Preliminary Biological Assessment Report Belaga HCS Recovery Site

Glenealy Plantations Sdn Bhd (GPSB)

Kapit Division, Sarawak Malaysia

November 2022



By Malaysian Environmental Consultants

Cover Page

Report Date	:	18 th November 2022	
Contact Information	:	Malaysian Environmental Consultants (MEC), No. 82 Jalan Ampang Hilir, 55000 Kuala Lumpur, Malaysia.	
		kisho@mec-consult.org info@mec-consult.org	
Company commission	:	Belaga HCS Recovery Site – Glenealy Plantations Sdn Bhd (GPSB)	
Location	:	Kapit Division, Sarawak, Malaysia.	
Centroid Coordinates	:	114° 1' 42.17" E, and 2° 59' 26.79"N	
Assessment Date	:	21 st – 30 th August 2022	
Total Area	:	1,853 ha (GIS Area)	
Project Land use	:	HCS Recovery Site	
Number of pages	:	124 pages, includes maps, tables, and appendices	



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List of Abbreviations

CITES	Convention on International Trade in Endangered Species of Wild			
	Fauna dan Flora			
Dbh	Diameter at breast height			
FMU	Forest Management Unit			
FTL	Forest Timber Licence			
GIS	Geographic Information Systems			
GPSB	Glenealy Plantations Sdn Bhd			
Ha/ha	Hectares			
HCS	High Carbon Stock			
IUCN	The International Union for Conservation of Nature - Red List of			
	Threatened Species			
КВА	Key Biodiversity Areas			
MEC	Malaysian Environmental Consultants Sdn Bhd			
МРОВ	Malaysian Palm Oil Board			
NDPE	No Deforestation, No Peat, No Exploitation			
WDPA	The World Database on Protected Areas			
WPO 1998 Sarawak	Sarawak Wildlife Protection Ordinance (1998)			
WWF	Worldwide Fund for Nature			

1 Introduction

This document presents the findings of a preliminary biological assessment of GPSB's Belaga HCS Recovery Site. This rapid assessment was undertaken to provide data and information to enable GPSB to formulate a 5 year management plan ensuring the conservation and sustainable management of this site.

Glenealy Plantations Sdn Bhd (GPSB) is part of the Samling group, with its activities focused mainly on the management of oil palm plantations in Malaysia and Indonesia. On the 10th of April 2020, GPSB committed to the oil-palm supply chain request of No Deforestation, No Peat, No Exploitation (NDPE) by publishing their own policy. This commitment applies to all of their oil palm plantation concessions, namely, the Lana Estate, Jelalong Estate, Belaga Estate (Sarawak, Malaysia); Sabah Timora Complex Estate (Sabah, Malaysia); PT. Abdi Borneo Plantation (ABP) and PT. Tunas Borneo Plantation (TBP) (North Kalimantan, Indonesia).

To implement this NPDE commitment, GPSB independently calculated the loss of high carbon stock (HCS) areas throughout their oil palm concessions in January 2021, which resulted in an identified area loss of 1,853 ha. After the calculations, GPSB established an area to serve as their compensation site in order to fulfil their HCS loss obligations. The area to be managed for conservation and rehabilitation, is currently larger than the initial compensation charged, amounting to a total area of 3,736 ha. GPSB is committed to bear the management costs as well as establish a framework to ensure that conservation activities are carried out for the long term.

Through the management and development of this compensation site, GPSB intends to maintain and preserve the natural resources, preserve the ecosystem and ensure there is a carbon stock increase within the Belaga HCS Recovery Site. The company intends to indirectly restore the function of the ecosystem by rehabilitating the areas that were previously affected by human disturbance. There is also the hope that this area could support the efforts to improve relationships between the company and the surrounding communities. As a first step, it is necessary to collect data regarding the biodiversity in the recovery area. Protection and conservation efforts must be supported by some level of baseline data of the area, regarding the species composition of the compensation area, in order for appropriate policies to be developed for the future management of the compensation site.

1.1 Purpose of the Preliminary Biological Assessment

The objectives are to:

- Identify the flora and fauna species composition in the Belaga HCS Recovery Site,
- Identify the flora and fauna that are protected, endemic, rare, and threatened,
- Calculate the above-ground carbon potential, and
- Identify the threats in the area as well as provide recommendations to manage the compensation site.

2 Description of the Belaga HCS Recovery Site

The Belaga Recovery HCS Site is located in the Belaga District, Kapit Division, Sarawak, Malaysia (see Map 2.1 and Map 2.2). The recovery site is approximately 83.3 km northeast from the town of Belaga and 161 km east from the town of Bintulu. The recovery site has an area of approximately 3,736.19 ha, an area calculation using GIS, and is located within a production forest area. The Belaga HCS Recovery Site is located at the coordinates, 114° 1' 42.17" E, and 2° 59' 26.79" N. The surrounding areas consist of heterogeneous land use and has an extensive network of roads cutting through the forest landscape. The recovery site is within the Sekiwa Forest Management Unit (FMU), a legal timber concession formerly known as the Paong FMU with the Forest Timber License (FTL) No. T/0404.



Map 2.1: Location of the Belaga HCS Recovery Site in Sarawak, Malaysia



Map 2.2: Location of Belaga HCS Recovery Site within the Belaga District, Kapit Division, Sarawak

2.1 Physical and Environmental Characteristics

<u>Climate</u>

The Belaga HCS Recovery Site is located within the equatorial region displaying a tropical (Type A) climate which is characterized by high average temperatures and high precipitation values throughout the year. Annual patterns indicate that over the months of April to August, temperatures were recorded to reach an average daily high of 30°C and above (see Figure 2.1). The hottest month of the year is May, with an average low of 24.9°C and a high of 31.2°C. The coldest period lasts from late December to the middle of February, with the average daily highs falling below 30°C. The coldest month of the year is February, with an average low of 23.7°C and a high of 28.8°C¹.



Figure 2.1: Averages of the highest and lowest temperatures in Belaga

The Belaga area has regular periods of rainfall throughout the year (Figure 2.2). On average, the month of December recorded the highest levels of rainfall, with an average of 275 millimeters of rainfall. Whereas the month of September recorde the lowest levels of rainfall, averaging 130 millimeters.



Figure 2.2: Monthly average rainfall levels in Belaga

¹ https://www.weather-atlas.com/en/malaysia/belaga-climate

Watershed

The recovery site is part of the Rajang River watershed, which is located between the Koyan River-Bala River, Batang Belaga River, and the Penyuan River (see Map 2.3). From this information, it can be concluded that the Belaga HCS Recovery Site plays an important role as a water catchment area for some of the rivers in the area. The Batang Belaga River is one of the upstream tributaries of the Rajang River, which is the largest river in Sarawak. There are at least two smaller rivers flowing through the recovery site, namely the Iga River and the Bera'an River. The Nyalang community is dependent on the Bera'an River as their water source.



Map 2.3: Watershed areas in the Belaga HCS Recovery Site and surrounding areas

<u>Soil</u>

Based on the Department of Agriculture Sarawak (1981), the Belaga HCS Recovery Site has a dominant soil type- red-yellow podsol, consisting mostly of the thin red-yellow podsol variant, occurring in steep areas. This variant covers about 94.99% of the total recovery site area. The remaining 5.01% of the area is covered by deep red-yellow podsol soil, occurring on gentle slopes (see Map 2.4). This type of soil is formed during periods of high rainfall and low temperatures. It has a very high content of quartz sand, high levels of acidity, is sensitive to erosion and has a granular texture. These soils can be distinguished from the levels of Fe/Al within, accumulation of humus and oxidation in the subsoil. The soil is acidic due to the accumulation of iron-aluminium-organic bound compounds within.



Map 2.4: The dominant soil types in the Belaga HCS Recovery Site and the surrounding areas

Topography

By using Alos Palsar data modeling with a resolution of 12.5m, the Belaga HCS Recovery Site is relatively hilly with a height range of 210 to 904 meters above sea level (m asl). Map 2.5 shows the elevation model of the Belaga HCS Recovery Site. The highest area is in the Southeastern part of the site, while the lowest is in the North. Map 2.6 displays the slope class model in the recovery site and the surrounding areas. The area shows great level of variation, starting with relatively flat areas (0°– 5°), undulating terrain (5° - 10°), followed by rolling terrain (10° – 15°), moderately steep terrain (15° - 25°) and finally very steep terrain (>25°), forming cliffs (Table 2.1).

Elevation (m	Slope (degrees)					Total	
asl)	0-5	5.01-10	10.01-15	15.01-20	20.01-25	25.01++	(Ha)
200.01-300	77.52	198.00	238.71	222.13	112.11	54.84	903.31
300.01-400	27.50	114.11	202.48	265.61	197.70	172.83	980.24
400.01-500	14.47	73.91	164.68	227.55	175.15	198.23	853.98
500.01-600	14.84	56.72	102.13	133.06	109.11	155.96	571.82
600.01-700	6.67	24.30	49.19	77.73	57.73	67.87	283.48
700.01-800	2.25	9.08	19.00	26.81	22.93	28.13	108.19
800.01-900	2.25	7.05	6.96	7.79	4.17	6.82	35.05
900.01-1000	0.02	0.02	0.04	0.03	0.0005	0.0022	0.11
Total Area	145.52	483.19	783.19	960.72	678.90	684.68	3,736.19

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Map 2.5: Elevation model of the Belaga HCS Recovery Site and the surrounding areas



Map 2.6: Slope model of the Belaga HCS Recovery Site and the surrounding areas

2.2 Biological and Ecological Characteristics

Based on the references to physical land and global conservation databases, specifically the Belaga HCS Recovery Site and the surrounding area produces the following descriptions:

Ecoregion

Based on the Terrestrial Ecoregion of the World published by Worldwide Fund for Nature (WWF), the Belaga HCS Recovery Site was part of Borneo's Lowland Dipterocarp Rain Forests (see Map 2.7). These rainforests optimally grow at an altitude below 500 m above sea level. Lowland dipterocarp rainforests were easily accessible making these areas prone to logging activities, resulting in degradation, eventually leading to a full conversion of land to either oil palm plantations or other types of agriculture. The importance of the lowland rainforest stems from the fact that these areas are probably the most enandgered ecosystem on the planet. The biodiversity consequences of further loss of the lowland dipterocarp rainforest ecosystems would be felt on a global scale.

Above the lowland dipterocarp rainforests, are the hill dipterocarp rainforests which grow between 500 – 1000 m above sea level. Patches of these forests can be found within the Belaga HCS Recovery Site. With the continual loss of most of the lowland dipterocarp rainforests, the hill dipterocarp rainforests may be the next best hope for Borneo's effort in conserving their flora and fauna species. Although these forests generally have a smaller species composition in comparison with lowland dipterocarp rainforests, hill forests still provide refuge to a number of protected and endangered species. The average temperatures in the hill dipterocarp rainforests are generally cooler when compared with the conditions of the lower altitude forests, supporting the idea that these areas may become more populated with species in the future as climate change forces these species to migrate to higher altitudes. In general, the hill dipterocarp rainforests are in better condition than lowland dipterocarp rainforests, as the higher elevations and steeper slopes make these areas less suitable for the planting of oil palms and other forms of development. Compared to the lowland dipterocarp rainforests, hill dipterocarp rainforests contain lower volumes of timber but, with an increasingly high demand for the commodity, these hill forests are still under threat.



Map 2.7: Terrestrial Ecoregion of the World in the Belaga HCS Recovery Site and the surrounding area

Protected areas

According to the World Database of Key Biodiversity Areas (KBA), the Belaga HCS Recovery Site does not overlap, and is not adjacent to any KBA (see Map 2.8). The closest KBA is just adjacent of the Batang Belaga River, namely the Dulit Range, approximately ±7.35 km to the North of the recovery site. The Dulit Range area is a forested landscape with several key species, such as *Cyornis caerulatus, Lophura bulweri, Lophura erythrophthalma, Melanoperdix niger, Nisaetus nanus, Ptilocichla leucogrammica, Pycnonotus zeylanicus, Setornis criniger, Spilornis kinabaluensis,* all of which are considered Vulnerable under the IUCN red list. Aside from this, the Usun Apau plateau area, approximately ±40.32 km to the East of the recovery site, is a forested landscape area which has similar key species like those found throughout the Dulit Range as well as many other threatened species.

In the context of conservation areas, data on protected forest areas and conservation areas from the World Database of Protected Areas (WDPA) show that the Belaga HCS Recovery Site is not within or adjacent to any protected forests (see Map 2.9). The closest conservation area is Batu Laga (Wildlife Sanctuary), about ± 30.40 km South of the Belaga HCS Recovery Site. The other conservation area is the *Duilt Range- KBA (National Park), around ± 25.56 km to the Northeast of the recovery site. About ± 49.55 km to the East of the recovery site is the *Usun Apau- KBA (National Park), while the Binyo-Penyilam National Park lies ± 50.21 km to the West.

*Two sources of information were used to analyse the proximity of conservation areas to the recovery site. The sources being the WDPA and KBA maps. Both show differing extents, and this is why the distance to the recovery site varies.



Map 2.8: Key Biodiversity Areas in the Belaga HCS Recovery Site and the surrounding areas



Map 2.9: WDPA and protected forests (Forest Reserve) in the Belaga HCS Recovery Site and the surrounding areas

Ecosystem model

According to the ecosystem model developed by MEC (unpublished data), the Belaga HCS Recovery Site original ecosystem was once a Lowland Dipterocarp Forest (63.59% of the total area) which covered the majority of the Northern area; and a Hill Dipterocarp Forest (36.41% of total area) which made up the Southern areas (see Map 2.10).



Map 2.10: Ecosystem model of the Belaga HCS Recovery Site and the surrounding areas

2.3 Land Use Trend within the recovery site and the surrounding areas

Land use trends depend on the distribution of the population throughout an area. In the areas surrounding the recovery site, the majority of the population are heavily influenced by traditional agricultural practices, specific to land use activities. be it in the past or the present. The dynamics of the land use began to change when timber companies began to develop the area. The road access built by these companies are still being used by the surrounding local communities. In a rural setting, road access is very important, and this has improved with the presence of oil palm and timber plantations, as well as timber concessions. Due to the development of oil palm plantations in the area, local communities gradually converted their plots of land into oil palm smallholdings.

Photo 2.1 shows the satellite imagery chronosequence of the Belaga HCS Recovery Site from the year **1990** to **2021**. The images shows that there have been changes in the land cover and land use over the last 30 years caused by human disturbances. The area, which was once predominantly lowland dipterocarp & hill dipterocarp forests, has now had its landscape altered. In addition to this, some of the flatter areas, especially those adjacent to the Koyan River, Batang Belaga River and Penyuan River, have been cleared out and are now inhabited by the local communities.

To begin with, records from the **1990's** show that a few of the forested areas both within and outside the Belaga HCS Recovery Site had already been impacted by logging, as seen from the network of logging roads that span throughout the entire region. From the **1990** chronosequence satellite image, it was noted that some of the forests within the recovery site were fragmented by these logging roads. Between the years of **1990** to **1995**, logging activities in the area were temporarily halted as seen from the regrowth of vegetation. During this time, the satellite image from **1995** shows that some of the areas outside of the recovery site which were once either shrubland or "highly disturbed" forests were cleared out and utilized by the local communities.

Over the years, between **1995** and **1999**, logging activities resumed both inside and outside of the recovery site. The majority of these logging activities occurred in the surrounding areas of the recovery site as seen in the **1999** satellite image. From **1999** to **2005**, several of these logged areas outside of the recovery site were converted into "plantation forests", either being planted with rubber, acacia, and/or eucalyptus trees. At this time, large-scale oil palm plantations were developed outside of the recovery site. Within the recovery site itself, the satellite image from **2005** shows that logging activities must have been halted again as the forests showed signs of regrowth.

From the year **2005** to **2010**, logging activities within and just south of the recovery site resumed again as seen in the **2010** satellite image. Between **2010** to **2021**, some of the forest plantations had been converted into oil palm plantations, while some of the older oil palm plantations had already been replanted. From the **2021** satellite image, the majority of the surrounding areas had already lost their original land cover and had undergone some form of development. As seen from the same image, most of the logged areas within the recovery site were showing signs of regrowth.

*The current state of the land use surrounding the Belaga HCS Recovery Site is shown in Map 2.11 below. This map shows the different concessions surrounding the recovery site, as well as the river and road network. Settlements in close proximity with the recovery site are also displayed.



Photo 2.1: Chronosequence of satellite images of the Belaga HCS Recovery Site and the surrounding areas from 1990-2021



Map 2.11: Roads, rivers, settlements, and other companies around the Belaga HCS Recovery Site

3 Methods and Data Analysis

3.1 Timeframe and Team Composition

This field study was conducted on the 21st to the 30th of August 2022. The assessment points are spread out within the Belaga HCS Recovery Site, consisting of several monitoring points in forested areas, as well as riverbanks. Installation and recovery of camera traps was carried out on the first and last days of the assessment period.

The team was divided into 3 sub-teams, namely the botany team, the wildlife team, and the drone mapping team. This entire team of experts was guided by the company (Samling representatives) and individuals from the local communities. The list of assessment teams members can be seen in Table 3.1.

No.	Name	Organisation	Role	Expertise
1	Muhammad Firdaus	MEC	Core team	Ecology and Wildlife
2	Galuh Muhammad Riyadi	MEC	Core team	Wildlife, mapping, camera trapping, Wildlife survey
3	Fitra Alhani	MEC	Core team	Ecology, Botany Expert (taxonomy), Vegetation survey
4	Deka Faizar	Independent Consultant	Field Team - Support	Vegetation Survey and Compassman (GPS)
5	Kresna Casanova	Independent Consultant	Field Team - Support	Vegetation Survey and Compassman (GPS)
6	Oktavianus Limpa	Independent Consultant	Field Team - Support	Vegetation Survey, forest carbon survey
7	Satriyo Dewo Sabuwono Purbowo	Independent Consultant	Field Team - Support	Wildlife survey, birds, mammals, insects
8	Muhammad Fernanda	Independent Consultant	Field Team - Support	Wildlife survey, herpetofauna expert
9	Aedam Alymann Jeyaraj	MEC	Core team	Ecological survey and drone survey
10	Eswaran Subramaniam	MEC	Core team	Ecological survey and drone survey
11	Yusuf bin Madi	MEC	Core team	Drone surveys and wildlife photography expert

Table 3.1: List of Assessment Members

Members from Samling-GPSB, as representatives of the Belaga HCS Recovery Site, namely:

- Mr. Chieng KS. (Senior Sustainability Manager),
- Belden Giman (Sustainability Executive),
- Fernandez Endrah (GIS Executive),
- Frankie Eban (Forest ranger),
- Louise Robert (Forest ranger), and
- employees and the local communities around Belaga Estate (GPSB).

3.2 Methods and Analysis

Ecological and Botanical Assessment (Flora)

A desktop study for assessing the site to support future planning involves compiling all available data including reports, maps, administrative documents, and legal laws related to the land use of the area and combining them into a Geographic Information System (GIS) database. For this assessment, various information and maps were combined and were used for the initial determination of assessment points for the field survey as well as for further analysis. Field surveys were conducted at pre-selected sampling points, or in areas as close to the locations of these points as possible if the actual assessment points are inaccessible due to unforeseen factors in the field. Two practical approaches were taken:

- Making vegetation plots and detailed enumerations (see Table 3.1), as well as
- regular stops along the field transects for off-plot species recording and sampling.



Photo 3.1: Illustration of the vegtation plots used for data collection

The assessment points were then geolocated with a GPS. The following information was recorded at each site visited for ecological descriptions, namely: soil type, elevation, topography, slope, habitat type, successional stage, dominant tree species, and non-tree species. Photos of the area's condition and canopy opening were also taken. All plants were recorded and then identified based on the available identification guidebooks. The current situation and threats to the locations were also recorded. This involved observing and confirming the ecological condition of the land, including the current condition of forested areas, rivers, riparian areas and other environmental attributes.

Wildlife Assessment (Fauna)

Data collection in the field was carried out by the means of rapid field observations aimed at obtaining information regarding the current occurence of wildlife in and around the assement areas. The method used was an exploration method using the same observation path as the botany team.

The presence of any encountered fauna species were recorded based on direct observations, field photos, wildlife calls, traps, traces of the presence of animals (such as scratches, nests, footprints, and feces), and interviews. Wildlife encounter points in the field were then geolocated with a GPS. Observations were made by slowly walking along the transects selected during the survey, where species from common taxa were recorded such as birds, mammals, reptiles, amphibians, fish, and insects (focusing mostly on butterflies and dragonflies).

Installation of Camera Traps

Camera trapping was used as an alternative method to increase the chances of encountering wildlife, rather than solely relying on direct observation during the transect walks (Ancrenaz et al., 2013). It is also more reliable for night observations. The locations of the camera trap installation was determined from the results of the desktop analysis. These areas include forest boundaries, corridors expected to be used by wildlife, forest trails along rivers or lakes/swamps, and areas where wildlife was seen based on local community interviews. The cameras were installed on the first day of the assessment and collected on the last day.

A total of 14 camera traps were installed for 8 days (22 – 29 August 2022) to assess the presence and diversity of wildlife species within the recovery site.

Species conservation status

Identification of the conservation status of recorded flora and fauna species were made based on the species list included in the CITES appendix, the IUCN red list and the nationally protected species list (Wildlife Protection Ordinance (1998) for Sarawak, Malaysia). Aside from this data, species endemicity data and distribution data were retrieved from online references such as the IUCN red list website(<u>https://www.iucnredlist.org/</u>) and from published species identification field books.

4 Findings and Data Analysis

4.1 Condition of the area

The scope of the assessment was the entire Belaga HCS Recovery Site. The visited assessment sites included representative areas of different types of land covers and forested areas with various levels of vegetation succession.

A total of 35 sample points were assessed. All the of the sample points in this study have been described according their current condition, presented in Table 4.1. The distribution of the locations are shown in Map 4.1 below.



Map 4.1: Distribution of ecological points visited at the Belaga HCS Recovery Site

	Table 4.1: Summary of survey	points and descriptions of	of ecological sites at	Belaga HCS Recovery Site
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No	Diate	Coor	rdinates	Description	Type of area and other records	Dict	uroc	
NO.	PIOLS	Х	Y	Description	Type of area and other records	Pictures		
1	P1 /B39	114° 5' 34.429" E	2° 59' 59.701" N	 Logged area (tree stumps). Overgrown with pioneer species and climbers. Multiple disturbance periods and instances of succession. 	 Moderately steep terrain (16°). Sandy Mineral Soil. Regenerating lowland forest (Dipterocarp). Middle succession. Area dominated by Macaranga gigantea, Macaranga bancana Clidemia hirta and Calamus sp1. RTE species; Begonia sp1, Ficus uncinata (WPO98). 	Middle successional vegetation in a regenerating lowland forest (Dipterocarp).	Forest disturbance shown by the presence of tree stumps.	
2	P2 /B40	114° 5' 37.817" E	2° 59' 58.178" N	 Logged area (tree stumps). Logging roads present. Close to a small river. Dominated by pioneer species. 	 Moderately steep terrain (23°). Sandy Mineral Soil. Regenerating lowland forest (Dipterocarp). Middle succession. Area dominated by Macaranga gigantea, Ficus uncinate, Uncaria sp and Calamus sp1. RTE species; Gonystylus consanguineous (VU, Schedule II (Part 2), Appendix II). 	Middle successional vegetation in a regenerating lowland forest (Dipterocarp).	Closed forest canopy.	

