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**DAILY ACTIVITY BUDGET OF DUSKY LEAF
MONKEY, *Trachypithecus obscurus* AT TAMAN PD
UTAMA, PORT DICKSON, NEGERI SEMBILAN,
PENINSULAR MALAYSIA**

by

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A report submitted in fulfillment of the requirements for the degree of
Bachelor of Applied Science (Natural Science Resources) with Honours

**FACULTY OF EARTH SCIENCE
UNIVERSITI MALAYSIA KELANTAN**

2024

DECLARATION

I declared that this thesis entitled “Daily Activity Budget of Dusky Leaf Monkey, (*Trachypithecus obscurus*) At Taman PD Utama, Port Dickson, Negeri Sembilan, Peninsular Malaysia” is the result of my own research except as cited in the references. The thesis has not been accepted by any degree and not currently submitted in the candidature of any other degree.

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Date : 10/6/2024

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ACKNOWLEDGEMENT

In the name of Allah, the Most Gracious and the Most Merciful.

All praises to Allah and His blessing for the completion of this thesis. I thank God for all the opportunities, trials and strength that have been showered on me to finish writing the thesis. I experienced so much during this process, not only from the academic aspect but also from the aspect of personality. My humblest gratitude to the holy Prophet Muhammad (Peace be upon him) whose way of life has been a continuous guidance for me. A verse that I will forever live by in the Holy book of Islam in the Quran that says:

وَيَرْزُقُهُ مِنْ حَيْثُ لَا يَحْتَسِبُ وَمَنْ يَتَوَكَّلْ عَلَى اللَّهِ فَهُوَ حَسْبُهُ

إِنَّ اللَّهَ بَلِّغُ أَمْرِهِ قَدْ جَعَلَ اللَّهُ لِكُلِّ شَيْءٍ قَدْرًا

And whoever puts their trust in Allah, then He alone is sufficient for them. Certainly, Allah achieves His Will. Allah has already set a destiny for everything.

[Quran 65:3]

First and foremost, I would like to say thank you my supervisor, Dr. Kamarul Ariffin B. Kambali @ Hambali for spending his time guiding and giving invaluable comments for me to write this thesis. The next of my thanks is go to the Ms Kyariatul Syafinie Binti Abdul Majid as the FYP coordinator because helping me to finish up this report throughout the guidelines given to me. My sincere thanks also go to Dr Jayaraj Vijaya a/l Kumaran and Dr Aainaa Syazwani Binti Mohd Amir Hamzah for their care and advice when examination and correction of my thesis. My thanks go again to the both examiner for comments, sharing of knowledge and advices in conducting my project throughout this period. They continuous support, advises as well as they understanding, expertise and help throughout final year project completion. Not forgotten, to my laboratory assistants, Mdm Syahida, and Mr Firdaus for their helps along the journey of this final year research project.

It is a great pleasure to address people who helped me throughout this project to enhance my knowledge and practical skills especially in research area Port Dickson, Negeri Sembilan. This project would not have been possible without the kind support and help of my team and my dearest friends, Muhd Syameer Norman Bin Muhd Zaid and Muhd Nazhif Bin Ismail that struggle helping me observing the subject behaviours. My gratitude also been extended to my beloved parents, Mr Awang Sukor Bin Awang Adeng and Mdm Rohaya Binti Morni because of their financial support and the moral support. Without them, this final year project would not be completed.

Last but not least, my deepest appreciation and thanks to my lovely family members, my lecturers, my fellow friends for their continuous support. They have been the source of inspiration through their encouragement, financial support, help, patience and care during this project.

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Daily Activity Budget of Dusky Leaf Monkey, (*Trachypithecus obscurus*) At Taman PD Utama, Port Dickson, Negeri Sembilan, Peninsular Malaysia

ABSTRACT

A study to obtain the daily activity budget of the dusky leaf monkey (*Trachypithecus obscurus*) in Taman PD Utama, Port Dickson, Negeri Sembilan, Peninsular Malaysia. This study aims to understand this species' activity budget in the urban environment, focusing on time-use allocation on behaviours such as moving, feeding, playing, vocalization, resting, grooming, and mothering. Observational data on these monkeys' activities were collected to establish their daily routine. The study involved a group of dusky leaf monkeys, comprising 12 to 18 members. During the 20 days of observation, it was found that resting accounted for 28.3% followed by moving (27.08%), feeding (20.85%), playing (8.02%), mothering (7.36%), grooming (6.04%), and vocalization (2.36%). The collection of this data is to show how they adapt to urban areas and how they behave depending on other resources and conditions. These findings shed light on their adaptation to urban environments and behaviour in response to resource availability and environmental circumstances. This study helps to understand the behavioural ecology of the dusky leaf monkey, giving crucial information for future management and conservation efforts and emphasising the significance of protecting urban green areas for wildlife.

Bajet Aktiviti Harian Lotong Cekung, (*Trachypithecus Obscurus*) Di Taman Pd Utama, Port Dickson, Negeri Sembilan, Semenanjung Malaysia

ABSTRAK

Satu kajian menerangkan mengenai bajet aktiviti harian Lotong Cekung (*Trachypithecus obscurus*) di Taman PD Utama di Port Dickson, Negeri Sembilan, Semenanjung Malaysia. Kajian ini bertujuan untuk memahami bajet aktiviti harian spesies ini dalam persekitaran bandar, dengan fokus kepada peruntukan masa pada tingkah laku seperti bergerak, makan, bermain, vokalisasi, berehat, dandanan, dan penjagaan anak. Data pemerhatian tentang aktiviti monyet ini dikumpul untuk menilai rutin harian mereka. Kajian ini melibatkan sekumpulan lotong cekung, yang terdiri daripada 12 hingga 18 individu. Sepanjang 20 hari pemerhatian, didapati bahawa berehat menyumbang sebanyak 28.3%, diikuti oleh bergerak (27.08%), makan (20.85%), bermain (8.02%), penjagaan anak (7.36%), dandanan (6.04%), dan vokalisasi (2.36%). Pengumpulan data ini adalah untuk menunjukkan bagaimana mereka menyesuaikan diri dengan kawasan bandar dan bagaimana mereka bertingkah laku bergantung kepada sumber dan keadaan lain. Penemuan ini memberikan gambaran tentang penyesuaian mereka terhadap persekitaran bandar dan tingkah laku mereka sebagai tindak balas kepada ketersediaan sumber dan keadaan persekitaran. Kajian ini membantu memahami ekologi tingkah laku lotong cekong, memberikan maklumat penting untuk usaha pengurusan dan pemuliharaan masa depan dan menekankan kepentingan melindungi kawasan hijau bandar untuk hidupan liar.

