



***FACTORS THAT INFLUENCE OCCURRENCE OF THE ENDANGERED
ASIAN TAPIR (*Tapirus indicus Desmarest*) ACROSS FOREST
RESERVES IN SELANGOR AND NEGERI SEMBILAN, MALAYSIA***

SAMANTHA LIZA ANAK DURIT

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By

SAMANTHA LIZA ANAK DURIT

**Thesis Submitted to the School of Graduate Studies, Universiti Putra
Malaysia, in Fulfilment of the Requirements for the Degree of
Master of Science**

September 2019

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Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfillment of the requirement for the degree of Master of Science

FACTORS THAT INFLUENCE OCCURRENCE OF THE ENDANGERED ASIAN TAPIR (*Tapirus indicus* Desmarest) ACROSS FOREST RESERVES IN SELANGOR AND NEGERI SEMBILAN, MALAYSIA

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Asian tapir, *Tapirus indicus* is an endemic large mammal to Southeast Asia, whereby their population is declining due to deforestation. It is currently classified as endangered under IUCN with less than 2,500 mature individuals remaining. Deforestation is one of the main cause for biodiversity loss especially mammalian species, including large-sized like tapir. Deforestation can lead to a direct loss of wildlife habitat as well as overall degradation of their habitat. To assess their occurrence, camera-trapping method was used to gather data in eight forest reserves in the states of Selangor and Negeri Sembilan. Out of 345 camera-trapping locations, *T. indicus* was detected at 39 camera-trapping locations, represented by 960 images. Assessment of vegetation structure and landscape variables was carried out to identify the key drivers that may influence the presence of tapir. Corrected AIC (AIC_c) was used to compare the models and the best model (lowest value of $AIC_c=2433$) was selected, explained 61.70% of variation in tapir occurrence tallied to best subsets with 11 variables. These data highlight the importance of conserving the remaining fragmented forests. It was found out that tapir occurrence significantly increased with the number of trees with DBH 5 cm - 45 cm, number of saplings, proximity to road, altitude, trees with DBH more than 45 cm, but decreased with number of dead fallen trees, number of palms as well as the percentage of canopy cover. The findings from this study provide useful information for tapir conservation planning in fragmented forest landscapes. Safeguarding the ecological integrity of forest reserves and maintaining landscape connectivity among them are critically important for the conservation of *T. indicus*, but these measures are limited in highly fragmented forestry landscapes, interspersed with urban and agricultural matrices. Conserving the isolated tapir populations in fragmented landscapes may require direct intervention approaches such as reintroduction and restocking that can be costly and must be backed up by strong political will.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia
sebagai memenuhi keperluan untuk ijazah Master Sains

**FAKTOR – FAKTOR YANG MEMPENGARUHI KEHADIRAN TAPIR ASIA
(*Tapirus indicus* Desmarest) YANG TERANCAM DI SELURUH HUTAN
SIMPAN DI NEGERI SELANGOR DAN NEGERI SEMBILAN, MALAYSIA**

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Tapir Asia, *Tapirus indicus* adalah mamalia besar endemik di Asia Tenggara, yang populasinya berkurangan akibat penebangan hutan. Spesies ini diklasifikasikan sebagai terancam oleh IUCN dengan kurang daripada 2,500 individu yang masih tinggal. Penebangan hutan adalah salah satu penyebab utama kehilangan biodiversiti terutama spesies mamalia yang bersaiz besar seperti tapir. Penebangan hutan boleh mengakibatkan kehilangan langsung habitat hidupan liar serta kemusnahan keseluruhan habitat. Untuk menilai kehadiran tapir, kaedah pensampelan kamera perangkap digunakan untuk mengumpul data di lapan hutan simpan di negeri Selangor dan Negeri Sembilan. Daripada 345 lokasi kamera perangkap, *Tapirus indicus* telah dikesan pada 39 lokasi kamera perangkap, diwakili oleh 960 imej. Penilaian struktur tumbuhan dan pembolehubah lanskap telah direkodkan untuk mengenal pasti faktor-faktor utama yang mempengaruhi kehadiran tapir pada setiap lokasi kamera perangkap. Pembetulan AIC (AIC_c) digunakan untuk membandingkan model dan model terbaik (nilai terendah $AIC_c = 2433$) dipilih, menjelaskan 61.70% variasi dalam kehadiran tapir diukur kepada subset terbaik dengan 11 pembolehubah. Data ini menunjukkan pentingnya memelihara hutan yang masih wujud. Didapati bahawa kehadiran tapir meningkat dengan bilangan pokok dengan DBH 5 cm - 45 cm, bilangan anak pokok, jarak dekat dengan jalan raya, ketinggian dari paras laut, pokok dengan DBH lebih daripada 45 cm, manakala, kehadiran tapir menurun dengan jumlah pokok yang mati, bilangan pokok palma serta peratusan penutupan kanopi. Hasil penemuan daripada kajian ini memberikan maklumat berguna untuk perancangan pemuliharaan tapir dalam lanskap perhutanan yang terpisah di antara satu sama lain. Memelihara integriti ekologi hutan dan mengekalkan hubungan lanskap adalah sangat penting untuk pemuliharaan mamalia besar, tetapi langkah-langkah ini terhad dalam lanskap hutan yang terpisah jauh, selari dengan matriks bandar dan pertanian. Bagi memelihara populasi tapir yang terencil di kawasan lanskap yang terpisah itu memerlukan

