

## POSITIONAL BEHAVIOR OF ROBINSON'S BANDED LANGUR (*Presbytis femoralis robinsoni*)

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**Abstract:** *Presbytis femoralis robinsoni*, locally known as the 'lutong ceneka', is an endemic *femoralis* subspecies to the northern part of Peninsular Malaysia and southern Thailand. This langur warrants immediate conservation attention, as it is categorized as Near Threatened by the International Union for Conservation of Nature (IUCN), with a declining numbers of population trend and being threatened with numerous conservation issues. With poor understanding on population status and unresolved conservation framework in Malaysia, data on behavioral ecology such as positional behavior of *P. f. robinsoni* are non-existent in Malaysia. Thus, this study describes the first record on qualitative aspects of the positional behavior of Robinson's banded langur (*P. f. robinsoni*) in the Sungai Sedim Recreation Forest (SSRF), Kedah, Malaysia. The positional behaviors of *P. f. robinsoni* in SSRF involve sitting, lying, quadrupedal standing, bipedal standing, clinging, and forelimb suspension. These varieties of observed positional modes may be identified as it may related to the primary forest habitat conditions. Understanding langur behavioural responses to their natural habitat environments are useful in developing an effective conservation framework for the Robinson's banded langur in Malaysia.

Keywords: Behavioral ecology, positional behavior, Peninsular Malaysia, colobine, Sungai Sedim Recreation Forest.

### Introduction

Positional behavior can be described as body posture with movement (Hunt *et al.*, 1996). Evolutionarily, primates exhibit more variations in positional movement and behaviour than any other mammals (Chatani, 2003). Different primate species have their own unique positioning characteristics related to their morphological and ecological characters and habitat (Chatani, 2003; Kamaluddin *et al.*, 2019). Primates use specific postures and locomotor behaviour to forage, avoid predators, and perform crucial social and reproductive behaviours. Positional behaviour plays a main role in a primate's chances of survival and reproduction. It helps the primates to determine the extent to which effective use of habitats surrounding them which ultimately affects

their foraging strategy, predator avoidance and reproductive success (Napier and Napier, 1967).

Studies on primate positional behavior have been carried out on many colobine species, such as the Dusky langur, *Trachypithecus obscurus* (Ch'ng and Md-Zain, 2009; Md-Zain and Ch'ng, 2011; Ruslin *et al.*, 2019); Delacour's langur, *T. delacouri* (Workman & Schmitt, 2012); Hatinh langur, *T. hatinhensis* and red-shanked douc, (*Pygathrix nemaeus*) (Workman & Covert, 2005); White-headed langur, *T. leucocephalus* (Huang & Li, 2005) and the Proboscis monkey, *Nasalis larvatus* (Matsuda *et al.*, 2017). Previous studies on two sympatric Malaysian colobines *Trachypithecus obscurus* and *Presbytis siamensis siamensis* showed differences in the frequency of leaping and quadrupedal locomotion that enable them to

exploit different aspects of their arboreal niche (Fleagle, 1978). These differences in positional behaviour were reflected in their lower limb joint anatomy and muscle mass (Fleagle, 1978). In Vietnam, *T. delacouri* does not show any specific adaptations for limestone karst. *T. delacour* seem to be a behaviourally flexible species and capable of locomoting through and living in the limestone rock area (Workman & Schmitt, 2012). In China, François' langurs *T. francoisi* spent more time on the hilltop areas which is low-risk and relatively food-poor area. However, when young leaves and fruit were scarce, the langurs increased their time at the valley basin which is high-risk and food-rich area. *T. francoisi* was semi terrestrial and used leaping and climbing as their main locomotor modes. These behavioural forms are associated to characteristics of topography and vegetation in limestone. The langurs limited movement to the main canopy and frequently leaping while traveling in the hillside and valley basin (Zhou *et al.*, 2013).

