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**HUMAN-MACAQUE CONFLICT AND PEST
BEHAVIOURS OF LONG-TAILED MACAQUES
(*Macaca fascicularis*) IN TERENDAK CAMP,
MELAKA, MALAYSIA**

by

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

FACULTY OF EARTH SCIENCE

UNIVERSITI MALAYSIA KELANTAN

2019

DECLARATION

I declare that this thesis entitled “Human-Macaque Conflict and Pest Behaviours of Long-Tailed Macaques (*Macaca fascicularis*) at Terendak Camp, Melaka, Malaysia” 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.

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APPROVAL

“I hereby declare that I have read this thesis and in our opinion this thesis is sufficient in terms of scope and quality for the award of the degree of Bachelor of Applied Science (Natural Resources) with Honours”

Signature :

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Date :

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ACKNOWLEDGEMENT

First and foremost, I would like to express all my deepest gratitude to my supervisor, Dr. Kamarul Ariffin bin Hambali@Kambali for her continuous support of my final year project in fulfilment of the requirements for the bachelor degree. Her exemplary guidance, monitoring, and constant encouragement throughout the course of this thesis are very important for the success of this project. It seemed almost impossible to carry out this research without proper guidance from appropriate expertise.

In addition, I would like to thank the Faculty of Earth Science, University Malaysia Kelantan for offering this research as a partial requirement in order to graduate from the university.

Finally but most importantly, I would like to thank my parents Thiyagarajan A/L V. Muthu and Anjalai A/P Jeganathan for always being my backbone, supporting me morally and financially. This thesis stands as a testament to my parent's unintentional support unconditional care and endless motivation. My heartfelt gratitude is also extended to my friends who helped me in completing the thesis.

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HUMAN-MACAQUE CONFLICT AND PEST BEHAVIOURS OF LONG-TAILED MACAQUES (*Macaca fascicularis*) IN TERENDAK CAMP, MELAKA, MALAYSIA

ABSTRACT

Human-macaque conflicts and the pest behaviour of long-tailed macaques (*Macaca fascicularis*) were studied at Terendak Camp, Melaka. The study location was focused at MRSM Terendak Camp and observation of macaque's pest behaviours were studied from 0800 hours until 1800 hours for 5 days a week for a about 40 days from July 2018 until August 2018 inclusive by intensive direct observations using the interval scan sampling method. In addition, the survey based on questionnaire were carried about the knowledge, opinion, and attitudes towards macaques by people. The most monitored pest behavior of long-tailed macaques was breaking into residence (42.93%), followed by messing up garbage cans (17.76%), damaging property (13.72%), littering (12.74%), disturbing people (11.61%) and the lowest was stealing (1.24%). In total, 70 out of 100 (70%) questionnaires were collected. The questionnaires were dispersed randomly to MRSM students. The questionnaire survey revealed that about 98.6% of respondent claimed that they aware about the ongoing human-macaque conflict at MRSM Terendak Camp and used to their disturbance. The results shows that the pest behaviour of macaques related to foraging anthropogenic food. This study is important to understand the pest behavior of long-tailed macaques at the study area which can lead to the pest management and conservation of the species in the future. Therefore, the authorities should take some action to reduce the disturbance. In order to solve this problem local authority, school management and Wildlife Department and National Park (PERHILITAN) need to work together and come up with solution. The government and non-governments organization need to cooperate in forming a buffer zone for macaques so that can reduce the disturbance at the study area. The school management has implemented the anti-monkey bins replacing the normal garbage bins to reduce the pest behavior of macaques and replace the cascading glass windows with fully enclosed ones to prevent monkeys sneaking through the gaps.

KONFLIK MANUSIA-KERA DAN KELAKUAN PEROSAK KERA (*Macaca fascicularis*) DI KEM TERENDAK, MELAKA, MALAYSIA

ABSTRAK

Konflik manusia-kera dan kelakuan perosak kera (*Macaca fascicularis*) telah selidik di Kem Terendak, Melaka. Lokasi kajian adalah tertumpu di MRSM Kem Terendak dan pemerhatian tingkah laku perosak kera telah dikaji dari jam 0800 hingga jam 1800 selama 5 hari seminggu bagi kira-kira 40 hari dari Julai 2018 hingga Ogos 2018 termasuk oleh intensif pemerhatian langsung dengan menggunakan kaedah persampelan imbasan selang. Di samping itu, kajian ini berdasarkan borang soal selidik telah dijalankan tentang pengetahuan, pendapat, dan sikap manusia terhadap manusia. Kelakuan perosak oleh kera yang dipantau tertinggi adalah mencerooboh kediaman (42.93%), diikuti oleh menyelongkar tong sampah (17.76%), merosakkan harta benda (13.72%), buang sampah merata tempat (12.74%), mengganggu orang (11.61%) dan yang terendah adalah mencuri (1.24%). Secara keseluruhan, 70 (70%) borang soal selidik telah dikumpul. Borang soal selidik ini telah tersebar secara rawak kepada pelajar-pelajar MRSM. Kajian soal selidik ini mendedahkan bahawa kira-kira 98.6% responden mendakwa mereka sedar tentang konflik manusia-kera di MRSM Kem Terendak dan membiasakan diri dengan gangguan sebegitu. Keputusan menunjukkan bahawa kelakuan perosak berkaitan dengan rutin harian iaitu mencari makanan. Kajian ini adalah penting untuk memahami kelakuan perosak kera di kawasan kajian yang boleh membawa kepada pengurusan perosak dan pemuliharaan spesies pada masa akan datang. Oleh itu, pihak berkuasa perlu mengambil beberapa tindakan untuk mengurangkan gangguan. Untuk menyelesaikan masalah pihak berkuasa tempatan, pengurusan sekolah dan Jabatan Hidupan Liar dan Taman Negara (PERHILITAN) perlu bekerjasama dan dapatkan penyelesaian. Pihak kerajaan dan Organisasi Kerajaan perlu bekerjasama dalam membentuk zon penampunan bagi kera supaya dapat mengurangkan gangguan di kawasan kajian. Pihak pengurusan sekolah telah melaksanakan tong sampah anti-kera yang menggantikan tong sampah biasa untuk mengurangkan tingkah laku perosak kera dan menggantikan tingkap kaca besar dengan tingkap yang tertutup sepenuhnya untuk menghalang kera menyelip masuk melalui jurang.

