

HIGH VALUE CONSERVATION FORESTS (HCVF) IN SFMLA 02/2015



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Prepared for Jawala Plantation Industries Sdn. Bhd.

This document follows the guidance of the MC&I V.2 (Plantation) Standard (2012) in mapping and managing HCVFs in SFMLA 02/2015.

Table of Contents

1	INTRODUCTION	5
1.1	Purpose.....	5
1.2	Objectives and scope.....	5
1.3	HCVF Guidance	5
1.4	HCVF Team	5
2	FOREST MANAGEMENT UNIT 11	6
2.1	Overview.....	6
2.1.1	Licence and Tenure.....	6
2.1.2	Contact Details.....	6
2.2	Location, extent and access	7
2.3	Landuse classification within FMU	7
2.4	Ecology.....	8
2.4.1	Climate	8
2.4.2	Physiography.....	8
2.4.3	Landscape ecology	10
2.5	Socio-economic	11
2.6	Forest Management System and impacts.....	14
2.7	Impacts of forest management	13
2.7.1	Forest degradation and Silviculture	15
2.7.2	Deforestation	13
3	METHODOLOGY	16
3.1	Identification of HCVF	15
3.2	Mapping of identified HCVF	15
3.3	Delineating HCV boundaries	15
3.4	Precautionary Principle	16
4	FINDINGS	19
4.1	HCV 1: Biodiversity Values	19
4.1.1	HCV1.1: Protected Areas.....	19
4.1.2	HCV1.2: Threatened and Endangered Species	21
4.1.3	HCV1.3 Endemism.....	22
4.1.4	HCV1.4: Critical Temporal Use	23
4.2	HCV2: Landscape-level Forest	23
4.3	HCV3: Ecosystems	24
4.4	HCV4: Services of Nature	25
4.4.1	HCV4.1: Watershed Protection.....	25
4.4.2	HCV4.2: Erosion Control	25
4.4.3	HCV4.3: Barriers to Destructive Fires	26
4.5	HCV5: Basic Needs of Local Communities.....	26
4.6	HCV6: Cultural Identify of Local Communities	28
5	INDICATIVE HCVF BOUNDARIES	31
5.1	Ulu Sg. Milian Forest Reserve.....	31
5.2	Sapulut Forest Reserve.....	31
6	HCVF MANAGEMENT AND MONITORING STRATEGIES.....	33

List of Tables

Table 1. Landuse classification within the natural forest management area of FMU14.	8
Table 2. Forest types and land use within Block A (Ulu Sg. Milian Forest Reserve) of FMU 11.	12
Table 3. Forest types and land use within Block B (Sapulut Forest Reserve) of FMU 11.	12
Table 4. Threatened and prohibited flora species recorded in FMU14.	21
Table 5. HCV 1.2 Fauna sightings in FMU14 that are listed endangered, threatened and vulnerable.	22
Table 6. Socio-economic baseline responses from five local communities living adjacent to FMU14.	26
Table 7. List of activities villagers depend for subsistence an living.	28
Table 8. List of food sources collected by villagers adjacent to FMU14.	28
Table 9. Identification of communities within one village community Fulfillment of Basic Needs.....	30
Table 10. Indicative size of HCVFs delineation by forest reserves.....	33
Table 11. HCV management and monitoring and framework for FMU14.....	34

List Figures

Figure 1. Location map of FMU14 showing Block A in the Ulu Sg. Milian Forest Reserve and Block B in the Sapulut Forest Reserve.	7
Figure 2. Physiography maps of elevation, slopes and major rivers in FMU14.	10
Figure 3. Forest types within FMU14.	12
Figure 4. Landuse zoning within FMU14 as per FMU2 (2012-2021).	13

List of Appendices

Appendix 1. Satellite image of the extreme lowland areas in Block A of FMU 11 (Cpt 138, 139 & 158).	36
Appendix 2. Soil associations in FMU14.....	39
Appendix 3. Plants species recorded from FMU 11.	40
Appendix 4. Mammals recorded from within FMU.	45
Appendix 5. Birds recorded from within FMU 11.	45
Appendix 6. Reptiles and amphibians recorded from within FMU 11.....	50

ABBREVIATIONS

a.m.s.l.	above mean sea level
BTSB	Bornion Timber Sdn. Bhd.
ca.	Approximate
CA	Conservation Area
CF	Community Forestry
CSR	Corporate Social Responsibility
DBH	Diameter at Breast Height
FMP1	Forest Management Plan (2002-2011)
FMU	Forest Management Unit
GIS	Geographic Information System
ha	hectare
HCV	High Conservation Value
HCVF	High Conservation Value Forest
ITP	Industrial Tree Plantation
JICA	Japan International Cooperation Agency
Km	Kilometer
Km ²	Square kilometer
Kg.	Kampong or village
LMDF	Lowland Mixed Dipterocarp Forest
m	Meter
MAB	UNESCO Man and Biosphere
M&E	Monitoring and Evaluation
MC&I	Malaysian Criteria and Indicators
NFM	Natural Forest Management
OVI	Objectively Verifiable Indicators
SBS	Socio-economic Baseline Survey
SFMLA	Sustainable Forest Management License Agreement
Sg.	Sugai or River
UMDF	Upland Mixed Dipterocarp Forest
VJR	Virgin Jungle Reserve (Class VI)
WWF	Worldwide Fund for Nature

1 INTRODUCTION

1.1 Purpose

This report presents the findings of an independent assessment of the High Conservation Value Forests (HCVFs) within SFMLA 02/2015 in the Sapulut District, Sabah, Malaysia. The parcel of 11,043 ha is licensed to Jawala Plantation Industries Sdn. Bhd. (JPISB) on a 100-year tenure by the State Government of Sabah on 12th August 2015. The management of the Licensed Area is defined in the Sustainable Forest Management Licence Agreement (SFMLA 02/2015) and the first 10-year Forest Management Plan (FMP1: 2015-2023). The primary landuse in the Licensed Area is industrial tree plantation, and the secondary landuses are natural forest management, conservation, community forestry and forest recreational areas. JPISB requested this assessment as part of their corporate social responsibility in delivering improved environmental, economic and social obligations in managing SFMLA 02/2015.

1.2 Objectives and scope

The primary objective of the assessment was to designate areas with outstanding biological, ecological and socio-economic significance in SFMLA 02/2015 to be conserved, protected and managed as natural forests. The specific tasks of the assessment include the following;

- a) Identify HCV's presence that are of significance or critical importance,
- b) Prescribe a management program to maintain or enhance the identified HCVF, and
- c) Develop an effective monitoring and evaluation (M&E) program to maintain or enhance HCVs.

The scope of assessment covered all six high conservation values (1 to 6) as prescribed in the Malaysian National Interpretation for High Conservation Values¹ taking a landscape approach to the assessment.

1.3 HCVF Guidance

The HCVF assessment was guided by the procedure prescribed in the Malaysian National Interpretation for HCV and the Proforest HCV Practical Guide². Both toolkits have been applied singularly or in combination to several forest areas in Sabah (e.g. Bornion Timber Sdn. Bhd.) as well as outside Sabah (Samling Reforestation (Bintulu) Sdn. Bhd.).

1.4 HCVF Team

The assessing team comprised of a 3-person team with professional backgrounds in forestry, ecology, and community liaison.

John Tay, PhD.

John specializes in tropical forest management, and has worked in the private and public forestry sectors over the last 30 years mostly in Sabah. He has conducted pre-forest certification audits and reviewed forest certification reports under the SIRIM QAS International to the requirements of the MC&I Standards. He lectures on forest management, forest engineering, forest valuation and forest restoration. His research interest is in promoting sustainable forestry leveraging on a strong networking among stakeholders. He assumes the role of team leader in this HCV assignment focusing on HCV1 and 4.

¹ WWF Malaysia, 2009. High Conservation Value Forest (HCVF) Toolkit for Malaysia.

² Stewart, C., George, P., Rayden, T. and George, P. 2008. Good practice guidelines for High Conservation Value assessments: A practical guide for practitioners and auditors.

Alex Hastie

Alex is a Tropical Plant Ecologist with over 10 years working experience within the forest of Borneo. He is a member of the Global Tree Specialists Group one of the International Union for the Conservation of Nature (IUCN) Species Survival Commissions. He is currently assisting the Sabah Forestry Department with the Red List assessments of the flora of Sabah. His research interests are within the field of tropical plant ecology, with a particular interest in Dipterocarp reproductive biology and ecology. In his current capacity, he is responsible for HCV2 and 3.

Helda

Helda is the Senior Liaison and Community Officer of JPISB first engaged in 2012. She hails from Sapulut and have close family ties among several of the local communities living near JPISB namely; Salung, Samatuou Helda's lineage with the local communities provided special access and a balance view to HCV 5 and HCV 6.

2 SFMLA 02/2015

2.1 Overview

2.1.1 Ownership, Licence and Tenure

SFMLA 02/2015 is licensed to Jawala Plantation Industries Sdn. Bhd. (JPISB: 819712-W) by the State Government of Sabah to plant, rehabilitate and harvest forests in the 11,043 ha. The Company was incorporated on 30th May 2008 operating in the Nabawan District with its headquarter located in Kota Kinabalu, Sabah, Malaysia.

JPISB is the principal subsidiary of JAWALA INC which is listed on the Catalyst Board of Singapore Exchange Securities Trading Limited ("SGX-ST") established on 1st June 2018. JAWALA INC is incorporated in Labuan on 8th August 2017 as a company limited by shares. Its immediate and ultimate holding corporation is Jawala Corporation Sdn. Bhd., a company incorporated in Malaysia, which operates as a general trading company in a variety of wood products.

JPISB holds a 100-year tenure over the Licensed Area commencing 12th August 2015 and ending 31st December 2115. The Licence Agreement may be extended upon expiry of the period at the discretion of the State Government of Sabah. Under the Licence Agreement, the Licensee is to manage, plant and implement silvicultural treatments on the natural and plantation forests including the felling, cutting, collecting, removing and manufacturing of forest products. The annual workplans are defined in a 10-year interval FMPs to the expiry of the Licence Agreement. The 1st FMP (2017-2026) has been approved by the Sabah Forestry Department on 13th March 2017.

2.1.2 Contact Details

Contact person	Official Address
Mr. Maxy Brian Self Position: Chief Operation Officer Email: maxybrayanself@gmail.com	Jawala Plantation Industries Sdn Bhd. Lot 2-10 & 2-11, Pusat Komersil Latitud 6, Jalan Lintas, 88000 Kota Kinabalu, Sabah Tel. +60-88-346708 Fax: +60-88-346707 Email: jawalacorp@jawala.com.my

2.2 Location, extent and access

The Licensed Area is located within the administrative forest district of Tibow, and the State administrative district of Nabawan (Long: 116° 26' E and 116° 36' E and Latitude: 4° 33' N and 4° 40' N; Figure 1). It is accessible by road from Kota Kinabalu takes approximately 3½ to 4 hours to reach its forest operation base at Sapulut. The alternative route is from Tawau which takes 4 hours by road.

The Licensed Area contains 11,043 ha divided into two parcels. The eastern portion of the FMU contains *ca.* 5,114 ha, while the western portion contains *ca.* 5,929 ha. The intertwining area between the two parcels are comprised of forest reserves and statelands.

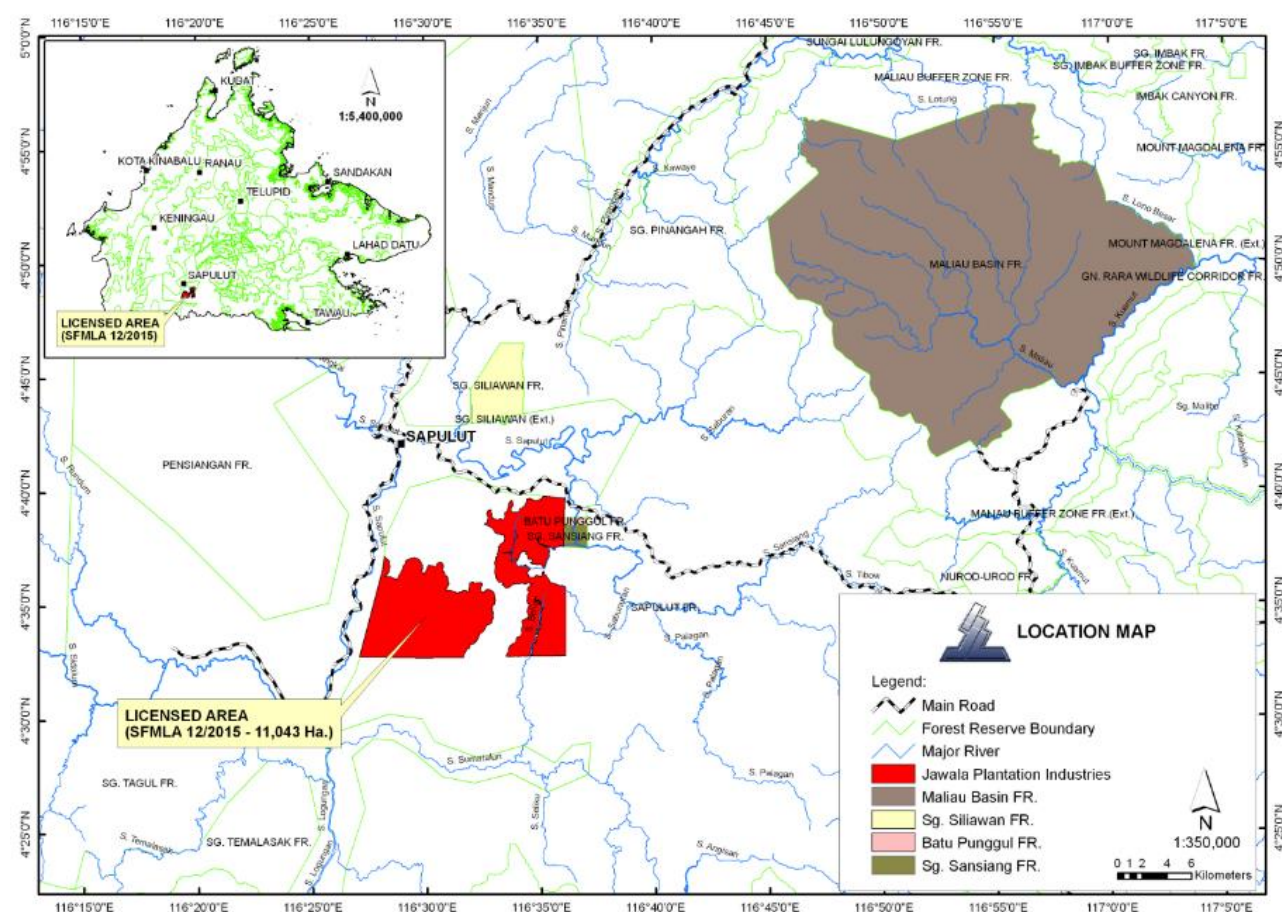


Figure 1. Location map of FMU14 showing Block A in the Ulu Sg. Milian Forest Reserve and Block B in the Sapulut Forest Reserve.

2.3 Past and Present Landuses

The whole of the licensed area is designated as a Class II Commercial Forest Reserve primarily for timber production. It was part of a larger forest management unit (FMU14: SFMLA 04/97) containing *ca.* 104,500 ha licensed to Sapulut Forest Development Sdn. Bhd. In 2012, SFMLA 02/2015 located on the western tip of SFMLA 04/97 ceased to be SFMLA 04/97 by approval of the state cabinet; the latter now contains 93,500 ha.

As per records from the Sabah Forestry Department, logging within SFMLA 02/2015 first occurred in late 1980's, and subsequently in 2011, 2013 and 2015 by previous licensees. The most recent logging of 2015 recorded a production yield of 151,676 m³ over 5,340 ha, and corresponded to a per hectare yield of only

28 m³ ha⁻¹; much lower than a primary forest yield of at least 70m³ ha⁻¹ for trees above 60 cm diameter. Only *ca.* 2,528 ha of the Licenced Area remained unlogged up to the changeover of ownership.

The repeated logging in the past had resulted in a relatively poor timber stocking in SFMLA 02/2015. Hence, the previous Licensee had designated the whole area for industrial tree plantation development as approved by the Sabah Forestry Department. A portion in the eastern block of the Licensed Area had been restpred with native dipterocarp species and fast growing tree species.

Presently, the Licensed Area is managed for three major landuses; (1) Industrial Tree Plantation (ITP) of 9,037 ha or 93%, (2) Natural Forest Management (NFM) of 488 ha or 4%, and (3) Conservation Area (CA) of 261 ha or 2% (Table 1). Total riparian reserves within these three landuses occupied 1,391 ha corresponding to 10% of the Licensed Area.

Table 1. Landuse classification within the Licensed Area.

Landuses	Size (Ha)	Percentage of Total (%)
(1) Industrial Tree Plantation (ITP)	10,294	93%
- 0°<15° slope	8,143	74%
- 15°<25° slope	998	9%
- >25° slope	23	<1%
- Riparian (3<50 m)	1,130	10%
(2) Natural Forest Management (NFM)	488	4%
- 0°<15° slope	268	2%
- 15°<25° slope	183	2%
- >25° slope	12	<1%
- Riparian (3<50 m)	25	<1%
(3) Conservation Area (CA)	261	2%
Total	11,043	100%

2.4 Physical Environment

2.4.1 Climate

The Licensed Area experienced an equatorial climate with monthly temperatures between 25°C and 31°C and rain between 80 and 350 mm throughout the year. Humidity levels were in the range between 70% and 90%. Mean monthly rainfall (1999-2009) recorded at the meteorological stations of Sapulut was between 240 mm and 248 mm with mean annual rainfall of 2,901 mm. As with the whole of Sabah, this local climate is generally influenced by regional climatic phenomena with the northeast monsoons bringing more rain and cooler temperatures between October and February and the southwest monsoon between May and August (FMP³). The inter-monsoon season which lasts from April to September is generally drier with occasionally prolonged droughts.