In addition, related cercopithecine positional behavior studies have also included long-tailed macaques, *Macaca fascicularis* (Cant, 1988); Assamensis macaques *Macaca assamensis* and rhesus macaque, *Macaca mullata* (Huang *et al.*, 2015). The positional behaviour of primate may be related to morphological and ecological factors (Huang *et al.*, 2015). For example, the Chinese sympatric macaques, Assamese macaque, *M. assamensis* and rhesus macaque, *M. mullata* morphologically vary in the limb length and body size. *Macaca assamensis* has longer limbs and larger body size than *M. mullata*. *M. assamensis* tend to climb vertically, whereas *M. mulatta* tend to walk horizontally (Huang *et al.*, 2015). *M. mulatta* tend to use smaller substrate more often than *M. assamensis*. In term of habitat utilisation, *M. assamensis* mostly uses limestone cliff faces and tend to be terrestrial. While *M. mulatta* mostly stay low on the hillsides and spent most of their time in the lower canopy of the tree.

In cercopithecoid comparison, sympatric long-tailed macaques *M. fascicularis* and spectacled

duky leaf monkey *T. obscurus* showed different movement in their daily patterns, in which the long-tailed macaques spent more time feeding and moving compared to resting whereby the dusky leaf monkey spent longer time in feeding and resting rather than moving (Md-Zain *et al.*, 2010; Ruslin *et al.*, 2019). Among the Old World monkeys, colobines generally sit while feeding, whereas cercopithecines tend to stand (McGraw, 1998a). This may relate to the differences in the distribution of preferred food sources, with leaves being more commonly distributed than fruits and insects in the canopy level (Grueter *et al.*, 2013).

Previous positional studies had also involved apes such as the Bornean orangutan, *Pongo pygmaeus* (Cunningham *et al.*, 1989; Thorpe & Crompton, 2006; Manduell *et al.*, 2012; Kamaluddin *et al.*, 2019) and Malayan siamang, *Symphalangus syndactylus* (Fleagle, 1976). Bornean orangutans of Bukit Merah Orangutan Island on captive condition preferred sitting and lying postures (Kamaluddin *et al.*, 2019). In captive condition, Bornean orangutan still maintained variety of positional modes as the great ape originating from the tropical inhabitants of wooded environments (Kamaluddin *et al.*, 2019).

The banded langur (*Presbytis femoralis*) is the Asian colobine monkey (Groves, 2001). It is classified as Near Threatened under the International Union for Conservation of Nature (IUCN) Red List of Threatened Species as their population trend is declining (Nijman *et al.*, 2008). This leaf monkey is arboreal and diurnal and inhabits primary forests, secondary forests, rubber plantations, and orchards (Md-Zain, 2004; Md-Zain & Md-Sharif 2005). Its diet includes young leaves and forest fruits (Abdul-Manan, 2018). It is commonly be found in Malay Peninsula, Ithmus of Kra (Thailand, Myanmar) and Sumatra (Indonesia) (Md-Zain 2001). Previously three subspecies of *P. femoralis* (*P. f. femoralis*, *P. f. robinsoni*, and *P. f. percura*) with non-overlapping distributions are recognized (Roos *et al.*, 2014), but recent molecular studies suggest that *P. f. robinsoni* may constitute a separate species (Abdul-Latiff *et al.*, 2019).

