
Research Article

The Daily Activity Budgets of Long-tailed Macaque (*Macaca fascicularis*) at Padang Teratak Wildlife Sanctuary, Beaufort, Sabah, Malaysia

Maisa Mohammad, Anna Wong*

Institute for tropical Biology and Conservation, Universiti Malaysia Sabah, Jalan UMS, 88400 Kota Kinabalu, Sabah

*Corresponding author: anna888@ums.edu.my

Abstract

At present, the conversion of natural forests into urbanized and agricultural plantation areas are rising at an accelerated rate. Due to the loss of suitable habitats, wildlife i.e. macaques are forced to move into or nearby areas close to humans. The increased encounters between humans and macaques have led to conflicts between both when macaques utilize human resources. A preliminary study was conducted to explore the daily activity pattern of macaques based on age-sex and time in human-dominated areas (e.g. human settlements, oil palm plantation and fruit orchards). The study was conducted in Padang Teratak Wildlife Sanctuary (PTWS) located in the district of Beaufort, eastern part of Sabah, Malaysia. Opportunistic observations were conducted along the roads encompassing seven villages in four days per month from December 2015 to January 2016. The survey was conducted in four time frames for 11 hours per day (06:00-09:00, 09:00-12:00, 13:00-15:00 and 15:00-18:00) to document behaviour of macaques with regards to the time of the day. Overall, a total of 1,462 individuals from 221 groups with total direct contact of 96 hours, 53 minutes out of 132 hours, consisting of multi-males multi-females (173 encounters), multi males (18), solitary male (28) and solitary female (2). There were 13 behavioural activities recorded and the study revealed that macaques spent most of their time for moving (28.4%), foraging (25.2%), resting (19.1%) and grooming (12.3%). Results from ANOVA showed that the daily activity patterns of each categories within age-gender varied showing there was a relation between daily activity budget and age-gender of macaques. In addition, Chi-square test indicated there were interactions between age-gender and time on daily activity. In contrast, time did not have an effect on their activity pattern. Good wildlife management practices by understanding the behaviour of macaques in human settlements near degraded forests is crucial since habitat sharing by humans and macaques raise the concern of safety and health issues.

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The frequent encounter between this species increases transmission of some zoonotic diseases to humans such as the malaria parasite (*Plasmodium knowlesi*).

Keywords: *Macaca fascicularis*, long-tailed macaque, daily activity budget, altered habitats, human-macaque conflict.

Introduction

Forested areas are being converted into urbanized areas and agricultural plantations, mainly oil palm at an accelerated rate throughout Southeast Asia. The loss of habitat has forced macaques to exploit human settlements and its surrounding forested areas (Fuentes et al., 2005; Gumert et al., 2011; Sha et al., 2009; Hambali et al., 2012b). Due to the exploitation of areas close to settlements, this has frequently caused conflicts between humans and macaques. They are described as pests in many areas, which include fields, roadsides, temples, tourist lodges, reserves and towns (Lee & Priston, 2005). Species of primates with home ranges and resource utilization that overlap with humans, i.e macaques and baboons, are a predicament in Asia and Africa (Hill, 2000; Priston, 2005).

The habituation of macaques to both humans and human foods stem from being fed often by people, which have led to the foraging in human dominated areas such as garbage bins around the city (Hambali et al., 2012b). In addition, increased food resources such as oil palm fruit and human food wastes are clearly affecting macaque behaviours including their preference in choosing sleeping tree nearest to human settlements (Kurland, 1973). This strategy mirrors the natural ability of macaques in exploiting available opportunistic resources (Kurland, 1973), albeit the environment is disturbed (Wheatley, 1999). The expansion of human population has led to rapid and extensive invasion into the forested habitat of macaques (Hambali et al., 2012b). The accumulation of both human food rubbish and food crops plantation in remaining home ranges caused the macaques to become habituated and dependant on humans and human food which in turn results in conflicts among humans and primates. These environmental changes urged the macaques to adapt allowing them to survive in urban areas.

Macaca fascicularis (Primates: Cercopithecidae), or commonly known as the long-tailed macaque or crab-eating macaque, has a widespread and diverse geographical range in the mainland and Southeast Asian region (Fooden, 1995). They are a native within their home ranges occurring in Malaysia, lower north of Thailand, southern Laos, Cambodia, Myanmar, Vietnam, Java, Sumatra and the

Philippines (Marsh & Wilson, 1981; San & Hamada, 2009). Long-tailed macaques are the most common monkey of both disturbed and secondary forest in the lowlands up to around 1,300 m in the mountains (Phillipps & Phillipps, 2016). They are also inhabitants to many small islands in Borneo which includes Gaya Island (Kota Kinabalu), Pulau Tiga (West Sabah) and Maratua (Northeast Kalimantan). In Sabah, they are distributed throughout the state in almost all vegetation except in montane forests (Yasuma & Andau, 2000).