2.4.2 Physiography

The Licensed Area straddles the Western Cordillera and the Central Highlands of Sabah, along a physiographic subregion known as the Talanka Valley; with the Wittti Range to the West and the Kuamut Highlands covering much of the licensed area³. The terrain is characterized by strongly dissected hills, steep slopes and narrow boulder strewn valley bottoms and ridge crests. In addition, the long foothills

³ 1st Forest Management Plan (2015-2023) for SFMLA 02/2015.

that rise to form the mountainous region with elevation extends from 190 m.a.s.l to its highest point at about 790 m.a.s.l. An estimated 84% of the licensed area is with ground slopes of up to 15°. Another 11% or 1,200 ha of the licensed area consists of slopes from 15° up to 25°. Less than 1% of the licensed area are with slopes above 25° (Figure 2)

The Sapulut Formation is the major soil strata of the licensed area found stretching from the Logungan Valley at the borders of Kalimantan, and extends northwards through Pensiangan and as far as the Milian Valley. This soil formation is predominantly of argillaceous deposits from the Upper Cretaceous to Upper Eocene period, with conglomerate beds containing blocks and cobbles of limestone, chert, siltstone and sandstone. The Sapulut Formation is complimented by the Labung Formation which is of a younger geological formation overlying the Sapulut Formation. The parent material of the Labung Formation can be found in the northern portion of the licensed area as part the Sapulut Valley which consists of sandstone, siltstone, grey-blue mudstone, and limestone outcrops.

The main soil associations of the licensed area are the Crocker (54%) and Lokan (46%) with a limited occurrence of the Gomantong and limestone. Soils in the licensed area are generally well-drained, derived from the sandstone and mudstone parent materials of the underlying rock formations. The main soil unit of the licensed area are Orthic Acrisols. These soils have developed from acidic parent materials, with a soil texture that is medium to fine. Chemically these soils are poor, due to its acidic nature, having low organic matter content and exchangeable bases (calcium, magnesium, potassium, and sodium), and therefore lack natural fertility if weatherable minerals are exhausted. Therefore, fertility levels are expected to vary considerably. These soils are susceptible to erosion due to the compact nature of the soil's argillic horizon especially on hillslopes. The soil pH of Orthic Acrisols is between 4 and 5 that limits the exchangeable cations of total nitrogen and phosphorous.

To a lesser extent, Lithosols are found scattered throughout the rugged landscape of the license area, often localized along steeply dissecting slopes with virtually bare-rock outcrops. These soils developed over the mudstone and sandstone parent materials, and are usually thin/shallow stony soils, often with a thicker raw humic layer compared with Orthic Acrisols. Lithosols are generally acidic with a variable cations exchange capacities that ranges from moderate to high. Exchangeable cations of total nitrogen and phosphorous are reported at moderate levels. As with Orthic Acrisols, Lithosols are also highly susceptible to erosion. Due to the shallow nature of these soils, root development of plants is expected to be severely impaired, and best to be avoided from plantation development.

The license area forms a minor portion of the wider catchment of Sg. Sapulut which has its upper catchment outside the Licensed Area (Figure 3). Sg. Sapulut flows south and converges to Sg. Logungan across the Kalimantan border. Sg. Salung which is a tributary (5th order river) of Sg. Sapulut covers much of the western portion of the Licensed Area of ca. 6,000 ha. The river eventually converges with Sg. Sapulut beyond the village of Kuala Salung. Sg. Sablangan, the second largest tributary of Sg. Sapulut, and a 4th order river drains from within the Licensed Area receives its headwaters from the hilly zone towards the northern portion of the license area covers ca. 2,600 hectares. Sg. Sablangan flows into the Sg. Sansiang forming one of the major tributaries of Sg. Sapulut. Sg. Beliar, a 4th order river, receives its water from a catchment area that covers much of the southern-western portion of the Licensed Area containing ca. 1,800 hectares. Sg. Beliar converges on Sg. Sumatalun near the village of Beliar to the south of the Licensed Area. The water catchment of Sg. Beliar forms the second largest within the licensed area. Minor tributaries with headwaters originating from within the licensed area, covers some 640 ha includes Sg. Sabunutan joining Sg. Sansiang at the lower stream.

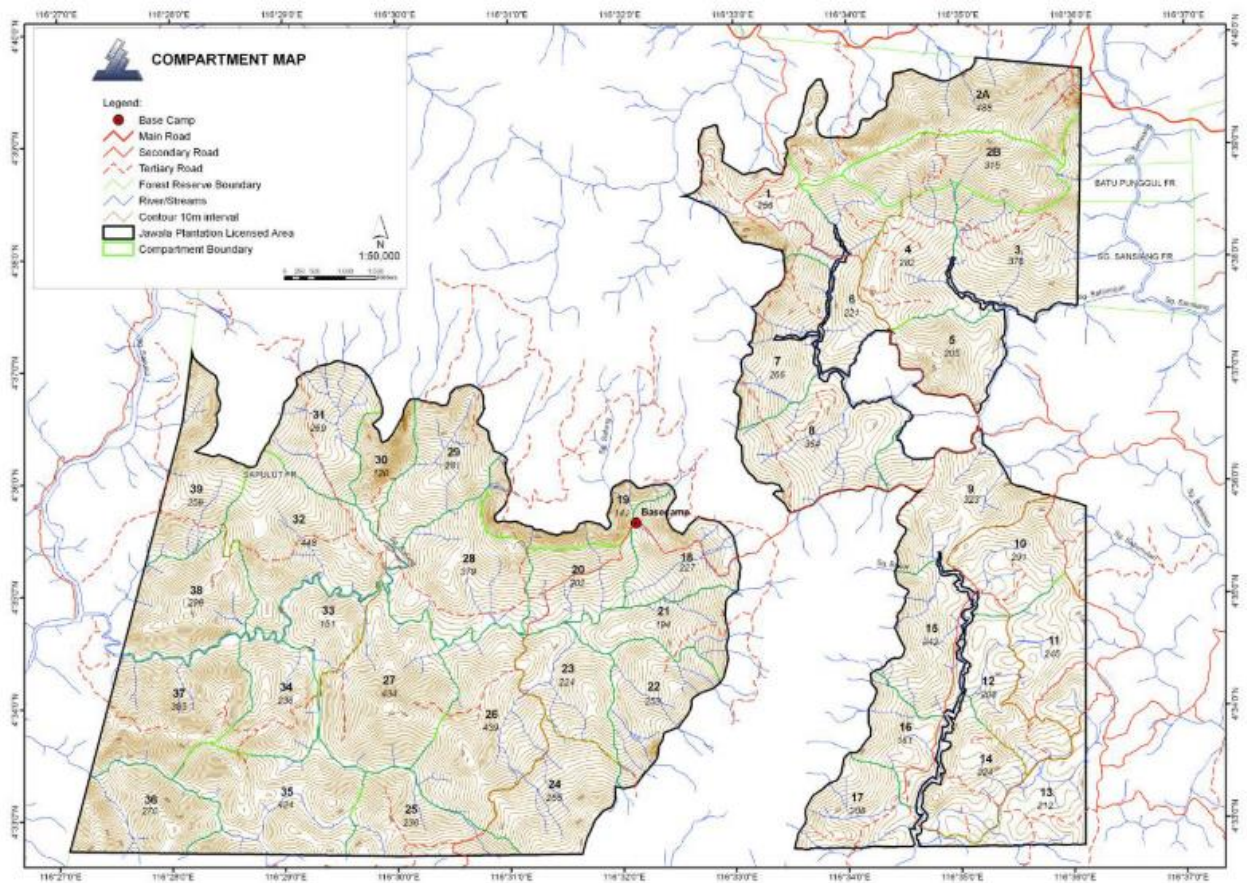


Figure 2. Map showing elevation and drainage system in SFMLA 02/2015.

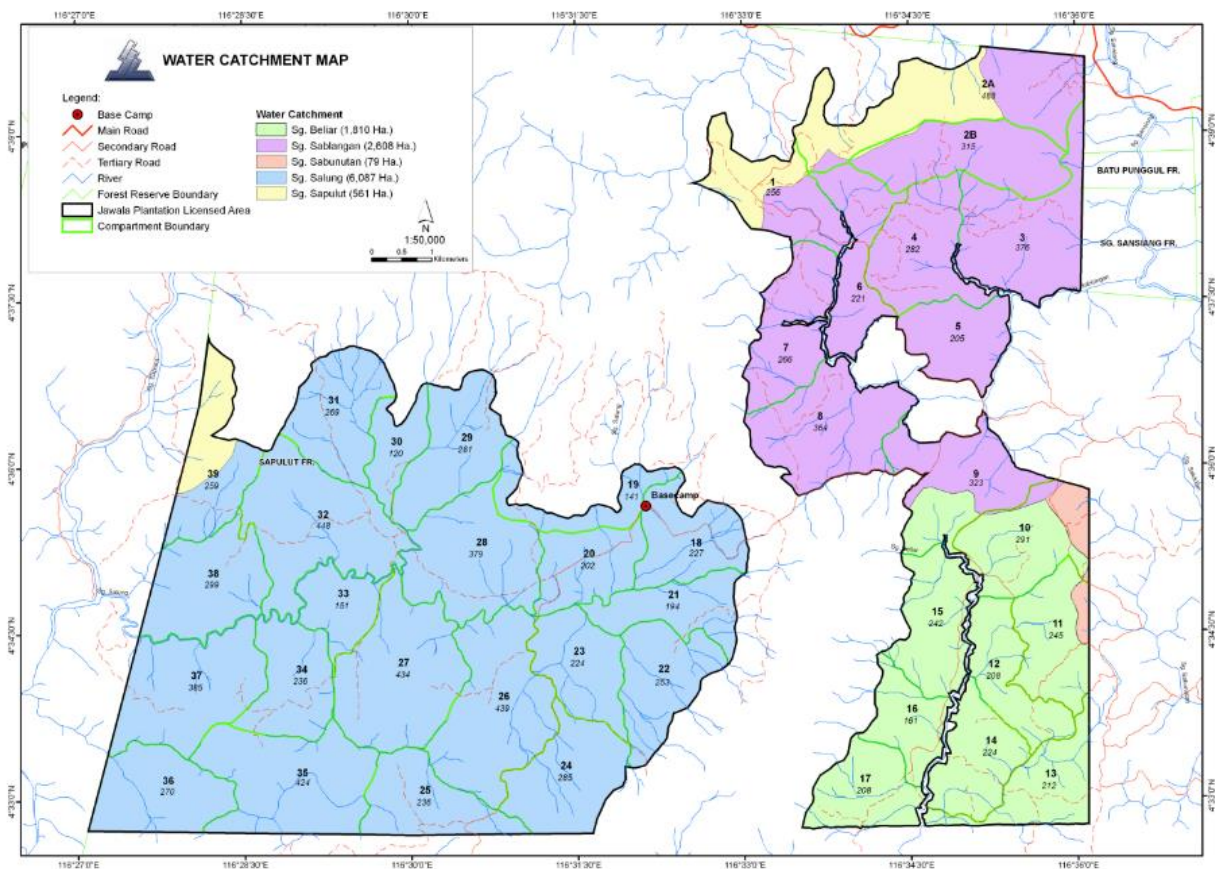


Figure 3. Map showing major watersheds and drainage system.

2.4.3 Forest Vegetation

Three floristic formations are recognized within the Licensed Area (Figure 4). These include the (1) Lowland Mixed Dipterocarp Forest (LMDF), (2) Upland Mixed Dipterocarp Forest (UMDF), and (3) Limestone Forest (LF).

Lowland Mixed Dipterocarp Forest once occupies 8,042 ha or 72% of the total Licensed Area (Table 2). Trees in the Dipterocarps family represents the dominant species in this forest formation with distinctive species as the *Parashorea* spp., *Shorea* spp., *Eusideroxylon* spp., *Dacrydes* spp., *Koompassia* spp., *Gluta* spp., *Dipterocarpus* spp., and *Dryobalanops* spp. Common non-Dipterocarps species include *Litsea* spp., *Polyalthia* spp., *Hydnocarpus* spp., *Castanopsis* spp., and *Canarium* spp. Pioneer tree species consisting of mainly *Croton* spp., *Macaranga* spp., *Neonauclea* spp., *Duabanga moluccana* (Magas) and *Endospermum* spp. are found mostly in undulating to flat lands within the Licensed Area due to past logging disturbances. Within this Forest Formation, extreme LMDF once covered an area of ca. 143 ha or 1.3% of the Licensed Area along the lower reaches of Sg. Salung.

Upland Mixed Dipterocarp Forest (UMDF) once covers 2,960 ha or 26% of the total Licensed Area. The common dipterocarps that exists in the upper canopy layers of this forest formation are the *Shorea* spp. (Rubroshorea), *Vatica* spp. (Resak) and *Dryobalanops* spp. (Kapur). Common non dipterocarps that are of commercial value include *Litsea* spp., *Elaeocarpus* spp., *Lithocarpus* spp., *Aglaia* spp., *Myristica* spp., and *Litsea* spp. Within. The presence of *Croton* spp., and *Macaranga* spp. in this forest formation is associated with past forest disturbance.

Of a smaller extent on the northern part of the eastern parcel of the Licensed Area is Limestone Forests (LF) ca. 37 ha or 0.3% of the Licensed Area. The vegetation is similar to the UMDF which includes the Dipterocarps and more common limestone vegetation such as species of Balsams, Begonias, Elatostemas, Ophiorrhizas, Paraboeas, Acatheaceae and Zingiberaceae⁴.

2.4.4 Fauna

The fauna richness and diversity were comparatively lower compared to other areas in Sabah. A total of 24 mammal species, 1 reptile species, and 106 bird species was found in the Licensed Area. Mammal richness was represented by 15 families, and most frequently sighted (indirectly) were *Sus barbatus* (Beaded Pig) and *Cervus unicolor* (Sambar Deer). Others include the Bornean Gibbon, Bornean-red Muntjac, Common Porcupine, Common-palm Civet, Gaint Squirrel, Flying Fox, Greater-mouse Deer, Lesser Tree-shrew, Flying Lemur, Leopard Cat, Long-tailed Macaque, Monitor Lizard, Otter Civet Pangolin, Malay Civet, Pig-tailed Macaque, Plantain Squirrel, Prevost Squirrel, Sun Bear, Masked-palm Civet, Teledu (Malay Badger). Most of these fauna were recorded by indirect sighting.

2.5 Socio-economic

There are 16 villages living near the Licensed Area. Nine of these villages (Kg. Sosogoh, Kg. Sinikaluan, Kg. Salong, Kg. Pangkalan, Kg. Bulait, Kg. Balantos, Kg. Tikandis, Kg. Agis, Kg. Sabulu) are located adjacent to the western parcel of the Licensed Area across the Sg. Sapulut. The remaining 7 villages (Kg. Tataluan, Kg. Bangau, Kg. Salarom Taka Kabua, Kg. Sandukan, Kg. Simatuoh, Kg. Labang, Kg. Sikait) are located in the eastern parcel of the Licensed Area. An estimated 166 households were located in the western

⁴ Kiew, R., Anthoonyamy, S., Wong, K.M. and Lim, S.P. 1995. Preliminary assessment of the flora of Limestone habitats at Balambangan Island. WWF Project Report. http://repository.wwf.org.my/technical_reports/B/BotanicalSurveyOfLimestoneHabitatsInSabahPhaseI/PreliminaryAssessmentOfTheFloraOfLimestoneHabitatsAtBalambanganIsland.pdf

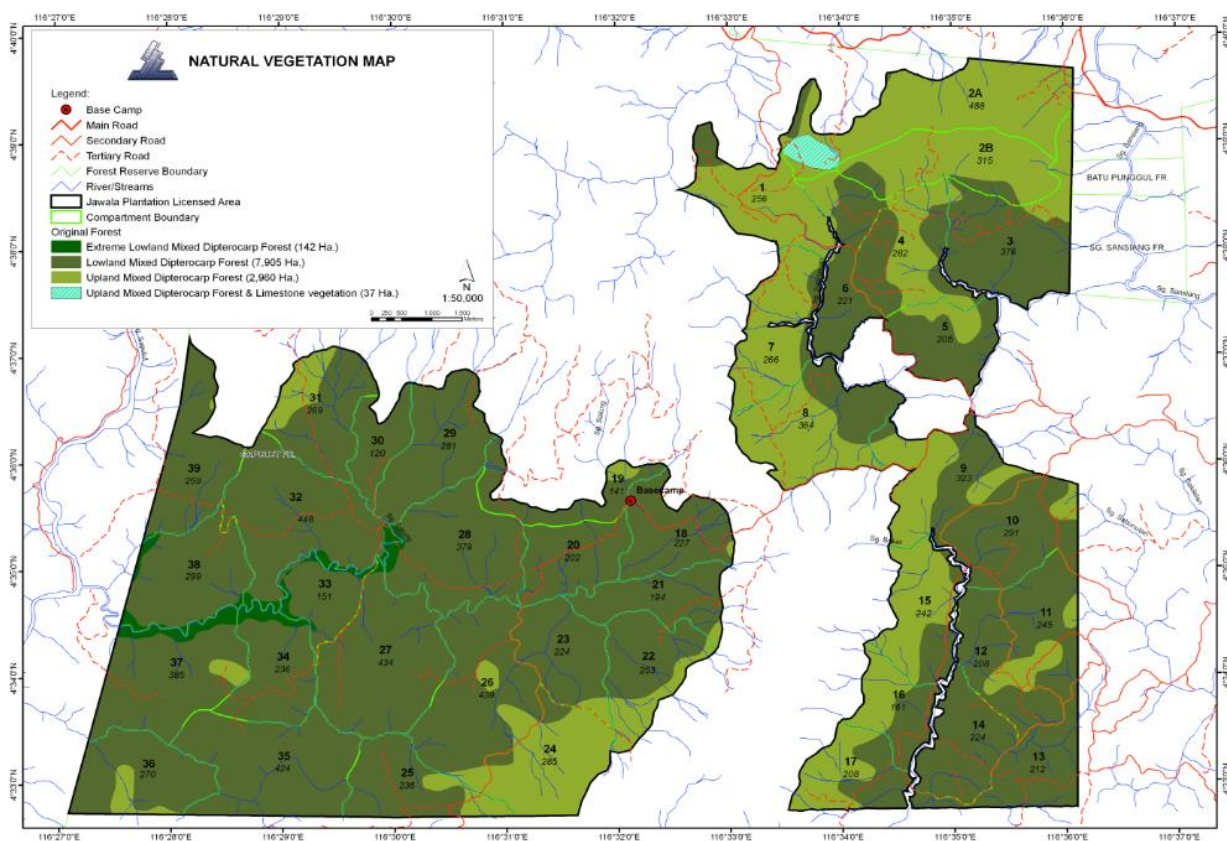


Figure 4. Forest types within FMU14.

