MALAYAN TAPIR BEHAVIOUR, HABITAT USE AND DENSITY IN BELUM, PERAK.

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MALAYAN TAPIR BEHAVIOUR, HABITAT USE AND DENSITY IN BELUM, PERAK.

by

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LIST OF SYMBOLS AND ABBREVIATIONS

AIC	Akaike Information Criterion
a.s.l.	above sea level
AFR	Amanjaya Forest Reserve
BTFC	Belum-Temengor Forest Complex
C.I	Confident Interval
DEM	Digital Elevation Model
DWNP	Department of Wildlife and National Parks
GJH	Gerik-Jeli Highway
GPS	Global Positioning System
IUCN	International Union for Conservation of Nature
JAKOA	Department of Orang Asli Development
JUPEM	Department of Survey and Mapping Malaysia
kg	kilogram
km	kilometer
km^2	kilometer square
m	meter
M	mean
MNS	Malaysian Nature Society
NDVI	Normalized Difference Vegetation Index
P	Detection probability
p.d.f	Probability density function
PFR	Permanent Reserve Forest

RAI	Relative Abundance Index
RBSP	Royal Belum State Park
RPSV	Root Pooled Spatial Variance
SE	Standard Error
SECR	Spatially Explicit Capture Recapture
TFR	Temengor Forest Reserve
TN	Trap Night
X	score
Z	Standardised value
g0[.]	Detection function
%	Percentage
Δ4	Coefficient of overlap
Ψ	Psi (Habitat use)
Σ	Standard deviation
σ [.]	Spatial scale parameter

TINGKAH LAKU, PENGGUNAAN HABITAT DAN KEPADATAN TAPIR ASIA DI BELUM, PERAK.

ABSTRAK

Diklasifikasi sebagai terancam di dalam Senarai Merah IUCN, pengetahuan ekologi terhadap tapir masih lagi serba kekurangan; bukan sahaja untuk Semenanjung Malaysia, malahan juga bagi negara-negara serantau Asia Tenggara. Dianggarkan cuma tinggal di antara 1,500 hingga 1,700 individu sahaja di negara ini, ancaman utama kepada tapir adalah kehilangan habitat dan fragmentasi. Sejak beberapa tahun kebelakangan ini, kes-kes kematian tapir akibat dilanggar di atas jalanraya semakin meningkat akibat daripada impak secara langsung oleh fragmentasi jalan. Kemusnahan hutan secara berskala besar juga menyebabkan tapir merayau ke kawasan penempatan manusia. Di dalam usaha pemuliharaan tapir, kajian ini bertujuan untuk memahami lebih terperinci populasi ekologi tapir dengan memperoleh corak aktiviti tapir, factor-faktor yang mempengaruhi kepenggunaan habitat, menilai status populasi dan menganggar Index Kelimpahan Relatif (RAI) dalam RBSP, yang merupakan hutan primer dan TFR, yang merupakan hutan sekunder. Didapati sebahagian besar corak aktiviti aktif tapir adalah pada waktu malam; 19:00 hrs to 06:59 hrs (83.20%). Corak activiti tapir tidak signifikan (P>0.05, Mann-Whitney) apabila dibandingkan dengan aktiviti manusia yang kebiasaannya pada waktu siang, dengan anggaran kepadatan kernel 0.16 (CI: 0.10-0.22) di TFR dan 0.12 (CI: 0.07-0.17) di RBSP. Penghindaran kawasan habitat manusia boleh diperhatikan melalui keputusan analisa kepenggunaan habitat, di mana tapir didapati lebih cenderong memilih kawasan hutan

yang berjauhan daripada penempatan-penempatan manusia dan kawasan-kawasan yang tinggi di dalam lanskap RBSP dan TFR. Dengan kawasan tanah rendah di Malaysia semakin diterokai untuk penanaman monokultur, terdapat juga risiko di mana kawasan tanah tinggi dijadikan gunatanah yang lain juga. Selain daripada menjadi habitat semulajadi yang penting kepada tapir, tanah tinggi juga berfungsi sebagai koridor untuk haiwan-haiwan lain seperti harimau. Justeru itu, adalah amat penting jika tiada penerokaan tanah tinggi untuk aktiviti-aktiviti penanaman dan sebarang guna tanah yang lain. Kajian ini memperoleh kepadatan 4.56 (SE±0.94) tapir dewasa per 100km^2 dan 3.88 (SE±0.99) tapir dewasa per 100km^2 di TFR dan RBSP masing-masing. Keputusan ini diperoleh daripada analisa menggunakan hanya 36.78% kadar individu berjaya dikenalpasti di TFR dan 16.31% kadar individu bejaya dikenalpasti di RBSP. Justeru itu angaran-angaran ini haruslah diguna secara was-was. RAI keseluruhan BTFC pula adalah 1.64 (SE±0.22). Keputusan yang diperoleh daripada kajian ini boleh digunakan untuk membantu dalam merumus pelan pengurusan pemuliharaan untuk spesis ini.

MALAYAN TAPIR BEHAVIOUR, HABITAT USE AND DENSITY IN BELUM, PERAK.

