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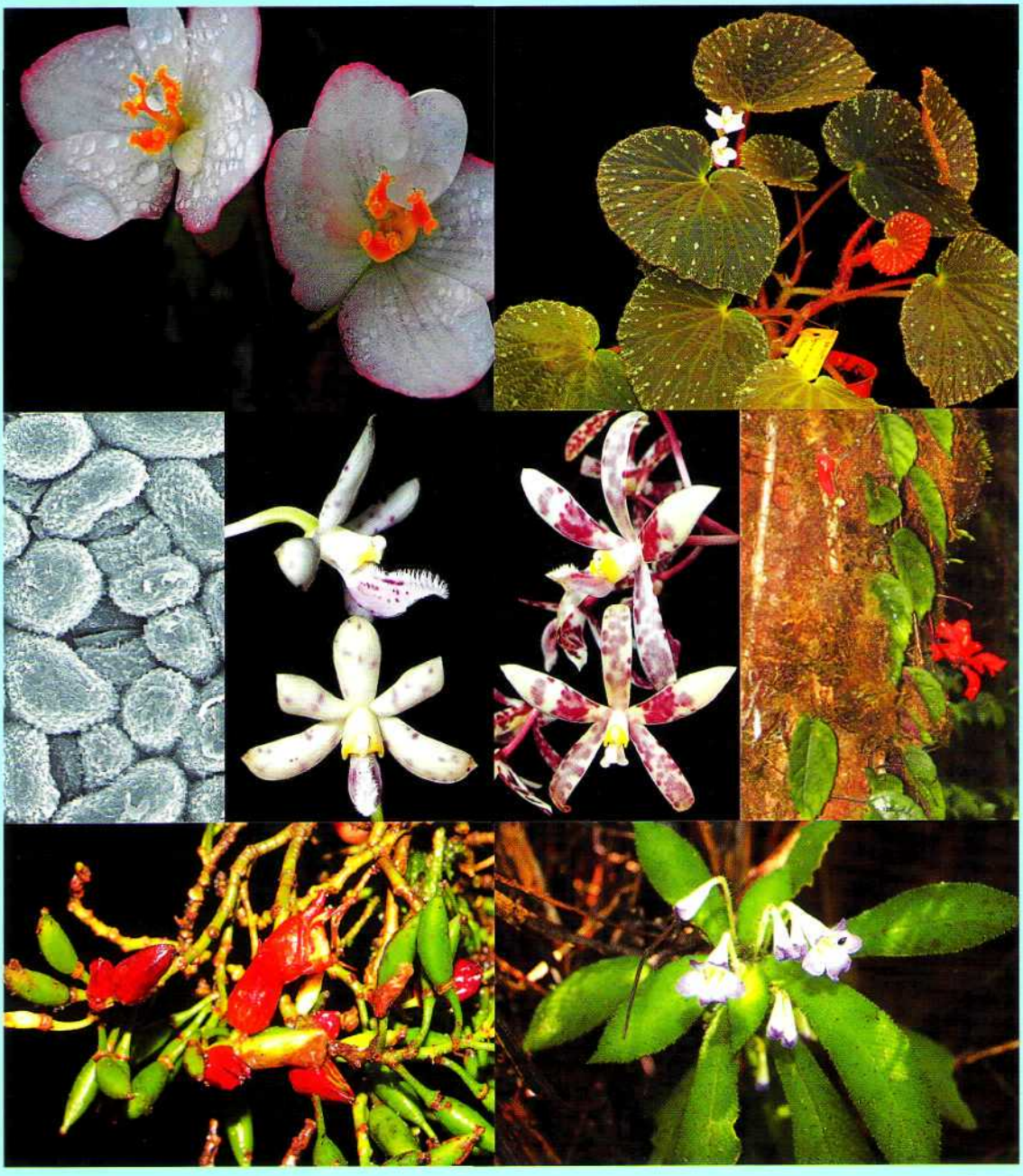

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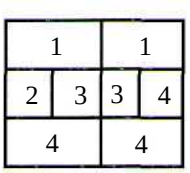

Cover images: 1. *Begonia holosericeoides* (female flower and habit) (Begoniaceae; Ardi *et al.); 2.* Abaxial cuticles of *Alseodaphne rhododendropsis* (Lauraceae; Nishida & van der Werff); *3. Dipodium puspitae, Dipodium purpureum* (Orchidaceae; O'Byrne); 4. *Agalmyla exannulata, Cyrtandra coccinea* var. *celebica, Codonoboea kjellbergii* (Gesneriaceae; Kartonegoro & Potter).