Table 2. Forest formation and landuses within SFMLA 02/2015 02/2015.

Forest Formation	Landuses (Ha)			Total
	NFM	ITP	CA	
Lowland Mixed Dipterocarp Forest	406	6,665	120	8,046
Upland Mixed Dipterocarp Forest	439	2,079	141	2,960
Limestone Forest	37	0	0	37
Total	882	8,744	261	11,043

parcel, and another 129 households on the eastern parcel with a total population of *ca.* 2,000 to 3,000 people⁵ (Figure xx). Each household has 5-8 people consisting of the parents and children. The Muruts are the main ethnic group representing these villages. By origins, they identify themselves separately as Murut Tahol, Murut Sapulut/Pensiangan and Murut Dayak based on origins with slight differences in dialect, dressing, dances and rituals.

Within each village, the Village Headman is the most influential person and respected for his wisdom, leadership and cultural norms and values of the Murut ethnic. The Village Headman also organizes communal works in shifting cultivation of hill padi, tapioca and fruit trees. Hunting and fishing captures are shared among members of the community.

Modernization has, however, weaken this communal farming practice to a more solitary gain. For example, one of the villagers of Salong now owns a plot of oil palm plantation within the Licensed Area.

⁵ Sage Consult. 2018. Social Impact Assessment FMU14(B) of Jawala Plantation Industries Sdn. Bhd.

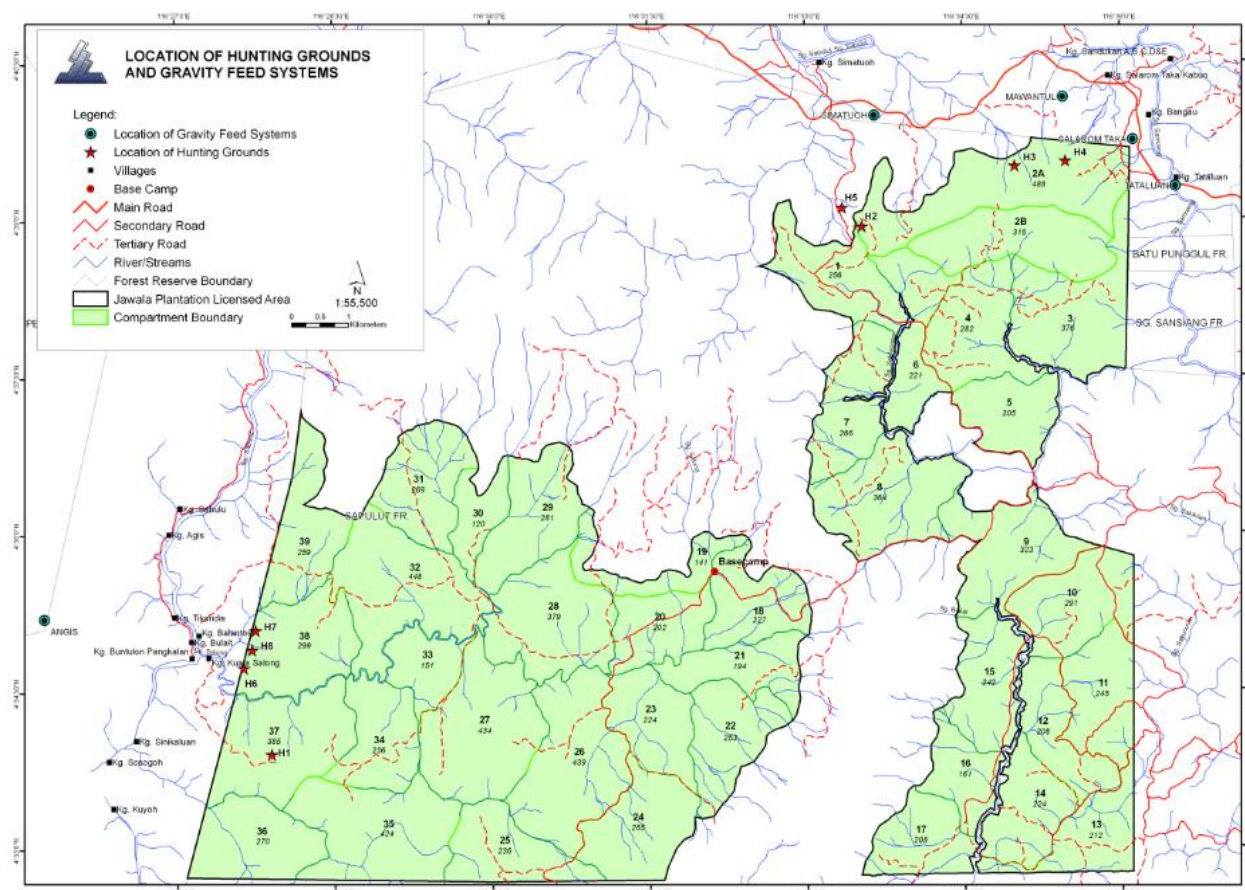


Figure 3. Location of villagers and their hunting grounds in SFMLA 02/2015.

In addition, traditional hunting methods using traps, hunting dogs and blowpipes are gradually replaced with more modern tools such as locally-made guns known as the “bakakuk” for individual trophies.

Education pursuit is of priority among the second and third generation Muruts. According to a recent survey, 64% of the respondents have attained tertiary schooling with a limited number reaching university level. They affirmed that education has offered them a new outlook to a modern society, and assuring them a secured income from employment with the government and private sectors.

On average, the monthly income per household is between RM890 and RM 1,800^{6(p.42)}. The main economic activities are farming, fishing and fixed employment income. Supplementary income mainly for subsistence comes in the form of hunting capture, fishing catch and craft-making that could represent a significant portion of monthly household income of between RM500 and RM800. Total expenditure per household ranges between 5% and 80% of total income which vary with the household size and total income.

Most of the villagers rely on rain (40%) and river water (34%) as the main source of water for domestic uses. Other sources of water supply comes from gravity fed and man-made ponds. These sources of water supply will be adversely impacted by prolonged droughts. Kg. Tataluan, Kg. Mawantul, Kg. Bangau, Kg. Simatuoh and Kg. Salrom Taka as well as Kg. Balantos-Belait and Kg. Salung are prone to water shortages during prolonged drought.

⁶ Sage Consult. 2018. Social Impact Assessment FMU14(B) of Jawala Plantation Industries Sdn. Bhd.

Among the villages, Kg. Salung, Kg. Balantos-Belait and Kg. Sinikaluan on the western part of the Licensed Area are both directly and indirectly impacted by the JPISB's operations. Kg. Silungai and Kg. Sabibingkol, in particular, are impacted indirectly because villagers have to pass through the Licensed Area to reach their villages. JPISB, however, allows the villages to get through their area on a designated route rather than allowing to wonder around the Licensed Area. Kg. Labang is the least impacted by JPISB because it is 4 km away from the nearest boundary of the Licensed Area.

Kg. Salung, Kg. Balantos-Belait and Kg. Sinikaluan have an on-going dispute with JPISB claiming that the company has encroached into their customary land. The three villages claimed native customary rights (NCR) along 1.5 km along both sides of the Sg. Sisilar (Compartment 34 and 37) and Sg. Lolobou (Compartment 20, 28, 32, 37 and 38) totaling *ca.* xxxx ha. Similarly, Kg. Mawantul and Kg. Bangau located on the northeastern part of the Licensed Area also claimed NCR of land of 607 ha near Compartment 2A and 1A.

These villages claimed that they have lost their traditional hunting and gathering grounds when natural forests are cleared for monoculture tree plantation. Hunting is not only a means of providing the main source of animal protein for the villagers but is also a recreational activity to show their hunting skills. The villagers also forage for wild plants, fruits, tubers, mushrooms and seeds in the forest for their diets. Villages also cut trees to be processed into building materials and boat-making. Certain trees exude latex or damar which can be used as ingredients in lacquers and varnishes as well as mending leaks in wooden boats.

2.6 Forest Operations and Impacts

JPISB adopts a clear-felling planting system to create new forests in the Licensed Area. Prior to planting, salvage logging will be conducted in 8,673 ha or 90% of the Licensed Area where all trees above 25 cm DBH are harvested and sold. Logging is scheduled over 6 years starting 2016 and ending 2021 (Table xx). The annual logging coupe ranges from 845 ha to 1,906 ha, and is generally larger than the annual planting area to maximize logging proceeds for reinvestment into the plantation development.

After all logs have been salvaged and cleared, the area is prepared for planting. JPISB plans to fully develop its tree plantation in 8 years starting 2018 and ending 2025 (Table xx). The total area to be planted is 8,769 ha with annual planting hectareage ranging from 663 ha to 1,507 ha. The extended planting schedule over the logging schedule is due to planted trees only matures in 8-12 years (Figure xx). To date, 600 ha has been planted with a mixture of fast-growing species including *Androcephalous* spp., *Albizia* spp. and *Eucalyptus* spp. in the proportion of 60%, 30% and 10% of total planted area, respectively.

Within the NFM area of 919 ha, trees greater than 60 cm DBH are harvested in designated areas using mandatory reduced impact logging (RIL) techniques followed by silviculture treatments until the next harvest cycle. No logging is allowed within riparian, steep areas and conservation areas. These areas are retained for their regulating and provisioning services as specified in the 1st FMP.

The operational impacts in SFMLA 02/2015 can be traceable to three major sources namely, (a) roads, (b) logging, and (c) clear-felling plantation. Forest roads are the basic infrastructure in plantation operations. The construction of main and secondary roads often results in earth movement that disturb the natural environment. The roads in the Licensed Area are designed to optimize timber harvesting and plantation establishment following natural features but avoiding steep areas, areas with high conservation values and riparian. Road density is estimated at xx /ha, and its width averaged 5 m. Bulldozers are employed to construct the main and secondary roads. During road construction, all ground vegetation and trees

Table xx. Landuses in SFMLA 02/2015.

Year	Total Area (Ha)	Restricted Area		Riparian		NFM		NetPlantable	
		Ha	%Total	Ha	%Total	Ha	%Total	Ha	%Total
2018	953	7	1%	106	11%	0	0%	841	88%
2019	789	57	7%	69	9%	296	38%	367	47%
2020	1,258	9	1%	139	11%	40	3%	1,071	85%
2021	1,526	22	1%	212	14%	0	0%	1,291	85%
2022	1,455	31	2%	154	11%	0	0%	1,270	87%
2023	1,275	49	4%	150	12%	75	6%	1,001	78%
2024	1,900	190	10%	202	11%	0	0%	1,507	79%
2025	1,887	30	2%	124	7%	451	24%	1,282	68%
Total	11,043	396	4%	1,155	10%	863	8%	8,630	78%

Table xx. Logging schedule

Year	Total	Steep>25°		Conservation		Riparian		NFM		Loggable		Loggable+NFM	
	Ha	Ha	%Total	Ha	%Total	Ha	%Total	Ha	%Total	Ha	%Total	Ha	%Total
2016	953	3	0%	0	0%	106	12%	0	0%	845	89%	845	89%
2017	2,047	8	0%	0	0%	207	10%	336	16%	1,832	90%	2,169	105%
2018	1,965	4	0%	141	9%	257	16%	0	0%	1,563	80%	1,563	80%
2019	2,055	5	0%	120	7%	236	13%	75	4%	1,694	82%	1,769	87%
2020	2,136	4	0%	0	0%	226	12%	0	0%	1,906	89%	1,906	89%
2021	1,887	11	1%	0	0%	124	6%	451	20%	1,752	93%	2,203	113%
Total	11,043	34	0.3%	261	2%	1,155	10%	863	8%	9,592	87%	10,455	95%

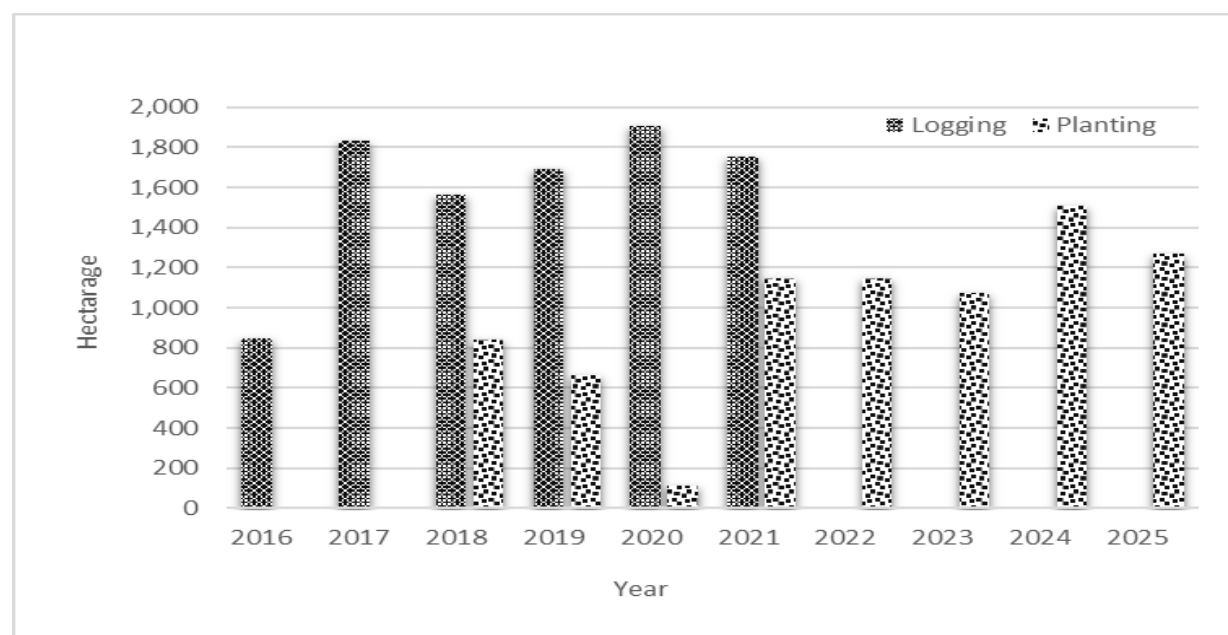


Figure xx. Logging and planting schedules

on the right-of-way are destroyed by the bulldozer. Some of these organic materials are intermixed with loose soils from slope cutting and levelling which are likely to be washed down to lower grounds in heavy downpours.

Once road access is established, site preparation for planting begins with salvage logging. Trees that are of marketable size greater than 25 cm DBH and of commercial species are felled using chainsaw and skidded to temporary log landings by bulldozers. The process of skidding logs creates loose soils that may be transported to lower grounds and water bodies during rain events. JPISB adopts the RIL techniques in planning and harvesting timber to minimize soil disturbances, in particular, retaining the organic top soils needed for plant growth.

Upon completion of salvage logging, the site is clear-felled for the development of new forest. Clear-felling plantation is a system of creating an even-aged stands in a fully-exposed microclimate. By removing all vegetative cover in a single-cut, clear-felling however destroys biodiversity associated with natural forest ecosystem. The sudden exposure of ground surface to sunlight causes increased insolation destroying most microhabitats. There is strong evidence that microhabitat availability influences flora and fauna species distribution and diversity in tropical forests. The practice of clear-felling also increases surface run-offs which accentuate the movement of topsoil and wood debris associated with logging which will be purge into water bodies. These adverse impacts are partially mitigated by the ability of new forests to grow faster than native tree species to reach canopy closure. In doing so, surface runoffs is reduced within a shorter time period.

Planting of trees begin immediately after site preparation. JPISB uses Traxcavator to construct plantation roads, clear and stake woody debris. Excavators have been reported to minimize soil disturbance and vegetation damages in plantation operations because of its extended reach from a stationery position, and its ability to separate organic materials more efficiently than bulldozer⁷. The process of establishing planting lines, holing and fertilizing have localized impacts on the environment. After planting, JPISB conducts under-brushing and spot circle weeding of planted trees from year 1 up to 3 years. Where weeds have perforated and becomes unmanageable by manual weeding, JPISB uses an environmental-friendly weedicide to mass eradicate competing weeds.

3 METHODOLOGY

3.1 Precautionary Principle

The Precautionary Principle has been applied to a diverse range of environmental policies and biodiversity jurisdictions to minimize the impacts of identified risks. Principle 15 of the Rio Declaration 1992 states that when an activity raises threats of harm to human health or the environment, precautionary measures should be taken even if cause-and-effect relationships are not fully established scientifically. In the context of tropical forests, the scientific knowledge and understanding of its ecosystem functioning is still at its infancy. The fact that tropical forest biodiversity has not been fully recreated in a man-made plantations warrants a precautionary approach to HCV mapping. The application of the Precautionary Principle involve an examination of the full range of alternatives including no action⁸.

⁷ FAO, 2017. Guide for planning, construction and maintenance of forest roads. <http://www.fao.org/3/a-i7051e.pdf>

⁸ Science for Environment Policy (2017) The Precautionary Principle: Decision making under uncertainty. Future Brief 18. https://ec.europa.eu/environment/integration/research/newsalert/pdf/precautionary_principle_decision_making_under_uncertainty_FB18_en.pdf.

3.2 Landscape Approach

3.2.1 Identification of HCVs

The process of identifying the HCVs in SFMLA 02/2015 began with a thorough review of the FMP⁹ and SIA Reports to understand the landscape context, landuse zoning, logging/planting schedules and progress of operations. A landscape approach to scoping the HCVs was adopted and guided by the inherent physiography, forest formations, river systems and approximate locations of settlements in SFMLA 02/2015. Of pragmatism, the steps in identifying the HCVs begins with landscape features (HCV 2) and/or ecosystems (HCV 3) before addressing species-specific issues (e.g. HCV 1). The final output was a working map showing all HCVs that had been identified on map of 1:50,000 scale.

