



# BIODIVERSITY OF THE MUNGKU BARU *ULIN* FOREST, CENTRAL KALIMANTAN, INDONESIA



# **Biodiversity of the Mungku Baru *Ulin* Forest, Central Kalimantan, Indonesia**

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Report on research commissioned by:

**International Animal Rescue (IAR)**

And performed by:

**The Orangutan Tropical Peatland Project (OuTrop)**

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## EXECUTIVE SUMMARY

Mungku Baru Forest is important for conservation because of its high abundance of *ulin* trees (threatened with extinction in Borneo) and pristine nature, which is remarkable considering its close proximity to the provincial capital, Palangka Raya. We surveyed the biodiversity and ape populations in Mungku Baru Forest between January-March 2010. This study included orang-utan nest surveys and gibbon triangulation surveys to estimate population densities, and transect surveys and camera traps to assess vertebrate fauna biodiversity.

The 16,000 ha Mungku Baru proposed conservation area contains a huge diversity of wildlife, including a number of species at risk of extinction, such as orang-utans, Bornean Southern gibbons, clouded leopards, rhinoceros hornbill and false gharial. Through sightings, camera-trap photographs and community surveys, we documented 34 species of mammal (19 of which are protected species by Indonesian law), 106 species of bird (27 protected), 20 species of reptile and amphibian (5 protected) and 15 species of fish. The World Conservation Union (IUCN) classifies 1 of these species as Critically Endangered (white-shouldered ibis, *Pseudibis davisoni*), 10 as Endangered and 16 as Vulnerable – meaning that they face a high threat of extinction in the immediate future and, hence, that the Mungku Baru Forest is important for their conservation.

The Mungku Baru proposed conservation area supports high-density populations of two flagship ape species: the Bornean orang-utan (*Pongo pygmaeus*) and the Bornean Southern gibbon (*Hylobates albibarbis*). These species are currently suffering range-wide population declines because of habitat loss caused by illegal logging, conversion to oil-palm plantation and fire, and thus Mungku Baru is important for their conservation.

Mungku Baru is home to a high abundance and diversity of hornbills, indicating high habitat quality. Five species were recorded, including the Rhinoceros hornbill (*Buceros rhinoceros*), an iconic Central Kalimantan species. The forest is remarkable in supporting eight species of primate and five species of cat, as well as pangolins, porcupine, otters, two stork species, white-shouldered ibis, great Argus pheasant, at least two species of crocodile and three species of turtle, all of which are at risk of extinction and in need of focused conservation efforts. In addition, numerous forest resources are harvested by the local communities and Mungku Baru Forest is important for local culture and identity.

Despite this wealth of wildlife and forest resources, the forest and its wildlife are currently threatened by conversion to oil-palm and potential coal mining concessions, gold mining in surrounding rivers, and over hunting of certain species.

## RECOMMENDATIONS

The forest of Mungku Baru contains a wealth of vertebrate fauna, including a number of species at risk of extinction, and has high habitat quality, including large areas of virgin rainforest. Many forest resources are also harvested by the local communities, and the area is important for local culture and identity. Despite this richness, the forest and its wildlife is currently threatened by conversion to oil-palm and potential coal mining concessions. Consequently, we recommend:

1. Protection of the 16,000 ha forest at Mungku Baru, in order to ensure continued conservation of the valuable biodiversity found here and to prevent further conversion of the forest into oil-palm plantations;
2. Work with the local community of Mungku Baru village to initiate a participatory forest management system, including developing sustainable harvesting methods of plants and wildlife;
3. Encourage further funding and establishment of local NGO / working group to continue the process of protection of Mungku Baru Forest;
4. Obtain support of the relevant government departments for conservation of the valuable natural resources of Mungku Baru under a participatory village management system, including from the regional Department of Nature Conservation (BKSDA), regional Departments of the Environment and Forestry, Kabupaten Gunung Mas and Kotamadya Palangka Raya;
5. Encourage regulation of upstream gold-mining to improve water quality and allow the recovery of fish stocks;
6. Maintain existing research camp, trail system and encourage continued biodiversity and forestry research in Mungku Baru;
7. Investigate potential of ecotourism in Mungku Baru as a means of generating income and sustainable use of Mungku Baru Forest. This is a potentially good area for ecotourism as this site is close to Palangka Raya, has relatively easy terrain on which to walk, and has a high abundance and diversity of fauna.

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# 1. INTRODUCTION

The work described in this report forms part of the wider Mungku Baru Forest Conservation Project, coordinated by International Animal Rescue. The overall objective of this project is to protect and rehabilitate the forest of Mungku Baru. This report contributes to this objective by providing information on the faunal biodiversity and ape populations of the forest, the importance of the forest for biodiversity conservation, community use of forest resources and threats to these.

Sundaland contains one of the richest concentrations of biodiversity on earth and preserving this biodiversity is critical for global biodiversity conservation (Myers *et al.*, 2000). The island of Borneo covers less than 0.2% of the earth's land surface (743,330 km<sup>2</sup>), yet houses a wealth of biodiversity, including up to 15,000 species of flowering plants (as many as the whole African continent), 3,000 species of tree, 222 species of mammal and 420 species of resident birds (MacKinnon *et al.*, 1996). This represents 4% of the world's plant species and 5% of birds and mammals (MacKinnon *et al.*, 1996). It is also home to 13 non-human primate species, eight of which are endemic (i.e., are found nowhere else on earth, Groves, 1993, 2001), and the large majority (54,000; 89%) of the world's remaining orang-utans (*Pongo spp.*, Wich *et al.*, 2008).

This biodiversity is facing severe threats, however, and biodiversity loss in Borneo is consequently among the highest in the world. Much of this biodiversity loss is due to loss in forest cover: Borneo is currently losing more than 500,000 ha of forest each year; one of the highest rates of forest loss in the world (FAO, 2010). The habitats most threatened by forest loss are the more accessible lowland areas, where species richness is greatest (MacKinnon *et al.*, 1996). This threatens even the most well-known of Borneo's wildlife; for example, it has been estimated that, of the Bornean orang-utan population at the beginning of the twentieth century, no more than 7% survive today (Rijksen and Meijaard, 1999). Further threats include habitat degradation and fragmentation, and hunting in some areas (MacKinnon *et al.*, 1996; Rijksen and Meijaard, 1999; Wich *et al.*, 2008). The continuing rapid expansion of oil-palm plantations is a particularly severe threat, especially to orang-utans (Fitzherbert *et al.*, 2008; Wich *et al.*, 2008).

The forests around the capital city of Central Kalimantan, Palangka Raya, have not been spared from destruction and degradation. Like the rest of the island, these forests have witnessed large-scale deforestation and drainage of peat-swamp forest, and consequent fires, for logging, agriculture and settlement (Page *et al.*, 2002). With the exception of the Sabangau peat-swamp forest (Morrogh-Bernard *et al.*, 2003), few areas of relatively intact forest remain in the vicinity of Palangka Raya. One of the only remaining intact forests in this district is the unprotected area Mungku Baru Forest, close to Mungku Baru village, and the study and conservation of this forest is therefore of great importance.

## 2. AIMS

The aims of this research were to document:

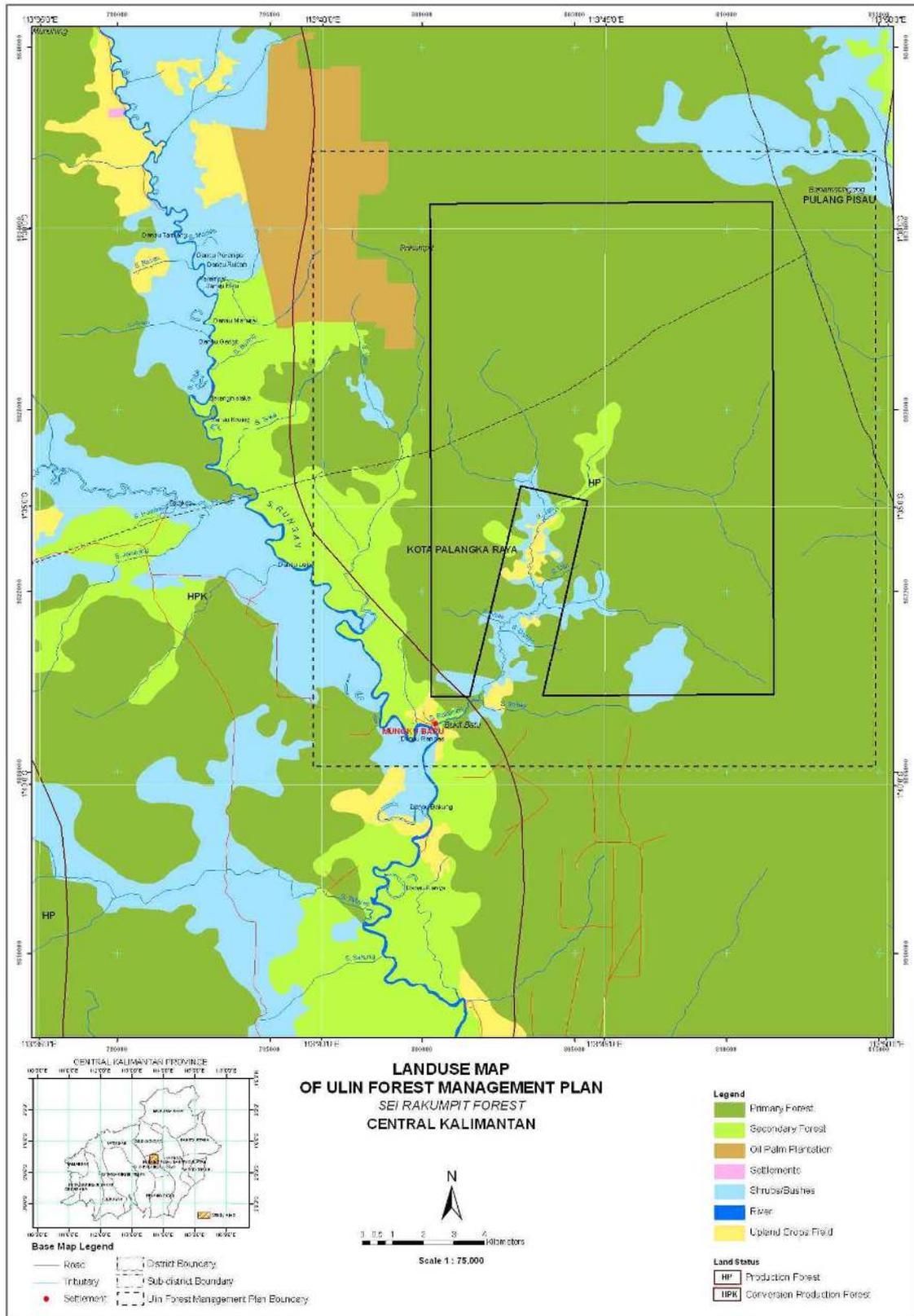
1. The species of fauna present in the area, in particular those species at risk of extinction;
2. The density of the area's flagship ape species, the southern Bornean orangutan (*Pongo pygmaeus wurmbii*) and Bornean southern gibbon (*Hylobates albibarbis*);
3. The use of natural forest resources by local community;
4. The importance of Mungku Baru Forest for biodiversity conservation;
5. Threats to biodiversity in the area.

## 3. SITE DESCRIPTION

The location of the Mungku Baru Forest is shown in Figure 3.1. Mungku Baru is notable as one of the few remaining forests that still contain large amounts of *ulin*, the Borneo Ironwood (*Eusideroxylon zwageri*). This tree is one of the most durable and heaviest timbers in the world, has known anti-bacterial properties and is commonly used for local medicinal purposes. Consequently, it is highly prized, expensive and is threatened by over-exploitation. It is now listed as "Vulnerable" by the World Conservation Union (IUCN). *Ulin* can grow for over 1,000 years, with a height of up to 50 meters and a diameter of 220 cm. Its' very slow growth rate (mean radial growth 0.058cm/year) prevents rapid recolonisation following disturbance and makes cultivation difficult, pushing this species further along the path to extinction.

During the 1960s, legend developed among the local Dayak people of Mungku Baru that anyone who removed an *ulin* tree from the Mungku Baru forest would die (Herry Mulyadi Tuwan, pers. comm.). This local belief arose through real-life observations and has been maintained in the community over the years, allowing the continued persistence of *ulin* in this forest.

