

# Daily Activity Budget of Long-tailed Macaques (*Macaca fascicularis*) in Kuala Selangor Nature Park

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**Abstract--** Long-tailed macaques (*Macaca fascicularis*) are widely distributed animals around the world that require special attention from the research and management perspectives. Daily activity budget of *M. fascicularis* were studied near the Kuala Selangor Nature Park as one part of study on its behavior and ecology. The study location was based along the *M. fascicularis* trails starting from the ticket counter of the local train station to the main entrance of KSNP and their daily activity budget were studied from February 2011 until July 2011 inclusive of intensive direct observation using the scanning method. Observations revealed that long-tailed macaques use most of their time for moving (20.27%), followed by feeding (18.78%), being inactive (17.05%), grooming (10.84%), playing (10.50%), vocalization (10.36%), mating (7.42%) and the last is fighting (4.78%). Qualitative results found that the interaction between the long-tailed macaques group with silvered-leaf monkeys are fighting and grabbing food. The long-tailed macaques also cause disruption in this area such as disturbing the visitors. There is a strange behavior that is rarely seen which is mating behavior between the long-tailed macaque with a cat that was found in the study area. Chi-square test demonstrated that daily activity budget differed significantly among the behaviors.

**Index Terms--** daily activity budget, long-tailed macaque, *Macaca fascicularis*, Kuala Selangor Nature Park, Peninsular Malaysia.

## I. INTRODUCTION

Primates attract attention of many researchers because they are closely related to human in terms of human social behavior. According to [6], primates are social animals and most of them interact with each other in their species. Social behavior means any behavior that involves another person [17]. Studies have shown that primate social behavior is more or less similar to human behavior such as eating, playing, fighting, keeping the baby and others [33]. Activity budgets for primates in disturbed areas such as human settlements are different from those in their natural habitat [18]. Many serious ecological changes had occurred due to the increasing human population and development of agricultural areas [10]. Primates have to change their daily behavior according to the environment to ensure their survival. Many studies have shown that the activity budgets vary by several environmental factors including diet, distribution and food sources [31, 32].

Long-tailed macaques are one of the primate species that is affected by human activities in exploiting their habitat. This is because the monkey is one of the most geographically

widespread and abundant non-human primate species in the world. This primate is widely distributed in the Southeast Asian region (Thailand, Indonesia, Singapore, Brunei, Malaysia, Philippines, Vietnam and Laos) [3]. Long-tailed macaques have also been introduced to humans in the island of Mauritius [20], Ngeuar Islands, Republic of Palau [41] and Hong Kong [43]. Because they are so widely distributed, their behavior, social organization, habitat usage, morphology and genetics are different [4, 12].

There are many past studies focused on the behavior of *M. fascicularis* in Malaysia such as on their aggressive behavior [29, 44], aspects of social behavior [14, 27, 36] and studies on the behavior of pests [24, 34, 35, 45]. This research focused on the daily activity budgets of *M. fascicularis* in Kuala Selangor Nature Park. This study is important in order to develop our knowledge on the social behavior of *M. fascicularis* that live in the human area and to clearly understand the daily activity budgets of macaque's which leads to the effective management of its species [13].

## II. MATERIALS AND METHODS

**STUDY SITE** – A field study of *M. fascicularis* was conducted in Kuala Selangor Nature Park (KSNP; Fig. 1). KSNP was established in 1987 by the Malaysian Nature Society (MNS) and the Selangor State Government. The size of the park is 732.4 acres and shelters a wide variety of habitats such as secondary forest forming from degenerating mangrove forest, the estuary of the Selangor River, mangrove forest, mudflats which opens to the Straits of Malacca and a man-made 25-acre brackish water lake system. This diverse habitat makes the Park a wonderful place for animals to feed, roost and breed. Other than the long-tailed macaques, which is the only species of macaques in the area, the animals recorded here are smooth otters (*Lutrogale perspicillata*), leopard cats (*Prionailurus bengalensis*), silvered leaf-monkeys (*Trachypithecus cristatus*), local birds (98 species), migratory birds (57 species), butterflies and other insects, reptiles like lizards such as mangrove skink (*Emoia atrocostata*) and monitor lizard (*Varanus salvator*), river dolphins (*Platanista gangetica*), four species of mudskippers (*Periophthalmodon schlosseri*, *Periophthalmus chrysospilos*, *Boleophthalmus boddarti*, and *Periophthalmus vulgaris*), mud lobsters (*Thalassinia anomala*) and 15 species of crabs including the king crab (*Lopholithodes mandtii*).