ABSTRACT

Listed as endangered under the IUCN Red List of Threatened Species, the ecological knowledge for the Malayan tapir is still severely lacking; not only for Peninsular Malaysia, but also for the Southeast Asia region. Estimated to be between 1,500 to 1,700 individuals left in the country, the Malayan tapir is now threatened mainly by habitat loss, and fragmentation. In recent years, there has been an increase in tapir road-kills due to the direct impact of road fragmentation. Large-scale natural forest conversion has likely caused tapirs to venture out into human dominated areas. In an effort to conserve Malayan tapirs, this thesis therefore seeks to better understand the population ecology of tapir by investigating its activity pattern, factors that influence its habitat preference, assessing its population status and Relative Abundance Index (RAI) within RBSP, a primary forest and TFR, a selectively logged forest. The Malayan tapir's activity pattern was found to be predominantly nocturnal; 1900 hrs to 0659 hrs (83.20%). Activity pattern of the Malayan tapir is not significantly different with predominantly diurnal activity of human in the landscape ($P>0.05$, Mann-Whitney) with kernel density estimate of 0.16 (CI: 0.10-0.22) in TFR and 0.12 (CI: 0.07-0.17) in RBSP. Spatial avoidance towards human habitation was observed from the habitat use analysis, where the Malayan tapir was found to prefer forested areas which are away from the human settlements and at high elevation in the RBSP and TFR landscape. With much of Malaysia's natural lowland forest being converted

to other monoculture, there is an imminent risk of highlands being converted to other landuses as well. Other than being an important natural habitat for the Malayan tapir, highlands also serves as corridors for other wildlife such as tigers. Therefore, it is imperative that these highlands be preserved in its natural state and not converted for agricultural activities or other landuses. This study derived a density of 4.56 (SE±0.94) adult tapir per 100km^2 and 3.88 (SE±0.99) adult tapir per 100km^2 in TFR and RBSP respectively. This result, however, was obtained from a 36.78% successful individual identification rate in TFR and 16.31% successful individual identification rate in RBSP. The RAI of the Malayan tapir in BTFC is 1.64 (SE±0.22). These results obtained from this study could be used to aide in formulation of informed conservation management for the species.

CHAPTER 1

INTRODUCTION

1.1 Introduction

Among the 11 countries in Southeast Asia, Malaysia is renowned as one the most megadiverse countries in the world. Based on the National Biodiversity Index, Malaysia ranked 12th internationally for its richness and endemism in flora and fauna. Being part of the Convension on Biological Diversity, Malaysia documented to be home to 15,000 species of vascular plants, which they exist alongside 306 species of mammals, 742 species of birds, 242 species of amphibians and 567 species of reptiles in its diverse ecosystems. With increasing research being carried out in the country, new discoveries are still being made and the record is still expanding.

Withal, Malaysia unfortunately has also lost three large mammals since 1950s, starting with the Javan rhinocerous (*Rhinoceros sondaicus*) and banteng (*Bos javanicus*) - Aiken and Leigh (1992). It was then followed by Sumatran rhinoceros (*Dicerorhinus sumatrensis*) recently, and despite efforts and constant plea to save the animal by various parties (Flynn & Abdullah, 1984; Khan, 1989; Zainuddin et al. 1990; Zafir et al., 2011) it still suffered the ill-fated route to extinction (Gokkon, 2019).

With the unresolved fundamental issues such as habitat loss (Koh & Wilcove, 2008; Aziz et al., 2010) and poaching (Belecky and Gray, 2020), large mammals in the country are still facing the risk of going extinct. Ten out of 12 large mammals found in Peninsular Malaysia are categorised as Threatened under the IUCN Red List. The Malayan tiger (*Panthera tigris*) is being listed as Critically Endangered and is facing the highest risk of becoming extinct in the wild. It is follow by three other mammals, which are listed as Endangered, and one of them is the Malayan tapir (*Tapirus indicus*); IUCN (2021).

Described first by Desmarest in 1819, the Malayan tapir is the only tapir that can be found out of the New World. Historically, the Malayan tapir were distributed throughout Peninsular Malaysia, Sumatra, Myanmar and Thailand to Cambodia and Vietnam (Khan, 1997). Its range has now been reduced to only Southern Thailand, Vietnam, Sumatra and Peninsular Malaysia (Lynam, 1999; Traeholt & Mohamad, 2009). It is estimated that the total global population for wild Malayan tapir is approximately 2,500 individuals (Traeholt et al., 2016, IUCN, 2021); with an estimated of 1,500-1,700 individuals as the population size range in Malaysia (Traeholt and Mohamed 2009; Clements et al., 2012; Rayan et al., 2012; IUCN, 2021).

The Malayan tapir, being among the biggest mammals in the forest, plays an important role in the forest as seed dispersal. Studies on Lowland tapir (*Tapirus terrestris*) revealed that the species ingests varieties of intact seeds (Bodmer, 1990;

Bodmer 1991), making it an important long-distance seed dispersal (Bodmer 1991; Rodrigues et al. 1993; Fragoso 1997; Henry et al. 2000; Galetti et al. 2001; Fragoso et al. 2003, Paolucci et al., 2019). Being its close cousin, and larger in size, the Malayan tapir, which consumes an astonishing 380 species of plants (Medway, 1972; Williams, 1980; Khadijah-Ghani, 2010; Syazwani, 2009) is assumed and expected to perform similar functions and contribute greatly to the seed dispersal in the Malaysian rainforest. With an average traveling distance of 14.40 km weekly (Mahathir et al., 2017), the animal could easily disperse the seed far from the sources. Albeit, Campos-Arceiz et al. (2012) highlighted that the Malayan tapir is more effective in dispersing small-seeded plants compare to medium- and large-seeded plants due to its seed predation nature on larger-sized seeds.