Around 1970, two big logging concessions managed the surrounding *ulin* forest. The northern part was managed by PT. Dayak Besar and the southern part by PT. Gempita. The resulting conflict between these companies ended up in court. To resolve this conflict a command was issued to the heads of the companies to reduce the boundaries of their areas by 3 km. In 1998, surveys were performed concerning plans for transmigration settlements, and a track was cleared to make a road. The community of Mungku Baru did not agree, however, and with help from the Forestry Department, this plan was blocked. In 2000, the Mayor and other government staff performed a survey of the *ulin* forest. Because of this, the *ulin* forest at Mungku Baru was granted a second reprieve from logging. This sequence of events has culminated in the continued presence of this pristine area of *ulin* forest within only two hours travel of Palangka Raya.



**Figure 3.1. Map showing location of Mungku Baru forest in Central Kalimantan and land use in the area. The black 'box' indicates the proposed Mungku Baru Conservation Area and the encroaching oil palm plantation is clearly visible in the North West. Map courtesy of International Animal Rescue.**

The forest at Mungku Baru is highly heterogenous (see pictures in Appendix III). The forest lies at low altitude (ca. 60 m above sea level), and the topography of the area is undulating, creating a mosaic of habitat types intersected by a number of small rivers/streams. Much of the forest is undulating lowland dipterocarp forest, which is pristine in many areas and has a tall canopy, with very little undergrowth and pockets with large amounts of *ulin*. In addition, there are areas of alluvial bench-like forest close to the rivers; fresh-water swamp/peat forest not far from the rivers in areas of poor drainage and containing a number of common swamp tree species, such as *Diospyros*, *Tristanopsis*, *Palaquium*, *Xylopi*a and *Syzygium*; very low-canopy kerangas forest with lots of small poles; and natural open areas with ferns. Fire has encroached upon some of these natural clearings, which are currently regenerating (this is possibly a natural cycle). The understory in some forest areas contains an abundance of rattan (*Calamus* spp.), varying from small viney species, to medium-sized species with hand-shaped leaves and big plants with nasty thorns.

Water quality/condition in the River Rakumpit, through which the forest is accessed, is very unstable. Heavy downpours lead to sharp increases in water level about three hours later and if there is no rain in three days the water level will fall again. This can happen rapidly: within one day the water level can rise or fall 80 cm. These rapid changes in water level created difficulties for the research team on the outward journey from the forest (see below).

## 4. METHODS

### 4.1 Timetable

A reconnaissance trip to discuss the project with the local villagers, and organise staff and logistics was conducted on 28<sup>th</sup> January 2010. Following this trip, two local villagers were sent to clear the River Rakumpit of fallen wood in advance of the field team's arrival.

The bulk of the fieldwork was conducted from 2-16<sup>th</sup> February 2010. The field schedule for this time is given in Table 4.1. The water level was high during the trip up, but a lack of rainfall after the first three days led to very low water levels and exceedingly difficult navigation for the return trip, which took three days.

A second trip into the forest was conducted from 27-28<sup>th</sup> February 2010, to change the camera trap batteries and obtain any missing GPS positions. Water level in the river was reasonably high during this trip and so navigation was not too difficult. A final trip was made on 18-19<sup>th</sup> March 2010, to remove the camera traps.

**Table 4.1. Fieldwork schedule, 2-16<sup>th</sup> February 2010.**

<b>Date (Feb 2010)</b>	<b>Activities</b>
2	Travel to MB, night on R. Rakumpit just outside forest. Biodiversity surveys from boat and disturbed forest.
3	Travel to forest camp. Biodiversity surveys from boat and on trails close to camp. Placing camera traps.
4	Orang-utan survey transect 1, gibbon survey training, biodiversity surveys (including nocturnal canoe trip)
5	Orang-utan survey transect 2, gibbon survey, biodiversity surveys (including nocturnal surveys)
6	Orang-utan survey transect 3, gibbon survey, biodiversity surveys (including nocturnal surveys)
7	Orang-utan survey transect 4, biodiversity surveys
8	Orang-utan survey transect 5, gibbon survey, biodiversity surveys
9	Gibbon survey, biodiversity surveys
10	Orang-utan survey transect 6, gibbon survey, biodiversity surveys
11	Orang-utan survey transect 7, biodiversity surveys (including nocturnal surveys)
12	Biodiversity surveys, changing camera trap batteries
13	Travel downriver (very low water level made travel difficult)
14	Travel downriver (very low water level made travel difficult)
15	Travel downriver (very low water level made travel difficult)
16	Travel from MB to Palangka Raya

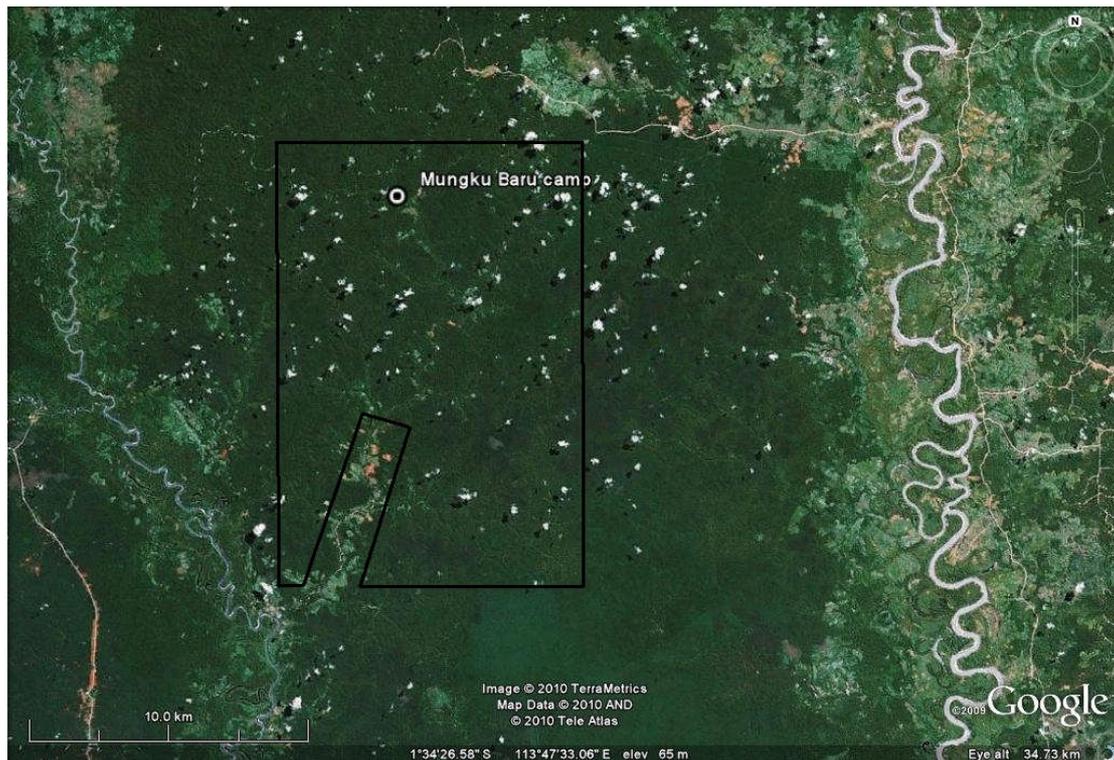
## **4.2 Survey Methods**

Research was conducted from the *Kayu Ulin* research camp in the north of the proposed protected area, constructed by Pak Herry Tuwan (Figure 4.1). The locations of the orang-utan survey transects, gibbon listening posts, camera traps and other locations mentioned in the text are shown in Figure 4.2 and the GPS coordinates for these locations are given in Table 4.2.

### **4.2.1 Biodiversity Surveys**

Biodiversity surveys were conducted on each day of the main block of fieldwork from 2-12<sup>th</sup> February 2010. These surveys involved a combination of different methods and did not follow a set pattern each day, as the objective of these surveys was to maximise the number of species sighted by (a) sampling all habitat types; (b) focussing surveys in those habitat types with higher faunal diversity; (c) using a variety of survey methods, as different methods are more effective for detecting different taxa. Surveys were focussed on avian and mammalian fauna, with additional surveys of fish, reptiles and amphibians, and were conducted for about 12 h each day.

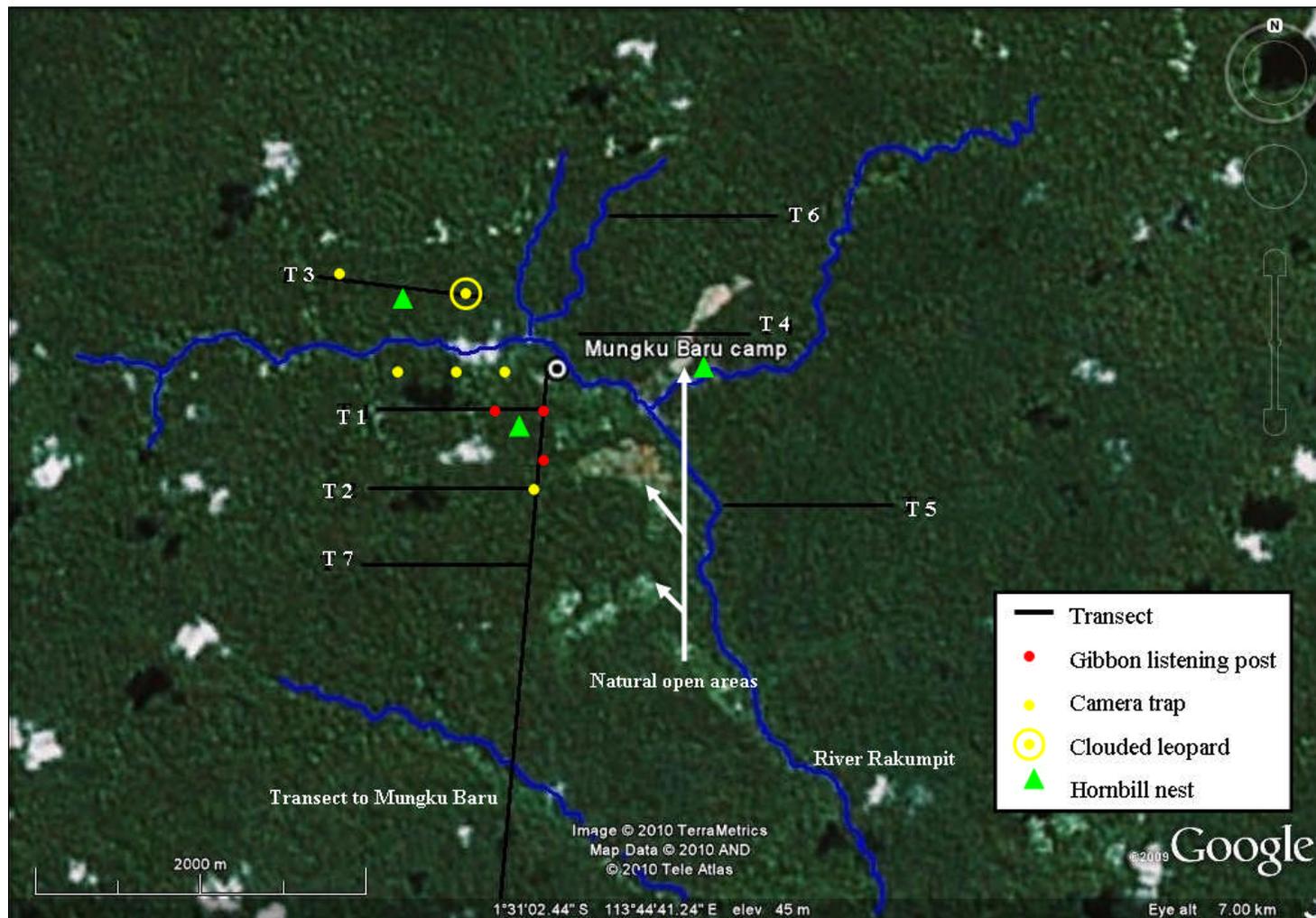
Bird species were identified by sight and call by an ornithologist experienced with Bornean avi-fauna (MLD). The ability to identify bird species by call is particularly important in tropical forests, due to the thick vegetation and low visibility in this habitat (Dragiewicz, 2005). Avian diversity was assessed through a combination of methods, including line-transect methods and point surveys (Barlow *et al.*, 2007; Husson *et al.*, 2007; Gardner *et al.*, 2008).