### BEHAVIOUR SAMPLING METHOD

Daily activity budgets observation was made from morning, 0800 hours until 1830 hours for 2 to 3 days a week. Ninety days of observation had been done starting from February 2011 until July 2011. Preliminary non formal observation was carried out to determine the behavior categories of the subjects [23]. Preliminary observation is critical for the observer to be familiar with the subjects and their behaviors, thus enabling them to choose the right measures and recording methods [28]. The study location is focused along the *M. fascicularis* trails in the vicinity of human paths starting from the ticket counter of a local train station (C in Fig. 1) to the main entrance of KSNP (B in Fig.1), which are hence the anthropogenic habitats. During the course of this study, one group of *M. fascicularis* which contains approximately 40 individuals at the study location was observed, based upon the reason that the group was easy to be observed and recognized. This group was marked by their alpha male who had a distinctive short tail compared to the others. They are also well habituated to humans allowing the researcher to come closer to them without any clear evidence of disturbing their behavior. Binocular was used if the study group is at a far distance and the observer faced obstacles to approach the group. Food was provisioned almost every day by humans to the macaques in this study area, either directly or indirectly through leaving the food within their reach, such as in garbage bins near to the ticket counter of a local train station. More foods were provisioned by humans during public holidays because more tourists came to the KSNP. Quantitative data was recorded using the interval scan sampling method [1, 21] every ten minute. In order to reduce bias, the surveys were stopped when the weather became cloudy or during rain as subjects were usually partially obscured or moved completely out of sight. Observations were also stopped when the subjects were not visible at the study sites. Behavior of daily activity budgets was taken based on previous studies by [4]. Behavior categories were modified to accommodate the behavioral activity of *M. fascicularis* at the study sites. Chi-square test was applied to analyze the behavior data set obtained. This nonparametric test is suitable to analyze the significance of activity budgets that did not follow the normal distribution.

### III. RESULTS AND DISCUSSIONS

Eight daily behaviors of long-tailed macaques were monitored throughout the study group during observation (Table 1). Based on the observations that have been carried out, the long-tailed macaques provides a lot of their time to perform moving activities (20.27%) followed by feeding (18.78%), not moving or resting (17.05%), grooming (10.84%), playing (10.50%), vocalization (10.36%), mating (7.42%) and the lowest daily activities is fighting (4.78%). Chi-square test results showed that all eight daily activities have significant difference.

The most observed daily activity from the study group was moving. This study was supported by [22, 34, 35] which show that the movement of the long-tailed macaques was the highest compared to other activities. This is because, the long-tailed macaques are diurnal animals that is active during the day where they use one full day to travel from one area to another in their territory searching for food.

The study group was found to live commensally with humans as they are found to move using the same route every day from the main entrance of KSNP to the ticket counter of a local train station. This is because the long-tailed macaques are attracted to human food thrown into the garbage bin near to the ticket counter and the food provided by tourists, especially during the holidays. Besides food, long-tailed macaques are also found to eat from plant sources along the route. This is supported by [30] which states that their movement patterns are influenced by the distribution of food resources. Near to the ticket counter, there is also a source of water from a man-made pond which the long-tailed macaques make it as a place to drink and bath. Sometimes the long-tailed macaques entered the nearest residential area which is Taman Malawati to find food in the resident's house, explored the garbage bin and stole the fruits grown by the residents. This study was supported by [22] which states that the long-tailed macaques was seen entering the student residential colleges to search for food. It's also supported by [26, 42] which states that the long-tailed macaques are a frugivorous animal that spends their time on the moving to find fruits. Although there is food in the KSNP, the long-tailed macaques prefer human food as their main food source compared to their native food. It is likely that the long-tailed macaques were habituated with the human presence that often gave them food and human food is more delicious than their native food. This is why the long-tailed macaques spent a lot of their time to on the move searching for human food. Thus, it appears that the environmental conditions greatly influenced the time budgets of long-tailed macaques.

