

## DAILY MOVEMENT, SLEEPING SITES AND CANOPY LEVEL USE OF HABITUATED SILVERED-LEAF MONKEYS (*Trachypithecus cristatus*) IN BUKIT MALAWATI, KUALA SELANGOR, MALAYSIA

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**Abstract:** A study on the daily movement, common use of sleeping sites, and canopy level of habituated silvered-leaf monkeys (*Trachypithecus cristatus selangorensis*) was carried out in Bukit Malawati, Kuala Selangor, Malaysia. The scan sampling method was used to observe behavioral data. The results showed that the daily movement of the study group was small and limited in the usage of their territories. They tended to move in the range of 10 to 200 m per day. The home range for the study group was estimated to be at 0.01 km<sup>2</sup>. The short and limited movement of the study group was closely related to the territorial factor. The factor of abundance and distribution of food resources was also a major factor affecting the movement of silvered-leaf monkeys in the study area. In addition, the movement pattern of the study group was believed to have been influenced by the habituation process. The movement styles that were used by the study group were crawling, hanging, and jumping at the study area. The forest structure and its contents are extremely important in determining the height of tree that will become the place for where silvered-leaf monkeys will search for food. The study showed that the study group spent the most time in the lower canopy (27%), followed by the middle canopy (26.3%), ground level (25.8%), upper canopy (16%), and finally the emergence (5%). For the choice of sleeping sites, members of the study group selected chosen higher canopies from the ground, specifically; the middle canopy (33%), upper canopy (30%), emergence (20%), and lower canopy (17%). It was found that the study group did not choose sleeping site at the ground level, where they would not be able to prevent attacks from the predators. Treetops act as protection for silvered-leaf monkeys.

Keywords: *Trachypithecus cristatus*, silvered-leaf monkeys, ranging behaviour, habituated, Bukit Malawati.

### Introduction

The silvered-leaf monkey or *Trachypithecus cristatus* (Raffles, 1821) is one of the Colobinae species that can only be found in the west coast of Peninsular Malaysia, Sumatra, Borneo, nearby islands, and the Riau Archipelago (Roos *et al.*, 2008; Figure 1). According to Medway (1970), silvered-leaf monkeys recently colonized Peninsular Malaysia from the Sumatra, while the broader population in Borneo and Sumatra is due to the absence of competitors. This species has been classified as near-threatened animals on the International Union for Conservation of Nature and Natural Resources (IUCN) Red List of Threatened Species due to the rate of population decline (IUCN, 2015). Khan (1978)

estimated that the species declined from 6,000 to 4,000 individuals in Peninsular Malaysia in 1958 to 1975. According to Chivers and Davies (1979), the population of this species is declining in Peninsular Malaysia due to poaching activities by the indigenous people. Meanwhile, in Sarawak, the indigenous people hunt this species to be traded and kept as pets in Sumatra (IUCN, 2011). The activities and events that are assumed to be the main causes of the population decline are logging, deforestation, forest fires, and uncontrolled poaching (Maklarin, 2008).

Silvered-leaf monkeys are abundant in mangroves, coastal and riparian areas, and farms. However, they do not like living in deep forests because there are many mature leaves



Figure 1: Distribution of *T. cristatus* in Peninsular Malaysia, Sumatra, Borneo, nearby islands, and the Riau Archipelago (adapted from Roos *et al.*, 2008)

that are low in quality (Lee, 2010). They are folivorous animals, eating mainly leaves as their diet; according to Hock and Sasekumar (1979), silvered-leaf monkeys' diet consists of 91% leaves, while fruits only make up 9% of their diet. Apart from leaves and fruits, they have also been found to choose seeds and flowers (Roonwal & Mohnot, 1977). Generally, leaf-eating monkeys engage in a small amount of daily movement and have a small home range compared with fruit-eating (frugivorous) monkeys (Clutton-Brock & Harvey, 1977; Chapman & Chapman, 2000). Previous studies have recorded that the quality and distribution of food affect the ranging behavior of primates (Pages *et al.*, 2005; Kirkpatrick, 2007; Lambert, 2007). Apart from these, there are also other factors such as temperature (Yang, 2003), rain (Olupot *et al.*, 1997), group size (Strier, 1987; Ostro *et al.*, 1999; Ganas & Robbins, 2005; Fashing *et al.*, 2007), water resources (Chapman, 1988), resting and sleeping sites (Liu *et al.*, 2004; Zinner *et al.*, 2001; Zhou *et al.*, 2007), predators (Boinski *et al.*, 2000; Treves, 2002), and habituation processes (Md-Zain *et*

*al.*, 2009) that influence their range. Therefore, this study was conducted to determine the behavior patterns of silvered-leaf monkeys in the study area.

