

Human-Macaque Conflict and Pest Behaviors of Long-Tailed Macaques (*Macaca fascicularis*) in Kuala Selangor Nature Park

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ABSTRACT.— Human-macaque conflicts and the pest behavior of long-tailed macaques (*Macaca fascicularis*) were studied near the Kuala Selangor Nature Park. The study location was based along the *M. fascicularis* trails starting from the ticket counter of a local train station to the main entrance of KSNP and pest behaviors were studied from February 2011 until July 2011 inclusive by intensive direct observations using the scanning method. In addition, human-macaque interactions in two nearby residential areas Taman Malawati and Taman Desiran were evaluated by questionnaire survey. Observations revealed six main categories of pest behaviors: littering (27%), damaging facilities (23%), breaking into human areas (18%), messing up garbage cans (18%), disturbing people (11%) and stealing (3%). The questionnaire survey revealed that most respondents had stayed there for 41-60 years (61%) and were well aware of the macaques and their disturbances. Their homes are often infiltrated by the macaques, which frequently steal items from their homes, especially food, and outside they often threw rubbish from the garbage cans, which caused an unpleasant sight around the housing area. In addition, the macaques often took their fruit (mainly mangoes and bananas) from the plantations. Overall, the pest behavior of the macaques was related to locating and obtaining of food. Therefore, government organizations, like the Wildlife Department and National Park (PERHILITAN), Kuala Selangor District Council (MDKS), and the non-government organizations, like the Malaysian Nature Society (MNS), need to create a buffer zone that can serve as a permanent habitat for *M. fascicularis*. This buffer zone must have some space that provides food for macaques every day in the morning, afternoon and evening, so as to reduce the pest behavior. In addition, MDKS needs to empty garbage cans daily and / or create garbage cans that cannot be opened by the macaques. In order to reduce pest behavior, organizations such as Universiti Putra Malaysia (UPM), PERHILITAN and MNS should initiate an awareness program for the local people nearby and also for the tourists.

KEY WORDS: Human-macaque conflict, pest behavior, *Macaca fascicularis*, long-tailed macaque, Kuala Selangor Nature Park, Peninsular Malaysia

INTRODUCTION

Macaca fascicularis Raffles (Primates: Cercopithecidae) is commonly known as the long-tailed macaque or crab-eating macaque. In the Malay Language, it is

called “kera” because of its calling sound (“Krrrrr...”). *M. fascicularis* is the most widespread and ecologically diverse of non-human primate species in the world (Fooden, 1995; Wheatly, 1999), being distributed throughout the whole of

Peninsular Malaysia, Sabah, and Sarawak as well as throughout Southern Asia; lower north of Thailand, Myanmar, southern Laos, Cambodia, Vietnam, Sumatra, Java and the Philippines (Marsh & Wilson, 1981; Malaivijitnond & Hamada, 2008; San & Hamada, 2009). The long-tailed macaque can be found everywhere in Peninsular Malaysia, Sabah and Sarawak, especially in lowland areas and along the coasts, plus nowadays they can be easily found in urban areas (Perhilitan, 2006).

Long-tailed macaques are reported to be pests in various places, such as in fields, tourist lodges, reserves, roadsides, temples and towns (Lee & Priston, 2005). Unfortunately, people like to feed the macaques and this has resulted in habituation to both humans and human food leading to foraging in, for example, garbage bins with the resultant unpleasant sights around the city of littered rubbish. Increased human population levels and activities with encroachment into and proximal to the macaques territory have led to ecological changes (including destruction) in the natural habitat of the long-tailed macaques that result in a high level of interactions between humans and non-human primates. The growth of human populations has not only led to a rapid and widespread invasion into monkey forest habitats, but the deposition of human food rubbish or plantation of food crops near the macaques remaining home ranges leads to the macaques to become habituated to humans and human food (and even dependent upon it) and so together these result in conflicts between humans and primates. Thus, primarily driven by the loss of habitat and food sources and supported by the subsequent habituation and adaptation to humans, *M. fascicularis* has invaded

agriculture areas and caused losses to the farmers (Siex, 2005).

In Peninsular Malaysia, *M. fascicularis* has become a major problem in some states, particularly in the fast human population growing states, such as Selangor and Johor (Perhilitan Annual Report, 2004). According to PERHILITAN (2006) the estimated size of the *M. fascicularis* populations that are causing problems is around 116860 to 126470 monkeys, ranging from between 32400 monkeys in Johor down to 2550 in Perlis. Habituation and adaptation to humans has even led to some truly urban populations of long-tailed macaques that live on the uncovered roofs of apartments and steal food from garbage cans around the places (Perhilitan, 2006).