No	Plots Coordinates		dinates	Description	Turne of even and other records	Dictures	
INO.	PIOLS	X	Y	Description	Type of area and other records	Pictures	
3	P3 /B41	114° 5' 41.205" E	2° 59' 56.940" N	 Logged area. Large amount of pioneer vegetation. Presence of commercial vegetation left over from local community planting. 	 Moderately steep terrain (23°). Sandy Mineral Soil. Regenerating lowland forest (Dipterocarp). Middle succession. Area dominated by Macaranga bancana, Shorea parvistipulata and Poikilospermum suaveolens. RTE species; Shorea guiso (VU), Gonystylus affinis (VU), Schedule II (Part 2), Koompassia excelsa Schedule II (Part 2). 	Composition of secondary vegetation in a regenerating lowland forest (Dipterocarp).Dense forest canopy.	
4	P4 /B37	114° 4' 45.808" E	3° 0' 27.061" N	 Logged area. Large amount growing and developing pioneer vegetation. Area opens up and becomes steeper towards the East of the assessment point, has a thin canopy cover. Relatively thin leaf litter layer. 	 Moderately steep terrain (23°). Sandy Mineral Soil. Regenerating lowland forest (Dipterocarp). Middle succession. Area dominated by Macaranga bancana, Duabanga moluccana, Clidemia hirta and Blechnum orientale. RTE species; Dipterocarpus cf. glabrigemmatus, Zingiber pachysipon (EN), Begonia stenogyna, Ficus obscura, Koompassia excelsa (Schedule II (Part 2)). 	Middle successional vegetation in a regenerating lowland forest (Dipterocarp).Dense forest canopy.	

Nie	Coordinates		dinates	Description	Turs of ever and other user use	Disturas		
NO.	Plots	X	Y	Description	Type of area and other records	Pictures		
5	P5 /B38	114° 4' 47.733" E	3° 0' 28.901" N	 Logged area. Saplings from tree species of the former land cover are present. According to company workers, logging of this area occurred in 2015. 	 Moderately steep terrain (18°). Sandy Mineral Soil. Regenerating lowland forest (Dipterocarp). Middle-to-late succession. Area dominated by Shorea parvistipulata, Shorea seminis, Dicranopteris linearis and Blechnum orientale. RTE species; Shorea seminis, Koompassia excelsa, Ficus sp1, Ficus uncinata (Schedule II (Part 2)). 	Middle successional vegetation in a regenerating lowland forest (Dipterocarp).Dense forest canopy.		
6	P6 /B13	113° 57' 50.137" E	2° 58' 45.106" N	 Logged area. Logging roads are present. Large amount growing and developing pioneer vegetation. Forest disturbance has resulted in the loss of commercially valuable forest cover and vegetation. 	 Moderately steep terrain (19°). Sandy Mineral Soil. Regenerating hill forest (Dipterocarp). Middle succession. Area dominated by Macaranga gigantea, Macaranga bancana, Mallotus paniculatus, Begonia spp and Zingiber pachysipon. RTE species; Hopea mengarawan (CR), Vatica stapfiana, Meistera oligantha, Zingiber pachysipon (VU), Begonia sp2, Begonia sp4, Ficus obscura, Ficus uncinata, Ficus villosa (Schedule II (Part 2)). 	Middle successional vegetation in a regenerating hill forest (Dipterocarp).Dense forest canopy.		
No	Diata	Соон	rdinates	Description	Type of area and other records	Dicturoc		
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NO.	PIOLS	X	Y	Description	Type of area and other records	Picu	ures	
7	P7 /B10	113° 57' 58.694" E	2° 58' 41.941" N	 Logged area (tree stumps). Logging roads are present. Sound of a chainsaw was heard just North of this area. 	 Moderately steep terrain (25°). Sandy Mineral Soil. Regenerating hill forest (Dipterocarp). Late succession. Area dominated by Macaranga bancana, Shorea flaviflora, Uncaria sp and Dicranopteris linearis. RTE species; Hopea mengarawan (CR), Shorea pauciflora (EN), Shorea flaviflora, Shorea laevis, Meistera oligantha (VU), Robiquetia spathulata (Appendix II, Schedule II (Part 2)). Ficus heteropleura, Ficus uncinata, Ficus sp1 (Schedule II (Part 2)). 	Condition of the regenerating hill forest (Dipterocarp).	Dense forest canopy.	
8	P8 /B11	113° 57' 55.188" E	2° 58' 41.786" N	 Logged area. Logging roads are present. Pioneer vegetation are present. Vegetation from the former land cover are present. 	 Very steep terrain (33°). Sandy Mineral Soil. Regenerating hill forest (Dipterocarp). Middle succession. Area dominated by Macaranga bancana, Hydnocarpus wrayi, Litsea sp2, Etlingera elatior and Blechnum orientale. RTE species; Shorea pauciflora (VU), Ficus obscura, Ficus uncinata, Ficus villosa (Schedule II (Part 2)). 	Middle successional vegetation in a regenerating hill forest (Dipterocarp).	Sandy mineral soil.	

No	Diata	Coor	dinates	Description	Turne of even and other records	Disturos	
NO.	Plots	X	Y	Description	Type of area and other records	Picto	ures
9	P9 /B12	113° 57' 48.579" E	2° 58' 40.300" N	 Logged area (tree stumps). There is a logging road is about 70 meters East from the point. High count of pioneer species and residual vegetation from the Dipterocarpaceae family are present. 	 Moderately steep terrain (24°). Sandy Mineral Soil. Regenerating lowland forest (Dipterocarp). Late succession. Area is dominated by Shorea laevis, Macaranga bancana and Calamus sp. RTE species; Hopea mengarawan, Shorea lepidota (CR), Shorea pauciflora (EN), Monocarpia euneura, Shorea laevis (VU), Koompassia excelsa, Koompassia malaccensis, Ficus sp1, Ficus sp2 (Schedule II (Part 2)). 	Late successional vegetation in a regenerating lowland forest (Dipterocarp).	Dense forest canopy.
10	P10 /B15	113° 57' 54.375" E	2° 58' 36.520" N	 Logged area (tree stumps). Rocky forest floor. Assessment point is close to an area with valleys and small rivers. High count of pioneer species are present. Vegetation from the former land cover are present. Leaf litter layer was thin. 	 Moderately steep terrain (19°). Sandy Mineral Soil. Regenerating hill forest (Dipterocarp). Late succession. Area is dominated by Parinari oblongifolia, Macaranga gigantea, Daemonorops sabut and Calamus sp. RTE species; Shorea flaviflora, Shorea guiso, Shorea laevis, Madhuca sericea, Meistera oligantha (VU), Ficus villosa (Schedule II (Part 2)). 	Late successional vegetation in a regenerating hill forest (Dipterocarp).	Evidence of logging around the assessment area.

No	Diata	Coor	dinates	Description	Turpo of area and other records	Dictures	
NO.	PIOLS	X	Y		Type of area and other records	Pict	ures
11	P11 /B14	113° 57' 51.134" E	2° 58' 37.427" N	 Logged area (tree stumps). There ia a late successional forest ± 20 meters East of the assessment area. The assessment point is dominated by pioneer vegetation with large diameters. 	 Moderately steep terrain (19°). Sandy Mineral Soil. Regenerating hill forest (Dipterocarp). Middle-to-late succession. Area is dominated by Macaranga bancana, Uncaria sp and Calamus sp1. RTE species; Hopea mengarawan (CR), Begonia sp2, Ficus sp1 (Schedule II (Part 2)). 	Regenerating hill forest (Dipterocarp).	Forest disturbance shown by the presence of tree stumps.
12	P12 /B17	113° 59' 47.461" E	2° 59' 48.523" N	 Former community planting area. The point is dominated by pioneer vegetation. Logging roads are present within and surrounding the area. Landscape becomes steeper, resulting in a valley just west of the assessment area. 	 Moderately steep terrain (22°). Sandy Mineral Soil. Regenerating lowland forest (Dipterocarp). Middle succession. Area is dominated by Cananga odorata, Macaranga bancana, Melicope glabra, Blechnum orientale and Etlingera brevilabrum. RTE species; Ficus geocharis, Ficus obscura, Ficus sp1 (Schedule II (Part 2)). 	Dominance of pioneer trees in a regenerating lowland forest (Dipterocarp).	Dense forest canopy.
13	P13 /B18	113° 59' 44.156" E	2° 59' 48.548" N	 Former community planting area that cleared through burning. The point is dominated by pioneer vegetation. The majority of the pioneer vegetation have small diameters, 5 – 10 dbh. 	 Rolling terrain (12°). Sandy Mineral Soil. Shrub area. Early-to-middle succession. Area is dominated by <i>Cananga</i> odorata, Dillenia suffruticosa Nephrolepis biserrata and Blechnum orientale. 	Visual representation of a shrub area.	Open forest canopy.

No	Diata	Coor	dinates	Description	Type of area and other records	Dictures		
NO.	o. Piots	Х	Y	Description	Type of area and other records	Pict	ures	
					 RTE species; Ficus grossularioides, Ficus obscura, Ficus uncinata (Schedule II (Part 2)). 			
14	P14 /B19	113° 59' 34.480" E	2° 59' 50.870" N	 Logged area (tree stumps). Just ± 40 meters south of the assement point, the area has opened up due to landlsides. Relatively steep areas are just east of the point. 	 Very steep terrain (30°) Sandy Mineral Soil. Regenerating lowland forest (Dipterocarp). Middle-to-late succession. Area is dominated by Macaranga pearsonii, Macaranga bancana, Calamus sp1 and Calamus sp2. RTE species; Parashorea lucida (CR), Shorea palembanica (CR, Schedule II (Part 2)), Durio dulcis (VU), Gonystylus brunnescens (ApII, Schedule II (Part 2)), Ficus sp1, Ficus uncinata (Schedule II (Part 2)). 	Regenerating lowland forest (Dipterocarp) dominated by pioneer vegetation.	Sandy mineral soil	
15	P15 /B20	113° 59' 35.617" E	2° 59' 53.199" N	 Logged area (tree stumps). Many climbers reaching from the tree canopy to the forest floor are present. 	 Moderately steep terrain (27°). Sandy Mineral Soil. Regenerating lowland forest (Dipterocarp). Late succession. Area is dominated by Artocarpus sericicarpus, Macaranga pearsonii and Calamus spp. RTE species; Parashorea lucida (CR), Durio dulcis, Zingiber pachysipon (VU), Gonystylus brunnescens (AppII, Schedule II (Part 2)), Begonia sp3, Ficus obscura (Schedule II (Part 2)). 	Late successional vegetation in a regenerating lowland forest (Dipterocarp).	Dense forest canopy.	

Nie	Dista	Coordinates		Description	Two of ever and other records	Diat	
NO.	Plots	X	Y	Description	Type of area and other records	Pict	ures
16	P16 /B16	113° 59' 38.821" E	2° 59' 49.848" N	 Logged area (tree stumps). To the west of the point, ± 70 meters, lies the Baan River, while just ± 30 meters to the north, is an access road that was used to reach the assessment point. 	 Very steep terrain (36°) Sandy Mineral Soil. Regenerating lowland forest (Dipterocarp). Middle-to-late succession. Area is dominated by Hopea bullatifoia, Shorea lepidota, Panandus yvanii and Scindapsus sp. RTE species; Parashorea lucida, Shorea lepidota (CR), Hopea cf. cernua (EN), Dipterocarpus gracilis, Shorea guiso, Durio graveolens, Artocarpus anisophyllus (VU) Coelogyne foerstermannii, Dendrobium compressum (AppII, Schedule II (Part 2)), Ficus villosa (Schedule II (Part 2)). 	Late successional vegetation in a regenerating lowland forest (Dipterocarp).	Condition of the steep slopes.
17	P17 /add 02	113° 59' 26.660" E	2° 58' 42.575" N	 Logged area (tree stumps). The assessment point is located on a ridge, areas just north and south of the area are steep. 	 Very steep terrain (38°) Sandy Mineral Soil. Regenerating lowland forest (Dipterocarp). Middle-to-late succession. Area is dominated by Hopea mengarawan and Calamus sp1. RTE species; Hopea mengarawan (CR), Dipterocarpus gracilis, Shorea cf. symingtonii, Shorea macrobalanos (VU), Gonystylus borneensis (AppII, Schedule II (Part 2)). 	Vegetation of a regenerating lowland forest (Dipterocarp).	Very dense vegetation.

No	Plots	Coordinates		Description	Type of area and other records	Dictures	
NU.	PIOLS	X	Y	Description		Fictures	
18	P18 /add 01	113° 59' 20.306" E	2° 58' 42.485" N	 Logged area. Many climbers reaching from the tree canopy to the forest floor are present. 	 Moderately steep terrain (22°). Sandy Mineral Soil. Regenerating lowland forest (Dipterocarp). Middle succession. Area is dominated by Duabanga moluccana, Alangium ridleyi, Selaginella sp1 and Spatholobus ferrugineus. RTE species; Shorea palembanica (CR, Schedule II (Part 2)), Begonia sp1, Begonia sp4, Ficus obscura, Ficus uncinata (Schedule II (Part 2)). 	Middle successional vegetation on moderately steep terrain. Dense forest canopy.	
19	P19 /add 04	113° 59' 6.104" E	2° 58' 40.350" N	 Logged area (tree stumps). Logging roads are present within and surrounding the area. A tributary is in close proximity with the assessment area. In the east and west directions, the forest has entered the late successional stage In the north and south areas of the assessment point, there are logging roads which have been overgrown with pioneer vegetation. 	 Moderately steep terrain (17). Sandy Mineral Soil. Regenerating lowland forest (Dipterocarp). Middle succession. Area is dominated by Shorea guiso, Callicarpa pentandra, Mcaranga spp and Begonia sp3. RTE species; Parashorea lucida (CR), Shorea guiso, Durio graveolens, Artocarpus tamaran, Zingiber pachysipon (VU), Claderia viridiflora (Appll, Schedule II (Part 2)), Begonia sp3, Koompassia excelsa, Ficus obscura, Ficus uncinata, Ficus villosa, Agrostophyllum sp (Schedule II (Part 2)). 	Vegetation of a regenerating lowland forest (Dipterocarp).Dense forest canopy.	

No	la Diata		dinates	Description	Type of area and other records		
NO.	PIOTS	Х	Y	Description	Type of area and other records	Pict	ures
20	P20 /add 03	113° 59' 12.707" E	2° 58' 38.683" N	 Logged area (tree stumps). Vegetation species from the former land cover are present in the assessment area. 	 Very steep terrain (31°) Sandy Mineral Soil. Regenerating lowland forest (Dipterocarp). Late succession. Area is dominated by Shorea fallax, Horsfieldia sp1, Calamus sp2 and Korthalsia sp1. RTE species; Vatica nitens (EN), Gonystylus borneensis (AppII, Schedule II (Part 2)), Begonia sp1, Ficus obscura, Ficus uncinata, Ficus villosa (Schedule II (Part 2)). 	Dense forest canopy.	Condition of late successional vegetation (Dipterocarp) on steep slopes.
21	P21 /add 10	114° 5' 1.648" E	2° 59' 54.960" N	 Logged area (tree stumps). The assessment point is in close proximity with a river. Many pioneer species are present in the area. 	 Very steep terrain (32°) Sandy Mineral Soil. Regenerating hill forest (Dipterocarp). Middle succession. Area is dominated Pterospermum javanicum, Ficus sp3, Uncaria spp and Daemonorops sabut. RTE species; Durio acutifolius (VU), Ficus obscura, Ficus uncinata, Ficus sp3 (Schedule II (Part 2)). 	Vegetation of a regenerating hill forest (Dipterocarp).	Dense forest canopy.

No	Dista	Coordinates		Description	Turne of area and other records	Dictures		
NO.	Plots	X	Y	Description	Type of area and other records	Pict	ures	
22	P22 /add 09	114° 4' 54.862" E	2° 59' 50.996" N	 Logged area. Logging roads are present within and surrounding the area, covered in pioneer vegetation. The assessment point is dominated by pioneer vegetation. 	 Moderately steep terrain (14°). Sandy Mineral Soil. Middle succession. Regenerating hill forest (Dipterocarp). Area is dominated by Macaranga gigantea, Macaranga pearsonii, Clidemia hirta and Blechnum orientale. RTE species; Shorea pauciflora (EN), Shorea macrobalanos, Shorea foxworthyi (VU), Begonia sp2, Begonia sp4, Ficus grossularioides, Ficus obscura, Ficus uncinata (Schedule II (Part 2)). 	Vegetation of a regenerating hill forest (Dipterocarp).	Former logging road covered by pioneer vegetation.	
23	P23 /add 11	114° 4' 47.939" E	2° 59' 43.800" N	 Logged area (tree stumps). Towards the north of this area, there is a logging road. The assessment point is dominated by pioneer vegetation. Climbers stretching from the tree canopy to the forest floor are present. 	 Moderately steep terrain (24°). Sandy Mineral Soil. Regenerating hill forest (Dipterocarp). Middle succession. Area is dominated by Macaranga gigantea, Macaranga pearsonii, Clidemia hirta and Uncaria sp1. RTE species; Ficus uncinata (Schedule II (Part 2)). 	Middle successional vegetation in a regenerating hill forest (Dipterocarp).	Dense forest canopy.	

No	Diata	Coor	dinates	Description	Type of area and other records	Dictures		
NO.	Plots	X	Y	Description	Type of area and other records	Pict	ures	
24	P24/ P24	114° 4' 40.454" E	2° 59' 54.957" N	 Logged area (tree stumps). The assessment point is in close proximity to a logging road. The area is dominated by pioneer species. Rubber trees are present within the assessment area. 	 Moderately steep terrain (19°). Sandy Mineral Soil. Regenerating hill forest (Dipterocarp). Middle succession. Area is dominated by Macaranga pearsonii, Macaranga gigantea, Etlingera brevilabrum and Blechnum orientale. RTE species; Dipterocarpus crinitus, Shorea foxworthyi (VU), Ficus uncinata (Schedule II (Part 2)). 	Middle successional vegetation interspersed with rubber trees.	Dense forest canopy.	
25	P25/ P25	114° 3' 44.960" E	3° 0' 18.104" N	 Logged area (tree stumps). There is a former logging road ± 40 meters south of the assessment point. 	 Very steep terrain (36°) Sandy Mineral Soil. Regenerating lowland forest (Dipterocarp). Middle-to-late succession. Area is dominated by Shorea ovalis, Aporosa lucida and Calamus sp1. RTE species; Dipterocarpus cf. stellatus, Dipterocarpus gracilis, Shorea macrobalanos, Vatica pauciflora, Aglaia angustifolia (VU), Coelogyne foerstermannii, Dendrobium compressum, Robiquetia spathulata, Gonystylus brunnescens (AppII, (Schedule II (Part 2)). Begonia sp1 (Schedule II (Part 2)). 	Late successional vegetation in a regenerating lowland forest (Dipterocarp).	Dense forest canopy.	

No	Diata	Coor	dinates	Description	Turne of even and other records	Distor	
NO.	PIOLS	X	Y	Description	Type of area and other records	Pictur	les
26	P26/ B32	114° 3' 52.207" E	3° 0' 18.475" N	 Logged area (tree stumps). The assessment point is in close proximity to a logging road. Leftover felled trees from the logging period are still present in the area. The assessment point is a forest patch surrounded by a mid- successional forest, with large pioneer trees. 	 Moderately steep terrain (20°). Sandy Mineral Soil. Regenerating lowland forest (Dipterocarp). Late succession. Area is dominated by Macaranga gigantea, Shorea cf. Symingtonii and Calamus sp2. RTE species; Hopea mengarawan, Shorea palembanica (CR), Vatica nitens (EN), Dipterocarpus gracilis, Shorea cf. symingtonii, Shorea laevis, Vatica nitens, Vatica stapfiana, Artocarpus anisophyllus (VU), Gonystylus borneensis (AppII), Shorea pinanga, Ficus grossularioides, Ficus obscura, Ficus sp2, Ficus villosa (Schedule II (Part 2)). 	• Condition of late successional vegetation in a regenerating lowland forest (Dipterocarp).	Dense forest canopy.
27	P27/ B33	114° 3' 48.967" E	3° 0' 18.749" N	 Logged area (tree stumps). The assessment point is in close proximity to a logging road. The area is dominated by pioneer species. 	 Moderately steep terrain (17[°]). Sandy Mineral Soil. Regenerating lowland forest (Dipterocarp). Middle succession. Area is dominated by Macaranga gigantea, Pleiocarpidia capituligera, Clidemia hirta and Blechnum orientale. RTE species; Gonystylus brunnescens (AppII), Ficus uncinata, Phalaenopsis sp (Schedule II (Part 2)). 	Regenerating lowland forest (Dipterocarp) dominated by pioneer species.	Dense forest canopy.

Nie	Dista	Coordinates		Description		Diat	
NO.	Plots	X	Y	Description	Type of area and other records	Pict	ures
28	P28/ P28	114° 3' 50.515" E	3° 0' 26.331" N	 Logged area (tree stumps). The assessment point is in close proximity to a logging road. The area is dominated by tree- level pioneer vegetation. Late successional vegetation is present within the assessment area. 	 Moderately steep terrain (25°). Sandy Mineral Soil. Regenerating lowland forest (Dipterocarp). Middle-to-late succession. Area is dominated by Macaranga pearsonii, Shorea ovalis, Calamus spp and Dicranopteris linearis. RTE species; Dipterocarpus cornutus, Parashorea lucida, Shorea johorensis (CR), Vatica nitens (EN), Shorea macrobalanos, Meistera oligantha (VU), Koompassia excelsa, Ficus uncinata (Schedule II (Part 2)). 	Vegetation in regenerating lowland forest (Dipterocarp).	Dense forest canopy.
29	P29/ P29	114° 3' 52.851" E	3° 0' 35.499" N	 Logged area (tree stumps). The assessment point is in close proximity to a logging road. Abandoned oil palms are present in the assessment area. This area is close to the Iga River. The river had a measurement of ± 6 meters, with flowing clear water and a rocky riverbed. Pioneer vegetation dominates the assessment area. 	 Moderately steep terrain (25°). Sandy Mineral Soil. Regenerating lowland forest (Dipterocarp). Middle succession. Area is dominated by Macaranga pearsonii, Shorea ovalis, Nephrolepis biserrata and Blechnum orientale. RTE species; Vatica nitens (EN), Dipterocarpus crinitus (VU), Shorea seminis, Ficus uncinata (Schedule II (Part 2)). 	Condition of the regenerating lowland forest (Dipterocarp).	The Iga River.

		Coordinates		Description	Turns of avera and other records	Dicturoc		
NO.	Plots	X	Y	Description	Type of area and other records	Pict	ures	
30	P30 /P30	114° 4' 6.946" E	3° 0' 30.200" N	 Former community planting area that hasn't been cleared since. The assessment point is dominated by pioneer vegetation. Towards the West, ± 40 meters, lies the Iga River. 	 Very steep terrain (39°) Sandy Mineral Soil. Regenerating lowland forest (Dipterocarp). Middle succession. Area is dominated <i>Pellacalyx axillaris,</i> <i>Ixora sp2, Ficus sp2, Clidemia hirta</i> and <i>Blechnum orientale.</i> RTE species; Dillenia borneensis (VU), <i>Ficus uncinata, Ficus sp2</i> (Schedule II (Part 2)). 	Steep conditions of the area.	Condition of the regenerating lowland forest (Dipterocarp).	
31	P31 /B02	114° 3' 7.744" E	3° 0' 18.900'' N	 Logged area (tree stumps). The assessment point is dominated by late sucessional vegetation. The forest floor is considerably rocky. 	 Very steep terrain (34°) Sandy Mineral Soil. Regenerating hill forest (Dipterocarp). Late succession. Area is dominated by <i>Litsea sp3</i>, Nephelium reticulatum, Calamus sp2 and Uncaria sp. RTE species; Dipterocarpus cornutus (CR), Vatica nitens (EN), Dryobalanops aromatica, Artocarpus tamaran (VU), Shorea macrophylla (Schedule II (Part 2)). 	Condition of the regenerating hill forest (Dipterocarp).	Dense forest canopy.	