3.2.2 Field verification and delineation of HCVs

The tentative HCVs that had been mapped were then verified in the field from xx to xx August 2019 (7 days). The main criteria for delineating the HCV boundaries or areas within SFMLA 02/2015 (Anon, 2005¹⁰) were as follows:

- Outstanding universal value in biodiversity that cannot be found elsewhere.
- A viable and functional ecosystem unit that protects a significant portion of overall biological diversity and/or safeguards significant local community dependence on forests in the FMU.
- A realistic possibility of future effective management.

A continuous process of refining the tentative HCVs was performed through discussions with JPISB's management staff. Local stakeholder consultation was held with the communities and Sabah Forestry Department over two days from xx-yy August 2019 in an organized gathering. The final HCV map was then presented to the BTSB's top management for endorsement.

3.2.3 Tree species inventory

Eighteen transects measuring 20m x 100m each were established within accessible HCV areas that had been identified earlier on map (Figure xx). The purpose of the inventory was to identify species that were protected under the IUCN RedList, The Forest Rules 1969 and The Wildlife Enactment 2000.

A sub-sampling of trees was undertaken within each transect in 5 quadrants each measuring 20m x 20m. All trees measuring 10<30 cm diameters were sampled within a subplot of 10m x 10m plot within a quadrant. This represented a sampling intensity of 25% within a transect. Trees with diameters 30<60 cm DBH were recorded in subplot measuring 10m x 20m representing 50% sampling intensity within a transect. Whereas all trees greater than 60cm DBH were sampled within the quadrant of 20m x 20m in a transect representing 100% sampling intensity.

In each transect, the parameters recorded were (a) location of transect coordinates, (b) compartment no., (c) elevation, (d) compass bearings of transect, (e) ground slopes, (f) tree diameters and (g) tree species. Data collected were checked, compiled and analyzed into summary tables of species by transects, protection categories according to IUCN RedList, The Forest Rules 1969 and The Wildlife Enactment 2000.

⁹ Chapter 6 (pp 76-103) of the FMP describes a tentative list of HCVs in SFMLA 02/2015 while the SIA provides an assessment of HCV 4 and 5.

¹⁰ Anon. 2005. Rainforest Alliance Smartwood Program HCVF Assessment Report.

3.2.4 Fauna Survey

3.2.5 Management and Monitoring of HCVs

An important component of HCV assessment is the management of the identified HCVs. The overall aim of HCV management is to maintain and, where possible, enhance significant and critical environmental and social values as part of responsible management. The level of detail required will depend on the scale, intensity and risk of the production activities.

Baseline data is needed before management starts, and this will feed into the monitoring process. must transform management objectives (e.g., preserve rare wetland habitat), into specific and measurable management targets

The management and monitoring framework of HCVs was determined by key staff of JPISB in a 1½ day workshop held at the Base Camp. Its strategic goal is to enhance the HCV attributes under a cohesive and effective protection framework addressed at a landscape level. The strategic goal was further categorized into: (1) Enhancement of rare, threatened and endangered (RTEs), (2) Enabling environment for HCVF management and monitoring, and (3) Sustainable financing. The management interventions varied from total protection of RTEs or habitat to improving capacity, equipment, access and financing.

A number of Objectively Verifiable Indicators (OVI) were associated with the monitoring framework. These OVIs are designed to report the state and response of management interventions in managing the HCVs. The targets are further classified into flora, fauna and habitat and where these conservation targets are deemed to face potential threats, the monitoring objective will specify how much of the threat can be reduced within a given timeframe.

4 FINDINGS

4.1 HCV 1: Biodiversity Values

4.1.1 HCV1.1: Protected Areas

Within SFMLA 02/2015, there is no totally protected areas. Outside SFMLA 02/2015, however, is the Pensiangan Class I Protection Forest Reserve covering an area of 67,964 ha which lies *ca.* 2 km across the Sg. Sapulut in the western part of SFMLA 02/2015. This is the second largest protected area within the vicinity of Sapulut landscape. The Reserve was logged in 1990s still dominated by secondary mixed hill dipterocarp forests and Kerangas Forest. The latter is a distinctive low statue forests found on higher altitude within the Pensiangan Forest Reserve and poor nutrient white sandy soils. There are, however, known to support high levels of endemic plant diversity¹¹ (e.g. nepenthes, orchids, ginger) and insects biodiversity¹².

Further east *ca.* 25 km from SFMLA 02/2015 lies the Maliau Basin Conservation Area (MBCA) containing 58,840 ha, a Class I Protection Forest Reserve under the provision of the Forest Enactment 1968. It forms the western part of a series of connected totally protected areas that includes the Imbak Canyon Conservation Area (27,600 ha) and the Ulu Segama Forest Reserve (242,884 ha). The catchment drains the Maliau river flowing southeast and joins the Kuamut River and the Kinabatangan before discharging its water in the South China sea. There are six forest types found in MBCA namely; Lowland Mixed Dipterocarp Forest, Hill Mixed Dipterocarp Forest, Upland Mixed Dipterocarp Forest, Montane Forest, Heath Forest and Riparian Forest¹³.

Of smaller extent to the northeast of the SFMLA 02/2015 lies the Sansiang Forest Reserve which is protected under Class VI Virgin Jungle Reserve for research and education. The Batu Punggul Forest Reserve is another protected area (Class IV – Amenity Forest)

Further east of FMU14 is a contiguous mass of protected areas comprising of the Malia Basin, Imbak Valley, Danum Valley and the Malua-Ulu Segama conservation areas. The Sg. Pinangah Forest Reserve (Class II Production Forest Reserve) provides an intervening buffer between FMU14 and the contiguous mass of protected areas from logging disturbances.

Two large protected forest reserves are found FMU14 (Compartments 31 and 32) shares its northern boundary with that of the Sg. Tongod Class I Protected Forest Reserve. Sg. Tongod Forest Reserve is *ca.* 8,000 ha that has only being recently upgraded to Class I Protected Forest Reserve. It serves a vital connectivity between FMU14 and FMU5 lying north of the Sg. Tongod Forest Reserve.

However, Virgin Jungle Reserves (VJR) are found in the southern part of the Ulu Sg. Milian Forest Reserve. VJRs are Class VI forest reserve mainly for education and research use. The Sg. Milian-Labau VJR is a series of three blocks totaling 2,710 ha (CAIMS, 2005¹⁴). The smallest of the four blocks is located within Compartment 117 of FMU14, and is relatively secured because the compartment is zoned for

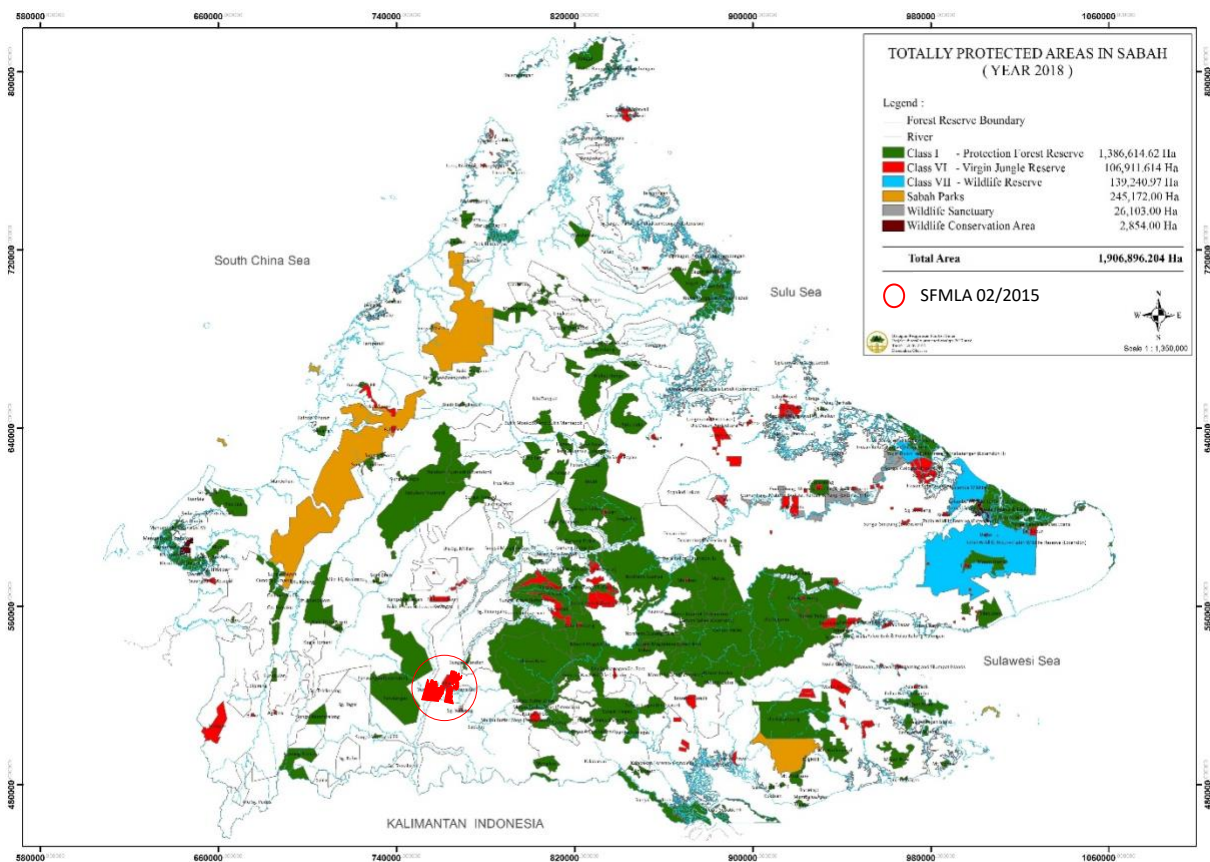
¹¹ Ministry of Tourism and Environmental Department. 20xx. Identification of potential protected areas Nabawan.
<http://www.epd.sabah.gov.my/v1/images/other-reports/SBP/05-nabawan.pdf>

¹² Chung, A.Y.C. 2018. Exploring the insect fauna of Pensiangan Forest Reserve, Sabah. Information paper presented at the 18th Malaysian Forestry Conference in Kuching, Sarawak. 31 July-2 August, 2018.

¹³

¹⁴ Sabah Forestry Department, 2005. Conservation Areas Information and Monitoring System (CAIMS).

conservation use. Block II is situated along Labau river flowing adjacent to eastern boundary of Compartment 170 in the process of being cleared for rubber planting. The largest block (Block III) is located further outside the FMU west of Block II within State land.



Block I and II of the VJR series are located in steep areas with slopes greater than 25°. Block II, in particular, exhibits steep terraces caused by the incision of Labau river. Both VJRs have been severely affected by fires during the 1997/1998 prolonged drought, and the vegetation is mainly shrubs and pioneer species. Block III contains remnants of the Kerangas Forests with stunted trees occurring in terraces due to the low-nutrient Kerangas soil. The Sabah Forest Department has recommended these VJR series to be conserved for their biodiversity, seed source, nature education, recreation and research.

Rationale for HCV Boundary Delineation

FMU14 contributes to the long term integrity of the protected areas of Sg. Tongod and Trus Madi Forest Reserves, and therefore all the forest contiguous with the protected area qualify as HCV1.1. Additionally, all forest areas adjacent to Block I and II of the VJR series are admissible for HCV1.1.

In view of the threats from fire, illegal encroachment and soil erosion originating from Compartment 170, the boundary for HCV1.1 is identified to provide a buffer strip of 50m x 2,000m (10 ha) along the eastern side of the Compartment up to the upper reach of the VJR comprising Block II. This contributes to the long-term stability of the VJR as well as protection of the rare, threatened and endangered habitats and species within it.

Rationale for Exclusions

In the northern part of the FMU, Compartments 31 and 32 are zoned for NFM which will operate within the guidelines of the SFMLA. These compartments are located on steep areas (>25°) that are prohibited from logging, hence, excluded from HCV boundary demarcation. Compartment 1 is located at the northwestern part of FMU14 bordering Trus Madi Forest Reserve. This Compartment is zoned for ITP. It is excluded from HCV demarcation as it falls within the ITP zone, but will be reconsidered in the ITP forest certification process.

4.1.2 HCV1.2: Threatened and Endangered Species

The presence of a variety of threatened and prohibited species are recorded in FMU14 (Table 4). Of the 148 species recorded, 122 or 82% have not been evaluated for the IUCN Red List (Appendix 3). Of the 26 species that have been assessed, 14 have been classified as threatened. Of these, 10 are Dipterocarps although the IUCN Red List over-estimate the threat status to these species (Ashton, 2004¹⁵; Maycock et al. 2012¹⁶), and are listed as needing up-dating (IUCN, 2015¹⁷). The remaining two species *Eusideroxylon zwageri* and *Aquilaria malaccensis* are listed as vulnerable due to habitat loss and over-exploitation. Six of the species in Table 5 are either listed as Prohibited to harvest by the Sabah Forestry Department, or listed on Schedule 1 of the Sabah Wildlife Conservation Enactment 1997.

Due to presence of high conservation value flora in the reserve, it is important to ensure adequate representative areas are set aside for protection and that the appropriate management techniques are employed within the NFM areas to ensure the continuation of viable populations of these species.

Rationale for HCV Boundary Delineation

With the exception of *Rafflesia pricei* and its host *Tetrastigma* sp., all of these species were found in the Lowland Mixed Dipterocarps Forest in Compartment 119 and 124, therefore the whole of these Compartments be demarcated for HCV 1.2. *Rafflesia pricei* and the host *Tetrastigma* sp. were sighted in Compartment 210, and be demarcated as HCV 1.2.

Table 3. Threatened and prohibited flora species recorded in FMU14.

Family	Species	Local name	Status
Dipterocarpaceae	<i>Dryobalanops beccarri</i>	Kapur merah	Endangered
	<i>Dryobalanops lanceolata</i>	Kapur paji	Endangered
	<i>Parashorea malaanonan</i>	Urat mata daun licin	Critically endangered
	<i>Shorea argentifolia</i>	Seraya daun emas	Endangered
	<i>Shorea hypoleuca</i>	Selagan batu	Critically endangered
	<i>Shorea leprosula</i>	Seraya tembaga	Endangered
	<i>Shorea macrophylla</i>	Kawang jantung	Vulnerable & Prohibited
	<i>Shorea mecistopteryx</i>	Kawang burung	Prohibited
	<i>Shorea pauciflora</i>	Ubah suluk	Endangered
	<i>Shorea xanthophylla</i>	Seraya kuning barun	Critically endangered
Lauraceae	<i>Eusideroxylon zwageri</i>	Belian	Vulnerable & Prohibited
Rafflesieae	<i>Rafflesia pricei</i>		Prohibited
Thymelaeaceae	<i>Aquilaria malaccensis</i>	Gaharu	Vulnerable & Prohibited
Vitaceae	<i>Tetrastigma</i> sp.		Prohibited

Site Context for Fauna

¹⁵ Ashton, P. 2004. Dipterocarpaceae. In *Tree Flora of Sabah and Sarawak*, Volume 5., Soepadmo, E., Saw, L. G. and Chung, R. C. K. eds. Government of Malaysia, Kuala Lumpur, Malaysia.

¹⁶ Maycock, C. R., Kettle, C. J., Khoo, E., Pereira, J. T., Sugau, J. B., Nilus, R., Ong, R. C., Amaludin, N. A., Newman, M. F. and Burslem, D. F.R.P. (2012), A Revised Conservation Assessment of Dipterocarps in Sabah. *Biotropica*, 44: 649–657. doi: 10.1111/j.1744-7429.2011.00852.x.

¹⁷ IUCN, 2005.

Of the 26 mammals recorded within FMU 11, 11 species are listed as threatened on the IUCN Red List (Table 5). Three of the species are listed as Totally Protected species under Schedule 1 of the Sabah Wildlife Conservation Enactment 1997, namely the Clouded Leopard, Orang Utan and Sun Bear. All other mammal species are listed under Schedule 2 or 3 of the Sabah Wildlife Conservation Enactment that allows for either limited hunting under licence (Schedule 2) or requires a licence to hunt (Schedule 3) (Appendix 4).

Of the 104 bird species recorded from FMU 11, only the Storm's stork (*Ciconia stormi*) is listed as threatened on the IUCN Red list (Appendix 5), and none of species are fully protected under the Sabah Wildlife Conservation Enactment 1997.

Table 4. HCV 1.2 Fauna sightings in FMU14 that are listed endangered, threatened and vulnerable.

FAMILY	VERNACULAR NAME	SPECIES	Status
Mammalia			
Cercopithecidae	Hose's Langur	<i>Presbytis hosei</i>	Vulnerable
	Pig-tailed Macaque	<i>Macaca nemestrina</i>	Vulnerable
Hylobatidae	Bornean Gibbon	<i>Hylobates muelleri</i>	Endangered
Pongidae	Orang-utan	<i>Pongo pygmaeus</i>	Endangered & Protected
Manidae	Pangolin or Scaly Anteater	<i>Manis javanica</i>	Critically Endangered
	Tufted Ground Squirrel	<i>Rheithrosciurus macrotis</i>	Vulnerable
Ursidae	Sun Bear	<i>Helarctos malayanus</i>	Vulnerable & Protected
	Otter Civet	<i>Cynogale bennettii</i>	Endangered
Felidae	Clouded Leopard	<i>Neofelis nebulosa</i>	Vulnerable & Protected
Elephantidae	Asian Elephant	<i>Elephas maximus</i>	Endangered
	Sambar Deer (Rusa or Payau)	<i>Cervus unicolor</i>	Vulnerable

Rational for Exclusions

In the absence of hunting, these species are known to persist under moderate logging regimes, so no particular area are specifically designated as HCV 1.2. However, critical temporal habitats for these species are identified under HCV 1.4.

4.1.3 HCV1.3 Endemism

Site Context

The Sook plains is an area of high endemism, however, most of the floral species are associated with the Kerangas forest, which are poorly represented within FMU 11. A total of 44 species of endemic plants were recorded from FMU 11 (Appendix 6), however, most are wide ranging Borneo endemics that are well represented within the protected area network across Borneo. Only two of these species (*Ixora polycephala* and *Hoya nabawanensis*) are range-restricted endemic i.e. endemic to Sabah alone, however, these species were not encountered in the recent surveys, and as such no areas could be delineated as HCV 1.3.