Macaques are one of the primate species closely associated with humans in terms of social behaviour. Research has shown that the social behaviour of primates is nearly similar to humans such as eating, playing, fighting and caring for their young (Rod, 1992). Krebs & Davies (1993) showed that behavioural activities of macaques are different between disturbed areas and those in their natural habitat (Krebs & Davies, 1993). Several studies have shown that activity budgets are affected by a variety of demographic and environmental factors: food sources, sex, social rank, reproductive condition, and the degree of human disturbance in the region (Peres, 1993; Passamani, 1998; Di Fiore & Rodman, 2001). According to van Schaik et al. (1983), as the group size increases, the activity budget of macaques is less encouraging. Macaques in bigger groups must expend more energy to get food sources and conflicts such as fighting within the group rises, whereas social interaction to reduce tension such as grooming decreases.

In true wild macaques, they have reduced home ranges with shorter day ranges and spend less time travelling and foraging and more time resting (Altmann & Muruthi, 1988; Kogenezawa & Imaki, 1999; Saj et al., 1999). Macaques that rely on anthropogenic foods in or surrounding urbanized areas spent less time consuming in wild fruits and flowers, reduced resting time and more time moving (Sha & Hanya, 2013). Forested habitats were used less often and they had a greater overall home range and mean monthly home range. Although there were contrasting results where food-motivated capuchins sustained a larger territory compared to their wild counterparts with comparable activity budget (McKinney, 2011), orangutans raiding on crops moved further on raiding days compared to days where they forage mainly on wild fruits (Campbell-Smith et al., 2011) and, in chimpanzees where they travelled further during crop-raiding days (Hockings et al. (2012). The diverse patterns emphasize on the complexity in ecological reactions of primate, depending on species and individual group and site condition (McKinney, 2011; Hockings et al., 2012; Sha & Hanya, 2013). Primates dependent on anthropogenic foods present opportunities to observe possible adaptation flexibility in their ecology and behaviour, which is predicted to differ

depending on how anthropogenic food resources are utilized (Sha & Hanya, 2013).

Padang Teratak Wildlife Sanctuary (PTWS), gazetted as a wildlife sanctuary reserve in 1978, is located in the district of Beaufort. It covers 2,270 hectares of wetland with its surrounding area consisting of fragmented forests, mangrove, oil palm plantation, rumbia plantation and villages. According to Berenstein (1986), macaques are more concentrated and widespread in disturbed forests compared to undisturbed forests and open areas. The loss of habitat and food resources in their habitat of origin pushed them to invade agricultural areas in addition to human settlements causing losses. Therefore, there is a need for comprehensive research and monitoring of daily activity budgets and behaviour of macaques covering various habitats such as PTWS.

Macaques have a multimales - multifemales social system where alpha males usually mate with large numbers of females throughout the year which lead to a population increase in a particular area. The increase in number causes a conflict between humans and macaques when they intrude and raid plantations, and the homes of villagers. Several cases of human-macaque conflict in the study area include house break-ins, raiding of orchards, obstructing roads and the chasing of women and children. Thus, the present study was conducted to explore the activity budget of macaques surrounding PTWS in terms of time of the day and age-gender groups. It is crucial to understand the behaviour of macaques inhabiting various habitats such as settlements, disturbed forests and agricultural areas. It is expected that macaques in altered habitats would rely highly on anthropogenic foods which will affect their behaviour (e.g. moving and foraging). The findings of this study are expected to assist in controlling and reducing conflict between humans-macaques, by providing necessary information to the Sabah Wildlife Department so that they are able to devise suitable management plans for example group relocation. It is vital to know which areas and what time macaques go out to forage for food for the placement of cages during translocation.

Methodology

Study Area

Padang Teratak Wildlife Sanctuary (PTWS), Beaufort (N 05 ° 19'39.4, E 115 ° 31'06.58) is located between the Padas Damit Forest Reserve and the Menumbok Forest Reserve Class V (Extension II), which covers 2,270 hectares of grassy marshland with scattered clumps of low bushes, surrounded on one side

by agricultural land and a small village as well as peat swamp forest on the other side (Sabah Forest Enactment, 1984; Malaysian Wetland Working Group, 1987). The agricultural land consists of oil palm and rumbia plantations.