No	Dista	Coordinates		Description		Distures			
NO.	Plots	Х	Y	Description	Type of area and other records	Pict	ures		
32	P32 /B01	114° 3' 14.605" E	3° 0' 21.899" N	 Logged area (tree stumps). The assessment point is in close proximity to logging roads. Towards the north of the point, the area is comprised of mostly middle successional vegetation. Late sucessional vegetation is present in the area. 	 Moderately steep terrain (24°). Sandy Mineral Soil. Regenerating hill forest (Dipterocarp). Late succession. Area is dominated by Macaranga pearsonii, Shorea cf. subcylindrica and Daemonorops sabut. RTE species; Hopea mengarawan (CR), Vatica nitens (EN), Shorea laevis, Shorea cf. subcylindrica (VU), Gonystylus borneensis (AppII, (Schedule II (Part 2)), Koompassia excelsa, Ficus villosa (Schedule II (Part 2)). 	Condition of the regenerating hill forest (Dipterocarp).	Dense forest canopy.		
33	P33 /B03	114° 3' 18.601" E	3° 0' 28.609" N	 Logged area (tree stumps). The assessment point is in close proximity to logging roads. The logging road have now been overgrown with pioneer vegetation. 	 Moderately steep terrain (25°). Sandy Mineral Soil. Regenerating hill forest (Dipterocarp). Late succession. Area is dominated by <i>Castanopsis</i> acuminatissima, Adinandra dumosa and <i>Calamus sp2</i>. RTE species; Parashorea lucida (CR), Dipterocarpus cf. glabrigemmatus (EN), Dryobalanops aromatica, Shorea cf. symingtonii, Shorea laevis, Artocarpus anisophyllus (VU). 	Late successional vegetation in a regenerating hill forest (Dipterocarp).	Dense forest canopy.		

No	Dista	Coor	dinates	Description	Two of ever and other records	Dictures		
NO.	Plots	X	Y	Description	Type of area and other records	Pict	ures	
34	P34 /B04	114° 3' 13.982" E	3° 0' 36.515" N	 Logged area. Logs of trees that were felled during the logging period are still present in the area. The forest floor is littered with rocks. The assessment point is dominated by pioneer vegetation and climbers. 	 Very steep terrain (26°) Sandy Mineral Soil. Regenerating hill forest (Dipterocarp). Middle succession Area is dominated Macaranga pearsonii, Vitex pinnata, Calamus spp and Schismatoglottis sp. RTE species; Parashorea lucida (CR), Shorea pauciflora (EN), Shorea cf. subcylindrica (VU), Cleisostoma subulatum (AppII, (Schedule II (Part 2))), Ficus obscura (Schedule II (Part 2)). 	Regenerating hill forest (Dipterocarp) undergoing middle succession.	Dense forest canopy.	
35	P35 /B05	114° 3' 12.114" E	3° 0' 43.538" N	 Logged area (tree stumps). The assessment point is in close proximity to logging roads. The area is close to a water runoff. Several rows of abandoned oil palm trees were found in this area, as it was observed that the palm trees had not be tended to and they were covered by other forest vegetation. The assessment point is dominated by pioneer vegetation and climbers. 	 Moderately steep terrain (23°). Sandy Mineral Soil. Regenerating lowland forest (Dipterocarp). Middle succession Area is dominated by <i>Croton</i> argyratus, Uncaria spp and Piper sp1. Species RTE; Begonia sp1, Ficus geocharis, Ficus obscura (Schedule II (Part 2)). 	Vegetation seen during middle succession.	Uncontrolled growth of abandoned oil palms.	

Note (Table 4.1): Vegetation species ending with the epiththets sp1, sp2, sp3 or spp are yet to be identified by the botany experts in MEC's ecology team. About 148 of the 470 recorded floral species in the Belaga HCS Recovery Site have not been given a species classification but have been identified down to their genus.

4.2 Ecology and Botanical Resources (Flora)

4.2.1 Forest and Vegetation Types (Habitats)

Overall, a major part of the Belaga HCS Recovery Site is covered with regenerating lowland forests and regenerating hill forests that have undergone forest disturbances such as, logging, forest/land fires, and/or conversions of forests to plantations and agricultural plots. To fully grasp the situation of the forest conditions in the recovery site, one must understand that the growth and development of vegetation is greatly influenced by the condition of the area in which it grows in. The maximum level of growth and development of vegetation can only occur if certain conditions and factors are met. Such factors that can affect the growth and development of vegetation are the climate, the natural environment in which the vegetation grows in, wind factors, atmospheric gases, topography of the area the edaphic aspects, and absence of disturbance. Throughout the Belaga HCS Recovery Site, there are only 5 classes of forest/ vegetation types found within, such as:

a) Shrub area (< 350 masl).

In general, this kind of vegetation occurs in areas where there has been a high level of disturbance. For the area within the recovery site, it is suspected that fire was used to clear the area for either the development of a small plantation or an agricultural plot. This idea is supported by the findings of remnant charred tree stumps found throughout this area. Only one sample plot was made within this type land cover during the assessment. The area had a topography of rolling terrain with a slope value of 12°. The soil texture is sandy. It should be noted that the impact of the former forest disturbances and the condition of the soil will affect the structure and composition of vegetation within the area. Pioneer vegetation is dominant throughout the area, with the poles averaging at heights below 8 meters. Some examples of pioneer trees and shrubs that dominate, or are commonly found within the area are the species Cananga odorata, Dillenia suffruticosa, Commersonia bartramia, Ficus grossularioides, Ficus obscura, Melastoma malabathricum. Lower stature vegetation such as ferns, herbs and climbers, examples being, Molineria capitulata, Lygodium longifolium, Blechnum orientale and several other species were also recorded throughout the assessment site. The dominant vegetation shows that the area is still undergoing early succession, in which the vegetation is still regenerating throughout the area. These plants are usually very much tolerant of high levels of sunlight, exposure and thrive in hot and dry conditions.



The disturbed condition of the vegetation in plot P13/B18.



b) Highly Disturbed Lowland Forest (< 350 masl).

Lowland forests are defined as forested areas that develop at an altitude range of 0-350 meters above sea level. These forests are located on mineral soils and the forest floors are rarely ever flooded. Thirteen sample plots were established in the Belaga HCS Recovery Site for this forest stratification. The stages of succession throughout these sample plots ranged from middle to late. For the most part, these sampling plots showed obvious signs of disturbance such as logging, land clearing for smallholdings, and poaching. The topographical conditions varied throughout the sampling points, ranging from flat to moderately steep slopes to very steep slopes. During the assessment, it was observed that these areas are not currently undergoing any sort of active logging and the vegetation in these areas are undergoing regeneration. Some of the areas that were previously disturbed are populated with a variety of pioneer vegetation such as, Macaranga gigantea, Macaranga bancana, Macaranga pearsonii, Ficus uncinata, Callicarpa pentandra, Duabanga mollucana, Pellacalyx axillaris and Melicope glabra. In addition to these, climax species such as Shorea ovalis, Shorea guiso, Shorea parvistipulata, Shorea palebanica, Shorea pauciflora, Shorea seminis, Shorea amplexicaulis, Parashorea lucida, Parinari oblongifolia, Alangium ridleyi, Pentace laxiflora, Sterculia macrophylla and Xanthophyllum obscurum can also be found throughout some of these sampling points. It should be noted that most of these species are from the family Dipterocarpaceae. Low stature vegetation such as ferns, herbs, and climbers namely, Nephrolepis biserrata, Blechnum orientale, Dicranopteris linearis, Etlingera brevilabrum, Calamus spp., Uncaria spp and several other species were present throughout the sampling points. Judging by the structure and composition of the vegetation found in this forest type, previous disturbances have greatly affected the number of individual species and the growth rates of these species, which in turn has had a major impact on the species diversity of the area. In relation to this issue, the lack of a viable number of mature trees will greatly affect the availability of seed sources for forest regeneration.



The condition of the highly disturbed lowland forest undergoing the transition from middle-tolate succession, found in plot P14/B19.



Highly disturbed lowland forest undergoing middle succession, found in plot P18/add01.

c) Moderately Disturbed Lowland Forest (< 350 masl).

Seven sampling plots were established in this type of forest stratification. The topographical conditions showed variation, ranging from flat areas to moderately steep slopes to very steep slopes. These areas, as a whole, have been affected by disturbance activities such as logging, as shown by the discovery of large diameter tree stumps within and outside the sampling plots. In addition to this, there are still traces of logging roads in close proximity to the sample plots. Based

on the team's observations, the remaining vegetation within these sample areas is still regenerating and can be classified as late sucessional vegetation. Trees during this stage can reach heights of over 25 to 30 meters, depending on the species composition, giving the area a likeness to an undisturbed primary forest. Shade tolerant species, such as trees from the genera, Shorea, Dipterocarpus, Hopea and Koompassia, have established themselves in these areas ane are likely to grow to heights over 30 to 40 meters. Other species belonging to the families, Burseraceae, Anacardiaceae and Sapotaceae have the potential to establish themselves in these areas, growing between 25 to 35 meters. Regarding the dominant species in these sampling plots, trees such as Hopea bullatifoia, Shorea lepidota, Hopea mengarawan, Shorea fallax, Shorea ovalis, Artocarpus sericicarpus, Macaranga pearsonii and Macaranga gigantea were found to be present, recording the presence of both pioneer and climax species. For lower stature vegetation, ferns, herbs, and climbers, such as, Dicranopteris linearis, Panandus yvanii, Sicndapsus sp., Calamus spp., Korthalsia spp and other species can be found throughout these sampling plots. Judging from the species composition, the disturbances that occurred during the logging periods did not affect these sampling plots as badly as the forests with "high disturbance" classifications. The level of succession in these areas suggest that there have not been any recent occurrences of disturbance.



showing late succession, found in plot P16/B16.

P25/P25.

Highly Disturbed Hill Forest (350-750 masl). d)

This forest stratification is usually found between the ranges of 350 to 750 masl. Similar to the lowland forests, these forests develop on mineral soils and the forest floor is never flooded. During the assessment, eight sample plots were established within this forest stratification. The topographical conditions range from moderately steep slopes to very steep slopes. The area has been affected by disturbance, specifically, logging, as shown by the density of logging roads found within and surrounding these sampling plots. During the assessment, the condition of the vegetation in these areas suggest that there has not been any recent occurrence of disturbance and these areas are currently undergoing middle or late succession. Since the canopy is relatively open, herbaceous plants such as ferns, forest gingers and forest tubers occur in this forest stratification. Throughout the sampling plots, the most dominant species are Macaranga gigantea, Macaranga bancana, Macaranga pearsonii, Pterospermum javanicum, Vitex pinnata, Mallotus paniculatus and several species of Ficus spp. These species listed are pioneer trees that have grown in these areas due to their ability to adapt to disturbed environments. Beneath the canopies of these tree species, the forest floor is dominated by low stature vegetation comprising of Blechnum orientale, Etlingera elatior, Zingiber pachysipon, Etlingera brevilabrum, Clidemia hirta, Daemonorops sabut, Schismatoglottis sp., Uncaria spp., Calamus spp and several other species.



e) Moderately Disturbed Hill Forest (350 - 750 masl).

The hill forests of the recovery site are also important ecosystems, as these forested areas have very high species diversity, in comparison with other forms of land cover in the Belaga HCS Recovery Site. These hill forests, within the sampling plots, are a remnant of the currently disappearing dipterocarp forests that used to span throughout the whole of Borneo. However, these habitats are now being threatened by deforestation and land clearing, due to the decreasing availability of intact lowland forests for timber and land conversion. Within the recovery site, six sample plots were established in this forest stratification. The topographical conditions range from moderately steep slopes to very steep slopes. The species diversity of these areas are relatively high due to its steepness and minimum logging impact. The dominating species recorded were Hopea mengarawan, Dryobalanops lanceolata, Shorea macroptera, Shorea laevis, Parinari oblongifolia, Nephelium reticulatum, Litsea spp., and several pioneer species, whose diameters ranged from medium to large trunks, such as, Macaranga bancana, Macaranga gigantea, and Adinandra Dumosa. For lower stature vegetation, the forest floor is dominated by Daemonorops cobut, Dicranopteris linearis, Spatholobus ferrugineus, Calamus spp., Uncaria spp. and several other species. These species can either be classified as climbers, ferns, and herbs. These habitats have the potential to regenerate and serve as refugia in the future. This being the case, the importance of maintaining the existing forest, as well as restoring the degraded patches cannot be underestimated.



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4.2.2 Floral Species Composition

As a result of the assessment in the Belaga HCS Recovery Site, 470 floral species from 92 families were recorded. The vegetation that is most commonly found and dominates the site belong to the family, Dipterocarpaceae, making up about 11% of the total species found. This family was followed up by the families Euphorbioaceae and Rubiaceae, each making up 5% of the total species list. Annonaceae, Moraceae and Phyllanthaceae each came up to about 4%. Behind this, Malvaceae, Lauraceae, Myristicaceae and Zingiberaceae each make up 3% of the total list. Based on data analysis, it can be evaluated that the number of species and the level of family dominance suggests that the composition of vegetation within the recovery site is high and diverse.

Ecologically, the Dipterocarpaceae family has a very important role in the formation of these forests, and the species of this family are commonly used to characterize the condition of of these areas. In addition to this, genera belonging to this family, such as *Shorea* and *Dipterocarpus*, have species that display relatively large diameters and, the crowns of these trees can form the uppermost canopy. These species can very easily dominate the forest landscape and this is why these forested areas are known as "Dipterocarp forests". Under the uppermost canopy, shade-tolerant tree families, such as the members from the families Euphorbiaceae, Rubiaceae, Annonaceae, Phyllanthaceae, Malvaceae and several other families can be found throughout the middle canopy layer. Factors such as the altitude, the various successional stages (early, middle, late) and forest disturbances, have contributed to the composition of the floral species diversity in the recovery site.

After analysing the total number of recorded species, it was evaluated that there are many species which hold a conservation status, are protected, or are considered rare and endemic. In the Belaga HCS Recovery Site, about 178 species from 47 families have an IUCN red list classification. From this a total of 37 species from 9 families were tagged as RTE (Rare, Threatened, Endangered) species. To begin with are the species that are tagged with the "CR" (Critically Endangered) status, namely the species *Dipterocarpus cornutus, Hopea mengarawan, Parashorea lucida, Shorea johorensis, Shorea lepidota* and *Shorea palebanica*. Next comes the species tagged with the "EN" (Endangered) status, namely *Dipterocarpus cf. glabrigemmatus, Hopea cf. cernua, Shorea cf. gratissima, Shorea pauciflora* and *Vatica nitens*. About 26 species were tagged with as "VU" (Vulnerable), some examples being the species *Dillenia borneensis, Dipterocarpus crinitus, Durio acutifolius, Gonystylus consanguineous* and *Zingiber pachysipon*. For the species that are listed under CITES Appendix II (species that may become endangered if trade continues without regulation), many are from the families, Orchidaceae and Thymeleaceae, some examples being *Gonystylus borneensis, Gonystylus consanguineous, Cleisostoma subulatum* and *Robiquetia spathulata*. Table 4.2 below summarises the conservation statuses of the plant species identified in the Belaga HCS recovery site.

No	Conservatior	Species	
1		Critically Enandgered - CR	6
2		Enandgered - EN	5
3		Vulnerable - VU	25
4	IUCN Red List (Global)	Near Threatened - NT	18
5		Least Concern - LC	117
6		Data Deficient - DD	4
7		Conservation Dependent - CD	2
8	Wildlife Protection Ordinance 1998	Schedule II (Part 2)	31
	(Sarawak)		
9	CITES	Appendix II	9
10	Endemic	Borneo	41

Table 4.2: Numbers of floral species based on conservation status found in the assessment site.

*Overlap in status occurs for the species listed in the table above, so a total of RTE species should not be evaluated by totalling the number of species.

With regard to the table above, there are also a number of species in the list that fall under the *Wildlife Protection Ordinance 1998 (Sarawak)*. As many as 31 species from 7 families are listed above as having a protected status, in accordance with this law. These species include *Shorea macrophylla*, *Koompassia malaccensis, Ficus obscura, Gonystylus affinis* and *Claderia viridiflora* and many others. In addition to this, there also 41 endemic species from 18 families that were recorded from the area. The endemicity of a species tells us about the specific biogeography of the areas the species occur in, as well the origin and history of the land and forests. There are many biological resources that are considered rare, threatened, and endemic to the island of Borneo and there are also many impacts on these habitats, resulting in scarcity and even the extinction of these species. Therefore, it is necessary to carry out the protection and rehabilitation of such areas to not only replace what has been taken, but to also protect these RTE and protected species from extinction.

4.2.3 Characteristics and Analysis of Above-ground Carbon

In addition to looking into the floral species composition, biomass and carbon stock values of the various forest stratifications, were evaluated from the data collected. The results of the assessment were analysed in accordance these classification, being shrub, young regenerating forests, low-density forests, medium-densitys, and high-density forests. The descriptions of the carbon stock and biomass values of the different stratas are as follows:

<u>Shrub</u>

For this assessment, only 1 of these plots was classified under the shrub strata. A shrub area is commonly classified as an area that has a plant community dominated by shrubs, grasses, ferns, and herbaceous plants. For this area, the most dominant trees had a height of <8 meters, leaving the canopy to be open. The carbon stock value of this sampling plot was 27.76 tons/ha, which lies within the carbon stratification range, between 15 tons/ha – 35 tons/ha. The results of the data analysis also reveal that the biomass value are 59.07 tons/ha (Table 4.3). Apart from the density of vegetation in the area, climatic factors such as temperature and the rate of rainfall affect the rate of increase in biomass within the area. This stratum is dominated by sunlight-tolerant plants such as grasses, ferns, climbers, shrubs, and pioneer vegetation. Judging by the condition of the sample plot, this stratum is still in the early succession stage and if no disturbance occurs, the area will eventually reach the middle succession stage, resulting in a more stable, humid, and shaded condition.

		Density (stem/ha)			Basal area (m²/ha)			Biomass (t/ha)			Carbon
No	Plot	Dbh> 15 cm	Dbh 5 - 14.9cm	Total	Dbh> 15 cm	Dbh 5 - 14.9cm	Total	Dbh> 15 cm	Dbh 5 - 14.9cm	Total	(t/ha)
1	P13	0	2,000	2,000	0.00	10.39	10.39	0.00	59.07	59.07	27.76

Table 4.3: Biomass and carbon stock values for the trees found in shrub sampling plots

Young Regenerating Forest

Young regenerating forests are forested areas that have previously undergone heavy disturbances and are one step higher along the early successional stage in comparison with shrub areas. Within the Belaga HCS Recovery Site, there are 8 sample plots of this forest stratum. The biomass values of these plots ranged from 86.46 tons/ha to 158.35 tons/ha, averaging at a value of 120.69 tons/ha (Table 4.4). An estimation of the forest biomass is useful in assessing the condition of the forest, as well as determining the forest productivity. Regarding the carbon stock values, the values range from 40.63 tons/ha to a value of 74.43 tons/ha, averaging at 56.72 tons/ha. This number falls in the range of values used in determining the classification of a young regenerating forest, this being from 35 tons/ha to 75 tons/ha. The results calculated are in accordance with the field findings, of which the vegetation in these areas are still undergoing middle succession, where the areas are still dominated by pioneer vegetation. Beneath the higher stature vegetation, the forest floor consists of shrubs, shade-tolerant herbs, ferns, forest gingers and tubers.

		Density (stem/ha)		Basa	Basal area (m²/ha)			Biomass (t/ha)			
No	Plot	Dbh> 15 cm	Dbh 5 - 14.9cm	Total	Dbh> 15 cm	Dbh 5 - 14.9.cm	Total	Dbh> 15 cm	Dbh 5 - 14.9cm	Total	(t/ha)
1	P34	220	800	1,020	6.92	5.53	12.45	53.83	32.63	86.46	40.63
2	P35	140	400	540	9.03	2.49	11.52	84.40	14.48	98.88	46.47
3	P30	200	1,100	1,300	6.68	8.36	15.04	51.99	51.02	103.01	48.41
4	P18	140	900	1,040	8.58	5.97	14.55	75.94	34.92	110.86	52.11
5	P23	260	1,200	1,460	10.74	4.81	15.56	90.66	25.49	116.15	54.59
6	P5	220	1,000	1,220	8.77	9.84	18.61	71.54	62.06	133.61	62.79
7	Р3	200	1,000	1,200	13.13	6.48	19.61	119.33	38.85	158.18	74.35
8	P8	220	400	620	15.83	2.19	18.02	145.43	12.92	158.35	74.43

Low-Density Forest

Forested areas that have been disturbed but are in the process of undergoing middle sucession, are classified under the low-density forest stratum. In comparison with the young regenerating forests, the composition of vegetation present begins to vary, in regard to the pioneer and climax species ratios. Only 6 sample plots were given the low-density forest density stratification. The method of which one determines if a forested area is classified as a low-density forest is if the carbon stock values fall between the range of 75 tons/ha and 90 tons/ha. For the sampling plots, the carbon stock values ranged between 78.08 tons/ha to 89.19 tons/ha (Table 4.5), averaging at a value of 83.64 tons/ha. From the results of the analysis, the total biomass values ranged from 166.12 tons/ha to 189.76 tons/ha, averaging at a value of 177.0 tons/ha. These values are dependent on the levels of disturbance, as high occurrences of impact can greatly the biomass and carbon stock of these forest stratifications.

	Plot	Density (stem/ha)			Basa	Basal area (m²/ha)			Biomass (t/ha)		
No		Dbh> 15 cm	Dbh 5 - 14.9cm	Total	Dbh> 15 cm	Dbh 5 - 14.9.cm	Total	Dbh> 15 cm	Dbh 5 - 14.9cm	Total	(t/ha)
1	P11	440	300	740	18.63	2.17	20.80	153.35	12.77	166.12	78.08
2	P2	380	500	880	17.47	3.40	20.86	150.37	20.13	170.50	80.13
3	P4	300	1,000	1,300	17.11	4.95	22.06	148.74	27.49	176.23	82.83
4	P24	360	500	860	18.01	3.98	21.99	152.95	24.18	177.13	83.25
5	P27	300	600	900	18.20	3.29	21.48	163.20	19.14	182.33	85.70
6	P22	580	1,400	1,980	14.98	12.40	27.38	111.56	78.19	189.76	89.19

Table 4.5: Biomass and carbon stock values for the trees found in low-density forests sampling plots

Medium-Density Forest

Medium-density forests are regenerating forested areas that are undergoing middle-to-late succession. For a forested area to receive this stratification, the carbon values would have to lie between 90 tons/ha to 150 tons/ha. In the Belaga HCS Recovery Site, 11 of the sample plots received this stratification. The carbon stock values ranged between 92.90 tons/ha to 148.41 tons/ha, averaging at a value of 118.00 tons/ha. In addition to this, the results of the data analysis display that the total values of each plot's biomass ranged between 197.65 tons/ha to 315.76 tons/ha, averaging at a value of 251.07 tons/ha (Table 4.6). These high values of biomass can be explained by the

continous growth of trees, as the majority of these tree species are still within their growth phase and have not matured yet. One must understand that carbon stock values are greatly influenced by biomass values, as any increase in the levels of biomass will result in an increase in the carbon stock values. The composition of vegetation within these areas were observed to be a mix of pioneer and climax species. If there are no further occurrences of disturbance, these areas will be able to enter the late stage of succession and the climax vegetation will dominate the forest landascape.

