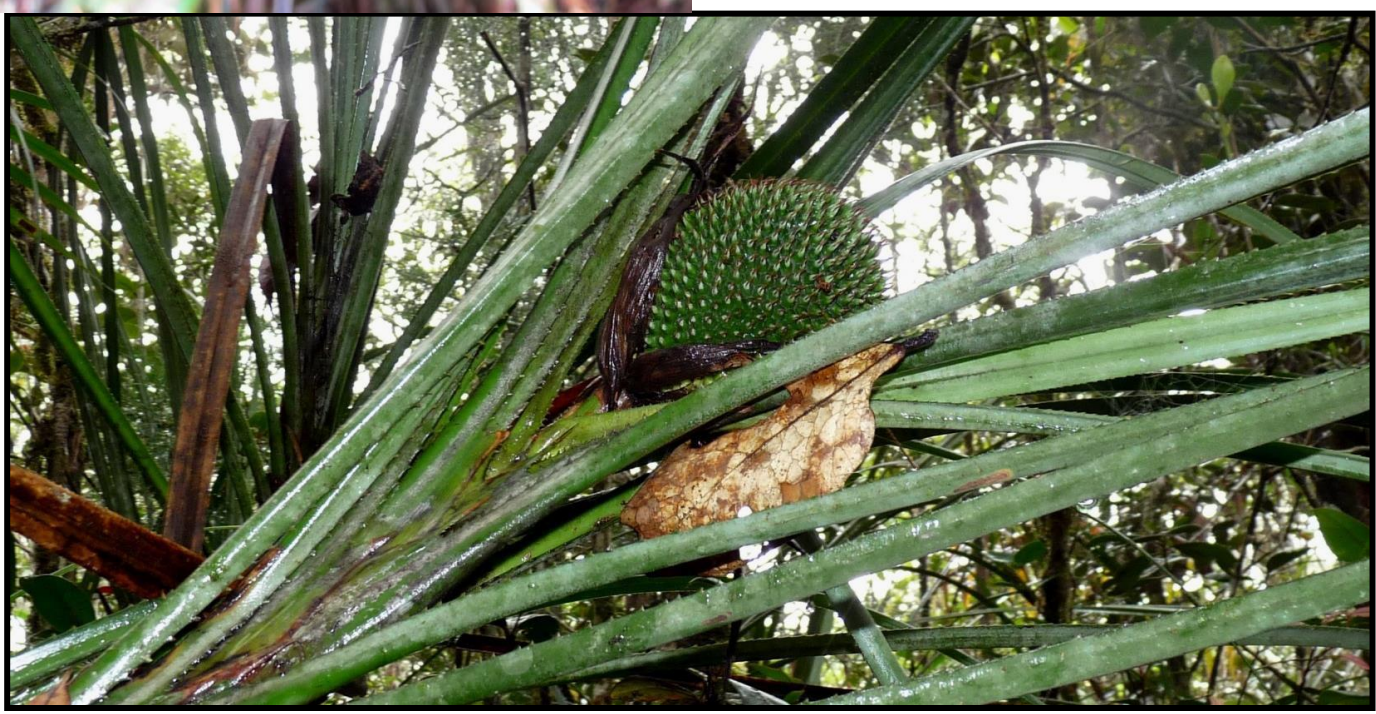


Wild Pandan

The Pandan or Pandanus is one of the five genera in the Pandanaceae family. The Pandanus, Benstonea and Freycinetia are the three genera that occurring in Borneo with approximately 30-

40 species recorded. In Payeh Maga, at least 6-8 species of Pandanus and two species of Freycinetia were sighted and recorded.

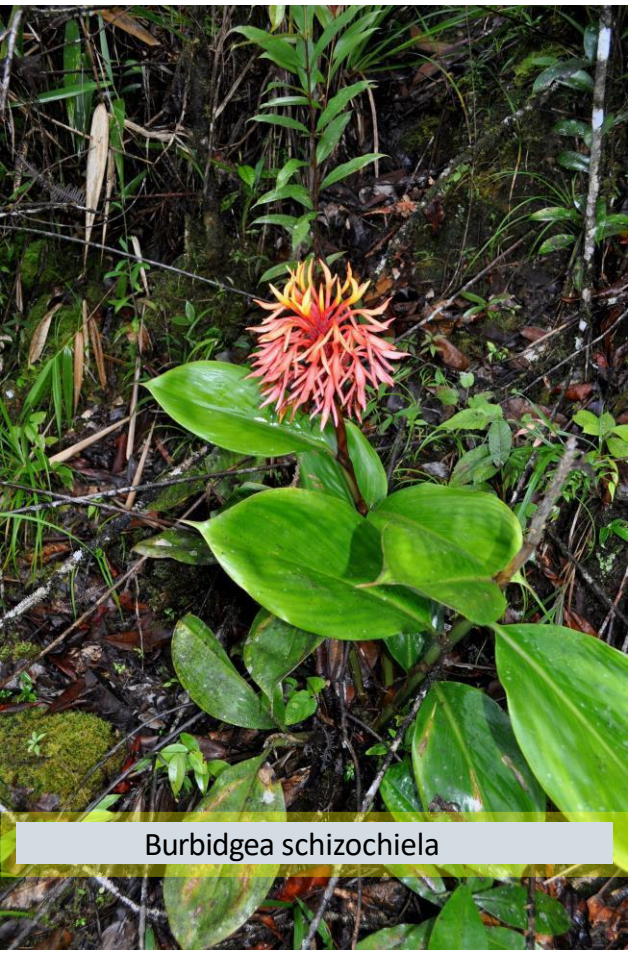
Two unidentified Pandan from Payeh Maga



The Gingers Family

The gingers are belonging to the family Zingiberaceae. There are c. 55 genera comprising approximately 1600 species of gingers around the world with only one genus and four genera recorded in tropical America and tropical Africa respectively. Borneo consisting of 22 genera with approximately 280 species were recorded.

The gingers are one of the most important plants of the ground cover of the tropical forests of Southeast Asia. They found from low altitude from the sea level of mangrove forests, rubber plantation, bamboo thickets as well as at high altitude in the mountains. During the expedition, 13 genera consisting of 40 recognized species were identified with a bundle of specimens yet to be identified. The genus Etlingera and Amomum with seven and five species respectively, are the most two specious genera.



Burbidgea schizochiela



Alpinia tamacuensis

Alpinia kinabaluensis – a new record to Sarawak







Genus *Etlingera*

The genus Etlingera is an Indo-pacific genus that commonly grows from sea level to 2500m altitude and occupies various habitats such as peat swamp forest, heath forest, limestone, secondary forest, virgin forest etc. This genus was re-established by R.E. Burtt and R.M. Smith (1986) integrated species that previously treated under the three genera, Achasma, Nicolaia and Geanthus. Poulsen (2006) in his recent revision on this genus reported 40 species were encountered in Borneo and about 30 species occurred in Sarawak.



Etlingera baculutea

Etlingera elatior is widely distributed among all the gingers

species, either encountered as wild in the forest or planted in the gardens due to its numerous uses. It also known with many common names, such as 'torch ginger', 'torch lily', 'porcelain rose',

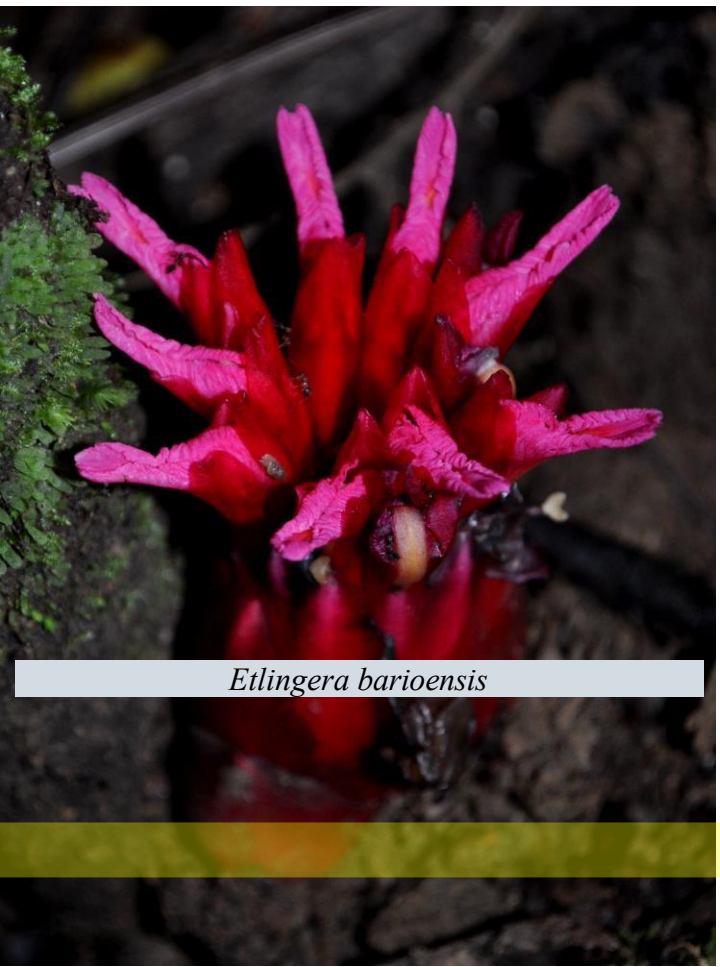
Philippine waxflower' or in Sarawak, locally known as 'kantan', 'kecala', 'sikoroh' or 'busuk ludo'. All the names are given because of its stunning inflorescence.