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This thesis was submitted to the Senate of Universiti Putra Malaysia and has been accepted as fulfilment of the requirement for the degree of Master of Science. The members of the Supervisory Committee were as follows:

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LIST OF ABBREVIATIONS

Adj	Adjusted
AHFR	Ayer Hitam Forest Reserve
AIC	Akaike's Information Criterion
BCFR	Bukit Cerakah Forest Reserve
BFR	Bangi Forest Reserve
C	Celsius
Cm	Centimetres
DBH	Diameter Breast Height
DWNP	Department of Wildlife and National Parks
FAO	Food and Agriculture Organization
FRIM	Forest Research Institute Malaysia
GLAMA	Gap Light Analysis Mobile App
GLMMs	Generalized Linear Mixed Models
GPS	Global Positioning System
Ha	Hectares
HD	High definition
IUCN	International Union for Nature of Conservation
KFR	Kenaboi Forest Reserve
Km	Kilometres
NSPSF	North Selangor Peat Swamp Forest
PFR	Pasoh Forest Reserve
PRF	Permanent reserved forest
SMFR	Sungai Menyala Forest Reserve
SLFR	Sungai Lalang Forest Reserve

UK	United Kingdom
UPM	Universiti Putra Malaysia
VSNI	VSN International
WWF	World Wildlife Fund



CHAPTER 1

INTRODUCTION

1.1 General Background

Loss of biodiversity has been attributed to many factors; with habitat destruction via land-use alteration is most likely the main factor (Purvis *et al.*, 2000; Sala *et al.*, 2000; Baillie *et al.*, 2004). Biodiversity is considerably poor in disturbed forests, which may differ by topography, taxonomic group, ecological measures and nature of disturbance (Gibson *et al.*, 2011). Habitat loss can have negative impacts on local and global species. Over 150,000 protected areas have been designated globally, aim to protect the species and the respective ecosystems. However, with anthropogenic impacts building up, maintaining these protected areas would be a great challenge (Clark *et al.*, 2013).

In Southeast Asia, deforestation has been associated with agricultural development, logging, habitat degradation and urbanization, that have greatly lead to species decimation and extinctions. Natural forests of Southeast Asia are among the primary sources of tropical hardwoods in the world (Lasco, 2002). Southeast Asia has the highest rate of deforested land in the world. However, massively logged forests becoming more vulnerable, mainly those that are apparent to be extremely degraded (Edwards *et al.*, 2011). Extinctions of wide-range of mammalian species are significantly because of habitat loss, which about 21-48% of mammal species are estimated to be inexistent by 2100 (Brook *et al.*, 2003). Sodhi *et al.* (2009) also discovered that mammals species are commonly more sensitive to forest disturbance compared to other taxa. Human activities had caused massive negative effects on terrestrial mammal particularly on large-bodied mammals (Ripple *et al.*, 2016, Ripple *et al.*, 2017).

Tapir is a large, herbivorous mammal which comprises four living species that each belong to family Tapiridae. All tapir species are categorized as Vulnerable and Endangered by IUCN Red List (IUCN, 2014). Asian tapir, *Tapirus indicus* is the largest among four tapir species and endemic to Southeast Asia. Asian tapir populations are declining due to deforestation and forest fragmentation, with 50% of their population had loss in the past three generations with less than 2,500 mature individuals remaining (Traeholt *et al.*, 2016). Habitat loss and fragmentation have shrunk and separated tapir populations worldwide as well increased their vulnerability to other human disturbances such as road construction and illegal hunting. Anthropogenic impacts such as deforestation and rampant hunting are the major threats to their habitat loss (Traeholt *et al.*, 2016).

In spite of their vulnerability towards human disturbances, all tapir species play a significant ecological roles in forest ecosystem. Large-bodied frugivores like tapir play an important role determining the structure of plant communities at different scales and maintaining plant diversity, because they are able to ingest more fruits, eat larger seeds and disperse them to larger distances than small bodied frugivores (Jordano *et al.*, 2007; Guimãraes *et al.*, 2008). Although most of the large-seeded plant species stated as dispersed by tapirs are consumed by other frugivore species (Donatti *et al.*, 2011). In Southeast Asia, Asian tapir is one of the most significant large-bodied seed dispersers (i.e. Asian elephants). In the Neotropics, tapirs are the largest existing seed dispersers (O'Farrill *et al.*, 2013).