**Figure 4.1.** Map showing location of the *Kayu Ulin* research camp within the proposed conservation area.

**Table 4.2.** GPS locations of places referred to in the text. Positions are in the WGS 84 datum, in the format hddd.mmsss.

South coordinate	East coordinate	Description
001.64839	113.70042	Mungku Baru village on the Rakumpit River
001.51208	113.73868	<i>Kayu Ulin</i> research camp
001.51568	113.73817	Start OU transect 1
001.51563	113.72932	End OU transect 1
001.52423	113.73677	Start OU transect 2
001.50947	113.73724	Start of OU transect 3
001.51055	113.74503	Start OU transect 4
001.51625	113.74509	Start OU transect 5
001.51629	113.75437	End OU transect 5
001.50640	113.73779	Start OU transect 6
001.50717	113.74742	End OU transect 6
001.53132	113.73517	Start OU transect 7
001.51568	113.73817	Gibbon listening post 1
001.51565	113.73539	Gibbon listening post 2
001.51853	113.73751	Gibbon listening post 3
001.51073	113.74703	IAR camera A (kerangas)
001.51248	113.73714	Camera trap N11
001.50948	113.73716	Camera trap N23
001.50919	113.72891	Camera trap N24
001.61349	113.73047	Tributary on Rakumpit - lots of dirty water came in
001.57807	113.74473	First tributary on Rakumpit - mine and dirty water
001.51820	113.74454	Big burnt area



**Figure 4.2. Map showing locations of places referred to in the text.** The rhinoceros hornbill nest was on Transect 3, the wrinkled hornbill nest near Transect 4 and the black hornbill nest on Transect 1.

Diurnal mammalian and other fauna were surveyed visually during the course of bird line-transects, point counts and river surveys, and records were taken of any new species encountered during orang-utan nest surveys, gibbon triangulation surveys, other fieldwork and time spent camping in the forest. Identifications were checked against appropriate field guides (Inger and Stuebing, 1997; Payne and Francais, 1998; Stuebing and Inger, 1999; Das, 2004; Davison and Fook, 2007; Myers, 2009), with photographs taken wherever possible. Nocturnal fauna were assessed at night by torchlight, using standard line-transect methods. This method is particularly appropriate for assessment of nocturnal primates (Nekaris *et al.*, 2008) and amphibians (Pearman *et al.*, 1995).

During all fieldwork, we remained alert to the presence of faunal species and all species and identifiable signs (e.g., sun bear, *Helarctos malayanus*, claw marks on trees). Photographs were taken of all new species encountered, where possible. A day-by-day account of biodiversity survey field activities is given in Appendix I.

#### **4.2.2 Camera Traps**

Eight camera traps were positioned throughout the forest in different habitat types, in order to picture as wide a range of species as possible. Unfortunately, the two roll-film camera traps malfunctioned, due to humidity destroying the films, but the remaining six digital cameras operated without fault. Following methods trialled in other areas of forest near Palangka Raya (Cheyne and MacDonald, in press), traps were positioned by fallen logs and along trails, where the likelihood of obtaining photographs is higher. Cameras were positioned on the 2<sup>nd</sup> February, batteries changed on the 12<sup>th</sup> and 28<sup>th</sup> February, and cameras removed on 18<sup>th</sup> March 2010. This yielded a total of 270 camera trap days/nights.

#### **4.2.3 Orang-utans**

Due to their elusive nature and typically low population densities, obtaining orang-utan population density estimates from sightings of actual animals is very difficult: vast distances would have to be walked in order to obtain a sufficient sample size of sightings for accurate density estimates. Thus, orang-utan density is estimated by counting nests along straight-line transects (van Schaik *et al.*, 1995), which is a quick, cost-effective method that uses indicators of presence, as opposed to actual counts of animals. Orang-utans make a new nest each night for sleeping and sometimes another nest during the day for feeding or resting. The perpendicular distance from the transect to the nest was measured, and the effective strip width and orang-utan nest density was estimated using the computer programme DISTANCE. Nest density was then converted to animal density using standardised nest-building parameters and conversion figures (Husson *et al.*, 2009) Thus, orang-utan nest density is a suitable indicator of abundance that can be compared between sites and to monitor trends over time (Husson *et al.*, 2007, 2009). Orang-utan nests were surveyed along 7.25 km of transects. This distance was distributed between seven transects covering areas of lowland *ulin* forest, fresh-water swamp forest, kerangas forest and open fern areas (Figure 4.2).

#### 4.2.4 Gibbons

As for orang-utans, obtaining gibbon population estimates from actual sighting of live animals is impractical in most cases. Gibbon density was estimated using fixed-point counts based on auditory sampling of morning singing bouts, as described by Brockelman and Ali (1987), at three distinct survey sites within the research area. This method has been recommended for the survey of gibbons for the following reasons: (i) gibbon's inconspicuous behaviour and preference for high canopy makes the use of line transects for surveying unsuccessful (Brockelman and Ali, 1987; Brockelman and Srikosamatara, 1993; O'Brien *et al.*, 2004; Nijman and Menken, 2005; Cheyne *et al.*, 2008); and (ii) the territorial behaviour of gibbons allows efficient mapping of triangulated points (Sutherland, 2000); (iii) the animals' loud calls, audible from a considerable distance, allow their detection from greater distances than by using sightings (Davies, 2002); and (iv) fixed-point counts allow quick, time-efficient surveys, with more reliable results than a line transect survey conducted within the same time frame (Nijman and Menken, 2005).

The density estimates were obtained with the following formula, developed by Brockelman and Ali (1987):

$$D = n / [p(m) \times E]$$

where  $n$  is the number of groups heard in an area, as determined by the mapping;  $p(m)$  is the estimated proportion of groups expected to sing during a sample period of  $m$  days; and  $E$  is the effective listening area. The correction factor  $p(m)$  was determined with the formula  $p(m) = 1 - [1 - p(1)]^m$ , with  $p(1)$  being the singing probability for any given day, and  $m$  being the number of survey days. The effective listening area was calculated using a fixed radius of 1 km around each listening post, and was defined by the area in which at least two of the listening posts could hear gibbons singing. Gibbon surveys were performed on five days, though no singing was heard on one day, due to heavy rain that morning. The minimum recommended sample size of four days to hear all groups in the area (Hamard *et al.*, in press) was therefore achieved.

#### 4.2.5 Community Interviews

Interviews were conducted with local forest workers and the Mungku Baru village community to identify any other (rare and relatively easy to identify accurately) species present in the area that may not be detected through our surveys, and to identify potential threats that these species may face (e.g., hunting). This can also provide an important back-up check of census data (van der Hoevena *et al.*, 2004; Meijaard and Marshall, 2008). Respondents were asked to confirm whether species shown in unlabelled (but pre-identified) photographs were present in the area's forest. A species was only recorded as potentially present in the area if the majority of respondents indicated that it was present, and any potentially dubious cases are noted.

Photographs of selected species that are not found in Borneo, but which have some resemblance to species that are very likely/certain to be found in Mungku Baru forest were also included, in order to check the reliability of responses. These include the serval cat, *Leptailurus serval*, which resembles the leopard cat; nine-banded armadillo, *Dasybus novemcinctus*, which resembles a pangolin; and great hornbill,

*Buceros bicornis*, which resembles the other hornbill species, as well as some species that are virtually certain to be in the study area (brahminy kite, *Haliastur indus*; and long-tailed macaque, *Macaca fascicularis*). The questionnaire used is reproduced in Appendix II.

## 5. FAUNAL BIODIVERSITY

### 5.1 The Biodiversity of Mungku Baru Forest

#### 5.1.1 Mammals

Combining data from sightings during biodiversity surveys, species caught on camera traps and species reliably identified as present in the area during community interviews, reveals a total of 34 species of mammal present in Mungku Baru Forest (Section 5.3). Of these species, seven are listed by the IUCN as “Endangered”, ten as “Vulnerable” and four as “Near Threatened”. Nineteen are legally protected in Indonesia. Note that, due to the limited survey period and area covered by surveys, this list is unlikely to be complete. Thus, whilst it should include the majority of diurnal and non-secretive species present in any number in the study area, there are likely to be many more species present in the area but unrecorded. Species groups that will be particularly under represented in this list are predominantly nocturnal and include bats, squirrels and rats (of which there are many similar-looking species that we were unable to distinguish from our sightings/photographs) and mustelids, including civets, many of which are nocturnal and secretive.

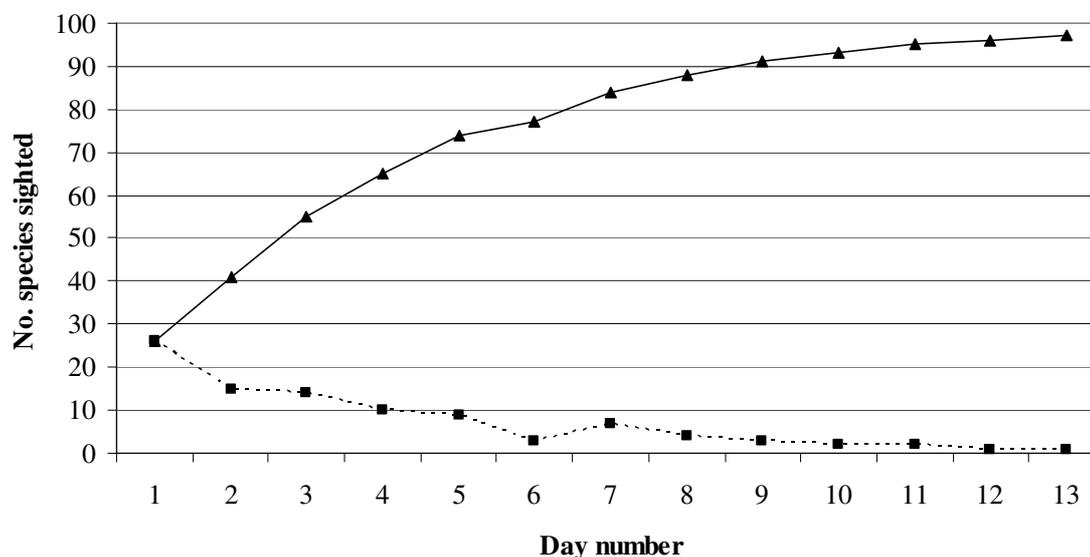
The abundance of many mammal species appeared high. In addition to the area’s apes (see below), red langurs and macaques were seen on most days, deer were heard barking on most days and there were numerous mouse deer encounters. In addition, the rare and little-known tufted ground squirrel was also sighted at very close proximity and a highly-secretive clouded leopard was pictured by a camera trap (see cover image and location of camera trap that took the picture in Figure 4.2).

#### 5.1.2 Birds

A total of 106 bird species were confirmed as present in Mungku Baru (Appendix III). Of these, one species is listed by the IUCN as “Critically Endangered”, one as “Endangered” and four as “Vulnerable”; 27 are protected in Indonesia. Four of these species at-risk species were identified as present in the area through the community questionnaires and, hence, their presence in the area cannot be 100% confirmed. These species are relatively distinctive, however, and the mere fact that they are rare means that it is likely that they will not be seen during rapid surveys such as these, highlighting the importance of community questionnaires to supplement field data.

Due to the fact that these biodiversity surveys were conducted over a relatively short period of time (13 days) and within a small area, it is possible that some species actually present in the area were not detected during our surveys. An impression of the completeness of a species inventory can be gained through assessing changes in the number of new species records obtained *per* unit time as the study period progresses. This can then be used to create a “species accumulation curve”, which allows assessment of the completeness of the sample (Colwell and Coddington,

1994). Such a curve for Mungku Baru is presented in Figure 5.1, with one survey day assumed to represent an equal amount of survey effort (a reasonable assumption, as each survey day was about 12 h long).



**Figure 5.1. Bird species accumulation curve for Mungku Baru.** The solid line represents the total number of species sighted by each day of the study period, and the dotted line represents the number of new species sighted on each day. Note that the total number of species sighted is not equal to the number of species listed in Section 5.3, because the presence of some species was confirmed through community interviews.