The second highest activity that has been observed was feeding. This study is equivalent to [22, 35, 39] studies. The main food of the long-tailed macaques in the study area consists of human food waste thrown into the garbage bin (Fig. 2). This study is equivalent to [22, 38] in which the long-tailed macaques get their food from food waste dumped from the residential area. As a result, the view of the study location become dirty with rubbish strewn all over and can cause diseases. In addition, the long-tailed macaques on site were found to eat from plant sources such as fruits, mature leaves, flowers, young leaves, seeds, shoots, insects and small animals. Results from this study found that the long-tailed macaques can be classified as omnivorous animals because they eat almost all kinds of food. Even so, according to [42], naturally, the long-tailed macaques are classified as frugivorous animals. The long-tailed macaques have a hierarchy in the group, so they have their own way to avoid a fight when looking for food together. Sometimes the long-tailed macaques in the study area is split into smaller groups when searching for food, in which this is the most effective strategy to avoid a fight and food struggle among them. In addition, the lower hierarchy moves towards food first before the higher hierarchy, so that they can eat first before the higher hierarchy conquers the food. This can be proven by experiments made during the observations in which food thrown towards the long-tailed macaques will initially be crowded with the lower hierarchy before the higher hierarchy came and chase away the lower hierarchy. This study was supported by [7] where the lower hierarchy arrived at the food first before the higher

hierarchy. In addition, there are circumstances which shown otherwise where the higher hierarchy conquers the food first before the remaining were eaten by the lower hierarchy. This is supported by [15] where the lower hierarchy of long-tailed macaques waits until the higher hierarchy left the food and then eats the remaining food. All of these actions are the way of the long-tailed macaques behaved to avoid fights that could cause injury when getting food.

Results from this study found that higher feeding behavior of long-tailed macaques caused lower resting behavior. This is supported by [16] which states that feeding is inversely related to resting. Therefore, inactive or resting behavior (Fig. 3) became the third highest behavior observed after feeding. This is in contrary to the study of macaque's species that live in cold areas such as Japanese macaques (*M. fuscata*) by [13] in which the highest behavior is resting. This is because of the food and weather factors, where the macaque's food in the cold weather is limited and the cold weather makes them rest more. The long-tailed macaques moved from one area to another area and would stop for a while to rest before continuing their journey. Many long-tailed macaques were found to rest after the search for food and when food sources are not many and it is supported by studies of [22]. In addition, the long-tailed macaques would normally rest in the afternoon which is very hot at that time. Place which is common for the long-tailed macaques to rest is at the branches of trees, and also under trees. While resting, the long-tailed macaques would normally take a nap by lying at the tree branch. The long-tailed macaques are also classified as resting when they sit down without doing any activity. The long-tailed macaques do not usually rest too long in the daytime because they will try very hard to find food to survive at night. This is because, at night they could not see clearly to find food and would bear with the food they find in the daytime. The long-tailed macaques use their night for sleep and rest enough so that they get the energy to find food the next day.

