



**FEEDING ECOLOGY OF LONG-TAILED
MACAQUE (*Macaca fascicularis*) IN SMK TINGGI
PORT DICKSON, PORT DICKSON, NEGERI
SEMBILAN, PENINSULAR MALAYSIA**

by

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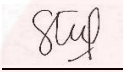
A report submitted in fulfillment of the requirements for the degree of
Bachelor of Applied Science (Natural Resources Science) with Honours

**FACULTY OF EARTH SCIENCE
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DECLARATION

I declare that this entitled Feeding Ecology of Long Tailed Macaque (*Macaca fascicularis*) in SMK Tinggi Port Dickson, Port Dickson, Negeri Sembilan is the result of my own research except as cited in the references. The thesis has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

Signature: 

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Date: 11/08/2024

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Feeding ecology of long-tailed macaque (*Macaca fascicularis*) in

SMK Tinggi, Port Dickson

ABSTRACT

The feeding ecology of long-tailed macaques (*Macaca fascicularis*) in SMK Tinggi Port Dickson was studied to understand their feeding ecology. This study was conducted over a period of one month, using direct observation and identifying the type of food eaten by long-tailed macaques. This study can reveal that the diet of these long-tailed macaques is very diverse, consisting of fruits, leaves, flowers, seeds and insects, with the majority of their food intake coming from sources provided by humans. Human settlements and nearby school facilities have led to increased interactions between long-tailed macaques and humans, causing them to frequently forage for food scraps and direct human food. This shift towards anthropogenic food sources has implications for their health, behavior and conservation management. Strategies to reduce conflict to humans and promote coexistence are essential to preserve the natural feeding ecology and ensure the welfare of both apes and local human populations. The study underscores the need for a comprehensive management plan that includes public education about the impact of feeding wildlife and the implementation of measures to secure food waste.

**Ekologi pemakanan kera ekor panjang (*Macaca fascicularis*) di
SMK Tinggi, Port Dickson**

ABSTRAK

Ekologi pemakanan kera ekor panjang (*Macaca fascicularis*) di SMK Tinggi Port Dickson telah dikaji untuk memahami keutamaan pemakanan mereka. Kajian ini dijalankan dalam tempoh satu bulan, menggunakan pemerhatian langsung dan mengenalpasti jenis makan yang dimakan oleh kera ekor panjang. Kajian ini dapat mendedahkan bahawa diet kera ekor panjang ini sangat pelbagai, terdiri daripada buah-buahan, daun, bunga, biji dan serangga, dengan sebahagian besar pengambilan makanan mereka datang dari sumber yang disediakan oleh manusia. Penempatan manusia dan kemudahan sekolah yang berhampiran telah membawa kepada peningkatan interaksi antara kera ekor panjang dan manusia, mengakibatkan mereka kerap mencari makan sisa makanan dan makanan langsung oleh manusia. Peralihan ke arah sumber makanan antropogenik ini mempunyai implikasi terhadap kesihatan, tingkah laku dan pengurusan pemuliharaan mereka. Strategi untuk mengurangkan konflik kera manusia dan menggalakkan kewujudan bersama yang mampan adalah penting untuk memelihara ekologi pemakanan semula jadi dan memastikan kebajikan kedua-dua kera dan populasi manusia tempatan. Kajian ini menggariskan keperluan untuk pelan pengurusan komprehensif yang merangkumi pendidikan awam tentang kesan memberi makan kepada hidupan liar dan pelaksanaan langkah-langkah untuk menjamin sisa makanan.

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LIST OF ABBREVIATIONS AND SYMBOLS

GPS	Global Positioning System
DWNP	Department of Wildlife Protection and National Parks
%	Percentage
'E	Earth
'N	North
TNB	Tenaga Nasional Berhad
etc	other similar things
ml	mature leaf
yl	young leaf
fr	fruit
sd	seed
in	insect
ot	other

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CHAPTER 1

INTRODUCTION

1.1 Background of Study

According to Hansen et al., (2022) the scientific name for the long-tailed macaque is *Macaca fascicularis*. The monkey species known as the long-tailed macaque (*Macaca fascicularis*) is a member of the genus *Macaca* and subfamily Cercopithecinae (Gumert, 2007). The habitat is very different because of its versatility, these monkeys can be found in a variety of settings, including urban areas, mangroves, forests and agricultural landscapes. Long-tailed macaques (*Macaca fascicularis*) has a wide distribution area in Southeast Asia. *Macaca fascicularis* is a polygamous animal that lives in groups. *Macaca fascicularis* is a group of animals that inhabit various habitats including highlands and lowlands. The population is dispersed throughout Southern Asia, including the whole of Peninsular Malaysia, Sabah, and Sarawak, Thailand's lower north, Myanmar's lower south, Vietnam, Sumatra, Java, Laos, Cambodia, and the Philippines (Hamada and Malaivijitnond, 2008). The long-tailed macaques can find over the whole Peninsula of Malaysia, Sabah, and Sarawak, particularly in the lowlands and along the beaches, and these days they are also readily discovered in cities. In the middle of the area inhabited by monkeys is one of the tourist destinations in Peninsular Malaysia. For example, Bukit Malawati Kuala Selangor, Templer Park, Penang Botanical Garden, Kuala Lumpur Garden, Kuala, Taiping Lake Gardens and Kuala Selangor Nature Park (Hambali et al., 2014). Macaques live in regions with a high concentration of humans and roads, and at least half of them eat some food that has been created by humans (Sha et al., 2009).