This curve actually indicates a relatively complete bird species sample for Mungku Baru, for those species that were liable to be sighted during the survey period. It is unlikely that the species list presented in Section 5.3 complete, however, because some species were not present/active during the survey period. These species that may have been missed include: (i) migratory species that are only present at certain times of year; (ii) species that occur only in habitat types that we were unable to sample; (iii) species that are very secretive or nocturnal; and (iv) very rare species. For example, information collected from the community questionnaires indicates that Storm's storks are present only in the dry season, whereas this study was carried out in the wet season, and a number of rare species were confirmed as present in the area through community interviews, but were not seen during the field surveys. Having said this, our list does appear to be a relatively complete list of the easily-detected, diurnal bird species found in the area close to the research camp at the time of year these surveys were performed.

Also of note is the identification of range extensions for three bird species, based on the most comprehensive and up-to-date account of bird distributions in Borneo (Myers, 2009). The grey-breasted babbler, hook-billed bulbul (both previously identified from only a few isolated patches throughout Borneo) and mangrove whistler (previously identified only from coastal areas) were all detected in the area, which is substantially outside of their documented ranges. The habitats found in

Mungku Baru all encompass these species' requirements and so their presence in the area is explicable on these grounds.

### 5.1.3 Reptiles, Amphibians and Fish

Creating species lists for other taxa was very difficult, due to the huge abundance of different, yet frequently similar-looking, species and their often secretive, aquatic or nocturnal habits. A total of 18 reptile, 2 amphibian and 15 fish species were recorded (Section 5.3), but these lists are very incomplete and the true number of species will be much higher, especially for amphibians and fish. Of the reptile species, one was listed as "Critically Endangered" by the IUCN, three as "Endangered" and two as "Vulnerable"; five are protected in Indonesia. No amphibian or fish species are listed by the IUCN or protected in Indonesia.

## 5.2 Key Species

### 5.2.1 Orang-utans

Orang-utans (*Pongo pygmaeus*) are endangered and are losing their habitat at a rapid and critical rate. The orang-utan is an iconic Kalimantan species, a flagship species for conservation in Kalimantan and the focus of many conservation programs. Orangutans were sighted regularly by the survey team (see cover image) and adult flanged male long calls were also heard regularly. A total 12.3 km of transect was surveyed for orang-utan nests, and a total of 98 nests were spotted, yielding a sighting frequency of 13.5 nests/km of transect and confirming the presence of orang-utans in the area. A total 89 nests were spotted along 7.25 km of transect in good quality *ulin* forest, and only 9 nests on 5.05 km of transect in poorer quality kerangas (heath forest) habitat.

The DISTANCE program was used to estimate the effective strip width of the transect, by plotting a histogram of nests sighted at different perpendicular distances from the transect, and fitting a curve to the data. The best-fitting model for this data was a half-normal curve, yielding an estimated strip width of 16.05 m. This resulted in a nest density of 543 nests / km<sup>2</sup> for *ulin* forest, and 127 nests / km<sup>2</sup> for kerangas forest. Nest densities were converted to orangutan density using three parameters, the proportion of nest-builders in the population (0.89), the nest-building rate (1.18 nests/day) and the nest degradation time (259 days). These are standardised values based on Husson *et al.* (2009).

Applying these parameters yields raw orangutan densities of 2.00 individuals per km<sup>2</sup> in good *ulin* forest, and 0.47 individuals per km<sup>2</sup> in poorer kerangas forest. For these densities to be fully comparable with other studies, further correction factors of 1.18 and 1.25 are applied to take into account differences in survey method (Husson *et al.*, 2009). The first corrects for only walking a transect in one direction, and the second for surveying along transects rather than in fixed plots. Although double-walks and plot surveys improve the method, they are time and staff-intensive, so single walks were used to maximise sightings and area coverage.

With these correction factors applied, the estimated orang-utan density for Mungku Baru is **2.94 individuals per km<sup>2</sup> in ulin forest**, and **0.69 individuals per km<sup>2</sup> in kerangas forest**. These figures are at the upper end of the range of densities recorded in Borneo (Husson *et al.*, 2009) and indicate a thriving population of this endangered ape in Mungku Baru. If we make a gross assumption of 70% *ulin* forest and 30% kerangas forest in the 16,000 ha of the proposed conservation area (based upon the proportion of these habitats encountered along our transects), we predict a population of approximately 360 orang-utans – a viable population that is part of a larger population of around 1,000 orang-utans found between the Rungan and Kahayan rivers in Central Kalimantan (Wich *et al.*, 2008).

### 5.2.2 Gibbons

Gibbons were sighted regularly by the various field teams (see cover image) and were heard singing on all except one of the five gibbon triangulation survey days, when rain resulted in no singing. The results of the gibbon surveys are shown in Tables 5.1 and 5.2. This density of gibbons is comparable to other high-density areas in Kalimantan (Campbell *et al.*, 2008; Cheyne *et al.*, 2008) and this number of gibbons in an area represents a sustainable population size. Thus, the forest at Mungku Baru is of clear importance for the conservation of this species.

**Table 5.1. Basic gibbon triangulation survey data.**

Days of survey	Width of buffer (km)	Calling probability ( $p(m)$ )	Effective Listening Area (ELA) (km <sup>2</sup> )	Total study groups in ELA	Individuals in ELA based on groups heard <sup>a</sup>
4	1	0.98	3.16	7	28

a. Individuals/km<sup>2</sup> based on groups heard, assuming four gibbons/group (Cheyne *et al.*, 2008).

**Table 5.2. Gibbon density and population data.**

Groups/km <sup>2</sup> ( $D = n / [p(m) \times E]$ )	Individuals /km <sup>2</sup> <sup>a</sup>	Individuals/10 km <sup>2</sup> (1,000 ha)	Groups/10 km <sup>2</sup> (1,000 ha)	Lone gibbons
2.26	8.86	88.61	22.60	4.87
<b>Total estimated population in 1,000 ha: 93</b>				
<b>Total estimated population in 16,000 ha: 1,496</b>				

a. Lone gibbons assumed to represent 5.5% of paired population (Cowlshaw, 1996; Cheyne *et al.*, 2008).

### 5.2.3 Other Primates

Four species of monkey were found in the area, all of which are threatened with extinction. The southern pig-tailed macaque is listed as “Vulnerable” by the IUCN, the silver langur as “Near Threatened”, and the red langur is a protected species in Indonesia. All species are in decline throughout their range, primarily due to habitat loss, with hunting, and capture for the medical and pet trades being additional threats

(Corlett, 2007). Although not listed as Endangered, or protected in Indonesia, the red langur is restricted to the island of Borneo and, considering the rapid rate of habitat loss on Borneo and sympatry with endangered primate species (Meijaard and Nijman, 2003; FAO, 2010), such as orang-utans and gibbons, this species is likely to also be equally, if not more, at risk of extinction than the silver langur or pig-tailed macaque. Excluding the macaque species, few areas in Borneo currently support four or more sympatric diurnal primate species (Smith, 2008), and so the forest at Mungku Baru is of clear importance for primate conservation in Borneo.

#### **5.2.4 Cats**

Based on camera-trap photos and community surveys, five species of protected cat inhabit this forest: flat-headed and Bornean bay cat (Endangered), clouded leopard and marbled cat (Vulnerable), and leopard cat (Least Concern). As a result of habitat conversion and degradation, and hunting for skin and body parts in some areas, the distribution of cats in Borneo is very patchy, with vast swathes of the island unsuitable for them (Sunquist *et al.*, 1994; Corlett, 2007; Wilting *et al.*, 2010). As top predators in the forest, cats naturally occur at low density (e.g., (Cheyne and MacDonald, in press), but the high abundance of deer, other mammals and birds in the area (based on both sighting frequencies and the number of pictures of mammalian prey caught on camera traps within the study period) indicates that this forest supports healthy cat populations.

#### **5.2.5 Sun Bear**

Although widespread, the sun bear is restricted to relatively low-altitude forest and is therefore threatened by habitat conversion and degradation, in addition to exploitation for body parts in traditional medicines (Meijaard, 1999; Fredriksson *et al.*, 2006, 2008). Consequently, it is classified as “Vulnerable” by the IUCN and is protected in Indonesia. Sun bears occur at low densities and are therefore very difficult to see, but the large number of characteristic sun bear spoor (i.e., claw marks on trees) seen indicates that this forest supports a substantial population of this vulnerable species.

#### **5.2.6 Pangolin**

Threatened by intensive hunting, primarily for medicinal purposes (Corlett, 2007; Duckworth *et al.*, 2008), the Sunda pangolin is now classified as “Endangered” and protected by Indonesian law. This species is notoriously difficult to detect and virtually no information is available on pangolin population levels in any part of Asia. Considering the pristine nature of the forest at Mungku Baru, we suspect that this forest is an important pangolin habitat.

#### **5.2.7 Otters**

Community interviews confirmed the presence of otters in the area. Although the exact species' present is uncertain, both the hairy-nosed otter (Endangered and protected in Indonesia) and the Asian small-clawed otter (Vulnerable) are likely to occur here and both are threatened with extinction. Hence, the presence of either in the area is of great conservation importance. Both species are threatened by the loss of suitable habitat, pollution and subsequent reductions in fish prey populations, and by

hunting (Hussain and de Silva, 2008; Hussain *et al.*, 2008), but the high fish populations and pristine waterways in the River Rakumpit inside the proposed conservation area (after the last gold-mining raft) and large number of tributaries should make this habitat ideal for otters.

### **5.2.8 Storks**

Two species of threatened stork have been identified as present in the Mungku Baru forest through the community interviews: Storm's stork (Endangered) and the lesser adjutant stork (Vulnerable, protected in Indonesia). These species are dependent on large, intact areas of lowland forest and, hence, are becoming increasingly rare (Danielsen *et al.*, 1998; Collar *et al.*, 2001). Both these storks have only previously been confirmed from three sites in Central Kalimantan (Collar *et al.*, 2001), so their presence here is of clear importance.

### **5.2.9 White-shouldered ibis**

As a result of deforestation, drainage of wetlands, hunting, disturbance, forest fires and other factors, the population of this species is declining and severely fragmented (Sözer and Nijman, 2005; IUCN, 2009), leading to its classification as Critically "Endangered" by the IUCN and legal protection within Indonesia. This species was indicated as being present in the area by 7 out of 15 respondents and so its probable presence in the area is of potentially huge significance: protection of this forest could be vital for the future of this endangered species.

### **5.2.10 Birds of prey**

All eagle and falcon species are protected under Indonesian law and the Wallace's hawk eagle is listed as vulnerable by the IUCN. These species are all threatened by habitat loss, degradation and fragmentation, with hunting being an additional threat in some locations. As top avian predators, their presence in an area indicates healthy populations of prey animals, which in turn indicates a healthy forest.

### **5.2.11 Hornbills**

All hornbills are protected in Indonesia and three of the five species of hornbill found in Mungku Baru are listed as "Near Threatened" by the IUCN (wrinkled, Asian black and rhinoceros hornbill). Due to their large size, frugivorous habits and need for large tree cavities for breeding, hornbills are essentially reliant on large trees in old-growth forest and, hence, are an indicator of forest health (Myers, 2009). The high abundance and diversity (5 species) of hornbills, in addition to the discovery of four nests (one black, one rhinoceros and two wrinkled) indicates that this forest is of high quality. The detection of the two wrinkled hornbill nests is particularly remarkable (Figures 5.2 and 5.3), as this species' breeding behaviour is little known and the nest was previously undescribed in Borneo (Myers, 2009). The timing of these surveys just after a Borneo-wide mast-fruiting event was opportune, as hornbills rarely breed outside of masting events (Myers, 2009).



**Figure 5.2. Wrinkled hornbill nest tree, with nest highlighted by box.** Note the low height of the surrounding trees, allowing easy access to the nest cavity.



**Figure 5.3. Wrinkled hornbill nest close-up, with female and chick bills protruding.** A male wrinkled hornbill was also photographed nearby (Appendix III) and so it is likely that it was the female sealed into the tree cavity, as occurs in most other hornbill species (Myers, 2009).