Most of the mammal species in FMU14 can be found elsewhere in Sabah or in the neighboring countries of Brunei and Kalimantan, Indonesia. Five Hornbills species had been identified in the FMU namely, *Rhinoplax vigil*, *Buceros rhinoceros*, *Anorrhinus galaritus*, *Anthraceroceros malaysanus*, and *Rhyticeros undulatus*. Most avifauna including the bird species are endemic to Borneo.

Rationale for Boundary Delineation

This HCV is not identified within FMU14.

4.1.4 HCV1.4: Critical Temporal Use

Site Context

Compartment 144 is located in the eastern part of Ulu Sg. Milian Forest Reserve. It has an undulating terrain dissected by a perennial river which provides the main source of water supply for the company's employees at Pingas Camp. The river derives its water from a watershed located further northeast of the compartment crossing two rubber plantation compartments (142 and 157) to the NFM areas. The 5m wide river is bounded by a 20m riparian on both sides of the river in compliance with the Sabah Forest Enactment 1968.

Two freshwater ponds were located along the main road by Compartment 124 and 148 not far from Compartment 144 of the Ulu Sg. Milian Forest Reserve. Compartment 124 is zoned for NFM while 148 for rubber plantation. These ponds are located immediately adjacent to a logged-over lowland mixed dipterocarp forest some 15-years ago. The areas north of Compartment 124 are designated for rubber plantations while on its west is NFM.

Rationale for HCV Boundary Delineation

Within Compartment 144, a salt lick is located within a 5 min walk to the riparian reserve from the staff quarters. Salt licks are deposits of mineral salts (sodium, calcium, iron, etc) used by animals to supplement their nutrition. Salt licks have also been located in Compartment 120, 144 and 165 of the FMU. They are recognized as critical temporal use under HCF1.4. Total estimated area to be demarcated is 15 ha at 5 ha per saltlick. The Precautionary Principle is called for in the demarcation of the salt lick boundary to ensure its functionality.

An Oriental Darter (*Anhinga melanogaster*) was sighted perching on driftwood in the middle of the pond hunting for food. The pond is next to Compartment 124. Freshwater fishes were seen in the pond next to Compartment 148. These ponds derive waters from streams located within the lowland mixed dipterocarp forests adjacent to them. The remnant forests have been logged some 15-20 years ago, and providing a refuge for wildlife as noted by tree bark laceration of sambar deer as well as exfoliated snake skin and freshwater fishes. Otters (*Lontra longicaudis*) had also been sighted in the ponds. The boundary demarcation for this HCV attribute includes a 20 m buffer strip around the two ponds extending to ca. 1,000m. Total area of the HCV boundary is estimated at 2 ha. The presence of ponds in any forest areas satisfies HCV1.4 as critical feeding, nesting, breeding or roosting site.

Rationale for Exclusions

Demarcation of salt licks shall confine to the specific sites. It is not necessary to include the whole of Compartment 144, 142 and 147 for this purpose. However, it is essential to extend the HCV boundary along the 20 m wide riparian reserve on each side of the river up to its catchment area. Where riparian has been removed in the ITP areas, this must be restored. Similar measures will apply for Compartment 124 and 148. Compartment 124, however, qualifies for HCV1.2 being representative of the rare lowland mixed dipterocarp forest. Hence, the whole compartment is retained as HCV.

4.2 HCV2: Landscape-level Forest

Site Context

Currently, no area can be recognized as HCV2 within FMU14. However, FMU14 is situated between the Sungai Tongod and Trus Madi Forest Reserves (Class 1 and 2) in the north and the Sg. Pinangah Forest Reserve (which in turn connects with the larger Maliau, Imbak, Ulu Segama forest complex) and has the potential to provide linkage between these forest complexes. For this to occur, there need to be the retention of suitable ecological corridors within the ITP in Block B and re-establishment of corridors in Block A. This also requires that any development within the Sg. Pinangah Forest Reserve retain suitable connectivity with those in FMU. 11.

+Rationale for exclusions

The proposed delineation are within the ITP areas, and are excluded from HCV delineation for NFM.

4.3 HCV3: Ecosystems

Site Context

Most of FMU14 has been logged prematurely and repeatedly in the past in in the last 20 to 30 years. There are, however, residual forests that have been selectively logged only once. Records and field observations showed that these forests still contain rare, endangered, threatened and endemic species.

Historically, FMU14 consists of five floristic associations namely; Lowland Mixed Dipterocarp Forest (and Extreme Mixed Dipterocarp Forest), Lowland Kerangas Forest, Upland Mixed Dipterocarp Forest, Upland Mixed Dipterocarp and Kerangas Forest, and Lower Montane Forest.

Of the five floristic associations found in FMU 11, the Lowland Kerangas Forests is of the highest conservation priority. The Lowland Kerangas Forest of the Sook Plains is an area of high endemism and represents a floristic association not found elsewhere in Sabah (Lamb 1988¹⁸). Most of the areas that supported Lowland Kerangas Forest within the Ulu Sg. Milian Forest Reserve have already been cleared because they are within the ITP areas. However, there may be some remnant Kerangas Forest remaining and these need to be found and classified as HCV3. Similarly there may be some remnant Lowland Kerangas Forest in Compartment 91, as this compartment contains soils from the Sook soil association, that is known to support Kerangas vegetation on the terrace remnants. However, satellite images suggest that most of this area has been disturbed by past shifting cultivations by local communities (Appendix 1.3).

Compartments 119 and 124 are representative areas of the two different Lowland Mixed Dipterocarp floristic associations identified within the Ulu Sg. Milian Forest Reserve. Compartment 119 is largely undisturbed and had a Selangan Batu/Kapur Bukit floristic association that occurs on the steeper terrain, while Compartment 124 had a *Eusideroxylon zwageri*/Red Seraya dominated forest found that occurs in the valley bottoms and other flatland areas. Due to inaccessibility and time constraints the extreme lowland areas could not be visited, so it was impossible to determine whether there are intact enough to qualify under HCV 3.

Compartment 210 in the Sapulut Forest Reserve qualifies for a Lower Montane Mixed Dipterocarp and Kerangas Forest and which are threatened and endangered ecosystems.

Among the five floristic associations, the Lowland Kerangas Forests are rare sites to be found in FMU14. Those within the Ulu Sg. Milian Forest Reserve have been cleared because they are within the ITP areas. The only representative Lowland Kerangas Forest that has been sighted is in Compartment 91 associated with the Sook soil association. This Compartment is under NFM found on terrace remnants, however,

¹⁸ Lamb, A. 1988. The Kerangas Forest of Nabawan: A botanical assessment of the non-tree flora and recommendations for conservation.

satellite images shows most of this area has been disturbed by past shifting cultivations by local communities.

Rationale for HCV Boundary Delineation

Compartments 119 and 124 in the Ulu Sg. Milian Forest Reserve and Compartment 210 in the Sapulut Forest Reserves have been determined to be HCV3. The boundaries to be delineated include the whole of Compartments 119, 124 and 210 along natural features.

4.4 HCV4: Services of Nature

4.4.1 HCV4.1: Watershed Protection

Site Context

FMU14 is located in the upper watershed of the Kinabatangan River Basin that has most of its headwaters flowing down from the western portion of the FMU to further east up to Sandakan District. Sg. Pingas and Sg. Labau flow from the Trus Madi in the north through the Ulu Sg. Milian Forest Reserve and join the Sg. Pinangah and Sg. Melikop outside the FMU, which then becomes the Sg. Milian. The headwaters of the Sg. Pinangah are located in the Sapulut Forest Reserve south of the Ulu Sg. Milian Forest Reserve. Sg. Pinangah flows northeastward outside the FMU and joins the Sg. Milian. These rivers provide critical water sources for drinking and utility for communities living downstream.

The forests along these major rivers moderate the flow in prolonging water availability during extended drought periods. Forests also help mitigate damage from flooding. Presently, steep areas over 25° slope are prohibited from logging by the Sabah Forest Enactment 1968 and Water Resource Enactment 1998. This restriction is also provided under HCV4.1.

Rationale for HCV Boundary Delineation

HCV4.1 is designated for any natural forest within 30 m of either side of perennial rivers, and extends to 100 m for much larger rivers such as the Sg. Pingas and Sg. Labau (McKenzie and Bio, 1995¹⁹). The demarcation width along small streams shall not be more than 20 m on either sides or as prescribed under the Reduced Impact Logging Guidelines.

4.4.2 HCV4.2: Erosion Control

Site Context

The terrain in the upper watershed of the Kinabatangan River Basin within FMU14 is steep with dissected terraces. More than 40% of the NFM areas in FMU14 have ground slopes greater than 25°. Over 80% of these steep areas have elevation between 700 and 1300m above mean sea level wherein lay the Hill and Lower Montane forests. Steep areas are prone to soil erosion associated with high rainfall intensity at more than 2,500 mm per annum. This attribute is provided under HCV4.2.

Rationale for HCV Boundary Delineation

Compartments 35, 37, 38 and 75 in the Ulu Sg. Milian Forest Reserve as well as 214, 215, 216, 219, 221, 222, 223, 224, 225, 226 and 227 in the Sapulut Forest Reserve have been zoned as CA. These compartments are located on slopes above 25°. The whole of these compartments shall be demarcated

¹⁹ McKenzie, E. and Bio, R.P. 1995. Important criteria and parameters of wildlife movement corridors.

for soil protection using the most pragmatic method if not accessible for the time being. In addition, all areas with slopes greater than 25° within the NFM areas shall be demarcated for HCV4.2.

4.4.3 HCV4.3: Barriers to Destructive Fires

Site Context

Fire risk is generally low in natural forest except for those areas adjacent to villages where traditional land clearing method is by burning. The last major fire occurrence in Sabah was in 1998 where wildfires destroyed *ca.* 5,000 ha in the logged-over forests in the central part of the Ulu Sg. Milian Forest Reserve. Within the NFM, the road infrastructure and river system/riparian act as fire barriers. Road density within the ITP is comparatively higher than in NFM acting as effective fire barriers.

Rationale for HCV Boundary Delineation

The Milian-Labau VJRs faces potential fire threat because it is situated on low nutrient Kerangas soil where species is vulnerable to extinction. Provision for fire and other threats have already been made under HCV1.1 to retain forest buffer within Compartment 170.

Rationale for Exclusions

This HCV is excluded from delineation being addressed by HCV1.1.

4.5 HCV5: Basic Needs of Local Communities

Site Context

There are 24 villages (17 villages and 7 sub villages) located adjacent to and one within FMU14. Those villages located adjacent to [within 2 km] FMU14 are; Kg. Kilo, Kg. Pinipi, Kg. Kuit, Kg. Alab Lanas, Kg. Batu Lunguyan, Kg. Simbuan, Kg. Mantanid, Kg. Maatol, Kg. Mototou, Kg. Kawakaan, Kg. Saup, Kg. Masaum, Kg. Kalindukan, Kg. Fontas - Mandalong, Kg. Pandiwan, Kg. Tompusison, Kg. Kogupil, Kg. Langkuku, Kg. Tataluan - Sg. Matoi, Kg. Solog, Kg. Paganitan, Kg. Kagasa, Kg. Matiku. Only Kg. Wawasan is located inside FMU14 within Compartment 59 zoned for Community Forest.

Out of the 24 villages, six villages (Kg. Wawasan, Kg. Bt. Lunguyan, Kg. Kagasu, Kg. Lanas, Kg. Paganitan and Kg. Pandiwan) were chosen for HCV assessment. These villages were representative of the major social groups actively or passively affected by the presence of natural forest in the FMU.

The socio-economic baseline survey revealed that most the communities are self-employed as farmers (Table 6). Kg. Paganitan has the highest number of self-employed (82% of respondents) followed by Kg. Lanas (42%) and Kg. Kagasu (33%). They plant paddy, vegetables and fruit trees to supplement their daily purchases from nearby shops.

The list of activities that the local communities practice to earn income include handicraft-making (88%), hunting (90%), collecting medicinal plants (74%) and fishing (40%). Most of the raw materials for these activities are sourced from nearby forests (Table 7).

The highest reliance on natural forest by the local communities are clean water for daily utility including irrigation for farming and fishing (Table 8 and 9). This is followed by collection of medicinal plants and fuel wood for cooking.

Table 5. Socio-economic baseline responses from five local communities living adjacent to FMU14.

Villages	Self Employed/Farmer	Government	Grand Total
Kg. Bt. Lunguyan	10 (8.13%)	1 (0.81%)	11 (8.94%)
Kg. Kagasu	5 (33.33%)	1 (6.67%)	6 (40.00%)
Kg. Lanas	10 (41.67%)	–	10 (41.67%)
Kg. Paganitan	9 (81.82%)	–	9 (81.82%)
Kg. Pandiwan	21 (6.65%)	–	21 (6.65%)

Table 6. List of activities villagers depend for subsistence an living.

Activities	Yes	No	Total
Handcraft	50 (87.72%)	7 (12.28%)	57 (100 %)
Hunting	51 (89.47%)	6 (10.53%)	57 (100 %)
Fishing	23 (40.35%)	34 (59.65%)	57 (100 %)
Traditional Medicine	42 (73.68%)	15 (26.32%)	57 (100 %)
Grand Total	166 (72.81%)	62 (27.19%)	228 (100 %)

Table 7. List of food sources collected by villagers adjacent to FMU14.

Food/water	Forest	Farming	Buy	All
Meat	22 (38.60%)	28 (49.12%)	7 (12.28%)	57 (100%)
Rice	–	29 (50.88%)	28 (49.12%)	57 (100%)
Vegetables	57 (100%)	57 (100%)	57 (100 %)	57 (100%)
Fruits	12 (21.05%)	57 (100%)	45 (78.95%)	45 (78.95%)
Medicine	57 (100%)	57 (100%)	57 (100 %)	57 (100%)
Clean Water	57 (100%)	57 (100%)	57 (100%)	57 (100%)

Rationale for Boundary Delineation

Compartments 8 and 9 at the northwestern corner of the FMU14 have been designated as CF in FMP2 primarily for the supply of water. Several local communities live outside these compartments (e.g. Kg. Pinipi, Kg. Kuit, Kg. Alab Lanas, Kg. Batu Lunguyan) benefit from these compartments. Two other compartments (54 and 56) further down Compartment 8 and 9 have also been designated as CF to provide water supply for Kg. Dumbun, Kg. Pututan, Kg. Simbuan and Kg. Mokotog. Within the FMU, Compartment 59 is catered for Kg. Wawasan. All five compartments are delineated for HCV5.

4.6 HCV6: Cultural Identify of Local Communities

Site Context

The Dusun are the main ethnic group residing near and within Ulu Sg. Milian Forest Reserve while the Murut ethnic group dominates the communities in the Sapulut Forest Reserve. All those interviewed in the social baseline survey still believe in the existence of mysticism and spirituality. Most indigenous people still believe in animism.

The Dusun believes that everything has life including rocks, trees and rivers (Sabah Tourism Association, 2015²⁰). They have souls and spirits that must be appeased from time to time through specific rituals. They believed that rice embodies the spirit of Bambaazon that must be protected from harm. The homecoming of Babaazon is an integral part of the Harvest Festival celebration. The Dusun believes that following death the spirit of the death proceeds to rest near in a sacred world. Some spirits of the dead are believed to go astray since they are captured enroute by harmful spirits or eaten by cannibal spirits. A period of formal mourning, which includes a number of ritual and ceremonial actions, is intended to ease the transition of the dead to their new life in the afterworld. The dead is buried as soon as all the family members are gathered.

The Muruts are one of the largest indigenous group in Sabah (Sabah Tourism Association, 2015). They are mostly shifting cultivators and hunters with some riverine fishing. The essence of Murut tradition of feasts is distinctive. No merrymaking will end at least until sunrise and can last up to seven days later. This is especially the case with weddings or funerals. The Murut keeps the bodies of their deceased in a jar and place them in colourful and elaborately decorated grave-huts along with the deceased's

²⁰ Sabah Tourism Association, 2005. <http://www.sta.my/kadazandusun.cfm>

belongings. The body will be placed in the foetal position inside the jar and a gong will be placed over the mouth of the jar to close it. However, this custom of burial is becoming rare with the availability of wooden coffins.

Rationale for Boundary Delineation

Seven burial grounds have been identified within FMU14 (4 within ITP and 3 within NFM areas). These are located in compartments 13, 19, 21 32 and 162 all in Ulu Sg. Milian Forest Reserve. The seven burial grounds are provided under HCV 6.

Table 8. Identification of communities within one village community Fulfillment of Basic Needs

Villages	:	Kg. Batu Lunguyan	(Population: 618, Household: 123)
	:	Kg. Lanas Station	(Population: 145, Household: 24)
	:	Kg. Pandiwan B	(Population: 357, Household: 66)
	:	Kg. Paganitan	(Population: 47, Household: 10)
	:	Kg. Kagasa	(Population: 51, Household: 7)
Ethnic Group	:	Dusun and Murut	
Needs	Rating	HCV 5	Summary Response
Foods			
Carbohydrates (e.g. rice, cassava ...)	1	N/A	Rice and cassava are planted on their land.
Animal protein (e.g. meat, fish)	2	N/A	Source of wild meat from forest. Fishes from rivers. Chicken meat from own farm.
Fruits, vegetables	1	N/A	Most of fruits and vegetables are grown on their own land.
Materials			
Housing	2	N/A	Timber for construction of village houses is from forest. Bricks and corrugated metal roof, cements, sands, paint, nails etc. are purchased from sundry shops.
Furniture, household, handicraft, tool...	2	N/A	Only some furniture is made of wood from the forest.
Boats	2		Timber for boat construction is collected from forest.
Fuel	3	N/A	Fire woods are taken from forest. Almost every household requires firewood for cooking.
Medicines	3	N/A	Local communities still collect medicinal plants from forest to treat illness. These include a range of leaves, barks and roots. The supply of these medicinal plants has declined due to logging activities in nearby forest without readily available alternatives.
Animal Feeds	0	N/A	
Water			
Drinking and daily needs	4	Applicable	Local communities use gravity water for their daily utility sourcing it from watersheds located within FMU14 without readily available alternatives.. In addition, they collect rain water to supplement their use.
Agriculture or Fishery	4	Applicable	The source of water is from watersheds within FMU14. Rainwater is also collected.
Cash income	2	N/A	
Cultural/spiritual/religious needs:	4	Applicable	Old burial grounds

Rating of Importance following the HCVF toolkit for Malaysia:

(0) **Non existent** = 0%;

(1) **Not important** = less than 15%

(2) **Important** = between about 15% and 50%

(3) **Critical** = more than 50% of a given need is fulfilled by one source

(4) **Essential** = 100% of a given need is fulfilled by one source

4.7 INDICATIVE HCVF BOUNDARIES

4.7.1 Ulu Sg. Milian Forest Reserve

All HCV attributes (1 to 6) were assessed within the Ulu Sg. Milian Forest Reserve (Figure 5). With the exception of HCV2, all have been identified in FMU14. The combined HCVs in both forest reserves within FMU14 comprises of 33,002 ha representing 68% of the total NFM area (Table 10).