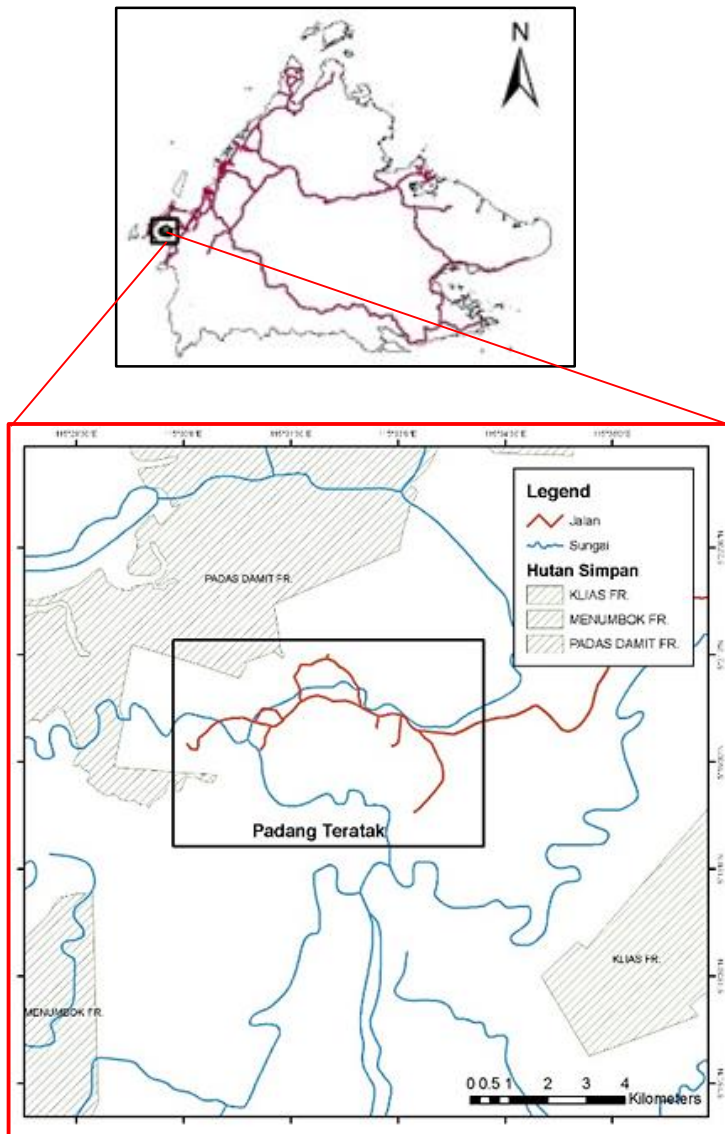


Figure 1. Map of the study area: Padang Teratak, Beaufort, western Sabah. (Source: GIS Laboratory, ITBC, Universiti Malaysia Sabah).

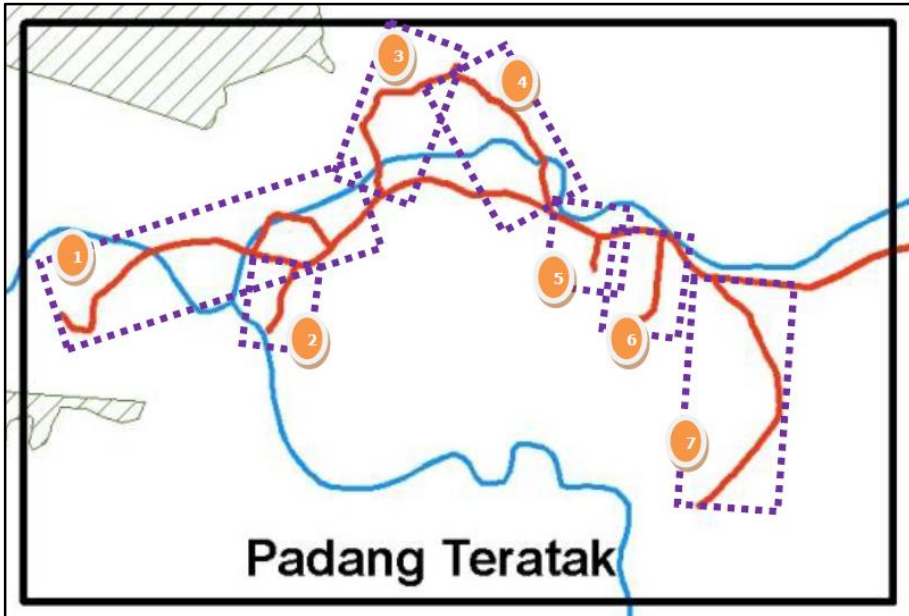


Figure 2. Map of PTWS showing the seven villages encompassing the main road (red line) used as observation transect: 1) Bentuka; 2) Teratak; 3) Shah Bandar; 4) Kukut; 5) Padas Damit; 6) Mentulud and 7) Bengkalalak. (Source: Mahad, 2016).