		Density (stem/ha)		Basa	ıl area (m²,	/ha)	Biomass (t/ha)			Carbon	
No	Plot	Dbh> 15 cm	Dbh 5 - 14.9cm	Total	Dbh> 15 cm	Dbh 5 - 14.9.cm	Total	Dbh> 15 cm	Dbh 5 - 14.9cm	Total	(t/ha)
1	P19	160	1100	1260	15.64	5.90	21.53	162.37	35.28	197.65	92.90
2	P29	460	400	860	22.50	2.22	24.72	190.45	12.70	203.15	95.48
3	P1	440	1900	2340	16.43	12.28	28.72	132.11	73.96	206.07	96.85
4	P12	480	800	1280	22.03	5.72	27.75	186.19	34.50	220.69	103.72
5	P21	340	200	540	23.28	1.58	24.86	214.68	9.98	224.66	105.59
6	P14	580	1600	2180	22.38	11.19	33.57	182.67	68.24	250.91	117.93
7	P15	380	1400	1780	23.72	7.55	31.26	214.70	43.12	257.83	121.18
8	P20	320	900	1220	25.49	5.89	31.37	243.05	35.10	278.15	130.73
9	P28	460	1000	1460	28.00	6.24	34.24	256.30	35.90	292.19	137.33
10	P31	400	200	600	31.30	1.31	32.61	306.80	7.86	314.66	147.89
11	P17	540	1800	2340	29.93	9.24	39.17	263.47	52.30	315.76	148.41

Table 4.6: Biomass and carbon stock values for the trees found in medium-density forests sampling plots

High-Density Forest

For this stratification, a forest would have to have a carbon stock value higher than 150 tons/ha. Even though a large part of the Belaga HCS Recovery Site has experienced disturbances, there are still a few patches that have begun to reach the final stage of succession, of which they resemble the conditions one would record in a primary forest. Within the recovery site, 9 sample plots were given this stratification during the assessment period. The total biomass values ranged from 332.42 tons/ha to 649.32 tons/ha, averaging at a value of 408.43 tons/ha (Table 4.7). Even with all the former disturbances, the remnants are still able to produce relatively high biomass values. This could be related to the large diameters that the trees in these areas have, as well as how dense the crown covers are. Furthermore, the carbon values from the plots ranged from 151.54 tons/ha to 305.18 tons/ha, averaging at 191.96 tons/ha, meeting the conditions required to be given this forest stratification. These types of forests are generally found in moderately steep areas, with a diverse range of species diversity, stemming from all the pioneer and climax vegetation that have grown after the disturbance periods.

		Density (stem/ha)			Basal area (m²/ha)			Biomass (t/ha)			Carbon
Νο	Plot	Dbh> 15 cm	Dbh 5 - 14.9.cm	Total	Dbh> 15 cm	Dbh 5 - 14.9.cm	Total	Dbh> 15 cm	Dbh 5 - 14.9.cm	Total	(t/ha)
1	P25	480	900	1.380	31.94	4.22	36.15	299.19	23.22	322.42	151.54
2	P32	560	1.500	2.060	32.09	8.56	40.65	285.80	49.71	335.51	157.69
3	P10	220	1,300	1,520	27.67	7.87	35.54	306.24	46.26	352.50	165.67
4	P16	420	1,600	2,020	32.25	10.08	42.33	306.10	59.71	365.81	171.93

Table 4.7: Biomass and carbon stock values for the trees found in high-density forests sampling plots

		Density (stem/ha)			Basal area (m²/ha)			Biomass (t/ha)			Carbon
No	Plot	Dbh> 15 cm	Dbh 5 - 14.9.cm	Total	Dbh> 15 cm	Dbh 5 - 14.9.cm	Total	Dbh> 15 cm	Dbh 5 - 14.9.cm	Total	(t/ha)
5	P26	320	1,500	1,820	30.93	10.18	41.11	308.46	61.17	369.63	173.73
6	P6	200	900	1,100	29.14	6.36	35.50	370.31	38.40	408.72	192.10
7	P33	800	1,700	2,500	40.20	10.04	50.24	354.71	60.03	414.74	194.93
8	Р9	580	1,700	2,280	40.52	10.06	50.58	399.32	57.93	457.25	214.91
9	P7	560	1,100	1,660	58.64	5.29	63.94	619.29	30.03	649.32	305.18

4.3 Wildlife (Fauna)

4.3.1 Species Composition

Based on the data analysis of the field findings, a total of 220 species from 80 families were identified and recorded (see Table 4.8). For the vertebrates, 106 species of birds, 27 species of mammals, 15 species of reptiles, 7 species of amphibians and 10 species of fish were recorded throughout the assessment. For the invertebrates, 36 species of butterflies, 19 species of dragonflies and a number of insect species from other families were identified. Based on the findings, 7 of these species are endemic to the island of Borneo. A list of wildlife species can be found in Appendix 1 (Table 9.3). A collection of wildlife photos can be seen in Appendix 2.

No.	Wildlife Classes	Families	Species								
	Vertebrates										
1	Birds	37	106								
2	Mammals	17	27								
3	Amphibians	4	7								
4	Reptiles	6	15								
5	Fishes	4	10								
	Invertebra	ates									
6	Dragonflies	6	19								
7	Butterflies	6	36								
	Total	80	220								

Table 4.8: Number of wildlife findings based on animal classes

From the total wildlife findings, 4 species of birds, 9 species of mammals and 3 species of reptiles were recorded with the camera traps that were installed for 8 days, scattered throughout the Belaga HCS Recovery Site. Map 4.1 shows the distribution of animal encounter points and camera trap locations.

The following is a brief description of the wildlife findings for each class that was identified during the assessment:

1) Birds

The easiest class of wildlife to be recorded and identified are birds. Birds play a multitude of important roles in the environment, be it from their roles in the food web, as seed dispersers, pollinators, and a number of ecological roles. During the assessment, 106 species from 37 families were identified, with 2 of these species being endemic. The most common families of birds that were encountered were Pycnonotidae and Timaliidae. From the camera traps, 4 species of birds were identified, some examples being the rare Great Argus (*Argusianus argus*) and the Crested Fireback (*Lophura ignita*).

In some of the forested areas adjacent to local community smallholdings, a number of common species were identified, from the families Columbidae (Doves), Pycnonotidae (Bulbuls) and Timaliidae (Babblers). For the areas that were relatively more difficult to reach, such as the disturbed hill forests, there was a higher diversity of bird species as well as the inclusion of rarer species. Some examples of these rarer birds belonged to the families Bucerotidae (Hornbills),

Trogonidae (Trogons), Phasianidae (Pheasants), Muscicapidae (Flycatchers) and a number of other families.



Photo 4.1: Great Argus (Argusianus argus)



Photo 4.2: Crested Fireback (Lophura ignita)

There are 7 species of birds of prey, all of them being raptors, identified during the assessment from the family, Accipitridae, one of which was a migrant, namely the Oriental Honey-Buzzard (*Pernis ptilorhynchus*). Birds of prey play a number of major roles in an ecosystem, namely being good examples of biological control, pest predators and bringing balance to the food web. One of the factors that contributes to the presence of birds of prey in an area, would be the presence of hilly and high-altitude areas, which serve as the ideal habitats for these birds to nest and breed. Birds of prey are extremely sensitive to changes in their environment, making them relatively good indicators of the health of an ecosystem. In addition to this, many birds of prey play a role as umbrella and key species for the environments they reside in.

In the field, as many as 8 species of birds from the family Nectariniidae were recorded. These birds are major flower pollinators due to their nature of being nectar consumers, allowing one to find them in areas with flower and fruit producing vegetation. A few of the species that were most commonly seen from this family were the Brown-throated sunbird (*Anthreptes malacensis*) and the Little Spiderhunter (*Arachnothera longirostra*). The roles of these birds as pollinators (ornithophily) should not be underestimated due to how important the process of pollination is in maintaining the continual survival of many species.

Hornbills, belonging to the family Bucerotidae, were recorded throughout the Belaga HCS Recovery Site. As many as 6 of the 8 Bornean species were recorded in the site, so maintaining the area is rather important considering their protected status and declining populations. Hornbills in general, are very important species in maintaining the relationships in the food web. Their ability to spread seeds vastly over a vast landscape is also important as these are some of the only bird species capable of spreading *Ficus* seeds.

2) Mammals

Mammals were the most difficult animals to record during the assessment, due to the rarity and nocturnal behavior of many of these species. Mammals play many important roles in the food web, filling up ecological niches such as being carnivores, herbivores, frugivores and even as pollinators and seed spreaders of flowering and fruit trees. In the Belaga HCS Recovery Site, 27 species from 17 families were identified, with 4 of them being endemic to the island of Borneo. Out of all the mammalian families, Sciuridae (Squirrels) and Cercopithecoidea (Old-World

Monkeys) were the most commonly recorded throughout the sampling points. Nine of these recorded species were identified through the installation of the camera traps, some examples being Sambar deer (*Rusa unicolor*), Southern pig-tailed macaques (Macaca nemestrina) and the Malayan porcupine (*Hystrix brachyura*).

Throughout the assessment, the most common wildlife footprints, were those of the Bearded Pig (*Sus barbatus*). There were other footprints, like those of Leopard cats (*Prionailurus bengalensis*), Sambar deer (*Rusa unicolor*) and traces of Sunda pangolins (*Manis javanica*). In addition to this, Sun Bear (*Helarctos malayanus*) scratch marks were found on trees throughout some of the sampling points. In some of the more vegetatively denser areas, species from the families Sciuridae and Tupaiidae were recorded, some examples of species being the Pale Giant Squirrel (*Ratufa affinis*), Lesser Treeshrew (*Tupaia minor*), Prevost's Squirrel (*Callosciurus prevostii*) and the Least Pygmy Squirrel (*Exilisciurus exilis*).

Three species of primates were identified throughout the assessment, these being Southern pigtailed macaques (*Macaca nemestrina*), Long-tailed macaques (*Macaca fascicularis*) and Northern Gray Gibbons (*Hylobates funereus*), the latter being endemic to the island of Borneo. The macaques are generally common species found along the edges of forest and adjacent to plantations, with some even showing up on the camera traps. These primates are very sensitive to forest disturbances, especially changes to the forest cover, due their semi-arboreal nature.

In regard to nocturnal mammals, a few bat species were identified, representing the families Pteropodidae and Rhinolophidae. Some examples of species were the Spotted-winged Fruit Bat (*Balionycteris maculata*), Lucas's Short-nosed Fruit Bat (*Penthetor lucasi*) and the Trefoil Horseshoe Bat (*Rhinolophus trifoliatus*). Bats have an important role in the food web, taking up roles of pollinators, seed dispersers and even pest control, for the species that are insectivores.



Photo 4.3: Prevost's Squirrel (*Callosciurus prevostii*)



Photo 4.4: Trefoil Horseshoe Bat (*Rhinolophus trifoliatus*)

Based on interviews with some of the Belaga staff, another important mammal species may still inhabit the assessment area. Bornean orangutans (*Pongo pygmaeus*) were spotted throughout the Belaga Recovery Site about one to two years ago. The orangutans were seen travelling as a pair, mother and child, between small forest enclaves in the Belaga oil palm estate to the current assessment area. Orangutans are known to be a very important umbrella and key species on the island of Borneo. The term umbrella is used because if orangutans are protected, then hundreds of fauna and flora species are also protected in the process, due to the extensive range orangutans use. They are also known as key species; due to the role they play in the maintenance of the health

of the ecosystems they inhabit. Orangutans are some of the larger frugivores on the island, making them important seed-dispersers due to their ability to consume larger seeds and travel great distances.

3) Reptiles and Amphibians

Reptiles are very important animals due their ecological roles of being able to control insect and rodent populations, as well as filling the niche of being prey species for larger predators. Likewise, amphibians play role of being used as environmental quality indicators, due to their sensitivity to changes in the environment as a result of not being able to internally regulate their body temperatures.

As many as 15 species of reptiles from 6 families were recorded during the assessment, 1 of these species being endemic to the island. The species that dominated the majority of the visited sampling points were the Rough Mabuya (*Eutropis rudis*) and the Common Mabuya (*Eutropis multifasciata*), which are usually found hiding amongst the thick leaf litter of the forest floor. On the branches and the trunks of trees, 4 species of gliding lizards were recorded. In addition to this several other species were identified, such as the Asian Leaf Turtle (*Cyclemys dentata*), the Mangrove Cat Snake (*Boiga dendrophila*), the White-spotted Cat Snake (*Boiga drapiezii*) and the Great Anglehead Lizard (*Gonocephalus grandis*). From the camera traps, the Common Water Monitor (*Varanus salvator*) was also identified and added to the species list. Reptiles are generalist and opportunistic in which they can occupy many different types of habitats, as long as there is a viable food source.



Photo 4.5: Asian Leaf Turtle (Cyclemys dentata)



Photo 4.6: Hose's Frog (Odorrana hosii)

As for the amphibians, 7 species of frogs from 4 families were identified during the assessment. The majority of these species were found at night, in small rocky rivers and inundated areas. Some examples of species would be the Giant River Toad (*Phrynoidis juxtasper*), Hose's Frog (*Odorrana hosii*) and the Giant River Frog (*Limnonectes leporinus*). Location wise, only the large rivers towards the downstream section of the recovery site were visited. Due to time constraints and limited access, the upstream rivers were not sampled for this assessment. All in all, these amphibians are highly dependent on the availability of water as their breeding grounds, as well as their dependence on microhabitats, in which these amphibians form their own territories within and alongside bodies of water.

4) Fishes

Fishes are the most diverse groups of vertebrates. Within the Belaga HCS Recovery Site, their habitats were generally located in nearby rivers such as the Iga River and the Bera'an River. This class of animals can be found throughout almost all major rivers, stagnant bodies of water, small rivers and even in upstream hilly areas.

During the assessment, 10 species of fish from 4 families were recorded. The characteristics of the species that live upstream vary from the species that live downstream. In the upper and middle forested areas, fast swimmers, and rock-suckers such as *Rasbora sp, Barbodes sellifer, Tor tambra, Tor tambroides* and *Channa lucius* dominate the rapids and faster flowing streams.



Photo 4.7: Javan mahseer (Tor tambra)



Photo 4.8: Saddle Barb (Barbodes sellifer)

It is suspected that many of the fish species in the Belaga HCS Recovery Site rely on riverside vegetation, due to the shade these plants can provide. In addition to this, some of these species can be used as bioindicators in determining the condition of the rivers and forest, due to these species only being able to live in relatively good forest conditions.

5) Butterflies and Dragonflies

Butterflies are very important to forest ecosystems, due to their roles as pollinators, indicators of climate change, dung decomposers and prey in the ecosystmem food web. At the recovery site, 36 species of butterflies from 6 families were identified. The majority of these species were found in open and shrubby areas, however, there were also a few species that required the shade of trees in forested areas, such as *Moduza procris*, *Euthalia monina*, *Paralaxita telesia*, *Tanaecia iapis* and *Charaxes Bernardus*. There were even records of the well-recognized and protected species Rajah Brooke's birdwing (*Trogonoptera brookiana*).



Photo 4.9: Rajah Brooke's birdwing (*Trogonoptera brookiana*)



Photo 4.10: Clear-winged Forest glory (Vestalis gracilis)

For the dragonflies, about 19 species from 6 families were recorded. Dragonflies also play a number of roles in the habitats they inhabit, such as in controlling the insect population and being excellent indicators of water quality. Dragonflies can be found throughout a number of habitats, such as open waters, wetlands, flowing rivers with low light intensity and even densely forested areas. Among the dragonflies identified, species such as *Vestalis amoena* and *Euphaea tricolor* require forest habitats with fast flowing rivers with clear water. Dragonflies that spend the majority of their lives as nymphs, require calm and clean water as a place of refuge. This is why dragonflies have been known to disappear from certain areas, due to their reluctance to stay in places where the forests have been damaged and the water has been polluted.

4.3.2 Feeding Guilds and Movement Patterns

The food sources in a habitat can be a good indicator of the types of wildlife one may be able to find. In the search for food sources, animals may choose to feed on the food that provides the highest amount of energy intake. From data analysis of the types of wildlife recorded during the assessment, it was noted that Belaga HCS Recovery Site was dominated by pure insectivorous animals (38.25%), followed by the nectarivores (16.59%) and frugivore-insectivores (13.82%); with smallest groups being the graminivore-insectivores (0.92%), pure herbivores (0.46%), aquatic carnivores (0.46%) and piscivore-insectivores (0.46%). Detailed percentages of the species feeding guilds can be seen in Graph 4.1 below.



Graph 4.1: Percentages of wildlife by feeding guilds.

Based on the graph above, there are 11 types of feeding guilds associated with the wildlife recorded in the Belaga HCS Recovery Site. This shows the variety of species and how all of these animals contribute to the food web. The dominance of insectivores, nectarivores and frugivores suggests that their food sources are the most plentiful within the recovery site. This is supported by the composition of species recorded for the assessment, an example being frugivores such as the members of the families Bucerotidae (Hornbills) and Columbidae (Doves) being major seed-dispersers in forested areas. Pure carnivores in the recovery site are rare, supporting the idea of how predators are usually greatly outnumbered by their food sources, some examples being Crested Serpent Eagle (*Spilornis cheela*),Wallace's hawk-eagle (*Nisaetus nanus*), Oriental Honey-Buzzard (Pernis ptilorhynchus), Crested Goshawk (Accipiter trivirgatus), Asian small-clawed otter (Aonyx cinereus), Malayan Civet (Viverra tangalunga), Leopard Cat (Prionailurus bengalensis), and all of the snake species recorded in this assessment. Nectarivores are also plentiful throughout the Belaga HCS Recovery Site, due to presence of many flowering plants, providing a display of the mutualistic relationship between both fauna and flora and how both groups rely on one another for continual survival.

It should be noted that changes in the land cover and function can greatly influence the food sources, breeding grounds and territory of the wildlife found within. Wildlife that have lost their habitat, begin to roam through plantations or residential areas, resulting in conflict between both humans and

animals, due to the struggle for space and resources. These incidents usually result in the death of these animals, brought upon by hunting or forced captures. Natural forest corridors must be established, maintained and monitored, in order to facilitate the movement of wildlife both to and from their natural habitat to ensure the safety and sustainability of the area.

Based on their mobility, some animals may migrate, be it because of changing seasons, or perhaps they may be chasing available food sources and searching for suitable breeding areas. Table 4.9 includes the number of species recorded that are known to migrate.

No.	Movement Patterns	Definition	No. of species	Jenis Species
1	Endemic	Species endemic to Borneo	7 species (2 Birds, 4 Mammals, 1 Reptile)	Birds: Caloramphus fuliginosus, Pycnonotus pseudosimplex, Mammals: Pongo pygmaeus, Hylobates funereus, Exilisciurus exilis, Arctogalidia stigmatica,
				Reptile: Draco cornutus
2	Migrants	Species that are considered migratory visitors. Usually travelling to Borneo (Malaysia) during the northern or southern winter seasons.	7 species (7 Birds)	Birds: Muscicapa dauurica, Muscicapa sibirica, Muscicapa griseisticta, Amaurornis phoenicurus, Eurystomus orientalis, Pernis ptilorhynchus, Hirundo rustica

Table 4.9: Recorded species that are either endemic or migrants

As it can be seen in the table above, the usual class of animals that are seen migrating are the birds. This number can easily fluctuate depending on the time and the conditions of the area in which the species observation takes place. There are migrating species in the recovery site due to the changes in climate, the suitability of the recovery site as a breeding habitat and food availability. Aside from these factors, rainy seasons also influence the movement of animals. During the rainy season, water will fill in some of the lowest areas and basins, creating ideal habitats for frogs, fishes, and other aquatic animals. These areas will also attract bird species such as Kingfishers (Alcedinidae) and other species of aquatic birds. Aside from this, the flowering season is another reason why animals may migrate to an area, purely for the nectarivores that will aid in pollination, such as butterflies, bats, and honeybirds. During the fruiting season, primates, wild boars, porcupines, bats and other frugivores will travel to areas where trees begin fruits, resulting in large seed dispersal events. Another example may be that Sambar deers will travel to areas dominated by shrubs, ferns, and newly sprouting vegetation as these serve as the ideal habitat for these species. The presence of endangered, endemic, protected, and migratory species within the Belaga HCS Recovery Site is a good sign that the forested areas provide suitable habitats for these species. The area has a high conservation value with its ability to maintain the populations, richness, and the diversity of species.

4.3.3 Conservation Status

The status of protection and conservation of species in the Belaga HCS Recovery Site is based on a number of protection criteria, focusing on:

- CITES trade categories (Appendix 1 and 2),
- Globally endangered population categories of the IUCN red list (*Vulnerable, Enandgered and Critically Enandgered*); and
- Sarawak laws and regulations based on the Wildlife Protection Ordinance (WPO) 1998.

Based on the analysis of collected field data, there is a significant number of protected faunal species. Table 4.10 shows the number of wildlife recorded with a protection and conservation status based on the categories above.

Conservation status	Birds	Mammals	Reptiles	Amphibianans	Fishes	Butterflies	Dragonflies	Total
IUCN - Critically Enandgered (CR)	1	2	-	-	-	-	-	3
IUCN - Enandgered (EN)	1	3	-	-	-	-	-	4
IUCN - Vulnerable (VU)	6	4	-	-	-	-	-	10
CITES - Appendix I	1	5	-	-	-	-	-	6
CITES - Appendix II	15	5	1	-	-	1	-	22
WPO 1998 - Totally Protected Animals (TP)	9	2	-	-	-	-	-	11
WPO 1998 - Protected Animals (P)	20	16	1	-	-	1	-	38

Table 4.10: Number of wildlife species under protection and have a conservation status

Any of these species can be placed in more than one category of protection. These apply for the species being protected by both national and international organizations.

Table 4.11 shows several animal species that can used as references when justifying for habitat protection in the Belaga HCS Recovery Site. All of the species below have relatively high conservation statuses. A complete list of wild animal species and their protected statuses can be seen in Appendix 1 (Table 9.3). The top sequence of the list can be recommended as a list of conservation priority animals for the Belaga HCS Recovery Site.

Table 4.11: Number of species found within the Belaga Recovery Site that are included in the protected criteria according to the IUCN Red list, CITES, and local regulations (Sarawak WPO 1998)

No	Class Family		Scientific Name	IUCN F	App.	WPO	Endemic	
				Category	Criteria	CITES	1998	
1	Mammal	Hominidae	Pongo pygmaeus	CR	A4abcd	I	TP	В
2	Bird	Bucerotidae	Rhinoplax vigil	CR	A3cd	I	TP	-
3	Mammal	Manidae	Manis javanica	CR	A2d+3d+4d	I	Р	-
4	Mammal	Cercopithecidae	Macaca fascicularis	EN	A3cd	П	Р	-
5	Mammal	Cercopithecidae	Macaca nemestrina	EN	A2cde+3cde	П	Р	-
6	Mammal	Hylobatidae	Hylobates funereus	EN	A4cd	-	Р	В
7	Bird	Chloropseidae	Chloropsis sonnerati	EN	A2cd+3cd+4cd	-	-	-
8	Mammal	Mustelidae	Aonyx cinereus	VU	A2cde+3cde	I	Р	-
9	Mammal	Ursidae	Helarctos malayanus	VU	A2cd+3cd+4cd	I	Р	-
10	Bird	Bucerotidae	Anthracoceros	VU	A2cd+3cd+4cd	Ш	TP	-
		D	malayanus				TO	
11	Bird	Bucerotidae	Buceros rhinoceros	VU	A3cd+4cd	II	IP	-
12	Bird	Bucerotidae	Rhyticeros undulatus	VU	A3cd+4cd	II	TP	-
13	Bird	Phasianidae	Argusianus argus	VU	A2acd+3cd+4acd	П	TP	-
14	Bird	Accipitridae	Nisaetus nanus	VU	A2c+3c+4c	П	Р	-
15	Bird	Phasianidae	Lophura ignita	VU	A2cd+3cd+4cd	-	TP	-
16	Mammal	Cervidae	Rusa unicolor	VU	A2cd+3cd+4cd	-	-	-
17	Mammal	Suidae	Sus barbatus	VU	A2cd	-	-	-

4.4 Current Status of Biodiversity Management

The location of the Belaga HCS Recovery Site was initially under the Forest Timber License No. T/3282, which was given to Samling Plywood (Lawas) Sdn. Bhd. and was merged into the Sekiwan Forest Management Unit (FMU), formerly known as Paong FMU. The site also had a legal license under the Forest Timber License No. T/0404, which was eventually given to Samling Plywood (Lawas) Sdn. Bhd., which took the place of Samling Plywood (Lawas) Sdn. Bhd. Due to GPSB's NDPE commitiment, its high carbon stock loss compensation is undertaken in the form of reserving a site in this concession. A legally recognised memorandum of understanding was eventually drawn up between the two parties, Glenealy Plantation Sdn. Bhd. (GPSB) and Samling Plywood (Lawas) Sdn. Bhd. This was so that GPSB could directly manage the area for conservation. The license was issued on the 15th of May 1993, expiring on the 14th of May 2033. GPSB and Samling Plywood (Lawas) Sdn. Bhd. have worked together to legally secure this site for a longer period of time, in the hopes of fulfilling the objectives of this restoration plan, whereby if Samling Plywood (Lawas) Sdn. Bhd. were to obtain a natural forest certification through the Sarawak Forest Department, the license period would be increased to 60 years, not only for the Belaga Recovery site, but for the entire Sekiwan FMU.

