



**Institute of Biodiversity and Environmental Conservation**

**Wildlife Densities and Hunting by the Kenyah and Penan Communities  
in the Upper Baram Region, Sarawak**

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Wildlife Densities and Hunting by the Kenyah and Penan Communities in the  
Upper Baram Region, Sarawak

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## DECLARATION

I declare that the work in this thesis was carried out in accordance with the regulations of Universiti Malaysia Sarawak. Except where due acknowledgements have been made, the work is that of the author alone. The thesis has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.



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## ABSTRACT

Rapid forest conversion of tropical rainforests has caused detrimental effects on wildlife communities. Despite its importance as wildlife habitat, tropical forests play significant roles in the livelihood of many forest-dependent people. This study aims to explore the diversity and abundance of medium to large mammals in the Upper Baram region, Sarawak, Malaysian Borneo, where human and wildlife coexist. Using line-transect method, the study documented 17 species of medium to large mammals, including 13 endemic species of Borneo. Distance sampling method was used to estimate the densities of selected mammals' species, including the Bearded pig (*Sus barbatus*), Long-tailed macaque (*Macaca fascicularis*) and Pig-tailed macaque (*Macaca nemestrina*). The study also assesses the hunting pattern and importance of wildlife in the livelihood of the *Orang Ulu* people, a group of indigenous ethnics in Sarawak living in the Upper Baram forest area. The study recorded 11 hunted animals, with Bearded pig (*Sus barbatus*) as the most hunted species. The results revealed an estimate of more than 5400 kg of wild meat were harvested over the study period. These findings are vital to provide information for future wildlife and forest conservation effort that considers the importance of the forest and its resources for the continuity of the local people traditional lifestyles in the region.

**Keywords:** Wildlife, mammals, species diversity, species density, distribution, hunting, indigenous communities

***Kepadatan Hidupan Liar dan Pemburuan Komuniti Kenyah dan Penan di Kawasan Ulu Baram, Sarawak***

**ABSTRAK**

*Penukaran hutan yang mendadak dan pembalakan di hutan tropika telah memberi kesan buruk kepada komuniti hidupan liar. Selain kepentingannya sebagai habitat hidupan liar, hutan tropika memainkan peranan yang penting dalam kehidupan penduduk asal yang bergantung dengannya. Kajian ini mendalami kepelbagaian dan kelimpahan mamalia bersaiz sederhana ke besar di kawasan Ulu Baram, Sarawak, Borneo Malaysia. Menggunakan kaedah transek garis, kajian ini telah merekodkan 17 spesies mamalia bersaiz sederhana ke besar, termasuk 13 spesies endemik kepada Borneo. Kaedah jarak persampelan telah digunakan untuk menganggar kepadatan bagi beberapa spesies mamalia terpilih termasuk Babi hutan (*Sus barbatus*), Kera (*Macaca fascicularis*) dan Beruk (*Macaca nemestrina*). Kajian ini juga menilai pola pemburuan dan kepentingannya dalam kehidupan seharian komuniti Orang Ulu, iaitu kumpulan etnik orang asal Sarawak yang mendiami kawasan hutan Ulu Baram. Dapatan kajian merekodkan 11 jenis haiwan yang diburu, dengan Babi hutan (*Sus barbatus*) sebagai spesies yang paling kerap diburu. Hasil kajian mendapati dianggarkan sebanyak 5400 kg daging hidupan liar buruan telah diperolehi sepanjang tempoh kajian. Hasil kajian ini penting untuk menyediakan maklumat untuk pemuliharaan hidupan liar dan hutan di masa akan datang yang turut mengambil kira kepentingan hutan dan sumbernya dalam meneruskan gaya hidup tradisional penduduk tempatan di kawasan tersebut.*

**Kata kunci:** *Hidupan liar, mammalia, kepelbagaian spesies, kepadatan spesies, taburan, pemburuan, komuniti orang asal*