Twelve Etlingera species were recorded during the expedition. Etlingera fimbriobracteata, the species with yellow flowers and the tallest among the species in the genus Etlingera was common. Other species recorded were included, E. amomoides, E. baculutea, E. barioensis, E. brachychila var. vinosa, E. brevilabrum, E. coccinea, E. elatior, E. inundata, E. longipetiolata, E. pubescens and E. velutina.

Etlingera fimbriobracteata



Etlingera barioensis



Etlingera brachychila var. *vinosa*



Genus *Amomum*

The genus Amomum is the second largest genus in the family Zingiberaceae.

Current classification based on molecular analysis and field characteristics; the genus has been segregated into 5-6 genera (de Boer et al. 2019).



Sundamomum sp. (previously under Amomum)





Boesenbergia orbiculata

Genus Boesenbergia

Boesenbergia mostly small herbs with short and fleshy rhizomes. The leaves are arranged at the base of the short stem.

[illegible] terminal between the leaves or lateral from the base of the shoot. All species have a single bag-shaped flower per bract, and the first flower appears from the top of the inflorescence. The genus Boesenbergia is the second largest genus in Sarawak with 35 species recorded, however, only two species were encountered during the scientific expedition.





Unidentified species from Payeh Maga



Genus *Globba*

In Sarawak, the species of Globba is unlikely to be misidentified because they are small herbs on the forest floor with strange-looking flowers. The filament and style are long exerted and arched like a bow and at the end of anthesis the style becomes free forming a bowstring (Larsen and Larsen, 2006). Globba atrosanguinea or locally known as pemulai sunti by the Iban is probably the most common Globba species in Borneo that is found from sea level up to 1400m altitude that occupied various types of habitat, such as peat swamp forest, kerangas forest, mixed dipterocarp forest, limestone and submontane forest. This species has been used to cure pains in the joints inflicted by curses (Poulsen, 2006b).



Globba atrosanguinea



Globba pendula

Genus *Sulettaria*

The genus Sulettaria is tall tufted herbs with stout rhizomes, closely allied to Amomum but differs in its inflorescence structure. The members of this genus can be distinguished from others by having inflorescence separate from the leafy shoot, prostrate mostly just below the surface of the ground, bearing two rows of sheaths and all the flowers are pointing upwards.

Two species were recorded in Payeh Maga during the expedition. Sulettaria longituba is the most common species encountered which is also recorded in Peninsular Malaysia. Sulettaria longipilosa is Bornean endemic species have long shooting inflorescence that reached more than 2.5m long that prostrate along the soil surface and often covered by the leaf litter.



Sulettaria longituba



Sulettaria longipilosa

Genus *Plagiostachys*

The generic name of this genus is referring to the characteristic appearance of the inflorescence that slanting on the pseudostem. About ten species recorded in Borneo and seven of them were found in Sarawak. Three species were recorded in Payeh Maga during the scientific expedition, viz. P. albiflora, P. bracteolata and one unidentified species with reddish bracts and flowers.



Plagiostachys bracteata

Plagiostachys strobilifera







Burbidgea stenantha

Genus *Burbidgea*

The genus Burbidgea is endemic to Borneo with five species having been described so far and all the species can be found in Sarawak. The genus Burbidgea was named in honour of British gardener and explorer, Frederick W. Burbidge. All members of this genus have the inflorescence terminal on leafy shoots. The flowers are with golden colour, orange or yellow and therefore

commercially known as "golden bush". Four species were recorded in Payeh Maga area; B. stenantha, B. schizocheila, B. nitida and B. longilora.

Burbidgea schizocheila (yellow-form)





Genus *Hedychium*

Most of the members in this genus are often as epiphytic or sometimes as lithophytes or terrestrial. The flowers are fragrant and pollinated by the butterfly. The generic name was derived from the Greek words, hedy means sweet and chion means snow. "Sweet snow" referring to fragrant and white flowers of the well-known H. coronarium, the first species that was described in the genus from the southern Himalaya. Hedychium was poorly represented in Borneo. In Sarawak, so far, only three species were recorded viz. H. cylindricum, H. lineare and H. muluense.



Hedychium borneensis



Genus *Hornstedtia*

The genus Hornstedtia is easily recognized by the spindle- shaped inflorescences that are surrounded by densely imbricate, involucral bracts. The inflorescences arising on a separate side shoot from the rhizomes. The flowers are often red with a narrow, protruding lip; no lateral staminodes and the corolla lobes and labellum are of the same length. Eleven species recorded in Sarawak and four species were encountered in Payeh Maga area, namely, H. scyphifera, H. gracile, H. incana and H. reticulata.

Hornstedtia havilandii





Zingiber sp.

Genus *Zingiber*

The generic name of this genus was derived from the Sanskrit word, sringavera, which mean 'horn-shaped root' or bull's horn. This probably refers to the rhizome, but some think this also might be refer to the unique structure of the anther crest. In Payeh Maga, at least 8-10 Zingiber species were recorded, Z. pacysiphon, Z. incomptum and Z. pseudopungens were the most abundant species.

Zingiber pseudopungens



The Ferns

The ferns group is botanically known as Pteridophytes, constitute the third major group besides the angiosperms (flowering plants) and the gymnosperms (includes conifers and cycads). The ferns are non- flowering plants but characterized by they reproduce by means of spores, single, unfertilized cells designed to be dispersed and give rise to an alternating generation of completely different and much simpler plants, the prothalli. They are widely distributed and occurred in every continent in the world with c. 12000 species from 225 genera have been recorded.









Matonia pectinata

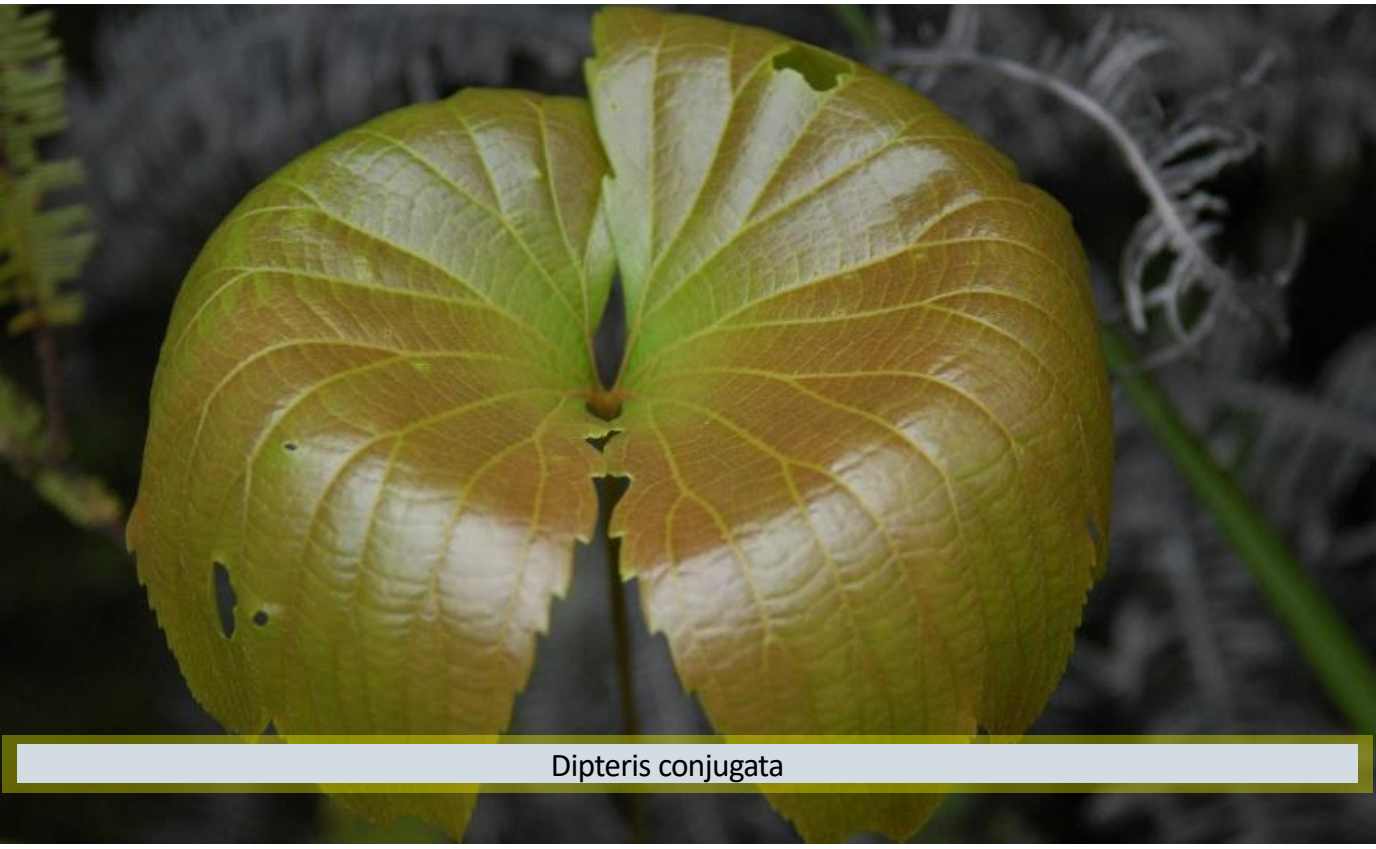
Matonia pectinata

Matonia pectinata is a member of Matoniaceae, one of the ancient fern family.