## Materials and Methods

### Study Area

This study was conducted in Bukit Malawati, Kuala Selangor, Selangor, Malaysia (3°20'27.42"N, 101°14'55.17"E; Fig. 2). Bukit Malawati is an area of 16.2 ha and is close to some historical landmarks. It faces the Straits of Malacca, which is the main ship route. The high terrain has caused it to be suitable for sighting the moon and preferable for lighthouse location. Bukit Malawati is surrounded by Kuala Selangor Nature Park, residential areas, schools, and small towns (Figure 2). There are only two primate species in the study area, namely long-tailed macaques (*Macaca fascicularis*) and silvered-leaf monkeys (*T. cristatus*). However, this study only focused on one of the groups of silvered-leaf monkeys that habituate the study area.



Figure 2: The location of study area (Source: Google Earth, 2016)

**Behavior Sampling Methods**

Scan sampling methods were used to observe the daily movement of the study group (Altmann, 1974; Lehner, 1979; Martin & Bateson, 1986). These data are related to the horizontal movement of the study group in the daytime at the study area. In this study, data observations were made during the time interval of 15 minutes starting from 0900 hours until 1800 hours. The data were then used to draw the path of real movement on the map of the study area. A minimum convex polygon (MCP)

method was utilized to estimate the home range of the study group (Meulman & Klomp, 1999; Baker, 2001; Creel & Creel, 2002; Rurik & Macdonald, 2003). To build the smallest convex polygon around the data, MCP is the easiest way to draw the boundaries of the home range. All of the sleeping sites were identified, marked, and mapped via a global positioning system (GPS). In addition, the uses of tree canopy level by the study group were recorded. The heights of the tree canopy level were classified into five levels, as shown in Table 1 below.

Table 1: Height classification of tree canopy levels (adapted from Whitmore, 1993)

Canopy Level	Code	Height (m)	Description
Emergence	EM	>36	Crown of the forest formed by a number of tall trees.
Upper Canopy	UC	26-35	The highest forest strata formed loosely by interconnected tall tree crowns.
Middle Canopy	MC	16-25	Middle forest strata formed by tightly enclosed tree crowns of medium-sized trees.
Lower Canopy	LC	6-15	Lower forest strata formed loosely by sparsely distributed small trees crown.
Ground Level	GR	0-5	Ground level, including stream and riverbanks and understory vegetation consists of herbaceous trees and bushes.

**Study Group**

One group of habituated silvered-leaf monkeys that has been habituating in Bukit Malawati near to the moon-sighting site was selected as the study group (Figure 3). The study group was very docile and easy to approach by the researcher and tourists. This is because they have been habituated to the presence of people. The study group was marked by their ranging area. The unique characteristics of each individual, the alpha-male, and the ranging area can help researchers to recognize a group of primates (Hamada *et al.*, 2005). The size of the study group were 47 individuals which consist of 3 (6.4%) were adult males, 25 (53.2%) were adult females, 8 (17%) were sub-adults, 5 (10.6%) were juveniles and 6 (12.8%) were infants (Table 2). The males:females ratio for this study group was 1:8.

**Results and Discussion**

The study group tended to move within 10 to 200 m per day. The daily movement, sleeping sites, and home range of the study group are shown in Figure 4. The home range for the study group was estimated to be at 0.01 km<sup>2</sup> (Figure 4). This may indicate that the study group was less prominent in the usage of their territories, having short and limited movement. The results of this study supported previous findings by Clutton-Brock and Harvey (1977), Chapman and Chapman (2000), and Maklarin (2008), who stated that the movement of most Colobinae species is small. However, the findings contradicted those of Furuya (1961) and Bernstein (1968), who reported that silvered-leaf monkeys would explore or walk about 200 to 500 m within their territories every day and were usually headed by an adult male. According to Hambali *et al.* (2014), leaf-eating