The presence of macaques at Kuala Selangor Nature Park (KSNP) brought a lot of problems to the Kuala Selangor District Council (MDKS), the management of KSNP, the residents who live near KSNP and the tourists. Indeed, complaints have been reported by the residents of nearby residential areas (Tamans). This research focused on the pest behavior of *M. fascicularis* at KSNP and determined the residents' perception towards the problem. We hope that the knowledge obtained from this research can be used in pest management of this species in this area, and by extrapolation, to other areas within the distribution range of *M. fascicularis*.

MATERIALS AND METHODS

Study Area.— A field study of *M. fascicularis* was conducted in KSNP (Fig. 1). KSNP was established in 1987 by the Malaysian Nature Society (MNS) and the Selangor State Government and is comprised of 732.4 acres that includes 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 into the Straits of Malacca and a man-made 25-acre brackish water lake system. These diverse habitats make the Park a wonderful place for animals to feed, roost and breed. Other than long-tailed macaques, 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, such as the mangrove skink (*Emoia atrocostata*) and monitor lizard (*Varanus salvator*), river dolphins (*Platanista gangetica*), four species of mudskippers (*Periophthalmodon*

schlosseri, *P. chrysospilos*, *Boleophthalmus boddarti* and *P. vulgaris*), mud lobsters (*Thalassina anomala*) and also 15 species of crabs including the king crab (*Lopholithodes mandtii*).

Intensive Direct Observation.— Pest behavior observations were made from 0800 hours until 1830 hours for 2 to 3 days a week for a total of 90 days from February 2011 until July 2011 inclusive. The study location focused along the *M. fascicularis* trails in the vicinity of human paths starting from the ticket counter of a local train station (D in Fig. 2) to the main entrance of KSNP (E in Fig. 2), which are hence anthropogenic habitats. During this study, there were two large groups (Table 1) of *M. fascicularis* in the study location but only one group was observed (troop 1 in Table 1), based upon that this group were easy to observe and recognize. They were also well habituated to humans allowing the researchers to come close to them without any clear evidence of disturbing their behavior. This group was marked by their alpha male who had a distinctive short tail compared to the others. Almost every day food was provisioned by humans to the monkeys in this study area, either directly or indirectly (inadvertently) through leaving of food items in their reach, such as in garbage bins near to the ticket counter of a local train station. Thus, more food was provisioned by humans during public holidays because more tourists came to Kuala Selangor. From our observations, the two troops interacted separately with the human residential areas, with one (troop 1 in Table 1) invading or interacting with only the residents of Taman Malawati while the other group (troop 2 in Table 1) invaded Taman Desiran. Table 1 shows the age-sex composition of these two groups of *M. fascicularis* in the study area,



FIGURE 1. Map of Peninsular Malaysia indicating the location of the Kuala Selangor Nature Park (KSNP).

TABLE 1. Age-sex composition of *M. fascicularis* at Kuala Selangor Nature Park. Troop 1 was selected for the study of pest behavior.

Troop no.	Adults		Subadults		Juveniles		Infants		Total (% Male)
	Male	Female	Male	Female	Male	Female	Male	Female	
Troop 1	4	5	5	6	6	8	3	4	41(43.9%)
Troop 2	1	2	1	3	1	3	0	0	11 (27.3%)
Total	5	7	6	9	7	11	3	4	52 (40.4%)

which is female biased, especially in the case of troop 2. Quantitative data was recorded using the interval scan sampling method (Altmann, 1974; Lehner, 1979; Martin & Bateson, 1986) every 10 minutes. The pest behavior categories were based on studies by Md-Zain et al. (2004). Six categories of pest behavior were recorded; messing up garbage cans, littering, disturbing people, stealing, breaking into human areas and damaging facilities, which are in accord with those reported before (Md-Zain et al., 2004). Disturbing people

included all aggressive behavior by the subjects, such as scaring and chasing people. Stealing is described as removal of objects, typically food, such as breads, biscuits, drinks and crop products, which belonged to humans. Breaking into human areas is where the subjects broke into houses, school hostels and mosques. While damaging facilities is the behavior of subjects that damaged property such as lamp posts, electric wires, car wipers, clothes line and so on. In order to reduce bias, the observations were stopped when the weather