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LIST OF ABBREVIATIONS

NHP	Non-Human Primate
DWNP	Department of Wildlife and National Parks
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
mm	Milimeter
ft	Feet
kg	Kilogram
lb	Pound
St.	Saint

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LIST OF SYMBOLS

%	Percentage
χ^2	Chi-square



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CHAPTER 1

INTRODUCTION

1.1 Background of Study

Macaque or its scientific name *Macaca fascicularis* is a forest dwelling monkey. This monkey species belongs to the family of *Cercopithecidae* and commonly known as crab-eating or long-tailed macaque. In Malaysia, this species is known as the “kera” in Malay language. The name “kera” was found from its sound (‘krrrr’.....) (Hambali *et al.*, 2012). Macaques (genus *Macaca*) are the most widely distributed genus of non-human primate (NHP) and as highly adaptable, highly opportunistic omnivores, often live in close proximity to human communities (Powell, 2017). This species is distributed throughout Philippines, Peninsular Malaysia and Sabah and Sarawak, Sumatra, Jawa, Timor, Lesser Sunda Islands, Myanmar, Nicobar Islands, and in Vietnam, Cambodia, Laos, and Thailand (Hambali *et al.*, 2012). The long-tailed macaque widely found throughout Peninsular Malaysia, and also in Sabah, Sarawak. It prefers primary lowland rainforests, riverine, coastal forest and mangrove. Surprisingly, the number macaque found to be inclined in urban territories. However, the increasing number of macaque in urban areas and its interface with humans has led to conflicts (Sha *et al.*, 2009).

Increasing in human population and rapid development has led to drastic or obvious changes to the natural habitat of the long-tailed macaque. The rise in conflict between human and macaque may have cause by the severe alterations of the ecology by humans. These alterations have reduced the gap between urban area and forest reserves. Ecological alterations have caused the macaque to be wild in urban areas which creates a human–macaque interface zone where conflict between the two species can occur and increased proximity between human and macaque populations (Sha *et al.*, 2009). Consequently, this situation truly explains the reasons for negative impact faced by both species from this competition of space over resources.

Meanwhile, development of urban areas has clearly led to migration of animals from forest to new a habitat. This creates space for the behaviour of macaques to change and lead to higher levels of interaction with people (Sha *et al.*, 2009). The growth and civilization of humans has not only led to a rapid invasion of urbans areas but also have disturbed forest habitats of long-tailed macaque. Deposition of human food waste, food residues or plantation crop waste surrounding the macaques new found home surroundings led macaques to become habituated to humans and their food, so together all of these have resulted in conflicts between humans and primates (Hambali *et al.*, 2012). Thus, *M. fascicularis* has invaded agriculture land areas for food hunt and caused losses to the farmers in consequence of losing its habitat and food sources, additionally supported by the subsequent habituation and adaptation to humans (Siex, 2005).

According to PERHILITAN (2006), macaques can live in the apartment buildings that are not covered and looks for food in garbage cans around the area due to adaptation and habituation to humans. In Peninsular Malaysia, based on the reports received from each state, the estimated population of long-tailed macaques throughout Peninsular Malaysia is about 116860 to 126470 macaques in which the state of Johor had the highest estimated number of 24340 to 30850 macaques followed by Selangor with approximately 32400 macaques whereas in Melaka the estimated population of long-tailed macaques is about 5300 macaques. The presence of long-tailed macaques at Terendak Camp, Melaka brought a lot of problems to residents who live nearby, MRSM Terendak Camp, district council and management of Terendak Camp. Up to now, not much publication and study has been done about the pest behaviour of macaques in Malaysia. Work on the pest behaviour of macaques should be necessary to furnish information, which helps to control the disturbance by managing and controlling the distribution of this species at human settlement.

1.2 Problem Statement

There is no observation had been done on conflict between human and macaque (*Macaca fascicularis*) and its pest behavioural at Terendak Camp, Melaka, Malaysia. This study was carried out to collect the data on pest behaviour of long-tailed macaques as an evidence for ongoing conflict between macaques and human at Terendak Camp, Melaka, Malaysia. It can a guide for other researchers to interpret the conflict between human and macaques and pest behaviour of long-tailed macaques.

1.3 Objective

The main purposes are:

- i. To determine the pest behavior of long-tailed macaques at Terendak Camp, Melaka, Malaysia.
- ii. To study the human perception on human-macaque conflict of long-tailed macaques at Terendak Camp, Melaka, Malaysia.

1.4 Scope of Study

The aim of this study is to investigate the human-macaque conflict and the pest behaviour of long-tailed macaques at Terendak Camp, Melaka, Malaysia. Direct observation on the pest behaviour of long-tailed macaques have been done for 40 days and questionnaire survey on about the opinions, knowledge and perceptions and attitudes towards macaques by residents have been conducted.

1.5 Significant of Study

It is necessary to conduct observation on conflict exist between human and long-tailed macaque and its pest behaviour in order to reduce the conflict. The outcome from this research can be used in supporting the management effort in controlling and managing

of this species in this area and other areas which has distribution of *Macaca fascicularis*. This study also aims to purpose the importance of creating a conservation for the long-tailed macaques (*Macaca fascicularis*) in Malaysia.



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CHAPTER 2

LITERATURE REVIEW

2.1 The Human-Macaque Interface

Since long-tailed macaques are generally dispersed crosswise over Southeast Asia and are very much balanced for living in human-modified environments. The connection between long-tailed macaques and people in these zones has for the most part been alluded as commensal, which means the macaques advantage from the relationship without profiting or hurting their human partners (Thierry, Singh, & Kaumanns, 2004). This relationship likewise has mutual and parasitic components. There are a few positive effects that long-tailed macaques have on people which considered as mutualistic (Thierry *et al.*, 2004). Long-tailed macaques are socially and religiously vital to individuals, where they inhabit Hindu and Buddhist temples all through Southeast Asia (Thierry *et al.*, 2004). In a few districts, macaques are a huge attraction of tourism (Thierry *et al.*, 2004). Macaques additionally utilized as research creatures in biomedical and mechanical sciences around the world (Thierry *et al.*, 2004). Long-tailed macaques have several impacts on humans such as compete with humans for food and space, becoming crop-raiders and urban pest, can be threatening to humans and spread infections among humans because of close biological similarities (Thierry *et al.*, 2004). The developing human populace influence

macaques in negative ways. Spatial land utilize can pull in macaques to human settlements and provisioning exercises can change their behaviour and foraging activities. Human activities also limits population growth of macaques directly by hunting and culling and indirectly by automobile traffic and electrical wiring. Methodologies and administration designs should be produced and executed so as to tackle a few issues happening in human-macaque interface zones all through Southeast Asia.