The hair on the backs, legs, and arms of the subspecies of long-tailed macaques varies in colour from light brown or greyish to brown, with a much lighter underside (Rowe, 1996; Groves, 2001). Their cheeks are pinkish-brown, and the hair on top of their heads frequently forms a crest when the fur falls back over their foreheads. While ladies have beards in addition to cheek whiskers, guys are characterised by moustaches and cheek whiskers that frame their features. The eyelids near the snout of both males and females are coloured white (Rowe, 1996). Their very extended tail, which may measure between 400 and 655 mm (1.31 and 2.15 ft) in length and is almost always longer than their height from head to rump, is what gives them their name (Fa, 1989; Groves, 2001). Newborns have a black natal coat, which eventually transforms into adult pelage as they get larger (Rowe, 1996). They start to shed their black coat at the age of two to three months, and by the time they are a year old, they have grown into adult colours. Long-tailed macaques exhibit sexual dimorphism similar to other macaques. Males usually weigh between 4.7 to 8.3 kg and measure between 1.35 to 2.13 feet. Females usually weigh between 2.5 to 5.7 kg and measure between 1.26 to 1.74 feet. Males have much bigger canine teeth than females, in addition to being heavier and taller (Dittus, 2004).

Due to their ecological flexibility, *Macaca fascicularis* will eat any type of food that is present in their home range (Sarah et al., 2014). Their ecological flexibility allows them to adapt to a broad range of environments. Food type adaptability, reproductive parameters, group size, and population home range all exhibit ecological plasticity. Long-tailed macaques is omnivorous animals. Long-tailed macaque eat plant and animal matter in a variety of their diets. Their opportunistic feeding patterns may change depending on the resources available in their particular environment. Some important features in their nutritional ecology such as fruits, leaves, insects and small

animals. Primates in this subfamily are characterized by low molars, have cheek pockets to store food for a short time, and fruits are part of the diet.

1.2 Problem Statement

There is not much information about the feeding ecology of long-tailed macaques (*Macaca fascicularis*) in SMK Tinggi Port Dickson, Negeri Sembilan. The underrepresentation of species in such places represents a knowledge gap that must be filled. Consequently, data are needed to define the feeding ecology of longtails in this area for use in future conservation initiatives. Despite the ecological importance and conservation importance of long-tailed macaques, there is a lack of comprehensive understanding of their specific feeding ecology. This knowledge gap hinders effective conservation strategies, habitat management, and ensuring the nutritional well-being of long-tailed macaque populations. A conservation plan will be ineffective if the relevant information is insufficient. This study was also carried out due to the presence of long-tailed macaques in the school grounds. The disturbance of the long-tailed macaque has had a negative effect on students, teachers and school staff such as being afraid to attend school.

1.3 Objective

- i. To determine feeding ecology of long-tailed macaque (*Macaca fascicularis*) in SMK Tinggi Port Dickson, Negeri Sembilan

1.4 Scope of study

From the research carried out, the title of this study is focused on the feeding ecology of long-tailed macaques in SMK Tinggi Port Dickson, Negeri Sembilan by using observational methods. This observation was carried out for a month and the study site was concentrated in SMK Tinggi Port Dickson, Negeri Sembilan. Using binoculars and cameras was help observers interact less with long-tailed macaques. In

this observation, the observer used a camera to take pictures of a long-tailed macaque eating. In this observation, the observer also used the Global Positioning System (GPS) to determine the coordinates of the tree eaten by the long-tailed macaque. Pen and notebook are also used to record the types of food eaten by long-tailed macaques.

1.5 Significant of study

This study has collected important data on the ecological determination of long-tailed macaque (*Macaca fascicularis*) feeding in SMK Tinggi Port Dickson, Negeri Sembilan. It can address information gaps about the species that live there and can be used to plan future conservation efforts. This study was conducted observationally. Food samples collected by observers were identified while for fruits and leaves using plant species identification keys or with the help of subject experts. All types of food eaten by long-tailed macaques have been monitored and identified. Therefore, the results of this study can be used to make more efficient and effective conservation and management plans for this species. This study can help to obtain more data on the feeding ecology of long-tailed macaques. The importance of this study can also help authorities, such as the Department of Wildlife Protection and National Parks (DWNP), to plan new conservation programs for the survival of this species.