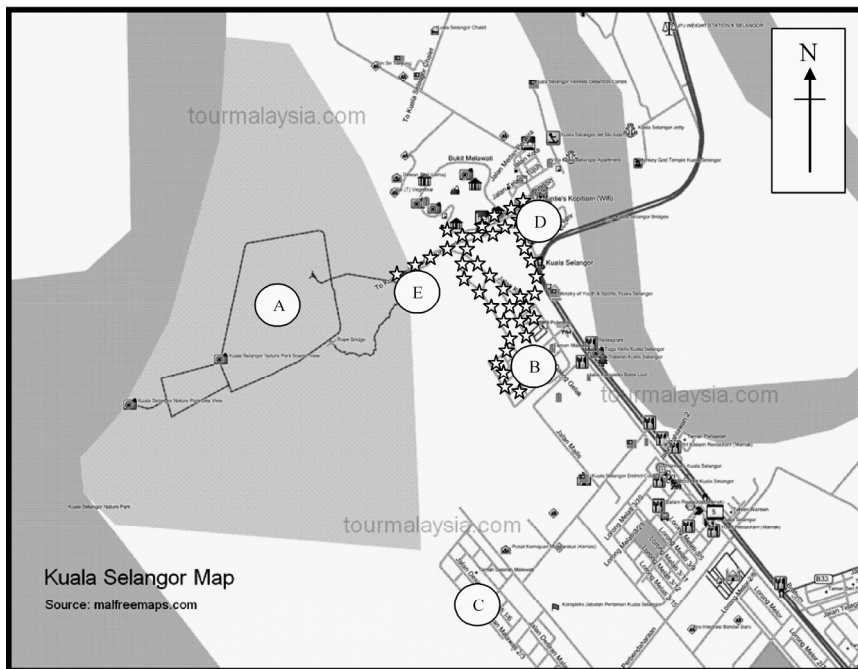


FIGURE 2. The location of study area. A: Kuala Selangor Nature Park; B: Taman Malawati; C: Taman Desiran; D: Ticket Counter and E: Main Entrance of KSNP. ☆: Home range of macaques (group study)

became cloudy or during rain. Observations were particularly difficult to conduct under rainy conditions as subjects were usually partially obscured or moved completely out of sight.

Questionnaire Survey.— For the questionnaire based survey, two residential areas were selected that were based on the nearest locations to the macaque habitat and had reported a high interaction with macaques. The chosen residential areas are Taman Malawati (B in Fig. 2) and Taman Desiran (C in Fig. 2), that are invaded by troops 1 and 2 (Table 1), respectively. Thus, although the direct observations were made on only one troop (troop 1, see above), the interactions of both troops with humans in the residential areas were covered in the questionnaire. Questionnaires were sent to the residents about the long-tailed macaque's disturbances towards humans. This questionnaire is divided into three parts (Part A, B and C; see Appendix), where Part A is on the respondent information, Part B is on the respondent's general knowledge of primates and Part C is related to the long-tailed macaque's disturbances towards humans. The questionnaires were picked up by the researchers after the respondents filled in their answers. A total of 100 questionnaires were distributed randomly to the two residential areas (50 questionnaires in each area). It is estimated that the number of household in Taman Malawati is 200 while there is 300 household in Taman Desiran. But it is also found that most of the houses at both areas are not occupied by the landlords because they work at other places and rarely going back home. Because of this problem, there are some difficulties to get the full feedback from the respondents.

RESULTS

From the intensive direct observation, the six classifications of pest behavior by *M. fascicularis* were classified based upon the frequency of occurrence, with the highest being littering (27%), followed by damaging facilities (23%), breaking into human areas (18%), messing up garbage cans (18%), disturbing people (11%) and finally stealing (3%). During the observations, *M. fascicularis* was seen to damage facilities, such as by jumping on the roof of the residents' houses, mosque and corridors. One of the residents reported that *M. fascicularis* had caused several incidents of damage to their rooftops. Besides, *M. fascicularis* also like to jump on lamp posts, which results in breaking the glass (shaking behavior), bite electric wires, car wipers, and car and house antennas.

With respect to breaking into human areas, macaques were seen to enter school areas and hostels and to disturb the students, such as by entering their classes, messing up garbage cans, and throwing student's clothes that were hung on the clothes line. Macaques tend to enter residents' houses through open doors and windows, those that are closed but not locked, and steal people's belongings from inside, especially food. Messing up garbage cans by carrying out the rubbish to the open area was frequently seen.

In total, 46 (46%) questionnaires were returned. The questionnaires were distributed randomly to two residential areas. Table 2 shows the percentage of information on the different categories of respondents. Most respondents were aged between 41-60 years old (62%) in Taman Malawati while 31-50 years old (58%) in Taman Desiran. One respondent in each residential area failed to give their age. The

TABLE 2. Age race and gender distribution of the respondents to the questionnaire survey.

A. Taman Malawati

Category	Taman Malawati	Percentage (%)
Age	20-30	4
	31-40	2
	41-50	7
	51-60	11
	61-70	4
Gender	Male	17
	Female	12
Race	Malay	23
	Chinese	2
	Indian	4

B. Taman Desiran

Category	Taman Desiran	Percentage (%)
Age	20-30	2
	31-40	5
	41-50	5
	51-60	4
	61-70	0
Gender	Male	13
	Female	4
Race	Malay	15
	Chinese	0
	Indian	2

respondents consist of 59% male and 41% female in Taman Malawati while 76% male and 24% female in Taman Desiran. It was found that the highest percentage of the respondents were Malays (79%), followed by Indians (14%) and Chinese (7%) in Taman Malawati while in Taman Desiran there is 88% Malays followed by 12% Indians and no Chinese respondent.