While attempting to manage the Belaga HCS Recovery Site, the conservation opportunities provided by this site must be fully analysed and understood before formulating management actions. In addition to this, factors such as legal considerations, financial support, and the enhancement of conservation values, long-term commitment, social support must be taken into consideration. Overall, management must take on a scientific approach and should be adaptive in nature.

In managing this area, GPSB has appointed an expert who is responsible for the management of the area. **Error! Reference source not found.** shows the organization chart of staff in charge of the area. M any of the staff are part of the GPSB management and 2 rangers have been appointed, assisted by a mapping and survey expert.



Figure 4.1: Organization chart of the Belaga Recovery Site
Non-formal communication has been undertaken with the surrounding local communities. A public consultation with the stakeholders around the Belaga HCS Recovery Site was also held on the 31st of March 2022 (Photo 4.13).

In addition to this, management activities have already been implemented. The following images, Photo 4.1 to Photo 4.2 show just several examples of signboards and boundary markers set down by the recovery site team in an effort to inform stakeholders of the recovery site area.



Photo 4.1: Signboards placed on the boundary of the Belaga HCS Recovery Site



Photo 4.2: The current progress of the recovery site's boundary marking



Photo 4.3: Public Consultation held with the stakeholders surrounding the recovery site

5 Threats

MEC's analysis of logging history of the recovery site, from the years 1990 to 2018, shows how extensively the land cover has changed over time. The majority of the forest land cover was affected by the disturbance, except for some of the steeper areas (see Map 5.1).

The eastern side of the recovery site had the lowest amount impact from the logging, due to the extreme steepness of the area, while the central and western parts were seen to have areas highly impacted by disturbances. The pockets of forest within the highly impacted areas appear to be fragmented, caused by the high density of logging roads that run through the area. Aside from this analysis, efforts to create a map displaying the impact zones has been made (see Map 5.1).

In order to implement a suitable management and monitoring plan for the conservation of an area, the threats to the area must be identified. Appropriate management actions can be planned out in order to deal with these threats. The emergence of these threats can have an impact on biodiversity in an area so the monitoring of these areas must be performed at regular intervals. Several types of threats found during the assessment can be seen in Photo 5.1 to Photo 5.8. Following this are some field findings and descriptions of potential threats in the Belaga HCS Recovery Site (see Table 5.1).

No	Potential Threats	Evidence and description of the threats
1.	Illegal logging	 Chainsaw operation was recorded, indicating ongoing logging activities. Fresh pieces of cut wood were found on the banks of the Bera'an River. There is easy access for logging activities to be carried out, and boundary markings have not been placed throughout the
		entire area.
2.	Land clearing agricultural for purposes / Claimed by local communities	 The local communities have cleared a lot of land from the northern side of the recovery side. These cleared areas are then converted into oil palm plantations and other types of agricultural plots for the needs of the local communities. There are indications of overlapping land ownerships with other areas, such as with the MPOB area and oil palm plantations owned by smallholders. The community's understanding of the recovery area's boundaries and the function of the site remains unresolved.
3.	Forest and land fires	 Found former burnt land, in which the vegetation has grown back. Based on some information from the local community, there is still land clearing for agricultural purposes, by methods of logging and burning.
4.	Wildlife poaching	 There were animal snares on some of the observation tracts. Some of the local community were using means of electro fishing to catch fish. The security posts are unguarded and boundary markings are not evident around the whole of the recovery site. A bullet casing was found close to the sampling plots. Former logging roads allow easier access for hunters to enter the recovery site.

Table 5.1: Threats found during the assessment and their descriptions

No	Potential Threats		Evidence and description of the threats
5.	Invasive species	•	Found forested areas where the crowns of trees were covered by <i>Mucuna bracteata</i> (choking).
		•	These affected areas were generally located on the margins of oil palm plantation blocks.
		•	There is the potential for invasive plants to enter the recovery sight, namely plants in the forest plantations, such as <i>Acacia mengium</i> and <i>Eucalyptus grandis</i> from the adjacent forest plantations.
6.	Potential erosion and sedimentation	•	The assessment areas in general were on or in close proximity to very steep slopes.
		•	Soil erosion has the potential to occur in areas where there is high rainfall, and there are not enough vegetation cover to bind the soil effectively.
		•	River sedimentation and silting can occur in watershed areas adjacent to former logging roads, and areas that are lacking vegetation.



Map 5.1: Impact of logging disturbances at the Belaga HCS Recovery Site



Photo 5.1: Felled trees left over from former logging activities



Photo 5.3: Snares for poaching found in the recovery site



Photo 5.2: Land clearing for community-owned oil palm plantations



Photo 5.4: *Mucuna bracteata* that covers the forest canopy cover and inhibits vegetation from growing naturally



Photo 5.5: Electrofishing in the Iga River



Photo 5.7: Evidence of illegal logging



Photo 5.6: Soil erosion in steep areas



Photo 5.8: Bullet casing, evidence of poaching

6 Managing and Monitoring Recommendations

Management actions are carried out to protect, maintain and enhance areas with the potential for high biodiversity. Trying to completely orient oneself towards the desired and ideal conditions for conservation and environmental management is not easily attained. These recommendations are still general as they are only based around the main threats on the recovery site. The proposed management and monitoring recommendations are summarized in Table 6.1 below. This should be considered when formulating the 5-year management and monitoring plan for the recovery site

No	Main Threats	Management	Monitoring
1	Illegal logging	 Marking of the boundaries and the installation of signboards calling for the prohibition of taking threatened flora out of the recovery site as well as stating the protection of RTE species. Investigation and strict action against perpetrators. Attempting to rehabilitate affected land with native vegetation. Building guard posts. Conduct community outreach programmes. 	 Monitor the conditions of the boundary markers and signboards. Investigate the origin of the perpetrators and the size of the affected areas. Report perpetrators to the authorities. Map areas prone to logging activities. Conduct regular area patrols.
2	Land clearing agricultural for purposes / claimed by the local communities	 Marking of boundaries and the installation of warning and prohibition signboards. Identification of land stakeholders. Settlement of land ownership conflicts and agreement on the boundaries. Conduct community outreach programmes. 	 Monitor the conditions of the boundary markers and signboards. Strengthening of the regional boundary documents. Coordinate with related stakeholders in the local communities and other companies around the area. Monitoring changes in the local community behavior and increasing the understanding of the existence of the Belaga HCS Recovery Site as an ecosystem service.
3	Forest and land fires	 Marking area boundaries and installing warning, prohibition, and fire hazard signboards. Identify areas prone to fires. Investigation and strict action in the event of a fire, reporting any incidences to the authorities. Training for workers related to forest and land fires (fire-fighting). Conduct community outreach programmes. Procurement of tools for fighting forest and land fires. 	 Monitor the conditions of the boundary markers and signboards. Monitor through remote sensing. Conduct regular field monitoring. Monitoring the condition of fire extinguishers (personnel equipment, semi-mechanical equipment and mechanical equipment). Coordinate with related stakeholders in the local communities and other companies around the area.

Table 6.1: Management and monitoring recommendations

No	Main Threats	Management	Monitoring
4	Wildlife poaching	 Marking of the boundaries and the installation of signboards calling for the prohibition of hunting wildlife in the recovery site as well as stating the protection of RTE species. Investigation and strict action in the case of poaching, and reporting any incidences to the authorities. Periodic data collection of wildlife with the involvement of competent experts. Increasing the capacity of rangers to further ensure the protection of wildlife. Building guard posts. Campaign and educate the surrounding stakeholders about protected fauna. 	 Monitor the conditions of the boundary markers and signboards. Conduct regular area patrols. Support local policies such as village regulations related to conservation. Monitoring positive changes in people's behavior towards the existence of biodiversity in the recovery site.
5	Invasive species	 Checking and cleaning of affected areas through the manual removal of these invasive species, rather than relying on chemical applications. 	 Monitor and control the growth of <i>Mucuna bracteata</i> in the surrounding plantations. Mapping areas prone to invasive species. Cooperate with nearby companies to combat against the uncontrolled spread of ground cover crops.
6.	Potential erosion and sedimentation	 Identify areas prone to erosion and sedimentation. Plan for land rehabilitation and species enrichment with native vegetation. Determining priority locations for rehabilitation. Minimizing activities that use chemicals that reduce soil and water quality. Building rainfall and water quality monitoring stations. Involving the community in the rehabilitation program. 	 Conduct regular monitoring of rainfall and water quality. Monitor the progress of the rehabilitation program. Collaborate with nearby companies in an effort to rehabilitate land.

7 End Note

The Belaga HCS Recovery Site has high conservation potential based on the number of species recorded in this preliminary biological assessment. A total of 470 floral species from 92 families and 220 faunal from 80 families. This site is identified as a compensation site for High Carbon Stock loss. The overall potential for Carbon Stock increase has also been recognized as this forest ecosystem is regenerating and going through successional phases actively sequestering carbon and over a period of time increase the carbon stock significantly.

This preliminary assessment provides the necessary data to support the establishment of this site, not only as a site for carbon stock, but also for ecosystem rehabilitation and conservation. The data provided by this assessment can be used to formulate management actions to ensure that this site is protected and managed to enhance its conservation potential.

8 References

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9 Appendix

9.1 Appendix 1: Data Tables

The following data tables consist of: List of plant species (see **Error! Reference source not found.**), s ummary of biomass and carbon data analysis (see **Error! Reference source not found.**), and a list of wildlife species identified in the Belaga HCS Recovery Site (see **Error! Reference source not found.**).

No.	Family	Species	IUCN Category	IUCN Criteria	CITES	Wildlife Protection Ordinance 1998	Borneo Endemic	Invasive Species
1	Dipterocarpaceae	Dipterocarpus cornutus	CR	A1cd+2cd ver 2.3	-	-	-	-
2	Dipterocarpaceae	Hopea mengarawan	CR	A1cd; B1+2c ver 2.3	-	-	-	-
3	Dipterocarpaceae	Parashorea lucida	CR	A1cd, B1+2c, C2a ver 2.3	-	-	-	-
4	Dipterocarpaceae	Shorea johorensis	CR	A1cd ver 2.3	-	-	-	-
5	Dipterocarpaceae	Shorea lepidota	CR	A1cd ver 2.3	-	-	-	-
6	Dipterocarpaceae	Shorea palembanica	CR	A1cd ver 2.3	-	Schedule II (Part 2)	-	-
7	Dipterocarpaceae	Dipterocarpus cf. glabrigemmatus	EN	B2ab(iii,v) ver 3.1	-	-	V	-
8	Dipterocarpaceae	Hopea cf. cernua	EN	A2cd ver 3.1	-	-	-	-
9	Dipterocarpaceae	Shorea cf. gratissima	EN	A2cd ver 3.1	-	-	-	-
10	Dipterocarpaceae	Shorea pauciflora	EN	A1cd ver 2.3	-	-	-	-
11	Dipterocarpaceae	Vatica nitens	EN	A1cd ver 2.3	-	-	-	-
12	Annonaceae	Monocarpia euneura	VU	A2c ver 3.1	-	-	-	-
13	Dilleniaceae	Dillenia borneensis	VU	A2c ver 3.1	-	-	-	-
14	Dipterocarpaceae	Dipterocarpus cf. stellatus	VU	A3cd+4cd ver 3.1	-	-	-	-
15	Dipterocarpaceae	Dipterocarpus crinitus	VU	A2cd ver 3.2	-	-	-	-
16	Dipterocarpaceae	Dipterocarpus gracilis	VU	A2cd ver 3.1	-	-	-	-
17	Dipterocarpaceae	Dryobalanops aromatica	VU	A2cd ver 3.1	-	-	-	-
18	Dipterocarpaceae	Shorea cf. subcylindrica	VU	A2cd ver 3.1	-	-	٧	-
19	Dipterocarpaceae	Shorea cf. symingtonii	VU	A2c ver 3.1	-	-	٧	-
20	Dipterocarpaceae	Shorea flaviflora	VU	A3cd ver 3.1	-	-	٧	-
21	Dipterocarpaceae	Shorea foxworthyi	VU	A2c ver 3.1	-	-	-	-
22	Dipterocarpaceae	Shorea guiso	VU	A2cd ver 3.1	-	-	-	-
23	Dipterocarpaceae	Shorea laevis	VU	A2cd ver 3.1	-	-	-	-
24	Dipterocarpaceae	Shorea macrobalanos	VU	A3cd ver 3.1	-	-	٧	-
25	Dipterocarpaceae	Vatica pauciflora	VU	A2cd ver 3.1	-	-	-	-
26	Malvaceae	Durio acutifolius	VU	A1c ver 2.3	-	-	٧	-
27	Malvaceae	Durio dulcis	VU	A2c ver 3.1	-	-	٧	-
28	Malvaceae	Durio graveolens	VU	A2c ver 3.1	-	-	-	-
29	Meliaceae	Aglaia angustifolia	VU	A1c ver 2.3	-	-	-	-
30	Moraceae	Artocarpus anisophyllus	VU	A2c ver 3.1	-	-	-	-

Table 9.1: List of identified plant species (flora) in theBelaga Recovery Site

No.	Family	Species	IUCN Category	IUCN Criteria	CITES	Wildlife Protection	Borneo Endemic	Invasive Species
						Ordinance 1998	Lindenne	opecies
31	Moraceae	Artocarpus tamaran	VU	A2c ver 3.1	-	-	V	-
32	Sapotaceae	Madhuca sericea	VU	A2c ver 3.1	-	-	-	-
33	Thymelaeaceae	Gonystylus affinis	VU	A2cd ver 3.1	11	Schedule	-	-
34	Thymelaeaceae	Gonystylus consanguineus	VU	A2cd ver 3.1	II	Schedule	٧	-
35	Zingiberaceae	Meistera oligantha	VU	B2ab(iii) ver 3.1	-	-	٧	-
36	Zingiberaceae	Zingiber pachysipon	VU	B2ab(iii) ver 3.1	-	-	٧	-
37	Orchidaceae	Claderia viridiflora	LC	ver 3.1	II	Schedule II (Part 2)	-	-
38	Orchidaceae	Cleisostoma subulatum	-	-	11	Schedule II (Part 2)	-	-
39	Orchidaceae	Coelogyne foerstermannii	LC	ver 3.1	II	Schedule II (Part 2)	-	-
40	Orchidaceae	Dendrobium compressum	LC	ver 3.1	II	Schedule II (Part 2)	-	-
41	Orchidaceae	Robiquetia spathulata	-	-	11	Schedule II (Part 2)	-	-
42	Thymelaeaceae	Gonystylus borneensis	-	-	11	Schedule II (Part 2)	V	-
43	Thymelaeaceae	Gonystylus brunnescens	NT	A2cd ver 3.1	11	Schedule II (Part 2)	-	-
44	Begoniaceae	Begonia sp1	-	-	-	Schedule II (Part 2)	-	-
45	Begoniaceae	Begonia sp2	-	-	-	Schedule II (Part 2)	-	-
46	Begoniaceae	Begonia sp3	-	-	-	Schedule II (Part 2)	-	-
47	Begoniaceae	Begonia sp4	-	-	-	Schedule II (Part 2)	-	-
48	Begoniaceae	Begonia stenogyna	-	-	-	Schedule II (Part 2)	-	-
49	Dipterocarpaceae	Shorea macrophylla	LC	ver 3.1	-	Schedule II (Part 2)	V	-
50	Dipterocarpaceae	Shorea pinanga	LC	ver 3.1	-	Schedule II (Part 2)	V	-
51	Dipterocarpaceae	Shorea seminis	LC	ver 3.1	-	Schedule II (Part 2)	-	-
52	Leguminosae	Koompassia excelsa	CD	ver 2.3	-	Schedule II (Part 2)	-	-
53	Leguminosae	Koompassia malaccensis	CD	ver 2.3	-	Schedule II (Part 2)	-	-
54	Moraceae	Ficus geocharis	-	-	-	Schedule II (Part 2)	V	-
55	Moraceae	Ficus grossularioides	LC	ver 3.1	-	Schedule II (Part 2)	-	-
56	Moraceae	Ficus heteropleura	-	-	-	Schedule II (Part 2)	-	-
57	Moraceae	Ficus obscura	LC	ver 3.1	-	Schedule II (Part 2)	-	-
58	Moraceae	Ficus sp1	-	-	-	Schedule II (Part 2)	-	-
59	Moraceae	Ficus sp2	-	-	-	Schedule II (Part 2)	-	-
60	Moraceae	FICUS SP3	-	-	-	Schedule II (Part 2)	-	-

No.	Family	Species	IUCN Category	IUCN Criteria	CITES	Wildlife Protection Ordinance	Borneo Endemic	Invasive Species
						1998		
61	Moraceae	Ficus uncinata	-	-	-	Schedule II (Part 2)	-	-
62	Moraceae	Ficus villosa	-	-	-	Schedule	-	-
63	Orchidaceae	Agrostophyllum sp	-	-	-	Schedule	-	-
64	Orchidaceae	Phalaenopsis sp	-	-	-	Schedule	-	-
65	Achariaceae	Hydnocarpus polypetalus	LC	ver 3.1	-	- II (Part 2)	-	-
66	Achariaceae	Hydnocarpus wrayi	-	-	-	-	-	-
67	Achariaceae	Ryparosa kostermansii	-	-	-	-	٧	-
68	Actinidiaceae	Saurauia javanica	-	-	-	-	-	-
69	Actinidiaceae	Saurauia sp1	-	-	-	-	-	-
70	Actinidiaceae	Saurauia sp2	-	-	-	-	-	-
71	Anacardiaceae	Campnosperma auriculatum	LC	ver 3.1	-	-	-	-
72	Anacardiaceae	Dracontomelon dao	LC	ver 3.1	-	-	-	-
73	Anacardiaceae	Drimycarpus luridus	-	-	-	-	-	-
74	Anacardiaceae	Gluta aptera	-	-	-	-	-	-
75	Anacardiaceae	Mangifera sp	-	-	-	-	-	-
76	Anacardiaceae	Melanochyla angustifolia	NT	B2b(iii) ver 3.1	-	-	-	-
77	Anacardiaceae	Semecarpus heterophyllus	NT	B2b(iii,v) Ver 3.1	-	-	-	-
78	Anacardiaceae	Swintonia glauca	-	-	-	-	-	-
79	Anisophylleaceae	Anisophyllea beccariana	LC	ver 2.3	-	-	٧	-
80	Anisophylleaceae	Anisophyllea disticha	LC	ver 2.3	-	-	-	-
81	Annonaceae	Artabotrys suaveolens	-	-	-	-	-	-
82	Annonaceae	Cananga odorata	LC	ver 3.1	-	-	-	-
83	Annonaceae	Cyathocalyx sp	-	-	-	-	-	-
84	Annonaceae	Enicosanthum paradoxum	-	-	-	-	-	-
85	Annonaceae	Goniothalamus macrophyllus	-	-	-	-	-	-
86	Annonaceae	Goniothalamus ridleyi	-	-	-	-	-	-
87	Annonaceae	Goniothalamus sp	-	-	-	-	-	-
88	Annonaceae	Maasia sumatrana	LC	ver 3.1	-	-	-	-
89	Annonaceae	Mezzettia parviflora	-	-	-	-	-	-
90	Annonaceae	Monocarpia kalimantanensis	LC	ver 3.1	-	-	٧	-
91	Annonaceae	Monocarpia sp	-	-	-	-	-	-
92	Annonaceae	Polyalthia flagellaris	-	-	-	-	-	-
93	Annonaceae	Polyalthia microtus	-	-	-	-	-	-
94	Annonaceae	Polyalthia sp1	-	-	-	-	-	-
95	Annonaceae	Polyalthia sp2	-	-	-	-	-	-
96	Annonaceae	Uvaria sp	-	-	-	-	-	-
97	Annonaceae	Xylopia malayana	LC	ver 2.3	-	-	-	-
98	Apocynaceae	Alstonia scholaris	LC	ver 3.1	-	-	-	-
99	Apocynaceae	Hoya sp	-	-	-	-	-	-

No.	Family	Species	IUCN Category	IUCN Criteria	CITES	Wildlife Protection Ordinance 1998	Borneo Endemic	Invasive Species
100	Apocynaceae	Tabernaemontana macrocarpa	LC	ver 3.1	-	-	-	-
101	Araceae	Aglaonema sp	-	-	-	-	-	-
102	Araceae	Alocasia longiloba	-	-	-	-	-	-
103	Araceae	Pothos sp1	-	-	-	-	-	-
104	Araceae	Pothos sp2	-	-	-	-	-	-
105	Araceae	Rhaphidophora sp1	-	-	-	-	-	-
106	Araceae	Rhaphidophora sp2	-	-	-	-	-	-
107	Araceae	Schismatoglottis sp	-	-	-	-	-	-
108	Araceae	Scindapsus pictus	-	-	-	-	-	-
109	Araceae	Scindapsus sp	-	-	-	-	-	-
110	Araliaceae	-	-	-	-	-	-	-
111	Arecaceae	Calamus sp1	-	-	-	-	-	-
112	Arecaceae	Calamus sp2	-	-	-	-	-	-
113	Arecaceae	Calamus sp3	-	-	-	-	-	-
114	Arecaceae	Daemonorops sabut	-	-	-	-	-	-
115	Arecaceae	Elaeis guineensis	LC	ver 3.1	-	-	-	-
116	Arecaceae	Korthalsia sp1	-	-	-	-	-	-
117	Arecaceae	Korthalsia sp2	-	-	-	-	-	-
118	Arecaceae	Licuala spinosa	-	-	-	-	-	-
119	Arecaceae	Pinanga sp	-	-	-	-	-	-
120	Arecaceae	Salacca zalacca	-	-	-	-	-	-
121	Asparagaceae	Dracaena sp	-	-	-	-	-	-
122	Aspleniaceae	Asplenium nidus	-	-	-	-	-	-
123	Aspleniaceae	Blechnum orientale	-	-	-	-	-	-
124	Aspleniaceae	Blechnum sp	-	-	-	-	-	-
125	Aspleniaceae	Stenochlaena palustris	-	-	-	-	-	-
126	Asteraceae	Mikania micrantha	-	-	-	-	-	V
127	Asteraceae	Vernonia arborea	LC	ver 3.1	-	-	-	-
128	Bignoniaceae	Oroxylum indicum	-	-	-	-	-	-
129	Burseraceae	Canarium hirsutum	LC	ver 3.1	-	-	-	-
130	Burseraceae	Canarium pilosum	-	-	-	-	-	-
131	Burseraceae	Canarium sp	-	-	-	-	-	-
132	Burseraceae	Dacryodes rostrata	LC	ver 2.3	-	-	-	-
133	Burseraceae	Dacryodes rugosa	LC	ver 3.1	-	-	-	-
134	Burseraceae	Dacryodes sp	-	-	-	-	-	-
135	Burseraceae	Santiria griffithii	LC	ver 2.3	-	-	-	-
136	Burseraceae	Santiria laevigata	LC	ver 2.3	-	-	-	-
137	Burseraceae	Santiria oblongifolia	-	-	-	-	-	-
138	Burseraceae	Santiria sp	-	-	-	-	-	-
139	Calophyllaceae	Calophyllum soulattri	LC	ver 2.3	-	-	-	-
140	Calophyllaceae	Calophyllum sp	-	-	-	-	-	-