Genus *Dipteris*

The genus Dipteris or "Umbrella fern" belong to the family Dipteridaceae. This family has a long fossil history dating back to about 251 million years ago. There are only two genera

Dipteris and Cheiropleuria. Both genera are occurring in
eris is commonly found in mountain clearings, on the steep
ong river banks and in the forests where sufficient light
reaches to the forest floor such as slopes near waterfalls or in the disturbed areas.



Dipteris conjugata



Dipteris lobbiana



Lycopodiella cernua

Lycopodiella cernua or Paku dawai is a species found throughout the tropics and subtropics from the lowland areas up to sub-montane forests. This terrestrial fern usually with creeping stem and erect shoot, resembling little pine trees, thriving commonly on acidic soils. This species occurs along forest fringes, in secondary forest,

n opened space along the roadsides of the logging



Lecanopteris

Lecanopteris is one of the genera in the family Polypodiaceae. Lecanopteris is a genus of many number of bizarre ferns having swollen hollow rhizomes that provide homes for symbiotic ants, that is why this genus sometimes is also known as "ant-plant". At least 2-3 Lecanopteris species have been sighted and recorded in Payeh Maga.

Genus *Asplenium*



The genus Asplenium is one of the largest fern genera with c. 700 species recorded throughout the world. In Southeast Asia, 40-50 species occur with

c. 30 species in Borneo. At least 6-8 species are
h Maga. Asplenium nidus or Langsuyar or Lukut
cies, epiphyte on tree trunks or branches.

jah is a member of the Angiopteridaceae family. They
p and wet places in primary and old secondary forest,
and river bank or steep clay slopes of mountain.



Angiopteris evecta

The starchy stipules and young leaves are cooked as a local delicacy

by the local people. This species is also believed to have many traditional medicinal values. In Payeh Maga, this species was recorded in the peat forest (trail to Matalan Peak) and sub- montane forest (trail to Tuyo Peak).

Genus *Selaginella*

The family Selaginellaceae is a monotypic family solely represented by a single genus, Selaginella. They are known with many vernacular names. Among the names are, Paku ekor merak, Paku lelipan or Paku ngelipan, Sondotnulogo, Sakat fatimah and many others. In Payeh Maga, at least 8-10 species were sighted and recorded.



The Bryophytes

The Bryophytes are one of the largest plant group, consist of about 20000 species that are divided into three groups, Anthocerotopsida, Marchantiopsida and Bryopsida. The last two groups contain the majority of species and usually known as liverworts and mosses, respectively.

Genus *Dawsonia*

Dawsonia is a genus in the family Polytrichaceae. Most of them are large and conspicuous, with erect and long stem for them to free-standing leaves are narrow and sharply pointed. They are the tallest among the mosses with a maximum height approaching 1m tall.



Dawsonia sp.

Sphagnum moss

The sphagnum moss or peat moss are from the genus Sphagnum in the Sphagnaceae family. Mostly growth of the Sphagnum spread out like a blanket and covers wet slopes or cliff surfaces at shaded sites. In Payeh Maga, the Sphagnum are found blanket on soil surfaces from altitude

1200-1700m, along the trail to Tuyo and Matalan Peaks. They are also found in opened space on the grassland near to the Base Camp.





Lichens

The lichen are composite organisms consisting of a symbiotic association of a fungus with a photosynthetic partner either a green alga or cynobacterium. The morphology, physiology and biochemistry of lichens are very different from those pure culture of alga and cynobacterium isolated from lichens. The lichens are the most widespread organisms that occur in the most extreme environments on Earth, viz. arctic tundra, hot deserts, rocky coasts and toxic heaps. However, they are abundant in tropics and subtropics forests.

The lichens are informally classified by growth form viz. crutose (paint-like, flat); filamentous (hair-like); foliose (leafy); fructicose (branched); leprose (powdery); squamulose (consisting of small scale-like structure, lacking lower cortex) and gelatinous lichens (in which the cynobateria

produce a polysaccharide that absorbs and retains water).

Squamulose lichen



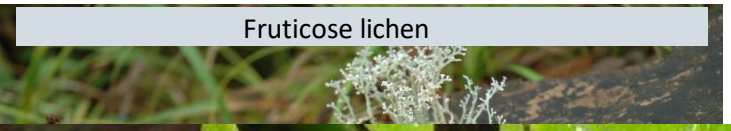
Crustose lichen





Filamentous lichen

Some of the lichens are vulnerable to environmental disturbances, and are useful to scientists in assessing the effects of air pollution, ozone depletion, and metal contamination. The lichens also have been used in making dyes, perfumes and as well as in traditional medicine. One of the genera that popularly known is Tahi angin or scientifically known as Usnea has been use long time ago in the Malay traditional medicines.



Fruticose lichen



Foliose lichen



Fungi



The collection of macro fungi during the expedition in Payeh Maga is the first ever record for that area. The diversity of macro fungi in Payeh Maga is tremendous. At least more than 50 genera from 20 over families have been identified in the provisional list.













A: the house of common Pangolin

B & C: animal droppings

D: damaged ginger plant by Pig-tailed Macaque

E: wild board footprint

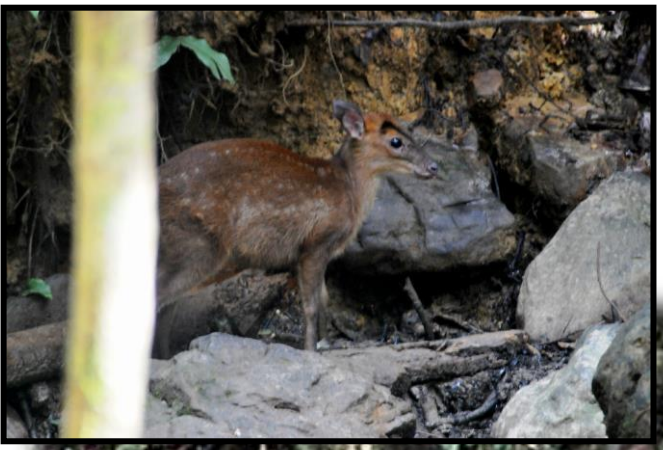
F: Wilughbeia fruit eaten by the macaques



Barking Deer

The genus Muntiacus is the oldest known deer appearing since 15-35 million years ago. One of the common Muntiacus species is the Barking Deer or known as many other vernacularly names, such as Common Muntjak, Red Muntjak, Indian Muntjak or in Malaysia as Kijang with scientific name as Muntiacus muntjak.

They are common and widespread throughout Southern Asia but the least known of all animals in South Asia. They are omnivorous, feeding on fruits, shoots, seeds, bird's eggs as well as small animals and even carrions. They give calls similar to barking or bark-like sound (hence the common name for all Muntjak, Barking Deer) as signal when danger is present.



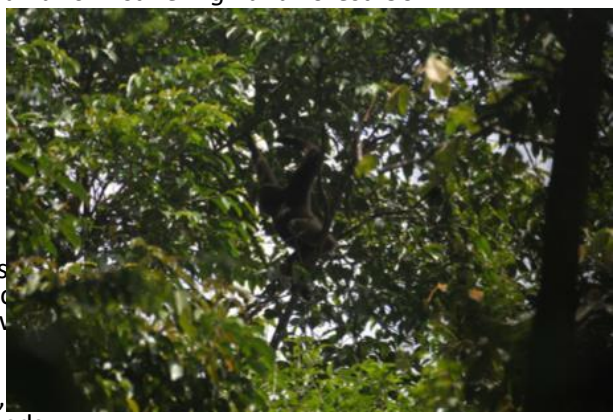


Leopard Cat

The Leopard Cat or Mayau tebiang (Iban) is the commonest wild cat in Borneo even though not many people have encountered them because they are nocturnal animal. Scientifically, it is known as Prionailurus bengalensis (synonym: Felix bengalensis). This species looks very much like a mini leopard with patches of black bands or spots on their skin and that is why they are so-called Leopard Cat.

The Leopard Cat are active only at night time. During the day, they retreat into holes that maybe a hollow tree, a cavity under root or in small cave. They feed on anything they can catch such rodents, reptiles, small birds, insects, frogs and even sometimes fish.