With respect to the respondent's general knowledge about *M. fascicularis*, the questionnaire sought to identify whether people can distinguish between *M. fascicularis* or *T. cristatus* since these are the only two species of non-human primates living in KSNP. The majority of the respondents claimed that they can differentiate between *M. fascicularis* and *T.*

cristatus (94%), and know something about *M. fascicularis* and *T. cristatus*, such as that *M. fascicularis* has mouth pouches to store food (81%) and the infants of *T. cristatus* are bright orange in color (84%). Most of the respondents (66%) identified that *M. fascicularis* are always disturbing (pests in) their housing areas, and they also claimed that they had heard the news about *M. fascicularis* disturbances (94%). Although the residents responses from both areas given above are grouped together (as in all 46 completed questionnaires), the responses of each of the two residential areas were not numerically different to each other.

From the questionnaires, overall most of the respondents claimed the *M. fascicularis* came to their residential areas in both the

morning (0700 till 1100 hours) (78%), and in the evening (1400 till 1800 hours) (78%), but at a village level there was a slight numerical prevalence for evening at Taman Malawati (90% vs. 83%) and a more pronounced morning bias at Taman Desiran (71% vs. 59%).

Respondents claimed that the highest population size of *M. fascicularis* was about 10-20 individuals in both residential areas (41-45%), although the response level for uncountable, which could be attributed to any of the population size categories, was large at 24% to 31% and so the trend of smaller troops invading residential areas in Taman Desiran 29% compared to 10% for Taman Malawati (Table 3). With respect to the demography of the *M. fascicularis* populations entering into the residential areas, the respondents in both residential areas claimed that sub-adults formed the highest proportion followed closely by adults, whilst juveniles formed a far lower proportion of the individuals (Table 4). This then does not reflect the age composition of the troop (Table 1), suggesting juveniles preferentially avoid the human habitations. Indeed, the purpose of asking about the population size and age classes of *M. fascicularis* in the questionnaire was to evaluate how large the group size and which age class has caused disturbance in the residential areas. Such information is likely

TABLE 3. Respondent's estimated number of monkeys in the group invading their residential area, as a % of all responses given.

No. of monkeys	Percentage (%)	
	Taman Malawati	Taman Desiran
1 to 10	10	29
10 to 20	45	41
20 to 30	14	6
Uncountable	31	24

to be important in formulating successful management plans in the future.

Most of the respondents claimed that they had seen *M. fascicularis* harassing other people and most also claimed that they had been harassed themselves (Table 5). The majority of the respondents are afraid of *M. fascicularis* (53-79%) but only three of the respondents (all in Taman Malawati) had been bitten by *M. fascicularis*. In general these traits were higher in the Taman Malawati residence than in Taman Desiran.

With respect to the negative aspects of *M. fascicularis* on the residential areas, most of the respondents agreed that their presence led to defacing of the residential areas and also can reduce the health level of the residents, especially the children and babies (Table 6). Moreover, they mostly believe that disturbances by *M. fascicularis* are increasing at all time. A majority of the respondents claimed that *M. fascicularis*

TABLE 4. Age-class of *M. fascicularis* visiting residential areas as derived from the questionnaire survey (% of the total responses from respondents).

Age class	Percentage (%)	
	Taman Malawati	Taman Desiran
Adult	28	35
Sub-adult	62	53
Juvenile	10	12

TABLE 5. Percentage of respondents who were afraid, harassed or bitten by *M. fascicularis*.

Category	Percentage (%)	
	T. Malawati	T. Desiran
Afraid	79	53
Have been harassed	79	65
Seen other people harassed	83	65
Had been bitten	10	0

TABLE 6. The respondents' views on the consequences of the presence of *M. fascicularis*

Consequence	Percentage (%)	
	T. Malawati	T. Desiran
Deface residential areas	93	94
Affect safety and health of residents	100	88
Disturbances increasing all the time	90	88
Entered house	86	59
Theft	97	76
---Food	86	88
---Drink	21	12
---Other items	34	24

always entered their house to steal something, and this was typically food but other items, such as clothes, soaps, make-up and drinks, were also reported as being stolen (Table 6). Outside the house, the macaques often threw rubbish from the trash can and that makes the house surrounding look unpleasant or dirty. In addition, the cultivated fruit, especially mangoes and bananas, were often eaten by macaques depriving the residents of the fruits of their labor.

M. fascicularis are capable of opening unlocked doors or windows on their own, which was the most common way they invaded the residents' houses. Besides that, *M. fascicularis* like to enter the residents' houses from the opened windows followed by back doors and front doors. Most respondents also claimed that their house contents were left scattered after *M. fascicularis* left, and that the monkeys left droppings and urine (Table 7).