2.2 Malaysia and the Long-Tailed Macaque Situation

The macaque or “kera” also as the family member of primate species have the ability to adapt easily to environmental alterations and coexist with humans. One of the factors that cause of rapid spreading of macaque throughout Peninsular Malaysia is their high reproductive rate, indicated by the trend of increasing macaque disturbance complaints received by the Department of Wildlife and National Parks (DWNP) in Peninsular Malaysia yearly. Furthermore, loss of habitat, uncooperative public, abandoned land, release areas which are not sufficient and cleanliness issues are factors that contribute to the increasing cases of macaque problems. The long-tailed macaque is a protected species under the Protection of Wild Life Act No. 76, 1972. As the agency responsible for managing wildlife in Peninsular Malaysia, the Department of Wildlife and National Park (DWNP) has focused much effort to overcome the problems. Management actions include communicating with the public, monitoring of macaque problem sites, drive-shooting, translocation and culling of certain problem animals. Macaques are classified in Appendix

II of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). This means that macaque can be traded with permission of the authorities along with proper permits. According to Section 55 of the same Act, the macaques can be shot dead if it causes significant damage to economical crops, vegetables and fruits, trees of life, chickens or livestock in the possession of an owner or occupier of the land after all reasonable efforts have been carried out to scare. Of the reports received from the states, the estimated population of problematic long-tailed macaques throughout Peninsular Malaysia is about 116,860 to 126,460 primates with the number of complaints received have shown an increase of over 300% from the year 1996 to 2005.

2.3 Long-Tailed Macaques

2.3.1 Morphology

The subspecies of long-tailed macaques will change colour from light black colour or greyish to darker shades covering back of the body, legs, and arms while bottom part of their body are considerably lighter (Liedigk *et al.*, 2015). They have dark pinkish appearances and the shade on their heads, and making a peak of hair on the highest point of their heads. Meanwhile, male long-tailed macaques have black thin layer moustaches and cheek bristles that edge their countenances while females have facial hair and in addition cheek stubbles. Both males and females long-tailed macaques have white colouration on the eyelids close to the nose. These macaques have trademark

characterization, and they are named accordingly with the trademarks of this species. They are named as long tailed macaques due to their uncommonly long tail that is quite often gets longer than their range from making a beeline for back-end and ranges long in the vicinity of 1.31 ft and 2.15 ft). Newborn children have a natal coat and are conceived dark. The natal coat changes to the grown-up pelage as they develop. By a few months of age, they start to lose their dark coat and by one year and start to have the grown-up colouration. Like different macaques (*Macaca*), long-tailed macaques are sexually dimorphic. Males measure in the vicinity of 1.35 ft and 2.13 ft, and weigh, all things considered, in the vicinity of 4.7 and 8.3 kg. Females measure just 385 to 503 mm (1.26 to 1.74 ft) and have normal weights in the vicinity of 2.5 and 5.7 kg. Notwithstanding being taller and heavier, males have substantially bigger canine teeth than females. Macaques have cheek pockets in which they can store nourishment as they scavenge, and transport it far from the rummaging site to eat. These macaques are basically arboreal and can jump removes between trees up to five meters which is about 16.4 ft, utilizing their long tails for adjusting. Long-tailed macaques move quadrupedal through the shade and invest some measure of energy in the ground (Liedigk *et al.*, 2015).

2.3.2 Ecology

Long-tailed macaques are animals who feed on fruits but also omnivorous with focus on food sources including bark, insects, clay, mushrooms, seeds, stems, young and mature leaves, flowers, grass, invertebrates, bird eggs (Kassim *et al.*, 2017). The daily

routine activities or better to be described as the movement patterns of long-tailed macaques involve travelling, feeding, resting and socializing. After leaving their nesting tree between 5:30 and 6:00 a.m., they spend the morning hours by doing vigorous activities. They sustain being vigorous till afternoon and while they spend the early afternoon hours by resting. Aggressive interactions such as fighting for food between group members are the highest while feeding on fruit and various food sources, indicating strong competition for valuable food resource. As macaques are facing food crisis due to developments and civilizations, a small amount of food looks very much valuable and irresistible for them. While it's resting time for the whole group, some individuals prefer to sleep, play, or groom. The youngest animals prefers spending time playing while the older animals sleep and groom (Chivers, 1980). After the midday period of rest, long-tailed macaques continues its food hunt and feed as they move closer to their sleeping trees. They enter the sleeping trees in the early evening, between 6:00 a.m. and 6:30 p.m. and stay there overnight (Chivers, 1980). Each tree will have a dozen of them gathering and individuals group together when they rest to keep up body temperature. Long-tailed macaques are incredible swimmers, and this might be a predator avoidance method: on the off chance that they are threatened, they essentially can escape by escaping into the water and swimming to a more secured place. Availability of anthropogenic foods in anthropogenic-influenced habitats causes changes in macaques foraging activities which eventually lead to conflict between humans and macaques.

2.3.3 Social Organization and Behaviour

Long-tailed macaques live in gatherings of male and female of six to 58 individuals. One reason primates shape bunches are because of the advantage of expanded protecting against predators. In a gathering, there is a higher probability of recognizing a predator, and the possibility of an individual primate turning into a victim of that predator is less when the group size is big. Frugivorous primates living in territories made with predators must make a tradeoff; expanding bunch estimate upgrades assurance against predators. This additionally builds rivalry for fruit resources, which can be thickly amassed and regularly factor. Female long-tailed macaques stay in their natal gatherings and display solid strength progressive systems in which rank is passed on from mother to daughter and stays inside a matrilineal (Van Schaik & Van Noordwijk, 1999). Females long tailed macaques in the group are either as sisters, half-sisters, cousins and mother-daughter (Jong, Ruiter, & Haring, 1994). The rank among females measured with the direction of grooming. High ranked female macaques are believed to have easier access to nourishment, expanded wellbeing from predators and aggressive male macaques. In addition expanded reproduction achievement (Wheatley, 1980). Males additionally display a strict predominance progressive system, with the most noteworthy positioning male having the most noteworthy access to regenerative females and fathering the greater part of infants conceived in the gathering amid his residency. The second-positioning male, or beta male, fathers the staying 20% of infants naturally introduced to the group. Grooming helped in maintaining the relationship between the alpha female and male. Aggressive interactions between males result in genuine wounds, particularly gashes from their long, sharp canine

teeth. Wounds got while battling can prompt mortality through contamination or predation. Males emigrate from their usual gatherings to gatherings of their associates before sexual maturity, usually between four and six years of age (Jong *et al.*, 1994). Males usually between four and six years old which before sexual maturity emigrate from their natal groups (Jong *et al.*, 1994). Males migrate multiple times over their lives and if they failed in achieving the top dominance rank, they will immigrate into a new group and attempt another take-over (Van Schaik & Van Noordwijk, 1999).