Grooming behavior becomes the fourth highest behavior have been observed after resting. This grooming behavior has been associated with resting. Usually the long-tailed macaques in the study area will do grooming another one is resting. Most of the grooming activities are carried out among the females, especially for adult females and have a baby, this case study is supported by [22] and could support a study conducted by [4] which states the male long-tailed macaques do not always groom themselves in the wild. For the female long-tailed macaques who have babies would often groom their baby. Grooming behavior between mother and baby can strengthen the relationship between them. This study was also supported by [22, 25] which states that the mother of long-tailed macaques always groom their baby until they leave the group. The long-tailed macaques at the study area are also found to do grooming in different age groups which the young will groom the adult. This may be due to the hierarchy factor where the higher long-tailed macaques get more grooming than the lower hierarchy. This study was supported by [11] where higher ranking adult females of long-tailed macaques received more grooming by the other subordinate females. Besides on the hierarchy, adult females often groom the bigger size males. This study was supported by [2, 22] who found that male long-tailed

macaques were usually groomed by the females. This may be due to female long-tailed macaques needs to obtain protections and also sharing of food from the males. This study was supported by [19] which state that females groom their mating males for the sake of protection and to share food.

Playing behavior is the fifth highest behavior that has been observed during the observation period. This behavior is often done by the infant and juvenile categories. This is supported by [17] which states that playing behavior may form a social competition and juveniles are in their active age period to learn on social relations. The mother of long-tailed macaques appears to be always monitoring their infant during play and sometimes they also play with them. This study was supported by [22] which states that the mother of long-tailed macaques were also seen playing with their infants. This is intended to keep their children from attacks by predators and also to teach them to live in their society. Usually, playing behavior occurred in the evening, where at that time the long-tailed macaques are already inactive and they are only waiting for the night time to rest. The behavior that can be categorized as playing in the study area are wrestling, chasing, swinging on the tree branches, playing with objects, biting mockery, playing with water, and pulling their tails to play with one another. It has many similarities to the study conducted by [22] in Universiti Kebangsaan Malaysia main campus.

Vocalization behavior becomes the sixth highest behavior that has been observed at the study location. Macaques often produce vocal while playing. This study is equivalent to [17, 22] who found that the vocal were produced by macaques while playing. The long-tailed macaques are also found to produce vocal when mating. This study was supported by [22] who found that vocalization was also produced after and during mating. This is related to the fact that females produce vocal during copulation which is a hormonal effect [9]. The long-tailed macaques are also found to produce vocal warnings to inform members of the group that there are predators around. Members of the group who heard the vocal warning will immediately climb to higher ground to escape. Apart from the vocal warning, macaques are also found to produce vocal during fighting and food snatching. This study is equivalent to [22] which states that vocalization was produced as warning for predator existence, during agonistic interaction and competing for food.

Mating behavior becomes the seventh highest behavior that has been observed. Female long-tailed macaques were found to choose only strong and dominant males to mate. This may be because the female long-tailed macaques want to give birth to a strong baby and get protection from the dominant males. This study was supported by [22, 40] who found that female long-tailed macaques prefer to mate with the dominant males. This evidence can be strengthened further with the study of [8] who found that dominant male monkeys were the father of almost all the children in their group. Mating behavior at the study area was found to be instituted by male long-tailed macaques where they will find suitable females for mating. Male long-tailed macaques were found to smell the female genitalia first to ensure that the females are ready or not to mate. This study was



supported by [4, 22] who found that male long-tailed macaques often show mating behavior more than females. The time taken by the long-tailed macaques during mating is very short, which is only a few seconds. During the observations made, there are a few times that the long-tailed macaques try to do homosexual relationships between male and male. It was also found that the long-tailed macaque at the study area trying to mate with a cat (Fig. 4). However, such behavior is extremely rare to be seen.

Fighting behavior is the last behavior and least observed at the study area. These findings conflict with the studies by [22, 35, 39] who found that mating behavior is the behavior that is least observed. Fighting behavior at the study area is usually done by long-tailed macaques to snatch food and partners for mating. This study was supported by [22, 37] who found that the fighting behavior is to get food and partners. Fighting behavior is often committed by male long-tailed macaques compared to females. This is because the males want to be the leader or to be dominant in the group. This study was supported by [4, 22] who found that male long-tailed macaques often show their fighting behavior. In addition, fighting behavior is also meant to chase out the other long-tailed macaque's group from entering their territory in order to protect members of the group and also their food source. This study was supported by [5, 22] who found that the fighting behavior exists between the long-tailed macaques to defend their food source.