In tapir ranges countries, the main threats to the survival of this genus seems to be the same. The leading threat is habitat loss, while hunting causes the decline in three of the four tapir species; Baird's tapir (*Tapirus bairdii*), Lowland tapir (*Tapirus terrestris*), Mountain tapir (*Tapirus pinchaque*) (IUCN, 2021; Thornback & Jenkins, 1982; Downer, 1995, 1996a, 1996b, 1997; Baillie & Groombridge, 1996). Hunting and trade were previously underlined as a threat for the Malayan tapir in Khan (1997), however further observation in Kawanishi et al., (2002) indicated that they are relatively minor compared to habitat loss. In the recent years, an increase of cases reported of tapir being a roadkill (Robertson, 2018; Bernama, 2021) also contributed to the high mortality of the animal in Peninsular Malaysia.

1.2 Rational of study

Distirbuted across in only four countries, the Malayan tapir's population has been on a decreasing trend (IUCN, 2021). Although Malaysia and Sumatra could possibly be an important refuge for the population, ecological knowledge on this animal is still very limited (Meijaard & van Strien, 2003). In Malaysia, the Malayan tapir has been listed as totally protected species since 1955; back then under the Wild Animals and Birds Ordinance no.2 of 1955 (Khan, 1997). In Peninsular Malaysia, under a local status assessment by the Department of Wildlife and National Parks, the species has been elevated to Endangered from Near Threatened in a mere less than a decade period (DWNP, 2010; DWNP, 2017).

Apart from camera-trapping capture rates and track encounter rates (Kawanishi & Sunquist, 2004; Mohd Azlan, 2006; Darmaraj, 2007; Magintan et al., 2017; Nasron et al., 2019; Jambari et al., 2019), there was one crude population estimate by Traeholt & Mohamed (2009) and only one robust population estimate of the Malayan tapir by Rayan et al., (2012). In Rayan et al., (2012) study, the results was actually derived from a non-tapir specific camera-trapping data set. Depending on the survey design, with Malayan tapir being among the most abundance species recorded by camera-trap (Kawanishi et al., 2010; Sanusi et al., 2013; Sasidhran et al., 2016; Magintan et al., 2017), there are high potentials for adoption of 'Best Available Data – B.A.D' (Kawanishi et al., 2013) in producing a more reliable nationwide population estimate and other ecological information such as distribution and occupancy for the Malayan

tapir in Malaysia. On top of that, large scale wildlife study which usually requires exorbitant amount of cost and fundings (Kawanishi et al., 2013) further strengthen the need to optimise the data collected, even if they are not targetted, as long as careful considerations are being established and reasonable caveats are being highlighted when presenting the results. With these in place, data can be extracted, analysed and be produced into useful information to be contributed to making more informed decision in improving wildlife conservation management for the species in Peninsular Malaysia.

In this study, which methodology was initially designed for tiger and tiger prey, an attempt is being made to generate useful information to be contributed as part of the puzzle in closing the knowledge gap on Malayan tapir in Peninsular Malaysia. Apart from understanding it's activity behaviors and establishing baseline density as well as Relative Abundance Index (RAI) in BTFC, a prediction on the habitat use of the Malayan tapir in BTFC will allow areas of importance for the species in the landscape to be identified and proposed for much better protection.

1.3 Aim of the study

The main aim of this study is to quantify the behaviour, habitat use and density, as well as Relative Abundance Index (RAI) of the Malayan tapir in the Belum-Temengor Forest Complex, Perak. The results produced is envisioned to heighten the knowledge

on the Endangered Malayan tapir. This could be crucial and can be used to positively influence the decision making by the management authorities for future conservation efforts of the Malayan tapir.

1.4 Objectives

1. To determine activity patterns and the activity class of the Malayan tapir in Temengor Forest Reserve (TFR) and Royal Belum State Park (RBSP).
2. To determine if human activities affects the activity pattern of the Malayan tapir in TFR and RBSP.
3. To investigate the factors which influence the habitat use of the Malayan tapir within TFR and RBSP.
4. To identify critical areas for Malayan tapir within the Belum-Temengor Forest Complex (BTFC) by producing a habitat suitability map.
5. To estimate the baseline population density and Relative Abundance Index (RAI) of the Malayan tapir in TFR and RBSP

1.5 Hypothesis

In this study, one logged over forest and one primary forest were chosen as the study site – namely Temengor Forest Reserve (TFR) and Royal Belum State Park (RBSP) respectively. Generally, the Malayan tapir has been reported to be a nocturnal

species (Malaysia: Kawanishi, 2002; WWF-Malaysia, unpublished data. Indonesia: Holden et al., 2003; Novarino et al., 2005). Due to the presense of large-scale human activities such as logging in TFR in comparison with the restricted, primary forest of RBSP, the activity pattern for both study sites are expected to be slightly different. In Gaynor et al. (2018), animals adapted to behave more nocturnally due to anthropogenic activities by humans. As human activities in TFR also happens more during the day, this study presents an opportunity to test the difference it makes toward a generally nocturnal animal in the alongside large-scale human activities.

The Malayan tapir, known to be a generalist which consumes various species of plants and fruits species (Simpson et al., 2013; Khadijah-Ghani, 2010; Syazwani, 2009), are among the most common species to be photographed in camera-traping studies (Kawanishi et al., 2010; Sanusi et al., 2013; Sasidhran et al., 2016; Magintan et al., 2017). With a high sampling efforts, this study, therefore attempts to investigate the factors that are deemed to influence habitat preferences of the Malayan tapir. Among the selected variables to be tested, one would expect the animal to prefer forest patches containing saltlicks (Traeholt & Mohamad, 2009) because of the mineral content which is required by herbivores like tapir to supplement their nutrient-poor plant diet (Matsubayashi et al., 2006; Robbins, 1993). Identified as a shy animal, the Malayan tapir is also expected to stay away from human settlements (Linkie et al, 2013; Kvasnes et al., 2014; van Strien & Grêt-Regamey, 2016) to avoid disturbances and it also prefers lower elevation (Traeholt and Mohamed, 2009; de Pinho et al., 2017; Musila et al., 2019; IUCN, 2021) presumably due to higher food availability including more fruting trees. Dense forest that has close canopy with high NDVI value (Pettorelli

et al., 2011) could also be an important determining factor in habitat preferences of the Malayan tapir.