2.3.4 Reproduction

The success of reproduction system in females is influenced by food availability, high food abundance over years, higher birth rates in particular years which exceeds year with food scarcity, and in years with mast fruiting, births occur earlier and are more frequent than in years with average fruit availability (Van Schaik & Van Noordwijk, 1987). Females reach sexual maturity at age of four years. Daughters with healthy reproductive system begin reproducing before five years of age while daughters with slightly unhealthy reproductive system begin reproducing after five years whereas males reach sexual maturity by age seven (Jong *et al.*, 1994). Females have a particular arrangement of vocalizations alluded to as "copulation calls" that are heard amid 80% of the copulations. Female long-tailed macaques have the tendency to do mating with their partner multiple times throughout the day during fertile period. Females give birth to singletons and the interval between births is with average of 18 months, with females more likely to skip a

year after giving birth to surviving infants (Van Schaik & Van Noordwijk, 1988). Female macaques reach the peak of reproductive capacity at age 10 and they continue to reproduce till the age of 24 though reproduction significantly decreases after age 20.

2.3.5 Parental Care

Long-tailed macaque mothers categorised as the primary caregivers and protectant. They are very protective as they don't allow their infants out of their hands (Wheatley, 1980). The long-tailed mother macaque maintains contact with her infant closely during the first weeks of life, but decreases as infant ages. After four months, mothers don't spend much time and begins to exhibit ovarian cycle again. Other females are likely to be interested in infants and tend to snatch it from the mother. They use "kidnapping" as the way for females with healthy reproductive system to decrease the reproductive success of merely unhealthy females in the group because if infants died, the mother will wait next year to give birth. In the first year of life, the survival rate of long-tailed macaque infants is 81%, but the overall survival rate from birth to four years are 68% (Van Schaik & Van Noordwijk, 1999). Adult males spend more time when infants reach juvenile hood (Wheatley, 1980).

2.3.6 Communication

Long-tailed macaques have a broad vocal correspondence collection to be used in various situations. If there is a need to discuss the communication skills of macaques, we have to be aware on the existence of two general classes of long-tailed macaque vocalizations, "harsh" and "clear" calls (Peters, 1983). Some vital "harsh calls" are the "kra call," named for its sound that is performed by charge and sex classes. This sounds are utilized as a part of both gently and exceedingly energized macaques to indicate alert. This alert sound is known as "caution calls". The "caution calls" are given by long-tailed macaques within the sight of a potential predator or when they feel undermined. The sounds are made of three to five, peep like heartbeats and "barks" which are heard amid forceful communications between people. "Clear calls" incorporate an assortment of "coos," which advance inviting for all other macaques to gather and avoid aggression between individuals. It is heard amongst subordinate and predominant females and additionally infants calling to their mothers.

2.4 Anthropogenic Influence on Macaque Behaviour and Ecology

Many macaque populations inhabit anthropogenic-influenced landscapes. Under the anthropogenic-influenced category, animals quickly learns and have high tendency to raid gardens or crops and to get foods from humans. They have also been known to enter houses and steal food if humans are not there to frighten or deter them. In some parts of

their range, it is found that at situations when long-tailed macaques come into contact with tourists at nature reserves, up to 22% of their diet can be from provisioned foods (Lucas & Corlett, 1991). The inclusion of high-quality foods from anthropogenic sources can significantly influence the behavior of the primates which often reflected by smaller home ranges and shorter day ranges, less time travelling and feeding and more time resting. Sustained feeding by humans can also alter the reproductive success of macaques, by lowering infant and juvenile mortality and thus increasing population growth (Fuentes, 2011). At situations when humans encounter macaques at reserves, mostly humans feed long-tailed macaques, and that causes both contact and non-contact aggression increases within and between groups of macaques at the same feeding site (Jones-Engel *et al.*, 2005). Serious injury or death can occur because of aggressive encounters between long-tailed macaques (Jones-Engel *et al.*, 2005). Moreover, humans are also faces risk when feeding long-tailed macaques because the possibility of disease transmission is found to be increased when the two species come into contact (Jones-Engel *et al.*, 2005).

2.5 Case Study

Previously the similar study has been done at main campus of Universiti Kebangsaan Malaysia (UKM), Kajang, Selangor, Malaysia (Badrul Munir Md. *et al.*, 2001). The paper focused on nuisance problems by long-tailed macaques and students perceptions at UKM. Several surveys have been conducted on long-tailed macques behavior which include investigation of daily behaviour and human-macaque conflict at

student residential colleges (Badrul Munir Md. et al., 2001). Other than this, there were many studies have been conducted to understand conflict issues in human settlement areas. The study on disturbance behaviour on long-tailed macaques at the human settlement in Bukit Lagi, Kangar, Malaysia by Tuan-Zubaidah in 2003. The study by Sia (2005) on the long-tailed macaque's daily activities and disturbance behaviour in Taman Tenaga, Puchong, Selangor and a study focused on the behaviour of macaques at the local residences in West Country, Bangi by Suhailan in 2004. This studies can help the district council and Department of Wildlife and Natural Parks (DWNP) in controlling the human-macaques conflict in Malaysia to conserve the species at the same time.