No.	Family	Species	IUCN Category	IUCN Criteria	CITES	Wildlife Protection Ordinance 1998	Borneo Endemic	Invasive Species
141	Calophyllaceae	Mesua oblongifolia	-	-	-	-	٧	-
142	Cannabaceae	Gironniera nervosa	-	-	-	-	-	-
143	Centroplacaceae	Bhesa paniculata	LC	ver 2.3	-	-	-	-
144	Chrysobalanaceae	Maranthes corymbosa	LC	ver 2.3	-	-	-	-
145	Chrysobalanaceae	Parinari oblongifolia	-	-	-	-	-	-
146	Clusiaceae	Garcinia griffithii	-	-	-	-	-	-
147	Clusiaceae	Garcinia hendersoniana	LC	ver 2.3	-	-	-	-
148	Clusiaceae	Garcinia sp1	-	-	-	-	-	-
149	Clusiaceae	Garcinia sp2	-	-	-	-	-	-
150	Commelinaceae	Amischotolype griffithii	-	-	-	-	-	-
151	Commelinaceae	Amischotolype sp	-	-	-	-	-	-
152	Connaraceae	Cnestis palala	-	-	-	-	-	-
153	Convolvulaceae	Merremia umbellata	-	-	-	-	-	-
154	Cornaceae	Alangium javanicum	LC	ver 2.3	-	-	-	-
155	Cornaceae	Alangium ridleyi	-	-	-	-	-	-
156	Costaceae	Cheilocostus speciosus	LC	ver 3.1	-	-	-	-
157	Cyatheaceae	Cyathea borneensis	-	-	-	-	-	-
158	Cyperaceae	Scleria purpurascens	-	-	-	-	-	-
159	Dilleniaceae	Dillenia suffruticosa	-	-	-	-	-	-
160	Dilleniaceae	Tetracera akara	-	-	-	-	-	-
161	Dilleniaceae	Tetracera indica	-	-	-	-	-	-
162	Dipterocarpaceae	Dipterocarpus borneensis	NT	A2cd ver 3.1	-	-	-	-
163	Dipterocarpaceae	Dipterocarpus caudiferus	NT	A2cd ver 3.1	-	-	٧	-
164	Dipterocarpaceae	Dipterocarpus confertus	NT	A4cd ver 3.1	-	-	٧	-
165	Dipterocarpaceae	Dryobalanops lanceolata	LC	ver 3.1	-	-	٧	-
166	Dipterocarpaceae	Dryobalanops oblongifolia	LC	ver 3.1	-	-	-	-
167	Dipterocarpaceae	Hopea bracteata	-	-	-	-	-	-
168	Dipterocarpaceae	Hopea bullatifolia	NT	A4cd ver 3.1	-	-	٧	-
169	Dipterocarpaceae	Hopea dryobalanoides	LC	ver 3.1	-	-	-	-
170	Dipterocarpaceae	Shorea amplexicaulis	NT	A4cd ver 3.1	-	-	V	-
171	Dipterocarpaceae	Shorea cf. argentifolia	LC	ver 3.1	-	-	٧	-
172	Dipterocarpaceae	Shorea cf. Sagittata	NT	A3cd ver 3.1	-	-	V	-
173	Dipterocarpaceae	Shorea coriacea	NT	A2cd+4cd ver 3.1	-	-	-	-
174	Dipterocarpaceae	Shorea fallax	LC	ver 3.1	-	-	-	-
175	Dipterocarpaceae	Shorea leprosula	NT	A2cd ver 3.1	-	-	-	-
176	Dipterocarpaceae	Shorea macroptera	LC	ver 3.1	-	-	-	-
177	Dipterocarpaceae	Shorea multiflora	LC	ver 3.1	-	-	-	-
178	Dipterocarpaceae	Shorea ovalis	LC	ver 3.1	-	-	-	-
179	Dipterocarpaceae	Shorea parvifolia	LC	ver 3.1	-	-	-	-
180	Dipterocarpaceae	Shorea parvistipulata	LC	ver 3.1	-	-	-	-
181	Dipterocarpaceae	Shorea sp1	-	-	-	-	-	-

No.	Family	Species	IUCN Category	IUCN Criteria	CITES	Wildlife Protection Ordinance 1998	Borneo Endemic	Invasive Species
182	Dipterocarpaceae	Shorea sp2	-	-	-	-	-	-
183	Dipterocarpaceae	Shorea sp3	-	-	-	-	-	-
184	Dipterocarpaceae	Shorea sp4	-	-	-	-	-	-
185	Dipterocarpaceae	Vatica coriacea	NT	A4cd ver 3.1	-	-	٧	-
186	Dipterocarpaceae	Vatica sp	-	-	-	-	-	-
187	Ebenaceae	Diospyros borneensis	LC	ver 3.1	-	-	-	-
188	Ebenaceae	Diospyros foxworthyi	LC	ver 2.3	-	-	-	-
189	Ebenaceae	Diospyros frutescens	-	-	-	-	-	-
190	Ebenaceae	Diospyros sp1	-	-	-	-	-	-
191	Ebenaceae	Diospyros sp2	-	-	-	-	-	-
192	Ebenaceae	Diospyros sumatrana	DD	ver 3.1	-	-	-	-
193	Elaeocarpaceae	Elaeocarpus griffithii	-	-	-	-	-	-
194	Elaeocarpaceae	Elaeocarpus sp1	-	-	-	-	-	-
195	Elaeocarpaceae	Elaeocarpus sp2	-	-	-	-	-	-
196	Elaeocarpaceae	Elaeocarpus stipularis	-	-	-	-	-	-
197	Elaeocarpaceae	Sloanea sp	-	-	-	-	-	-
198	Euphorbiaceae	Blumeodendron kurzii	LC	ver 3.1	-	-	-	-
199	Euphorbiaceae	Blumeodendron tokbrai	LC	ver 3.1	-	-	-	-
200	Euphorbiaceae	Croton argyratus	LC	ver 3.1	-	-	-	-
201	Euphorbiaceae	Croton sp1	-	-	-	-	-	-
202	Euphorbiaceae	Croton sp2	-	-	-	-	-	-
203	Euphorbiaceae	Elateriospermum tapos	-	-	-	-	-	-
204	Euphorbiaceae	Endospermum diadenum	LC	ver 3.1	-	-	-	-
205	Euphorbiaceae	Hancea penangensis	LC	ver 3.1	-	-	-	-
206	Euphorbiaceae	Hancea sp	-	-	-	-	-	-
207	Euphorbiaceae	Koilodepas longifolium	-	-	-	-	-	-
208	Euphorbiaceae	Macaranga bancana	-	-	-	-	-	-
209	Euphorbiaceae	Macaranga conifera	-	-	-	-	-	-
210	Euphorbiaceae	Macaranga gigantea	-	-	-	-	-	-
211	Euphorbiaceae	Macaranga hypoleuca	-	-	-	-	-	-
212	Euphorbiaceae	Macaranga lowii	LC	ver 3.1	-	-	-	-
213	Euphorbiaceae	macaranga motleyana	-	-	-	-	-	-
214	Euphorbiaceae	Macaranga pearsonii	LC	ver 3.1	-	-	٧	-
215	Euphorbiaceae	Macaranga winkleri	LC	ver 3.1	-	-	٧	-
216	Euphorbiaceae	Mallotus paniculatus	LC	ver 3.1	-	-	-	-
217	Euphorbiaceae	Moultonianthus leembruggianus	-	-	-	-	-	-
218	Euphorbiaceae	Neoscortechinia philippinensis	LC	ver 3.1	-	-	-	-
219	Euphorbiaceae	Paracroton pendulus	LC	ver 3.1	-	-	-	-
220	Euphorbiaceae	Pimelodendron griffithianum	-	-	-	-	-	-
221	Euphorbiaceae	Ptychopyxis sp	-	-	-	-	-	-

No.	Family	Species	IUCN Category	IUCN Criteria	CITES	Wildlife Protection Ordinance 1998	Borneo Endemic	Invasive Species
222	Fagaceae	Castanopsis acuminatissima	LC	ver 3.1	-	-	-	-
223	Fagaceae	Castanopsis sp	-	-	-	-	-	-
224	Fagaceae	Lithocarpus andersonii	-	-	-	-	٧	-
225	Fagaceae	Lithocarpus conocarpus	-	-	-	-	-	-
226	Fagaceae	Lithocarpus gracilis	LC	ver 3.1	-	-	-	-
227	Fagaceae	Lithocarpus sp1	-	-	-	-	-	-
228	Fagaceae	Lithocarpus sp2	-	-	-	-	-	-
229	Fagaceae	Lithocarpus sp3	-	-	-	-	-	-
230	Fagaceae	Quercus sp1	-	-	-	-	-	-
231	Fagaceae	Quercus sp2	-	-	-	-	-	-
232	Gentianaceae	Utania volubilis	-	-	-	-	-	-
233	Gesneriaceae	Aeschynanthus sp	-	-	-	-	-	-
234	Gleicheniaceae	Dicranopteris linearis	LC	ver 3.1	-	-	-	-
235	Hanguanaceae	Hanguana sp	-	-	-	-	-	-
236	Hypericaceae	Cratoxylum arborescens	LC	ver 2.3	-	-	-	-
237	Hypericaceae	Cratoxylum formosum	LC	ver 2.3	-	-	-	-
238	Hypericaceae	Cratoxylum sumatranum	LC	ver 3.1	-	-	-	-
239	Hypoxidaceae	Molineria capitulata	-	-	-	-	-	-
240	Ixonanthaceae	Ixonanthes reticulata	-	-	-	-	-	-
241	Juglandaceae	Engelhardia sp	-	-	-	-	-	-
242	Lamiaceae	Callicarpa pentandra	LC	ver 3.1	-	-	-	-
243	Lamiaceae	Clerodendrum sp	-	-	-	-	-	-
244	Lamiaceae	Teijsmanniodendron bogoriense	LC	ver 3.1	-	-	-	-
245	Lamiaceae	Teijsmanniodendron sp	-	-	-	-	-	-
246	Lamiaceae	Vitex pinnata	LC	ver 3.1	-	-	-	-
247	Lamiaceae	Vitex vestita	LC	ver 3.1	-	-	-	-
248	Lauraceae	Actinodaphne borneensis	LC	ver 3.1	-	-	-	-
249	Lauraceae	Actinodaphne glabra	LC	ver 3.1	-	-	-	-
250	Lauraceae	Actinodaphne sp	-	-	-	-	-	-
251	Lauraceae	Cinnamomum pendulum	LC	ver 3.1	-	-	-	-
252	Lauraceae	Cryptocarya impressa	LC	ver 3.1	-	-	-	-
253	Lauraceae	Cryptocarya sp	-	-	-	-	-	-
254	Lauraceae	Dehaasia firma	LC	ver 3.1	-	-	٧	-
255	Lauraceae	Dehaasia sp	-	-	-	-	-	-
256	Lauraceae	Lindera sp	-	-	-	-	-	-
257	Lauraceae	Litsea elliptica	LC	ver 3.1	-	-	-	-
258	Lauraceae	Litsea oppositifolia	-	-	-	-	-	-
259	Lauraceae	Litsea sp1	-	-	-	-	-	-
260	Lauraceae	Litsea sp2	-	-	-	-	-	-
261	Lauraceae	Litsea sp3	-	-	-	-	-	-
262	Lauraceae	Litsea sp4	-	-	-	-	-	-

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263	Lauraceae	Litsea umbellata	LC	ver 3.1	-	-	-	-
264	Lecythidaceae	Barringtonia macrostachya	-	-	-	-	-	-
265	Lecythidaceae	Planchonia valida	-	-	-	-	-	-
266	Leguminosae	Archidendron clypearia	LC	ver 3.1	-	-	-	-
267	Leguminosae	Archidendron sp	-	-	-	-	-	-
268	Leguminosae	Bauhinia sp	-	-	-	-	-	-
269	Leguminosae	Fordia brachybotrys	-	-	-	-	-	-
270	Leguminosae	Fordia splendidissima	LC	ver 3.1	-	-	-	-
271	Leguminosae	Guilandina bonduc	LC	ver 3.1	-	-	-	-
272	Leguminosae	Parkia speciosa	LC	ver 3.1	-	-	-	-
273	Leguminosae	Sindora leiocarpa	LC	ver 3.1	-	-	-	-
274	Leguminosae	Spatholobus ferrugineus	-	-	-	-	-	-
275	Leguminosae	Vigna sp	-	-	-	-	-	-
276	Lindsaeaceae	Davallia sp	-	-	-	-	-	-
277	Loganiaceae	Norrisia major	-	-	-	-	-	-
278	Lythraceae	Duabanga moluccana	LC	ver 3.1	-	-	-	-
279	Malvaceae	Commersonia bartramia	LC	ver 3.1	-	-	-	-
280	Malvaceae	Durio cf. griffithii	-	-	-	-	-	-
281	Malvaceae	Durio lanceolatus	NT	A2c ver 3.1	-	-	-	-
282	Malvaceae	Durio oxleyanus	NT	A2c ver 3.1	-	-	-	-
283	Malvaceae	Microcos antidesmifolia	-	-	-	-	-	-
284	Malvaceae	Microcos crassifolia	-	-	-	-	-	-
285	Malvaceae	Neesia synandra	-	-	-	-	-	-
286	Malvaceae	Pentace laxiflora	LC	ver 3.1	-	-	٧	-
287	Malvaceae	Pentace sp	-	-	-	-	-	-
288	Malvaceae	Pterospermum javanicum	LC	ver 3.1	-	-	-	-
289	Malvaceae	Scaphium macropodum	LC	ver 2.3	-	-	-	-
290	Malvaceae	Sterculia macrophylla	-	-	-	-	-	-
291	Malvaceae	Sterculia rubiginosa	-	-	-	-	-	-
292	Malvaceae	Sterculia sp	-	-	-	-	-	-
293	Marantaceae	Calathea sp	-	-	-	-	-	-
294	Marantaceae	Donax canniformis	-	-	-	-	-	-
295	Marantaceae	Stachyphrynium repens	-	-	-	-	-	-
296	Marattiaceae	Angiopteris evecta	-	-	-	-	-	-
297	Melastomataceae	Clidemia hirta	-	-	-	-	-	V
298	Melastomataceae	Clidemia sp	-	-	-	-	-	-
299	Melastomataceae	Clidemia sp	-	-	-	-	-	-
300	Melastomataceae	Dissochaeta sp	-	-	-	-	-	-
301	Melastomataceae	Melastoma malabathricum	-	-	-	-	-	-
302	Melastomataceae	Memecylon cf. paniculatum	-	-	-	-	-	-
303	Melastomataceae	Memecylon durum	-	-	-	-	-	-

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304	Melastomataceae	Pternandra cogniauxii	-	-	-	-	-	-
305	Melastomataceae	Pternandra crassicalyx	-	-	-	-	٧	-
306	Melastomataceae	Pternandra rostrata	-	-	-	-	-	-
307	Meliaceae	Aglaia silvestris	NT	ver 2.3	-	-	-	-
308	Meliaceae	Aglaia simplicifolia	NT	ver 2.3	-	-	-	-
309	Meliaceae	Aglaia sp1	-	-	-	-	-	-
310	Meliaceae	Aglaia sp2	-	-	-	-	-	-
311	Meliaceae	Aglaia tomentosa	LC	ver 2.3	-	-	-	-
312	Meliaceae	Chisocheton sp	LC	ver 3.1	-	-	-	-
313	Meliaceae	Dysoxylum alliaceum	-	-	-	-	-	-
314	Meliaceae	Dysoxylum sp	-	-	-	-	-	-
315	Menispermaceae	Coscinium fenestratum	DD	ver 3.1	-	-	-	-
316	Moraceae	Artocarpus elasticus	LC	ver 3.1	-	-	-	-
317	Moraceae	Artocarpus integer	-	-	-	-	-	-
318	Moraceae	Artocarpus nitidus	-	-	-	-	-	-
319	Moraceae	Artocarpus odoratissimus	NT	A2c ver 3.1	-	-	-	-
320	Moraceae	Artocarpus rigidus	-	-	-	-	-	-
321	Moraceae	Artocarpus sericicarpus	LC	ver 3.1	-	-	-	-
322	Musaceae	Musa sp	-	-	-	-	-	-
323	Myristicaceae	Gymnacranthera farquhariana	-	-	-	-	-	-
324	Myristicaceae	Horsfieldia grandis	LC	ver 3.1	-	-	-	-
325	Myristicaceae	Horsfieldia polyspherula	-	-	-	-	-	-
326	Myristicaceae	Horsfieldia sp1	-	-	-	-	-	-
327	Myristicaceae	Horsfieldia sp2	-	-	-	-	-	-
328	Myristicaceae	Knema glauca	-	-	-	-	-	-
329	Myristicaceae	Knema glaucescens	LC	ver 3.1	-	-	-	-
330	Myristicaceae	Knema hirtella	-	-	-	-	٧	-
331	Myristicaceae	Knema latericia	-	-	-	-	-	-
332	Myristicaceae	Knema latifolia	LC	ver 2.3	-	-	-	-
333	Myristicaceae	Knema percoriacea	-	-	-	-	٧	-
334	Myristicaceae	Myristica maxima	LC	ver 2.3	-	-	-	-
335	Myristicaceae	Myristica sp	-	-	-	-	-	-
336	Myrtaceae	Syzygium antisepticum	-	-	-	-	-	-
337	Myrtaceae	Syzygium cerasiforme	-	-	-	-	-	-
338	Myrtaceae	Syzygium fastigiatum	-	-	-	-	-	-
339	Myrtaceae	Syzygium hirtum	-	-	-	-	-	-
340	Myrtaceae	Syzygium polyanthum	-	-	-	-	-	-
341	Myrtaceae	Syzygium sp1	-	-	-	-	-	-
342	Myrtaceae	Syzygium sp2	-	-	-	-	-	-
343	Myrtaceae	Syzygium sp3	-	-	-	-	-	-
344	Myrtaceae	Syzygium sp4	-	-	-	-	-	-

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345	Myrtaceae	Syzygium tawahense	LC	ver 3.1	-	-	V	-
346	Myrtaceae	Tristaniopsis obovata	-	-	-	-	-	-
347	Olacaceae	Ochanostachys amentacea	DD	ver 2.3	-	-	-	-
348	Olacaceae	Scorodocarpus borneensis	-	-	-	-	-	-
349	Olacaceae	Strombosia ceylanica	-	-	-	-	-	-
350	Oleaceae	Chionanthus curvicarpus	-	-	-	-	-	-
351	Oleaceae	Chionanthus sp	-	-	-	-	-	-
352	Panandaceae	Freycinetia angustifolia	-	-	-	-	-	-
353	Panandaceae	Freycinetia sp	-	-	-	-	-	-
354	Panandaceae	Panandus sp	-	-	-	-	-	-
355	Panandaceae	Panandus yvanii	-	-	-	-	-	-
356	Pentaphylacaceae	Adinandra dumosa	LC	ver 3.1	-	-	-	-
357	Phyllanthaceae	Antidesma bunius	LC	ver 3.1	-	-	-	-
358	Phyllanthaceae	Antidesma neurocarpum	-	-	-	-	-	-
359	Phyllanthaceae	Antidesma sp	-	-	-	-	-	-
360	Phyllanthaceae	Aporosa benthamiana	-	-	-	-	-	-
361	Phyllanthaceae	Aporosa frutescens	-	-	-	-	-	-
362	Phyllanthaceae	Aporosa grandistipula	-	-	-	-	-	-
363	Phyllanthaceae	Aporosa lucida	-	-	-	-	-	-
364	Phyllanthaceae	Aporosa lunata	-	-	-	-	-	-
365	Phyllanthaceae	Aporosa nitida	-	-	-	-	V	-
366	Phyllanthaceae	Aporosa sp	-	-	-	-	-	-
367	Phyllanthaceae	Baccaurea macrocarpa	-	-	-	-	-	-
368	Phyllanthaceae	Baccaurea polyneura	LC	ver 3.1	-	-	-	-
369	Phyllanthaceae	Baccaurea sp	-	-	-	-	-	-
370	Phyllanthaceae	Baccaurea tetrandra	LC	ver 3.1	-	-	-	-
371	Phyllanthaceae	Bridelia glauca	LC	ver 3.2	-	-	-	-
372	Phyllanthaceae	Cleistanthus sp	-	-	-	-	-	-
373	Phyllanthaceae	Glochidion glabrum	-	-	-	-	-	-
374	Phyllanthaceae	Glochidion sp	-	-	-	-	-	-
375	Piperaceae	Piper aduncum	LC	ver 3.1	-	-	-	٧
376	Piperaceae	Piper porphyrophyllum	-	-	-	-	-	-
377	Piperaceae	Piper sp1	-	-	-	-	-	-
378	Piperaceae	Piper sp2	-	-	-	-	-	-
379	Piperaceae	Piper sp3	-	-	-	-	-	-
380	Polygalaceae	Xanthophyllum griffithii	-	-	-	-	-	-
381	Polygalaceae	Xanthophyllum obscurum	-	-	-	-	-	-
382	Polypodiaceae	Drynaria sparsisora	-	-	-	-	-	-
383	Polypodiaceae	Nephrolepis biserrata	-	-	-	-	-	-
384	Polypodiaceae	Taenitis sp	-	-	-	-	-	-
385	Primulaceae	Ardisia forbesii	LC	ver 3.1	-	-	-	-