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CONTRIBUTION OF THE HEART OF BORNEO (HoB) INITIATIVE TOWARDS BOTANICAL EXPLORATION IN SABAH, MALAYSIA

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ABSTRACT
SABRAN, S., NILUS, R., PEREIRA, J. T., SUGAU, J. B. & KUGAN, F. 2014. Contribution of the Heart of Borneo (HoB) initiative towards botanical exploration in Sabah, Malaysia. *Reinwardtia* 14(1): 137 – 142. — The Heart of Borneo (HoB) declaration is a conservation agreement initiated by WWF and signed by three countries, *i.e*., Brunei Darussalam, Indonesia and Malaysia in Bali, Indonesia on 12th February 2007 to protect more than 23 million hectares of forested region on Borneo Island. These forested areas could be well protected when conservation management plan is in place. One of the crucial activities to facilitate the planning and formulation of conservation plan is to conduct scientific expeditions that include botanical exploration. The primary objective of the expedition is to identify the key conservation targets within the forest reserves. For the past five years, several expeditions have been conducted by the Sabah Forestry Department under the auspices of the HoB project to explore various forest reserves with conservation issues within the Heart of Borneo area. This paper will present the findings which include plant richness, endemism and plant conservation status in each forest reserves that has been explored.

Key words: Botanical exploration, endemism, Heart of Borneo (HoB), plant conservation status, plant richness.

ABSTRAK
SABRAN, S., NILUS, R., PEREIRA, J. T., SUGAU, J. B. & KUGAN, F. 2014. Kontribusi dari the Heart of Borneo (HoB) terhadap kegiatan eksplorasi botani di Sabah, Malaysia. *Reinwardtia* 14(1): 137 – 142. — Deklarasi the Heart of Borneo merupakan kesepakatan konservasi yang dipelopori oleh WWF dan ditandatangani oleh 3 Negara yaitu Brunei Darussalam, Indonesia dan Malaysia di Bali, Indonesia pada tanggal 12 Februari 2007 untuk melindungi lebih dari 23 juta hektar kawasan hutan di Pulau Borneo. Kawasan hutan ini dapat dilindungi dengan baik ketika rencana managemen konservasi diterapkan. Salah satu kegiatan yang paling penting adalah memfasilitasi perencanaan dan formulasi dari rencana konservasi untuk melakukan ekspedisi ilmiah yang meliputi kegiatan eksplorasi botani. Tujuan utama dari ekspedisi yang dilakukan adalah untuk mengidentifikasi target kunci konservasi dalam kawasan hutan. Selama lima tahun terakhir, beberapa ekspedisi telah dilakukan di Departemen Kehutanan Sabah dibawah naungan proyek HoB untuk mengeksplorasi berbagai macam kawasan hutan dengan isu konservasi dalam kawasan the Heart of Borneo. Makalah ini menyajikan beberapa penemuan meliputi kekayaan tumbuhan, endemisitas dan konservasi tanaman di masing-masing kawasan hutan yang telah dieksplorasi.

Kata kunci: Heart of Borneo (HoB), eksplorasi botani, endemisitas, kekayaan tumbuhan, status konservasi tumbuhan.

INTRODUCTION

The Heart of Borneo (HoB) Vision and Area

The Heart of Borneo (HoB) initiative was first mooted by World Wildlife Fund (WWF) and the declaration was signed by the three participating countries *i.e.* Brunei Darussalam, Indonesia and Malaysia in Bali, Indonesia on the 12th February 2007. The declaration envisioned in the protection of about 22 million hectares of forested region on Borneo Island (Fig.1). To date, the area has increased to 23 million ha which includes 16.777.840 ha for Kalimantan, 6.089.900 ha for Malaysia and about 405.960 ha for Brunei Darussalam (Table 1). In Sabah, 3.916.640 ha has been designated HoB area of which occupies more than half of the total state land mass. The HoB area in Sabah covers most of the interior heartlands, which is an important ecosystem for biodiversity and home to many local indigenous communities (Fig. 2).

In 2008, the Sabah state government published the first Strategic Plan of Action (SPA) for Sabah to support the HoB Initiative. The Sabah SPA was drawn up based on the Sabah HoB Project Document (PD) and the Tri-national Strategic Plan of Action to conserve the HoB area. A set of targets was formulated for the SPA for the period 2008–2012.