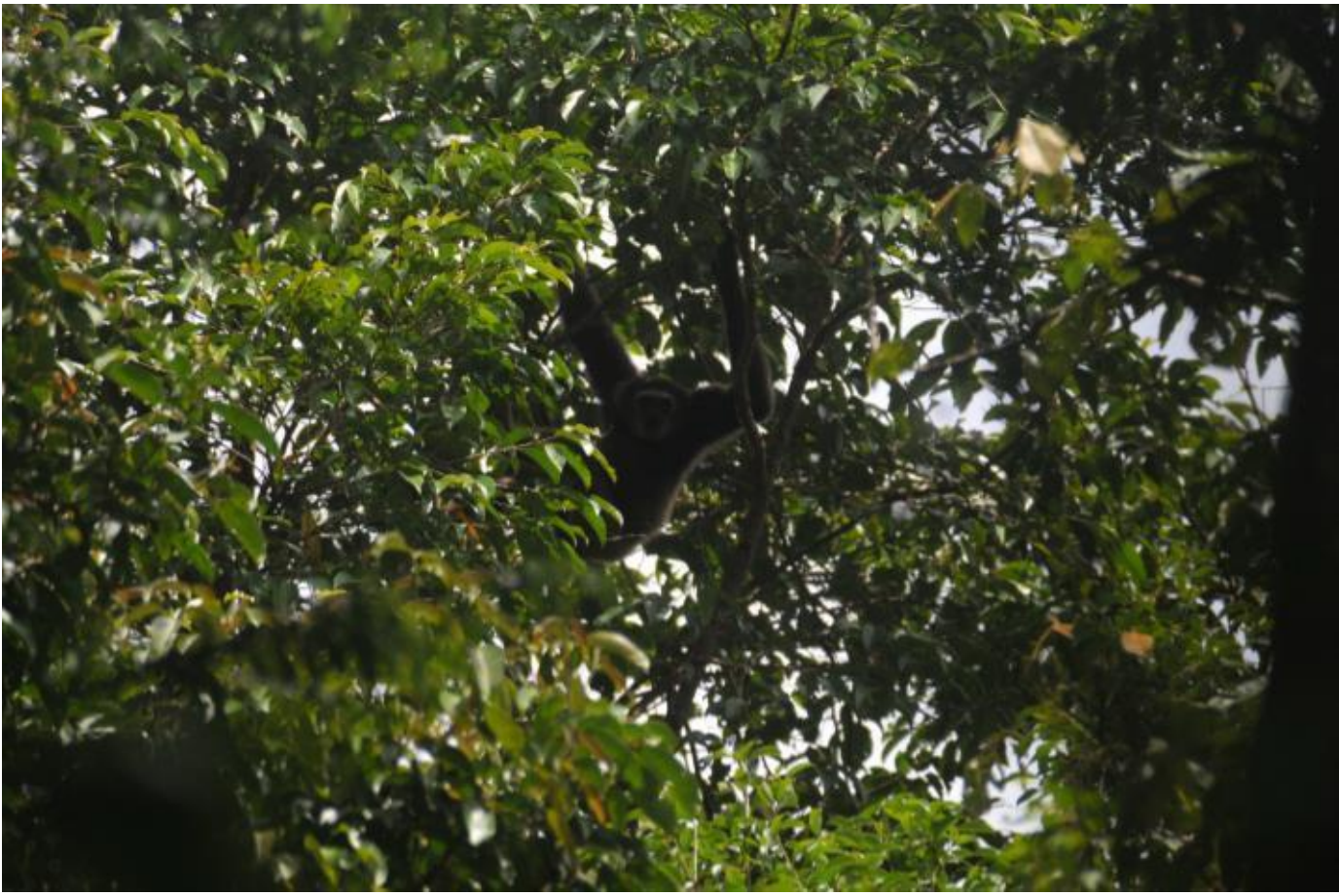


Muller's Bornean Gibbon

The Muller's Bornean Gibbon or scientifically known as Hylobates muelleri, is an endemic primate species of Borneo from the family Hylobatidae. They are diurnal rain

forest-dwellers, characterized by the long arms they branchiate through the trees. They live to defend their family territory against intruders v out above all

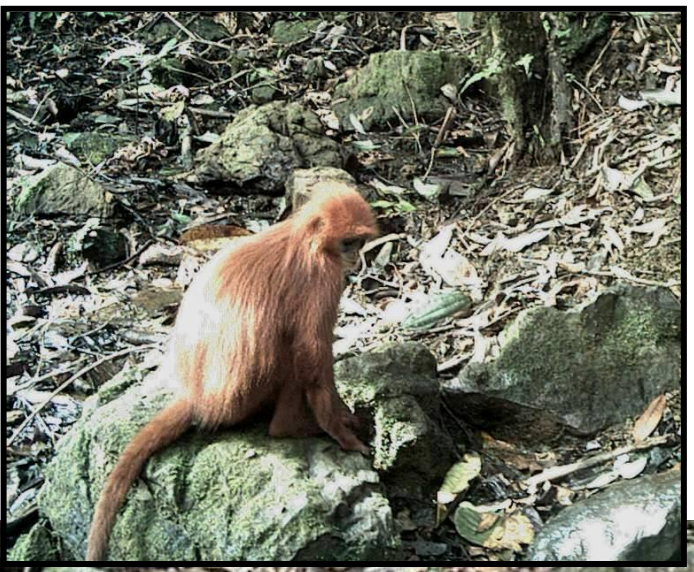
else early in the morning. Like other primates, folivore, but also consume fruits, flowers and seeds.



Red Langur

The Red Langur or Presbytis rubicunda is an endemic to Borneo. This species lives in primary and secondary lowland forest up to 1500m altitude and as well in swamp forests and redeveloped logged over forests. The Red Langur are folivorous species but it could also be considered as graminivorous because in certain months of the year, they rely more heavily upon seeds.

They occasionally move in a group from 2 to 13 individuals which are composed of one adult male, one or more adult females, subadults, juveniles and infants or popularly known as unimale social system and a polygynous mating system. The Red Langur is a territorial species that will chase other groups out of the home territory. This species was found to form associations with the Hose's Leaf-monkey.





Hose's Leaf-Monkey

The Hose's Leaf-monkey or Presbytis hosei is also a primate species endemic to Borneo. This species occurs in primary and secondary forest in an altitude range 1000-1300m and occasionally enter plantations. Similar to Presbytis rubicunda, this species also primarily a folivorous species but will also consume flowers, fruits and seeds.

Presbytis hosei ssp. everetti is the subspecies that was recorded in Payeh Maga. This subspecies could be differentiated from other subspecies by its sexual dichromatic with the male having black coloured hair on the crown, but for female the black colour hairs covers the forehead, the nape and extends laterally to the ear (Groves, 2001).







Rodents

The rodents are including squirrels, rats and porcupines that are grouped in the order Rodentia. They can be recognized by their dentition, with large, curved, chiseling incisors in both the upper and lower jaw, no canines and a wide diastema before the cheek teeth (Payne and Francis, 2007). The Giant Squirrel (Ratufa affinis) was the only squirrel sighted brachiated on the tree canopy around the Gunung Doa site.

The rats and mice are classified into family Muridae which can be found almost everywhere. The number of rat species in Payeh Maga, somehow rather poor with only 3-4 species recorded. The Whitehead's Rat (Maxomys whiteheadi), Long-tailed Giant Rat (Leopoldamys sabanus) and Chestnut-bellied Spiny Rat (Maxomys ochraceiventer) are the common three species trapped during the expedition.

The other member of rodents recorded in the Payeh Maga was the porcupines. Common Porcupine (Hystrix brachyura) was the only porcupine species recorded via camera trapping in the area during the expedition.







Yellow-Throated Martens

The Yellow-Throated Martens or Martes flavigula belongs to the family Mustelidae. Their slender and agile body are adapted to hunting small vertebrate animals, as well as invertebrates. They are active mainly during the day, but sometimes at night. Their movement is fairly quick on the ground or in the tree canopy. Their diets include a wide range of small vertebrates and invertebrates, bee nests and nectar. They normally rest in tree holes and on large branches. Usually alone or in pairs (Payne and Francis, 2007).

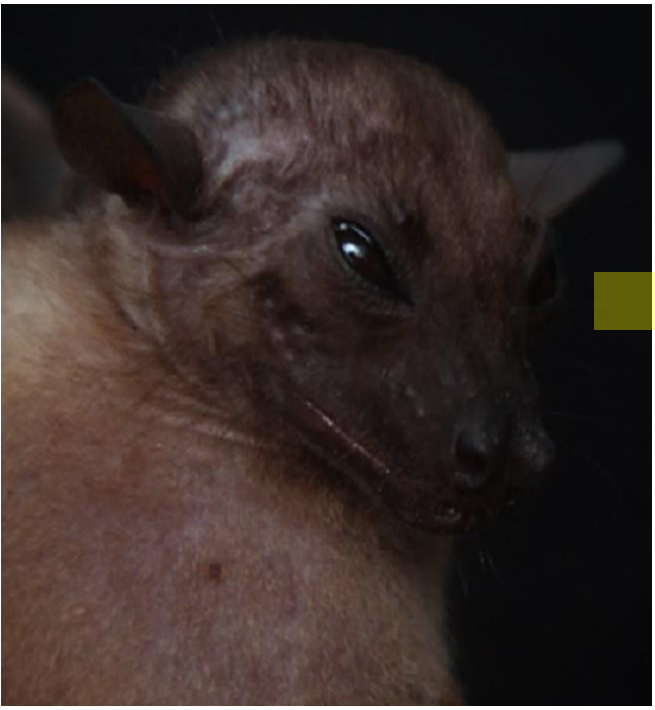


Bats

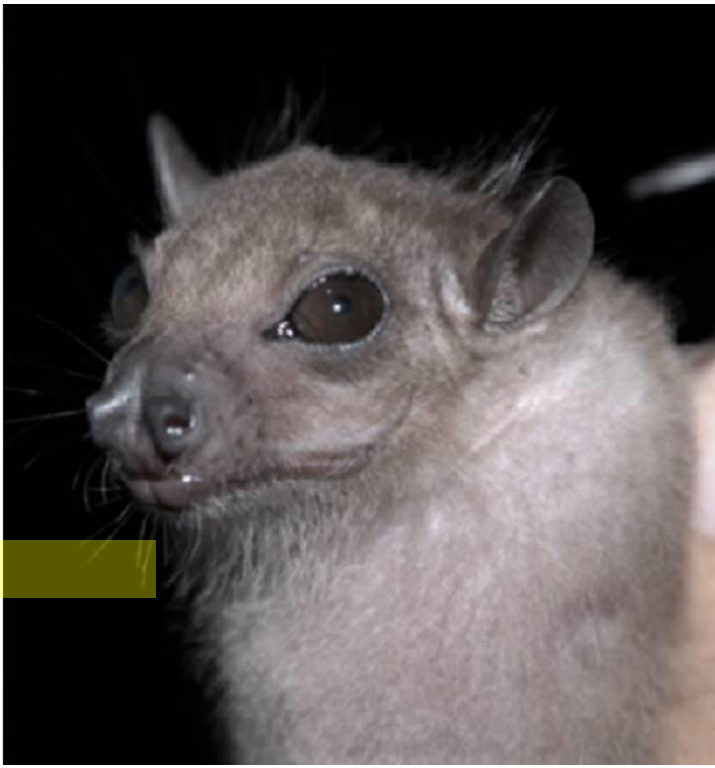
The Bats are placed in the Order Chiroptera. They are differing from all other mammals by their wings and ability to fly. The bats are difficult to identify unless they are captured and examined closely. They are normally frugivorous and the mist-nets are the most effective method for capturing bats that navigate with the help of their eyes and smell.