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386	Primulaceae	Ardisia sp1	-	-	-	-	-	-
387	Primulaceae	Ardisia sp2	-	-	-	-	-	-
388	Proteaceae	Helicia sp	-	-	-	-	-	-
389	Pteridaceae	Vittaria sp	-	-	-	-	-	-
390	Putranjivaceae	Drypetes crassipes	-	-	-	-	-	-
391	Rhamnaceae	Ziziphus elegans	-	-	-	-	-	-
392	Rhamnaceae	Ziziphus sp	-	-	-	-	-	-
393	Rhizophoraceae	Pellacalyx axillaris	-	-	-	-	-	-
394	Rosaceae	Prunus beccarii	-	-	-	-	-	-
395	Rosaceae	Rubus buergeri	-	-	-	-	-	-
396	Rubiaceae	Aidia sp	-	-	-	-	-	-
397	Rubiaceae	lxora sp1	-	-	-	-	-	-
398	Rubiaceae	lxora sp2	-	-	-	-	-	-
399	Rubiaceae	Lasianthus borneensis	-	-	-	-	٧	-
400	Rubiaceae	Lasianthus cyanocarpus	-	-	-	-	-	-
401	Rubiaceae	Nauclea officinalis	-	-	-	-	-	-
402	Rubiaceae	Nauclea sp	-	-	-	-	-	-
403	Rubiaceae	Neolamarckia cadamba	-	-	-	-	-	-
404	Rubiaceae	Neonauclea calycina	LC	ver 3.1	-	-	-	-
405	Rubiaceae	Neonauclea gigantea	-	-	-	-	-	-
406	Rubiaceae	Pleiocarpidia capituligera	-	-	-	-	-	-
407	Rubiaceae	Porterandia anisophylla	-	-	-	-	-	-
408	Rubiaceae	Praravinia sp	-	-	-	-	-	-
409	Rubiaceae	Prismatomeris sp	-	-	-	-	-	-
410	Rubiaceae	Psychotria sp	-	-	-	-	-	-
411	Rubiaceae	Psychotria viridiflora	-	-	-	-	-	-
412	Rubiaceae	Tarenna sp	-	-	-	-	-	-
413	Rubiaceae	Uncaria sp1	-	-	-	-	-	-
414	Rubiaceae	Uncaria sp2	-	-	-	-	-	-
415	Rubiaceae	Uncaria sp3	-	-	-	-	-	-
416	Rubiaceae	Urophyllum arboreum	LC	ver 3.1	-	-	-	-
417	Rubiaceae	Urophyllum sp	-	-	-	-	-	-
418	Rutaceae	Acronychia pedunculata	LC	ver 3.1	-	-	-	-
419	Rutaceae	Luvunga sp	-	-	-	-	-	-
420	Rutaceae	Melicope accedens	LC	ver 3.1	-	-	-	-
421	Rutaceae	Melicope glabra	-	-	-	-	-	-
422	Sapindaceae	Allophylus cobbe	-	-	-	-	-	-
423	Sapindaceae	Guioa pleuropteris	-	-	-	-	-	-
424	Sapindaceae	Nephelium cuspidatum	LC	ver 3.1	-	-	-	-
425	Sapindaceae	Nephelium reticulatum	LC	ver 3.1	-	-	٧	-
426	Sapindaceae	Nephelium sp1	-	-	-	-	-	-

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427	Sapindaceae	Nephelium uncinatum	LC	ver 3.1	-	-	-	-
428	Sapindaceae	Paranephelium xestophyllum	LC	ver 3.1	-	-	-	-
429	Sapindaceae	Pometia pinnata	LC	ver 3.1	-	-	-	-
430	Sapindaceae	Xerospermum noronhianum	-	-	-	-	-	-
431	Sapindaceae	Nephelium sp2	-	-	-	-	-	-
432	Sapotaceae	Madhuca kingiana	NT	A2c ver 3.1	-	-	-	-
433	Sapotaceae	Madhuca sp	-	-	-	-	-	-
434	Sapotaceae	Palaquium quercifolium	LC	ver 3.1	-	-	-	-
435	Sapotaceae	Palaquium sericeum	LC	ver 3.1	-	-	-	-
436	Sapotaceae	Palaquium sp1	-	-	-	-	-	-
437	Sapotaceae	Palaquium sp2	-	-	-	-	-	-
438	Sapotaceae	Palaquium sp3	-	-	-	-	-	-
439	Schizaeaceae	Lygodium longifolium	-	-	-	-	-	-
440	Selaginellaceae	Selaginella sp1	-	-	-	-	-	-
441	Selaginellaceae	Selaginella sp2	-	-	-	-	-	-
442	Smilacaceae	Smilax setosa	-	-	-	-	-	-
443	Smilacaceae	Smilax sp	-	-	-	-	-	-
444	Stemonuraceae	Stemonurus sp	-	-	-	-	-	-
445	Styracaceae	Styrax sp	-	-	-	-	-	-
446	Symplocaceae	Symplocos fasciculata	-	-	-	-	-	-
447	Symplocaceae	Symplocos ophirensis	LC	ver 3.1	-	-	-	-
448	Symplocaceae	Symplocos sp	-	-	-	-	-	-
449	Tetramelaceae	Octomeles sumatrana	LC	ver 3.1	-	-	-	-
450	Theaceae	Camellia sp	-	-	-	-	-	-
451	Thymelaeaceae	Gonystylus sp	-	-	-	-	-	-
452	Urticaceae	Elatostema sp	-	-	-	-	-	-
453	Urticaceae	Poikilospermum suaveolens	-	-	-	-	-	-
454	Vitaceae	Ampelocissus imperialis	-	-	-	-	-	-
455	Vitaceae	Cissus sp	-	-	-	-	-	-
456	Vitaceae	Leea indica	LC	ver 3.1	-	-	-	-
457	Vitaceae	Vitis cissoides	-	-	-	-	-	-
458	Zingiberaceae	Amomum sp	-	-	-	-	-	-
459	Zingiberaceae	Etlingera brevilabrum	LC	ver 3.1	-	-	-	-
460	Zingiberaceae	Etlingera elatior	DD	ver 3.1	-	-	-	-
461	Zingiberaceae	Etlingera fimbriobracteata	LC	ver 3.1	-	-	-	-
462	Zingiberaceae	Etlingera nasuta	LC	ver 3.1	-	-	V	-
463	Zingiberaceae	Etlingera sp	-	-	-	-	-	-
464	Zingiberaceae	Globba atrosanguinea	LC	ver 3.1	-	-	-	-
465	Zingiberaceae	Globba sp	-	-	-	-	-	-
466	Zingiberaceae	Hornstedtia reticulata	-	-	-	-	V	-
467	Zingiberaceae	Plagiostachys albiflora	LC	ver 3.1	-	-	-	-

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468	Zingiberaceae	Plagiostachys sp1	-	-	-	-	-	-
469	Zingiberaceae	Plagiostachys sp2	-	-	-	-	-	-
470	Zingiberaceae	Zingiber sp	-	-	-	-	-	-

Source: Data Analysis, MEC – 2022

		Dens	sity (steam	/ha)	Basa	al area (m²	/ha)	Bi	omass (t/h	ia)	Carbon (t/ha)
No.	Plot	Dbh> 15cm	Dbh 5 - 14.9cm	Total	Dbh> 15cm	Dbh 5 - 14.9cm	Total	Dbh> 15cm	Dbh 5 - 14.9cm	Total	
1	P13	0	2000	2000	0.00	10.39	10.39	0.00	59.07	59.07	27.76
2	P34	220	800	1020	6.92	5.53	12.45	53.83	32.63	86.46	40.63
3	P35	140	400	540	9.03	2.49	11.52	84.40	14.48	98.88	46.47
4	P30	200	1100	1300	6.68	8.36	15.04	51.99	51.02	103.01	48.41
5	P18	140	900	1040	8.58	5.97	14.55	75.94	34.92	110.86	52.11
6	P23	260	1200	1460	10.74	4.81	15.56	90.66	25.49	116.15	54.59
7	P5	220	1000	1220	8.77	9.84	18.61	71.54	62.06	133.61	62.79
8	Р3	200	1000	1200	13.13	6.48	19.61	119.33	38.85	158.18	74.35
9	P8	220	400	620	15.83	2.19	18.02	145.43	12.92	158.35	74.43
10	P11	440	300	740	18.63	2.17	20.80	153.35	12.77	166.12	78.08
11	P2	380	500	880	17.47	3.40	20.86	150.37	20.13	170.50	80.13
12	P4	300	1000	1300	17.11	4.95	22.06	148.74	27.49	176.23	82.83
13	P24	360	500	860	18.01	3.98	21.99	152.95	24.18	177.13	83.25
14	P27	300	600	900	18.20	3.29	21.48	163.20	19.14	182.33	85.70
15	P22	580	1400	1980	14.98	12.40	27.38	111.56	78.19	189.76	89.19
16	P19	160	1100	1260	15.64	5.90	21.53	162.37	35.28	197.65	92.90
17	P29	460	400	860	22.50	2.22	24.72	190.45	12.70	203.15	95.48
18	P1	440	1900	2340	16.43	12.28	28.72	132.11	73.96	206.07	96.85
19	P12	480	800	1280	22.03	5.72	27.75	186.19	34.50	220.69	103.72
20	P21	340	200	540	23.28	1.58	24.86	214.68	9.98	224.66	105.59
21	P14	580	1600	2180	22.38	11.19	33.57	182.67	68.24	250.91	117.93
22	P15	380	1400	1780	23.72	7.55	31.26	214.70	43.12	257.83	121.18
23	P20	320	900	1220	25.49	5.89	31.37	243.05	35.10	278.15	130.73
24	P28	460	1000	1460	28.00	6.24	34.24	256.30	35.90	292.19	137.33
25	P31	400	200	600	31.30	1.31	32.61	306.80	7.86	314.66	147.89
26	P17	540	1800	2340	29.93	9.24	39.17	263.47	52.30	315.76	148.41
27	P25	480	900	1380	31.94	4.22	36.15	299.19	23.22	322.42	151.54
28	P32	560	1500	2060	32.09	8.56	40.65	285.80	49.71	335.51	157.69
29	P10	220	1300	1520	27.67	7.87	35.54	306.24	46.26	352.50	165.67
30	P16	420	1600	2020	32.25	10.08	42.33	306.10	59.71	365.81	171.93
31	P26	320	1500	1820	30.93	10.18	41.11	308.46	61.17	369.63	173.73
32	P6	200	900	1100	29.14	6.36	35.50	370.31	38.40	408.72	192.10
33	P33	800	1700	2500	40.20	10.04	50.24	354.71	60.03	414.74	194.93
34	P9	580	1700	2280	40.52	10.06	50.58	399.32	57.93	457.25	214.91
35	P7	560	1100	1660	58.64	5.29	63.94	619.29	30.03	649.32	305.18

Table 9.2: Summary of biomass and carbon stock data analysis

No	Class	Familly	Scientific Name	English Name	Malay Name	Feeding Guild	IUCN	CITES	WPO 1998	Endemic	Res /Mig	Habitat
1	Bird	Bucerotidae	Rhinoplax vigil	Helmeted Hornbill	Enggang Terbang Mentua	Frugivore	CR	I	ТР	-	BR	F
2	Mammal	Hominidae	Pongo pygmaeus	Bornean Orangutan	Orang Utan	Frugivore	CR	I	TP	В	BR	F
3	Mammal	Manidae	Manis javanica	Sunda Pangolin	Tenggiling	Insectivore	CR	I	Р	-	BR	F/O
4	Bird	Chloropseidae	Chloropsis sonnerati	Greater Green Leafbird	Burung Daun Besar	Frugivore- insectivore	EN	-	-	-	BR	F
5	Mammal	Cercopithecidae	Macaca fascicularis	Long-tailed Macaque	Kera	Omnivore	EN	Ш	Р	-	BR	F/O
6	Mammal	Cercopithecidae	Macaca nemestrina	Southern Pig-tailed Macaque	Beruk	Omnivore	EN	11	Р	-	BR	F/O
7	Mammal	Hylobatidae	Hylobates funereus	Northern Gray Gibbon	-	Frugivore	EN	-	Р	В	BR	F
8	Bird	Accipitridae	Nisaetus nanus	Wallace's Hawk-eagle	Helang-rajawali Rimba	Carnivore	VU	П	Р	-	BR	F
9	Bird	Bucerotidae	Anthracoceros malayanus	Black Hornbill	Burung Kekek	Frugivore	VU	II	TP	-	BR	F
10	Bird	Bucerotidae	Buceros rhinoceros	Rhinoceros Hornbill	Enggang Badak	Frugivore	VU	П	TP	-	BR	F
11	Bird	Bucerotidae	Rhyticeros undulatus	Wreathed Hornbill	Enggang Gunung	Frugivore	VU	П	ТР	-	BR	F
12	Bird	Phasianidae	Argusianus argus	Great Argus	Burung Kuang	Frugivore- insectivore	VU	II	ТР	-	BR	F
13	Bird	Phasianidae	Lophura ignita	Bornean Crested Fireback	Burung Pegar	Frugivore- insectivore	VU	-	ТР	-	BR	F
14	Mammal	Cervidae	Rusa unicolor	Sambar Deer	Payau	Herbivore	VU	-	-	-	BR	F
15	Mammal	Mustelidae	Aonyx cinereus	Asian Small-clawed Otter	Memerang	Carnivore	VU	I	Р	-	BR	F/W
16	Mammal	Suidae	Sus barbatus	Bearded Pig	Babi Janggut	Omnivore	VU	-	-	-	BR	F/O
17	Mammal	Ursidae	Helarctos malayanus	Sun Bear	Beruang Matahari	Carnivore	VU	I	Р	-	BR	F
18	Bird	Accipitridae	Accipiter trivirgatus	Cresrted Goshawk	Helang Sewah Besar	Carnivore	LC	П	Р	-	BR	F
19	Bird	Accipitridae	Ictinaetus malaiensis	Black Eagle	Helang Hitam	Carnivore	LC	П	Р	-	BR	F/O
20	Bird	Accipitridae	Nisaetus alboniger	Blyth's Hawk-eagle	Helang-rajawali Gunung	Carnivore	LC	11	Р	-	BR	F
21	Bird	Accipitridae	Nisaetus cirrhatus	Changeable Hawk- eagle	Helang Hindek	Carnivore	LC	II	Р	-	BR	F/O
22	Bird	Accipitridae	Pernis ptilorhynchus	Oriental Honey- buzzard	Helang Lebah	Carnivore	LC	II	Р	-	М	F/O

Table 9.3: List of wildlife species found in the Belaga HCS Recovery Site

No	Class	Familly	Scientific Name	English Name	Malay Name	Feeding Guild	IUCN	CITES	WPO 1998	Endemic	Res /Mig	Habitat
23	Bird	Accipitridae	Spilornis cheela	Crested Serpent-eagle	Burung Helang Kuik	Carnivore	LC	II	Р	-	BR	F/O
24	Bird	Alcedinidae	Lacedo melanops	Black-faced Kingfisher	-	Piscivore- Insectivore	LC	-	Р	-	BR	F
25	Bird	Alcippeidae	Alcippe brunneicauda	Brown Fulvetta	Burung Rimba Murai Coklat	Frugivore- insectivore	NT	-	-	-	BR	F
26	Bird	Anhingidae	Anhinga melanogaster	Oriental Darter	Burung Kosa	Aquatic Carnivore	NT	-	TP	-	BR	F/W
27	Bird	Apodidae	Collocalia esculenta	Glossy Swiftlet	Layang-Layang Perut Putih	Insectivore	LC	-	Р	-	BR	F/O
28	Bird	Bucerotidae	Anorrhinus galeritus	Bushy-crested Hornbill	Burung Kawan	Frugivore	NT	П	TP	-	BR	F
29	Bird	Bucerotidae	Anthracoceros albirostris	Oriental Pied Hornbill	Burung Kelingking	Frugivore	LC	Ш	TP	-	BR	F
30	Bird	Caprimulgidae	Caprimulgus macrurus	Large-tailed NightJar	Burung Malas	Insectivore	LC	-	-	-	BR	F/O
31	Bird	Caprimulgidae	Lyncornis temminckii	Malay Eared nightjar	-	Insectivore	LC	-	-	-	BR	F/O
32	Bird	Chloropseidae	Chloropsis cyanopogon	Lesser Green Leafbird	Burung Daun Kecil	Frugivore- insectivore	NT	-	-	-	BR	F
33	Bird	Cisticolidae	Orthotomus atrogularis	Dark-necked Tailorbird	Burung Perenjak Belukar	Insectivore	LC	-	-	-	BR	F
34	Bird	Cisticolidae	Orthotomus ruficeps	Ashy Tailorbird	Peranjak Kelabu	Insectivore	LC	-	-	-	BR	F/O
35	Bird	Cisticolidae	Orthotomus sericeus	Rufous-tailed Tailorbird	Perenjak Ekor Merah	Insectivore	LC	-	-	-	BR	F/O
36	Bird	Cisticolidae	Prinia flaviventris	Yellow-bellied Prinia	Perenjak Kuning	Insectivore	LC	-	-	-	BR	F/O
37	Bird	Columbidae	Chalcophaps indica	Grey-capped Emerald Dove	Punai Tanah	Frugivore	LC	-	-	-	BR	0
38	Bird	Columbidae	Spilopelia chinensis	Eastern Spotted Dove	Punai	Frugivore	LC	-	-	-	BR	0
39	Bird	Coraciidae	Eurystomus orientalis	Oriental Dollarbird	Tiong Batu	Insectivore	LC	-	Р	-	BR+M	F
40	Bird	Corvidae	Corvus enca	Slender-billed Crow	Burung Gagak Hitam	Insectivore	LC	-	-	-	BR	F
41	Bird	Cuculidae	Cacomantis merulinus	Plaintive Cuckoo	Burung Mati Anak	Insectivore	LC	-	-	-	BR	F
42	Bird	Cuculidae	Cacomantis variolosus	Brush Cuckoo	Sewah Gila	Insectivore	LC	-	-	-	BR	F
43	Bird	Cuculidae	Centropus bengalensis	Lesser Coucal	Bubut Kecil	Insectivore	LC	-	-	-	BR	F/O
44	Bird	Cuculidae	Centropus sinensis	Greater Coucal	Bubut Besar	Insectivore	LC	-	-	-	BR	F/O
45	Bird	Cuculidae	Phaenicophaeus curvirostris	Chestnut-breasted Malkoha	Cenuk Birah	Insectivore	LC	-	-	-	BR	F
46	Bird	Cuculidae	Rhinortha chlorophaea	Raffles's Malkoha	Cenok Kera	Insectivore	LC	-	-	-	BR	F

No	Class	Familly	Scientific Name	English Name	Malay Name	Feeding Guild	IUCN	CITES	WPO 1998	Endemic	Res /Mig	Habitat
47	Bird	Cuculidae	Zanclostomus javanicus	Red-billed Malkoha	Burung Cenok Api	Insectivore	LC	-	-	-	BR	F
48	Bird	Dicaeidae	Dicaeum minullum	Plain Flowerpecker	Sepah Puteri Bongsu	Frugivore	LC	-	-	-	BR	F/O
49	Bird	Dicaeidae	Dicaeum trigonostigma	Orange-bellied Flowerpecker	Sepah Puteri Dada Oren	Frugivore	LC	-	-	-	BR	F/O
50	Bird	Dicaeidae	Prionochilus xanthopygius	Yellow-rumped Flowerpecker	Burung Sepah Putih	Frugivore	LC	-	-	-	BR	F/O
51	Bird	Estrildidae	Lonchura fuscans	Dusky Munia	-	Gramnivore- insectivore	LC	-	-	-	BR	F
52	Bird	Eurylaimidae	Cymbirhynchus macrorhynchos	Black-and-red Broadbill	Takau Rakit	Insectivore	LC	-	-	-	BR	F/W
53	Bird	Eurylaimidae	Eurylaimus ochromalus	Black-and-yellow Broadbill	Burung Takau Hitam Kuning	Insectivore	NT	-	-	-	BR	F
54	Bird	Hemiprocnidae	Hemiprocne comata	Whiskered Treeswift	Layang-Layang Berjambul Kecil	Insectivore	LC	-	Р	-	BR	F/O
55	Bird	Hirundinidae	Hirundo javanica	House Swallow	Burung Layang-layang Pasifik	Insectivore	LC	-	Р	-	BR	F/O
56	Bird	Hirundinidae	Hirundo rustica	Barn Swallow	Layang-Layang Hijrah	Insectivore	LC	-	Р	-	М	0
57	Bird	Irenidae	Irena puella	Asian Fairy-bluebird	Murai Gajah	Frugivore- insectivore	LC	-	-	-	BR	F
58	Bird	Megalaimidae	Caloramphus fuliginosus	Bornean Brown Barbet	Takor Dahan	Frugivore- insectivore	LC	-	-	В	BR	F
59	Bird	Megalaimidae	Psilopogon chrysopogon	Gold-whiskered Barbet	Burung Takor Jambang Emas	Frugivore- insectivore	LC	-	-	-	BR	F
60	Bird	Megalaimidae	Psilopogon duvaucelii	Black-eared Barbet	Burung Takur	Frugivore- insectivore	LC	-	-	-	BR	F
61	Bird	Megalaimidae	Psilopogon mystacophanos	Red-throated Barbet	Takor Raya	Frugivore- insectivore	NT	-	-	-	BR	F
62	Bird	Megalaimidae	Psilopogon rafflesii	Red-crowned Barbet	Takor Gunong	Frugivore- insectivore	NT	-	-	-	BR	F
63	Bird	Meropidae	Merops viridis	Blue-throated Bee- eater	Burung Beberek Leher Biru	Insectivore	LC	-	-	-	BR	F
64	Bird	Monarchidae	Hypothymis azurea	Black-naped Monarch	Kelicap Ranting	Insectivore	LC	-	-	-	BR	F
65	Bird	Muscicapidae	Copsychus saularis	Oriental Magpie-Robin	Burung Murai Kampung	Insectivore	LC	-	-	-	BR	F
66	Bird	Muscicapidae	Cyornis turcosus	Malay Blue-flycatcher	Sambar Biru Malaysia	Insectivore	NT	-	-	-	BR	F
67	Bird	Muscicapidae	Kittacincla malabarica	White-rumped Shama	Murai Batu	Insectivore	LC	-	Р	-	BR	F

No	Class	Familly	Scientific Name	English Name	Malay Name	Feeding Guild	IUCN	CITES	WPO 1998	Endemic	Res /Mig	Habitat
68	Bird	Muscicapidae	Muscicapa dauurica	Asian Brown Flycatcher	Burung Sambar Asia	Insectivore	LC	-	-	-	BR+M	F
69	Bird	Muscicapidae	Muscicapa griseisticta	Grey-streaked Flycatcher	Sambar Coklat Kelabu	Insectivore	LC	-	-	-	BR+M	F
70	Bird	Muscicapidae	Muscicapa sibirica	Dark-sided Flycatcher	Sambar Sisi-gelap	Insectivore	LC	-	-	-	BR+M	F
71	Bird	Nectariniidae	Aethopyga siparaja	Crimson Sunbird	Burung Kelicap Sepah Raja	Nectarivore- insectivore	LC	-	-	-	BR	F
72	Bird	Nectariniidae	Anthreptes malacensis	Brown-Throated Sunbird	Kelicap Mayang Kelapa	Nectarivore- insectivore	LC	-	-	-	BR	F
73	Bird	Nectariniidae	Anthreptes simplex	Plain Sunbird	Kelicap Kelabu	Nectarivore- insectivore	LC	-	-	-	BR	F
74	Bird	Nectariniidae	Arachnothera crassirostris	Thick-billed Spiderhunter	Kelicap Jantung Paruh Tebal	Nectarivore- insectivore	LC	-	-	-	BR	F
75	Bird	Nectariniidae	Arachnothera longirostra	Little Spiderhunter	Burung Kelicap Jantung	Nectarivore- insectivore	LC	-	-	-	BR	F
76	Bird	Nectariniidae	Chalcoparia singalensis	Ruby-cheeked Sunbird	Burung Kelicap Belukar	Nectarivore- insectivore	LC	-	-	-	BR	F
77	Bird	Nectariniidae	Cinnyris jugularis	Olive-backed Sunbird	Kelicap Bukit	Nectarivore- insectivore	LC	-	-	-	BR	F
78	Bird	Nectariniidae	Kurochkinegramma hypogrammica	Purple-naped Sunbird	Kelicap Rimba	Nectarivore- insectivore	LC	-	-	-	BR	F
79	Bird	Oriolidae	Oriolus xanthonotus	Dark-throated Oriole	Burung Kunyit Leher Hitam	Frugivore- insectivore	NT	-	-	-	BR	F
80	Bird	Pachycephalidae	Pachycephala cinerea	Mangrove Whistler	Siul Bakau	Insectivore	LC	-	-	-	BR	F
81	Bird	Passeridae	Passer montanus	Eurasian Tree Sparrow	Pipit Urasia	Gramnivore- insectivore	LC	-	-	-	BR	F/O
82	Bird	Pellorneidae	Malacopteron affine	Sooty-capped babbler	Burung Rimba Tinjau Belukar	Insectivore	NT	-	-	-	BR	F
83	Bird	Pellorneidae	Malacopteron magnum	Rufous-crowned Babbler	Burung Rimba Tua Besar	Insectivore	NT	-	-	-	BR	F
84	Bird	Pellorneidae	Pellorneum bicolor	Ferruginous Babbler	Rimba Sampah	Insectivore	LC	-	-	-	BR	F
85	Bird	Pellorneidae	Pellorneum malaccense	Short-tailed Babbler	Rimba Ekor Pendek	Insectivore	NT	-	-	-	BR	F
86	Bird	Pellorneidae	Pellorneum nigrocapitatum	Black-capped Babbler	Rimba Kepala Hitam	Insectivore	LC	-	-	-	BR	F
87	Bird	Pellorneidae	Pellorneum rostratum	White-chested Babbler	Rimba Dada Putih	Insectivore	NT	-	-	-	BR	F
88	Bird	Picidae	Chrysophlegma humii	Chequer-throated Yellownape	Belatuk	Insectivore	NT	-	Р	-	BR	F