CHAPTER 2

LITERATURE REVIEW

2.1 Long-tailed macaque

The long-tailed macaque or *Macaca fascicularis* comes from Southeast Asia and is known as a cercopithecine monkey. This species has a long history with humans in everyday life. It has been seen alternately as an agricultural pest, a sacred animal and more recently as the subject of medical experiments (Rifqi et al., 2023). There are many different types of habitats where the long-tailed macaque may be found, including plantations, mangroves, primary and secondary forests, and the edges of cities and settlements. Its diverse diet of fruits, leaves, small animals, birds, mussels, crabs, and leftover human food is primarily responsible for its success. Its color which is often grey-brown or reddish-brown, the length of its tail, and the form of the nose may all be used to identify it. It may occasionally roam in sizable troupes of up to thirty and has an aggressive, boisterous nature.

2.1.1 Morphology

The hair on the backs, legs, and arms of the subspecies of long-tailed macaques varies in color from light brown or greyish to brown, with a much lighter underside (Rowe, 1996; Groves, 2001). Their cheeks are pinkish-brown, and the hair on top of their heads frequently forms a crest when the fur falls back over their foreheads. While ladies have beards in addition to cheek whiskers, guys are characterized by moustaches and cheek whiskers that frame their features. The eyelids near the snout of both males and females are colored white (Rowe, 1996). Their enormous tails, which may be anywhere from 400 to 655 millimetres (1.31 to 2.15 feet) in length and

nearly twice as long as they are tall from head to rear (Fa, 1989; Groves, 2001). Newborns have a black birth coat, which eventually changes to adult fur as they grow (Rowe, 1996). They start to shed their black coat at the age of two to three months, and by the time they are a year old, they have grown into adult colors. Long-tailed macaques exhibit sexual dimorphism similar to other macaques. Males usually weigh between 4.7 to 8.3 kg and measure between 1.35 to 2.13 feet. Females usually weigh between 2.5 to 5.7 kg and measure between 1.26 to 1.74 feet. Males have much bigger canine teeth than females, in addition to being heavier and taller (Dittus, 2004). Macaques carry food from the foraging location to their cheek pouches, where they can store it until they are ready to eat. Macaques carry food from the foraging location to their cheek pouches, where they may store it until they are ready to eat (Lucas and Corlett 1998). Primarily arboreal, these macaques can jump up to five meters (16.4 ft) between trees by utilizing their long tails as a balancing aid (Rodman, 1991; Rowe, 1996). Quadrupedal through the canopy, long-tailed macaques also spend some time on the ground (Rodman, 1991).

2.1.2 Habitat of long-tailed macaque

Long-tailed macaques are highly adaptable and inhabit diverse environments across Southeast Asia, including forests, coastal areas, and urban landscapes (Fooden, 1995). The species is found in Sumatra, Java, Borneo, Southern Thailand, Peninsular Malaysia, and the Philippines. It is the most prevalent primate in Singapore. Their ability to thrive in varied habitats reflects their ecological flexibility and adaptability to different ecological niches. The best places for long-tailed macaques to survive are disturbed environments and the edges of forests. Their densest populations in Sumatra are found in riverine forests, secondary hill forests, and mixed mangrove swamps. Some were also found in rubber groves, lowland primary forests, scrub grasslands,

and freshwater marshes. Long-tailed macaques may be found in deciduous, bamboo, and evergreen forests in Thailand. They are widespread in Malaysia's lowland coastal woodlands. This species, which frequently inhabits areas near bodies of water, has been seen to consume a lot of water and crabs. The swamp woods appear to have the largest number of long-tailed macaques among all the places they call home. The long-tailed macaques population have seen an expansion in their range in recent years due to habitat modification. This species has colonised cleared ground in Malaysia including plantation regions. It has been shown that compared to certain pure forests, certain disturbed environments exhibit larger troop and population proportions. This long-tailed macaque species has population densities ranging from 10 to 400 individuals per square km (Bonadia, 2019).

2.1.3 Foods habit of long-tailed macaque

Long-tailed macaques are omnivores ripe, luscious fruits make up 66.7% of their diet on Borneo in Kalimantan, and even more fruit (82%), is consumed by macaques in Sumatra (Wich et al., 2002). During times of the year when fruit is sparse, such as the dry season into the early rainy season, long-tailed macaques focus on various food sources such insects, stems, young and mature leaves, flowers, seeds, grass, mushrooms, invertebrates, bird eggs, clay, and bark. Long-tailed macaques spend a lot of time eating crabs while they forage in mangroves; they have also been observed devouring prawns, octopuses and frogs. In addition to picking fruits by hand or using teeth to harvest them. Long-tailed macaques also turn over rocks, catch insects from the air, and store food in cheek pouches.