#### **5.2.12 Great Argus Pheasant**

This species is listed as “Near Threatened” by the IUCN and is protected in Indonesia. It is threatened by the twin effects of hunting and habitat loss/fragmentation (Nijman, 1998). Although not sighted or heard by the research team during the study period, some possible display areas 10-12 m in circumference were found and the majority of interview respondents indicated that this species is present, so its presence in the area is very likely and important. A number of other threatened and spectacular pheasant species could also be present in the area, based on their preference for primary lowland dipterocarp and alluvial habitats and ranges within Borneo (Myers, 2009): crestless fireback (*Lophura erythrophthalma*, Vulnerable), crested fireback (*L. ignita*, Near Threatened) and Bornean peacock pheasant (*Polyplectron schleiermacheri*, Endangered and endemic to Borneo).

#### **5.2.13 Crocodiles and Gharials**

Although it is certain that crocodiles inhabit this forest (immature crocodiles were seen by the research team and all interview respondents confirmed their presence), it is not currently possible to confirm the exact species present, as crocodile species taxonomy is notoriously difficult (Brochu, 2003). The large majority (13/15) of respondents indicated that the “Critically Endangered” and protected Siamese crocodile is present in the area. Although this requires confirmation for Mungku Baru, this species has been reported in both East (Kurniati *et al.*, 2005) and Central Kalimantan (Cox *et al.*, 1993) and its possible presence here is of great significance, as this species is severely threatened by habitat destruction, illegal hunting and

persecution (Cox *et al.*, 1993; Ross, 1998). Although listed by some authorities (Cox *et al.*, 1993; Martin, 2008), the Borneo crocodile (*Crocodylus raninus*) is not recognised as a distinct species by others (Ross, 1998; Brochu, 2000), including the IUCN. Thus, although this species may be present in the area, it is more likely that it is the estuarine crocodile (*C. porosus*, protected in Indonesia) that inhabits the waterways in this forest. Of greater conservation significance is the confirmed presence of the “Endangered” false gharial in the area, which is protected in Indonesia.

#### **5.2.14 Turtles**

The “Endangered” spiny hill turtle was confirmed as present in the area, as was the “Vulnerable” South Asian box turtle. Softshell turtles were also confirmed as present, though it is uncertain whether it is the Cantor’s giant softshell turtle (Endangered) and/or the South Asian softshell turtle (Vulnerable) that is present in the area. Regardless, it is clear that the forest at Mungku Baru harbours significant turtle populations. This is important, because all of these species are threatened by hunting for the food trade, in addition to habitat loss (Iskandar and Erdelen, 2006; Shepherd and Nijman, 2007; Schoppe, 2009).

### **5.3 Species Lists**

Please see overleaf.

### 5.3.1 Mammals

Family	Latin Name	English name	Sighting / interview?	IUCN listing	CITES listing	Prot. Indo?	Trend	Notes
Soricidae	<i>Tupaia</i> spp.	Treeshrew spp.	S	LC	II		Decline	Species not determined (many similar species)
Cynocephalidae	<i>Galeopterus variegatus</i>	Colugo/Sunda flying lemur	I	LC		Y	Decline	
Pteropodidae	<i>Pteropus vampyrus</i>	Large flying fox	S	NT	II		Decline	
Lorisidae	<i>Nycticebus menagensis</i>	Bornean Slow loris	I	VU	I	Y	Decline	
Tarsiidae	<i>Tarsius</i> sp.	Tarsier sp.	I	VU	II	Y	Decline	Species not determined (many similar species and taxonomy difficult)
Cercopithecidae	<i>Presbytis rubicunda</i>	Red leaf monkey	S	LC	II	Y	Decline	Borneo endemic
Cercopithecidae	<i>Trachypithecus cristatus</i>	Silver leaf monkey	I	NT	II		Decline	
Cercopithecidae	<i>Nasalis larvatus</i>	Proboscis monkey	I	EN	I		Decline	
Cercopithecidae	<i>Macaca fascicularis</i>	Long-tailed macaque	S	LC	II/r		Decline	
Cercopithecidae	<i>Macaca nemestrina</i>	Southern Pig-tailed macaque	S	VU	II		Decline	
Hylobatidae	<i>Hylobates albibarbis</i>	Bornean Southern gibbon	S	EN	I	Y	Decline	Borneo endemic
Hominidae	<i>Pongo pygmaeus</i>	Bornean orangutan	S	EN	I	Y	Decline	Borneo endemic
Manidae	<i>Manis javanica</i>	Sunda Pangolin	S	EN	II	Y	Decline	
Sciuridae	<i>Callosciurus prevostii</i>	Prevost's squirrel	S	LC			Decline	
Sciuridae	<i>Sundasciurus hippurus</i>	Horse-tailed squirrel	S	NT			Decline	
Sciuridae	<i>Nannosciurus melanotis</i>	Black-eared pygmy squirrel	S	LC			Decline	
Sciuridae	<i>Callosciurus notatus</i>	Plantain squirrel	S	LC			Increase	
Sciuridae	<i>Rheithrosciurus macrotis</i>	Tufted ground squirrel	S	VU			Decline	
Sciuridae	<i>Ratufa affinis</i>	Giant squirrel	S	NT			Decline	
Hystricidae	<i>Hystrix brachyura</i>	Common porcupine	S	LC		Y	Decline	
Ursidae	<i>Helarctos malayanus</i>	Malayan Sun-bear	S	VU	I	Y	Decline	Characteristic field signs (claw marks)

Family	Latin Name	English name	Sighting / interview?	IUCN listing	CITES listing	Prot. Indo?	Trend	Notes
								and feeding remains) detected
Mustelidae	<i>Aonyx cinerea</i>	Asian small-clawed otter	I	VU	II		Decline	Both species of otter indicated as present in questionnaires, but distinguishing these species very difficult, so both may not be present
Mustelidae	<i>Lutra sumatrana</i>	Hairy-nosed otter	I	EN	II	Y	Decline	Both species of otter indicated as present in questionnaires, but distinguishing these species very difficult, so both may not be present
Felidae	<i>Neofelis nebulosa ssp?</i>	Clouded leopard	S	VU	I	Y	Decline	
Felidae	<i>Prionailurus bengalensis</i>	Leopard cat	I	LC	I	Y	Stable	
Felidae	<i>Pardofelis marmorata</i>	Marbled cat	I	VU	I	Y	Decline	
Felidae	<i>Prionailurus planiceps</i>	Flat-headed cat	I	EN	I	Y	Decline	Indicated as present in questionnaire by 7/13 reliable respondents, but 5/13 indicated absent, so presence likely, but not confirmed
Felidae	<i>Pardofelis badia</i>	Bonean bay cat	I	EN	II	Y	Decline	
Suidae	<i>Sus barbatus</i>	Bearded pig	S	VU			Decline	
Cervidae	<i>Tragulus kanchil</i>	Lesser mouse-deer	S	LC		Y	Unknown	
Cervidae	<i>Tragulus napu</i>	Greater mouse-deer	S	LC		Y	Decline	
Cervidae	<i>Muntiacus muntjak</i>	Bornean red muntjac	S	LC		Y	Decline	
Cervidae	<i>Muntiacus atherodes</i>	Bornean yellow muntjac	S	LC			Decline	
Cervidae	<i>Cervus unicolor</i>	Sambar deer	S	VU		Y	Decline	

IUCN categories: CR = Critically endangered; EN = Endangered; VU = Vulnerable; NT = Near Threatened; LC= Least Concern DD = Data Deficient, NE= Not Evaluated. CITES categories: I = international trade prohibited, except in exceptional non-commercial cases; II = international trade may be permitted, but requires export permit; III = limited trade.

Species protected in Indonesia (Peraturan Pemerintah Nomor 7, Tahun 1999); Y = protected, blank = not protected.

Population trends are global, as listed by IUCN.

### 5.3.2 Birds

Family	Latin name	English name	Sighting / interview?	IUCN listing	CITES listing	Prot. Indo?	Trend	Notes
Phasianidae	<i>Argusianus argus</i>	Great Argus pheasant	I	NT	II	Y	Decline	
Ciconiidae	<i>Ciconia stormi</i>	Storm's stork	I	EN			Decline	Possible confusion with lesser adjutant stork; one certainly in area, both likely
Ciconiidae	<i>Leptoptilos javanicus</i>	Lesser adjutant stork	I	VU		Y	Decline	Possible confusion with Storm's stork; one certainly in area, both likely
Threskiornithidae	<i>Pseudibis davisoni</i>	White-shouldered ibis	I	CR		Y	Decline	Indicated as present by 7/15 respondents and absent by 8/15, so requires confirmation
Falconidae	<i>Microhietax fringillarius</i>	Black-thighed falconet	S	LC	II	Y	-	
Accipitridae	<i>Spilornis cheela</i>	Crested serpent eagle	S	LC	II	Y	-	
Accipitridae	<i>Spizaetus nanus</i>	Wallace's hawk eagle	I	VU		Y	Decline	
Columbidae	<i>Chalcophaps indica</i>	Emerald dove	S	LC			-	
Columbidae	<i>Ducula aenea</i>	Green imperial pigeon	S	LC			-	
Columbidae	<i>Treron</i> sp.	Green pigeon	S	-			-	
Psittacidae	<i>Loriculus galgulus</i>	Blue-crowned hanging parrot	S	LC			-	
Cuculidae	<i>Cacomantis sonneratii</i>	Banded bay cuckoo	S	LC			-	
Cuculidae	<i>Centrops bengalensis</i>	Lesser Coucal	S	LC			-	
Cuculidae	<i>Centropus sinensis</i>	Greater common coucal	S	LC			-	
Cuculidae	<i>Phaenicophaeus chlorophaea</i>	Raffles malkoha	S	LC			-	
Cuculidae	<i>Phaenicophaeus curvirostris</i>	Chestnut breasted malkoha	S	LC			-	
Cuculidae	<i>Surniculus lugubris</i>	Drongo cuckoo`	S	LC			-	
Tytonidae	<i>Phodilus badius</i>	Oriental bay owl	S	LC			-	

Family	Latin name	English name	Sighting / interview?	IUCN listing	CITES listing	Prot. Indo?	Trend	Notes
Strigidae	<i>Ninox scutulata</i>	Brown hawk-owl	S	LC	II		-	
Caprimulgidae	<i>Eurostopodus temminckii</i>	Malaysian-eared nightjar	S	LC			-	
Apodidae	<i>Hemiprocne longipennis</i>	Grey rumped tree swift	S	LC			-	
Apodidae	<i>Rhaphidura leucopygialis</i>	Silver-rumped swift	S	LC			-	
Trogonidae	<i>Harpactes diardii</i>	Diard's trogon	S	NT		Y	Decline	
Trogonidae	<i>Harpactes duvaucelii</i>	Scarlet rumped trogon	S	NT		Y	Decline	
Trogonidae	<i>Harpactes kasumba</i>	Red-naped trogon	S	NT		Y	Decline	
Alcedinidae	<i>Alcedo</i> sp.	Kingfisher sp.	S	-		Y	-	
Alcedinidae	<i>Ceyx rufidorsa</i>	Rufous-backed kingfisher	S	LC		Y	-	
Alcedinidae	<i>Lacedo pulchella</i>	Banded Kingfisher	S	LC		Y	-	
Alcedinidae	<i>Pelargopsis capensis</i>	Stork-billed kingfisher	S	LC		Y	-	
Meropidae	<i>Merops viridis</i>	Blue-throated bee-eater	S	LC			-	
Bucerotidae	<i>Aceros corrugatus</i>	Wrinkled hornbill	S	NT	II	Y	Decline	
Bucerotidae	<i>Anorrhinus galeritus</i>	Bushy-crested hornbill	S	LC	II	Y	-	
Bucerotidae	<i>Anthracoceros albirostris</i>	Oriental pied hornbill	S	LC	II	Y	-	
Bucerotidae	<i>Anthracoceros malayanus</i>	Asian black hornbill	S	NT	II	Y	Decline	
Bucerotidae	<i>Buceros rhinoceros</i>	Rhinoceros hornbill	S	NT	II	Y	Decline	
Ramphastidae	<i>Megalaima australis</i>	Blue-eared barbet	S	LC			-	
Ramphastidae	<i>Megalaima chrysopogon</i>	Gold-whiskered barbet	S	LC			-	
Ramphastidae	<i>Megalaima rafflesii</i>	Red-crowned barbet	S	NT			Decline	
Picidae	<i>Drycopus javensis</i>	White-bellied woodpecker	S	LC	I		-	
Picidae	<i>Meiglyptes tukki</i>	Buff-necked woodpecker	S	LC			-	
Picidae	<i>Mulleripicus pulverulentis</i>	Great slaty woodpecker	S	LC			-	