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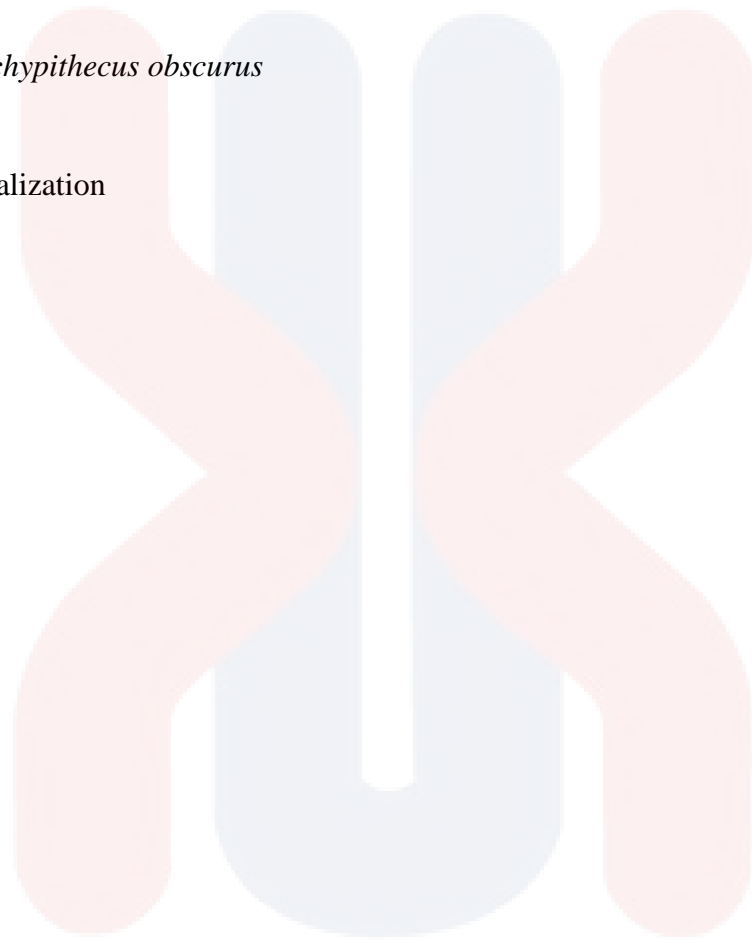
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LIST OF ABBREVIATIONS

df	Degree Of Freedom
DLM	Dusky Leaf Monkey
E	East
FD	Feeding
GPS	Global Positioning System
GR	Grooming
IUCN	International Union for Conservation of Nature
Kg	Kilogram
MV	Moving
MT	Mothering
N	North
PD	Port Dickson
PL	Playing
RT	Resting

SLL Spectated leaf langur
T. o. *Trachypithecus obscurus*
VL Vocalization



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LIST OF SYMBOLS

lbs.	Pound
E_i	Expected Value
km^2	Kilometer Square
p	P Value
P_i	Observed Value
X^2	Chi-Square
Σ	Sum
%	Percentage

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CHAPTER 1

INTRODUCTION

1.1 Background of the Study

In Malaysia, the dusky leaf monkey (*Trachypithecus obscurus*) is locally known as 'lotong celak', 'lotong mata puteh', or 'cekong' due to its dietary habits and white mascara patch over the eye respectively (Md-Zain & Ch'ng, 2010). The range of dusky leaf monkeys extends from southern Myanmar to Peninsular Malaysia (Faudzir *et al.*, 2019). According to Viswanathan (2002), the dusky leaf monkey top parts can be brown, grey, or black, with whiter underparts, rear legs, and tail. The face is grey with a white fur patch around the eyes and lips. The hands and feet of dusky leaf monkeys are highly developed, with hairless palms and black soles. Their opposable thumb gives them different fingers. The non prehensile tail varies in length and fur coverage from short and hairless, to long and hairy.

Dusky leaf monkeys are gregarious creatures that wander in groups of 10-17 individuals (Cheng & Ruppert, 2017). Differences in the habitat quality and distance to food resources determined the species group size (Koenig, 2002). These monkeys are active during the day since they are diurnal creatures. The primates spend most of their time active in the tree canopy, at heights of over 35 meters. They navigate between trees by climbing, leaping, and walking along tree branches with all four legs. Dusky leaf monkeys migrate to their roosts in the trees as the night falls (Animalia, 2023). Dusky langurs also

go by the name dusky leaf monkey was known due to most of their diet being composed of leaves. They are likely consuming high amount of ripe fruit and seeds derived from urban/cultivated plants (Ruslin *et al.*, 2019). They consume up to 2 kg (4.4 lbs.) of daily food. They are mostly herbivorous species but, in some cases, they have accepted insects in captivity (Boonratana *et al.*, 2008).

The International Union for Conservation of Nature (IUCN) is one such organization that assesses the conservation status of species worldwide and categorizes them based on criteria such as population size, trends, and threats. If the dusky leaf monkey is considered endangered, it means that the population of this species is declining, and various factors are putting them at risk. These factors may include habitat loss due to deforestation, hunting, and other human activities (Lappan & Ruppert, 2019). Conservation efforts are typically implemented to try to reverse the decline and protect the species.

Taman PD Utama is a charming residential area located in Port Dickson. The lush vegetation and forested areas in and around Taman PD Utama provide a natural habitat for these monkeys, offering them shelter and a reliable source of food. At the same time, the presence of these unique primates adds to the ecological diversity and natural beauty of the region. Taman PD Utama's contain green environment and natural surroundings also play a vital role in providing a habitat for primates. These habitats provide diverse fruits, leaves, and insects that form a significant part of their diet (Leen *et al.*, 2019). This area is near to a reserve forest which is Sungai Menyala Forest Reserve, which covers an area of 1,280 hectares near Port Dickson was just about 6 kilometers from Taman PD Utama. Dusky lead monkey is often found in this area and that place is their place of habitat.

The primary rainforests of Southeast Asia are home to the arboreal, folivorous primate *Trachypithecus obscurus* (Aifat *et al.*, 2020) As they make use of the most numerous food leaves and are found there at the maximum biomasses, the species has a basic relationship with the upper layers of the dipterocarp rainforest (Yap *et al.*, 2016). The study area Taman PD Utama was an area that was often visited by the dusky leaf monkey that were around to do their daily routine such as eating and resting. The species can be found in different settings such as beach, botanical gardens, urban, and coastal woods. Taman PD Utama also has a secondary forest nearby that is the habitat of wild animals in the area. Next, the part of the surrounding area is also used as an industrial and agricultural area. So, the wildlife habitat, especially the dusky leaf monkey, becomes limited. Based on the observation made by Yap *et al.*, (2019) at Penang Island, langurs can still be found in the major lowland and hill forests They also could live in disturbed habitats such as secondary woods, parks, and urban areas. The recent increase in the number of human-primate contacts on Penang Island indicates that habitat fragmentation may pressure their population (Most food plant species, however, were found in the secondary forest, possibly explaining the larger home range area in the forest.