A newly revised Strategic Plan of Actions for the period 2014–2020 was commissioned by the Sabah State Committee in 2013. The HoB initiatives in

Fig. 1. Area designated under the HoB initiative (dark green shade) in Borneo Island (source: wwf.panda.org).

Table 1. HoB area in Borneo Island (Source: WWF)

Country	Region/State	Area (ha)	Total Area (ha)
Indonesia	Kalimantan Timur	8,906,190	16,777,840
	Kalimantan Tengah	2,988,240	
	Kalimantan Barat	4,883,410	
Malaysia	Sarawak	2,173,260	6,089,900
	Sabah	3,916,640	
Brunei Darussa-lam		405,960	405,960
Grand Total HoB Area (Ha)			23,273,700

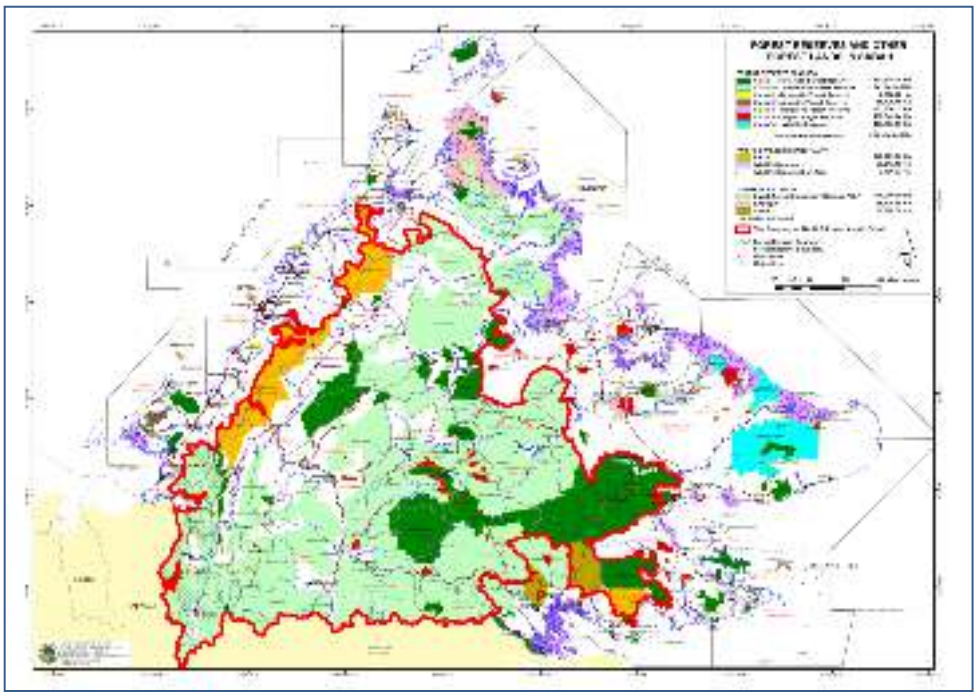

Fig. 2. The boundary of the HoB project area in Sabah (Source: Sabah Forestry Department).

Sabah are to pursue:

- The consolidation of the network of protected areas and their viability and coverage.
- Replication of sustainable forest management within the production forest be exponentially increased.
- Building capacity and strengthening the institution governing conservation.
- Creating smart partnership between government, the private sector, non-governmental organizations and local community.
- To expand and improve collaboration with neighboring state or country, including international organizations.

Therefore, to pursue the first objective, Sabah Forestry Department spearheaded the scientific expeditions to enhance biological resource data within the HoB area as essential background information for the formulation of the Conservation Management Plan (CMP) of designated protected areas under the 9th and 10th Malaysian Plan. The primary objective of the scientific expedition is to identify the key conservation targets within the reserves and highlight potential threats and recommend conservation measures to further