Family	Latin name	English name	Sighting / interview?	IUCN listing	CITES listing	Prot. Indo?	Trend	Notes
Picidae	<i>Picus mineaceus</i>	Banded Woodpecker	S	LC			-	
Picidae	<i>Reinwardtipicus validus</i>	Orange-backed woodpecker	S	LC			-	
Picidae	<i>Sasia abnormis</i>	Rufous piculet	S	LC			-	
Eurylaimidae	<i>Calyptomena vividis</i>	Green broadbill	S	NT			Decline	
Eurylaimidae	<i>Corydon sumatranus</i>	Dusky broadbill	S	LC			-	
Eurylaimidae	<i>Cymbirhynchus macrorhynchus</i>	Black and red broadbill	S	LC			-	
Eurylaimidae	<i>Eurylaimus javanicus</i>	Banded broadbill	S	LC			-	
Eurylaimidae	<i>Eurylaimus ochromalus</i>	Black and yellow broadbill	S	NT			Decline	
Pachycephalidae	<i>Pachycephala grisola</i>	Mangrove whistler	S	LC			-	
Incertae	<i>Philentoma pyrhopterum</i>	Rufous-winged philentoma	S	LC			-	
Aegithinidae	<i>Aegithina viridissima</i>	Green iora	S	NT		Y	Decline	
Rhipiduridae	<i>Rhipidura javanica</i>	Pied fantail	S	LC		Y	-	
Rhipiduridae	<i>Rhipidura pelrata</i>	Spotted fantail	S	LC			-	
Monarchidae	<i>Hypothymis azurea</i>	Black-naped monarch	S	LC			-	
Monarchidae	<i>Terpsiphone paradis</i>	Asian paradise flycatcher	S	LC			-	
Dicruridae	<i>Dicrurus paradiseus</i>	Greater racket-tailed drongo	S	LC			-	
Corvidae	<i>Platysmurus leucopterus</i>	Bornean black magpie	S	NT			Decline	
Pityriaseidae	<i>Pityriasis gymnocephala</i>	Bornean bristlehead	S	NT			Decline	
Nectarinidae	<i>Aethopyga modesta</i>	Grey-breasted spiderhunter	S	LC		Y	-	Recently revised from <i>Arachnothera affinis</i>
Nectarinidae	<i>Aethopyga siparaja</i>	Crimson sunbird	S	LC		Y	-	
Nectarinidae	<i>Anthreptes simplex</i>	Plain sunbird	S	LC		Y	-	

Family	Latin name	English name	Sighting / interview?	IUCN listing	CITES listing	Prot. Indo?	Trend	Notes
Nectarinidae	<i>Anthreptes singalensis</i>	Ruby cheeked sunbird	S	LC		Y	-	
Nectarinidae	<i>Arachnothera longirostra</i>	Little spiderhunter	S	LC		Y	-	
Nectarinidae	<i>Arachnothera robusta</i>	Long-billed spiderhunter	S	LC		Y	-	
Nectarinidae	<i>Nectarina calcostetha</i>	Copper throated sunbird	S	LC		Y	-	
Dicaeidae	<i>Dicaeum trigonostigma</i>	Orange-bellied flowerpecker	S	LC			-	
Dicaeidae	<i>Prionochilus maculates</i>	Yellow breasted flowerpecker	S	LC			-	
Dicaeidae	<i>Prionochilus thoracicus</i>	Scarlet-breasted flowerpecker	S	NT			Decline	
Chloropseidae	<i>Chloropsis cochinchinensis</i>	Blue-winged leafbird	S	LC			-	
Chloropseidae	<i>Chloropsis cyanopogon</i>	Lesser green leafbird	S	NT			Decline	
Chloropseidae	<i>Chloropsis sonnerati</i>	Greater green leafbird	S	LC			-	
Irenidae	<i>Irena puella</i>	Asian fairy-bluebird	S	LC			-	
Estrildidae	<i>Lonchura fuscans</i>	Dusky munia	S	LC			-	
Estrildidae	<i>Lonchura leucogastra</i>	White-bellied munia	S	LC			-	
Muscicapidae	<i>Copcyclus malabaricus</i>	White-rumped shama	S	LC			-	
Muscicapidae	<i>Copcyclus saularis</i>	Magpie robin	S	LC			-	
Muscicapidae	<i>Culicicapa ceylonensis</i>	Grey-headed canary-flycatcher	S	LC			-	
Muscicapidae	<i>Cyornis caerulatus</i>	Large-billed blue flycatcher	S	VU			Declining	
Muscicapidae	<i>Cyornis tucosis</i>	Malaysian blue flycatcher	S	NT			Declining	
Muscicapidae	<i>Rhinomyias umbratilis</i>	Grey chested jungle flycatcher	S	NT			Decline	
Muscicapidae	<i>Trichixos pyrrhopygus</i>	Rufous-tailed shama	S	NT			Decline	
Pycnonotidae	<i>Alophoixus bres</i>	Grey-cheeked bulbul	S	LC			-	

Family	Latin name	English name	Sighting / interview?	IUCN listing	CITES listing	Prot. Indo?	Trend	Notes
Pycnonotidae	<i>Alophoixus phaeocephalus</i>	Yellow-bellied bulbul	S	LC			-	
Pycnonotidae	<i>Pycnonotus atriceps</i>	Black headed bulbul	S	LC			-	
Pycnonotidae	<i>Pycnonotus brunneus</i>	Red-eyed bulbul	S	LC			-	
Pycnonotidae	<i>Setornis criniger</i>	Hook billed bulbul	S	VU			Decline	
Pycnonotidae	<i>Tricholestes criniger</i>	Hairy-backed bulbul	S	LC			-	
Hirundinidae	<i>Hirundo striolata</i>	House Swallow	S	LC			-	
Timaliidae	<i>Macronous bornensis</i>	Bold-striped tit- babbler	S	LC			-	
Timaliidae	<i>Macronous pitposus</i>	Fluffy-backed babbler	S	NT			Decline	
Timaliidae	<i>Malacocincla magnum</i>	Rufous-crowned babbler	S	NT			Decline	
Timaliidae	<i>Malacocincla malaccensis</i>	Short-tailed babbler	S	NT			Decline	
Timaliidae	<i>Malacopteron affine</i>	Sooty-capped babbler	S	NT			Decline	
Timaliidae	<i>Malacopteron cinerum</i>	Scaly-crowned babbler	S	LC			-	
Timaliidae	<i>Malacopteron magnirostre</i>	Moustached babbler	S	LC			-	
Timaliidae	<i>Ophrydornis albogularis</i>	Grey-breasted babbler	S	NT			Decline	Recently revised from <i>Malacopteron albogulare</i>
Timaliidae	<i>Pellorneum capistratum</i>	Black-capped babbler	S	LC			-	
Timaliidae	<i>Pomatothinus montanus</i>	Chestnut-backed scimitar babbler	S	LC			-	
Timaliidae	<i>Stachyris erythroptera</i>	Chestnut-winged babbler	S	LC			-	
Timaliidae	<i>Stachyris maculate</i>	Chestnut rumped babbler	S	NT			Decline	
Timaliidae	<i>Trichastoma rostratum</i>	White-chested babbler	S	NT			Decline	
Cisticolidae	<i>Orthotomos atrogularis</i>	Dark-necked tailorbird	S	LC			-	
Cisticolidae	<i>Orthotomos ruficeps</i>	Ashy tailorbird	S	LC			-	
Cisticolidae	<i>Orthotomos sericeus</i>	Rufous-tailed tailorbird	S	LC			-	

<b>Family</b>	<b>Latin name</b>	<b>English name</b>	<b>Sighting / interview?</b>	<b>IUCN listing</b>	<b>CITES listing</b>	<b>Prot. Indo?</b>	<b>Trend</b>	<b>Notes</b>
Sylviidae	<i>Phylloscopus trivirgatus</i>	Mountain leaf warbler	S	LC			-	

IUCN categories: CR = Critically endangered; EN = Endangered; VU = Vulnerable; NT = Near Threatened; LC= Least Concern DD = Data Deficient, NE= Not Evaluated.

CITES categories: I = international trade prohibited, except in exceptional non-commercial cases; II = international trade may be permitted, but requires export permit; III = limited trade.

Species protected in Indonesia (Peraturan Pemerintah Nomor 7, Tahun 1999); Y = protected, blank = not protected.

Population trends are global, as listed by IUCN.

### 5.3.3 Herpetofanua (Reptiles and Amphibians)

Family	Latin name	English name	Sighting / interview?	IUCN listing	CITES listing	Prot. Indo?	Trend	Notes
Elapidae	<i>Naja sumatrana</i>	Sumatran cobra	S					
Colubridae	<i>Chrysopelea pelia</i>	Twin-barred tree snake	S					
Colubridae	<i>Psammodynastes pulverulentus</i>	Common mock viper	S					Genus certain, species not 100% certain
Crotalinae	<i>Trimeresurus popeoram</i>	Pope's pit Viper	S					
Xenopeltidae	<i>Xenopeltis unicolor</i>	Iridescent earth snake	S					
Crocodylidae	<i>Crocodylus raninus / porosus</i>	Crocodile sp.	S			Y		Species uncertain; both may be found in this area. <i>C. porosus</i> protected in Indonesia.
Crocodylidae	<i>Crocodylus siamensis</i>	Siamese crocodile	I	CR		Y	Decline	Identified as present by 13/15 respondents, but difficult to distinguish from common crocodile and very rare, so requires confirmation
Crocodylidae	<i>Tomistoma schlegelii</i>	False gharial	I	EN		Y	Decline	
Geoemydidae	<i>Cuora amboinensis</i>	South Asian box turtle	I	VU	II		Decline	
Trionychidae	<i>Dogania subplana / Pelochelys cantorii</i>	South Asian softshell turtle / Cantor's giant softshell turtle	I	VU / EN	II	Y	Decline	Identification uncertain; both species could be in the area
Gekkonidae	<i>Cyrtodactylus pubisulcus</i>	Inger's bow-fingered gecko	S					
Gekkonidae	<i>Gekko smithii</i>	Smith's green-eyed gecko	S					
Agamidae	<i>Draco</i> sp.	Gliding lizard	S					
Varanidae	<i>Varanus salvator</i>	Water monitor lizard	S			Y		
Scincidae	<i>Apterygodon vittatus</i>	Skink	S					

Family	Latin name	English name	Sighting / interview?	IUCN listing	CITES listing	Prot. Indo?	Trend	Notes
Scincidae	<i>Mabua multifasciata</i>	Skink	S					
Scincidae	<i>Mabua rudis</i>	Skink	S					
Bufo	<i>Ansonia / Leptophryne</i> sp.	Toad sp.	S					Identification uncertain; many species of toad and frog present
Bufo	<i>Pseudobufo subasper</i>	Aquatic swamp toad	S					

IUCN categories: CR = Critically endangered; EN = Endangered; VU = Vulnerable; NT = Near Threatened; LC= Least Concern DD = Data Deficient, NE= Not Evaluated.  
CITES categories: I = international trade prohibited, except in exceptional non-commercial cases; II = international trade may be permitted, but requires export permit; III = limited trade.

Species protected in Indonesia (Peraturan Pemerintah Nomor 7, Tahun 1999); Y = protected, blank = not protected.

Population trends are global, as listed by IUCN.