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## LIST OF ABBREVIATIONS

AIC	Akaike Information Criterion
asl	Above Sea Level
eg.	For Example
GDP	Gross Domestic Product
GPS	Global Positioning System
ha	Hectare
HoB	Heart of Borneo
ID	Identification
IUCN	The International Union for Conservation of Nature
km	Kilometre
km <sup>2</sup>	Kilometre Square
m <sup>3</sup>	Meter Cube
NGO	Non-profit Organization
PLEO	Pooled Local Expert Opinion
SWLPO	Sarawak Wild Life Protection Ordinance
TPA	Totally Protected Area
UNESCO	United Nations Educational, Scientific and Cultural Organization

# CHAPTER 1

## INTRODUCTION

### 1.1 Study Background

#### 1.1.1 Borneo as Biological Diversity Hotspot

Borneo, the world's third largest island is a biodiversity hotspot region in Southeast Asia and exceptionally home to 25 species of carnivores, which includes more endemic species than does any other island except Madagascar (Shepherd et al., 2011). The island is shared by the Malaysian states of Sabah and Sarawak, Kalimantan Indonesia and Brunei covered by a thick and dense vegetation of tropical rainforests. Borneo island is recognised as one of the top priority regions in biological conservation for all three dimensions of biodiversity: taxonomic, phylogenetic and trait (Brum et al., 2017). Such areas harbour not only high species richness and endemism but also unique evolutionary lineages and distinct ecological traits emphasising the importance of preserving these regions (Brum et al., 2017)

To date, there are 247 terrestrial and 30 marine mammals, and 673 species of birds are reported to occur in the island, of which 63 mammals' and 69 birds' species are endemic to Borneo (Phillips & Phillips, 2014; Phillips & Phillips, 2018). Borneo tropical rainforests bears some endemic mammals including elusive felids such as Clouded leopard (*Neofelis diardii*), Bay cat (*Catopuma badia*), Flat-headed cat (*Prionailurus planiceps*), endemic carnivores such as Hose's Palm civet (*Hiplogalei hosei*) and home to endangered primates including Orangutans (*Pongo pygmaeus*), Proboscis monkey (*Nasalis larvatus*), and the endemic Naked bat (*Chrysomeles torquatus*) (Phillips & Phillips, 2018).

### 1.1.2 Main Threats to Bornean's Wildlife

Natural forest conversion is the main threats to the loss of pristine forest cover and wildlife habitat in Borneo island. In 1970s, it is estimated about 75% of Borneo were covered by more than 500,000 km<sup>2</sup> of intact old-growth forest (Gaveau et al., 2014). However, in 2010, the covered area has reduced to 380,000 km<sup>2</sup>, which is about 53% of the island (Gaveau et al., 2014). Other factor of degradation includes forest fire, however this is prevalent in Kalimantan Borneo compared to the Malaysian parts of the island (Langner et al., 2007).

Logging is the one of the major forest loss in Borneo and has been exacerbated in the recent decades. This alone has been responsible for the loss of many lowland forests (<500 m asl) in the island (Gaveau et al., 2014). In Sarawak particularly, logging activity has accelerated in the 1990s, following the international ban on Indonesia round logs (Samejima, 2020). This is responsible for the vast establishment of logging road network in the state, which also has the lowest proportion of intact forest compared to the other parts of Borneo (Gaveau et al., 2014).

Between 2005-2015, agricultural plantation especially oil palm (*Elais guineensis*) is the biggest driver of deforestation across Borneo, and the loss is more intense in Malaysian Borneo than the Indonesian part (Foester et al., 2011; Meijaard et al., 2018). In Sarawak, the expansion of Rubber (*Hevea brasiliensis*) plantation has initiated the loss of forest cover in the state, before the emergence of timber industry (Hon & Samejima, 2020). The expansion of agricultural activity is also linked to the change in hunting patterns of many indigenous communities, particularly those living in the forested area of the region (Okino & Ichikawa, 2020; Kurz et al., 2021).