Camera-trapping is widely used methodology to assess and monitor ground-dwelling terrestrial animal (Ahumada *et al.*, 2011) like tapir. Apart from precision in species identification, camera-trapping also initiated less disturbance to environmental, make it reliable to identify nocturnal and diurnal animal (Silveira *et al.*, 2003). Camera trap enables scientist to gather valuable information on the community of ground vertebrates, including species range, abundance, occupancy, community structure (Ahumada *et al.*, 2011), as well as activity pattern and animal behaviour (O'Connell *et al.*, 2011).

1.2 Problem Statements

In most of the tropical regions, Southeast Asia is a home of wide range of native mammals and has the highest rate of deforestation and risk of extinction (Sodhi *et al.*, 2009). According to Davidson (2009), about one-quarter of entire mammalian species facing an extinction and over half of their populations are declining. Most of large-bodied mammals in tropical ecosystems are cryptic or naturally occur at low densities, affecting complications to access and study about this faunal species (Linkie *et al.*, 2008).

The main pressures for tapir conservation across its distribution range are persistent deforestation, forest fragmentation, poaching, forest fires, droughts, floods, and road killing (Mendoza and Carbajal-Borges, 2011; Naranjo *et al.*, 2015). Shrinkage of forest to isolated fragments had increased their vulnerability to survive within fragments (Sodhi *et al.*, 2010). Road construction, which is also a part of fragmentation processes, has destroyed behavioural patterns and habitat use of most mammal species (Laurance *et al.*, 2009; Ngoprasert *et al.*, 2007). Road kill that caused directly to mortality can be a major threat to biodiversity (Laurance *et al.*, 2009). This threat mainly problematic for big-sized mammal like tapirs with slow reproduction rate and long generation periods which may take them longer to recover (Medici and Desbiez, 2012; Ascensão *et al.*, 2017). Even though roadkilled is not the main threat to tapir, however it is still consider anthropogenic effect, caused by more opening of roads within forest areas. Creating passage structures on highways could lead to the number of mortality and affected the dispersion ability in the population (Miotto *et al.*,

2011). Tapirs also may be exclusively vulnerable to hunting, compared to other ungulates, due to their relatively low population density (low reproductive rate; Bodmer *et al.*, 1997). Hunting may not only harmfully affect tapir populations but may ultimately disturb the composition and structure of the forest, since tapirs play an important ecological role, affecting the structure, composition, growth and regeneration of the vegetation (Bodmer, 1991; Dirzo and Miranda, 1991; Fragoso, 1997; Wright *et al.*, 2000).

Tapir population is decreasing in Malaysia. Although tapirs are totally protected and seems to be rather abundant among large mammals (>20kg) in Peninsular Malaysia, based on camera trapping evidence and track encounter rates (Kawanishi and Sunquist, 2004; Mohd Azlan, 2006; Darmaraj, 2007), robust population estimation for this species is lacking. The only approximation presently accessible for this species is a rough estimate of 3.72 adult tapirs/10km² (Traeholt and Mohd Sanusi, 2009) between 2002 to 2006 from a primary forested area of Krau Wildlife Reserve, Pahang. Even though there is good quality data and information accessible on Asian tapir, some fundamental knowledge is still deficient in South East Asian countries. Data on diet, habitat use, habitat selection, spatial ecology, intra-specific interactions, population demography, reproductive parameters and even current presence/absence information are deficient. This information is crucial for modelling the current status, viability and risk of extinction for tapir populations, besides predicting the impacts of climate change and other future consequences (García *et al.*, 2012). For future conservation planning, the factors that influence this species also need to be taken into consideration.

Inadequate information on mammalian studies is the main challenge encountered in conserving these species (Jones and Safi, 2011). Therefore, more scientific studies on biodiversity study are needed and provide an effective plan in conserving and protecting of faunal biodiversity. On the other hand, poor law enforcement to evade harmful practices such as poaching, persistent logging, and overgrazing within protected areas remains an unresolved problem (Naranjo *et al.*, 2009).

1.3 Aim of the Research

This study aims to assess the population of *Tapirus indicus* in fragmented forest reserves using non-intrusive camera trapping method. The population of tapir is expected to be higher in large fragmented forest area, explaining their home ranges which usually over 10 km² (Abdul Ghani, 2009; Traeholt, 2005; Traeholt and Sanusi, 2009).

1.4 Research Objectives

- i. To quantify the occurrence of tapir in different forest reserves of Peninsular Malaysia, particularly in the states of Selangor and Negeri Sembilan.
- ii. To identify the key environmental factors that influence the occurrence of Asian tapir in the forest reserves.



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