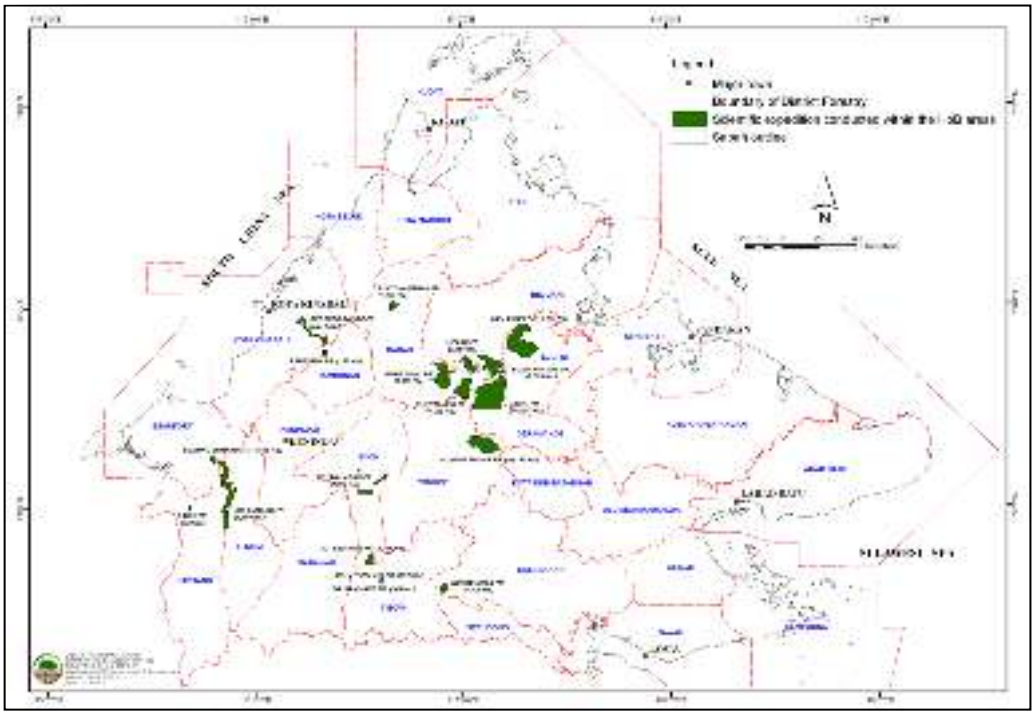

Fig. 3. The location of 18 forest reserves where scientific expeditions have been conducted under the Sabah HoB initiative from 2008–2013 (Source: Sabah Forestry Department).

enhance or maintain the ecological integrity of the ecosystem and the continuous survival of the forest biological richness. Thus far, 15 scientific expeditions have been carried out, covering rapid assessments on the flora and fauna in these areas. A few agencies such as Sabah Parks, University of Malaysia Sabah (UMS) and Sabah Agriculture Department were also involved in the expeditions. This paper presents the botanical findings from 15 forest reserves covered during the expeditions.

STUDY SITE AND METHODS

Eighteen forest reserves, namely Batu Punggul, Bidu-Bidu, Bukit Hampuan, Bukit Kuamas, Bukit Taviu, Crocker Range, Ganui, Gn. Lumaku, Gunong Lumaku, Gunung Tinkar, Lipaso, Milian-Labau, Nurod Urod, Rafflesia, Sg. Siliawan, Sg. Sansiang, Tawai and Ulu Telupid were surveyed from 2008−2013 (Fig. 3). Flora data from only 15 forest reserves are presented in this paper which excludes flora data from Ganui, Crocker Range and Milian Labau Forest Reserves. Plant herbarium specimens were collected from the survey area and deposited at the Sandakan Herbarium (SAN). Sterile voucher specimens were also collected within 0.1-ha transect or 0.07-ha circular plots that were established to assess forest composition in different forest types in the reserve. Plant specimens were collected mainly of vascular plants, comprising the Angiosperms (Dicotyledon and Monocotyledon), Gymnosperms, Fern ally and Ferns. The common tree species were identified directly to species level in the field by means of their distinctive field characteristics. For those that could not be readily identified, voucher specimens were collected for subsequent determination at SAN. Prior to identification, the specimens were oven-dried at a temperature range of 45–50°C for several days. All oven-dried specimens were sorted according to morphospecies and identified to species level by cross-checking with existing specimens at SAN and related flora references (Airy Shaw, 1975; Argent *et al*., 2007; Ashton, 2005, 2006; Beaman & Beaman, 1998; Chan *et al*., 1994; Chung, Soepadmo & Lim 2005; Clarke, 1997; Dransfield, 1984, 1992; Julia, 2005; Kern, 1974; Sugau, 2005; Wong & Sugau, 1996; Wood, 1997; and Wood & Cribb, 1994). Past collecting records from the various forest reserves surveyed were also obtained from the SAN database (BRAHMS) and combined with the present flora data. The data for endemism is obtained from literature materials of the respective plant groups. Plant conservation status were obtained from the IUCN Red list website (IUCN, 2013).

RESULTS AND DISCUSSION

1. Plant Richness

A total of 3413 taxa were recorded from 15 forest reserves surveyed (Table 2). The Angiosperm (Dicotyledon) represents the largest

Table 2. The plant richness in 15 forest reserves where scientific expeditions have been conducted under the Sabah HoB initiative from 2008–2013.