CHAPTER 3

MATERIALS AND METHODS

3.1 Study Area

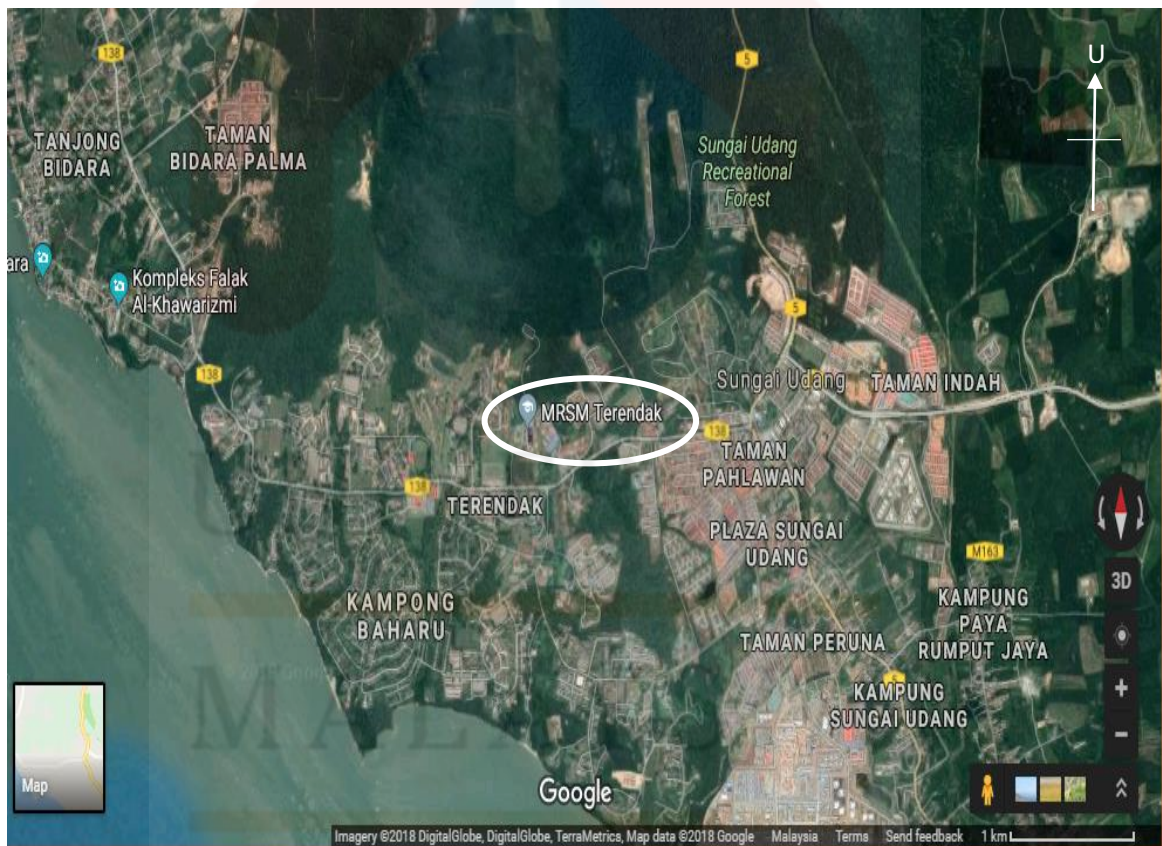


Figure 3.1 Map of Terendak Camp, Melaka, Malaysia

© (Source: Google Earth, 2018)



Figure 3.2 Map of MRSM Terendak Camp, Terendak Camp, Melaka, Malaysia

☆ Home range of macaques (study group)

© (Source: terendak.mrsm.edu.my, 2018)

This study conducted at Terendak Camp, Melaka, Malaysia. Terendak camp was chosen to carry out this study as the long-tailed macaques can be found at this location. This is a military camp of the Malaysian Armed Forces which is situated on the coast of the Malacca straits about 23 km to the north of the state capital of Malacca. Earlier in 1950's the camp was built to house the 28th Commonwealth Infantry Brigade Group in Malaysia in conjunction with their move from North Malaysia in 1959 – 1960. The construction of this camp was started in 1957 and was funded by Governments of Great Britain, Australia and New Zealand on a percentage basis. Construction of Terendak was started in June 1957 and was completed by 1964. The Terendak Camp covers an area of close to 1,500 acres

with an additional training area of 3,500 acres. 28th Commonwealth Infantry Brigade occupancy started in late 1959 and by the mid 1960's the camp was fully occupied. Terendak Camp was handed over to the authority of the Malaysian army after 28th Commonwealth Infantry Brigade vacated by end of 1970, and remains occupied by a Malaysian Infantry Brigade. The facilities within the camp that was built initially were are military hospital, churches including St. John's Protestant and Corpus Christie Roman Catholic, swimming pools, 900 married quarters, Clubs and Messes, Shopping arcades, Schools and kindergartens. The camp or site also includes a wide variety of habitats such as primary forest and secondary forest which are inhabited by long-tailed macaques. The study location focused at the MRSM Terendak Camp, Melaka which covered up to 19 acre area of Terendak Camp.

3.2 Methods

3.2.1 Direct Observation

Observation of macaque's pest behaviour were made from 0800 hours until 1800 hours for 5 days a week for a about 40 days from July 2018 to August 2018. The study location focused at MRSM Terendak Camp. The macaque group was identified through their physical features and by its movement in tandem with the movement of the group to confirm each individual belongs to certain groups. This could help to avoid observation errors such as assigning individuals in more than one group. Table 3.2 shows the age-sex

composition of these two groups of *M. fascicularis* in the study area, troop 1 was selected due to their dominance as the number of male in troop1 is higher than troop 2. The interval scan sampling method was used to obtain the quantitative data on the pest behaviour of macaques with interval of 10 minutes. The pest behaviour of macaques which were observed and recorded was classified into six categories which are messing up garbage cans, littering, disturbing people, stealing, breaking into residence and damaging property (Table 3.1). Disturbing people includes all aggressive behaviour by the subjects, such as threats, scratching or biting and chasing people. Stealing is described as grabbing food from a person. Breaking into residence is where the subjects broke into houses, school, hostel rooms and mosque. Damaging property is the behaviour of subjects that damage properties belongs to humans. The observation not be conducted during cloudy weather or rainy to reduce errors as subjects usually partially obscured or moved completely out of sight.

Table 3.1 Pest behaviours of *M. fascicularis* with descriptions.

Pest Behaviour	Description
Messing up garbage cans	Messing up garbage cans
Littering	Litter garbage all over the place
Disturbing people	All aggressive behaviour by the macaques such as threats, scratching or biting and chasing people
Stealing	Grabbing food and people's belongings
Breaking into residence	Broke into houses, school, hostel rooms
Damaging property	Damaging properties belongs to humans

Table 3.2 Age-sex composition of *M. fascicularis* at MRSM Terendak Camp, Melaka. Troop 1 was selected for the study of pest behaviour.

Troop no.	Adults		Subadults		Juveniles		Infants		Total (% Male)
	Male	Female	Male	Female	Male	Female	Male	Female	
Troop 1	10	16	11	11	7	4	6	3	68 (50%)
Troop 2	8	10	6	13	2	10	3	5	57 (33.3%)
Total	18	26	17	24	9	14	9	8	125 (42.4%)

3.2.2 Questionnaire Survey

The survey based on questionnaire were about the knowledge, opinion, and attitudes towards macaques by people. The total respondent surveyed were about 70 people The questionnaire was divided into three parts (Part A, B, and C), where Part A is about respondent's information, Part B is about the respondent's general knowledge of long-tailed macaques and Part C is about the respondent's experience, perception and attitude towards long-tailed macaques (Appendix C). This questionnaire survey is intended to identify the problems of long-tailed macaque (*Macaca fascicularis*) disturbance at Terendak Camp, Melaka. This study is expected to find the best solution to overcome the

problems arised in the residential areas and this study results can be used as a reference to any related parties.