TABLE I

Percentage and frequency of daily activity budget of long-tailed macaques			
Behavior	Observation	Percentage (%)	$\frac{(O-E)^2}{E}$
Moving	2894	20.27	689.01*
Feeding	2682	18.78	450.76*
Inactive	2435	17.05	236.69*
Grooming	1548	10.84	31.47*
Playing	1500	10.50	45.50*
Vocalization	1479	10.36	52.46*
Mating	1060	7.42	294.47*
Fighting	682	4.78	681.57*
Total	14280	100	2481.93*

\* Showed significant differences ( $p < 0.05$ ) by using the chi-squared test ( $\chi^2$ ).

#### IV. CONCLUSIONS

In Kuala Selangor Nature Park, the presence of macaques brought a lot of problem to human especially to resident's people and tourists. According to the results obtained from the study; moving, feeding and resting are the most common daily activity budgets of the macaques. Mating behavior between the long-tailed macaque and a cat is extremely rare behavior that I found at the study area. This study is important in order to understand clearly the daily activity budgets of macaques in the study area which can leads to the effective management and conservation of this species in the future.

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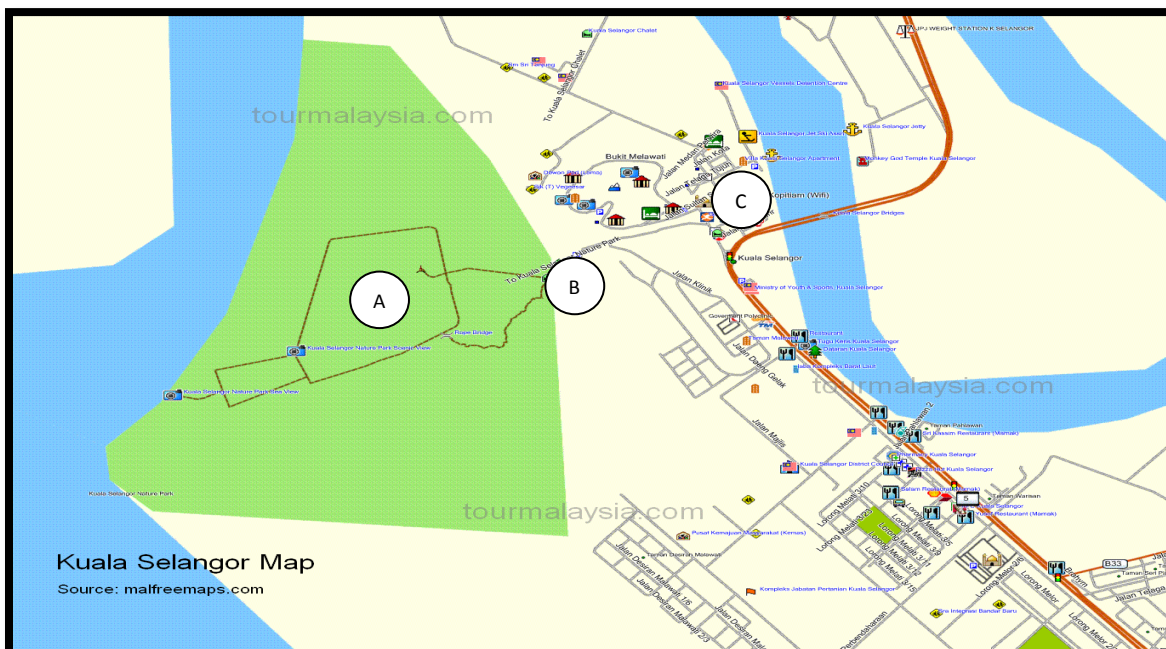


Fig. 1. The location of study area.

A: Kuala Selangor Nature Park

B: Main Entrance of KSNP

C: Ticket Counter





Fig. 2. The main food of the long-tailed macaques in the study area consists of human food waste thrown into the garbage bin.



Fig. 3. Picture of resting behavior.



Fig. 4. The long-tailed macaque was trying to mate with a cat.