Spotted Winged Fruit Bat



Sunda Tailless Fruit Bat



Dusky Fruit Bat



Camera Trapping Record

Camera trapping is among the best method or strategy

to record the occurrence of the animals in particular areas. Some animals are very difficult to record or photograph in the wild due

nan's odour. Among the animals that Barking Deer, Bearded Pig, Red Langur, g-tailed Giant Rat, Malayan Porcupine,













Amphibian

The amphibians are including frogs, toads, salamanders and caecilians. There are approximately 150 species of frogs recorded in Borneo from six families. The frogs are placed into the order Anura, which existed since 200 million years ago.


Rhacophorus sp.


Meristogenys sp.


Ansonia hanitschii


Rhacophorus sp.


Limnonectes kuhlii




Rhacophorus everetti


Occidozyga laevis

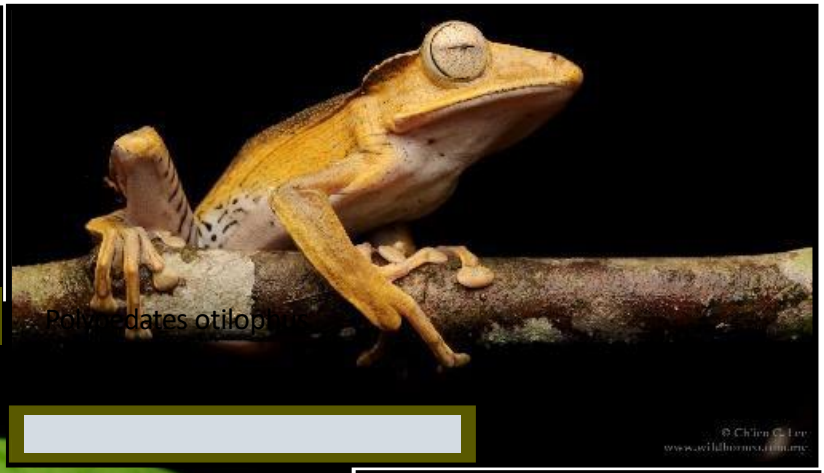

Philautus bunitus


Leptobrachium abbotti

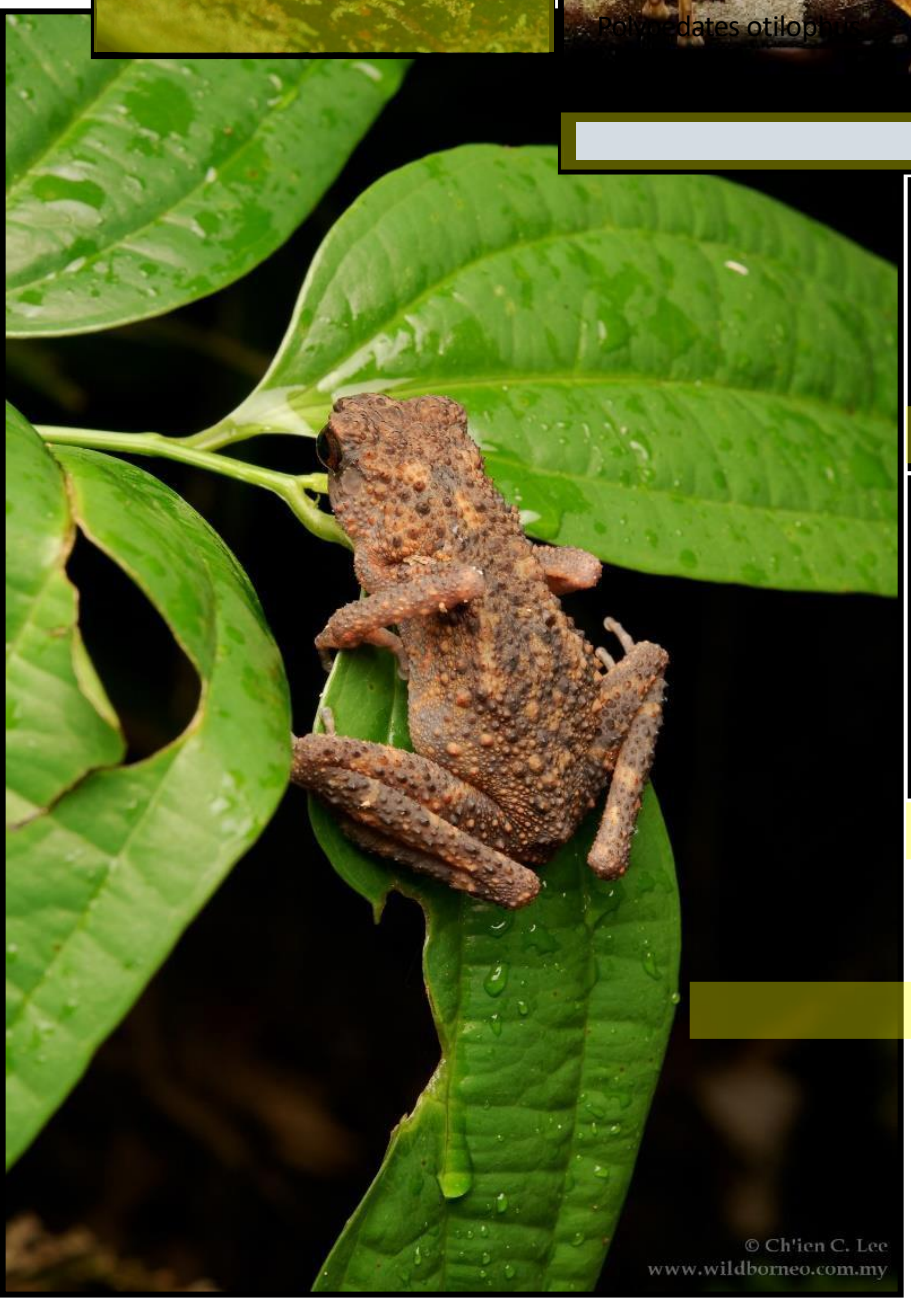
endemic species are very restricted to only one geographical area, for example, Leptobrachella mjobergi and Pedostibes rugosus.



Philautus petersi



Polypedates otilophus



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Rhacophorus baluensis



Ansonia longidigita

Ansonia hanitschii

Avifauna

The hill and sub-montane forests of Payeh Maga are important habitats for many resident birds recorded in Sarawak. They are home to a large community of avian species including several unique and endemic species such as Calyptomena whiteheadii, Harpactes oreskios ssp. dulitensis, Oriolus hosei, Prionochilus percussus, etc. The provisional result showed

the diversity of avian fauna in Payeh Maga is tremendous. At least more than dozens of bird species are sighted and recorded during the expedition. An early estimation suggested that the number of species might ranges between 50-70 species or more.

Crested Serpent Eagle







Calyptomena whiteheadii

The 'Whitehead's Braodbill belongs to the Eurylaimidae family. This species is restricted to submontane and montane forest in the northern part of Borneo. Being the largest member of the genus Calyptomena, they are insectivorous and carnivorous. Prey taken include insects, spiders, centipedes and millipedes, as well as lizards and tree frogs.

Orange—breasted Trogon

The Orange-breasted Trogon or Harpactes oreskios spp. dulitensis is a member of the Trogonidae family. This beautiful bird generally has olive to olive-yellow coloured head, orange breast that changes to bright yellow on upper and lower portions. They are also insectivorous and carnivorous.




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Black Oriole

The Black Oriole or Oriolus hosii belongs to the Oriolidae family. This species is endemic to Borneo (Sarawak and Kalimantan) and they inhabit in tropical moist montane forest. This species is threatened by habitat loss and yet not many information is available on this highland bird species.





distributed from Thailand to Borneo. The Blue-crowned Hanging Parrot is mostly green and the adults have black beaks red rump and yellow lower back. The adult females are duller in colour. Their diets are including flowers, buds, fruits, nuts and seeds.

Red Cuckoo-Dove

The Red Cuckoo-Dove is a bird in the genus Macropygia. They have several vernacular names such as Brown Pigeon, Pheasant Pigeon and Cuckoo-Dove. The name Cuckoo-Dove is referred to the elegant and long-tail shaped. The red Cuckoo-Dove inhabit the rainforest edges, scrubs and secondary forest, in open places of low vegetation and also in a primary forest from lowland to highland areas.