### 5.3.4 Fish

Family	Latin name	English name	Sighting / interview?	IUCN listing	CITES listing	Prot. Indo?	Trend	Notes
Balitoridae	<i>Nemacheilus</i> sp.	Ray fin	S					
Bagridae	<i>Leiocassis myersi</i>		S					
Bagridae	<i>Mystus nemurus</i>	Asian green catfish	S					
Bagridae	<i>Mystus nigriceps</i>	Catfish	S					
Channidae	<i>Channa cyanospilos</i>	Blue-spotted snakehead	S					
Channidae	<i>Channa micropeltes</i>	Giant snakehead	S					
Cyprinidae	<i>Luciosoma trinema</i>	Apollo shark	S					
Cyprinidae	<i>Osteochilus triporos</i>		S					
Cyprinidae	<i>Rasbora borneensis</i>		S					
Cyprinidae	<i>Rasbora cephalotaenia</i>		S					
Cyprinidae	<i>Rasbora kalochroma</i>		S					
Hemiramphidae	<i>Dermogenys / Hemirhamphodon</i>	Halfbeak sp.	S					
Osphronemidae	<i>Luciocephalus pulcher</i>	Giant pikehead	S					
Osphronemidae	<i>Betta edithae</i>		S					
Siluridae	<i>Kryptopterus macrocephalus</i>	Striped glass catfish	S					

None of the above species are currently listed by either the IUCN or CITES, or are protected in Indonesia.

Species protected in Indonesia (Peraturan Pemerintah Nomor 7, Tahun 1999); Y = protected, blank = not protected.

## 6. COMMUNITY USE OF FOREST RESOURCES

### 6.1 Plant Resources (Harvesting)

Various plant resources are harvested for local use. Local residents often search for traditional medicines in the forest, because they believe this medicine is very effective for healing many illnesses, including skin diseases, coughs, sore loins and others. Although *ulin* roots have medicinal uses, they appear not to be used locally, presumably due to local beliefs pertaining to the removal of *ulin* from the forest. We were unable to obtain Latin names for the plants used, but the following medicinal plants are used (local names), which can all be found close to the river and in the *ulin* forest at Mungku Baru:

- Bajakah tampelas
- Tepe pari
- Ater petak
- Saluang belum – tree roots used for back pain, etc.
- Pasak bumi
- Tabat barito
- Akar tabalien
- Sambung maut
- Dawan takapal

A number of species of edible fruit are also found in the forest. These include durian (*Durio* sp.), rambutan (*Nephelium* sp.), langsung (*Lansium* sp.) and jackfruit (*Artocarpus heterophyllus*, known locally as campedak). Jackfruit and langsung were in fruit while these surveys were performed and were harvested by the local field assistants to be brought back to the village (the fruit tasted excellent). An orang-utan was also seen eating from a jackfruit tree during the surveys.

Rubber collection from plantations is the primary economic activity in the area and so rubber collection from native forest trees appears not to occur. Villagers collected gemur (*Alseodaphne coriacea*) bark up until 1997, but this no longer occurs as the species is now very rare or locally extinct. Rattan (*Calamus* sp.) collection does not occur here because there are no buyers.

### 6.2 Animal Resources (Hunting)

A number of species of animal are hunted in the area, including:

- Fish – target species, medium intensity, hunted commonly for daily consumption.
- Pigs – target species, medium intensity, hunting is part-time/“holiday” work. Pigs are hunted both for food and because they destroy *ladangs*.
- Shamas and leaf birds – target species, medium intensity. These are popular pet cage birds in Kalimantan and other areas. Catches vary from 1-6 birds/day, with no catch at all on some days, and hunters can expect to obtain around IDR 65,000/bird, depending on the quality (either by selling the birds directly in the village, or by selling on for sale in Palangka Raya, where birds sell for about IDR 200,000).

- Argus pheasants – hunted for the males’ spectacular tail feathers, which are used as decorations in traditional Dayak headdresses. Presence seasonal (though respondents did not indicate when the season occurred).
- Soft-shell turtles – not targeted, encountered in fishing nets, medium intensity. Captures seasonal, with at most five animals caught each trip, depending on location.
- Deer – includes both sambar and mouse deer, low-medium intensity. Generally encountered while hunting for pigs.
- Primates – includes both proboscis monkeys (present on the River Rungan, but not thought to be inside the Mungku Baru proposed conservation area; listed as “Endangered” by the IUCN and protected in Indonesia) and pig-tailed macaques, low intensity, presumably shot.

Unlike some other areas of Kalimantan (Struebig *et al.*, 2007), hunting of large flying foxes (*Pteropus vampyrus natunae*) does not appear to occur in this area. Questionnaire respondents believe this to be a result of the variable presence of these animals (present only in the fruiting season), but it is likely that the real reason may be paucity of buyers, due to large distance, and consequent expense and difficulties in transporting live animals to the nearest major market (Palangka Raya).

## **7. CONSERVATION OF MUNGKU BARU FOREST**

### **7.1 Importance of Mungku Baru for Biodiversity Conservation**

Despite its proximity to the provincial capital, Palangka Raya, the relatively pristine state of Mungku Baru Forest makes it an important site for biodiversity conservation. Disturbance and burning only occur in/around *ladang* clearings near the village and the interior forest is still largely undisturbed. Mungku Baru Forest is one of the richest areas we have seen in south-east Asia in terms of wildlife. A number of “Critically Endangered” or “Endangered” species are confirmed, or likely, to be present in the forest, including Bornean agile gibbon, orang-utan, Sunda pangolin, hairy-nosed otter, flat-headed cat, Bornean bay cat, white-shouldered ibis, Storm’s stork, lesser adjutant stork, Wallace’s hawk eagle, large-billed blue flycatcher, hook-billed bulbul, Siamese crocodile, false gharial, spiny hill turtle and Cantor’s giant softshell turtle. A total of 174 vertebrate species were recorded as present (or likely to be present) within only 13 days of surveys in one small area of the reserve. It is likely that the true number of species present in the area is much higher than this figure.

This forest supports a high-density, viable population of orang-utans, with an estimated 360 animals found within the boundaries of the proposed conservation area. The total orang-utan population here, including both the proposed conservation area and the wider buffer areas, is likely to be around 1,000 individuals, and thus of high importance for orangutan conservation.

The forest is also an important habitat for the “Endangered” Bornean Southern gibbon, which declining due to forest destruction and degradation, draining of peat swamps, logging, forest conversion for plantations, fire, and hunting and collection for the wildlife trade. The estimate of 1,496 gibbons in the proposed 16,000 ha

conservation areas indicates that this forest supports a viable gibbon population and, hence, is important for this species' conservation.

Orang-utans and gibbons are recognised as “umbrella species” – i.e., species that are dependent on relatively intact, undisturbed forest, which is therefore also likely to be home to a wide array of other species of fauna and flora – and their high abundance in here indicates that the forest is good condition and likely to support a wide diversity of fauna and flora. Other signs also point towards the Mungku Baru forest being pristine and diverse, and substantiate the argument that this forest is important for biodiversity conservation. For example, as discussed above, hornbills are dependent on undisturbed old-growth forest for survival, and the high diversity and abundance of hornbills indicates that the forest is in excellent condition.

Furthermore, the heterogenous nature of the forest is likely to help support a larger variety and abundance of animals than in more homogenous forests. In areas with many different habitat types, animals are able to move between habitats when fruit availability in one or more habitats becomes low, enabling heterogenous forests to support a higher abundance of animals, including orang-utans (Leighton and Leighton, 1983; Hemingway and Bynum, 2005; Husson *et al.*, 2009). A number of very large figs (*Ficus* spp.) were also encountered around the research camp (Figure 7.1). Figs are frequently referred to as a “keystone resources” because, as a result of the relatively consistent availability of their ‘fruits’ in the environment and the palatability to many animals, they form an important food item in many species’ diets, particularly in times of overall fruit shortage in the forest (Janzen, 1979; van Schaik, 1996). The high abundance of large figs in this forest therefore provides further evidence that this forest is able to support a high abundance and diversity of frugivorous animals.

## **7.2 Threats to Biodiversity Conservation in Mungku Baru**

Unfortunately, this important wealth of biodiversity is facing a number of threats and, consequently, is not guaranteed a secure future. Many obstacles stand in the way of the successful conservation of this biodiversity. Foremost among these is from companies wishing to make profit from the area – for example mining and plantation companies – and local people. The majority of questionnaire respondents, all of whom were local people familiar with the forest, report that populations of many Critically Endangered, Endangered and Vulnerable species (orang-utan, clouded leopard, Storm’s stork, lesser adjutant stork and white-shouldered ibis) have decreased in the time they have been resident in the area. These declines need to be reversed if local extinction is to be prevented.

### **7.2.1 Forest Conversion due to Oil Palm**

Oil-palm companies to the north of Mungku Baru Forest are expanding, approaching the forest at a fast pace (see Figures 3.1 and 7.2). The forest is under severe threat of being converted into oil-palm plantations. The local belief in the sacred nature of *ulin* that has protected this forest for so many years will likely be insufficient to prevent conversion of this forest, which does not currently have protected status.



**Figure 7.1 Huge fig in Mungku Baru Forest.** The supporting tree DBH was 1.5 m.



**Figure 7.2 Oil-palm plantation near to the proposed Mungku Baru conservation area.** Photograph by Karmele Llano Sanchez.

### 7.2.2 Coal Mining

Although not currently a threat, an application for a coal-mining concession has been submitted for some areas bordering the forest and this is potentially one of the biggest threats to the area. Although the mine itself is likely to be relatively small (up to 1,000 ha), and only a small percentage of the forest is allowed to be cleared, the biggest risk is forest destruction by building access roads, consequent encroachment along these roads, and unregulated mine employees engaging in illegal logging and hunting. If a mine is to be dug here, a system of regulations should be discussed and agreed with the mining company.

### 7.2.3 Gold Mining

Gold mining is still commonplace on the River Rakumpit: five mining rafts were sighted on the river, though only one appeared operational (Figure 7.3), and most of the questionnaire respondents (10/15) had participated in mining activities in the region at some point in their lives. As a result of this, the river has become shallower and very difficult to navigate in the dry season. The water quality, which is excellent by the research camp (untreated water is safe to drink), drops drastically downstream of the first mining float, making the water non-usable for cooking and drinking, and threatening the health of local villagers and the future of river fish stocks. In addition to silt pollution of waterways, the gold extraction process also uses a lot of mercury, which causes severe pollution, threatening the health of villagers and the area's wildlife, especially piscivorous birds (UNEP, 2002; Evers *et al.*, 2005).



**Figure 7.3** Active gold mining raft pictured just outside the Mungku Baru proposed conservation area.

#### **7.2.4 Wildlife Hunting**

As mentioned above, a number of species of fauna are hunted in the area for food and sale as pets, and village residents report that, for the last five years, it has become increasingly difficult to find many of the above-named animals hunted in the area. With the information available, it is impossible to assess whether the current level of hunting of these species is sustainable or not. Some of the hunted species (great Argus pheasant and Cantor's giant softshell turtle, and proboscis monkeys outside the proposed conservation area) are currently at real risk of extinction in the near future and hunting has been identified as one of the chief reasons behind these species' declines (Nijman, 1998; Meijaard and Nijman, 2000; van Dijk *et al.*, 2000; Iskandar and Erdelen, 2006; IUCN, 2010). It is therefore likely that hunting is also threatening these species' survival in the Mungku Baru Forest. The large and rapid fluctuations in water level, sharp river turns and fallen wood blocking the waterways results in difficult navigation (numerous *klotok* propellers were lost on each trip), presumably helping to keep hunting levels from becoming too high.

#### **7.2.5 Illegal Logging**

The forest near Mungku Baru has never been under a logging concession and has never suffered from high levels of illegal logging, which has left the forest in pristine condition. The only wood harvesting is local residents cutting trees for stilted-house construction. At current levels, this is not a major threat to the area's forest, mainly because of the enduring power of local beliefs about the forest. This will become a bigger risk if coal mines are opened, outsiders employed in the workforce and access roads constructed.

#### **7.2.6 Problems for Fishing**

As a result of mining activities in the area, the river water has become very dirty and fish populations in the river have decreased. This is a major issue for local villagers, who are dependent on fish as their primary source of protein. Informal discussions with villagers also revealed that, on occasion, some local residents also use electric fishing, which kills indiscriminately and threatens the entire fish stock.

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## APPENDIX I: BIODIVERSITY SURVEY DAILY SCHEDULE

Feb 2-

1400-1430: Biodiversity surveys from boat along the lower Rakumpit River to house of Pak Sahel

1430-1700: Biodiversity surveys on river edge and in disturbed forest behind house

Feb 3-

0530-0730: Biodiversity surveys on river edge and in disturbed forest behind house.