State variables to measure population status or trend such as abundance or distribution is much needed to aid the assessment and conservation for the Malayan tapir. As it has been shown that, individual identification of the Malayan tapir (Holden et al., 2003; Noss et al., 2003; Novarino et al., 2005; Trolle et al., 2008; Traeholt and Mohamad, 2009; and Rayan et al., 2012) has been carried out and subsequently analysis with the use of Spatially Explicit Capture Recapture (SECR), is possible, this study will investigate further the use of such information to derive a baseline for the population status of the Malayan tapir in a TFR and RBSP. Linking this to hypothesis on the avoidance of the species towards disturbed area, density and Relative Abudance Index (RAI) are expected to be higher in study site with lower human disturbances - the RBSP.

Although comparison of results would be made in these two sites coincidently being a primary forest and a logged over forest, generalisation of results implying the forest types would be avoided as to prevent pseudoreplication (Ramage et al., 2013).

CHAPTER 2

LITERATURE REVIEW

2.1 Tapir

The family Tapiridae has been found to exist in the Eocene of North America nearly 50 million years ago, and the genus *Tapirus* first appeared in the Miocene, between 25-5 million years ago, to which it is a derivation from an ancient lineage (Eisenberg, 1997). There are a total of four species of tapir in the world namely Baird's tapir (*Tapirus bairdii*), Lowland tapir (*Tapirus terrestris*), Mountain tapir (*Tapirus pinchaque*) and Malayan tapir (*Tapirus indicus*). *Tapirus kabomani* was claimed as a major discovery in 2013 and was proposed as the fifth species into the genus *Tapirus* (Cozzuol et al., 2013), however, the proposal was still being debated (Voss et al., 2014; Cozzuol et al., 2014), and has not been formally accepted under the IUCN Red List (2021). Baird's tapir's distribution spreads from Southern Mexico to North-Western Columbia (Reid, 1997; Lawton, 2000; Naranjo, 2009; Kappelle & Brown, 2001), while the Mountain tapir occurs in Northen Andes (Downer, 2001), and the Lowland tapir can be found in South American tropical forest (Eisenberg, 1989; Emmons & Feer, 1997).

2.2 Malayan Tapir in the region

The Malayan tapir, fascinatingly, is among the animal of interest to many coutries including the European countries. Acting as an exhibition animal, the Malayan tapir could be found in most zoo in southeast Asia (Khan, 1997). In the United States of America, the import of Malayan tapir could be traced back to 1929 (Fontaine, 2008). The animal was kept in the Dallas Zoo and lived for 29 years. According to the records in Gilmore (2007), zoos in the US housed at least 58 individuals of the animal, whereas 9 inviduals were reported to be under the care of captive facilities in the UK (Clauss et al., 2009).

In China, a country where tapirs are not found, Harper (2013) discussed in detail on the use of the cultural reference of the name *Mó* (貘) which was once associated and confused between the giant panda (*Ailuropoda Melanoleuca*) and Malayan tapir (*Tapirus indicus*) in Chinese literatures. While in Japan, *Baku* (獏), existed as a mythylogical creature which believed to help with 'good sleep and good dreams' (Murad, 2020). This animal and its folklore is also linked to inspired the creation of a character (drowzee) in a famous electronic game played world wide – the Pokemon.

In Malaysia, the Malayan tapir is given numerous local names. They are being called the *badak tampong*, *badak bodoh*, *machan*, *cipa*n, *tenuk*, *badak murai* and

teronok, while in Indonesia, this animal is referred to as *badak*; similar to the rhinoceros (Khan, 1997). In Sumatra, the Malayan tapir is known as *tenuk* or *seladang*, *gindol*, *babi alu*, *kuda ayer*, *kuda rimbu*, *kuda arau*, *marba*, *cipan* and *sipan* (Khan 1997); some of which are the same or similar to common names in Malaysia. Whereas in Thailand, it is known as P'somm-sett, which literally means 'mixture'. According to folklore in Thailand, the *P'somm-sett*, is a combination of leftover animal parts (Sanborn and Watkins, 1950). Correspondingly in Malaysia, the Malayan tapir has been called 'Si bu xiang' (四不相) by the Chinese immigrants in the 15th century, which literally means 'blend of four animals' (Kawanishi et al., 2002). The four animals the Chinese referred to were horse, rhino, elephant and pig.

The Malayan tapir is the largest and heaviest among all four species of tapir. The heaviest ever recorded for this species was 540 kg, and the minimum, was 240 kg (MacKinnon, 1985; Khan, 1971; Lekagul & McNeely, 1977; Burton and Pearson, 1987). It ranges from 1.8 m to 2.5 m in length and has a height of approximately 0.9 m to 1.1 m. One distinguishing feature belonging to this species that separates the Malayan tapir from the other three other tapir species is its colouration. Its front and back sections are black with a white saddle from behind the front legs and going over the back to the tail. There were also reports of melanistic Malayan tapir (Kuiper, 1926; Mohd. Azlan, 2002; Arulsani et al., 2017), but these occurances are extremely rare. Baby tapir is born with pattern and pelage colour which changes when it grows up (Donny et al., 2019). Due to its habitat that is usually dense with undergrowth vegetation, the colouration of the Malayan tapir is thought to act as an effective camouflage from predators (Meijaard and van Strien, 2003). Apart from that, its high

olfactory sensitivity and the ability to move swiftly through thick vegetation are added advantages for the Malayan tapir to avoid and escape from predators (Arumugam et al., 2020).