No	Class	Familly	Scientific Name	English Name	Malay Name	Feeding Guild	IUCN	CITES	WPO 1998	Endemic	Res /Mig	Habitat
89	Bird	Picidae	Meiglyptes tukki	Buff-necked Woodpecker	Belatuk Tuki-tuki	Insectivore	NT	-	Р	-	BR	F
90	Bird	Picidae	Picus puniceus	Crimson-winged Woodpecker	Belatuk Sayap Merah	Insectivore	LC	-	Р	-	BR	F
91	Bird	Picidae	Sasia abnormis	Rufous Piculet	Belatuk Kecil	Insectivore	LC	-	Р	-	BR	F
92	Bird	Psittacidae	Loriculus galgulus	Blue-crowned Hanging- parrot	Serindit	Frugivore	LC	II	Р	-	BR	F
93	Bird	Pycnonotidae	Brachypodius atriceps	Black-headed Bulbul	Merbah Siam	Frugivore- insectivore	LC	-	-	-	BR	F
94	Bird	Pycnonotidae	Euptilotus eutilotus	Puff-backed Bulbul	Burung Merbah Coklat Berjambul	Frugivore- insectivore	NT	-	-	-	BR	F
95	Bird	Pycnonotidae	lole charlottae	Buff-vented Bulbul	Merbah Riang	Frugivore- insectivore	NT	-	-	-	BR	F/O
96	Bird	Pycnonotidae	Ixidia cyaniventris	Grey-bellied Bulbul	Merbah Kelabu	Frugivore- insectivore	NT	-	-	-	BR	F/O
97	Bird	Pycnonotidae	Ixidia erythropthalmos	Spectacled Bulbul	Burung Merbah Mata Merah Kecil	Frugivore- insectivore	LC	-	-	-	BR	F/O
98	Bird	Pycnonotidae	Ixos malaccensis	Streaked Bulbul	Merbah Lorek Bukit	Frugivore- insectivore	NT	-	-	-	BR	F
99	Bird	Pycnonotidae	Pycnonotus brunneus	Red-eyed Bulbul	Merbah Mata Merah	Frugivore- insectivore	LC	-	-	-	BR	F/O
100	Bird	Pycnonotidae	Pycnonotus goiavier	Yellow-vented Bulbul	Merbah Kapur	Frugivore- insectivore	LC	-	-	-	BR	F/O
101	Bird	Pycnonotidae	Pycnonotus plumosus	Olive-winged Bulbul	Burung Merbah Belukar	Frugivore- insectivore	LC	-	-	-	BR	F
102	Bird	Pycnonotidae	Pycnonotus pseudosimplex	Cream-eyed Bulbul	-	Frugivore- insectivore	LC	-	-	В	BR	F
103	Bird	Pycnonotidae	Pycnonotus simplex	Cream-vented bulbul	Merbah Mata Putih	Frugivore- insectivore	LC	-	-	-	BR	F/O
104	Bird	Pycnonotidae	Tricholestes criniger	Hairy-backed Bulbul	Burung Merbah Bulu Panjang Tengkuk	Frugivore- insectivore	LC	-	-	-	BR	F
105	Bird	Rallidae	Amaurornis phoenicurus	White-breasted Waterhen	Ruak-Ruak	Omnivore	LC	-	-	-	BR+M	W
106	Bird	Rhipiduridae	Rhipidura javanica	Sunda Pied Fantail	Burung Murai Gila	Insectivore	LC	-	Р	-	BR	F/O
107	Bird	Sturnidae	Gracula religiosa	Common Hill Myna	Tiong Emas	Frugivore- insectivore	LC	II	Р	-	BR	F

No	Class	Familly	Scientific Name	English Name	Malay Name	Feeding Guild	IUCN	CITES	WPO 1998	Endemic	Res /Mig	Habitat
108	Bird	Timaliidae	Cyanoderma erythropterum	Chestnut-winged Babbler	Rimba Merbah Sampah	Insectivore	LC	-	-	-	BR	F
109	Bird	Timaliidae	Macronus ptilosus	Fluffy-backed Tit- Babbler	Burung Pong-pong	Insectivore	NT	-	-	-	BR	F
110	Bird	Timaliidae	Mixornis bornensis	Bold-striped Tit- Babbler	Burung Rimba	Insectivore	LC	-	-	-	BR	F
111	Bird	Timaliidae	Stachyris maculata	Chestnut-rumped Babbler	Burung Rimba Rembah Besar	Insectivore	NT	-	-	-	BR	F
112	Bird	Timaliidae	Stachyris nigricollis	Black-throated Babbler	Burung Rimba Bertam	Insectivore	NT	-	-	-	BR	F
113	Bird	Trogonidae	Harpactes diardii	Diard's Trogon	Kesumba Diard	Insectivore	NT	-	-	-	BR	F
114	Bird	Trogonidae	Harpactes duvaucelii	Scarlet-rumped Trogon	Kesumba Puteri	Insectivore	NT	-	-	-	BR	F
115	Bird	Trogonidae	Harpactes kasumba	Red-naped Trogon	Burung Kesumba Batang	Insectivore	NT	-	-	-	BR	F
116	Mammal	Erinaceidae	Echinosorex gymnura	Moonrat	Tikus Ambang Bulan	Omnivore	LC	-	-	-	BR	F
117	Mammal	Felidae	Prionailurus bengalensis	Leopard Cat	Kucing Batu	Carnivore	LC	I	Р	-	BR	F
118	Mammal	Hystricidae	Hystrix brachyura	Malayan Porcupine	Landak Raya	Omnivore	LC	-	Р	-	BR	F/O
119	Mammal	Muridae	Leopoldamys sabanus	Giant Rat	Tikus Munduk Ekor Panjang	Omnivore	LC	-	-	-	BR	F
120	Mammal	Muridae	Rattus sp.	Rat	-	Omnivore	-	-	-	-	BR	F
121	Mammal	Pteropodidae	Balionycteris maculata	Spotted-winged Fruit Bat	Cecadu Sayap Berbintik	Frugivore- insectivore	LC	-	Р	-	BR	F/O
122	Mammal	Pteropodidae	Penthetor lucasi	Lucas's Short-nosed Fruit Bat	Cecadu Hitam-pudar	Frugivore- insectivore	LC	-	Р	-	BR	F/O
123	Mammal	Rhinolophidae	Rhinolophus trifoliatus	Trefoil Horseshoe Bat	Kelawar Ladam Muka Kuning	Frugivore- insectivore	NT	-	Р	-	BR	F/O
124	Mammal	Sciuridae	Callosciurus notatus	Plantain Squirrel	Tupai Kampong	Frugivore	LC	-	-	-	BR	F
125	Mammal	Sciuridae	Callosciurus prevostii	Prevost's Squirrel	Tupai Asia Tiga Warna	Frugivore	LC	-	-	-	BR	F
126	Mammal	Sciuridae	Exilisciurus exilis	Least Pygmy Squirrel	-	Frugivore	DD	-	-	В	BR	F
127	Mammal	Sciuridae	Ratufa affinis	Pale Giant Squirrel	Tupai Kerawak Putih Kuning	Frugivore	NT	-	TP	-	BR	F
128	Mammal	Sciuridae	Ratufa bicolor	Black Giant Squirrel	Tupai Kerawak Hitam	Frugivore	NT	П	-	-	BR	F
129	Mammal	Tupaiidae	Tupaia minor	Lesser Treeshrew	Tupai Moncong Akar	Frugivore	LC	II	Р	-	BR	F
130	Mammal	Viverridae	Arctogalidia stigmatica	Bornean Striped Palm Civet	-	Frugivore	LC	-	Р	В	BR	F

No	Class	Familly	Scientific Name	English Name	Malay Name	Feeding Guild	IUCN	CITES	WPO 1998	Endemic	Res /Mig	Habitat
131	Mammal	Viverridae	Hemigalus derbyanus	Banded Palm Civet	Musang Belang	Omnivore	NT	Ш	Р	-	BR	F
132	Mammal	Viverridae	Paradoxurus hermaphroditus	Common Palm Civet	-	Frugivore- insectivore	LC	111	Р	-	BR	F/O
133	Mammal	Viverridae	Viverra tangalunga	Malay Civet	Musang Tenggalung	Carnivore	LC	-	Р	-	BR	F
134	Reptile	Agamidae	Draco cf. quinquefasciatus	Five-lined Flying Dragon	Cicak Terbang Lima Jalur	Insectivore	LC	-	-	-	BR	F
135	Reptile	Agamidae	Draco cornutus	Horned Flying Lizard	-	Insectivore	LC	-	-	В	BR	F
136	Reptile	Agamidae	Draco melanopogon	Black-barbed Flying Dragon	Cicak Terbang Berjanggut Hitam	Insectivore	LC	-	-	-	BR	F
137	Reptile	Agamidae	Draco sp.	-	-	Insectivore	-	-	-	-	BR	F
138	Reptile	Agamidae	Bronchocela cristatella	Green crested lizard	-	Insectivore	LC	-	-	-	BR	F
139	Reptile	Agamidae	Gonocephalus grandis	Great Anglehead Lizard	Cicak Kepala Segi Besar	Insectivore	LC	-	-	-	BR	F
140	Reptile	Colubridae	Boiga dendrophila	Mangrove Cat Snake	Ular Bangkit	Carnivore	LC	-	-	-	BR	F
141	Reptile	Colubridae	Boiga drapiezii	White-spotted Cat Snake	Ular Mata Kuching	Carnivore	LC	-	-	-	BR	F
142	Reptile	Colubridae	Dendralaphis sp.	-	-	Carnivore	-	-	-	-	BR	F
143	Reptile	Geoemydidae	Cyclemys dentata	Asian Leaf Turtle	Kura-kura	Omnivore	NT	-	-	-	BR	W
144	Reptile	Gekkonidae	Gekko monarchus	Spotted House Gecko	-	Insectivore	LC	-	-	-	BR	F
145	Reptile	Gekkonidae	Cyrtodactylus consobrinus	Peters' Bow-fingered Gecko	-	Insectivore	LC	-	-	-	BR	F
146	Reptile	Scincidae	Eutropis multifasciata	Common Mabuya	Mengkarung Matahari	Insectivore	LC	-	-	-	BR	F/O
147	Reptile	Scincidae	Eutropis rudis	Rough Mabuya	-	Insectivore	LC	-	-	-	BR	F
148	Reptile	Varanidae	Varanus salvator	Common Water Monitor	Biawak	Omnivore	LC	II	Р	-	BR	W
149	Amphibianans	Bufonidae	Phrynoidis juxtasper	Giant River Toad	Katak Puru Sungai	Insectivore	LC	-	-	-	BR	F
150	Amphibian	Dicroglossidae	Limnonectes leporinus	Giant River Frog	-	Insectivore	LC	-	-	-	BR	W
151	Amphibian	Dicroglossidae	Limnonectes sp.	Frog	-	Insectivore	-	-	-	-	BR	W
152	Amphibian	Ranidae	Odorrana hosii	Hose's Frog	Katak Batu Beracun	Insectivore	LC	-	-	-	BR	W
153	Amphibian	Ranidae	Pulchrana cf. glandulosa	Rough-sided Frog	Katak Bersisi Kasar	Insectivore	LC	-	-	-	BR	F
154	Amphibian	Ranidae	Pulchrana glandulosa	Rough-sided Frog	Katak Bersisi Kasar	Insectivore	LC	-	-	-	BR	F
155	Amphibian	Rhacophoridae	Polypedates leucomystax	Four-lined Tree Frog	Katak Pokok Berjalur Empat	Insectivore	LC	-	-	-	BR	W

No	Class	Familly	Scientific Name	English Name	Malay Name	Feeding Guild	IUCN	CITES	WPO 1998	Endemic	Res /Mig	Habitat
156	Fish	Channidae	Channa gachua	Dwarf Snakehead	Haruan Kerdil	Carnivore	LC	-	-	-	BR	W
157	Fish	Channidae	Channa lucius	Forest Snakehead	Bujuk	Carnivore	LC	-	-	-	BR	W
158	Fish	Cyprinidae	Barbodes sellifer	Saddle Barb	-	Omnivore	-	-	-	-	BR	W
159	Fish	Cyprinidae	Tor tambra	Javan Mahseer	Semah	Omnivore	DD	-	-	-	BR	W
160	Fish	Cyprinidae	Tor tambroides	Malayan Mahseer	lkan Kelah	Omnivore	DD	-	-	-	BR	W
161	Fish	Andionidae	Rasbora argyrotaenia	Silver Rasbora	Buntung	Omnivore	LC	-	-	-	BR	W
162	Fish	Andionidae	Rasbora cf. cephalotaenia	Porthole Rasbora	-	Omnivore	LC	-	-	-	BR	W
163	Fish	Andionidae	Rasbora sp.	Rasbora	-	Omnivore	-	-	-	-	BR	W
164	Fish	Andionidae	Trigonopoma gracile	Graceful Rasbora	-	Omnivore	LC	-	-	-	BR	W
165	Fish	Nemacheilidae	Nemacheilus sp.	Stone Loaches	-	Omnivore	-	-	-	-	BR	W
166	Butterflies	Geometridae	Dysphania sp 1.	-	-	Nectarivore	-	-	-	-	BR	F
167	Butterflies	Geometridae	Dysphania sp 2.	-	-	Nectarivore	-	-	-	-	BR	F
168	Butterflies	Lycaenidae	Caleta elna	Elbowed Pierrot	-	Nectarivore	-	-	-	-	BR	0
169	Butterflies	Lycaenidae	Hypolycaena erylus	Common Tit	-	Nectarivore	-	-	-	-	BR	0
170	Butterflies	Nymphalidae	Athyma kanwa	Dot-Dash Sergeant	-	Nectarivore	-	-	-	-	BR	F/O
171	Butterflies	Nymphalidae	Athyma nefte	Colour Sergeant	-	Nectarivore	-	-	-	-	BR	F
172	Butterflies	Nymphalidae	Athyma pravara	Lance Sergeant	-	Nectarivore	-	-	-	-	BR	F
173	Butterflies	Nymphalidae	Cethosia hypsea	Malay Lacewing	-	Nectarivore	-	-	-	-	BR	F
174	Butterflies	Nymphalidae	Charaxes bernardus	Tawny Rajah	-	Nectarivore	-	-	-	-	BR	0
175	Butterflies	Nymphalidae	Cirrochroa emalea	Malay Yeoman	-	Nectarivore	-	-	-	-	BR	0
176	Butterflies	Nymphalidae	Coelites euptychioides	-	-	Nectarivore	-	-	-	-	BR	F
177	Butterflies	Nymphalidae	Euthalia monina	Malay Baron	-	Nectarivore	-	-	-	-	BR	F
178	Butterflies	Nymphalidae	Hypolimnas anomala	Malayan Egg-fly	-	Nectarivore	-	-	-	-	BR	F
179	Butterflies	Nymphalidae	Ideopsis vulgaris	Blue Glassy Tiger	-	Nectarivore	-	-	-	-	BR	F
180	Butterflies	Nymphalidae	Moduza procris	Commander	-	Nectarivore	-	-	-	-	BR	F
181	Butterflies	Nymphalidae	Mycalesis fusca	Malayan Bush Brown	-	Nectarivore	-	-	-	-	BR	0
182	Butterflies	Nymphalidae	Mycalesis horsfieldi	Bush Brown	-	Nectarivore	-	-	-	-	BR	F
183	Butterflies	Nymphalidae	Neorina lowii	Malayan Owl	-	Nectarivore	-	-	-	-	BR	F

No	Class	Familly	Scientific Name	English Name	Malay Name	Feeding Guild	IUCN	CITES	WPO 1998	Endemic	Res /Mig	Habitat
184	Butterflies	Nymphalidae	Neptis hylas	Common Sailor	-	Nectarivore	-	-	-	-	BR	F
185	Butterflies	Nymphalidae	Neptis leucoporos	Grey Sailor	-	Nectarivore	-	-	-	-	BR	F
186	Butterflies	Nymphalidae	Polyura athamas	Common Nawab	-	Nectarivore	-	-	-	-	BR	F
187	Butterflies	Nymphalidae	Rhinopalpa polynice	Wizard	-	Nectarivore	-	-	-	-	BR	F
188	Butterflies	Nymphalidae	Tanaecia iapis	Horsfield's Baron	-	Nectarivore	-	-	-	-	BR	F/O
189	Butterflies	Nymphalidae	Vindula dejone	Cruiser	-	Nectarivore	-	-	-	-	BR	0
190	Butterflies	Nymphalidae	Ypthima fasciata	Common Six Ring	-	Nectarivore	-	-	-	-	BR	F/O
191	Butterflies	Nymphalidae	Ypthima pandocus	Common Three Ring	-	Nectarivore	-	-	-	-	BR	F/O
192	Butterflies	Papilionidae	Graphium agamemnon	Tailed Jay	-	Nectarivore	-	-	-	-	BR	0
193	Butterflies	Papilionidae	Graphium delessertii	Malayan zebra	-	Nectarivore	LC	-	-	-	BR	0
194	Butterflies	Papilionidae	Graphium doson	Common Jay	-	Nectarivore	-	-	-	-	BR	0
195	Butterflies	Papilionidae	Papilio memnon	Great Mormon	-	Nectarivore	-	-	-	-	BR	F
196	Butterflies	Papilionidae	Pathysa antiphates	Five Bar Swordtail	-	Nectarivore	-	-	-	-	BR	0
197	Butterflies	Papilionidae	Trogonoptera brookiana	Rajah Brooke's Birdwing	-	Nectarivore	LC	II	Р	-	BR	F
198	Butterflies	Papilionidae	Troides amphrysus	Malay Birdwing	-	Nectarivore	LC	-	-	-	BR	F/O
199	Butterflies	Papilionidae	Troides helena	Common Birdwing	-	Nectarivore	LC	-	-	-	BR	F
200	Butterflies	Pieridae	Appias lyncida	Chocolate Albatross	-	Nectarivore	-	-	-	-	BR	F
201	Butterflies	Riodinidae	Paralaxita telesia	Malay Red Harliquin	-	Nectarivore	-	-	-	-	BR	F
202	Dragonflies	Calopterygidae	Neurobasis chinensis	Stream Glory	-	Insectivore	LC	-	-	-	BR	W
203	Dragonflies	Calopterygidae	Vestalis amoena	Charming Flashwing	-	Insectivore	LC	-	-	-	BR	W
204	Dragonflies	Calopterygidae	Vestalis gracilis	Clear-winged Forest glory	-	Insectivore	LC	-	-	-	BR	W
205	Dragonflies	Chlorocyphidae	Heliocypha biforata	Magenta-backed Jewel	-	Insectivore	LC	-	-	-	BR	W
206	Dragonflies	Devadattidae	Devadatta sp.	-	-	Insectivore	-	-	-	-	BR	W
207	Dragonflies	Euphaeidae	Dysphaea dimidiata	Black Velvetwing	-	Insectivore	LC	-	-	-	BR	W
208	Dragonflies	Euphaeidae	Euphaea tricolor	Torrent Dart	-	Insectivore	LC	-	-	-	BR	W
209	Dragonflies	Libellulidae	Brachydiplax chalybea	Rufous-backed Marsh Hawk	-	Insectivore	LC	-	-	-	BR	W
210	Dragonflies	Libellulidae	Camacinia gigantea	Giant Forest Skimmer	-	Insectivore	LC	-	-	-	BR	W

No	Class	Familly	Scientific Name	English Name	Malay Name	Feeding Guild	IUCN	CITES	WPO 1998	Endemic	Res /Mig	Habitat
211	Dragonflies	Libellulidae	Cratilla metallica	Dark- tipped Forest	Pepatung Metalik	Insectivore	LC	-	-	-	BR	F/O
				Skimmer								
212	Dragonflies	Libellulidae	Neurothemis fluctuans	Common Parasol	-	Insectivore	LC	-	-	-	BR	W
213	Dragonflies	Libellulidae	Orchithemis pulcherrima	Variable Sentinel	-	Insectivore	LC	-	-	-	BR	F/W
214	Dragonflies	Libellulidae	Orthetrum glaucum	Blue Marsh Hawk	-	Insectivore	LC	-	-	-	BR	W
215	Dragonflies	Libellulidae	Orthetrum pruinosum	Crimson-tailed marsh	-	Insectivore	LC	-	-	-	BR	F/W
				hawk								
216	Dragonflies	Libellulidae	Orthetrum sabina	Green Marsh Hawk	Pepatung	Insectivore	LC	-	-	-	BR	F/W
217	Dragonflies	Libellulidae	Rhodothemis rufa	Rufous Marsh Glider	-	Insectivore	LC	-	-	-	BR	W
218	Dragonflies	Libellulidae	Rhyothemis obsolescens	Flutterers	-	Insectivore	LC	-	-	-	BR	F/O
219	Dragonflies	Libellulidae	Trithemis festiva	The black stream glider	-	Insectivore	LC	-	-	-	BR	W
220	Dragonflies	Platycnemididae	Prodasineura verticalis	Red-striped black	-	Insectivore	LC	-	-	-	BR	W
				bambootail								

Source: MEC – 2022

Notes:

- The order of the species lists begins with the identified RTE species, based on their taxonomy
- IUCN Redlist Ver.3.1: EN=Enandgered; VU= Vulnerable; NT= Near Threatened; LC= Least Concern.
- CITES: animal species in the CITES trade ctegories = Appendix I and Appendix II.
- Sarawak Wildlife Protection Ordinance 1998 (WPO 1998): TP= Totally Protected (Shcedule 1.1); P= Protected (Shcedule 1.2)
- Res /Mig (Resident or Migrant): BR= Breeding resident; M= Migrant species; BR+M= Breeding residents with populations seasonally augmented by non-breeding.
- Habitat: A= aerial; O= open & disturbed areas; Oc= open areas near the coast; F= forest species; W= wetlands.

9.2 Appendix 2: Photos of flora and fauna found in the Belaga HCS Recovery Site

9.2.1 Floral species collection





Begonia sp3 - Schedule II

Begonia sp4 - Schedule II

Durio dulcis – Endemic to Borneo




9.2.2 Fauna species collection

Birds





Irena puella (Asian Fairy Bluebird)-Least Concern

Caloramphus fuliginosus (Bornean Brown Barbet)-Least Concern

Hypothymis azurea (Black-naped Monarch)-Least Concern



Malacopteron affine (Sooty-capped Babbler)-Near Threatened



Pycnonotus goiavier (Yellow-vented Bulbul)-Least Concern

Ixidia erythropthalmos (Spectacled Bulbul)-Least Concern



Mammals









Hemigalus derbyanus (Banded Palm Civet)-Near Threatened, Protected (Footprint)



Rusa unicolor (Sambar Deer)-Vulnerable, Protected (Footprint)

Reptiles





Amphibians



Fishes



Butterflies



113





Dragonflies





Other Insects





Order: Neuroptera

Order: Coleoptera