Twenty six species of bird recorded on lower river, saw one unidentified black snake in the river, signs of bearded pig behind river house, multiple gibbon groups calling from forest beyond clearings, orang-utan long call also heard, 4 species of fish caught in the river

800-1030: Watched for wildlife along lower Rakumpit River from boat. No birds (too noisy), saw one juvenile water monitor

1030-1500: Biodiversity surveys along south river trail

1500-1630: Biodiversity surveys along northwest trail

Saw 15 additional species of bird for the day

Feb 4-

0500-1010: Biodiversity surveys on northwest trail, saw 4 squirrel species, heard gibbons, saw a yellow muntjac and one flying fox

1040-1600: Biodiversity surveys on the Mungku Baru transect and Transect #1: found a nest of a black hornbill with a chick in it

1600-1700: Biodiversity surveys along northwest trail

1900-1940: Night canoe: heard 2 species of owl and saw two aquatic swamp toads

Recorded 14 new species of bird for the day and 5 new species of fish

Feb 5-

0430-0620: Rain

0630-0730: Biodiversity surveys from camp: 4 new species of bird feeding on nearby fruit tree, heard gibbons

0740-0930: Rain

0930-1130: Biodiversity surveys from camp

1130-1640: Biodiversity surveys along northwest trail: found orange-backed woodpecker constructing a nest cavity, several new bird species, giant squirrel, saw rhinoceros hornbill, 10 new species of bird for the day

2000-2045: Night Walk: saw several large katydids, a centipede and other arthropods

Feb 6-

0500-1200: Biodiversity surveys on south river trail: found a clearing that had burned naturally recently, heard gibbons, saw long-tailed macaques

1255-1710: Biodiversity surveys on northwest trail: saw wrinkled hornbill, photographed giant squirrel, saw Prevost's squirrel, and more long-tailed macaques.

The other team saw gibbons, a mouse-deer and two orang-utans, Hendri photographed signs of a sun bear. Recorded nine new species of bird today and one new fish

0720-0750: Night walk: saw arthropods and one frog

Feb 7-

0510-1310: Surveyed Mungku Baru transect and transect # 2 (5 km roundtrip): Saw red leaf-monkeys and gibbons, heard a barking deer, three new species of bird for the day, total 47 species of bird encountered today, one new species of fish

1430-1730: Transect #1 25 m (hornbill nest): Tried to get photograph of black hornbill and wrote description of nest

Feb 8-

0450-1130: Transect # 3: Saw and photographed iridescent ground snake, found nest of green broadbill, saw another flying fox, saw and photographed wrinkled hornbill, heard gibbons, saw red leaf-monkeys and long-tailed macaques, photographed damselflies and butterflies, saw *Draco* sp. lizard

1215-1730: Northwest trail: saw a gibbon and heard a lot of hornbills, identified a mystery nest as long-billed spider-hunter, photographed butterflies; the other team saw a bearded pig and another tree with signs of sun bear; seven new species of bird today

Feb 9-

0450-0850: Northwest trail: saw red leaf monkeys, gibbons, three mouse-deer

0930-1630: Transect #3: photographed rhinoceros hornbill and found its nest, saw two tufted ground squirrels and gibbons; four new species of bird today

Feb 10-

0444-1730: Transect #3: return off trail along small river: saw and photographed a young orang-utan, heard gibbons, found a wrinkled hornbill nest, three new species of bird for the day; the other team saw an orang-utan, mouse-deer and a Pope's pit viper

Feb 11-

0510-0730: Northwest trail: saw gibbons

0800-1100: South river trail: heard barking deer

1140-1525: Transect#3: saw Sumatran cobra and red leaf-monkeys, photographed banded kingfisher

1900-2100: Night-walk northwest trail: saw many arthropods and one gecko

The other team saw red leaf-monkeys today; two new species of bird today

Feb 12-

0530-0900: Transect#3: saw red leaf-monkeys, found second wrinkled hornbill nest, saw a mouse-deer, heard gibbons

0930-1330: Northwest trail:

1330-1630: Transect #3: Photographed wrinkled hornbill nest in afternoon light

Feb 13-

0700-1630: Travel down river: saw and photographed a bat and a snake

Feb 14-

0700-1720: Travel down river: heard one new species of bird in the morning

Feb 15-

0700-1600: Travel down river: saw one new species of bird

## **APPENDIX II: QUESTIONNAIRE USED IN COMMUNITY INTERVIEWS**

All interviews were conducted in Bahasa Indonesia/local languages. The questionnaire was designed so that innocuous questions (personal details, length of time in the area etc.) are asked first, so that the interviewee feels comfortable with the interview before the more important questions (e.g. hunting in the area, etc.) are asked. Interviews were conducted with at least ten people experienced in the area's forest (i.e., ex/current hunters, loggers, collectors of forest products, etc.).

*It is vital that the pictures of the different fauna enquired about in this questionnaire are taken along on each interview. With all interviews, it is vital to stress that data is being collected for research purposes only, that their identity has not been recorded and that their anonymity will be maintained at all times.*

### **Questionnaire**

#### **Before Starting**

The following introduction should be given to each person interviewed:

INTERVIEWER: "Excuse me sir, I am a conducting community research for International Animal Rescue/Kapal in the region, and I was hoping that you might let me ask you some questions regarding biodiversity in this area. This should only take a short amount of your time. Please understand that these questions are being asked purely for research purposes, and that your identity will not be recorded or revealed at any time to anyone for any reason. You may terminate the interview at any point should you not wish to proceed. Do I have your permission to ask these questions?"

INTERVIEWEE: "Yes"

INTERVIEWER: "Thank you. Please answer the following questions as honestly as possible."

START QUESTIONNAIRE. Note that, unless indicated, all the options do not need to be read out to the interviewee; just tick the relevant box.

#### **Profile**

1. DON'T ASK THIS QUESTION!! Record whether the hunter is:
  - a. Male
  - b. Female
2. How old are you?
  - a.  $\leq 20$
  - b. 21-30
  - c. 31-40
  - d. 41-50
  - e.  $\geq 51$
3. Are you married?
  - a. Yes
  - b. No

4. How many children do you have?
  - a. None
  - b. 1
  - c. 2
  - d. 3
  - e. 4
  - f. 5
  - g. 6
  - h.  $\geq 7$
5. What is your ethnic origin?
  - a. Dayak from KALTENG
  - b. Dayak from KALTIM
  - c. Dayak from KALBAR
  - d. Dayak from KALSEL
  - e. Javanese (resettled during transmigration)
  - f. Javanese (moved to Palangka Raya post-transmigration)
  - g. Sumatran
  - h. Other (please state)
6. What is your religion?
  - a. Christian
  - b. Muslim
  - c. Kaharingan
  - d. Other (please state)
7. How long have you been hunting at your present site?
  - a. First season ( $\leq 1$  year)
  - b. 1-2 years
  - c. 2-5 years
  - d. 6-10 years
  - e. 11-15 years
  - f. 16-20 years
  - g.  $\geq 21$  years
  - h. Don't know/can't remember

#### **Village and Work Site Questions**

8. How long does it take to get from your village to the nearest large town/market (name the town/market)?
9. Which mode of transport is used to get from your village to the nearest large town/market?
  - a. Speed boat
  - b. Klotok
  - c. Canoe
  - d. Car/bus/motorbike (note if asphalt or dirt road)
  - e. Bicycle
  - f. Walk
  - g. Other (state)

### **Biodiversity Present in the Area**

10. Are the following species of fauna found in the area? (rate on a scale of 0-4; 0 = never; 1 = in past, over 5 years ago, but not recently; 2 = present, but rare; 3 = present and occasionally seen; 4 = abundant; *show pictures as read out species names to confirm identities, ask for description of any unknown primate species*).

- a. Orang-utan
- b. Gibbon
- c. Red leaf monkey
- d. Silver leaf monkey
- e. Proboscis monkey
- f. Long-tailed macaque
- g. Pig-tailed macaque
- h. Slow loris
- i. Tarsier
- j. Other primate species (name)
- k. Colugo
- l. Sun bear
- m. Oriental small-clawed otter
- n. Hairy-nosed otter
- o. Clouded leopard
- p. Serval
- q. Leopard cat
- r. Marbled cat
- s. Flat-headed cat
- t. Bay cat
- u. Sambar deer
- v. Pangolin
- w. Armadillo
- x. Storms stork
- y. Lesser adjunct stork
- z. White-shouldered ibis
- aa. Argus pheasant
- bb. Brahminy kite
- cc. Wallace hawk eagle
- dd. Black hornbill
- ee. Great hornbill
- ff. Bushy-crested hornbill
- gg. Rhinoceros hornbill
- hh. Helmeted hornbill
- ii. Oriental pied hornbill
- jj. White-crowned hornbill
- kk. Wreathed hornbill
- ll. Wrinkled hornbill
- mm. False gharial
- nn. Estuarine crocodile
- oo. Siamese crocodile
- pp. Asian giant soft-shelled turtle
- qq. South Asian box turtle

### **Threats to Biodiversity in the Area**

11. Where is the area of local forest (i.e., between Sg. Mentaya and Katingan/within the Starling project area) with which you have most experience?
12. What is the forest type in this area?
  - a. Tall canopy ( $\geq 20$  m) peat-swamp forest
  - b. Low canopy ( $< 20$  m) peat-swamp forest
  - c. Very low ( $< 15$  m) peat-swamp forests
  - d. Mangrove forest
  - e. Other forest (note forest type)
13. How disturbed is this forest as a result of present/past logging and other activities?
  - a. Pristine (no logging, no fire)
  - b. Disturbed, but not burnt
  - c. Highly disturbed, but not burnt
  - d. Highly disturbed and burnt
14. Which forest activities are currently present in the area? (rate on a scale of 0-3; 0 = not present; 1 = very low intensity, very few people; 2 = medium intensity, small number of people; 3 = high intensity, major village activity).
  - a. Logging for forest conversion (state reason)
  - b. Illegal logging for forest conversion (state reason)
  - c. Illegal logging for wood
  - d. Fishing
  - e. Jelutong (or other – name) sap collection
  - f. Gemur (or other – name) bark collection
  - g. Rattan collection
  - h. Pig hunting
  - i. Deer hunting
  - j. Bird hunting
  - k. Fruit-bat hunting
  - l. Turtle hunting
  - m. Other species hunting (name all species)
  - n. Mining (state of gold, coal, etc.)
15. Which forest activities are you/have you been engaged in (rate on a scale of 0-4; 0 = never; 1 = in past, rarely; 2 = in past, intensive; 3 = currently, occasionally; 4 = currently, major activity).
  - a. Logging for forest conversion (state reason)
  - b. Illegal logging for forest conversion (state reason)
  - c. Illegal logging for wood
  - d. Fishing
  - e. Jelutong (or other – name) sap collection
  - f. Gemur (or other – name) bark collection
  - g. Rattan collection
  - h. Pig hunting
  - i. Deer hunting
  - j. Bird hunting
  - k. Fruit-bat hunting (if “yes”, please complete additional questionnaire)

- l. Turtle hunting
  - m. Other species hunting (name all species)
  - n. Mining (state of gold, coal, etc.)
16. Have the populations of the following species remained stable (= 1), increased (= 2) or decreased (= 3) over the time you have lived in the area?
- a. Orang-utans
  - b. Gibbons
  - c. Red leaf monkeys
  - d. Proboscis monkeys
  - e. Clouded leopard
  - f. Leopard cat
  - g. Marbled cat
  - h. Flat-headed cat
  - i. Bay cat
  - j. Storms stalk
  - k. Lesser adjunct stalk
  - l. White-shouldered ibis
  - m. Argus pheasant
17. Why has this change occurred? (ring all that apply)
- a. Hunting
  - b. Concession logging
  - c. Illegal logging
  - d. Fire
  - e. Other (please state)
  - f. Don't know

**Other Information**

Do you have any other information that we may find useful? (continue on a separate sheet if necessary):

**Closing the Interview**

Thank the person for his/her time and cooperation, and reassure him/her that his/her answers will be dealt with anonymously and his identity will not be revealed.

### **APPENDIX III: FOREST AND FAUNA PHOTOGRAPHS**

Please see separate file.