1.2 Problem Statement

The species is usually found in primary rainforests, but due to the rapid destruction of rainforests for human development, the species must be adapted to nearby urban areas to survive. Due to limited information on their behaviour, this study aims to determine their behaviours within the residential area by using the observation method. The behaviours of animals are crucial to understanding their existence center, protection of resources, and individual survival of the species for further study. This outcome can reveal insights into their ability to cope with the environment of the study area in resource abundance and the flexibility of their daily activities. Understanding their daily behaviour can help us better predict the potential effects of climate change or habitat alteration on their activity ecology.

1.3 Objective

- a) To study the behaviours of dusky leaf monkeys at Taman PD Utama, Port Dickson, Negeri Sembilan, Peninsular Malaysia

1.4 Scope of Study

In this study, the title focuses on the behaviours of the wild dusky leaf monkey at Taman PD Utama, Negeri Sembilan by using the observation method. The observation will be conducted within in one month and the study site was a residential area. Using binoculars and a camera helped to reduce human-animal interaction. The study also be supported with the images from the camera captured.

1.5 Significance of Study

The study on the behaviours of *Trachypithecus obscurus* still needs to be improved in Malaysia and some detected areas. Data collected from this study can be used to provide information and make it easier for future researchers to understand the behaviours of the species. A clear understanding of the species' behaviours could lead to the protection of the species since it was categorized as an endangered species by the IUCN (IUCN, 2020). Another important of this study is for conservation purposes. Conservators can use the data collected from this study to protect the species in the future.

CHAPTER 2

LITERATURE REVIEW

2.1 Dusky Leaf Monkey

The Dusky leaf monkey belongs to the Colobinae family of leaf-eating monkeys, mostly found in Thailand and the Malay Peninsula (Groves, 2005). Their range extends from southern Myanmar (Myanmar) to sections of Thailand and the Malaysian islands of Langkawi, Penang, and Perhentian Besar (Kathleen, 2016). Because of its appearance, *Trachipterus obscurus* is also known as the dusky leaf monkey (SLL), dusky leaf monkey (DLM) or dusky langur. It has a partially completed white circle around its eye. Malaysians refer to this monkey as 'lotong bercelak' or 'lotong cekung' due to its peculiar physical attributes and its favors to leaves. It features contrasting naked pink patches on its top and lower lips, in addition to the white-ringed eyes. The upper half of its body is greyish-brown to dark grey, with lighter grey underparts, outside of the hind legs, tail, and head crest (Francis, 2008). Young dusky leaf monkey has pinked face and some youngster's body colour are yellow to light orange. Within 6 months, the young's fur will turn grey or brownish. These primates favor lofty trees with canopies over 114 feet (35 meters). Yap *et al*, (2019) mentioned that, the herbivorous monkeys prefer to eat leaves and graze on 56 different plants. It was also discovered that they devour shoots, seedlings, blooms, and ripe and unripe fruits depending on their environment and plant species availability.

2.2 Habitat and Distribution

The dusky leaf monkey is an arboreal primate that lives in primary and secondary forests (Priston & McLennan, 2012). It is also found in a variety of environments, including urban, riverine, coastal, and park environments (Francis, 2008). According to Chivers (1989), langurs have an important relationship with the top rainforest layer because they take advantage of the most abundant food leaves and biomasses available there. Primates living near the forest's edge near nearby cities, where human-produced food is available alongside naturally occurring foods from cultivated plants. Colobines are found in such fragmented environments because they eat a lot of both wild and cultivated plant fruits (Dela 2012).

At least five subspecies live on the Malaysian Peninsula. *Trachypithecus obscurus obscurus* (Reid's dusky leaf monkey) is the most common in Peninsular Malaysia except along the north coast, *T. o. flavicauda* (Blond-tailed dusky leaf monkey) is found in northern Peninsular Malaysia, *T. o. styx* (Perhentian dusky leaf monkey) is found on Perhentian Island and possibly adjacent coastal areas, *T. o. halonifer* (Cantor's dusky leaf monkey) (Brandon-Jones *et al.*, 2004). This species identified in the family *Cercopithecidae* (Old World monkeys) and is classified as a member of the subfamily Colobinae (mostly arboreal, lacking cheek pouches, with a long tail and a large, multichambered stomach) (Francis & Barrett, 2008). Brandon- Jones (2014) stated that, *T. obscurus* is a species in the subfamily Colobinae, with 11 subspecies that are distributed from Peninsular Malaysia to India, including *T. o. obscurus*, *T. o. corax*, *T. o. flavicauda*, *T. o. halonifer*, *T. o. carbo*, *T. o. styx*, *T. o. phayrei*, *T. o. shanicus*, *T. o. smithi*, *T. o. seimundi*, and *T. o. sanctorum*.

2.3 Behaviours of Dusky Leaf Monkey

The behaviours are a concept that outlines the normal actions of animal over times through the populations. According to Zhang *et al.* (2019), These behaviours depend on various factors such as reproductive demands, environment conditions and resources availability. Animals in highly seasonal environments frequently face significant constraints on their time and energy budgets as a result of environmental fluctuations. Dusky langur's behaviours mostly are foraging, eating, interacting, being active, traveling, and grooming (Siti-Kauthar *et al.*, 2019). Dusky leaf monkey's diet comprised nuts, fruits, seeds, and even insects. Its daily main diet of meals will depend on where it is placed and travel as long as the items are easily accessible. Moving is also the second most common action performed by dusky leaf monkey in a day (Ruslin *et al.*, 2014). The mentioned traveling activity has nothing to do with foraging.

Dusky leaf monkey, on the other hand, exhibits social activity by communicate with others. They communicate by making their own vocalization noises. It makes a sound not just for mating but also to react to predators when in danger. Distinct call signals cause a single mature male to adapt to a distinct escape tactic. Grooming is a "cleaning" activity performed by the majority of terrestrial and hairy animals. They washed and stroked various regions of their bodies with their limbs. The dusky leaf monkey is passive while sleeping or relaxing, which is most prevalent at night.