It is located about 120 km away from the state capital, Kota Kinabalu. It was gazetted in 1978 as a wildlife sanctuary reserve as it is a suitable environment for various wildlife in Sabah (Russell, 2006). The reserve is known as an important site for resident migratory birds such as ducks and egrets, which they use as a wintering site from November to January. Meanwhile, other parts of the reserve offers habitat to the Estuarine crocodile and Proboscis monkey (Malaysian Wetland Working Group, 1987; Payne & Vaz, 1998).

Data collection

The present study was conducted between the months November 2015 to January 2016 for four days per month. Ad libitum sampling method was applied since macaques in this area were not fully habituated to humans. Opportunistic observations were carried out every three hours for a total of four times per day (06:00-09:00, 09:00-12:00, 13:00-15:00 and 15:00-18:00), where the total direct contact hours with macaque groups was 11 hours. The survey was conducted along roads encompassing seven villages: Bentuka, Teratak, Shah Bandar, Kukut, Padas Damit, Mentulud and Bengkalalak. The starting point of the sampling were chosen at random every three hours at which village, road or junction surveyed. Surveys were discontinued during rain to reduce bias as the macaques would

usually seek shelter or hide to avoid getting wet. The behavioural activities were recorded at random where groups of macaque were observed until the group disappeared from the observer's sight. Apart from that, this method was also used to construct an activity catalogue (ethogram). The data recorded during sampling are: date, time, coordinate type of area, age-gender and behavioural activity. Macaques were distinguished by age by referring to characteristics in Table 1 and activities definitions in Table 2.

Table 1. Demography categories of macaques used to differentiate individuals in this study.

Age-Gender	Approximate Age	Characteristics
Adult Male (AM)	At least 5 years old	Taller, tail is longer and thicker compared to other age classes, limbs are relatively longer than AF, facial hair is short, have a moustache, penis is more visible, scrotum is bigger and pink in colour.
Sub-adult Male (SM)	4 ½ - 5 ½ years	Height is similar to younger AM, thinner, less muscular, penis can be seen clearly but scrotum is smaller than M.
Adult Female (AF)	At least 4 years old	Body hair colour is greyish and faded, nipples are longer, facial hair is always present.
Sub-adult Female (SF)	4 - 5 years	Thinner and smaller, nipples are shorter than F, hair is relatively shorter on the face.
Juvenile (JV)	1 - 4 years	Thinner, gender is normally difficult to distinguish.
Infant (IN)	0 - 1 year	Clinging to mother's body or carried by its mother.

Source: Fittinghoff, 1978.

Table 2. Definition of activity budget category used in this research.

Activity	Definition
Moving (MOV)	Any movement between 2 locations. Divided into: 1. Moving on the same tree; 2. Moving between different trees; 3. Moving on the ground; walking; jumping; climbing
Foraging (FOR)	Subject inserting food item into the mouth or chewing on food.
Resting (RES)	Subject is sitting or lying down and is not involved in any other activities.
Grooming (GRO)	Any activity of scratching or cleaning of the body with hands, feet or mouth. This activity is divided into: 1. Subject is grooming itself; 2. Subject is grooming other individual; 3. Subject is groomed by other individual.

Drinking (DRI)	Subject is drinking or licking any fluid.
Playing (PLA)	Chasing, wrestling, exploring and other movements with no particular purpose. Subject playing by itself or involving 2 or more individuals.
Agonistic (AGO)	Subject giving or receiving offensive action and threatening. This activity is divided into: 1. Without physical touch such as face expression; 2. With physical touch such as biting or grasping.
Copulation (COP)	Subject having sex by taking positions behind or above other individuals in ventral-dorsal position.
Vocalization (VOC)	Any sound produced by the subject.
Cling (CLI)	Subject (infant) hugging or hugging the ventral of another subject.
Urination (URI)	Subject discharging urine.
Defecation (DEF)	Subject discharging faeces.

Source: Bennett, 1983.

Data Analysis

Analysis of Variance (ANOVA) was conducted using SPSS statistical analysis version 10 to observe the differences between the daily activities in terms of gender and time in addition to the effect of interaction between age-gender and time factors on the daily activity of macaques. Chi-square test (χ^2) was conducted to observe the relation between daily activities of macaques with age-gender and time, whether the activities were dependent with both independent variables. The relation between daily activities with age-gender and time were considered as significant when the statistic value of Chi-square test is high whereas the critical value (K) is less than 0.05. The result of the test is shown in a cross-table to compare percentage of daily activities for each category within the independent variables, age-gender and time.