2.3 Habitat and feeding habits of Malayan Tapir

The Malayan Tapir is known to occur in wide range of forest types – from lowland to cloud forest (Holden et al., 2003; Steinmetz et al., 2008). Although Malayan tapirs are more predominantly found in lowland areas (Traeholt and Mohamed, 2009; IUCN, 2021), the species is also known to be commonly found in montane forest as shown by a study conducted in Thailand (Steinmetz et al., 2008). Tapirs have been observed using forest fringes and logged/disturbed forest, and occasionally, found wandering into rubber and oil palm plantations (Khan, 1997). This is not unusual when secondary forest is among the important habitats for this species in Peninsular Malaysia (Clements et al., 2012).

The Malayan tapir is known mainly to feed on young leaves, twigs and wide range of plants (Williams, 1978, Medway, 1972; Williams & Petrides, 1980; Syazwani, 2009; Khadijah-Ghani, 2010). As one of the largest mammals in the Malaysian forest after the elephant and gaur, the Malayan tapir's role as a seed disperser is crucial. The Malayan tapir is responsible to process fruits too large for

other frugivores, and dispersing the seeds far from the sources, thereby expanding the plants' distribution.

2.4 Tapir Distribution and Population in Malaysia.

In Peninsular Malaysia, the Malayan tapir can be found in most of the states (DWNP, 2009; Abdul Kadir & Hasdi, 2003; Clements et al., 2012) – Figure 2.1. There were also records where archeological evidence of the Malayan tapir has been found in East Malaysia. Three records from Sarawak and one from Sabah (Cranbrook & Piper, 2009) were reported, however, habitat fragmentation and intense hunting pressure were hypothesised as the cause of the local extinction in Borneo.

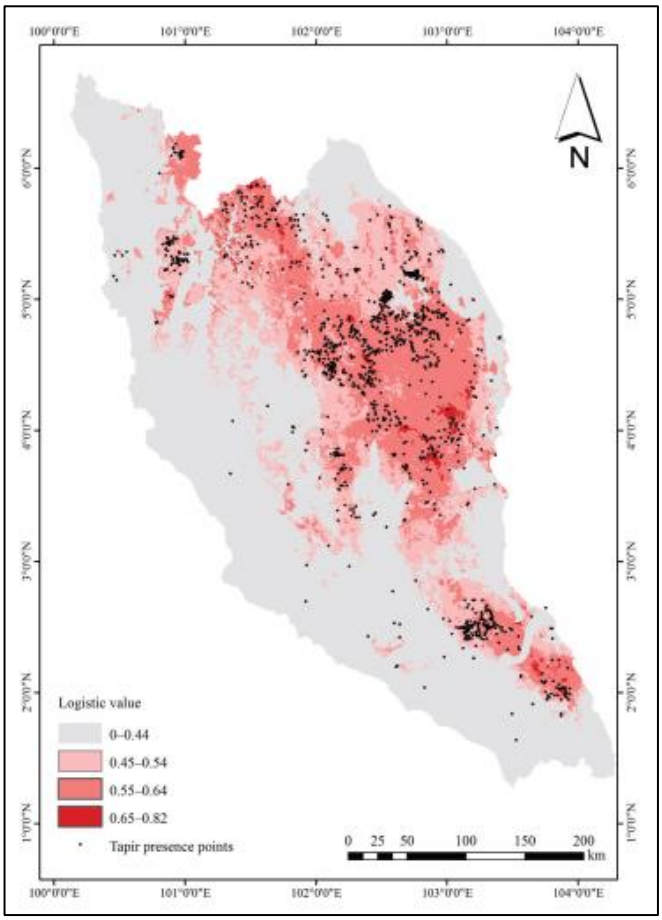

Figure 2.1: Predicted distribution of the Malayan tapir in Peninsular Malaysia; (Source: Clements et al., 2012).

Despite it being widespread, the Malayan tapir is among the least studied large mammals in Malaysia. Very little is known about its distribution (see Abdul Kadir and Hasdi, 2003) and population status (see Meijaard and van Strien, 2003). There are four national level figures for the population size of the Malayan tapir in Peninsular Malaysia; 369 (Meijaard and van Strien, 2003; Khan, 1997), 3,500 (Zainal et al., 2001) and 1500 to 1700 (Clements et al, 2012, Rayan et al., 2012 and Traeholt and Mohamed, 2009). However, these estimates were very crude as very little research was carried out in establishing them. Up to date, no robust scientific method has been used to assess the reliability of all the three national wide guesstimates, except Rayan et al.

(2012)'s site specific density estimate of 9.49 adult tapirs/100 km^2. Although tapirs seem to be relatively abundant compared to other large mammals, as perceived from camera trap and track encounter records (Kawanishi & Sunquist, 2004; Mohd Azlan, 2006; Darmaraj, 2007), such hypothesized high abundance is not likely to be continually observed if current habitat loss, degradation and fragmentation is not minimised.