Bay Owl

The Bay Owls or Phodilus badius are placed into the family Tytonidae, subfamily Phodilinae. The Bay Owls are

feather tufts and a more U-shaped facial disk. They are brous.

Phodilus badius



Chestnut-breasted Malkoha



Red-bearded Bee Eater



Blue-eared Kingfisher



Yellow-rumped Flowerpecker

Chequer-throated Woodpecker Streak

Wren Babbler







Dusky Munia



Velvet-fronted nuthatch



Pink-necked green pigeon

Great hornbill



Temminck's sunbird


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Snakes

Snakes are elongate, legless carnivorous reptiles from the suborder Serpents. They differ from the legless lizard by their lack of eyelids and external ears. There are 15 recognized families of snakes in the world comprises of 456 genera and 2900 species.

Genus *Asthenodipsas*

This genus belongs to the family Pareatidae (formerly Pareinae, a subfamily of the Colubrinae). They are unique among the Southeast Asia snake, by having large scales that ovelap on their chin rather than having them separated by a straight groove (Lim, 2009). They are known to feed mainly on terrestrial molluscs (Stuebing and Inger, 1999).



Liopeltis tricolor – Ular Berbelang Melayu



Phoxophrys spiniceps

This lizard belongs to the family Agamidae. Phoxophrys spiniceps

is endemic to Borneo and inhabits high altitudes.

Sphenomorpus sp.

This small terrestrial skink belongs to family Scincidae. This species with slender body can be found on the leaf litter and also climbing trees. Dorsum dark brown with yellowish stripes and small dots on the sides.





Cytodactylus matsuii

Grouped in the family Gekkonidae. Commonly known as Bent-toed geckos or bow-fingered geckos.

Ptychozoon kuhlii

A parachuting gecko that found in the lowland to hill forests, inhabits in large trees and occasional enters wall of houses. Their foods include, arthropods, insects such as grasshopper, crickets, katydids, moths, etc.

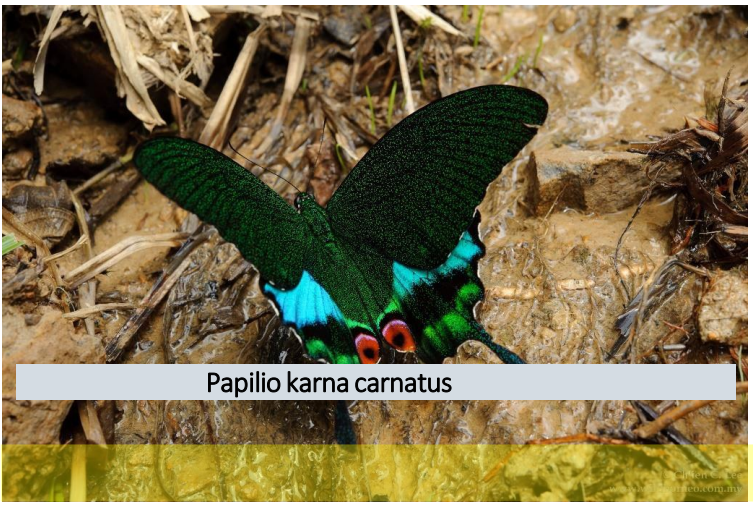




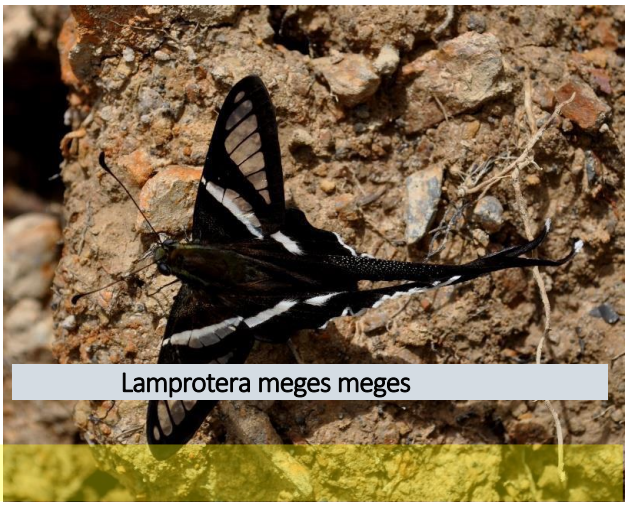
Graphium agememnon

Lepidoptera – Rhopalocera and Heterocera

The diversity of butterflies and moths at Payeh Maga highland is tremendous. Among the families observed during the expedition were; butterflies (Papilionidae, Pieridae, Nymphalidae, Lycaenidae, etc.) and moths (Noctuididae, Geometridae, Lasiocampidae, etc.).



Papilio karna carnatus



Lamprotera meges meges



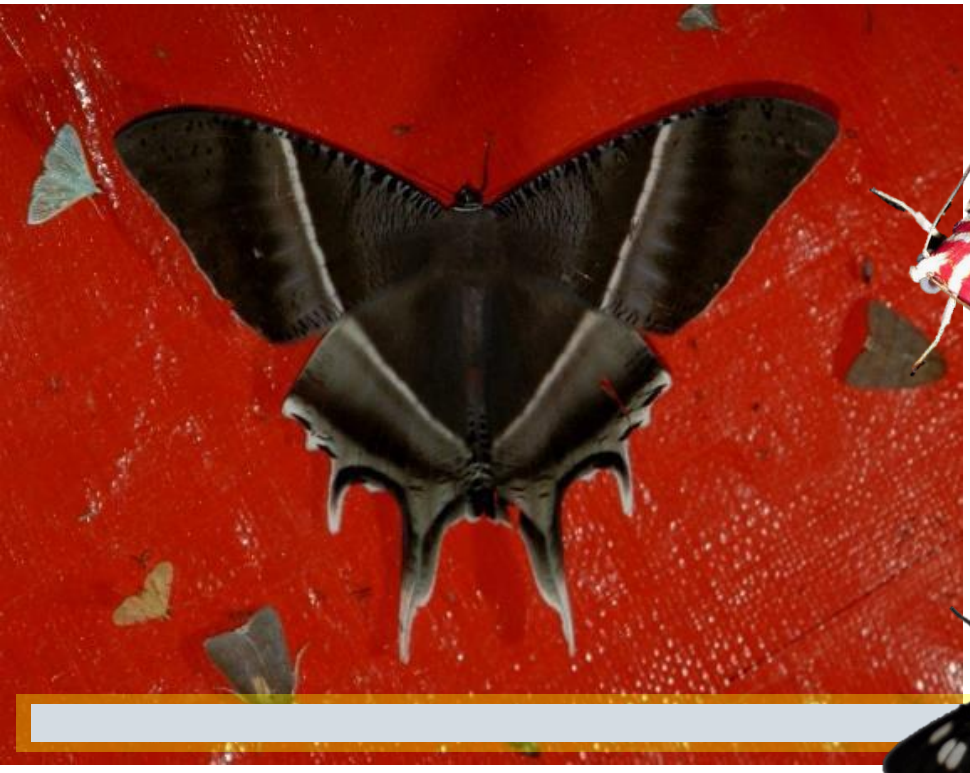


Cirrochroa surya siamensis



Anthreraea rosieri

Milionia basalis





Sinna calospila





Lyssa zampa docile

Attacus atlas





Lymantria sp.