3.3 Data Analysis

The Chi-square (χ^2) test was used to test for differences in frequency between different categories of pest behaviour of long-tailed macaques. This help in determine which types of pest behaviour were more common than others. The SPSS software is also used to analyses questionnaire data. Statistical significance for all tests were set at $P < 0.05$.

$$\chi^2 = \sum \frac{(O-E)^2}{E}$$

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CHAPTER 4

RESULT AND DISCUSSION

4.1 Direct Observation

Six pest behaviours by long-tailed macaques were monitored throughout the study and recorded based on the frequency of occurrence. The most monitored pest behaviour of long-tailed macaques was breaking into residence (42.93%), followed by messing up garbage cans (17.76%), damaging property (13.72%), littering (12.74%), disturbing people (11.61%) and the lowest was stealing (1.24%). During the observation, macaques were seen to break into school and hostel areas more often and interrupt the students such as breaking into their classrooms, run away student clothes that were hung on clothes line and stealing student belongings, especially food. Macaques were likely to damage properties such as jumping and playing on the rooftops of school, hostel and corridors which had caused damage on the rooftops and besides that macaques also like to bite bike seat, car wipers, electric wires and antennas and likely to jump on the lamp post to break the lamp. Messing up garbage cans and littering was observed to happen frequently. Chi-square test result showed that all six pest behaviours of *M. fascicularis* have significant difference (Table 4.1).

Breaking into residence (42.93%) was the highest percentage of pest behaviour recorded where *M. fascicularis* frequently breaks into hostel rooms during class hours and into classrooms during recess hour. Macaques mostly spends their time roaming in the school compound whereby someday macaques would stay up till the next morning. *M. fascicularis* tend to break into residence more often to look for foods and the macaques learned on how to open doors or gate to enter on their own. The reason behind this problem might be because they had lost their habitat due to human development, they also attracted to being fed by humans and attracted to anthropogenic foods. Macaques have an assortment of explicit techniques for getting and controlling food that they have procured through experience and individual learning (Sussman & Tattersall, 1981).

The second highest pest behavior recorded was messing up garbage cans (17.76%). *M. fascicularis* spends more time searching for foods as macaques adapt to man, they know that there are so much food waste available in garbage cans as it become one of their favorite food sources. During the study, macaques were always seen messing up garbage cans as they choose the food waste that can be eaten and littered what they did not want all around the place. Therefore, frequent garbage cleanup could decrease the possibilities for the macaques to mess up the garbage cans.

The third highest pest behaviour observed was damaging property (13.72%). *M. fascicularis* known for their property damaging behaviour. Macaques often seen done damage to school properties such as jumping and playing on rooftop of school, hostel,

corridors, mosque and dining hall which had caused severe damage to the rooftops. Besides that, macaques also likely to jump on the lamp post and shaking it until broke the lamp. They also caused damage to vehicle such as car and bike. Macaques often seen bite the bike seat, car wiper and antenna and also electrical wires which could cause death.

The fourth highest pest behaviour observed was littering (12.74%), where rubbish was littered around the area by long-tailed macaques, including from their scavenging through garbage cans. *M. fascicularis* was always seen grabbing food waste from the garbage cans and then carrying it away from trash cans to avoid competition with other members of the troop without food. *M. fascicularis* threw the food containers and wrappers, for example bottles, polystyrenes, drink cans, plastics and others, to the ground after eating and so spread the litter from the garbage container all over the place. This behaviour degrades the environment and uncomfortable for students. Of relevance then is that this study area is school area that have a lot of garbage cans. As macaques adapt to man, they know that there are so much food waste available in garbage cans as it become one of their favorite food sources. During the study, macaques were always seen messing up garbage cans as they choose the food waste that can be eaten and littered what they did not want all around the place.

The fifth highest pest behaviour was disturbing people (11.61%). During the observation, *M. fascicularis* seen disturbing students and others by making sounds and being aggressive towards them which is parallel with the fact that macaques tend to be

aggressive when people approach them. The lowest pest behaviour recorded was stealing (1.24%). Macaques tend to steal student belongings especially foods by breaking into hostel or classrooms and the clothes hung at the clothes line. Chi-square test results showed that all six pest behavior have significant difference.

Table 4.1 Percentage and frequency of pest behaviours of long-tailed macaques, and *showed significant differences ($p < 0.05$) by using the chi-square test (X^2).

Pest Behaviour	Observation	Expected	(O-E)	(O-E)²	(O-E)²/E	Percentage (%)
Messing up garbage cans	6470	6071.6667	389.333	158669.4	26.13	17.76
Littering	4640	6071.6667	-1431.667	2049669.4	337.58	12.74
Stealing	450	6071.6667	-5621.667	31603136.1	5205.02	1.24
Disturbing people	4230	6071.6667	-1841.667	3391736.1	558.62	11.61
Breaking into residence	15640	6071.6667	9568.333	91553002.8	15078.73	42.93
Damaging property	5000	6071.6667	-1071.667	1148469.4	189.15	13.72
Total	36430	36430	-	-	21395.23	100

4.2 Questionnaire Survey

In total, 70 out of 100 (70%) questionnaires were collected. The questionnaires were dispersed randomly to MRSM students. The frequency and percentage of information on different categories of respondents shown in the table 4.2. Most of the respondents aged 14 (35.7%) followed up by aged 13 (30%). The respondents consists of 30 male (42.9%) and 40 female (57.1%). Malays (82.9%) were found to be the highest percentage of respondent, followed by Chinese (11.4%) and Indians (5.7%).

Table 4.2 Age, race and gender distribution of the respondents of the questionnaire survey.

	Category	Frequency	Percentage (%)
Age	13	21	30
	14	25	35.7
	15	11	15.7
	16	7	10
	17	6	8.6
Gender	Male	30	42.9
	Female	40	57.1
Race	Malay	58	82.9
	Chinese	8	11.4
	Indian	4	5.7

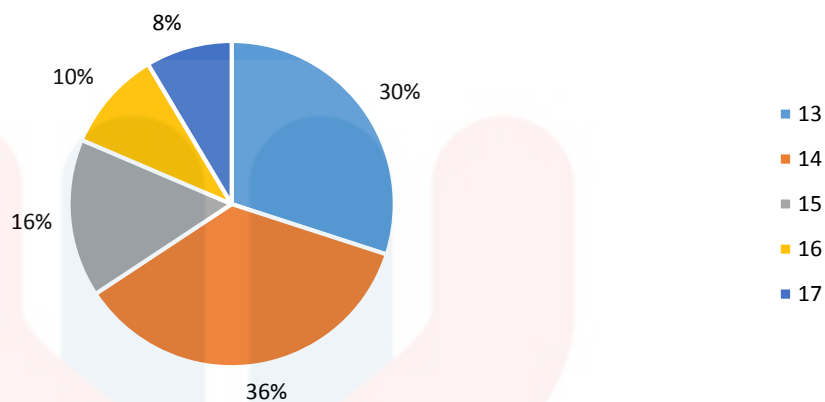


Figure 4.1 Age of respondent of the questionnaire survey.