About half of the respondents claimed that they knew the presence of *M. fascicularis* in their homes by seeing the macaques entering the residents' houses (Table 8). In addition, they knew of the presence of *M. fascicularis* in their house

after the event by seeing the rubbish that was strewn everywhere. However, almost an equal proportion of respondents were able to identify the presence of *M. fascicularis* from their sound (Table 8).

In terms of the potential (in) tolerance to *M. fascicularis*, only 21% and 0% of the responding residents from Taman Malawati and Taman Desiran, respectively, had made a complaint (Table 9). However, that this

TABLE 7. The entry means of *M. fascicularis* into residents' houses and the condition of the house after they left.

Port of Entry / House condition	Percentage (%)	
	T. Malawati	T. Desiran
Open door	17	29
Open back door	34	41
Open windows	38	41
They first opened doors/windows	66	18
Not scattered	10	24
Scattered	76	35
Droppings and urine	52	29

TABLE 8. Methods by which respondents know about the presence of *M. fascicularis* outside their house (% of total responses given by respondents).

Method	Percentage (%)	
	Taman Malawati	Taman Desiran
Sound	45	35
Direct sighting	48	53
Rubbish scattered everywhere	48	35

TABLE 9. Percentage of residents' complaints about *M. fascicularis*.

Action taken	Percentage (%)	
	Taman Malawati	Taman Desiran
Resident made a complaint	24	0
Blamed authority	69	76
Authority to take certain steps	100	94

may not simply reflect tolerance is shown by the fact that most of the residents in both residential areas blamed the authorities for the disturbances and want them to take certain steps to reduce the disturbances of *M. fascicularis*. Many of the respondents also claimed that the authority does not take any action before this.

In terms of what action the responding residents would like the authority to take to reduce the *M. fascicularis* disturbances in the two residential areas, most of them want to cooperate with PERHILITAN to put up traps to catch the monkeys for subsequent relocation elsewhere, and they want to be provisioned with trash cans that cannot be opened by *M. fascicularis* (Table 10). Less popular choices (0-12% respondents) were

TABLE 10. Resident support for steps to be taken by the authorities to reduce *M. fascicularis* disturbance

Action	Percentage (%)	
	T. Malawati	T. Desiran
Install nets on windows	7	12
Cut nearby trees	7	12
Provide trash cans that cannot be opened by <i>M. fascicularis</i>	38	53
Cooperate with PERHILITAN to put out traps	79	59
Install electric fences	10	0

TABLE 11. Residence support for methods to reduce the invading populations of *M. fascicularis* in the human residential area.

Action	Percentage (%)	
	Taman Malawati	Taman Desiran
Capture-transfer	90	82
Vasectomy	69	41
Poisoned or shot	28	12

the installation of nets on windows or electric fences around fruit plantations and properties, or to installing electric fences, installing nets on windows and cutting down nearby trees (Table 10).

Alternative methods suggested by the responding residents to reduce the disturbances by *M. fascicularis* were to reduce the marauding populations in the residential areas. The most popular was to “capture and transfer *M. fascicularis* to their natural habitat”, followed by to induce a “vasectomy of the male” and so reduce the subsequent birth rate (Table 11). The least common proposal was to cull the population by “poisoning or shooting the species”. It is of interest though that more support for all these measures including killing was found in the residents of Taman Malawati that appear to suffer more from *M. fascicularis* induced damages and disturbances. Regardless, that most of the respondents in both residential areas did not want the animals’ killed is likely to reflect their faith, because all religions in Malaysia do not allow its followers to kill the animals indiscriminately.

DISCUSSION

From the results, the highest percentage of pest behavior recorded was littering (27%), where rubbish was littered around the area by *M. fascicularis*, including from their foraging through trash containers. In the trails near to the entrance of KSNP, *M. fascicularis* was always seen taking food waste from the garbage cans and then bringing it away from the garbage containers, so as to get away from other members of the troop without food to avoid competition. After they finished eating, they threw the food containers and wrappers,

such as bottles, polystyrenes, drink cans, plastics and others, to the ground and so spread the litter from the garbage container over relatively large distances. This behavior worsens the environment and gives a bad impression to tourists. This result is similar to that reported by Wan (2004), who found that littering was the most frequently observed pest behavior.

Of relevance then is that this study area is located near to residential town areas and tourist attractions that have a lot of public garbage cans. As macaques adapt to man, garbage cans have become one of the macaque's favorite food sources as they know that there are so much food waste available in them in. During our observations, macaques were always seen to get inside the garbage cans and choose the food waste that can be eaten, but they also discarded what they did not want and so dispersed litter all around the place.