Forest Reserves	Area (ha)	Plant Group										Total Taxa
		Lycophytes		Ferns		Gymnosperm		Angiosperm				
								Monocot		Dicot		
		No. Family	No. Taxa	No. Family	No. Taxa	No. Family	No. Taxa	No. Family	No. Taxa	No. Family	No. Taxa	
Bidu-Bidu	16094	1	1	13	28	3	7	12	118	77	481	635
Bukit Hampuan	1253	2	6	15	41	3	8	14	197	89	674	936
Bukit Kuamas	7324	1	1	15	25	1	2	12	32	71	430	490
Bukit Taviu	8630	1	1	12	20	-	-	14	85	76	537	643
Batu Punggul & Sg. Sansiang	494	2	6	19	47	-	-	14	66	74	477	596
Gn. Lumaku & Gunong Lumaku	11845	2	6	19	68	2	6	15	225	88	1225	1530
Gunung Tinkar	10150	3	3	16	30	2	5	12	109	84	667	814
Lipaso	3866	1	1	7	11	-	-	12	81	62	237	330
Nurod-Urod	1705	1	5	18	54	2	3	13	70	75	451	583
Rafflesia	356	3	4	19	78	3	4	15	106	83	470	662
Sg. Siliawan	2136	1	4	12	33	1	1	8	58	62	689	785
Tawai	22697	1	2	13	25	2	13	16	155	87	875	1070
UluTelupid	7508	-	-	3	3	-	-	9	18	40	142	163

plant group with 2.684 taxa or 79% of the total taxa recorded, followed by the Angiosperms (Monocotyledon) with 488 taxa (14%), Gymnosperms with 21 taxa (1%), Ferns with 204 taxa (6%) and Fern Ally with 16 taxa (0.5%). Most of the surveyed areas are classified as tropical rainforest that are pristine and also areas subjected to various degree of human disturbances in the past that resulted with moderately disturbed to secondary dominated vegetation conditions. The botanical collections were largely made on various forest formations, *i.e.* mixed dipterocarp, ultramafic, limestone and montane forest.

The highest number of taxa was recorded from the combined Gn. Lumaku and Gunong Lumaku FRs with overall taxa of 1,530, followed by Tawai FR with 1,070 taxa and Bukit Hampuan FR with 936 taxa. While the lowest number of taxa was recorded from Ulu Telupid FR with 163 taxa. It is expected that larger number of taxa will be recorded in the larger sized forest reserves and also areas that have been widely botanized in the past.

2. Endemism

The number of endemic species for Borneo and Sabah recorded from the 15 forest reserves are as listed in Table 3. Of the entire recorded plants, 493 taxa are known to be endemic to Borneo and 110 taxa are endemic to Sabah. These numbers equate 18% of the estimated total flora endemic to Borneo and 10% to Sabah (Maycock, pers. comm*.)*. The highest number of endemic plants to Sabah is recorded in Tawai FR with 35 taxa, including four hyper-endemic species. This is followed by Batu Punggul FR and Sg. Sansiang FR with 21 taxa; Bukit Hampuan FR with 19 taxa; Gunung Tinkar with 18 taxa; and Nurod Urod FR with 15 taxa. Outstandingly, five hyper-endemic taxa have been discovered; four taxa recorded in Tawai FR, namely *Rhododendron sugaui* (Ericaceae), *Semecarpus angustifolius* (Anacardiaceae), *Syzygium soepadmoi* (Myrtaceae) and a new species of *Tristaniopsis* (which is yet to be published but currently known as *Tristaniopsis merguensis* subsp. *tavaiensis* (Berhaman, *pers. comm.*) and one taxon in Bukit Hampuan FR, *Pittosporum linearifolium* (Pittosporaceae). Other notable endemic plants to Sabah include *Adinandra longipedicellata* (Pentaphylacaceae), *Nepenthes macrovulgaris* (Nepenthaceae), *Paphiopedilum rothschildianum* (Orchidaceae), *Rhododendron fallacinum* (Ericaceae) and *Shorea symingtonii* (Dipterocarpaceae).