2.3.1 Foraging Behaviour

According to Kamil (1985), animal foraging behavior refers to the ways in which animals search for, obtain, and consume food. Foraging behavior can vary widely among different species and can be influenced by factors such as food availability, competition, predation risk, and environmental conditions. Some animals, such as herbivores, are specialized to feed on plants, while others, such as carnivores, feed on other animals. Omnivores feed on both plants and animals. According to Vogel *et al.* (2017), foraging strategies can also vary depending on the type of food being sought. For example, some animals use visual cues to locate prey, while others use chemical cues or auditory cues. Animals can also use a variety of foraging strategies to obtain food. Some species are active foragers, meaning they actively search for food, while others are passive foragers, meaning they wait for food to come to them. The foraging behaviour of prey across a patchy environment by reducing activity times, moving in groups, changing food, rotating locations, and being more vigilant while foraging (Childress & Lung, 2003). These behaviours are most likely adaptations to their forest environment, which has thick foliage and few food options.

2.4 Dietary

Animal feed composition is a basic part of the ecology that influences animal behavior, distribution, and conservation (Gizzi & Givens, 2004). The nutritional composition of an animal's diet refers to the relative proportions of various elements found in the meals they ingest, such as carbs, proteins, fats, vitamins, and minerals. These nutrients are required for an animal's development, reproduction, as well as overall health and well-being (Bowman, 2023). Some animals are specialised feeders, relying on a limited

number of food sources, whilst others are generalist feeders, consuming a large range of foods. Ruslin (2018) analysed the nutritional content of the food of the dusky leaf monkey in a lowland evergreen dipterocarp forest. According to Azman and Khan (2022) research, most of the colobine monkeys contain higher nutritional value of fiber contain than other elements. This article may be relevant to whereas it gives current information on the food composition of the dusky leaf monkey, which can help to understand the elements that impact their eating behaviour and design appropriate conservation policies to conserve this endangered species.

2.5 Food Availability

Food availability is a critical factor that influences the survival and reproductive success of animal populations. The availability of food resources can vary greatly across different habitats and ecosystems and can be influenced by a range of factors, including climate, vegetation, and human activities. Based on the research made by Wang *et al.* (2006), the ability of animals to adapt to changes in food availability can have important implications for their survival, as well as for the health and stability of ecosystems. In recent years, there has been growing concern about the impact of human activities on food availability for wildlife. Habitat destruction and fragmentation, as well as climate change, can lead to changes in the availability and quality of food resources for animals (Lappan & Ruppert, 2019). These changes can have significant impacts on the survival and reproductive success of animal populations, as well as on the health and stability of entire ecosystems. The dusky leaf monkey had a flexible diet that included a wide variety of plant species, with leaves being the most consumed food item, based on Yap *et al.* (2019) research at Penang. The dusky leaf monkey consumed more fruit during the fruiting season,

and the availability of fruit had a significant impact on the feeding behavior of the species (Siti-Kauthar *et al.*, 2019).

2.6 Habitat Fragmentation

Habitat disturbance has become a major threat to the survival of animal populations around the world (Kasso & Bekele, 2014). Habitat loss and fragmentation, pollution, overhunting, and climate change are all examples of human activities that can harm animal species. Lappan and Ruppert (2019), said that habitat loss and fragmentation are particularly concerning, as they can have a devastating impact on animal populations. As human populations grow and expand, natural habitats are often destroyed or fragmented, leaving animals with limited resources and reduced access to food, water, and shelter. This can lead to declines in population size, genetic diversity, and reproductive success, increasing the risk of extinction (Doherty *et al.*, 2021). This could be related to dusky leaf monkey nature where their habitat is being destroyed at an alarming rate due to human activities such as logging, agriculture, and urbanization. As a result, the monkeys are losing access to their natural food sources and shelter, and are being forced to adapt to new, less suitable habitats. This can lead to declines in population size, genetic diversity, and reproductive success, increasing the risk of extinction (Pinto *et al.*, 2022)