Dragonfly

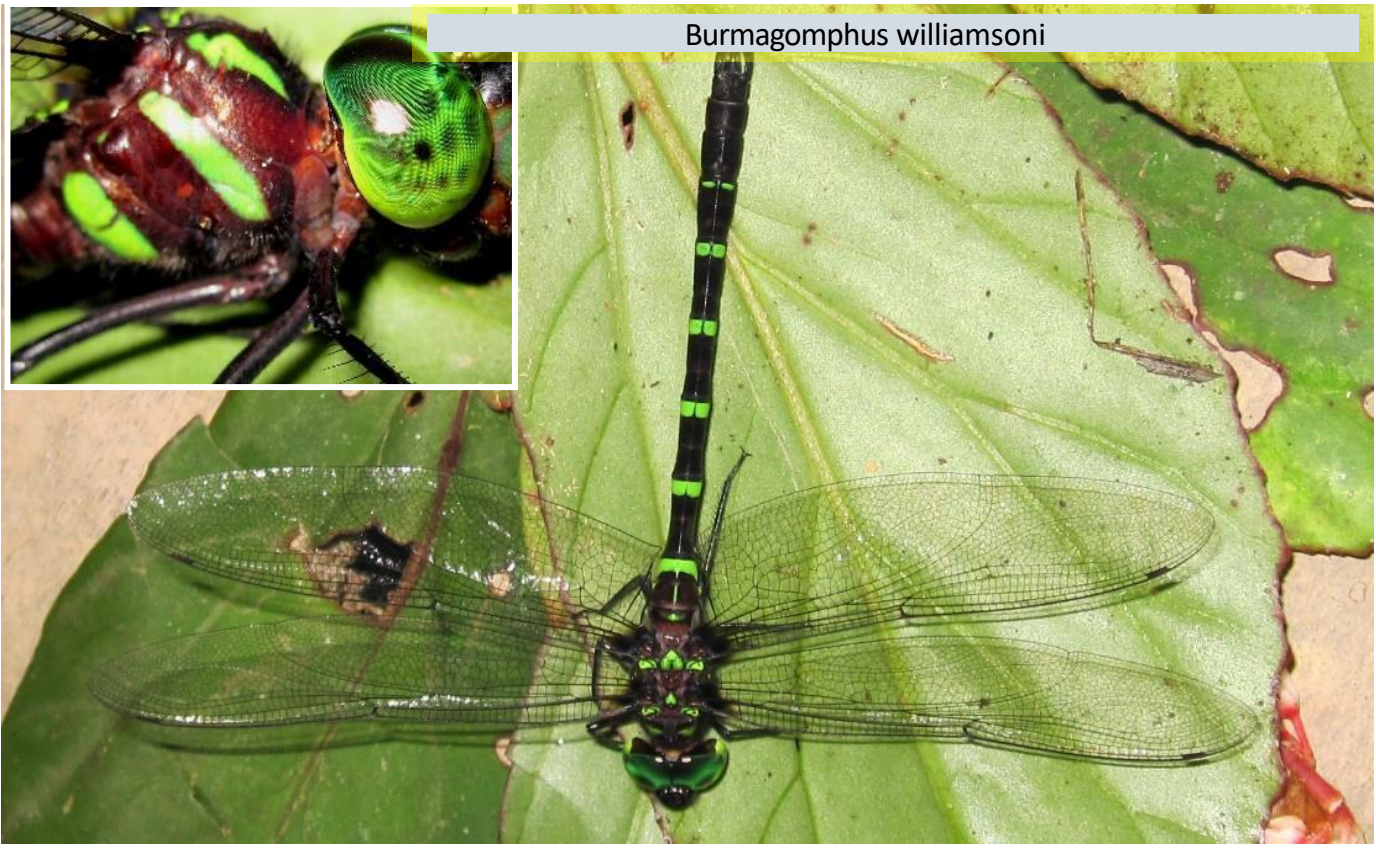


Orthetrum pruinosum

The dragonflies are among the most beautiful insects belonging to order Odonata. They are most often found near the freshwater, their breeding sites.

However, they also adapted to many habitats, suburban drains, garden ponds, open lakes, dams, marshy wayside places, swamp forests, seepages in mixed dipterocarp forest and montane forest (Orr, 2005).

During the expedition, the number of dragonfly species recorded is unexpectedly very low. Only three species were recorded, Burmagomphus williamsoni, Orthetrum pruinosum and Neurothemis fluctuans.



Burmagomphus williamsoni



Ischnura heterosticta

Damselfly

The damselflies are group together with the dragonflies in the order Odonata

nilar morphological characteristics. They can be differentiated by the fact that the wings are held together and parallel to the body when they are resting. In addition, the sizes of damselflies are usually smaller than dragonflies, more delicate and they are weaker fliers in comparison and also their eyes are separated.

The damselflies are inhabiting near slower moving waters, margin of streams, ponds and lakes. In Sarawak, they are poorly studied particularly the highland areas such as Payeh Maga. During the expedition, only one species of damselfly was recorded, Ischnura heterosticta is the common species occupied the streams, ponds and water-filled cavities.



Ischnura heterosticta (female)



Stag Beetle

Commonly known as "pinching bug", they are from the family Lucanidae. They has a broad rectangular prothorax and a pair of long protruding jaws, taking various forms. The males have large mouth – parts exhibiting the pair of antler-like mandibles, in which they used to impress their mates and be used to battle with other males for its mate. Those with large and longer mandibles will tend to be previleged.



Scarabaeidae



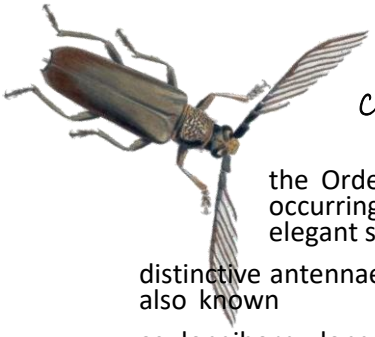
The family Scarabaeidae includes the biggest and bulkiest known beetles such as Scarab Beetles, Dung Beetles and Chafers. Many of the Scarabs are found dwelling in the debris and decaying trees, flowering plants, plant roots

and carrion. The Chafers typically with brilliant nectar or foliage sap. The Dung beetles are ea animals and easily collected in traps with bait.









Cerambycidae

The family Cerambycidae is the second largest family in the Order Coleoptera (beetle group) with several thousand species occurring all over the world. This family includes countless beetles with elegant shaped and beautiful coloured bodies bearing the most distinctive antennae, often longer than the body, that is why this beetle group is also known as longihorn, longcorn or timber beetles. The mouth- parts include a pair of short, powerful, sharp mandibles used for biting and cutting. They caused damage annually to valuable timber trees, fruit trees and some cultivated crops.



Phasmids

The Phasmids are grouped in
insects and the leaf insects. All phasm
almost all tropical forests, but they ar

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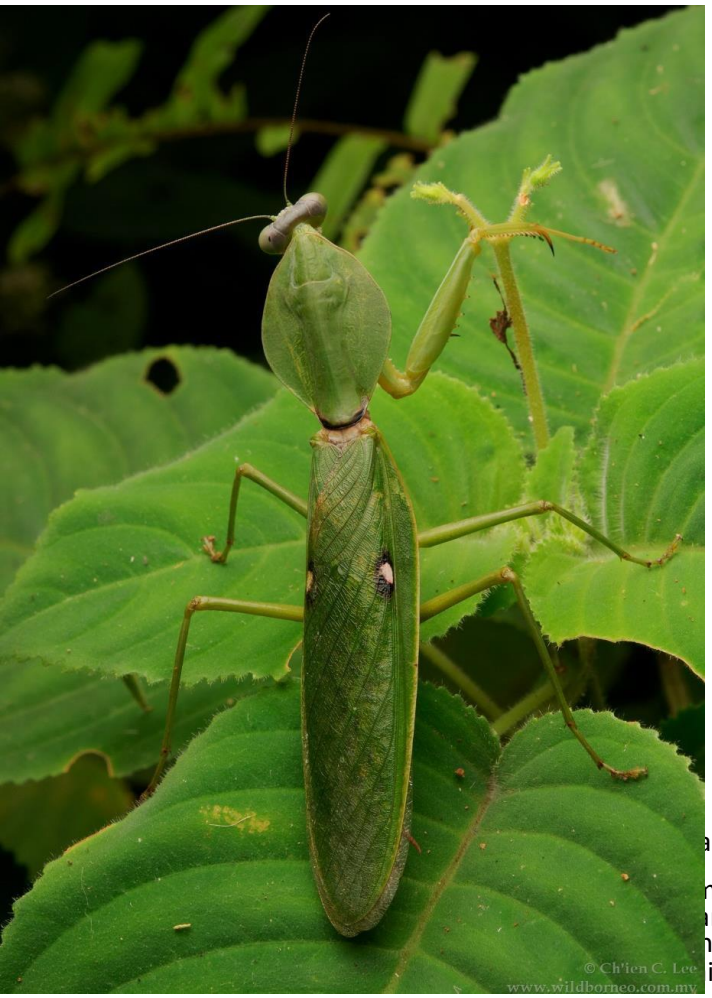



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Mantis

The mantis, or usually known as the praying mantis, because of the typical "praying-like stance". They belong to the Order Mantodea, with c. 2200 species in 15 families around the world. The mantis has two grasping, spike foreleg, in which prey items are caught and held securely.

achnida that

ned species such as spiders, scorpions, arachnids have eight legs, although some nsory function. The word arachnid was ich mean "spider".