2.5 Threats to the Malayan Tapir.

Loss of habitat due to deforestation has been happening globally, and is definitely a serious threat to wildlife. There are hypotheses that selective logging is among the biggest cause of species extinction of animals in Southeast Asia, implicating animals like Malayan tiger (*Panthera tigris*), Asian sun bear (*Helarctos malayanus*) and Malayan tapir (*Tapirus indicus*) - Pimm and Raven (2000), Okuda et al. (2003), Bischoff et al. (2005), Jamhuri et al., (2018). Although the rate of global forest loss seems to have reduced from 16 million hectares per year in 1990s to an estimated 13 million hectares per year between 2000 and 2010, the world is still experiencing a loss of 5 million hectares to 6 million hectares of forest in the same period of time (FAO, 2012). In countries of main occurrences of the Malayan tapir, Thailand has only 32.66% of forest cover in 2004 compared to 53.33% in 1961 (Lakanavichian, 2006). Whereas in Sumatra, about 70% of the total forest in that island had been converted and cleared mainly for of agro-industrial development (Margono

et al., 2012). For Myanmar, the forest cover dropped from 57.9% in 1990 to 47.6% in 2005 (FAO, 2006).

In Malaysia, as of 2003, 45% of the total land was still forested (FDPM, 2003). Of the 45% forested area, 36% are Permanent Reserves Forest, 3% state land forest and 6% are protected areas. In 2010, Miettinen et al. (2011) reported that the figure had been further reduced to only 37.70% (4,947,000 ha) of forest cover remaining in Peninsular Malaysia. In 2013, Malaysia was listed as among the few countries that has the most percentage of forest loss (Hansen et al., 2013) and was also reported to be the country with the highest deforestation rate (Butler, 2013). Since 1950s two commodities became the contributing factors which reduce the forest cover in Peninsular Malaysia; first the rubber then the oil palm (Abdullah and Nakagoshi, 2008; Miyamoto et al., 2014). Even forest reserves are not spared from the expansion of monoculture crops (Aziz et al., 2010). These, in the name of development, has cost the loss of habitat for many forest depend species, including the Malayan tapir (Santiapillai & Ramono, 1990; Khan, 1997; Jasmi, 2000; Holden et al., 2003; Meijaard & van Strien, 2003; Novarino et al., 2004; Corlett, 2007).

Other than the above, some other threats for tapir include accidental and unintentional hunting, and trade (Khan, 1997). Although the trades were claimed to be relatively minor probably due to the low demand for tapir parts which are deemed worthless (Khan, 1997), Holden et al. (2003) reported otherwise. However, the reason of such incidences are due to the reason that the tapir parts are sold in disguised as

parts of the critically endangered Sumatran rhinoceros (*Dicerorhinus sumatrensis*) among the traditional medicine practitioner (Holden et al., 2003). Apart from that, in Sumatra, tapir often fall victim to traps set for other animals like tigers (Campbell et al., 2019). With the increase in snaring activities over the years (Belecky & Gray, 2020) in the Southeast Asia region, this tragedy could be happening in Malaysia undetected.

In recent years, high roadkills of tapirs were recorded by the DWNP. From 2009 to 2019, a total of 102 tapirs were victims of road kill (The Star, 2020a). Large scale habitat loss could have been a factors which led the tapir away from their original habitat (Magintan et al., 2012). Figure 2.2, an infographic, reveals some statistics of Malayan tapir roadkills from 2013 to 2020.

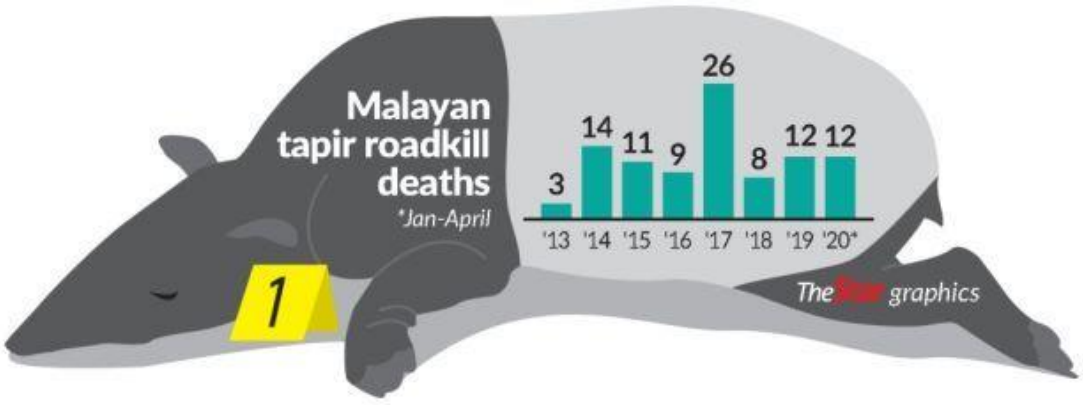

Figure 2.2: One of the infographics containing statistics of Malayan tapir road kills from 2013 to 2020 (source: The Star, 2020a)

As the Malayan tapir is a forest reliance species, understanding habitat preferences would enable prioritising important habitat patches as well as in aiding in planning for future infrastructure development.

2.6 The National Tapir Action Plan for Malaysia (NTAPM)

Stemming from the first tapir symposium in Costa Rica in 2001, the Malayan tapir was being highlighted as one of the species to be paid more attention due to the threats the Malayan tapir were facing. Besides that, the in-situ conservation research being carried out on the species was low; not only in Malaysia but in other tapir ranges countries as well (Medici et al., 2003). Important information in filling up the knowledge gap about the Malayan tapir would greatly aid in conservation for the species.