MATERIALS AND METHODS

3.1 Study Area

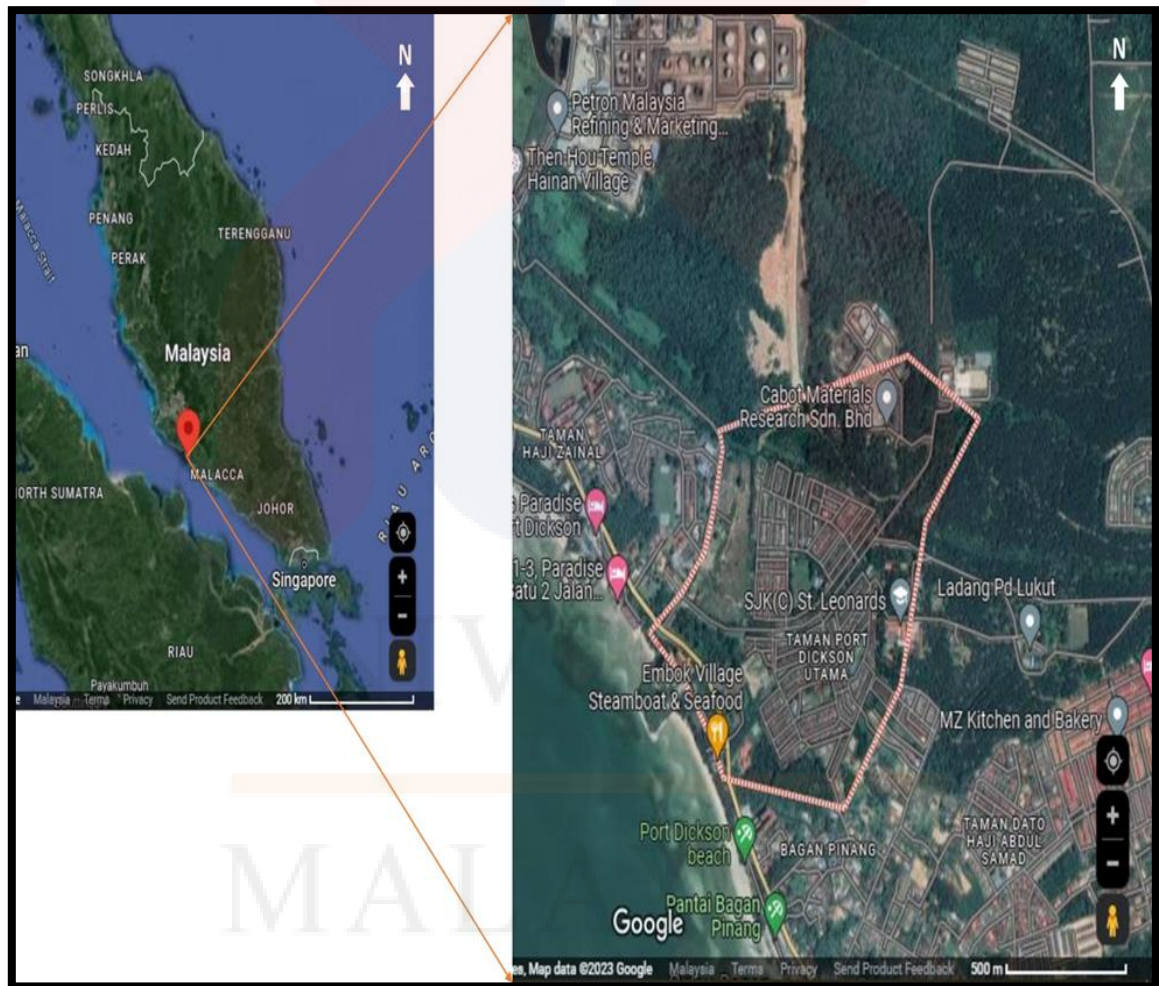


Figure 3.1: Map of study area. (Source: Google Maps)

This study was conducted in the Taman PD Utama area (2°30'58.8"N 101°49'49.6"E) which this area near to a forest which is a habitat area for the dusky leaf monkey. The assumption of the Taman PD Utama was about 6,697.10 km².

The landform in the study area is horizontal at the road and residential area while there is a slight slope. As a result, there are varieties of human activities such as walking, jogging, exercising, riding, trading, and feeding the monkeys. There are several large trees around the area which are considered as their place to search for food and do their behaviour such as moving, resting, and playing. Some of the trees are natural food items for the primates. There are three primate species in the study area, namely long-tailed macaques (*Macaca fascicularis*), silvered-leaf monkeys (*Trachypithecus cristatus*), and dusky-leaf monkeys (*Trachypithecus obscurus*). However, this study only focused on one group of dusky-leaf monkeys that habituated the study area which may consist of 5-17 individuals. Apart from a few high and large-sized trees, there are also electric poles and cables between the electric poles, which are often used by dusky langur to move from one place to another.

3.2 Material

These are the materials that have been used to conduct this research in Taman PD Utama, Port Dickson, Negeri Sembilan to get the data on the daily activity of dusky leaf monkeys.

Table 3.1: List and pictures of material. (Source: Google Image)

Material	Picture
Binoculars	
Gps 72H	
Camera	

3.3 Methods

3.3.1 Finding the Location of Dusky Leaf Monkey

The location of the group of dusky leaf monkeys determined by moving around the study area. The search concentrated on tall trees and their natural food resources, which consist of young leaves, as well as the locations where they are typically found. The search take place in within a day starting from 0730 till 1910. The weather also influenced the search, as the species not be founded if it rains.

3.3.2 Observing the Behaviour and Following the Movement

Observation method used is scan sampling within 10 minutes interval. Binoculars was used to observed the formation of the groups, the captivating activity of the behavior and the movement of the dusky leaf monkey group. Positioned strategically on a nature reserve trail, scans the treetops with binoculars to get a better look at the monkeys. The camera was used to documenting and recording their behaviours with great care for better observation of their activities. Both the items helped to provide better view whereas observation must be conducted afar as the species felt shyness and run into the forest while being observed (Karimullah, 2014).

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3.3.3 Collecting Data from the Observation

In Taman PD Utama, a nature reserve in Malaysia, binoculars and a notebook were used to conduct the observations of dusky leaf monkeys using an ethogram. Various behaviours of the monkeys were systematically recorded, including;

Table 3.2: List of behaviours and its example.

Behaviour	Example
feeding	eating leaves and fruits
social interactions	grooming and play
spatial behaviors	resting and moving through trees
reproductive behaviors	mothering and carrying infants

For example, during a specific observation period, research made by Cheng and Ruppert (2017) at Penang National Park, notes the group's feeding habits in the tree canopy, social bonding through mutual grooming, and playful behavior exhibited by the monkeys. The monkeys' movement to a different area involves traveling behavior, while aggressive interactions, resting, and territorial marking contribute to the comprehensive ethogram data. This method allows an insight into the social structure and behaviours of dusky leaf monkeys in their natural habitat, contributing to a better understanding of their behavior within Taman PD Utama.

3.4 Data Analysis

The Chi-square test is used to examine the association between categorical variables and is particularly useful for analyzing the distribution of frequencies within a contingency table (Joseph, 2010). The behavioural patterns per period between the morning and the evening was examined by using a Chi-square analysis. Modes of observation were therefore centered on labeling observed actions like moving, feeding, playing, vocalization, resting, grooming, in active and mothering. The relative frequencies of these activities are presented in tabular form, which indicates variations for different periods. In this manner, the null hypothesis suggested no significant difference in behavioral patterns among dusky leaf monkeys while the alternate hypothesis suggested a considerable differentiation. A statistic was computed using the Chi-square test formula. Based on the assumption of no association, observed and expected percentages will be calculated. The formula is expressed as;

$$\chi^2 = \sum \frac{(O_i - E_i)^2}{E_i}$$

Here O_i represents the observed value of a specific activity, and E_i is the expected value. Following the computation of the Chi-square statistic, a comparison with the critical value from the Chi-square distribution table guided the decision to either reject the null hypothesis or retain it. This analytical approach aimed to elucidate whether dusky leaf monkeys exhibit statistically significant variations in the percentage distribution of their behavior's patterns offering insights into their behavioral adaptations within the day.

CHAPTER 4

RESULTS AND DISCUSSION

Table 4.1 and Figure 4.1 showed the information of the species behaviours that have been observed during the time of study period.

Table 4.1: Number of observations and its percentage.