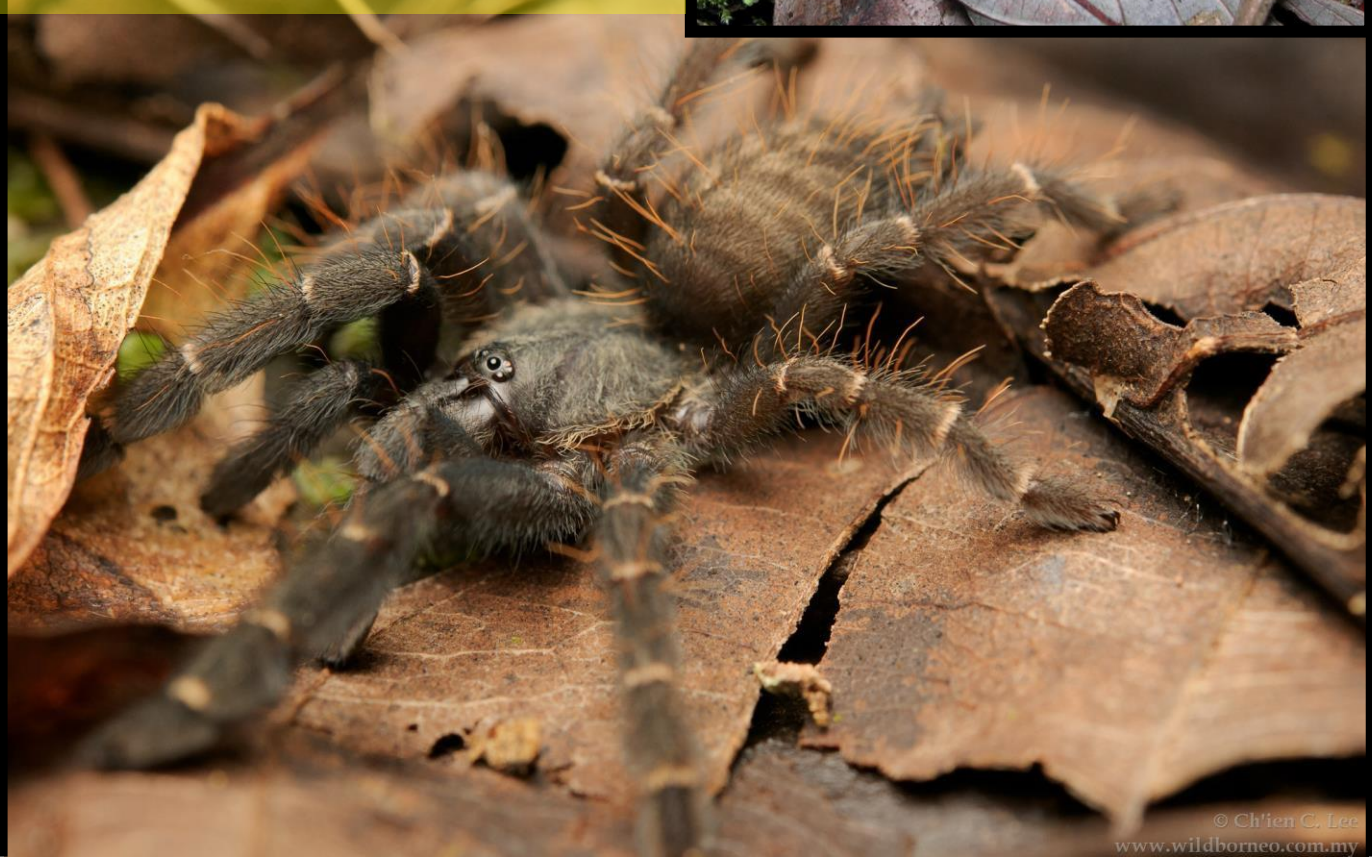




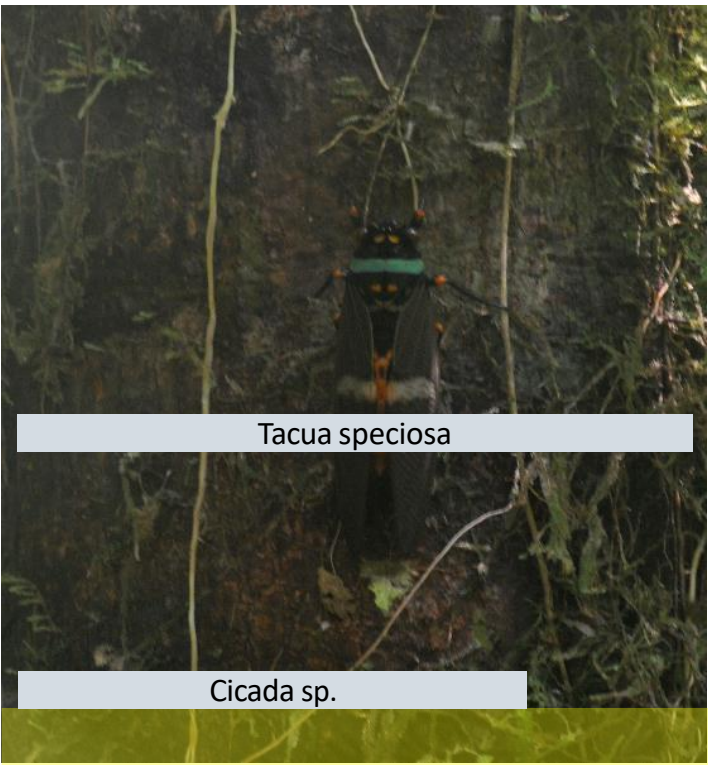


Diversity of spider in Payeh Maga is tremendous. Field observations sighted diversity in term on their sizes, from as small as few millimeters up to 10 cm or more of body length; various colorations (blackish, brownish, reddish, greenish, yellow and orange); terrestrial (such tarantula), jumper-spiders and mostly are web-spiders.

Tarantula sp.



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Tacua speciosa

Cicada sp.

Cicadas

The word 'cicada' is a Latin word which means 'tree cricket'. They are classified in the order Hemiptera. There are c. 2500 species around the world, and many are still unidentified. The cicadas are related to leafhoppers and spittlebugs.





Dundubia vaginata









Katydids

Sometimes also known as bush-crickets, they belong to the family Tettigoniidae. The Katydids, together with their sisters, the grasshoppers are placed in the order Orthoptera. They are different from their sisters by the length of filamentous antennae which exceed their own body length or more. There are c. 6400 species of katydids around the world.



Fish samplings









Fish

The diversity of fish fauna in Payeh Maga is considered very low.

Only two species were collected and recorded during the expedition.









Genus Nemacheilus

Also known as the Ray-finned fish, this genus belongs to the family Baliotoridae. One of the species, recorded in Payeh Maga was N. fasciatus, the Barred Loach or Red-tailde Banded Loach. It is a small fish with a maximum body length up to only 8 cm long.

Payeh Maga – The Way Forward

The Payeh Maya Highland area is very rich in biodiversity and considered as one of the richest pristine highland forests in Sarawak. The State Government of Sarawak has taken the right step to initiate comprehensive documentation of the area for further consideration. More studies and researches in the area could unveil much more biodiversity treasure of Payeh Maga for future generation to savour and future planning.











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HEART OF BORNEO SERIES 2

Payeh Maga

Sarawak's Pristine Highland Forest (New Edition)

A PUBLICATION
PROJECT HEART OF BORNEO INITIATIVE FOR SARAWAK

2021



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MESSAGE

Bismillahir-Rahmannir-Rahim, Selawat dan Salam Ke Atas Nabi Muhammad SAW

Assalamualaikum Warahmatullahi-wabarakatuh

I am honoured to be given privilege of writing the message for this publication, *Heart of Borneo Series 2: Payeh Maga – Sarawak's Pristine Highland Forest (New Edition).* I should, first of all congratulates the International Affair Division for their effort to republish (new edition) of this book.

The committee and editorial team deserve much credit for the time and effort put in the success of this book published. Special appreciations go to all the valued contributors who have been courteous to provide paper and photos which concluded into meaningful publication.

Datu Hamden Bin Haji Mohammad
Pengarah Hutan
Jabatan Hutan Sarawak

Forward

Payeh Maga Scientific Expedition: Sarawak's Pristine Highland Forest, was held from 28 September to 12 October 20101 with participation of over 80 researchers and scientists from various government institutions, universities and local NGOs and also participants from Brunei Darussalam and Indonesia. It was conceived as an activity to illustrate and provide invaluable insight to the mystery of Payeh Maga Forest. The expedition was jointly organized by the Forest Department Sarawak and Sarawak Forestry Corporation and mainly funded and supported by the Ministry of Natural Resources and Environment Malaysia and State Government of Sarawak as a continuation project under the Heart of Borneo (HoB) initiative. Payeh Maga Scientific Expedition, in fact is a second scientific expedition conducted in the project that revealed the diverseness of floras and faunas in the State.

I am privileged and honored to write the foreword for this book of very important scientific observations and discoveries on Payeh Maga Forest which ranks as among the superb wilderness areas, not only in Sarawak, but in Malaysia. The book entitled, "The Heart of Borneo Series 9: Payeh Maga – Sarawak's Pristine Highland Forest" is mainly a collection of provisional results that were presented by the participants during the expedition and as well as field observations from the authors.

It is my fervent hope that this publication on the Payeh Maga Forest would provide readers, especially its stakeholders, researchers and the public at large, with extensive references into the Payeh Maga's rich natural resources and its vast scientific potential.

The organizing committee deserves much credit for the time and effort put in for the success of the expedition. Special appreciation goes to all the esteemed writers and researchers who have been gracious to provide the data and photos which culminated into wonderful publication.

Former Director of Forests
Datu Haji Ali Yusop

Preface

This book gives us a glimpse of the findings of the Scientific Expedition to Payeh Maga made in 2010, which was jointly organized by the Forest Department Sarawak and Sarawak Forestry Corporation.

This book is one of the series of publications under the Heart of Borneo Project Initiative for Sarawak. It highlights the results of the 2010 expeditions with photographs and information on activities, the physical environments, flora, and fauna studies.

From the 14-day expedition, a tremendous amount of data was collected by researchers and scientists from various government departments, institutions, universities, and NGOs from Malaysia, Brunei Darussalam and Indonesia. The area covered in the expedition is relatively small, less than 20 percent of the Payeh Maga areas. The biodiversity recorded is exceptionally rich, many species of flora and fauna have been recorded and compiled. From the flora component, orchids and gingers are the two most diverse groups recorded in the Payeh Maga areas. Preliminary results indicate that the orchids with 45 genera consisting approx. 130 species and the gingers with 16 genera comprising more than 40 species have been recorded. Twelve species of Rhododendron were recorded in Payeh Maga which is possibly the highest number for a spot of Rhododendron in Sarawak. Apart from orchids, gingers, and rhododendrons, other plant species from the group of ferns, bryophytes, and fungi are found abundantly in the area. From those plant groups, many new records have been created. The fauna component is also exceptionally rich. Great numbers of mammals, birds, and insects have been recorded which are comparatively high as compared with those in the Lanjak Entimau Wildlife Sanctuary (LEWS).

Apart from the flora and fauna, the atmosphere of Payeh Maga itself is also unique with beautiful sceneries. Indeed, Payeh Maga area is probably the only highland area in Sarawak that is covered with peat swamp vegetation. Many waterfalls and seasoning rock streams with high aesthetic values for ecotourism spots are also found in this area.

Authors


FOREST DEPARTMENT SARAWAK