The second most commonly reported pest behavior was that of macaques disturbing people (11%), which is consistent with the fact that macaques tend to be aggressive when people approach them. Lastly, the least frequently observed of the reported pest behaviors was stealing (3%). From our observations, macaques do not steal food items that people brought or bought, but rather they steal crop products inside or outside of the human houses.

From the questionnaires collected, the majority of the respondents had experienced some forms of the monkeys' disturbances in their area. When the respondents were presented with several questions related to the general knowledge of monkeys, it appeared that they knew the macaques very well. For example, they can distinguish between *M. fascicularis* and *T. cristatus*. In addition, they knew that macaques gave many problems to the residents, and about

the interference of macaques in this country that has been published in the media. However, this was not universal as there were still some respondents who were unable to distinguish *M. fascicularis* from *T. cristatus*. This is in broad agreement with previous studies, which reported that most of the respondents were able to identify macaques very well (Tuan-Zaubidah, 2003; Wan, 2004; Zuraidah, 2003; Mastura, 2008).

In both housing areas, it was found that disturbances by macaques occurred during both the morning (0700 till 1100 hours) and evening (1400 till 1800 hours), which may be because at these times there is a lot of food that has been thrown away by people outside of their homes before the arrival of the garbage trucks. The reason for the apparent slight preference for morning visits in Taman Desiran is less clear. Overall, these results are similar to the study of Forbes and King (1982), who reported that the monkeys were very active in the morning and evening, and Else and Eley (1985), who stated that monkey attacks usually occurred during the day.

With respect to the population size of the invading macaques that caused the disturbances, most of the respondents recorded 10-20 individuals, although in Taman Desiran smaller size estimates (1-10) were also frequently given. However, this depends on the time of the respondents' sightings of the macaques as large numbers of macaques were seen in the mornings and evenings compared to the afternoons. Sub-adults and adults were seen more frequently by the respondents to enter human houses than juveniles and in a greater proportion than that of the troop composition, because they are not afraid of humans compared with the juveniles.

In addition, many people were afraid of macaques because they had either directly

experienced being disturbed or saw other people being disturbed by the macaques, including that some people had been bitten by the macaques. Mastura (2008) also reported that the majority of the respondents from the Universiti Kebangsaan Malaysia main campus did not like macaques and were afraid of them. In contrast, macaques that have been habituated to humans or are living outside of their natural habitat and always interact with humans are not afraid of humans, especially women (Cords, 1982; Krebs and Davies, 1993; Tuan-Zubaidah, 2003).

At this study site near the KSNP, the macaques entered the houses of residents and stole their belongings, but typically food. Importantly, the macaques can open the doors and windows on their own to enter houses, as reported before (Kurland, 1973; Sia, 2004). This is similar to previous studies that also reported they raid crops and mess the dumping area (Else and Eley, 1985; King and Lee, 1987), making the area dirty (Zuraidah, 2003; Sia, 2004). In addition, the monkeys also affect the safety and health of humans. For example, besides that the spreading of garbage encourages vermin and insects, the transmission of simian foamy virus (SFV) from free-ranging *M. fascicularis* to human workers at monkey temples suggests that nonhuman primates (NHP)-human transmission of infectious agents can occur in Asia and others may evolve such horizontal transfer as the frequency of macaque-human interactions increases and given the high population density and mobility of macaques (Jones-Engel et al., 2005).

Although the reason why macaques enter the residents' houses and searched for food in the garbage cans might be because they had lost their natural habitat, they are also habituated to being fed by humans and so

habituated to humans' food. Certainly, at this study site near the KSNP, as elsewhere, it seems that people from all races like to feed the monkeys. These explanations of course are not mutually exclusive but rather go hand in hand. According to the study by Sussman and Tattersall (1981), macaques have a variety of specific techniques for obtaining and manipulating food that they have acquired through experience and individual learning.

Most of the residents recognized when the macaques had disturbed their residential areas in three ways; (i) they saw the macaques came from the forest, (ii) the garbage cans were lying around, and leftovers of fruits were littered by the macaques and (iii) by the macaques' calling. This shows that people have become familiar with the situation over the years and sensitized towards the disturbances by macaques in their house areas. That only a few people had made formal complaints may reflect the scant information available to them on how, where and to whom they should complain to, rather than tolerance. In accord, they often blame the authorities for not taking any action and many residents agreed that the authorities should take action to solve the pest behavior of macaques.

In order to reduce these disturbances by macaques at residential areas the local authorities need to work with the Wildlife Department and National Park (PERHILITAN), the sole agency responsible for looking after the wildlife in Peninsular Malaysia, to set up traps, provide garbage cans that cannot be opened by the macaques, and fix electrical fences that can give boundaries between humans and macaques. The concept of working together with PERHILITAN is also supported by other reports (Zuraidah, 2003; Tuan-Zubaidah, 2003; Sia, 2004). In addition, some people agreed to fix nets on

their windows to prevent macaques from entering their houses, whilst others have already fixed their nets, presumably because of the low cost and ease of fixing. The next problem is to either cut down the fruit trees near their homes to reduce the attraction of the area to macaques but render the loss of food and income from these fruits, or at an initial large expense to install electric fences or similar means of protecting the crops.