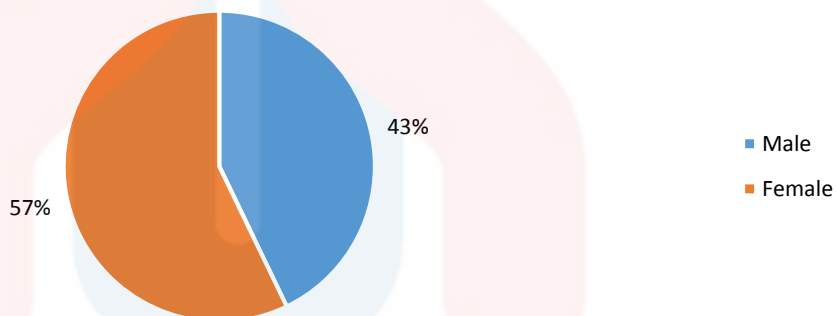


Figure 4.2 Gender distribution of respondent of questionnaire survey.

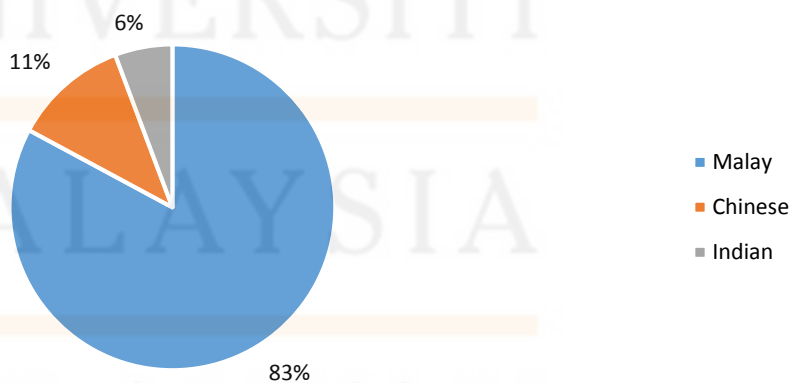


Figure 4.3 Race distribution of respondent of questionnaire survey.

From the questionnaires of the respondent's general knowledge about *M. fascicularis*, all the respondent said they know something about the long-tailed macaques and 100% of respondent also claimed that they heard news about the long-tailed macaques' disturbances.

The respondents mostly have claimed that the macaques can see around the campus all the time (78.6%), at afternoon (12.9%), at evening (7.1%) and one respondent said macaques can be seen around campus during night time. This study shows that macaques spend most of their time in the campus area and proves that macaques well adapt to human settlements for foraging food and shelter. Macaques waited for specific time at dining hall for the student breakfast, lunch and dinner break throughout the day to collect the food waste from the garbage cans after the break.

Respondents have claimed that 50 and above individuals (42.9%) was the highest population size of long-tailed macaques, followed by 20-30 individuals (24.3%) and the response level for the 40-50 and 30-40 individuals were at 17.1% and 15.7% (Table 4.3). The overall results for population size shows that macaques do come to school and invade in large number. With respect to the age composition of the troop, respondents have claimed that the highest proportion was by sub-adults (47.1%) followed by adults (44.3%) closely, while juveniles (8.6%) have far lower number of individuals in the troop suggesting that juveniles preferentially prevent the human settlements (Table 4.4). The main aim of surveying about the population size and age classes of long-tailed macaques in the

questionnaire was to evaluate the group size and which age class has caused disturbance in the school area and this is important in planning future management plans.

Table 4.3 Estimated number of macaques in a troop by respondent.

No. of macaques	Percentage (%)
20-30	24.3
30-40	15.7
40-50	17.1
50 and above	42.9

Table 4.4 Age-class of *M. fascicularis* visiting residential areas as derived from the questionnaire survey.

Age class	Percentage (%)
Adult	44.3
Sub-adult	47.1
Juvenile	8.6

All the respondent have experienced the nuisance from macaques and had seen *M. fascicularis* disturbing other people. The respondent have claimed that they mostly been chased or followed by macaques (58.6%), followed by threatened (18.6%) and property

damage (17.1%) but only four of the respondents claimed had been bitten or scratched by *M. fascicularis* (Table 4.5). Macaques that have been at the human settlements for a long time and interact with humans are no longer afraid with humans especially girls.

Table 4.5 Percentage of respondent who were experienced different type of nuisance from macaques.

Category	Percentage (%)
Threatened	18.6
Chased or Followed	58.6
Bitten or Scratched	5.7
Property Damage	17.1

With respect to the causes of human-macaque interaction, majority of respondent agreed that attraction to food (80%) could be the main reason for the interaction to be happened, followed by the reason being aggressive and provoked by humans (Table 4.6). Only one respondent claimed that being playful could cause the human-macaque interaction.

Table 4.6 Causes of human-macaque interaction.

Causes	Percentage (%)
Attraction to food	80.0
Provoked by humans	7.1
Being playful	1.4
Being aggressive	11.4

The majority of respondent have claimed that they were neutral about macaques (52.9%) and followed by disliking for macaques (42.9%) (Table 4.7). About 3 respondent shows liking towards macaques. The attitude of humans toward macaques may varies from time to time due to their experience with macaques. Most of the respondents (92.9%) agreed that the existence of macaque can affect the health and safety of the people especially the students. Besides that, they mostly (94.3%) claims that disturbance by *M. fascicularis* are increasing all the time. The spreading of garbage encourages vermin and insects, the transmission of simian foamy virus (SFV) from free-ranging *M. fascicularis* to workers at monkey temples suggests that cross species transmission of infectious agents can occur in Asia and others may evolve such horizontal transfer as the frequency of macaque-human contacts increases and given the high population density and mobility of macaques (Jones-Engel *et al.*, 2005).

Table 4.7 Percentage of respondents' attitude towards macaques.