Table 2: Age structure of study group

Adult Males	Adult Females	Sub-adults	Juveniles	Infants	Total
3	25	8	5	6	47



Figure 3: Study group at the moon-sighting site, Bukit Malawati, Kuala Selangor

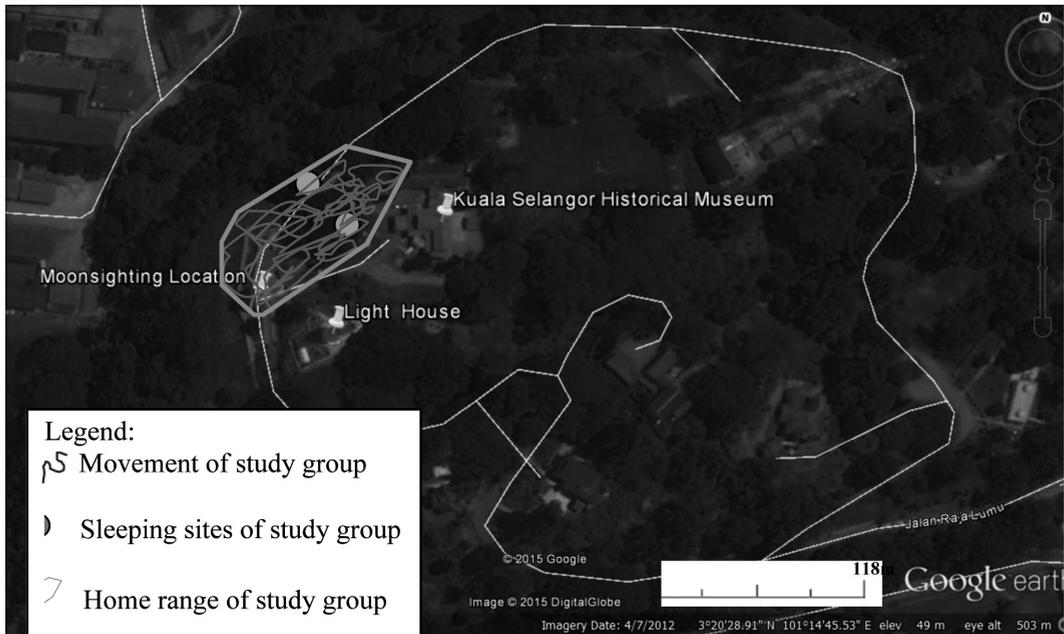


Figure 4: Map of the study area showing the movement patterns, sleeping sites and home range of the study group

monkeys also exhibit small daily movement and a small home range compared with fruit-eating monkeys.

In short, limited movement of the study group was closely related to the territorial factor. According to Wolf (1978), the boundary or territory is often disputed and quite flexible. During the study, it was found that the home range of the study group overlapped with those of another group of silvered-leaf monkeys, showing that they can tolerate with each other. Mohd-Daut (2005) demonstrated that silvered-leaf monkeys would embrace when they clash with other groups. However, each group of silvered-leaf monkeys still needs to defend its territory from invasion by other groups. The division of the territory into overlapping habitats occurs to minimize the competition for limited resources (Maklarin, 2008; Hambali *et al.*, 2014). Although silvered-leaf monkeys rarely live with other Colobinae species, there is evidence that their habitat can overlap with *Presbytis siamensis* in Peninsular Malaysia and *Macaca nemestrina* in Peninsular Malaysia, Sumatra, and Borneo (Francis, 2008). At the

study area, it could also be seen that the study group shared their habitat with *M. fascicularis*. This is supported by Bernstein (1968), who reported that in the overlapping habitat of silvered-leaf monkeys with *M. fascicularis*, silvered-leaf monkeys will try to avoid a clash to reduce aggressive interactions. Meanwhile, according to Furuya (1961), when silvered-leaf monkeys eat with *M. fascicularis*, the silvered-leaf monkeys will relent and give space to *M. fascicularis* without fighting. Finally, according to Hambali *et al.* (2012), who conducted a study on daily activity budget of long-tailed macaques near the study area, fighting behavior was observed least frequently of all activities.

The factor of abundance and distribution of food resources was also a major factor affecting the movement of silvered-leaf monkeys in the study area. This result was supported by the findings of Pages *et al.* (2005), Kirkpatrick (2007), Lambert (2007), and Hambali *et al.* (2014); these researchers stated that the quality and distribution of food affects the ranging behavior of primates. In addition, the movement pattern of the study group was believed to

have been influenced by the habituation process. According to Md-Zain *et al.* (2009), the habituation process is an adaptation of the animals toward an environment that is not their original habitat, and this happens gradually. The presence of tourists that keep feeding the silvered-leaf monkeys was found to be the main reason the study group has become habituated and docile. As a result of this behavior, the study group was no longer afraid of humans and often wandered around the study area to obtain food resources from the tourists. In comparison, wild silvered-leaf monkeys would run away or hide if they came across humans.