Results

Overall, a total of 1,462 individuals from 221 different groups of macaques were observed during the study. The age structure of macaques sighted were males (n=398), females (n=311), sub-males (n=236), sub-females (n=105), juveniles (n=335) and infants (n=77). The total of direct observation time with the macaques encountered was 96 hours, 53 minutes out of 132 hours. Because of the shyness of the macaques, we did not manage to follow the animals throughout the daylight hours. Most of our observations (63%, the total number of observations was 915 = 42hours, 29 minutes) were conducted only during the morning (06:00-9:00 h) and evening (15:00-18:00). Even so, we managed to record a total of 14 behavioural activities (based on pooled data across all

individual monkeys observed). The major behavioural activities were moving (28.4%), foraging (25.2%), resting (19.1%) and grooming (12.3%). Nine types of behavioural activities form the minor activities which were playing (3.6%), agonistic (3.1%), clinging (2.6%), swimming (1.6%), vocalization (0.5%), pest behaviour (0.4%), drinking (0.3%), breastfeeding (0.2%), and defecate (0.1%). The types of groups found throughout the survey period were multi-males multi-females (173 encounters), multi males (18), solitary male (28) and solitary female (2) (Mahad, 2016).

Table 3. The overall percentage and frequency of daily activity budgets (diurnal) of *M. fascicularis* at PTWS.

Type of Daily Activities	Activities	Frequency	Percentage (%)
Major	Moving	414	28.4
	Foraging	368	25.2
	Resting	280	19.1
	Grooming	180	12.3
Minor	Playing	52	3.6
	Agonistic	46	3.1
	Cling	38	2.6
	Copulation	38	2.6
	Swimming	24	1.6
	Vocalization	7	0.5
	Pest Behaviour	6	0.4
	Drinking	5	0.3
	Breastfeeding	3	0.2
	Defecate	1	0.1
	Total:		1,462

The result from the two way ANOVA showed the main effect of daily activities were influenced by age-gender factor ($F_{5, 1437} = 17.491$, $k < 0.05$). Overall, it was found that the effect of interaction between both dependent variable (age-gender*time) on dependent variable exist significantly ($F_{5, 1437} = 2.253$, $k < 0.05$). As much as 14.4% of the variation in daily activities is contributed by gender and the combination between age and time.

Table 4. Two way ANOVA test to observe the effect of gender, time and the interaction between age-gender and time on daily activity budget of macaques.

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	1487.849 ^a	23	64.689	10.524	0.000
Intercept	9942.317	1	9942.317	1617.420	0.000
Time	15.359	3	5.120	0.833	0.476
Age-Gender	537.586	5	107.517	17.491	0.000
Time * Age-Gender	207.710	15	13.847	2.253	0.004
Error	8833.273	1437	6.147		
Total	27160.000	1461			
Corrected Error	10321.123	1460			

a. R Squared = 0.144 (Adjusted R Squared = 0.130)

The Chi-square test (χ^2) showed that there was a significant relationship between gender and daily activities of macaque ($\chi^2 = 1000.653$, $df = 65$, $K < 0.05$). In addition, there was a significant relationship between time and overall daily activities of macaques ($\chi^2 = 80.231$, $df = 39$, $K < 0.05$). In contrast, there was no significant relationship between time and daily major activities of macaques ($\chi^2 = 13.418$, $df = 9$, $K > 0.05$).

Table 5. Daily activities percentage (diurnal) of macaques for each age-gender category based on cross-table of age-gender and daily activities. The highest percentage of daily activities by each age group in major and minor activities were bolded.

Daily Activities	Time-Gender	Adult Male	Adult Female	Sub-male	Sub-female	Juvenile	Infant
Major (%)	Moving	30.4	25.1	26.6	21.9	37.6	5.2
	Foraging	26.1	25.4	29.5	35.2	19.1	18.2
	Resting	22.4	21.5	17.7	19.0	16.7	7.8
	Grooming	10.1	17.7	14.3	13.3	7.2	16.9
Minor (%)	Antagonistic	4.5	1.0	8.0	0.0	1.8	0.0
	Copulation	4.3	6.1	0.4	1.0	0.0	0.0
	Playing	0.8	0.3	1.3	1.0	13.1	0.0
	Clinging	0.0	0.0	0.0	0.0	0.0	49.4
	Swimming	0.3	2.6	0.4	3.8	3.0	0.0
	Vocalization	0.8	0.3	0.4	1.0	0.3	0.0
	Pest Behaviour	0.0	0.0	0.8	2.9	0.3	0.0
	Drinking	0.5	0.0	0.4	1.0	0.3	0.0
	Breastfeeding	0.0	0.0	0.0	0.0	0.3	2.6
	Defecation	0.0	0.0	0.0	0.0	0.3	0.0

Table 6. Daily activities percentage of macaques for each time period based on cross-table of time and daily activities.