2.1.4 Behavior of long-tailed macaque

Long-tailed macaques (*Macaca fascicularis*) exhibit a variety of social interactions, communication techniques and hierarchical structures. Extensive research has been conducted on their behavioral habits, providing insight into their complex social and relationship lives. These long-tailed macaques consist of several individuals under a dominant male and female leadership, and social relations and access to resources are controlled by a formal hierarchy (Gumert, 2011). The group's eating, grooming and mating habits are influenced by this social structure. Long-tailed macaques use a wide variety of vocalisations, facial expressions, and body language to communicate. These monkeys communicate information about food sources, danger, and social cues within the group using a variety of vocal calls (Gumert and Malaivijitnond, 2013). In addition to body language, facial expressions and posture are important means of conveying emotions and establishing authority. Similar to other *Macaca* species, these animals most likely employ a variety of sensory cues to communicate, including visual cues like body postures and facial expressions, auditory cues like vocalisations, physical signals like grooming and play, mating behaviours, and aggressiveness, and maybe even chemical cues like smell. (Bonadio, 2000).

2.1.5 Conservation status of long-tailed macaque

There are two sanctuaries, nine reserves, and nine national parks where long-tailed macaques may be found. For a population of 5,000 long-tailed macaques to be sustainably maintained, there must be at least 500 square kilometres of habitat, regardless of the kind. For this species, a reserve must be at least this big. In Thailand's temple ruins and Bali's temples, long-tailed macaques find some safety as well as sustenance. In Malaysia, long-tailed macaques are fed and kept safe in parks and urban

woods under legal protection. There is a strong desire to preserve this species in the Philippines. Although the species is well protected in Indonesia, there are plans to drill and collect oil from some of the deposits. In fact, some people in Bali believe that these primates are sacrosanct. Their chances of surviving in these reserves may rise as a result. Only licences are required for the hunting, capture, or custody of long-tailed macaques in Thailand. This species is subject to quota regulations regarding its export. Long-tailed macaques have a few sanctuaries, but hunting is still an issue. They are hunted for food in Borneo and Thailand. Additionally, because this species is a problem to agriculture, it is eliminated. The fact that these macaques ruin crops has kept some governments from committing significant resources to conservation. Long-tailed macaques are collected for medical research. They are one of the five most used primate species in medical research. Many of these macaques were exported to the United States and Great Britain. Habitat loss in these organisms is occurring due to extensive logging operations (Bonadio, 2000).

CHAPTER 3

MATERIALS AND METHODS

3.1 Study area





Figure 1: Maps of Negeri Sembilan




This study was conducted in SMK Tinggi Port Dickson, Port Dickson, Negeri Sembilan. The area is laying longitude and latitude 2.5218515'E, 101.817259'N as shown in figure 1. This observation was carried out for a month around the school area, there are several species of large trees such as *Elaeis guineensis*, *Fagraea berteriana*, *Prunus avius* and *Musa acuminata*. This research area is focused on the entire school area because the researcher has to follow these long-tailed macaques to record the types of food they eat. Based on observations carried out for a month from 10 february to 10 march, it was found that all these plants are natural food that the study group obtained from their habitat. The terrain in the study area is flat on the road and the class area is slightly hilly. The study area is close to the teachers' quarters and the TNB quarters so that the distance is only a few meters. This school is also facing

the beach where several resorts live such as Sunshine Bay Resort and Temasek Retreat. Therefore, there are various human activities such as walking, jogging, exercising, riding, trading, and feeding monkeys. Food given by humans or taken from the study group mostly consists of fruits such as mangoes, bananas, apples and oranges. In addition, bread, cookies, snacks and chocolate were also provided by humans to the study group. Besides some tall and big trees, there are too many electric poles and cables between the electric poles which are often used by long-tailed macaques to move from one place to another (Hambali et al., 2014). Long-tailed macaques in the study area are more likely to move on the trees that are in the school area and they will also wander into the school area when the students are resting and the school hours are over.

3.2 Materials

Table 1: List of materials

Material	Picture	Function
GPS 72H	 <p data-bbox="746 1514 956 1547">Source: Internet</p>	To determine the coordinates of trees eaten by long-tailed macaques
Binocular	 <p data-bbox="746 1872 956 1906">Source: Internet</p>	To observe the movement of the long-tailed macaque more clearly

Camera	 <p>Source: Internet</p>	To capture and record the feeding of long-tailed macaques
Notebook	 <p>Source: Internet</p>	To record the types of food eaten by long-tailed macaques
Pen	 <p>Source: Internet</p>	To record the types of food eaten by long-tailed macaques

3.2.1 Global Positioning System (GPS)

Global Positioning System (GPS) is also used when conducting observations of long-tailed macaques. This GPS is used to see the coordinates of trees eaten by long-tailed macaques around SMK Tinggi, Port Dickson in more detail. There are several types of large trees that are always the focus of the group of long-tailed macaques.