Many wildlife population in tropical forests receive much pressure from intensive hunting, especially of mammals (Brodie et al., 2014; Benítez-López et al., 2017). In Borneo, hunting of wild animals is widespread, particularly in the rural areas mostly for subsistence purposes (Bennett & Robinson, 2000; Yi & Mohd-Azlan, 2018). In addition, the killing of wild animals meat for sale and trade is also rampant, which frequently involved endangered species to meet human demands, such as for direct meat consumption or traditional medicine purposes (Kirupaliny & Mohd-Azlan, 2012; Gomez et al., 2020; Sahmat & Mohd-Azlan, 2022). Additionally, the selling of a highly-demanded wild animals parts also provide opportunities for some communities to gain economic return (Okino & Ichikawa, 2020).

## **1.2 Problem Statement**

Land-use change has been responsible for the loss of habitat for many tropical forest species. In Borneo, most of its forest cover has been cleared due to logging and agricultural plantation on top of human development, which resulted to fragmented and forest mosaics across its landscapes (Gaveau et al., 2014; Gaveau et al., 2018). This has caused many implications, both for biodiversity and human livelihood (Meijaard et al., 2013). The implications of land-use change on wildlife assemblages have been greatly discussed by many researchers (Bernard et al., 2014; Davison et al., 2019; Maiwald et al., 2020). Of these, mammals communities are greatly impacted as they receive additive pressure from human activities, such as hunting (Brodie et al., 2014; Benítez-López et al., 2017). Studies suggested that modified landscapes benefits some mammals species, however may greatly impact human-sensitive species (Brodie et al., 2014; Maiwald et al., 2020; Tucker et al., 2020).

In Borneo, the alteration of natural forest landscapes resulted from the combination of logging, oil palm plantation and shifting cultivation as practiced by many local

communities across the region (Gaveau et al., 2014; McAlpine et al., 2018; Samejima & Hon, 2020). These areas are usually unprotected by law, which indicates intense factors such as continuous land-use change and human interference, especially in rural areas where human are highly dependent on forest resources for subsistence (Bennett et al., 2000; Gallego-Zamorano et al., 2019). There is a need for research that considers the coexistence of human and wildlife to give insights on the influence of these factors on species assemblages and population, particularly of mammals communities (Samejima & Hon, 2020). This change also impacts the human and nature relationships, such as hunting patterns and its driven factors among the local communities (Okino & Ichikawa, 2020; Kurz et al., 2021). Hence, it is crucial to provide evidence that clearly explains the impact of landscapes change on this relationship.

Often, the existing literature focus on the quantifying species diversity and mammals' assemblages in such disturbed landscapes (Jati et al., 2018; Maiwald et al., 2020). Most of these studies used surrogate approach to assess species population, such as diversity indices and occupancy (Mackenzie et al., 2006; Cheyne et al., 2016;). Yet, there is a paucity of information on species abundance and density, which is imperative for effective conservation strategies and long-term management of species population (Buckland et al., 2015; Gestich et al., 2016; Tucker et al., 2020). Many of the available information focuses on single focal species, especially species of conservation importance (Nijman, 2004; Ahmed et al., 2013; Hearn et al., 2016; Seaman et al., 2019). However, this information is largely absence for many key species, particularly for tropical forest mammals (Ahmad et al., 2020).

### **1.3 Objectives**

The study aims to assess species assemblages in the forest of Upper Baram and hunting practices among the indigenous communities (Kenyah and Penan) in the forest area. This can be achieved through the following set of objectives:

- i. To identify medium to large mammals' species diversity and its distribution in the Upper Baram region.
- ii. To estimate density of selected large mammals in the Upper Baram region.
- iii. To investigate hunting practices and the significance of wildlife in the livelihood of the indigenous communities in the Upper Baram region.

### **1.4 Chapter Summary**

Chapter 1 presents information on Bornean's wildlife and main threats to its habitat and population. The aim and objectives of the study were outlined in the next part of the chapter, and lastly followed by problem statement.