No.	Behaviours	Total Observations	Percentage
1	Moving (MV)	287	27.08%
2	Feeding (FD)	221	20.85%
3	Grooming (GR)	64	6.04%
4	Playing (PL)	85	8.02%
5	Vocalization (VL)	25	2.36%
6	Resting (RT)	209	28.3%
7	Mothering (MT)	78	7.36%
	Total	1060	100%

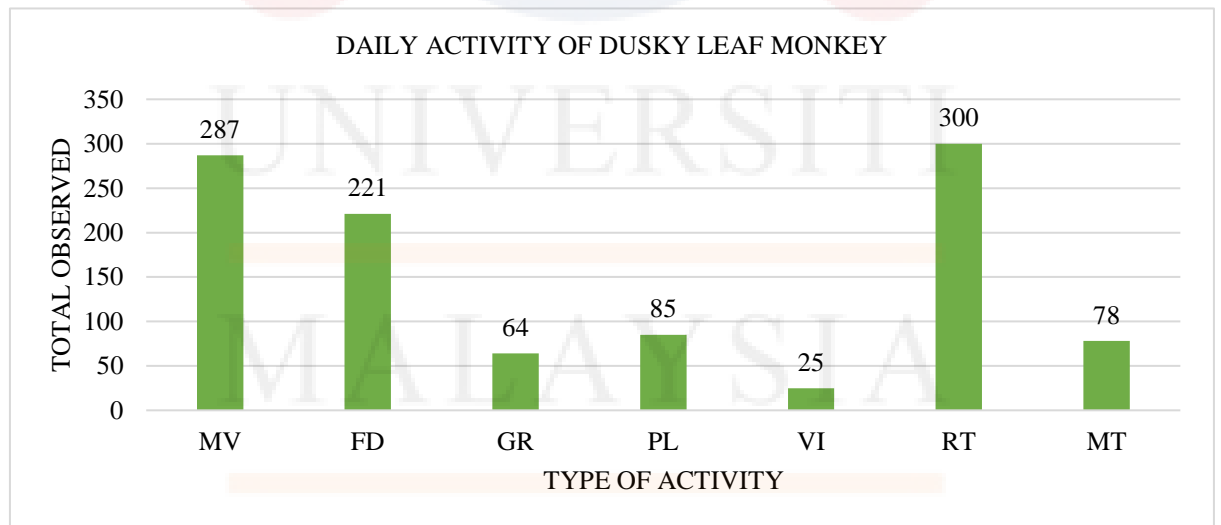


Figure 4.1: The graph shows the daily activities of the dusky leaf monkey in Taman PD Utama.

Dusky leaf monkeys are categorised as a social monkey where they often found socialized within a social group. The species group that has been found in the studied area consist of 12-18 of individuals. The total effort for this sampling was over 20 days. There were somedays within the study time where it's raining and causing the study subjects does not came out. The study group was followed from 0730 until 1910 where their daily motion was varies time to time. Timing of the observation was taken within 10 minutes interval. But then, the species are

hardly to be observed due to its shyness, greater stealth, and unpredictable behaviours (Chivers, 1998). Thus, human interaction in form of harassment to protect themselves where they cast the animal away also make the species avoid and scared to human. Sometimes the study was immediately stopped due to limitation where the study group enter the forest and private land. The study was carried out to observe the behaviours and determine association between different behaviours of *Trachypitecus obscurus* in Taman PD Utama, Port Dickson, Negeri Sembilan. Based on the Table 4.1, showing that behaviours of the species such as in active, moving, feeding, grooming, playing, vocalization, resting and mothering were observed. The highest frequency of the activity budget was resting (28.3%) followed by moving (27.08%), feeding (20.85%), and the lowest was in active (8.58%). The indirect behaviour such as playing was recorded 8.02%, mothering at 7.36%, and grooming at 6.04%, all of which accounted for a larger proportion of time than vocalization (2.36%).

Table 4.2: Chi-square value dusky leaf monkey daily activity's budget at Taman PD Utama

Behaviours	Percentage	Observed	Expected	χ^2
Moving (MV)	27.08%	287	151.4286	543.946
Feeding (FD)	20.85%	221	151.4286	322.535
Grooming (GR)	6.04%	64	151.4286	27.049
Playing (PL)	8.02%	85	151.4286	47.712
Vocalization (VL)	2.36%	25	151.4286	4.127
Resting (RT)	28.3%	300	151.4286	594.340
Mothering (MT)	7.36%	78	151.4286	35.606
Total	100%	1060		1575.315

$\chi^2=1575.315$; Showed significant difference ($p<0.0001$), degree of freedom=6

Based on Table 4.2, showed that that every daily activity of dusky leaf monkey has significant different ($\chi^2=1575.315$; $df=6$, $p<0.0001$) meaning that there were differences occurred during the daily activity. Distribution and abundance of food resources s may in the Taman PD Utama influence the activity pattern of *T. obscurus* whereas the study was conducted during fruit season; rambutan and mango. The study made in Bukit Soga Perdana by Siti-Kauthar et al. (2019), noted a higher number of feeding activity percentage (39%) due to seasonal variations and quality of food. As the observation was conducted within 20 days, the percentage of resting (28.3%) higher than moving (27.08%) and feeding (20.85%). The percentage of moving as the second. highest does not relevant to dusky leaf monkey nature behaviour as the species known as folivores species. They do not require ton amount of energy to digest but having naps half of the day as their digestive mechanism. (Downey, 2021). However, due to distribution of food resources and fruit seasons at Taman PD Utama, they have to allocate more time to moving than feeding.



Figure 4.2: Map of dusky leaf monkey most favoured trees at Taman PD Utama. (Source: Google Maps)

Based on the Figure 4.2, showing that distribution of trees as food resources at Taman PD Utama where they are located far from each other. It proved that the study group have to allocate more time on moving to gain their food resources. As explained by Arseneau-Robar *et al.* (2020), Md-Zain and Ch`ng (2010) folivores groups may adjust their time budgets and movement patterns, depending on the availability of different food items and their distribution. The langurs will keep moving until they find suitable feed trees for the group's needs.

In this study, the dusky leaf monkey allocation on social behaviours (grooming, playing, mothering, and vocalization) overall recorded lower than 10% compared to other behaviours. According to provided sources, study made by Md-Zain and Ch`ng (2010)

explained that during feeding activities there is no correlation between the behaviours and grooming behaviours. This research shows that monkeys put eating before social interactions like grooming, playing, and allomothering, thus it can be said that these activities are more of a daily routine for them than a social interaction. As for vocalization that recorded lowest (2.36%) among all the behaviours as the groups only vocalized when threatened, playing and contact calls. Grooming behaviours recorded second lowest at 6.04% as it is one of the non-functional behaviours in this study where it did not show hygiene. This behaviour rarely seen and only occur frequently when the monkey's mother cleans its infant or baby. Mothering behaviour also recorded among the lowest (7.36%). Apparently, only four infants were found during the observation. It could be said that the percentage of dusky leaf monkey mothering behavior varies depending on the number of infants and their environment in Taman PD Utama.