The purpose of the survey was in part to obtain information and suggestions from the public in order to select the best method to manage the human-macaque interactions in their area in the future. The following methods could be used to reduce the population of macaques in both residential areas of this study. Although many respondents supported the capture and translocation of macaques from the residential areas into far away forest areas, this is not very effective because the macaques learn quickly (Else and Eley, 1984), can escape and learn from their past experiences, and can be replaced by others (especially as humans encroach into their habitat more and more). Alternatively, some respondents support the idea of alpha male vasectomy in order to prevent the macaque populations from increasing dramatically. The support for these two methods is probably because they are viewed as not being cruel or killing the animals and so are in accord with their moral or religious beliefs. Note that the information about translocation and vasectomy as possible choices was given to the respondents by the researchers in the survey, and so does not reflect their *a priori* awareness but rather their choice from a list of options. However, killing of encroaching macaques may be acceptable or become acceptable as a last resort if others fail.

Furthermore, there were differences in the human-macaque interactions between the Taman Malawati and Taman Desiran residential areas. Human-macaque interactions were higher at Taman Malawati than at Taman Desiran, presumably since Taman Malawati is located much closer to the entrance route into KSNP where many tourists visit. Macaques are directly or indirectly (e.g. garbage bin foraging) fed by humans in this area, and the macaques are more concentrated in these areas including along the trails starting from the ticket counter of the local train station to the main entrance of KSNP. In addition, the residents in Taman Malawati also planted many fruit trees, such as mangoes and bananas, near their houses and these attract the macaques.

The attitude of humans towards macaques in Taman Malawati residential area and the tourist area varies markedly. In general the tourists like the macaques, perhaps because they are spared the disturbances they cause (being visitors to the region and not residents), and they like to feed the macaques, and watch them up close. In contrast, in general the residents of Taman Malawati and Taman Desiran do not like the presence of the macaques in their residential areas because of the already discussed problems the macaques bring to them. One management plan for Taman Malawati then would be to create a feeding area for the macaques and feed them every day, once each in the morning, afternoon and evening, so as to reduce the macaques' disturbance in Taman Malawati. This could be near to the area that the tourists visit to become a tourist attraction. However, whilst this may reduce the problems of macaques in residential areas searching for food (as long as the provisioned food level always meets the existing demand by the macaque population), it would lead to habituation and

potential dependence on humans, a potential macaque population increase and potential macaque-human disease issues. It does have the advantage of attracting the visitors (economically important to the region) and to take care of the welfare of the macaques there. In contrast, the management plan for the macaques in Taman Desiran, which is further away, is to trap and transfer them to the undisturbed habitat areas or forest reserves away from these residential areas.

Malaysia is still at a poor level in managing the pest behavior of macaques. This may be due to lack of monitoring and action from the responsible authorities in wildlife, especially PERHILITAN, in areas that have a high interference level from macaques. Lack of awareness by the public against these pests will also cause an increase in the interference of macaques. In addition, some communities in Malaysia also like to have macaques as pets, while the Hindus regard these animals as sacred and honored. Problems caused by the macaques will get worse as the abundance of macaques in some tourist areas increases, such as Bukit Malawati Kuala Selangor, Templer Park Kuala Lumpur, Penang Botanical Gardens and the Taiping Lake Gardens. Here tourists like to feed the macaques and this can lead to the macaques feeling safe (habituating to humans) and so explore nearby human residential areas and so result in the increase in macaque's population level and residential human-macaque interactions and disturbances. Poor maintenance of garbage collection in Malaysia will also contribute to the increased population and interference levels of macaques in human residential areas. This is because the macaques do not have to trouble themselves in searching for food but rather can eat trash from the garbage area. In other countries, such as in Kenya, they have

used three methods to prevent the primates from disrupting their farm. These methods are chasing, shooting and trapping and poisoning the primates (Else and Eley, 1984). In comparison with Uganda, the main techniques used to protect their farm were patrolling the area with dogs, spears and bells to get rid of baboons (Hill, 2000).

CONCLUSION

According to the results obtained from the study; littering, damaging facilities, breaking into human areas and messing up garbage cans were the most common pest behaviors of the macaques.

From the survey, it was discovered that many of the respondents had been staying in the vicinity for a long time and so were familiar with macaque identification and their disturbances. They have to live under stress because their homes were often infiltrated by the macaques and the macaques also frequently stole items from their homes, especially food.