3.2.2 Binocular

In the observation of long-tailed macaques, binoculars are used to see the diet of long-tailed macaques in more detail. These binoculars can help researchers to see long-tailed macaques that are far away or high on trees more closely. This can prevent long-tailed macaques from feeling threatened by the presence of humans. These long-tailed macaques are very aggressive and they will act like pouncing on humans who are in close proximity to them. The use of binoculars can also guarantee the researcher's safety when observing the group of researchers.

3.2.3 Camera

While observing the diet of the long-tailed macaque, the researcher also use a camera to take pictures. The purpose of the researcher using the camera is to take pictures while the long-tailed macaque is eating. The picture can be use as reference material and evidence for the researcher to prepare the report. The pictures can be included in the report results.

3.2.4 Notebook

Notebooks are also used when conducting observations. Notebooks play an important role in collecting, recording, and analyzing data related to macaque nutrition. Through notebooks, observers can record important details about the types of food taken by long-tailed macaques.

3.2.5 Pen

The use of a pen can make it easier for observers to record the type of food consumed by long-tailed macaques. A pen is used to record the amount and type of fruits, leaves, insects, seeds, flowers and animals eaten by monkeys.

3.3 Method

3.3.1 Observation

This observation was carried out for a month at SMK Tinggi, Port Dickson. This study was conducted in two periods of time, from 0800 to 1200 hours and 1500 to 1900 hours. This observation focuses on the feeding ecology of long-tailed macaques at SMK Tinggi, Port Dickson.

3.3.2 Focus group

The selection of the study group was made during title selection with supervisor. The results of early observations have found that there is a group of long-tailed macaques which is often found in the area of SMK Tinggi, Port Dickson and often hovers in the classroom to find food. Therefore, the presence of long-tailed macaques has caused disturbances in the school area. The group easily approached by researchers and can also turn aggressive when they feel threatened. There are also some students or workers at the school who give food, but most of the long-tailed macaques like to take food supplies brought by students when they are not in class. However, this group is found to be wary of the threat of predators such as dogs. The study the group consists of about 50 individuals and has was marked by the presence of a cleft female long-tailed macaque classified according to unique characteristics every individual, cleft-female and their range area. Therefore, this group was selected as the main study group.

3.3.3 Food data collection

This study was conducted from dawn to dusk, that is, from 0800 to 1200 hours and 1500 to 1900 hours. Based on the survey, this group can also be detected by the presence of noise and swaying trees in the area. The study group was observed at a distance of 2 meters from the observer. Observers use binoculars if the study group is

at a long distance and when the observer faces obstacles to approach the group. Food consumed by the study group was recorded at 10-minute intervals using the scan sampling method (Altmann, 1974). In areas that are difficult to observe, indirect observation will be done by following their path as closely as possible. Food left on the ground such as plants, insects, and other food will be identified. The type and portion of food eaten by the long-tailed macaque was recorded in a table every ten minutes. The names of the plant and animal species eaten by the long-tailed macaque have been identified with the help of taxonomists. All trees selected by the study group as food options were identified, marked and mapped through the Global Positioning System (GPS).

3.4 Data Analysis

The chi-square test is a statistical method used to determine whether there is a significant association between categorical variables. In the context of feeding ecology analysis of long-tailed macaques, researchers might employ chi-square to analyze categorical data related to their diet preferences or food choices. The examination of the connection between the macaques' food preferences and the availability of various food kinds using chi-square analysis (Riley, 2007). Researchers can ascertain whether observed dietary choices differ significantly from what would be predicted in the absence of any relationship between food availability and intake by using this statistical approach. With the use of this statistical method, one may gain better knowledge of the elements that affect long-tailed macaques' food selection and gain insight into their eating ecology and environmental adaptation.