The first action plan for the Malayan tapir was formulated by Khan (1997). The importance of conserving the Malayan tapir and plans of implementation according to identified problems were highlighted in this document. Six fields of concern, act as action points for the conservation of the Malayan tapir. They are:

a. Tapir Conservation Strategy

b. Field research

c. Recovery of population at risk

d. Conservation activities in protected areas

e. Capacity development and

f. Monitoring of tapir trade

Not all of the above thematics has been looked into specifically or worked on in the past. Nevertheless, numerous efforts by the government have now been made to improve the previous action plan particularly by adopting more systematic and synergistic approaches with NGOs and research institutions to overcome the challenges faced in conserving the Malayan tapir in the country. The draft of the current Action Plan (DWNP, unpublished) enlisted 61 actions in four main pillars – habitat management, ex-situ management, research and awareness.

2.7 Priority research on the Malayan Tapir in Malaysia

While there has been a number of studies that have been carried out on the Lowland tapir [*Tapirus terrestris* (Linnaeus, 1758)] (Jafferally, 2001; Noss et al., 2003; Trolle et al., 2008), Mountain tapir [*Tapirus pinchaque* (Roulin, 1829)] (Lizcano and Cavelier, 2000, 2004), Baird's tapir [*Tapirus bairdii* (Gill, 1865)] (González-

Maya et al., 2009), research on the Malayan tapir is still relatively limited, especially in Malaysia.

Among the first research done on Malayan tapir in Peninsular Malaysia was by Williams (1979). An individual was radio-collared and the home-range of the Malayan tapir was investigated. His work allowed the first crude population density of the Malayan Tapir to be estimated in Peninsular Malaysia. With a home-range size of 12.75 km^2, density of tapirs in Taman Negara was estimated to be 0.08 individuals/km^2; equivalent to a population size of 340 tapirs in that National Park. The robustness of this result is, however, questionable due to the low sample size (n=1).

In Krau Wildlife Reserve, a crude population size of 45-50 Malayan tapir was estimated (Traeholt and Mohamed, 2009). The same study also proposed that individual tapirs could be identified with confidence, using the necklines of the animal. Incorporating the methodology by Traeholt and Mohamed (2009), and combination with other methods of identifying individuals of the Malayan tapir (e.g. Holden et al., 2003; Noss et al., 2003; Novarino et al., 2005; Trolle et al., 2008), Rayan et al. (2012) estimated the first population density of Malayan tapirs in Malaysia using the 'spatially explicit capture recapture' (secr) maximum likelihood framework - 9.45 adult Tapirs/100 km^2 - the same framework is also used in estimating density of Malayan tapir in this study. However, since not all detections from the photographs could be confidently assigned to individuals, a considerable amount of data had to be discarded

(40% unidentified photographs). This rendered the density estimate to be an underestimate of the true population size. Hence, the estimate was deemed conservative and extrapolation to obtain nationwide population would not be appropriate.

Despite the limited data, DWNP (2009) has predicted the distribution of Malayan tapir across the country. Clements et al. (2012) re-examined the results by analyzing data collected over a 13-year period (1999 to 2011) using software MaxEnt. In Clements et al. (2012) an updated and scientifically-defensible distribution map was produced and the study also highlighted the importance of selectively logged forest as habitat for the Malayan tapir in Malaysia.

CHAPTER 3

METHODOLOGY

3.1 Study Area

This study was conducted in the Belum-Temengor Forest Complex (BTFC; Figure 3.1), from 2009 to 2011. In TFR the sampling duration was from October 2009 to May 2010, while in RBSP, the sampling period was from August 2010 to April 2011. BTFC is a contiguous forest landscape that is linked to Halabala Wildlife Sanctuary and Bang Lang National Park in Thailand. This landscape forms part of the main range of Peninsular Malaysia, amounting to a total area size of approximately 20,000 km^2. BTFC is one of three priority sites for tigers and elephants in Peninsular Malaysia (Dinerstein et al., 2006; DWNP, 2008; DWNP, 2013). Two sites were selected from this forest complex; Temengor Forest Reserve (TFR) and Royal Belum State Park (RBSP). Both forests fall under different status and management. While RBSP is a primary forest managed by the Perak State Parks Corporation, TFR is a Permanent Reserved Forest (PRF), which is also a production forest under the management of Perak State. RBSP and TFR are bisected by the Gerik-Jeli Highway (GJH) – Figure 3.1. Permits to carry out the research were requested and provided by Department of Wildlife and National Parks, Perak Forestry Department and Perak State Park Corporations.