In this study, that conducted in Taman PD Utama, it was found that dusky leaf monkey mothers with a lower number of infants displayed a lower percentage of maternal behaviors such as carrying, grooming, and nursing. Their mothering behavior plays a vital role in the survival and well-being of their offspring (Meliantari *et al.*, 2023). The dusky leaf monkey juveniles and infant are mostly showing their playing behaviour, with most of the monkeys' adults being disengaged from play. These observations reveal that play activities of the monkeys can be categorized into four different behaviors: jumping, chasing, wrestling and tail-pulling, mainly engaged by the young members of the monkeys. Adult groups, particularly males, have known functions within social group, such as monitoring frontiers, determining predators, and keeping group coherence. While juvenile's species tend to have been more free-spirited, mature species don't slack off in play, and concentrate on their roles within the group. Such differing behavior of play in the dusky

leaf monkeys during split of age and label position is a clear indicator of activity level different among the dusky leaf monkeys. In a study made by Hambali *et al.* (2012), explained that colobine monkeys spend 10.50% on their time playing. Juvenile and infant were found frequently in this activity.



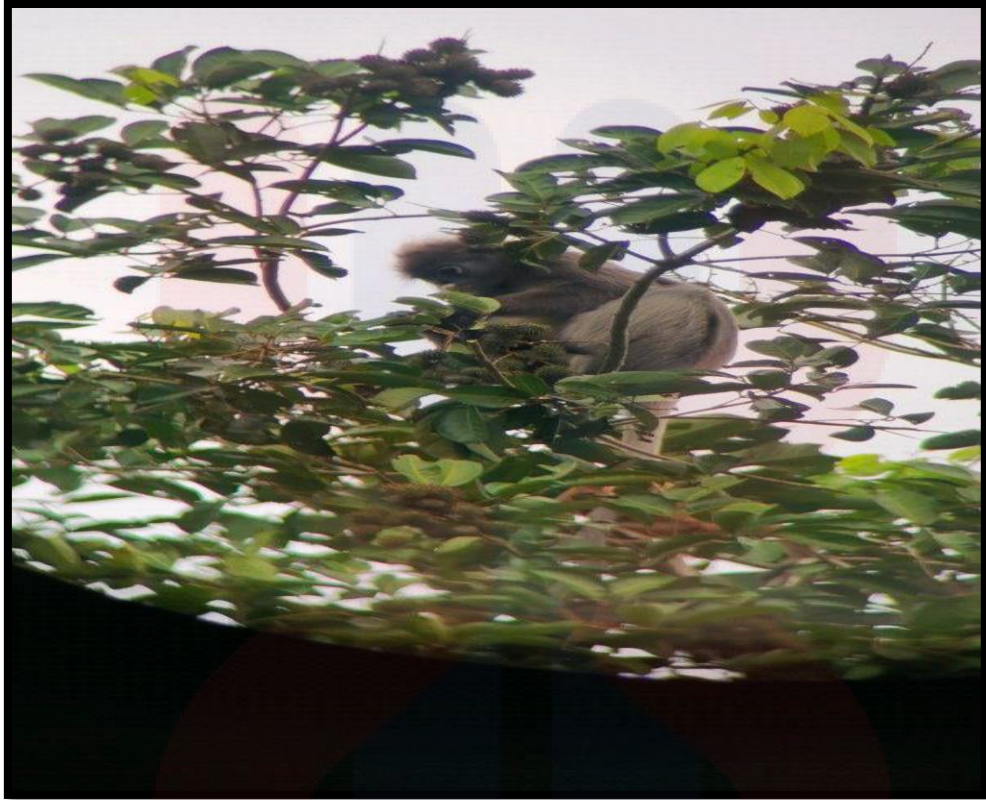
Figure 4.3: A group of dusky leaf monkey at Taman PD Utama.

Figure 4.3 illustrate a group of dusky leaf monkey that firstly consist of 16-17 individuals then become into 8-9 individuals in a sub group as for foraging as seen above. This picture was taken around 1900 where they are moving back to their nesting site at the secondary forest. These monkeys show different types of social behaviors – there is one adult male in each group (Ruslin *et al.*, 2014). It has revealed that these monkeys have shown that they spend a lot of time feeding and moving at intervals and the variations in daily activity patterns when compared with other primates. These species nocturnal where

they active during morning and spend more resting in the night. That's why the study only conducted starting at dawn (0730) till dusk (1910) where the main group will split up into 2 subgroups to foraging. At dawn the alpha will call for the group to regroup as it will also vocalize when rainy and interfere with danger. The vocalizations were one of the ways in which the alpha male would exhibit this position. This posture is meant to encourage laying out of objects that make langur feel threatened and repel. Typically, this position can either be sitting or bowing over to other species so that the langur can appear large in regard (Santoso & None Sutopo, 2023).

Vocalization is the expression through the use of sound to employ other species and surroundings (Irawan, 2011). It also has a wide range of vocal communication and may also use its vocal sounds to express various feelings like an increase in distress or aggression or contentment based on the people in its group. Furthermore, vocal sounds may also be used in maintaining relationships among the individuals within any group and establishing dominance relationships between the individuals in the group (Riley, 2005). Furthermore, geographic boundaries have been explained as a way by which neighboring groups are discouraged from encroaching into other groups territories through vocal sounds. It is also possible that these vocal sounds have a function in mating behaviour. This study was supported by previous research that observed the vocalizations of monkeys during copulation and associated with the reality that during sex females produced vocal calls which is a hormonal effect (Engelhardt *et al.*, 2005).

(a)



(b)



Figure 4.4: Showing dusky leaf monkey feed on young rambutan (a) and mango (b).

Figure 4.4 showed that the dusky leaf monkey has been captured feeding on young rambutan and mango at Taman PD Utama. Dusky leaf as folivores is known for primarily feeding on leaves, but there have been occasional observations of them consuming young fruit as well. This suggests that their diet may be more versatile than previously thought, and further research is needed to understand the factors influencing this occasional dietary variation. This information suggests that dusky leaf as folivores primarily feed on leaves but have been observed consuming young fruit occasionally. This occasional consumption of young fruit indicates that their diet is not strictly limited to leaves, and they may have the ability to adapt their feeding behavior based on resource availability or nutritional needs (Chaves & Bicca-Marques, 2016).

The primary sources of information on these diets are accurate, detailed observation of feeding behaviours, the collection and classification of feeding remains, and faecal contents analysis. Dusky leaf monkeys have illustrated that they can occasionally eat the fruit when it is young, which suggests the presence of their dietary flexibility and adaptability of these food restrictions in terms of the resource availability or nutritional needs. However, the leaves are their primary diet, but consuming young fruits shows that they can feast on different types of diet objects. This flexibility is therefore vital for survival in times of food shortage probably or when the body needs particular nutrients in a large proportion. A study conducted by at Bangi Campus, UKM can be used for internetting the point of number balancing in foraging decisions as the intermix of process and resource are significant (Ruslin *et al.*, 2014).

(a)



(b)



Figure 4.5: Showing dusky leaf monkey playing (a) and moving (b) on the ground.