HCV1.1 is located in the southern tip of the Ulu Sg. Milian Forest Reserve within Compartment 170. The indicative boundary is a buffer strip of 50 m x 2,000 m equivalent to *ca.* 10 ha. This HCV boundary serves as a buffering function against fire or encroachment threats from Compartment 170 into the Milian-Labau VJR (Block II). *HCV1.2* is identified in Compartment 144 within a riparian reserve in a stand of mixed dipterocarp forests containing several prohibited species including *Eusideroxylon zwageri*, *Shorea macrophylla* and *Aquilaria* sp. The indicative boundary for this HCV is a 20 m wide riparian reserve along both sides of the river extending to the upper watershed across rubber plantation estimated at 5,000 m approximately 200 ha. A larger patch of representative stand of lowland mixed dipterocarp species is located at elevation of 350-400 m a.m.s.l. in Compartment 124 and is admitted for HCV1.2. The indicative boundary for this HCV is the whole compartment totaling 546 ha. *HCV1.4* is identified in Compartment 120, 144 and 165 with the presence of salt lick. Total area for this is 15 ha to be demarcated exercising discretionary administrative decision around the salt lick to ensure its long-term functionality. Two freshwater ponds were identified near Compartments 124 and 128. The rubber trees along the edge of the pond shall be under-planted with native tree species along a strip of 20 m x 500 m totaled 2 ha.

Two compartments i.e. 119 and 124 qualified as threatened and endangered ecosystems under *HCV3*. Botanical collections confirmed these area are representative of the Lowland mixed Dipterocarp Forest. They are situated on elevation less than 400 m a.m.s.l. stocked with natural regeneration. The indicative boundary for these three compartments is estimated at 1,899 ha.

HCV4.1 and 4.2 are most extensively identified within the NFM in the Ulu Sg. Milian Forest Reserve. The indicative boundary for this attribute is estimated at 27,658 ha on the basis that 40% of the NFM is steep areas, and all CAs are admitted for HCV4.1 and 4.2.

The boundary for *HCV5* includes Compartments 8, 9, 54, 56 and 59 with a total area 2,608 ha. This is on the basis that several of the local communities depend on the watersheds in FMU14 for gravity-feed water, collection of medicinal plants and fuel wood for cooking.

HCV6 is indicated by the presence of sacred grounds scattered across Ulu Sg. Milian Forest Reserve with two burial grounds located in the NFM area within Compartment 32. The remaining 5 burial grounds are in ITP areas within Compartment 13, 20, 21 and 162.

4.7.2 Sapulut Forest Reserve

Only HCV1.2, 3, 4.1 and 4.2 have been identified for Sapulut Forest Reserve. The *Rafflesia pricei* and its host *Tetrastigma* sp. are sighted in Compartment 210 admitted for HCV1.2. Additionally, Compartment 210 is founded on a forest formation dominated by Upland Mixed Dipterocarp and Kerangas Forest and the Lower Montane Dipterocarp Forest confirmed by the presence of trees in the Fagaceae and Lauraceae families that inherits HCV3. The indicative boundary for HCV1.2 and 3 is the whole of Compartment 210 (300 ha) extending to areas outside the Compartment following natural boundary of approximately 600 ha in total.

HCV4.1 and 4.2 are extensively identified with a large portion that has already zoned for conservation under the FMP2. The indicative boundary for this HCV is estimated at 11,283 ha.

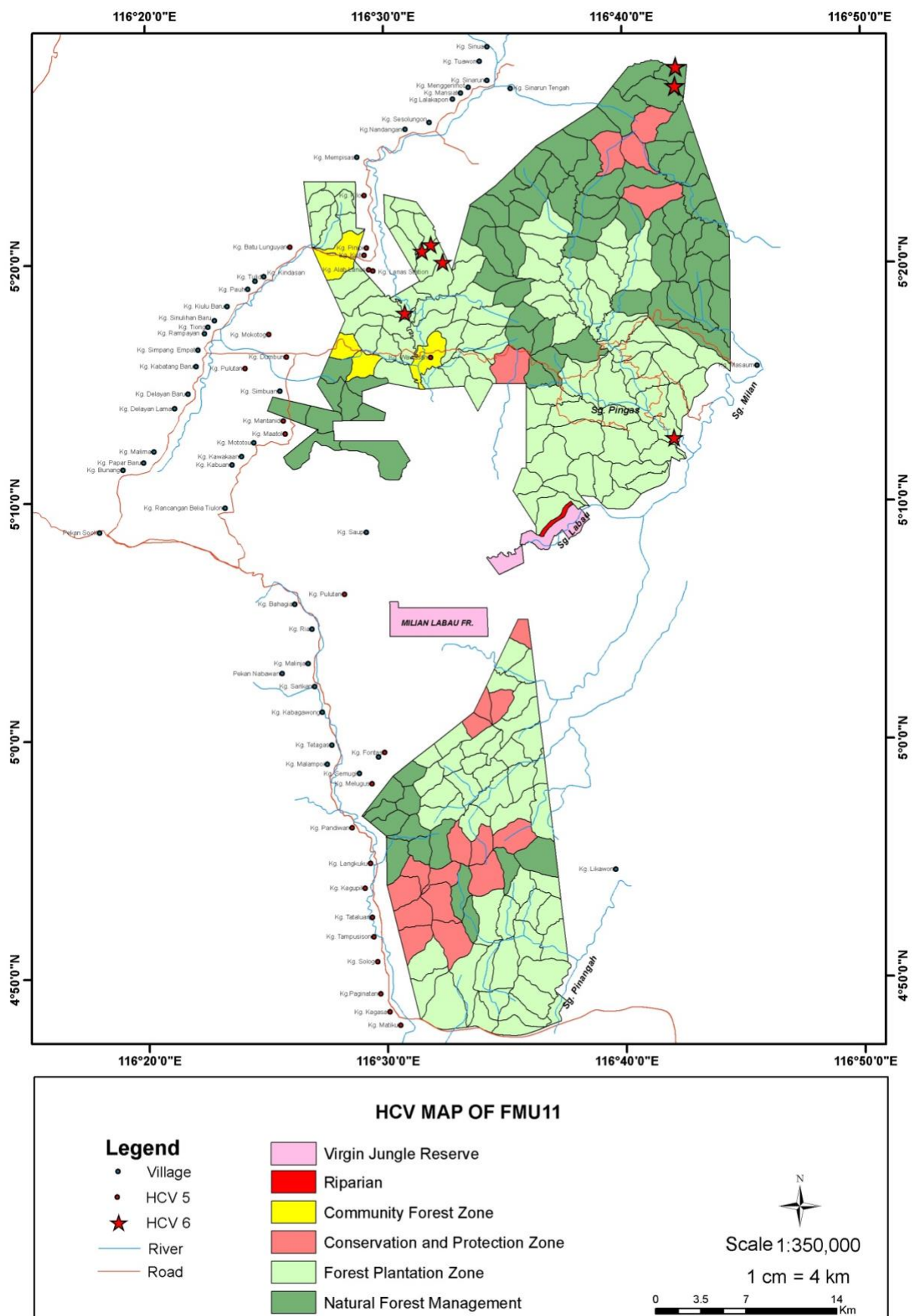


Figure 5. Location of HCVFs identified and assessed in FMU14.

Table 9. Indicative size of HCVFs delineation by forest reserves.

HCV	Attributes	Compt	Forest Reserve	Landuse	Area (ha)	Basis of calculation
1.1	Buffering strip to protect Milian-Labau VJR (Block II)	117	Ulu Milian	ITP	10	50 m (w) x 2000 m (l)
1.2	Prohibited tree species	144	Ulu Milian	ITP	200	Along riparian reserve @ 40 m (w) x 5,000 m (L)
	<i>Rafflesia pricei</i> and host	210	Sapulut	NFM	-	Include in HCV3 Ecosystem
1.4	Salt lick	120/144/165	Ulu Milian	NFM/ITP	15	@ 5 ha per salt lick x 3 units (Cpt120=NFM; Cpt144/165=ITP)
	Freshwater pond	124	Ulu Millian	NFM	1	Along edge of pond @ 20 m x 500 m
3	Lowland Mixed Dipterocarp Forest and Kerangas Forest	119 124 138	Ulu Milian	NFM	1,899	Whole of three compartments (Cpt 119=864 ha; Cpt 124=546 ha; Cpt 138=489 ha)
	Lower Montane forest	210	Sapulut	NFM	600	Along ridge @ 2000 m (w) x 3,000 m (L)
4.1 & 4.2	Water and soil conservation	FMU14	Ulu Milian	NFM+CA	16,376	@40% of NFM (25,243 ha) + CA (6,279 ha)
	- Ditto -		Sapulut	NFM+CA	11,283	@40% of NFM (4,480 ha) + CA (9,491 ha)
5	Basic needs for local communities	8/9/54 56/59	Ulu Milian	CF	2,608	Whole of compartment
6	Burial grounds	13/20/21 32/162	Ulu Milian	NFM(2)/ ITP(5)	0.08 0.20	@ 20 m x 20 m per cemetery (NFM=Cpt32; ITP=Cpt 13,20,21,162)
Total				NFM+CA	32,772.08	
				All	32,992.28	@68% of FMU (48,101 ha)

5 HCVF MANAGEMENT AND MONITORING STRATEGIES

The strategic goal of the HCVFs within FMU14 is to enhance their attributes under a cohesive and effective protection at a landscape level. This strategic goal is broken down into three categories namely, (1) Enhancement of rare, threatened and endangered (RTEs), (2) Enabling environment for HCVF management and monitoring, and (3) Sustainable financing. The management interventions vary from total protection of RTEs or habitat to improving capacity, equipment, access and financing.

Monitoring of HCV management strategies is through a number of objectively verifiable indicators (OVI). It is designed to identify the state and response of management interventions to aid decision-making. The OVIs address quantitative objective that will be achieved within a given time-frame. It includes conservation targets for flora, fauna and habitat or area. Where these conservation targets are deemed to face potential threats, the monitoring objective will specify how much the threat will be reduced over a certain timeframe. For conservation interventions, it will relate to whether a planned intervention was implemented according to the specification and timeframe.

The management and monitoring framework for each of the HCVFs identified is provided in Table 12. It should be noted that the strategies are necessarily high-level in nature and are supplemental to existing efforts carried out through implementation of the SFMLA and forest certification exercise.

Table 10. HCV management and monitoring and framework for FMU14.

Strategy	Objectively verifiable Indicators (OVIs)	Baseline	Target	Sources of Verification	Risks and Assumptions									
Goal#1: Enhance HCVF attributes in FMU14 which brings critically, endangered and threatened species under protection at a landscape level.	Forest containing RTEs of globally, nationally and locally significance within FMU landscape.	The Milian-Labau VJR (Block II) is located in the south of Ulu Milian Forest Reserve, and is facing threat from forest conversion in Compartment 170 along its western boundary.	By end of 3 rd year, a buffer strip 50m (width) x 5,000 km (length) will be created by enrichment planting of native tree species.	- Nursery/Planting records - HCV Monitoring report	No prolonged drought.									
		The list of tree species classified under RTE represents only 20-30% of the data recorded in the Brahms for Ulu Milian and Sapulut Forest Reserves.	By end of 3 rd year, the proportion of RTE sightings for flora species will increase by 50%.	HCVF Monitoring record and report	Precautionary Principle is applied particularly in forest areas that are subject to impending logging.									
		Wildlife populations within the FMU landscape, together with those at adjacent protected areas, are currently estimated at; <table><tr><th>Category</th><th>#Species</th></tr><tr><td>A. Mammals</td><td>22</td></tr><tr><td>B. Birds</td><td>57</td></tr><tr><td>C. Reptile</td><td>3</td></tr><tr><td>D. Amphibia</td><td>20</td></tr></table>	Category	#Species	A. Mammals	22	B. Birds	57	C. Reptile	3	D. Amphibia	20	- By end of Year 3, wildlife sightings by categories shall increase by 30% within the FMU landscape. - At least 10f wildlife survey transects will be created annually.	HCVF Monitoring Report
	Category	#Species												
A. Mammals	22													
B. Birds	57													
C. Reptile	3													
D. Amphibia	20													
HCVFs boundary are clearly demarcated in the field adhering to the Precautionary Principle.	All HCVFs areas that have been identified and assessed from 9 to 10 October 2014 have not been demarcated in the field.	- Complete demarcation of HCV boundaries of Compartment 124 and 144 including signage by November 2016 . - Complete demarcation of HCV boundary of Compartment 148 by year 1. - Complete demarcation of HCV boundary of Compartment 119 by Year 2. - Install at least 60 GPS points per year in lieu of painted boundary for HCV4.1 and 4.2. - Complete UAV survey of Compartment 124, 199 and 210 by Jun 2015.	HCVF Monitoring report	There is accessibility to the designated sites.										
	Basic needs and cultural heritage of local communities living within and adjacent to FMU14 preserved.	There are 24 villages living close to the FMU who depend on forest for water, food sources, and materials. Seven burial grounds are located within the FMU. Conflicting land claims have been a recurrent issue.	- Conduct HCV awareness program for local communities annually - Work with NGOs (WWF/Forever Sabah) to develop joint/collaborative community projects by end of 2015	- Awareness program and records - Memorandum of Collaboration										

Strategy	Objectively verifiable Indicators (OVIs)	Baseline	Target	Sources of Verification	Risks and Assumptions
Goal#2: An enabling environment for HCVF management and monitoring	HCVF management and monitoring System is created and fully integrated into the organizational structure.	A dedicated HCVF unit does not exist within the organization that strains the existing resources.	- By Nov 2015, a HCV management and monitoring Unit/system is created. - By end of 2015, UAV equipment is purchased or outsourced.	- Minutes of Meeting - HCV Monitoring reports	Budget constraint.
	Sufficient staff/manpower to implement HCV management and monitoring activities.	Present HCV portfolio is under three officers who have other duties to perform. The inventory/ silviculture crew (6) is expected to perform the HCV demarcation which will overload them to be effective in carrying HCV works.	- Recruit a Conservation Officer by end of November 2015 to head the HCV Management and Monitoring Unit - Recruit 10 forest rangers for HCVF tasks	Recruitment record	Budget constraint.
	Capacities of staff within FMU to implement HCVF task.	- Present staff are not trained in HCVF management and monitoring tasks. - Field crews have basic knowledge in identifying RTE species .	- Engage WWF to conduct at least one HCV training in first quarter of 2016. - Engage FRC to conduct a tree identification course by Nov 2015. - Develop R&D capacity with academia (UMS) by end of 2016.	- Certificates of Participation in training - Memorandum of Collaboration/Letter of Intent	Staff trained in HCVF are retained.
	Enforcement effectiveness of HCVF monitoring is institutionalized.	Cases of unauthorized hunting and collection of wildlife/plants remains high at 10 reported cases per year.	By Year 3, threats from illegal hunting/ collection recorded per Km² of patrolling is reduced by 50% by implementing the following measures; - Conduct weekly mobile/foot patrolling - Conduct joint patrol with SFD/SWD on a quarterly basis - Fly UAV to monitor intactness of forest at least twice a year	Patrol and enforcement records	Illegal cases are recorded.
Goal#3: Sustainable financing of HCVFs associated FMU landscape	Budget for HCV management and monitoring allocated.	There is no budget for HCV management and monitoring tasks.	A yearly budget is allocated not exceeding 5% of total forest operating budget .	Annual financial reports	
	An effective financial/ accounting system for fund management and disbursement for HCV management and monitoring.	Integrate HCV costings in financial/accounting system	Adaptive system in place by Year 1	Operating manuals	Expertise available to establish system and conduct training

Appendix 1a. Satellite image of the extreme lowland areas in Block A of FMU 11 (Cpt 138, 139 & 158).



Appendix 1b. Satellite image of the extreme lowland areas in Block A of FMU 11 (Compartment 132 & 135).



Appendix 1c. Satellite image of the extreme lowland areas in Block A of FMU 11 (Remnant Kerangas Forest).



Appendix 2. Soil associations in FMU14.

Nine soil associations are found within FRM 11. Four of these soil associations (Kepayan, Brantian, Sook and Sinarun) have been derived from alluvium that has been deposited to form terraces. These terraces vary in soil texture due to the different alluvial deposits and as a consequence different forest types can be found on these soil associations. The Kepayan soil association occurs as small pockets within Compartments 13, 14, 52, 58 & 59 and covers an area of 1.02 km². This soil association is characterized by flat terraces with only minor surface dissection that are derived from coarse-textured tiered alluvial deposits. The soils are sandy and would naturally support Kerangas vegetation on the terraces, with a mixed dipterocarp forest found on the terrace edge. The Sook soil association is a series of low terraces and floodplains. The terraces are slightly dissected and composed of medium- to coarse-textured alluvium. Kerangas forest is found on the terrace remnants, with mixed dipterocarp forest found in the floodplains. The Brantian soil association are mainly medium- to fine-textured and generally flat to slightly undulating with short steep slopes in dissected parts. In the context of FMU 11, they occur in both Block A and B. In Block A they occur as continuous blocks running through compartments 13, 14, 52, 58 & 59. The soils also contain variable amounts of pebbles, with deep pebble deposits sometimes occurring. The soils support a lowland dipterocarp forest that is often rich in *Eusideroxylon zwageri* while Kerangas forest occurs sporadically. The Sinarun soil association is formed on strongly dissected terrace remnants and comprises medium- to fine-textured alluvium overlying sandstone and mudstone rocks. The dissected terraces are in the form of low hills and alluvial flats with an amplitude of about 30 to 45 m, convex crests and short moderate to very steep slopes and usually support a mixed dipterocarp forest.