Remarkably, most of the endemic taxa are found growing on ultrabasic substrates (Table 3). Plants that colonize and survive on ultramafic soils, evolved on a separate trajectory from their non-ultramafic relatives. In many cases, the new species survived on a patch of ultramafic soil because they are poor competitors on other substrates. As a result of this island effect, ultramafic substrates house a large number of species that are found only or endemic on ultramafic habitats and vulnerable to human

Table 3. The number of Sabah and Borneo endemic taxa recorded in the 15 forest reserves where scientific expeditions have been conducted under the Sabah HoB initiative from 2008–2013.

Forest Reserve	Soil Parent Materials	No. of Endemic Taxa	
		Sabah	Borneo
Bidu-Bidu	Ultrabasic Igneous Rock	11	37
Bukit Hampuan	Ultrabasic Igneous Rock; Basic Igneous Rock	19 (including one hyper-endemic species)	68
Bukit Kuamas	Basic Igneoud Rock; Ultrabasic Igneous Rock	8	44
Bukit Taviu	Sandstone & Mudstone	3	58
Batu Punggul & Sg. Sansiang	Sandstone & Mudstone; Limestone	21	75
Gg. Lumaku and Gunong Lumaku	Sandstone & Mudstone	13	112
Gg. Tinkar	Ultrabasic Igneous Rock	18	116
Lipaso	Basic Igneous Rock	2	36
Nurod Urod	Major Sandstone & Minor Mudstone	15	123
Rafflesia	Sandstone & Mudstone	5	45
Tawai	Ultrabasic Igneous Rock	35 (including four hyper-endemic species)	98
Ulu Telupid	Basic Igneous Rock	0	29
Sg. Siliawan	Sandstone & Mudstone	0	0

Table 4. Number of threatened plant taxa from seven forest reserves within the HoB.

Forest Reserve	Conservation Status				
	CR	EN	VU	NT	LC
Batu Punggul & Sg. Sansiang	6	5			4
Gg. Lumaku & Gunong Lumaku	14	11	13	10	-
Gunung Tinkar	17	8	7	15	10
Nurod Urod	7	2	8	-	-
Rafflesia	4	3	2	9	9

Note
CR: critically endangered
EN: endangered
VU: vulnerable
NT: near threatened
LC: least concern

activities (Primack, 2000). However, endemic plants can easily become endangered because of their restricted habitat and highly restricted ranges (Kruckeberg, 1984).

3. Plant Conservation Status

The plant conservation status of each taxon was identified based on IUCN Red List of Threatened Species (version 2013.2) (IUCN, 2013). So far, the exercise was done for five forest reserves as listed in Table 4. The result shows that 32 taxa are categorized as threatened, *i.e.*, critically endangered (CR), 23 endangered (EN) and 25 vulnerable (VU). All of these threatened taxa are trees. It is noteworthy that all the critically endangered taxa are represented by the Dipterocarpaceae. The endangered taxa represented mostly by Dipterocarpaceae (19 taxa), Podocarpaceae (3 taxa) and Rosaceae (1 taxon). Thirteen families, namely Anacardiaceae (3 taxa), Araucariaceae (1 taxon), Dilleniaceae (1 taxon), Dipterocarpaceae (2 taxa), Illiciaceae (1 taxon), Lauraceae (1 taxon), Leguminosae (2 taxa), Meliaceae (2 taxa), Myristicaceae (1 taxon), Rosaceae (1 taxon), Rutaceae (1 taxon), Sterculiaceae/Malvaceae (5 taxa) and Thymelaeaceae (4 taxa) are categorized as Vulnerable (VU).

4. Other Research and Management Contribution

The botanical findings and recommendation for management implications that resulted from the surveys conducted in six forest reserves located within the vicinity of Telupid district (Tawai, Bidu-Bidu, Bukit Kuamas, Ulu Telupid, Lipaso and Bukit Taviu forest reserves) have been utilized

for the formulation of a Conservation Area Management Plan (CAMP) for Telupid Forest Reserve Complex. Currently, a Conservation Area Management Plan for Gn. Lumaku and Gunong Lumaku FRs is being prepared and the botanical resources and proposed conservation issues will be incorporated. Through these botanical surveys, it has also facilitated plant taxonomic researches. Based on the flora survey, one paper has been presented internationally, while another two papers were presented in national conferences. A technical paper has also been published in the international journal. It is anticipated that more scientific accounts will be generated from the active botanical inventories carried out in the HoB areas under this auspices initiative.

CONCLUSION

Over the five years of botanical exploration in various protected areas under the HoB initiative, a great understanding of plant richness, endemism and plant conservation status have been achieved. Most of the important findings have been or will be significantly use to facilitate the planning and formulation of conservation plans for the respective protected areas.

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