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

Figure 2: Formula of chi square

χ^2 = chi squared

O_i = Observed value

E_i = Expected value

CHAPTER 4

RESULTS AND DISCUSSION

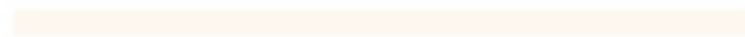
4.1 Result

According to the data presented in Table 4.1.1, the study group consumed a total of 29 different kinds of food while they were in the area under investigation. The largest percentages came from the five different kinds of food that were documented. Among these are *Fangrea berteriana*, which accounts for (15.38%) of the total, *Elaeis guineensis* and rice, which both have the same proportion (8.65%), and *Averrhoa bilimbi*, *Mangifera indica*, and bread, which both have around the same percentage (6.73%). Fruit is produced by every tree, and the members of the study group consume the fruit that the tree produces. For the purpose of the study, it was carried out during the time of year when local fruits were growing fruit. One possible interpretation of this is that the long-tailed macaque, which is characterised by its long tail, is a frugivorous animal, which means that it consumes fruits as part of its regular diet. In addition to the fact that each research location contains a distinct assortment of plant species, stages of growth, and seasons, it also provides a distinct distribution of potential food resources. *Macaca fascicularis* will observe up to ground level and consume leftover food that humans have thrown away, such fried chicken, rice bread, and other foods. Using each tree canopy level, beginning with the highest point and working their way down to the ground level, the research group discovered. This skill is a result of their arboreal specialisation, their small body size, and the extent to which food distribution plays a significant role in their behaviour. When it comes to choosing and plucking fruits from small branches, *Macaca fascicularis* is shown to be highly quick and effective. While they are perched on the tree, they make advantage of their

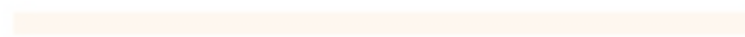
ability to cling to branches in order to obtain food. The monkey was seen to initially store food in their cheek pouches before consuming it, and this is one of the advantages that have been observed in ape species.



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Table 4.1.1 Number and percentage of food types recorded

No	Common Name	Number	Percentage (%)
1	<i>Elaeis guineensis</i>	9	8.65
2	<i>Musa acuminata</i>	5	4.81
3	<i>Fagrea berteroana</i>	16	15.38
4	<i>Averrhoa bilimbi</i>	7	6.73
5	<i>Citrus sinensis</i>	2	1.92
6	<i>Nephelium lappaceum</i>	3	2.88
7	<i>Leucaena leucocephala</i>	2	1.92
8	<i>Mangifera indica</i>	7	6.73
9	<i>Annona reticulata</i>	1	0.96
10	<i>Etilingera elatior</i>	1	0.96
11	<i>Citrullus lanatus</i>	3	2.88
12	<i>Cucumis sativus</i>	6	5.77
13	<i>Prunus cerasus</i>	2	1.92
14	<i>Malus domestica</i>	2	1.92
15	<i>Phyllanthus acidus</i>	1	0.96
16	<i>Lodoicea</i>	1	0.96
17	Others	36	34.59
	Total	104	100

Table 4.1.2 Definition of plant part and animal matters eaten by *Macaca fascicularis* (adapted from Davies 1984) and some modifications

Food matter	Code	Definitions
Mature leaf	ml	Fully developed leaf, usually dark green in colour
Young leaf	yl	Distinguished from mature leaves by smaller size, paler colour, redder or less turgid
Flowers	fl	Reproductive tissues, calyx, corolla and germ cells
Fruits	fr	The carpel and the tissues which surround it, excluding fibrous pericarp
Seeds	sd	The embryo and cotyledons but not thick testes
Others	ot	Rubbish discarded by humans
Animal	an	Small vertebrates and invertebrates other than insects
Insect	in	Insects such as vespa, crickets etc

4.2 Parts eaten by long-tailed macaques (*Macaca fascicularis*)

There are 16 different kinds of food that long-tailed macaques consume, as shown in table 4.2.1. These include mature leaf, young leaf, flower, seed, and fruit, all of which come from different areas of the trees that are located in the research area, as well as food that is gathered from all around the place. An example of a tree that is consumed is the *Elaeis guineensis* tree. The mature leaf, young leaf, and the fruit are the parts of the tree that are consumed, while the long-tailed macaque consumes just the fruit of the *Lodoicea* tree. *Elaeis guineensis* is the same as *Fagraea berteriana* and *Leucaena leucocephala* in terms of the component that is consumed inside them. Young leaves and fruit were the components of *Averrhoa bilimbi*, *Nephelium lappaceum* and *Prunus cerasus* that were consumed by the group that was being studied. *Citrus sinensis*, *Annona reticulata*, *Citrullus lanatus*, *Cucumis sativus*, *Malus domestica*, and *Phyllanthus acidus* are the individuals that fall under the category of fruits. After that, the food that the long-tailed macaque consumes comes from human waste. For examples bread, biscuits, vitagen, chocolate, rice, nata de coco, fried chicken and syrup drink. These are all examples of foods that fall into the category of other foods. *Crickets*, *Vespa*, *Opodipthera eucalypti* and *Caelifera* are some examples of the classes of insects that fall under this group.