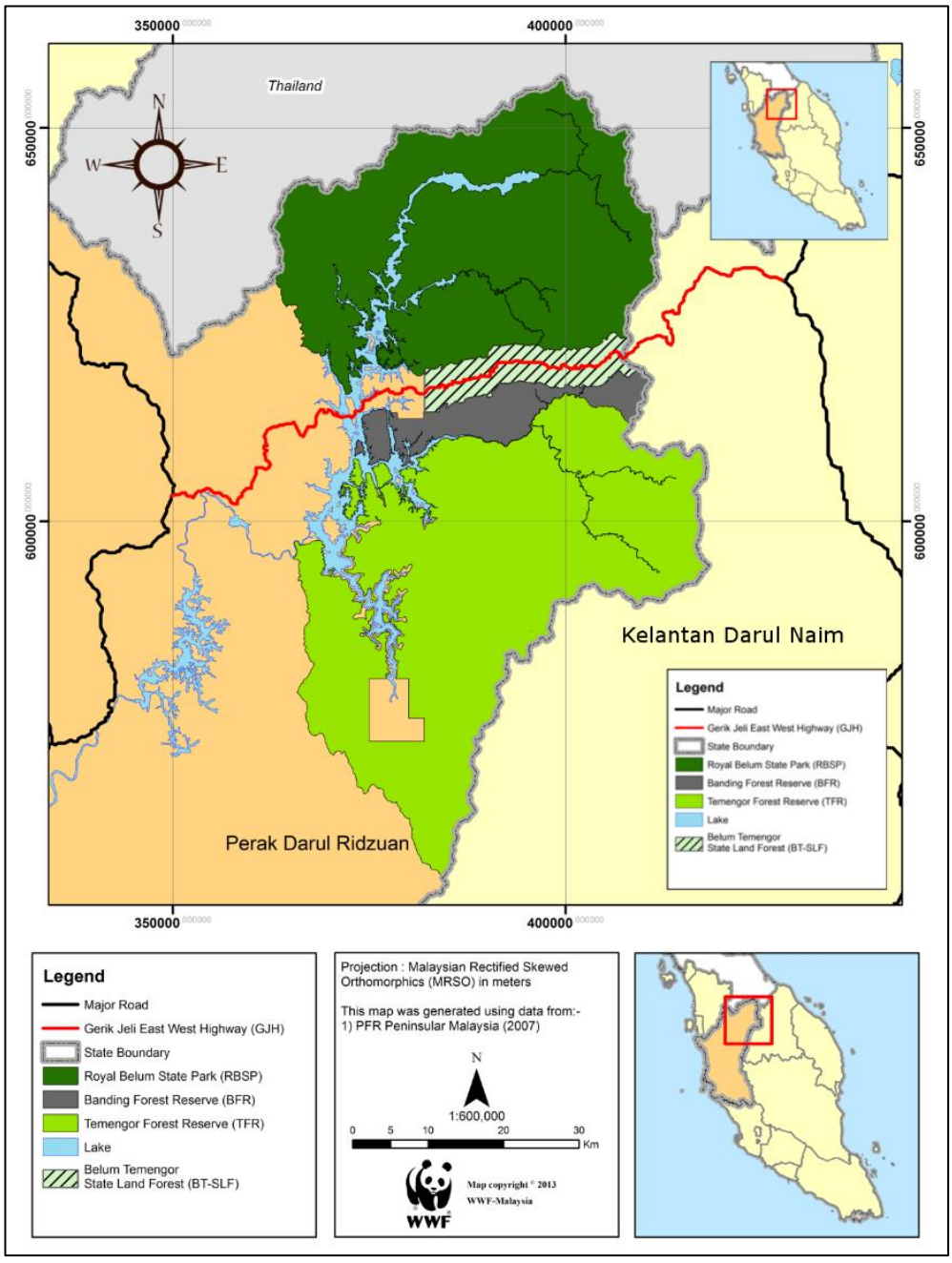

Figure 3.1: Study site - Belum-Temengor Forest Complex. (Source: WWF-Malaysia)

3.1.1 Temengor Forest Reserve (TFR)

Temengor Forest Reserve was gazetted on 25th September 1991 (Government of Perak, 1991). It covers an area of 1,489 km^2 and is the second largest forest reserve in Peninsular Malaysia after Ulu Jelai Forest Reserve at 1,952 km^2. Part of the forest complex was flooded via the damming of several rivers in 1978 for hydroelectric purposes, as well as to provide irrigation and as a water catchment (Yeap et al., 2005). This flooding formed a lake, known by the name of Lake Temengor, encompasses an area of 172 km^2 (Yeap et al., 2005) and extends into both TFR and RBSP. This lake rises to about 260 m above sea level, with a maximum depth of almost 100 m (Davison, 1995). Temengor Lake is the third largest artificial lake in Malaysia after Bakun in Sarawak and Kenyir in Terengganu.

Geographically, approximately 40% of TFR falls higher than 1,000 m a.s.l.; areas in which logging is prohibited by the Forestry Department of Peninsular Malaysia. Logging activities in TFR has started since the 1970s and has been ongoing ever since. Efforts in campaigning to halt logging totally in the forest reserve continues up until today, mainly by MNS.

TFR is also known to support a substantial population of large mammals (Davison et al., 1995). Ratnam et al. (1995) identified a total of 101 species of mammals that can be found in TFR, comprising 10 orders and 28 families. This

represents approximately half of the mammal species known to occur in Peninsular Malaysia. Prior to this study, a reconnaissance camera-trapping trip conducted in 2007-2008 in TFR, has recorded at least 27 species of mammals. All of the large mammal species found in Peninsular Malaysia have been photographed, except the Sumatran rhino (*Dicerorhinus sumatrensis*).

3.1.2 Royal Belum State Park (RBSP)

RBSP, which spreads across an area of 1,175 km^2, is the second largest protected area in Peninsular Malaysia and is approximately a quarter of the size of Taman Negara National Park. North of the state park borders Thailand's Halabala Wildlife Sanctuary, and east of the park borders the State of Kelantan. Two main indigenous villages can be found in RBSP; Kampung Kejar at Sungai Perak and Kampung Tiang at Sungai Tiang, which both are the main rivers that runs within the state park. From the data provided by JAKOA Gerik (2018) (refer to Appendix A) , the villages are home to approximatly 950 people. The majority of the residents are of the Jahai tribe. Non-timber forest products, for example agarwood, honey, honey, fish and hunting of mammals and birds are among the dependence of the villages (Azrina et al., 2011). The tourism activities in RBSP have also created alternative livelihoods (e.g. home-stays, and handicraft making) for the indigenous people (Suksuwan and Kumaran, 2003).