Daily Activities	Time	06:00-09:00	09:00-12:00	12:00-15:00	15:00-18:00
Major (%)	Moving	29.3	27.0	29.3	28.4
	Foraging	23.6	27.2	29.3	23.6
	Resting	19.8	14.6	19.3	22.1
	Grooming	14.5	11.1	6.7	13.1
Minor (%)	Antagonistic	2.7	4.0	2.0	3.2
	Copulation	3.2	1.5	5.3	2.1
	Playing	2.7	5.8	1.3	3.2
	Clinging	2.7	2.8	0.7	2.9
	Swimming	0.5	4.0	4.0	0.0
	Vocalization	0.2	0.8	0.7	0.4
	Pest Behaviour	0.5	0.3	0.7	0.4
	Drinking	0.0	1.0	0.0	0.2
	Breastfeeding	0.2	0.0	0.7	0.2
	Defecation	0.0	0.0	0.0	0.2

Discussion

The Chi-square test shows that the daily activity patterns in each category age-gender vary indicating that there is a strong relationship between the daily activities of long-tailed macaques. Daily activities of macaques were divided into main and minor activities. Based on the observation (Table 3), macaques spend most of their time moving (28.4%), followed by foraging (25.2%), resting (19.1%) and grooming (12.3%). Vocalisation, antagonistic, drinking, breastfeeding and defecating were less visible which led to fewer records made resulting in low percentage in those activities.

The highest activity observed in this study was moving. This is supported by Hambali et al. (2012b) and Md-Zain et al. (2010) where macaques travel to forage for food during the day. Moreover, the presence of researchers indirectly affected the percentage of moving activities since they were not fully habituated to human presence. Since macaques are diurnal, they spend most of their time travelling from one area to another in search of food resources during daylight. The chart shows that juvenile monkeys were more active in moving compared to adult males. In contrast, infants recorded the lowest percentage as they cling to adult females to move. This behaviour allows the movements of the group to go smoothly.

PTWS provides the macaques with diverse and high availability of food resources, with abundant foraging sites such as oil palm plantations, human settlements, mangrove, fruit orchards and areas with areca nut and rubber trees. Thus, foraging was observed the second highest. They have been observed to forage on grasses; young tree leaves (fig, bamboo, oil palm, rubber, coconut, bushes and tree sapling) and fruits (coconut, guava, areca nut and banana). This incidence verified the abundance and continued availability of resources in PWTS. Oil palm was widespread in the study site, where it was planted by several plantation companies and the villagers of the surrounding areas on their private land. Mature oil palms are able to produce 1,000 to 4,000 fruit seeds per bunch depending on the age and durability of the trees. The increase in quality resources from anthropogenic sources is clearly influencing primate behaviour (Fuentes et al., 2005; Hadi et al., 2007). Anthropogenic foods provide higher energy compared to natural food as they are more palatable, rich in calories, easier to digest, abundant and in cluster (Forthman-Quick, 1986; Forthman-Quick & Demment, 1988; Saj et al., 1999). Due to the ease in obtaining food in human-dominated areas, one of the effects that is frequently observed are reduction in territory range and daily distance travelled, where more time spent

to rest and forage (Malik & Southwick, 1988; Wheatley et al., 1996; Saj et al., 1999; Strum, 2010).

The observation revealed that males (n=104), females (n=79), sub-males (n=70) and sub-females (n=37) were more frequent in foraging for food. This behaviour allows males to maximize the absorption of nutrients to gain energy and for muscle building. Large and muscular body size benefits the males to compete for a mating partner (Cowlshaw & Dunbar, 1991). Meanwhile, female macaques need to extract more food sources to meet their reproductive needs. The findings of this study were supported by the study of Trivers (1972) and Wrangham (1979) where the quality and number of offspring produced by the females were determined by the quality of the resources obtained.

Resting is the third highest observed behaviour during the survey period. For sub-adults, the percentages of these two activities were of inverse proportion to one another. This finding was similar to Hambali et al. (2012), where when foraging behaviour increase, macaques spend less time resting. Since macaques only forage during daylight, they exert more effort in eating to be able to last through the night. Moreover, this study shows that males rested more than females, similar to the observation by Fuentes et al. (2007) in Padangtegal, Bali Indonesia. Since macaques are generally in a multi-male multi-female group with an alpha male, the number of females is usually higher than males within the group. Females are less likely to rest as they are often interacting with other members of the group such as grooming infants.