The movement styles that were used by the study group were crawling, hanging, and jumping at the study area. The forest structure and its contents are extremely important in determining the height of tree that will become the place for where silvered-leaf monkeys will search for food. Through observations on the use of tree canopy levels, we found that the study group most frequently used the lower canopy (27%), followed by middle canopy (26.3%), ground level (25.8%), upper canopy (16%), and emergence (5%). This study exhibited some similarities with that of Hambali *et al.* (2014), who found that the long-tailed macaques at the entrance of Kuala Selangor Nature Park also often choose the ground level, followed by the lower canopy, middle canopy, upper canopy, and finally the emergence. However, the results of this study contradicted those of Maklarin (2008), who found that the Colobinae species *Presbytis rubicunda* in Tawau, Sabah frequently uses the middle canopy, followed by the upper canopy, lower canopy, ground floor, and emergence. This contradiction in the results may have emerged because the study group in the study area has been habituated to the presence of humans, whereas in Tawau, Sabah, they are still living in the wild. Silvered-leaf monkeys that have been habituated in Bukit Malawati are frequently found in the lower and middle canopies, because it is easier for them to get down to ground level to obtain food from humans.

It was found that in the morning, the study group was not very active and spent most of the

time resting on tree canopy levels, such as at middle canopy, upper canopy, and emergence. This is supported by Ampeng and Md-Zain (2012) who found that the species of *Presbytis chrysomelas chrysomelas* is also less active in early morning. These monkeys were found in the middle of the canopy level before gradually descending to the lower level at 10-6 m. According to a study conducted by Mohd-Daut (2005), the resting behavior of the habituated silvered-leaf monkeys in Bukit Malawati was high at 1000 hours to 1200 hours. Moreover, in the afternoon, the study group also became less active, as the warm weather caused them to find a shady place to rest, such as at the ground level, as well as lower and middle canopy; they avoided being at the emergence at this time. In the evening, the study group was found to be very active and was regularly using ground level, lower canopy, and middle canopy. This may be due to the presence of many tourists who came to feed the silvered-leaf monkeys. This contradicts the study by Ampeng and Md-Zain (2012) who found that the species of *P. chrysomelas chrysomelas* more often uses the middle canopy than the lower canopy in the evening.

Silvered-leaf monkeys belong to the diurnal group, and thus these animals are active during the day. Normally, the silvered-leaf monkeys began to leave their sleeping sites in the morning and went back to their sleeping sites in the evening. This is supported by Maklarin (2008), who stated that most primate species begin and end their daily movement at their sleeping sites. The study group was found to choose two large, tall trees in the study area as their sleeping sites (Figure 4). The use of the canopy level for their sleeping sites was also observed. The results showed that the animals in the study group chose their sleeping sites at the high levels, such as the lower canopy (17%), middle canopy (33%), upper canopy (30%), and emergence (20%). It was found that the study group did not choose sleeping sites at the ground level, where they would not be able to prevent attacks from the predators. Treetops act as protection for silvered-leaf monkeys (Medway, 1969; Streck,

2002). This is supported by Maklarin (2008) and Hambali *et al.* (2014), who stated that the higher level of tree canopy was safe and allowed the animals to easily monitor the danger of encroachment by predators and other groups of primates.

Avian raptors that can be potential predators of silvered-leaf monkeys in the study area were *Haliastur indus*, *Milvus migrans*, *Nisactus* sp., and *Lophotrioichis kienerii*. Bernstein (1968) stated that the presence of eagles in Kuala Selangor has frightened the silvered-leaf monkeys; he also found that the male silvered-leaf monkeys will try to chase away eagles and owls from their resting place. The potential predators in the land area include *Cuon alpinus* (wild dogs), *Canis familiaris* (dogs), and *Arctictis binturong* (binturong); these predators can take away the young juveniles of silvered-leaf monkey groups (Streck, 2002; Francis, 2008). According to Hambali *et al.* (2014), who conducted a study on long-tailed macaques at the entrance of Kuala Selangor Nature Park, which is near the study area, long-tailed macaques are extremely afraid of the presence of dogs. However, the rate of victimization for Asian Colobinae species is very low (Davies & Oates, 1994). Victimization rates are difficult to measure in a primate species, but it may be low when the predator is shy and in areas that are fragmented, as in such areas, the predator population is smaller compared to an undisturbed habitat (Isbell, 1994; Hill & Dunbar, 1998; Hill & Lee, 1998; Hart, 2007). In Africa, there are not many avian raptors that are large enough to eat primate species and weigh more than 2 kg (Streck, 2002; Hart, 2007).

### Conclusion

This study showed that the daily movement of habituated silvered-leaf monkeys at the study area was small and limited. The study also showed that the study group frequently used the lower canopy, followed by the middle canopy, ground level, upper canopy, and finally the emergence. For the choice of sleeping sites, the study animals chose higher canopies from the

ground, namely the middle canopy, followed by the upper canopy, emergence, and lower canopy.

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