The remaining five soil associations (Crocker Dalit, Kalabakan, Lokan and Maliau) found within FMU 11 have been derived *in situ* from mudstone and sandstone parent material, however, different topographic relief and composition of these two rock types has resulted in the formation of different soil associations. The Crocker Association is the most extensive soil association found in Sabah. It occurs on extensive mountain ranges formed of interbedded sandstone and mudstone. The terrain is usually steep with amplitudes in excess of 300 m and slopes greater than 25°. Most of the area is under dipterocarp forest (lowland or upland MDF depending upon the altitude), with lower montane forest occurring on the higher peaks. The Dalit soil association occurs on low hills and alluvial flats. The hills are interbedded reddish brown sandstone and mudstone with an amplitude of about 60 m at altitudes below 150 m. The hills are convex in shape with slopes ranging from 10-15°, but exceeding this on some incised lower slopes. The alluvial flats are often more than 400 m wide and are dissected by shallow gullies. Lowland dipterocarp forest covers the low hills, with an impoverished forest of small trees and an undergrowth of sedges occurring on many of the wet alluvial flats. The Lokan soil association occurs on very high hills formed of interbedded sandstone and mudstone. They are characterised by steep slopes and narrow ridges with amplitudes up to 300 m and support mixed dipterocarp forest. Similarly, the Kalabakan soil association supports mixed dipterocarp forest. Kalabakan soils are predominantly derived from mudstone and occur on low hills and ridges with a relief amplitude of about 60 m and slopes in the 10 to 20° range. The Maliau soil association is predominantly from sandstone parent material and occurs on hills and mountains at altitudes ranging from 150 m to over 1,650 m. This soil association supports a mixture of mixed dipterocarp and Kerangas forests. The dipterocarp forest is usually found on the scarp slopes and dissected dip slopes, while the Kerangas forest is associated with the long plane dip slopes that are characteristic features of the topography found in areas with this soil association.

Appendix 3. Plants species recorded from FMU 11.

[The abbreviation of the IUCN status follows the standard IUCN protocol (IUCN 2015), with NE signifying species that have not been evaluated, LC species that are of least concern i.e. no immediate threat of extinction, NT are species that are near threatened. VU, EN and CR indicate species that are vulnerable, endangered or critically endangered, respectively, and indicate an increase likelihood of extinction. Endemism was obtained from the Sabah Plant Checklist (Sugau & Maycock, unpublished data), with Sb indicates the species occurs in Sabah, S in Sarawak, B in Brunei and K in Kalimantan. Status refers to whether the species is on Schedule 1 of the Sabah Wildlife Enactment (1997) or listed as a prohibited by the Sabah Forestry Department].

	Family	Species	IUCN Status	Endemism	Status	Data source
1	Achariaceae	<i>Hydnocarpus sumatrana</i>	NE			Secondary Data (Sungai Millian)
2	Actinidiaceae	<i>Saurauia ferox</i>	NE	Borneo (Sb,S,B,K)		Secondary Data (Camp C)
3	Anacardiaceae	<i>Camptosperma auriculatum</i>	NE			Sighting
		<i>Drimycarpus luridus</i>	NE			Secondary Data (Camp C)
4	Annonaceae	<i>Artabotrys suaveolens</i>	NE			Secondary Data (Camp C)
		<i>Friesodielsia glauca</i>	NE			Secondary Data (Sungai Millian)
		<i>Hubera rumphii</i>	NE			Secondary Data (Camp C)
		<i>Maasia sumatrana</i>	NE			Secondary Data (Camp C)
		<i>Phaeanthus ophthalmicus</i>	NE			Secondary Data (Camp C)
		<i>Polyalthia miliusoides</i>	NE	Borneo (Sb,B)		Secondary Data (Camp C)
		<i>Popowia pisocarpa</i>	NE			Secondary Data (Camp C)
		<i>Artabotrys</i>	NE			Sighting
5	Apocynaceae	<i>Alyxia reinwardtii</i> var. <i>meiantha</i>	NE			Secondary Data (Sungai Millian)
		<i>Chilocarpus vernicosus</i>	NE			Secondary Data (Sungai Millian)
		<i>Dischidia</i> aff. <i>Acutifolia</i>	NE			Secondary Data (Sungai Millian)
		<i>Hoya nabawanensis</i>	NE	Sabah		Secondary Data (Sungai Millian)
		<i>Hoya obtusifolia</i>	NE	Borneo (Sb,S)		Secondary Data (Sungai Millian)
		<i>Tabernaemontana pauciflora</i>	NE			Sighting
6	Araceae	<i>Amydrium medium</i>	NE			Secondary Data (Sungai Millian)
		<i>Pothos beccarianus</i>	NE	Borneo (Sb,S,B)		Secondary Data (Sungai Millian)
		<i>Scindapsus pictus</i>	NE			Secondary Data (Sungai Millian)
		<i>Amydrium medium</i>	NE			Sighting
7	Araliaceae	<i>Hydrocotyle javanica</i>	LC			Secondary Data (Sungai Millian)
8	Arecaceae	<i>Calamus blumei</i>	NE			Secondary Data (Camp C)
		<i>Calamus conirostris</i>	NE			Secondary Data (Camp C)
		<i>Calamus laevigatus</i> var. <i>laevigatus</i>	NE			Secondary Data (Sungai Millian)
		<i>Daemonorops didymorphylla</i>	NE			Secondary Data (Camp C)
9	Burseraceae	<i>Dacryodes rugosa</i>	NE			Secondary Data (Camp C)
10	Celastraceae	<i>Euonymus castaneifolius</i>	NE			Secondary Data (Sungai Millian)
		<i>Microtropis platyphylla</i>	NE			Sighting
11	Centroplacaceae	<i>Bhesa paniculata</i>	LC			Secondary Data (Sungai Millian)

	Family	Species	IUCN Status	Endemism	Status	Data source
12	Clusiaceae	<i>Garcinia parvifolia</i>	NE			Secondary Data (Camp C)
13	Compositae	<i>Crassocephalum crepidioides</i>	NE			Sighting
14	Connaraceae	<i>Connarus grandis</i>	NE			Secondary Data (Sungai Millian)
15	Convolvulaceae	<i>Argyreia caudate</i>	NE	Borneo (Sb,?S,?K)		Secondary Data (Sungai Millian)
		<i>Erycibe borneensis</i> var. <i>collina</i>	NE	Borneo (Sb,S,B,K)		Secondary Data (Camp C)
16	Dilleniaceae	<i>Dillenia borneensis</i>	NE	Borneo (Sb,S,K)		Sighting
17	Dipterocarpaceae	<i>Dipterocarpus confertus</i>	NE	Borneo (Sb,S,B,K)		Dipterocarp database
		<i>Dryobalanops beccarri</i>	EN			Sighting
		<i>Dryobalanops lanceolata</i>	EN	Borneo (Sb,S,B,K)		Sighting
		<i>Parashorea malaanonan</i>	CR			Sighting
		<i>Shorea angustifolia</i>	NE	Borneo (Sb,S,B,K)		Dipterocarp database
		<i>Shorea argentifolia</i>	EN	Borneo (Sb,S,B,K)		Sighting
		<i>Shorea fallax</i>	NE	Borneo (Sb,S,B,K)		Sighting
		<i>Shorea ferruginea</i>	NE	Borneo (Sb,S,B)		Sighting
		<i>Shorea hypoleuca</i>	CR	Borneo (Sb,S)		Sighting
		<i>Shorea laevis</i>	LC			Dipterocarp database
		<i>Shorea leprosula</i>	EN			Sighting
		<i>Shorea macrophylla</i>	VU		Prohibited	Sighting
		<i>Shorea macroptera</i>	NE	Borneo (Sb,S,B,K)		Sighting
		<i>Shorea mecistopteryx</i>	NE	Borneo (Sb,S,B,K)	Prohibited	Sighting
		<i>Shorea ovalis</i> subsp. <i>sarawakensis</i>	NE	Borneo (Sb,S,B,K)		Sighting
		<i>Shorea parvifolia</i> subsp. <i>parvifolia</i>	NE			Sighting
		<i>Shorea parvistipulata</i> subsp. <i>parvistipulata</i>	NE	Borneo (Sb,S,B,K)		Sighting
		<i>Shorea pauciflora</i>	EN			Dipterocarp database
		<i>Shorea xanthophylla</i>	CR	Borneo (Sb,S,B)		Sighting
		<i>Vatica albiramis</i>	NE	Borneo (Sb,S,B)		Secondary Data (Camp C)
		<i>Vatica umbonata</i> ssp. <i>acrocarpa</i>	LC	Borneo (Sb,K)		Sighting
18	Elaeocarpaceae	<i>Elaeocarpus clementis</i> var. <i>borneensis</i>	NE	Borneo (Sb,S)		Secondary Data (Sungai Millian)
19	Euphorbiaceae	<i>Agrostistachys borneensis</i>	NE			Secondary Data (Sungai Millian)
		<i>Blumeodendron concolor</i>	NE			Secondary Data (Camp C)
		<i>Elateriospermum tapos</i>	NE			Secondary Data (Camp C)
		<i>Hancea penangensis</i>	NE			Secondary Data (Camp C)
		<i>Macaranga gigantea</i>	NE			Sighting
		<i>Macaranga hypoleuca</i>	NE			Sighting
		<i>Macaranga triloba</i>	NE			Sighting
		<i>Mallotus korthalsii</i>	NE			Secondary Data (Camp C)
		<i>Mallotus lackeyi</i>	NE			Secondary Data (Camp C)

	Family	Species	IUCN Status	Endemism	Status	Data source
		<i>Paracroton pendulus</i>	NE			Secondary Data (Camp C)
		<i>Spathiostemon javanensis</i>	NE			Secondary Data (Camp C)
20	Fagaceae	<i>Castanopsis hypophoenicea</i>	NE	Borneo (Sb,S,B,K)		Secondary Data (Camp C)
		<i>Lithocarpus meijeri</i>	NE			Secondary Data (Camp C)
21	Gentianaceae	<i>Utania cuspidata</i>	NE			Secondary Data (Sungai Millian)
		<i>Fagraea cuspidata</i>	NE			Sighting
22	Gesneriaceae	<i>Cyrtandra</i>				Sighting
23	Hypericaceae	<i>Cratoxylum sumatranum</i>	NE			Secondary Data (Sungai Millian)
24	Icacinaceae	<i>Phytocrene anomala</i>	NE	Borneo (Sb,S)		Secondary Data (Sungai Millian)
25	Lauraceae	<i>Cryptocarya ferrea</i> var. <i>ferrea</i>	NE			Secondary Data (Camp C)
		<i>Eusideroxylon zwageri</i>	VU		Prohibited	Sighting
		<i>Nothaphoebe heterophylla</i>	NE	Borneo (Sb,S,B,K)		Secondary Data (Camp C)
26	Lecythidaceae	<i>Barringtonia lanceolata</i>	NE	Borneo (Sb,S,B,K)		Secondary Data (Camp C)
27	Leguminosae	<i>Bauhinia excelsa</i> var. <i>excelsa</i>	LC	Borneo (Sb,S,B,K)		Secondary Data (Sungai Millian)
		<i>Crudia ornate</i>	NE	Borneo (Sb,S,K)		Secondary Data (Sungai Millian)
		<i>Crudia tenuipes</i>	NE	Borneo (Sb,S,B,K)		Secondary Data (Camp C)
		<i>Dialium indicum</i>	NE			Sighting
		<i>Spatholobus hirsutus</i>	NE	Borneo (Sb,S,B,K)		Secondary Data (Sungai Millian)
		<i>Bauhinia excelsa</i> var. <i>excelsa</i>	NE			Sighting
		<i>Mimosa pudica</i>	NE			Sighting
		<i>Mimosa diplotricha</i>	NE			Sighting
		<i>Fordia splendidissima</i>	NE			Sighting
28	Linaceae	<i>Indorouchera griffithiana</i>	NE			Secondary Data (Sungai Millian)
29	Loganiaceae	<i>Strychnos axillaris</i>	NE			Secondary Data (Sungai Millian)
30	Loranthaceae	<i>Helixanthera coccinea</i>	NE			Secondary Data (Sungai Millian)
		<i>Taxillus</i>				Sighting
31	Malvaceae	<i>Microcos hirsuta</i>	NE			Secondary Data (Sungai Millian)
		<i>Microcos reticulata</i>	NE			Secondary Data (Sungai Millian)
32	Melastomataceae	<i>Diplectria</i> cf. <i>divaricata</i>	NE			Secondary Data (Sungai Millian)
		<i>Clidemia hirta</i>	NE			Sighting
		<i>Dissochaeta biligulata</i>	NE			Secondary Data (Sungai Millian)
		<i>Pternandra azurea</i> var. <i>subalata</i>	NE			Secondary Data (Camp C)
		<i>Pternandra coerulescens</i>	NE			Sighting
		<i>Dissochaeta biligulata</i>	NE			Sighting
		<i>Diplectria</i> cf. <i>divaricata</i>	NE			Sighting
		<i>Melostoma malabathricum</i>	NE			Sighting
33	Meliaceae	<i>Aglaia crassinervia</i>	NT			Secondary Data (Camp C)

Family	Species	IUCN Status	Endemism	Status	Data source
	<i>Aglaia hiernii</i>	NT			Secondary Data (Camp C)
	<i>Aglaia leucophylla</i>	NT			Secondary Data (Camp C)
	<i>Aglaia luzoniensis</i>	NT			Secondary Data (Camp C)
	<i>Aglaia monozyga</i>	NT			Secondary Data (Camp C)
	<i>Aglaia simplicifolia</i>	NT			Secondary Data (Camp C)
	<i>Dysoxylum pachyrhache</i>	NE	Borneo (Sb,S,B,K)		Secondary Data (Camp C)
	<i>Dysoxylum rugulosum</i>	NE			Secondary Data (Camp C)
	<i>Pseudoclausena chrysogyne</i>	NE			Secondary Data (Camp C)
34	Moraceae				
	<i>Artocarpus brevipedunculatus</i>	NE	Borneo (Sb,S,B)		Secondary Data (Camp C)
	<i>Ficus pellucido-punctata</i>	NE			Secondary Data (Camp C)
	<i>Ficus recurva</i> var <i>ribesioides</i>	NE			Secondary Data (Sungai Millian)
35	Myristicaceae				
	<i>Horsfieldia wallichii</i>	LC			Secondary Data (Camp C)
	<i>Knema latericia</i> subsp. <i>ridleyi</i>	NE			Secondary Data (Camp C)
	<i>Knema latifolia</i>	LC			Secondary Data (Camp C)
36	Myrtaceae				
	<i>Dacrydium</i>				Sighting
	<i>Syzygium</i> sp.1				Sighting
	<i>Syzygium</i> sp.2				Sighting
	<i>Decaspermum</i> sp.				Sighting
	<i>Tristaniaopsis</i> cf. <i>whiteana</i>	NE			Sighting
37	Ochnaceae				Secondary Data (Camp C)
	<i>Gomphia serrata</i>	LC			
38	Olacaceae				Secondary Data (Sungai Millian)
	<i>Harnandia mekongensis</i>	NE			
39	Oleaceae				Secondary Data (Sungai Millian)
	<i>Chionanthus porcatus</i>	NE	Borneo (Sb,S,K)		
40	Phyllantaceae				Secondary Data (Camp C)
	<i>Antidesma tomentosum</i>	NE			
	<i>Cleistanthus striatus</i>	NE	Borneo (Sb,S)		Secondary Data (Camp C)
	<i>Glochidion rubrum</i>	NE			Secondary Data (Camp C)
41	Podocarpaceae				Secondary Data (Camp C)
	<i>Podocarpus rumphii</i>	NT			
42	Polygalaceae				Secondary Data (Camp C)
	<i>Xanthophyllum vitellinum</i>	NE			
43	Primulaceae				Secondary Data (Camp C)
	<i>Ardisia sanguinolenta</i>	NE			
44	Rafflesieae				Sighting
	<i>Rafflesia pricei</i>	NE	Borneo (Sb,S,B,K)	Prohibited	
45	Rhamnaceae				Secondary Data (Sungai Millian)
	<i>Alphitonia incana</i>	NE			
46	Rubiaceae				Secondary Data (Camp C)
	<i>Ixora polycephala</i>	NE	Sabah		
	<i>Ixora pyrantha</i>	NE	Borneo (Sb,S,K)		Secondary Data (Camp C)
	<i>Lasianthes</i>				Sighting
	<i>Pavetta indica</i>	NE			Secondary Data (Sungai Millian)
	<i>Praravinia suberosa</i>	NE	Borneo (Sb,S)		Sighting
	<i>Schradera nervulosa</i>	NE			Secondary Data (Sungai Millian)
	<i>Tarenna cumingiana</i>	NE			Secondary Data (Sungai Millian)

	Family	Species	IUCN Status	Endemism	Status	Data source
		<i>Timonius ovalis</i>	NE	Borneo (Sb,S,B,K)		Secondary Data (Sungai Millian)
		<i>Psychotria</i>				Sighting
		<i>Ophiorrhiza</i>				Sighting
		<i>Urophyllum</i>				Sighting
47	Sapindaceae	<i>Lepisanthes falcata</i> subsp. <i>borneensis</i>	NE			Secondary Data (Camp C)
48	Sapotaceae	<i>Palaquium beccarianum</i>	NE	Borneo (Sb,S,K)		Secondary Data (Camp C)
		<i>Palaquium dasyphyllum</i>	NE			Secondary Data (Camp C)
49	Simaroubaceae	<i>Eurycoma longifolia</i>	NE			Secondary Data (Sungai Millian)
50	Sterculiaceae	<i>Sterculia stipulata</i>	NE	Borneo (Sb,S,B,K)		Secondary Data (Sungai Millian)
		<i>Scaphium longipetiolatum</i>	NE	Borneo (Sb,S,B,K)		Sighting
51	Thymelaeaceae	<i>Aquilaria malaccensis</i>	VU		Prohibited	Sighting
52	Trigoniaceae	<i>Trigonistrum hypoleucum</i>	NE			Secondary Data (Sungai Millian)
53	Urticaceae	<i>Poikilospermum cordifolium</i>	NE			Secondary Data (Sungai Millian)
54	Vitaceae	<i>Cissus adnata</i>	NE			Secondary Data (Camp C)
		<i>Tetrastigma coriaceum</i>	NE		Prohibited	Sighting
55	Zingiberaceae	<i>Globba propinqua</i>	NE	Borneo (Sb,S,K)		Secondary Data (Sungai Millian)
		<i>Plagiostachys</i>				

Appendix 4. Mammals recorded from within FMU.