Grooming is one of the main activities that show the hierarchical structure within their group. Adult females (n=55) recorded the highest frequency of grooming activity compared to the other gender groups: adult males (n=40), sub-males (n=34), sub-females (n=14), juveniles (n=24), and infants (n=13). This finding is supported by Gumert (2007) where grooming is considered as an exchange to gain access to infants as females were seen to have an interest in caring for young other than their own. Meanwhile, adults of both genders were normally seen grooming each other after mating. As a result from Table 5, copulation activity was highest for adults compare to sub-adults. The study of Gumert (2007) stated that grooming can be regarded as a reward for couples after copulation. Lower-ranked females tend to groom higher-ranked females. The purpose of this behaviour is to obtain cooperation during aggression, to reduce interference and to gain access to food during resources shortages (Hambali, 2012). Macaques are polygamous species where males were observed to copulate with more than one female. Engelhardt (2005) found that dominant

males are able to detect fertile females. Females typically prefer to mate with dominant males (Md-Zain et al., 2010).

Males obtain a high position in the hierarchy through successful antagonistic interactions such as fighting (Arlet et al., 2009). These studies (Sussman et al., 2003; Md-Zain et al., 2010; Hambali et al., 2012) agree that antagonistic behaviour is driven by competition for food and mating partners. Agonistic behaviour and mating were influenced by the number of fertile females within the group (Girard-Buttoz et al., 2009). This means that the more fertile females are available within the group, the less competition there are among males. Thus, leading to higher copulation activities within the group. There were a group of multi-males during the observation period that exhibited agonistic behaviour by staring aggressively, making squeaky sounds and shaking tree branches after seeing researchers. This group did not escape but threatened researchers by moving towards them.

Playing is a social interaction involving more than one individual (Kipper & Todt, 2002). Opposite to Hambali et al., (2012), this study did not record any playing activity by infants. This occurred due to infants constantly clinging to adult females. Sub-adults were often seen playing with juveniles. An example of their playing activity observed includes jumping from one branch to another, pulling of tails and chasing each other. They had been observed swimming several times in the nearby small river and drainage. Fooden (1995) that this species are good swimmers among the primate species and often enter the water for fun. Swimming may be one of the mechanisms for cooling down since the weather is usually warm between 12:00-15:00. Furthermore, this behaviour is a survival strategy when their feel threatened. A group was swimming before they spotted the researcher and fled to another location through drainage.

Despite the low pest behaviour recorded, it was significant enough to trigger the anger and fear of villagers around Padang Teratak. Some 0.4% of the interrupting activities around Padang Teratak were done by adults and juveniles. Their small body sizes allowed them to enter houses through holes on floor and walls, windows and roofs. The same group of macaque often enter houses between 12:00 to 15:00 when the residents were not at home. They do not only rummage dustbins and properties inside the house, but have been seen stealing food such as rice, eggs and snacks. In the fruiting season, this species invades the orchards to eat fruits and other crops. Victims of monkey disruptions at this area claimed that macaques block roads and chase out women and children. However, there

was no report on any injury cases received by the Wildlife Sanctuary, Padang Teratak.

Conclusion

Padang Teratak Wildlife Sanctuary and its surrounding areas provide easy access of varied anthropogenic foods and protection against natural predators to macaques. These have led to the increase in the number of macaques over the years. Their presence in this area poses a conflict between humans and macaques. Based on observation from the study, the most common daily activity budgets of macaques were moving, feeding, resting and grooming. Side activities such as mating and pest behaviour also need to be investigated in the future. The understanding of the behaviour of macaques is vital in order to manage the increase in population, avoid conflict with humans and for health reasons as they are known to be a vector for zoonotic disease (i.e. malaria, herpes B virus, pox virus, measles, rabies and bacterial infections).