Chapter 2 discusses available literature and previous research relevant to the study topic, including the gaps in the current body of knowledge. The chapter elaborates the important aspects of this study including species diversity studies in Borneo and different forest landscapes, hunting and its significance for the forest-dependent community, the importance of community-based conservation, and the background of methods used in this study.

The third chapter presents findings on species assemblages and large mammals' density in the Upper Baram forest. Here, methods and analysis that were used were explained

in details. This chapter discusses findings based on the first and second study objective, including species diversity, distribution and density of selected large mammals. These were further elaborated with supported information from previous studies in the discussion part.

Chapter 4 focuses on hunting among the indigenous communities in the study area and analysis of hunting return data based on survey results, which is the third objective of this study. The chapter listed out the most hunted wildlife species in the study area. Study findings on the driven factors of hunting practices and its importance for the people were further discussed in this chapter.

In the final chapter, results from both study chapters were discussed and summarized in details. Based on the findings of the study, some suggestions were provided to aid conservation efforts, both at local and regional levels. Further insights into future studies in the study region were also outlined later in this chapter.

## CHAPTER 2

### LITERATURE REVIEW

#### 2.1 The Flora and Fauna of Borneo

Borneo, the world's third largest island is a biodiversity hotspot region in Southeast Asia and exceptionally home to 25 species of carnivores, which includes more endemic species than does any other island except Madagascar (Shepherd et al., 2011) . The island is shared by the Malaysian states of Sabah and Sarawak, Kalimantan Indonesia and Brunei covered by a thick and dense vegetation of tropical rainforests. Borneo island is recognised as one of the top priority regions in biological conservation for all three dimensions of biodiversity: taxonomic, phylogenetic and trait (Brum et al., 2017). Such areas harbour not only high species richness and endemism but also unique evolutionary lineages and distinct ecological traits emphasising the importance of preserving these regions (Brum et al., 2017).

To date, there are 247 terrestrial and 30 marine mammals, and 673 species of birds are reported to occur in the island, of which 63 mammals' and 69 birds' species are endemic to Borneo (Phillips & Phillips, 2014, 2018). Borneo tropical rainforests bears many endemic mammals including elusive felids such as Clouded leopard (*Neofelis diardi*), Bay cat (*Catopuma badia*), Flat-headed cat (*Prionailurus planiceps*), endemic carnivores such as Hose's palm civet (*Hiplogalei hosei*) and home to endangered primates including Orangutans (*Pongo pygmaeus*), Proboscis monkey (*Nasalis larvatus*), and the endemic Naked bat (*Chrysomeles torquatus*) (Phillips & Phillips, 2018).

Generally, about 40% of mammals' species in Sundaland realm are endemic to the region, highest than those in the Phillipines and Wallecea hotspot region and the highest in

terms of amphibians' species endemism (~80%) of the whole Southeast Asia (Sodhi et al., 2004). The floristic diversity of the Borneo tropical rainforests is also known to be a centre of distribution and species diversity for several economically important families and genera of flowering plants (Soepadmo & Wong, 1995).

Of the 386 known species of the Dipterocarpaceae, about 75% (291 species) are recorded from Borneo, of which 257 species (about 66%) occur in Sabah and Sarawak alone with each of it plays major important ecological roles such as mass fruiting phenomenon and carbon absorption (Soepadmo & Wong, 1995; Curran et al., 2000; Sodhi et al., 2004). Lee et al. (2002) estimated a small area of Lambir Hills National Park in Sarawak has included about one quarter of all 5000 species of North-west Borneo, indicating a high floristic composition of such forests. Approximately 3,000 magnificent species of orchid can be found in the island which is more than anywhere else on earth (World Wildlife Fund, 2010). Despite of this, the rapid destruction of tropical habitats generally in Southeast Asia due to land use demands has posed serious threats where natural habitats especially the lowland rainforests is being destroyed (Sodhi et al., 2004).