[The abbreviation of the IUCN status follows the standard IUCN protocol (IUCN 2015), with NE signifying species that have not been evaluated, LC species that are of least concern i.e. no immediate threat of extinction, NT are species that are near threatened. VU, EN and CR indicate species that are vulnerable, endangered or critically endangered, respectively, and indicate an increase likelihood of extinction. Endemism was obtained from the A Field Guide to the Mammals of Borneo (Payne *et al.* 1985), with Sb indicates the species occurs in Sabah, S in Sarawak, B in Brunei and K in Kalimantan. The number in the Schedule column refers to which of the Schedule the animal is listed on under the Sabah Wildlife Enactment (1997)].

FAMILY	VERNACULAR NAME	SPECIES	IUCN Status	Schedule	
Cercopithecidae	Red Leaf monkey	<i>Presbytis rubicunda</i>	LC	2	Borneo (Sb,S, B,K)
	Hose's Langur	<i>Presbytis hosei</i>	VU	2	Borneo (Sb,S, B,K)
	Long-tailed (Crab-eating) Macaque	<i>Macaca fascicularis</i>	LC	2	-
	Pig-tailed Macaque	<i>Macaca nemestrina</i>	VU	2	-
Hylobatidae	Bornean Gibbon	<i>Hylobates muelleri funereus</i>	EN	2	Borneo (Sb,S, B,K)
Pongidae	Orang-utan	<i>Pongo pygmaeus morio</i>	EN	1	Borneo (S & K)
Manidae	Pangolin or Scaly Anteater	<i>Manis javanica</i>	CR	2	-
Sciuridae	Giant Squirrel	<i>Ratufa affinis</i>	NT	2	-
	Tufted Ground Squirrel	<i>Rheithrosciurus macrotis</i>	VU	2	Borneo (Sb,S, B,K)
Hystriidae	Common Porcupine	<i>Hystrix brachyuran</i>	LC	3	-
	Thick-spined Porcupine	<i>Hystrix crassipinis</i>	LC	2	Borneo (Sb,S, B,K)
Ursidae	Sun Bear	<i>Helarctos malayanus</i>	VU	1	-
Mustelidae	Yellow-throated Marten	<i>Martes flagivula</i>	LC	2	-
	Malay Weasel	<i>Mustela nudipes</i>	LC	2	-
Viverridae	Malay Civet	<i>Viverra zangalla</i>	LC	2	-
	Small-toothed Palm Civet	<i>Arctogalidia trivirgata</i>	LC	2	-
	Otter Civet	<i>Cynogale bennettii</i>	EN	2	-
Felidae	Sunda Clouded Leopard	<i>Neofelis diardi</i>	VU	1	-
	Leopard Cat	<i>Felis bengalensis</i>	LC	2	-
Elephantidae	Borneo Pygmy Elephant	<i>Elephas maximus borneensis</i>	EN	2	-
Suidae	Bearded Pig	<i>Sus barbatus</i>	LC	3	-
Tragulidae	Lesser Mouse-deer	<i>Tragulus javanicus</i>	LC	3	-
	Greater Mouse-deer	<i>Tragulus napu</i>	LC	3	-
Cervidae	Red Muntjac	<i>Muntiacus muntjac</i>	LC	3	-
	Bornean Yellow Muntjac	<i>Muntiacus atherodes</i>	LC	3	Borneo (S,S, B,K)
	Sambar Deer (Rusa or Payau)	<i>Cervus unicolor</i>	VU	3	-

Appendix 5. Birds recorded from within FMU 11.

[The abbreviation of the IUCN status follows the standard IUCN protocol (IUCN 2015), with NE signifying species that have not been evaluated, LC species that are of least concern i.e. no immediate threat of extinction, NT are species that are near threatened. VU, EN and CR indicate species that are vulnerable, endangered or critically endangered, respectively, and indicate an increase likelihood of extinction. Endemism was obtained from BirdLife International (2015), with Sb indicates the species occurs in Sabah, S in Sarawak, B in Brunei and K in Kalimantan. The number in the Schedule column refers to which of the Schedule the animal is listed on under the Sabah Wildlife Enactment (1997)].

FAMILY	VERNACULAR NAME	SPECIES	IUCN status	Schedule	Endemism
Anhingidae	Oriental Darter	<i>Anhinga melanogaster</i>	NT	2	-
Accipiteridae	Brahminy Kite	<i>Haliastur indus</i>	LC	2	-
	Crested Serpent-Eagle	<i>Spilornis cheela</i>	LC	2	-
	Lesser Fish-Eagle	<i>Ichthyophaga humilis</i>	NT	2	-
Alcedinidae	Malay Blue-banded Kingfisher	<i>Alcedo peninsulae</i>	NT		-
	Blue-eared Kingfisher	<i>Alcedo meninting</i>	LC		-
	Collared Kingfisher	<i>Halcyon chloris</i>	LC		-
	Stork-billed Kingfisher	<i>Halcyon capensis</i>	LC		-
Bucerotidae	Bushy-crowned Hornbill	<i>Anorrhinus galeritus</i>	LC	2	-
	Helmeted Hornbill	<i>Rhinoplax vigil</i>	NT	2	-
	Rhinoceros Hornbill	<i>Buceros rhinoceros</i>	NT	2	-
	White-crowned Hornbill	<i>Berenicornis comatus</i>	NT	2	-
Campephagidae	Wreathed Hornbill	<i>Rhyticeros undulatus</i>	LC	2	-
	Black-winged Flycatcher-shrike	<i>Hemipus hirundinaceus</i>	LC		-
	Bar-winged Flycatcher-shrike	<i>Hemipus picatus</i>	LC		-
	Pied Triller	<i>Lalage nigra</i>	LC		-
Capitonidae	Blue-eared Barbet	<i>Megalaima australis</i>	LC		-
	Gold-whiskered Barbet	<i>Megalaima chrysopogon</i>	LC		-
	Red-crowned Barbet	<i>Megalaima rafflesii</i>	NT		-
	Red-throated Barbet	<i>Megalaima mystacophanos</i>	NT		-
Caprimulgidae	Yellow-crowned Barbet	<i>Megalaima henrici</i>	NT		-
	Large-tailed Nightjar	<i>Caprimulgus macrurus</i>	LC		-
	Malaysian Eared Nightjar	<i>Eurostopodus temminckii</i>	LC		-
	Common Iora	<i>Aegithina tiphia</i>	LC		-
Chloropseidae	Greater Green Leafbird	<i>Chloropsis sonnerati</i>	LC		-
	Green Iora	<i>Aegithina viridissima</i>	NT		-
	Lesser Green Leafbird	<i>Chloropsis cyanopogon</i>	NT		-
	Storm's Stork	<i>Ciconia stormi</i>	EN	2	-
Columbidae	Common Emerald Dove	<i>Chalcophaps indica</i>	LC	2	-
	Little Green Pigeon	<i>Treron olax</i>	LC		-
Coraciidae	Dollarbird	<i>Eurystomus orientalis</i>	LC		-
Corvidae	Slender-billed Crow	<i>Corvus enca</i>	LC		-

FAMILY	VERNACULAR NAME	SPECIES	IUCN status	Schedule	Endemism
Cuculidae	Banded Bay Cuckoo	<i>Cacomantis sonneratii</i>	LC		-
	Chestnut-breasted Malkoha	<i>Phaenicophaeus curvirostris</i>	LC		-
	Square-tailed Drongo Cuckoo	<i>Surniculus lugubris</i>	LC		-
	Greater Coucal	<i>Centropus sinensis</i>	LC		-
	Indian Cuckoo	<i>Cuculus micropterus</i>	LC		-
	Lesser Coucal	<i>Centropus bengalensis</i>	LC		-
	Plaintive Cuckoo	<i>Cacomantis merulinus</i>	LC		-
	Raffle's Malkoha	<i>Phaenicophaeus chlorophaeus</i>	LC		-
Dicaeidae	Orange-bellied Flowerpecker	<i>Dicaeum trigonostigma</i>	LC		-
Dicruridae	Bronzed Drongo	<i>Dicrurus aeneus</i>	LC		-
	Greater Racket-tailed Drongo	<i>Dicrurus paradiseus</i>	LC		-
Eurylaimidae	Banded Broadbill	<i>Eurylaimus javanicus</i>	LC		-
	Black-and-Red Broadbill	<i>Cymbirhynchus macrorhynchos</i>	LC		-
	Black-and-Yellow Broadbill	<i>Eurylaimus ochromalus</i>	NT		-
Falconidae	White-fronted Falconet	<i>Microhierax latifrons</i>	NT	2	Borneo (Sb,S)
Hemiprocidae	Whiskered Treeswift	<i>Hemiprocne comata</i>	LC		-
Hirundinidae	Pacific Swallow	<i>Hirundo tahitica</i>	LC		-
Meropidae	Blue-throated Bee-eater	<i>Merops viridis</i>	LC		-
	Red-bearded Bee-eater	<i>Nyctyornis amictus</i>	LC		-
Motacillidae	White Wagtail	<i>Motacilla alba</i>	LC		-
	Western Yellow Wagtail	<i>Motacilla flava</i>	LC		-
Muscicapidae	Asian Paradise Flycatcher	<i>Terpsiphone paradisi</i>	LC	2	-
	Black-naped Monarch	<i>Hypothymis azurea</i>	LC		-
	Bornean Blue Flycatcher	<i>Cyornis superbus</i>	LC		Borneo (Sb,S, B,K)
	Malaysian Pied Fantail	<i>Rhipidura javanica</i>	LC		-
	Rufous-winged Philentoma	<i>Philentoma pyrropterum</i>	LC		-
Nectariniidae	Little Spiderhunter	<i>Arachnothera longirostra</i>	LC		-
	Olive-backed Sunbird	<i>Nectarinia jugularis</i>	LC		-
	Plain Sunbird	<i>Anthreptes simplex</i>	LC		-
	Purple-naped Sunbird	<i>Hypogramma hypogrammicum</i>	LC		-
	Scarlet Sunbird	<i>Aethopyga mystacalis</i>	LC		-
Oriolidae	Asian Fairy-Bluebird	<i>Irena puella</i>	LC		-
	Dark-throated Oriole	<i>Oriolus xanthonotus</i>	NT		-
Pellorneidae	Scaly-crowned Babbler	<i>Malacopteron cinereum</i>	LC		-
	Striped Wren-Babbler	<i>Kenopia striata</i>	NT		-
	Temminck's Babbler	<i>Pellorneum pyrogenys</i>	LC		-
	White-chested Babbler	<i>Trichastoma rostratum</i>	NT	2	-

FAMILY	VERNACULAR NAME	SPECIES	IUCN status	Schedule	Endemism
Phasianidae	Great Argus	<i>Argusianus argus</i>	NT	2	-
Picidae	Crimson-winged Woodpecker	<i>Picus puniceus</i>	LC		-
	Rufous Piculet	<i>Sasia abnormis</i>	LC		-
Pittidae	Garnet Pitta	<i>Pitta granatina</i>	NT		-
Ploceidae	Chestnut Munia	<i>Lonchura atricapilla</i>	LC		-
	Dusky Munia	<i>Lonchura fuscans</i>	LC		Borneo (Sb,S, B,K)
	Eurasian Tree Sparrow	<i>Passer montanus</i>	LC		-
Podargidae	Large Frogmouth	<i>Batrachostomus auritus</i>	NT	2	-
Psittacidae	Blue-crowned Hanging-Parrot	<i>Loriculus galgulus</i>	LC	2	-
	Long-tailed Parakeet	<i>Psittacula longicauda</i>	NT	2	-
Pycnonotidae	Cream-vented Bulbul	<i>Pycnonotus simplex</i>	LC		-
	Grey-cheeked Bulbul	<i>Criniger bres</i>	LC		-
	Hairy-backed Bulbul	<i>Tricholestes criniger</i>	LC		-
	Olive-winged Bulbul	<i>Pycnonotus plumosus</i>	LC		-
	Asian Red-eyed Bulbul	<i>Pycnonotus brunneus</i>	LC		-
	Spectacled Bulbul	<i>Pycnonotus erythrophthalmos</i>	LC		-
	Yellow-vented Bulbul	<i>Pycnonotus goiavier</i>	LC		-
Ralidae	White-breasted Waterhen	<i>Amaurornis phoenicurus</i>	LC		-
Strigidae	Brown Wood-Owl	<i>Strix leptogrammica</i>	LC	2	-
	Buffy Fish-Owl	<i>Ketupa ketupu</i>	LC	2	-
Sturnidae	Common Hill Myna	<i>Gracula religiosa</i>	LC	2	-
	Asian Glossy Starling	<i>Aplonis panayensis</i>	LC		-
Sylviidae	Ashy Tailorbird	<i>Orthotomus ruficeps</i>	LC		-
	Dark-necked Tailorbird	<i>Orthotomus atrogularis</i>	LC		-
	Rufous-tailed Tailorbird	<i>Orthotomus sericeus</i>	LC		-
	Yellow-bellied Prinia	<i>Prinia flaviventris</i>	LC		-
Timaliidae	Chestnut-backed Scimitar-Babbler	<i>Pomatorhinus montanus</i>	LC		-
	Chestnut-rumped Babbler	<i>Stachyris maculate</i>	NT		-
	Chestnut-winged Babbler	<i>Stachyris erythroptera</i>	LC		-
	Fluffy-backed Tit-Babbler	<i>Macronous ptilosus</i>	NT		-
	Pin-striped Tit-Babbler	<i>Macronous gularis</i>	LC		-
Trogonidae	Scarlet-rumped Trogon	<i>Harpactes duvaucelii</i>	NT		-
Turdidae	Oriental Magpie Robin	<i>Copsychus saularis</i>	LC	2	-
	Rufous-tailed Shama	<i>Copsychus pyrrropygus</i>	NT		-
	White-rumped Shama	<i>Copsychus malabaricus</i>	LC	2	-

Appendix 6. Reptiles and amphibians recorded from within FMU 11.

[The abbreviation of the IUCN status follows the standard IUCN protocol (IUCN 2015), with NE signifying species that have not been evaluated, LC species that are of least concern i.e. no immediate threat of extinction, NT are species that are near threatened. VU, EN and CR indicate species that are vulnerable, endangered or critically endangered, respectively, and indicate an increase likelihood of extinction. Endemism was obtained from IUCN Red List (2015), with Sb indicates the species occurs in Sabah, S in Sarawak, B in Brunei and K in Kalimantan. The number in the Schedule column refers to which of the Schedule the animal is listed on under the Sabah Wildlife Enactment (1997)].

FAMILY	VERNACULAR NAME	SPECIES	IUCN status	Schedule	Endemism
Reptiles					
Colubridae	Twin-barred Tree Snake	<i>Chrysopelea pelias</i>	LC	-	-
Scincidae	Common Sun Skink	<i>Mabuya multifasciata</i>	NE	-	-
	Lesser Skink	<i>Lygosoma bowringii</i>	NE	-	-
	Striped Tree Skink	<i>Apterygodon vittatum</i>	NE	-	-
Varanidae	Asian Water Monitor Lizard	<i>Varanus salvator</i>	LC	2	-
Amphibia					
Bufonidae	Brown Slender Toad	<i>Ansonia leptopus</i>	NT	-	-
	River Toad	<i>Phrynoidis asper</i>	LC	-	-
	Giant River Toad	<i>Phrynoidis juxtasper</i>	LC	-	-
	Common Sunda Toad	<i>Duttaphrynus melanostictus</i>	LC	-	-
	Brown Tree Toad	<i>Pedostibes hosii</i>	LC	-	-
Megophryidae	Dring's Slender Litter Frog	<i>Leptolalax dringi</i>	NT	-	Borneo (Sb,S,K)
	Bornean Horned Frog	<i>Megophrys nasuta</i>	LC	-	-
Ranidae	Poisonous Rock Frog	<i>Odorrana hosii</i>	LC	-	-
	Kuhl's Creek Frog	<i>Limnonectes kuhlii</i>	LC	-	-
	Giant River Frog	<i>(Limnonectes leporinus</i>	LC	-	Borneo (Sb,S,B,K)
	Cricket Frog	<i>Hylarana nicobariensis</i>	LC	-	-
	Spotted Stream Frog	<i>Hylarana picturata</i>	LC	-	-
	Striped Stream Frog	<i>Hylarana signata</i>	LC	-	-
	Rock Skipper	<i>Staurois latopalmaris</i>	LC	-	Borneo (Sb,S,B,K)
	Black-spotted Rock Frog	<i>Staurois guttatus</i>	NE	-	Borneo (Sb,?S,?B, ?K)
Rhacophoridae	Hose's Bush Frog	<i>Philautus hosii</i>	NT	-	Borneo (Sb,S,K)
	Four-lined Tree Frog	<i>Polypedates leucomystax</i>	LC	-	-
	Dark-eared Tree Frog	<i>Polypedates macrotis</i>	LC	-	-
	File-eared Tree Frog	<i>Polypedates otlophus</i>	LC	-	-
	Short-nosed Tree Frog	<i>Rhacophorus gauni</i>	NT	-	Borneo (Sb,S,K)