Table 4.2.1 Types of foods eaten by long-tailed macaques (*Macaca fascicularis*)

No	Order/Species	Local name	Common name	Parts eaten
1	<i>Elaeis guineensis</i>	Kelapa sawit	Oil Palm	ml, yl, fr
2	<i>Musa acuminata</i>	Pisang	Banana	fr
3	<i>Fagraea berteriana</i>	Pokok bunga minyak wangi	Pua kenikeni	ml, yl, fr
4	<i>Averrhoa bilimbi</i>	Belimbing buluh	Bilimbi, Cucumber Tree	yl, fr
5	<i>Citrus sinensis</i>	Limau	Orange	fr
6	<i>Nephelium lappaceum</i>	Rambutan	Rambutan	yl, fr
7	<i>Leucaena leucocephala</i>	Pokok petai belalang	Lead Tree, Reuse Wattel, White Popinac, Horse Tamarind, Wild Tamarind	ml, yl, fr
8	<i>Mangifera indica</i>	Mangga	Mango	fr, sd
9	<i>Annona reticulata</i>	Buah nona	Custard Apple or Sugar Apple	fr
10	<i>Etilingera elatior</i>	Bunga kantan	Torch Ginger	fl
11	<i>Citrullus lanatus</i>	Tembikai	Watermelon	fr
12	<i>Cucumis sativus</i>	Timun	Cucumber	fr
13	<i>Prunus cerasus</i>	Ceri	Cherry	yl, fr
14	<i>Malus domestica</i>	Epal	Apple	fr
15	<i>Phyllanthus acidus</i>	Belimbing	Star Gooseberry, Otaheite Gooseberry	fr
16	<i>Lodoicea</i>	Kelapa laut	Sea coconut	fr
17	Breads	Roti	Yeast bread, quick bread, fruit bread, flatbread	ot

18	Biscuits	Biskut	Biscuits	ot
19	Vitagen	Susu yogurt	Yogurt milk	ot
20	Chocolate	Coklat	Chocolate	ot
21	Rices	Beras	Rices	ot
22	Nata de coco	Gel kelapa	Chewy, translucent	ot
23	Fried chicken	Ayam goreng	Fried chicken	ot
24	Lemon Tea Drink	Teh limau	Lemon Iced Tea	ot
25	Syrup drink	Sirap	Syrup Drink	ot
26	<i>Vespa</i>	Tebuang	Wasp	in
27	<i>Opodiphtera eucalypti</i>	Rama-rama	Gum Moth	in
28	<i>Cealifera</i>	Belalang	Grasshopper	in
29	Crickets	Cengkerik	Crickets	in

4.3 Percentage of food matter

Long-tailed macaques consumed plant components that included 16 different kinds of plants and 4 different species of insects over the course of the study period, which lasted for a total of 25 days (Table 4.1.1). There were a total of 104 different kinds of food that were seen and collected for the research group. Fruits make up the largest proportion of the food that long-tailed macaques consume, accounting for (37.43%) of their total consumption. Long-tailed macaques have a preference for young leaves (21.23%), followed by other (16.76%). In addition to fruits, they also enjoy young leaves. The term "other" refers to the waste that is left behind by humans and is consumed by long-tailed macaques (table 4.3.1). Subsequently, the next group consists of mature leaves (11.17%), followed by flowers (6.7%), young leaves (13.2%), and finally, seeds and insects (3.35%) have the same percentage.

4.3.1 Table percentage of food matter

No	Food matter	Number	Percentage(%)
1	Mature leafs	20	11.17
2	Young leafs	38	21.23
3	Flowers	12	6.7
4	Fruits	67	37.43
5	Seeds	6	3.35
6	Others	30	16.76
7	Insects	6	3.35
8	Animals	0	0
	Total	179	100

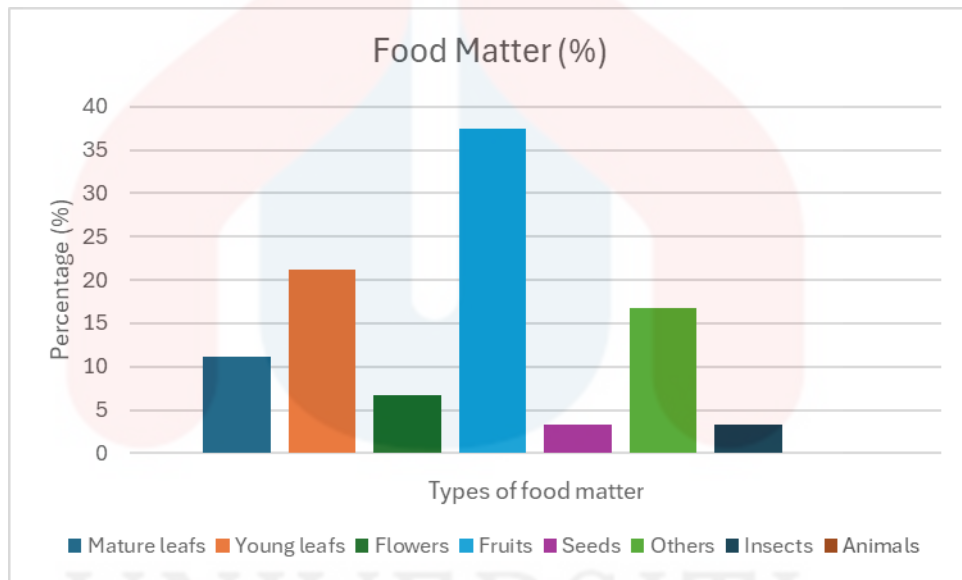


Figure 4.3.1 Food items in the diet of *Macaca fascicularis* based on observation record of food selection