Attitude	Percentage (%)
Liking for macaques	4.3
Disliking for macaques	42.9
Neutral about macaques	52.9

The majority of respondent claimed that they knew the presence of macaques in that area by seeing the rubbish scattered everywhere (44.3%). About (42.9%) respondents agreed that they knew the presence of macaques by seeing the monkey coming and only (12.9%) respondent claimed they were able to identify the presence of macaques from their sound. Majority of the respondents knew the macaques had messed up the campus area by three ways such as saw the macaques coming out from jungle, the garbage scattered everywhere with garbage cans lying on the ground and by the vocalization of macaques (Table 4.8). This shows that this problem had occurred for many years. 40 out of 70 respondents (57.1%) claimed that they had reported the disturbance of macaques to the management. Although many of them had made formal complain the authority still fail to overcome the pest behaviour of macaques.

With respect to the awareness of human-macaque conflict, about 98.6% of respondent claimed that they aware about the ongoing human-macaque conflict at MRSM Terendak Camp. Majority of respondent (98.6%) agreed that the authorities should take

some action to reduce the disturbance. In order to solve this problem local authority, school management and Wildlife Department and National Park (PERHILITAN) need to work together and come up with solution. The school management has implemented the anti-monkey bins replacing the normal garbage bins to reduce the pest behavior of macaques.

Table 4.8 Actions by which respondents know about the presence of *M. fascicularis*

Action	Percentage (%)
The sound of the macaques	12.9
By seeing the macaques coming	42.9
Conditions of rubbish scattered everywhere	44.3

In term of possible action should be taken by the authority to reduce the *M. fascicularis* disturbance, most of them want PERHILITAN to remove nuisance macaques from the affected area, followed by complete eradication of macaques from Terendak Camp and macaque population reduction. The least choices were educating on co-existence with macaques (14.3%) and keeping nuisance macaques from urban areas (11.4%) (Table 4.9).

Table 4.9 Actions supported by resident should be taken by the authorities to reduce *M. fascicularis* disturbance

Action	Percentage (%)
Complete eradication of macaques from Terendak Camp	25.7
Population reduction	18.6
Removal of nuisance macaques	30.0
Keeping nuisance macaques from urban area	11.4
Education on coexistence	14.3

The lack of monitoring and action by the responsible wildlife authorities such as PERHILITAN in managing the pest behaviour of macaques cause the massive outbreaks of macaques at specific place in Malaysia especially army base and tourist attraction areas. The main reason could be because of people's behaviour to feed macaques, thus contribute to human-macaque conflict and disturbance. Lack of awareness by public on these pests make condition even worse as the interference of the macaques increases, while some religion like Hindus honored these animals and some communities like to keep macaques as pet. The massive deforestation in Malaysia could be the main reason why the macaques invade urban areas. In other countries, such as in Hong Kong, the conservation department focuses on sterilization of female macaques to control the number of macaques.

CHAPTER 5

CONCLUSION AND RECOMMENDATION

5.1 Conclusion

In MRSM Terendak Camp, the presence of long-tailed macaques have brought a lot of problem to people especially students. According to the result, messing up garbage cans, littering, stealing, disturbing people, breaking into residence and damaging property were the most common pest behaviours of *M. fascicularis*.

From the survey, it was identified that respondent knew about macaques and used to their disturbance. The results shows that the pest behaviour of macaques related to foraging anthropogenic food. This study is important to understand the pest behaviour of long-tailed macaques at the study area which can lead to the pest management and conservation of the species in the future.

5.2 Recommendation

It is recommended that MRSM Terendak Camp needs to cooperate with PERHILITAN and local authorities to reduce this pests. As the suggestions, the school's management have to replace the cascading glass windows with fully enclosed ones to prevent monkeys sneaking through the gaps and replace the normal garbage bins with anti-monkey bins. The government and non-governments organization need to cooperate in forming a buffer zone for macaques so that can reduce the disturbance at the study area.

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APPENDIX A



Long-tailed macaques's pest behavior messing up garbage cans



Long-tailed macaque's pest behavior littering



Long-tailed macaque's pest behavior disturbing people



Long-tailed macaque's pest behavior breaking into residence



Long-tailed macaque's pest behavior damaging property



Long-tailed macaque's pest behavior stealing

APPENDIX B

This questionnaire survey is intended to identify the problems of long-tailed macaque (*Macaca fascicularis*) disturbance at Terendak Camp, Melaka. This study is expected to find the best solution to overcome this problem in the residential areas and can be as a reference to any related parties.

PART A (Respondent information)

1. Age:
2. Sex () Male () Female
3. Race () Malay () Chinese () Indian () Others

PART B (General knowledge)

4. Do you know anything about Macaque?
Yes / No
5. Have you heard any news about Macaque disturbance?
Yes / No

PART C (Experience, Perception and Attitude)

6. At what time the Macaque come and disturb your area?
.....
7. How many Macaques that you have seen disturbing your area?
 - A. 20-30
 - B. 30-40
 - C. 40-50
 - D. 50 and above
8. Which Macaque age range that you see the most?
 - A. Adult (large-sized, large scrotum, elongated nipples)
 - B. Sub- adult (slimmer, smaller scrotum than adult male, shorter-nipple than adult female)
 - C. Juvenile (medium-small, sexes hard to distinguish, independent on mother during travel)
10. Do you ever experienced a nuisance from macaques?
Yes / No
11. What kind of nuisance problems you experienced?
 - A. Threatened
 - B. Chased or followed
 - C. Bitten or scratched

- D. Property damage
12. What are the causes of macaque-human interaction?
- A. Attraction to food
 - B. Provoked by humans
 - C. Being playful
 - D. Being aggressive
13. What is your attitude towards macaque?
- A. Liking for macaques
 - B. Disliking for macaques
 - C. Neutral about macaques
14. Do you feel the existence of Macaque affect the safety and health of all residents?
- Yes / No**
15. Do you feel that Macaque disturbance is increasing from time to time?
- Yes / No**
16. How you know on the existence of Macaque in your area?
- A. The sound of the Macaque
 - B. By seeing the monkey coming
 - C. Conditions of rubbish scattered everywhere
17. Have you ever reported about the disturbance of Macaque at your house area?
- Yes / No**
18. Do you aware of human-macaque conflict in Terendak Camp?
- Yes / No**
19. Do you agree that the authorities need to take some actions to reduce this disturbance?
- Yes / No**
20. Which steps that you agree should be taken by the authorities to overcome this problem?
- A. Complete eradication of macaques from Terendak Camp
 - B. Population reduction
 - C. Removal of nuisance macaques
 - D. Keeping nuisance macaques from urban areas
 - E. Education on co-existence with macaques