## **2.2 Threats to Wildlife in Borneo Tropical Rainforests**

Anthropogenic activities has found to severely affect the assemblages and distribution of wildlife species in the region (Meijaard & Sheil, 2007), in which wildlife are still hunted and available for sale (Kirupaliny & Mohd-Azlan, 2012) and forest is continuously being cleared for logging and development (Sodhi et al., 2004; Mathai et al., 2016; Gaveau et al., 2018; Alamgir et al., 2020) therefore immediate action shall be considered to mitigate the impacts. Sodhi et al. (2010) listed the need for sustainable timber harvest and oil palm plantation as the main conservation imperatives in Malaysia. However,

the impact of hunting should not be overlooked as it is widespread in the region (Bennett et al., 2000). Importantly, there is a paucity of information on distributions and population statuses of the cryptic mammals' species such as the five felids inhabiting Borneo Island (Wearn et al., 2013). Therefore, a credible, accurate and up-to-date information about carnivore's distribution and ecology is scarce despite of their undoubted importance in Borneo (Mathai et al., 2016).

### **2.3 Anthropogenic Activities Lead to Habitat Loss in Borneo**

Forest conversion, forest fire, hunting and wildlife trade are the responsible cause for habitat and biological loss in Southeast Asia (Sodhi et al., 2004). The tropical forests in Southeast Asia are threatened by high deforestation rates and increasing loss of pristine forests (Langner et al., 2007). In Borneo, the lowland forest cover has changed with a deforestation rate of -1.8% change per year from 2002 to 2005 (Langner et al., 2007). In 1973, it is estimated about 75.7% of Borneo were covered by more than 500,000 km<sup>2</sup> of intact (unlogged) old-growth forest (Gaveau et al., 2014). The area, however, has been reduced by more than 160,000 km<sup>2</sup> in 2010, representing the loss of 30.2% forests cover over the last four decades (Gaveau et al., 2014).

Additional cause to land cover change is due to fire which has affected 37% of cultivation forest mosaic, the most severed compared to other land type (Sodhi et al., 2004; Langner et al., 2007). The driven factor is mostly linked to the seasonal land clearing activities of shifting cultivators in the island (Langner et al., 2007). In general, Sarawak natural vegetation encompasses seven forest types, varying according to soil type and elevation which are: beach forest, mangrove forest, peat swamp forest, riverine forest, Kerangas or tropical heath forest, limestone forest, lowland and hill dipterocarp forest and

montane forest (Bennett, 1992). Of these, the lowland tropical rainforest is mostly deteriorated due to severe threats from industrialisation and anthropogenic activities (Gaveau et al., 2013; Gaveau et al., 2017).

Habitat alteration in Borneo has been caused by a range of factors including the expanding oil palm industry (*Elaeis guineensis*) across its land area. According to Kato & Soda (2020), land use for oil palm plantation in Sarawak particularly has increased drastically over the past 20 years in which, currently in 2017 more than 1 million ha oil palm planted area were estimated in the state. Remarkably, as in 2018 more than 70% from 1.5 million ha of oil palm plantation area in Sarawak are owned by private estates surpassing those own by government sectors and smallholders (Malaysia Palm Oil Council, 2019). The oil palm plantations in Sarawak in the beginning was mostly developed along the coast, small holders' cultivation however, has contribute to the currently spreading of oil palm plantation throughout the inland hill zones on vast post-swidden area, contributing about 14% of total oil palm plantation area in Sarawak (Kato & Soda, 2012; Ministry of Primary Industries, 2018).

Initially, Sarawak is a late comer in Southeast Asia timber industries compared to Sabah, Indonesia and The Phillippines (Samejima, 2020). Due to its low density of commercial trees without holes, the export of Sarawak timber is lower than that of Phillippines, Sabah and Kalimantan (Samejima, 2020). Previously, the state government did not depend on timber export royalties to the same extent as the Philippines and Sabah except for one valuable tree species called Ramin (*Gonystylus bancanus*), found in peat swamp forests that has been exported out of Sarawak for the total of 1.1million m<sup>3</sup> logs in 1965 (Samejima, 2020). Nonetheless the logging production from the state increased drastically