Overall, the results of this study suggested that the pest behaviors of the macaques were related to locating and obtaining food. The same result has also been reported in previous studies (Fuentes et al., 2005; Md-Zain et al., 2004; Sha et al., 2009).

RECOMMENDATIONS

It is recommended that Malaysian Nature Society (MNS) needs to cooperate with the Kuala Selangor District Council (MDKS) and the Wildlife Department and National Park (PERHILITAN) to reduce this pest behavior. As a suggestion, the government link organizations, like PERHILITAN and MDKS, and the non-government organizations,

like MNS, must create a buffer zone that can be a permanent habitat to *M. fascicularis*. This buffer zone must have some space that provides food for macaques every day, once in the morning, afternoon and evening so as to reduce pest behavior in the study area.

Besides, MDKS needs to reduce the number of garbage cans at the study area, collect the garbage everyday and on time. Other than that, MDKS must think innovatively on how to create garbage cans that cannot be open by the macaques. In order to reduce pest behavior, agencies such as Universiti Putra Malaysia (UPM), PERHILITAN and MNS should initiate an awareness program for the local people nearby and also the tourists.

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Appendix

Questionnaire Survey



This questionnaire survey is intended to identify the problems of Macaque disturbance (*Macaca fascicularis*) at Kuala Selangor residential areas. 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 (a) Male (b) Female
3. Race (a) Malay (b) Chinese (c) Indian (d) Others
4. Residential Area Name:.....
5. Types of area: (a) Rural (b) Urban

PART B (circle your answer)

1. Can you differentiate between Macaque and Silvered-leaf monkey? Yes / No
2. Do you know anything about Macaque? Yes / No
3. Do you know anything about Silvered-leaf monkey? Yes / No
4. Which species that is/are always disturbing your area? Macaque / Silvered-leaf monkey
5. Have you heard any news about Macaque disturbance? Yes / No

PART C (circle your answer)

6. At what time the Macaque come and disturb your house area?
 - A. Morning (0700 till 1100 hours)
 - B. Evening (1400 till 1800 hours)
7. How many Macaques that you have seen disturbing your house area?
 - A. 1-10
 - B. 10-20
 - C. 20-30
 - D. Uncountable
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)
9. Are you afraid of Macaque?
 - A. Yes
 - B. No
10. Have you been disturbed or chased by Macaque?
 - A. Yes
 - B. No
11. Have you ever seen other people being disturbed by Macaque?
 - A. Yes
 - B. No
12. Have you been bitten by Macaque?
 - A. Yes
 - B. No
13. Does the existence of Macaque contaminate the area of your house?
 - A. Yes
 - B. No
14. Do you feel the existence of Macaque affect the safety and health of all residents?
 - A. Yes
 - B. No

15. Do you feel that Macaque disturbance is increasing from time to time?
 - A. Yes
 - B. No
16. Have the Macaques entered to your house?
 - A. Yes
 - B. No
17. Have the Macaques stole or took anything from your house?
 - A. Yes
 - B. No
18. What type of thing that Macaque stole or took from you?
 - A. Food
 - B. Drink
 - C. Others, please state:
19. How does Macaque enter your house?
 - A. By the opened front door / By opening the front door
 - B. By the opened back door / By opening the back door
 - C. From an open window
 - D. Macaque knows how to open door/window that is not closed or locked properly
20. What is your house situation after it is entered by Macaque?
 - A. Not scattered as the Macaque just take what they want
 - B. Scattered
 - C. Macaque leave their droppings and urine
21. How you know on the existence of Macaque in your house area?
 - A. The sound of the Macaque
 - B. By seeing the monkey coming
 - C. Conditions of rubbish scattered everywhere
22. Have you ever reported about the disturbance of Macaque at your house area?
 - A. Yes
 - B. No
 - C. Do not know where and how to report.
23. Do you think that the authorities do not care about the problem of Macaque disturbance at your house area?
 - A. Yes
 - B. No
24. Do you agree that the authorities need to take some actions to reduce this disturbance?
 - A. Yes
 - B. No
25. Which steps that you agree should be taken by the authorities to overcome this problem?
 - A. Put nets on windows
 - B. Cutting trees near your house
 - C. Provide bins that cannot be opened by Macaque
 - D. Request traps from PERHILITAN to put at house area
 - E. Set electric fence along the residential area
26. Does the Macaque need to be caught and transferred (translocation) to another place as a way to reduce disturbance?
 - A. Yes
 - B. No

(Translocation: capture and then releases the animals from one habitat to another)
27. Do the male Macaques need to be sterile (vasectomy) to reduce the population of the Macaque and indirectly reduce the disturbance?
 - A. Yes
 - B. No

(Vasectomy: surgical procedure designed to make the male monkeys sterile to prevent pregnancy)
28. In your opinion, does the Macaque need to be poisoned or be shot to reduce the disturbance?
 - A. Yes
 - B. No