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4.4 Factor food selection of long-tailed macaque (*Macaca fascicularis*)

The findings of this research make it abundantly evident that long-tailed macaques, also known as *Macaca fascicularis*, consume a wide variety of foods, including both natural and manufactured foods. It is often the case that the long-tailed macaque, also known as *Macaca fascicularis*, consumes solely natural foods (Smith, J. A., & Tan, C. L. 2000). This suggests that the sort of food that they consume has changed. As a result of the fact that the study space is a school, it is occupied by students, teachers, and other members of the school staff. Particularly the school canteen, which serves food that has been processed, so that long-tailed macaques (*Macaca fascicularis*) might get used to consuming food that has been treated. The long-tailed macaque is a frugivore, meaning that fruits are its primary source of nutrition while it is in its native environment. The long-tailed macaque will often choose fruit depending on a variety of traits that are associated with the fruit. Particularly appealing colour, an aroma that is aromatic, the weight of the fruit, and the height of the nutritious content (Jones, H. G., & Lin, D. 2005). This shift in the kind of food is due to the fact that the type of processed food with a flavoured material that can be held and bit into has been introduced. According to the findings of the research conducted in the region under investigation, long-tailed macaques often and unintentionally stuffed all of their food into their mouths out of fear of being consumed by another long-tailed monkey. Long-tailed macaques will often stuff their cheek pouches with food if they are hungry. When the situation is deemed to be safe, the food will be made available once again for the purpose of being chewed and ingested (Roberts, C. A., & Zhang, W. 2007). Additionally, according to observations, the long-tailed macaque will first sniff the meal before eventually putting it in his mouth. This occurs before the item is really placed into his mouth. When selecting food, long-tailed macaques often rely on their

instincts to choose high-value food items that are not only nutritious but also do not pose any risks to their health. These food items also have an adequate fragrance and flavour that they can experience. According to the findings of firsthand observations made in the region under investigation, long-tailed macaques (*Macaca fascicularis*) have a strong desire to exert as much control over their food as they can, even if they are unable to swallow all of the food. This often results in or encourages altercations. He will approach and take the food that he enjoys more when there is another food that he likes more, and he will leave the meal that he was eating before leaving. The findings of Putra et al. (2000), which say that in general, *Macaca fascicularis* has a predisposition to consume the whole object even if it is unable to complete it all, are in agreement with this finding. There is a connection between his desire to be able to demonstrate his might against other people initiating a fight and the large amount of food that he has accumulated.

4.5 Chi-square test

With 7 degrees of freedom, the squared value of chi is 153.9162. The result of the two-tailed P statistic is lower than 0.0001. It is generally agreed that this difference is very statistically significant, according to the standards that are often used.

Table 4.5.1 Chi-square test

O	20	38	12	67	6	30	6	0
E	22.375	22.375	22.375	22.375	22.375	22.375	22.375	22.375
(O - E) ² /E	0.252095	10.91131	4.810754	89.0007	11.98394	2.598464	11.98394	22.375
χ^2	153.9162							

CHAPTER 5

CONCLUSION AND RECOMMENDATION

5.0 Conclusion

It was discovered that the long-tailed macaque that lives in frugivorous environments in SMK Tinggi Port Dickson chooses fruits as their primary source of nutrition, followed by young leaves, others, mature leaves, flowers, seeds, and insects. This research helps us know the food that long-tailed macaques at the study site prefer to eat, and as a result, it contributes to the management plan that is being developed by the Port Dickson District Council (MDPD) in conjunction with the Department Wildlife and National Park (DWNP). It is necessary to have such knowledge and to work together in order to take the proper actions regarding the long-tailed macaque in order to guarantee the health, hygiene, and well-being of populations of humans.

5.2 Recommendation

For the purpose of enhancing the conservation and management of the long-tailed macaque, it is essential to do further study on the feeding ecology of this species. It would be beneficial for SMK Tinggi to do further research on the long-tailed macaque. According to this location, Port Dickson is a school area that is located nearby to both the ocean and the forest.

It is contemplating the development of new tactics for the purpose of doing more study in this field. One of these strategies involves the use of drones to track the long-tailed macaques more carefully when they penetrate the forest nearby to the school. To make sure that a greater quantity of data can be recorded, it is necessary to accurately identify both the sample period and the sampling time.

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APPENDIX A

Picture while the long-tailed macaque is eating in SMK Tinggi, Port Dickson

	Eating biscuit
	Eating banana
	Eating apple
	Drinking vitagen



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