Figure 4.5 showed the presence of dusky leaf monkey moving and playing on the ground. The dusky leaf monkey, is a tree-dwelling monkey found in Southeast Asia, and it expresses a very high degree of arboreal behaviour. These monkeys are free-moving four-limbed animals whose way of life entails feeding, resting, and social behaviors such as grooming and playing on trees. They are primarily suited for an arboreal life although there is evidence that dusky langurs do visit the ground to feed on shrubs and other low growing vegetation. This is usually so in places where their natural environment overlaps with human habitation for example on plantations and in urban setups.

Despite this, the study on the silvered-leaf monkeys at Bukit Malawati established that they spent a considerable amount of time at the ground levels of the forest as well, albeit mostly sleeping in the trees further up in the canopy for predator deterrence (Hambali *et al.* 2016). These observations directly show that these primates are able to alternate between both arboreal and terrestrial habitats depending on factors such as behavior, age, and increase in food availability. Nevertheless, due to habitat fragmentation resulting from human activities like development at Taman PD Utama, these monkeys have learnt to alter their behavior by foraging the underside of low vegetation and shrubs on occasions when their distribution range intersects human habitation. This behavior is a way of adapting to the altering habitat and interference of human life in their natural habitat and habitat modifications in order to survive in the new habitat modifications.



Figure 4.6: Dusky leaf monkeys on resting position.

Dusky langur will rest more during the day after moving or feeding (Figure 4.6). This can be attributed to several factors, ranging from the process in the body's metabolism after eating to the influence of air temperature that affects body condition. During the observation the subject spent 1–2 hours resting and sleeping within the day. The rest location usually chosen had a sturdy branch or a dense canopy, such as *Moringa oleifera* species.

The resting position of the monkeys includes hunched sitting with one hand holding the trunk or branch of a nearby tree as shown on Figure 4.6. The positions found were bending over with the head tucked into the stomach between the two knees of the legs, the soles of the feet overlapping each other and the hands holding the branches (Giovana, 2015).

The behavior of the male individual was to assume the lying posture as compared to the female individual. This posture is longitudinal and is often common amongst the living species of postural patterns of the primate (Chatani, 2003). The resting position aligns the leaf monkey body better in terms of the arms reaching the branches and embracing them. This position is usually noted at the lower level than the upper level of tree canopy. The position of resting displayed are known as sprawl (back lie) where its preferred to lie down during rest time, as it is a more comfortable and relaxing posture for them to sleep and rest (Md-Zain *et al.*, 2019).as preferred from the previous journal by Ch'ng and Md-Zain (2009) dusky langur will lie down on a particular branch which acts as the horizontal supporting stratum during resting time; moreover, both hindlimbs and forelimbs dangle down the branch on the langur subjects belly. The situation happened exactly the same resting position mentioned as shown on Figure 4.6

CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

The behavior and patterns of activity budget of Dusky leaf monkeys at Taman PD Utama was studied and the time used by the animals doing a particular activity was recorded (Ruslin *et al.*, 2014). The study concludes that the dusky leaf monkeys constituted a higher time in moving and feeding activities than rested. Long-tailed macaques also were found doing this behavior pattern spending more time foraging and moving (Nasution & Rukayah, 2020). This implies that the daily activity budget for each species differs considerably and may be affected by a variety of factors such as the level of their diets and their habitats. Additionally, previous study has revealed that activity patterns also differ in various primate species. The results of this study offer significant information on the behavioral patterns of dusky leaf monkeys, and its preferred areas of activity, especially in the areas of feeding and moving and its absence in resting. These findings contribute to a growing body of knowledge on primate behavior and provide important information for conservation efforts and habitat management. In summary, the dusky leaf monkeys at Taman PD Utama exhibits daily activity pattern in which resting and moving are exhibited with greater percentage in line with their natural history as leaf monkeys.

5.2 Recommendation

The data obtained in this study could be used as a baseline for future studies especially on daily activity budget of dusky leaf monkey throughout the day. The absence of some species of wild felids like the tiger, marble cat, and flat-headed cat could be a cause for further addition studies on their distribution of the population. Besides that, sampling site and weather in Port Dickson have influences the observation activities. The below was the factors that may be influencing the data observation on dusky leaf monkey daily activity budget in Taman PD Utama.

5.2.1 Sampling Effort

According to the Department of Wildlife and National Parks (DWNP)Y in Port Dickson, the dusky leaf monkey habitat range are wide and their actual sleeping area are within the secondary forest near the study site. The agility of the dusky leaf monkey to move tress to tress make it hard to observe the subject frequently. Study made by Md-Zain *et al*, (2019) found much more reliable data in the study period of 13 weeks. This study has only conducted for 20 days in Taman PD Utama which is only approximately 38% of the length of time of their study in Bukit Soga Perdana, Johor. In addition, by increasing the period of observation could make the data observation to be more statistical power and generalizability.

5.2.2 Equipment for Observation

Observation of the daily activity budget of dusky leaf monkeys at Taman PD Utama could be done with the help of the given equipment as such can give reliable and precise results (Ruslin *et al.*, 2014). The suggested survey equipment for monitoring the daily activity budget of the dusky leaf monkeys of Taman PD Utama is high visual camera. In addition, it also recommended using a high-resolution DSLR or mirrorless camera, for example, the Canon EOS R5. These cameras both provide exceptional image quality with high megapixels (45MP and 61MP, in that order respectively) that capture significant detail even from great distances. Furthermore, the ability of these cameras to focus and providing good performance in low-light conditions is important due to the generally dynamic scenes and varying light intensity found in forest habitats. The camera has to be capable of recording 4K to capture the behaviors of the individuals and groups in detail.

5.2.3 Understanding Their Nature Behaviour in The Forest

Due to the limited knowledge regarding the actual living conditions of dusky leaf monkey (*Trachypithecus obscurus*) in the forested habitat, there is a need to perform specific field surveys. Due to scarcity of research in this field, carrying out keen observation and gathering data on their routine tasks including feeding, social interactions, spatial behaviors and reproductive behaviors are necessary. These studies should be conducted within their nature habitat in the forest ecosystems in order to get a clear picture of the general behavior of the species. Some common or useful approaches include camera trapping, GPS tracking, and direct observation. Additionally, cooperation with other organizations and local communities could help to reveal important assets that should be protected and improve the existing conservation measures. Knowing these behaviours will help in designing the future policies on the conservation of their natural environments to

support the species survival. Furthermore, this knowledge can help mitigate the impacts of habitat fragmentation and human-wildlife conflict, ensuring a balanced ecosystem where both wildlife and human interests are respected.



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