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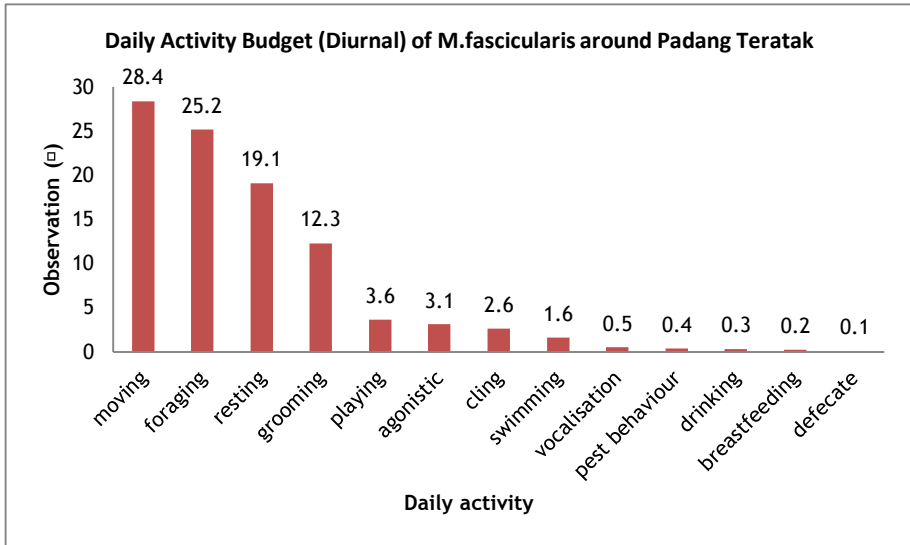
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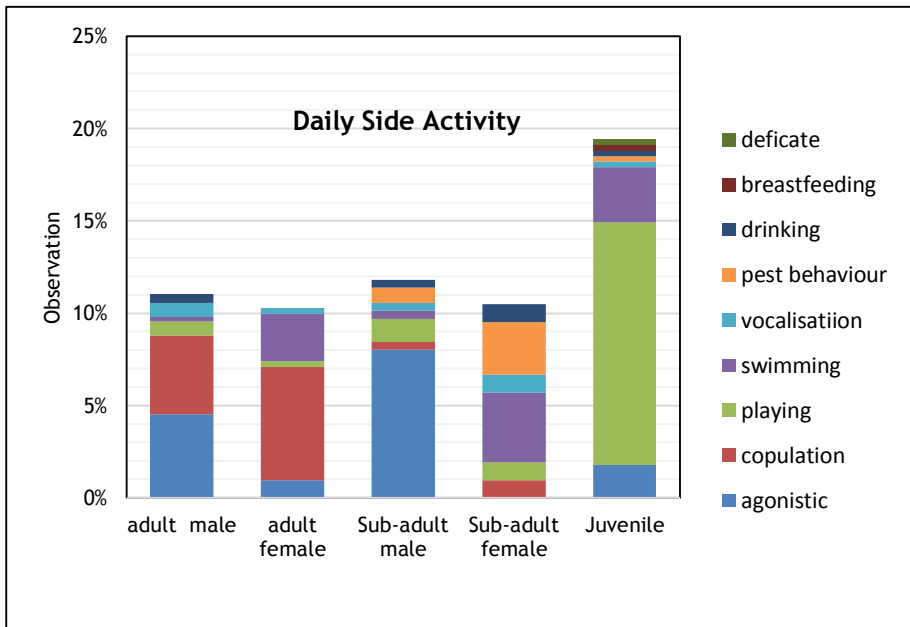
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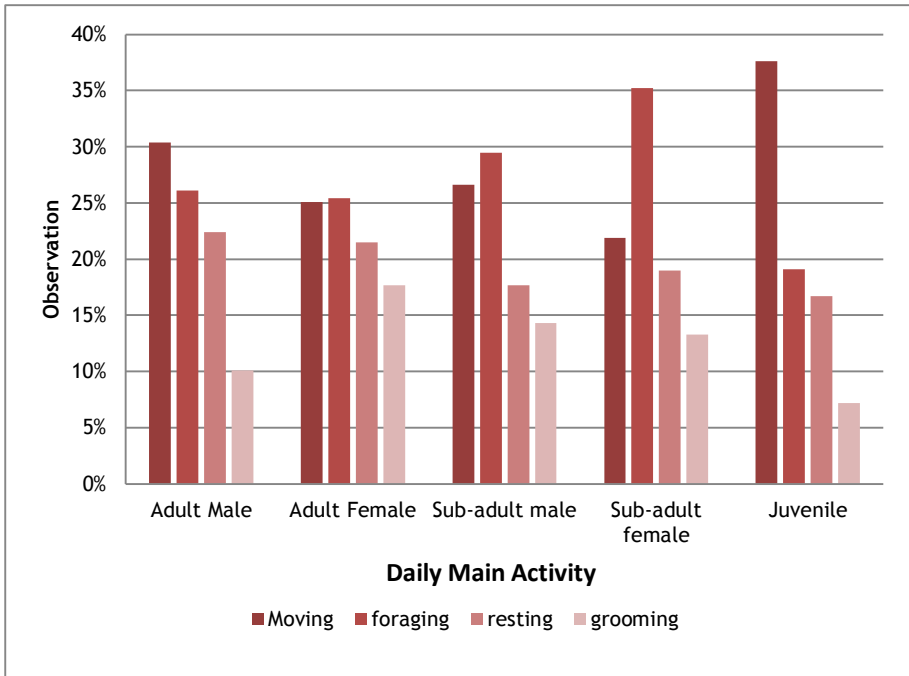
Appendix



Appendix 1. Percentage of Daily Activity Budgets (Diurnal) of macaques at around Padang Teratak.



Appendix 2. Percentage of daily minor activities for adult, sub-adult and juvenile.



Appendix 3. Percentage of daily main activity of macaques by age group: adult, sub-adult and juvenile.