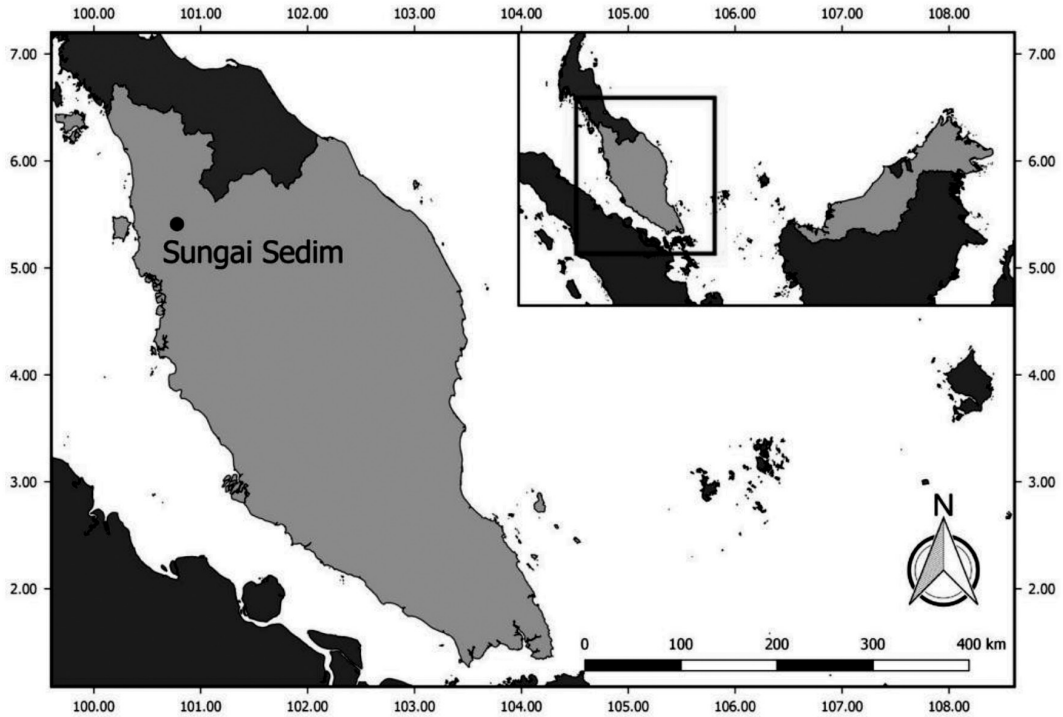


Figure 1: Map of Sungai Sedim Recreational Park (SSRP)

To date, few studies are available on the behavioral ecology of the Malaysian *P. femoralis* group, *P. f. robinsoni* (Abdul-Manan, 2018) as compared to molecular data studies (Md-Zain et al., 2008; Vun et al., 2011; Abdul-Latiff et al., 2017a, Abdul-Latiff et al., 2019). One of the main conservation issues regarding *P. f. robinsoni* in Malaysia is their involvement in human-primate conflict. Abdul-Latiff et al., (2019) reported that banded langurs (*P. f. robinsoni* and *P. neglectus*) are currently inhabiting rubber and oil palm plantations as means of adapting to rapid and excessive land use change and habitat destruction (Abdul-Latiff et al., 2017b). Lee and Priston (2005) has proved that understanding primate behavior plays a huge role in resolving human-primate conflict and serves as means to change human attitudes toward non-human primates. Thus, the objective of this study is to describe the positional behavioral modes of *P. f. robinsoni* in low dipterocarp forest. This information is very crucial to disseminate the understanding on different stances and positions of these

endangered banded langurs to ensure that humans do not treat every positional behavior as threats and signs of aggressive behavior.

### Materials and Methods

The Sungai Sedim Recreation Forest (SSRF) ( $5^{\circ}40'91''$  N,  $100^{\circ}77'71''$  E) is located 30 km northeast of Kulim, Kedah (Figure 1). This forest reserve is also a popular recreational site for nature activities and outdoor lovers. Robinson's banded langur of Sungai Sedim are not well habituated to human observers. They show signs of fright, vigilance, or avoidance directed at human observers. We observed the positional behavior of one langur group (group A) for 30 days from 0700 to 1000 h or 1600 to 1900 h between July 2017 and April 2018. On each observation day, focal sampling continued until contact with the Group A was lost. Group A consisted of eight individuals (seven adults and an infant). The group was scanned for its positional behavior for every 10 minutes observation. Their positional behaviors were

qualitatively recorded. The description of the positional behavior of *P. f. robinsoni* was made according to Hunt *et al.* (1996) and defined qualitatively.

## Results and Discussions

The positional behaviors of *P. f. robinsoni* were divided into six main categories, namely sitting, lying, quadrupedal standing, bipedal standing, clinging, and forelimb suspension. Based on the observations, the most frequent-used posture for the *P. f. robinsoni* was the sit-in position under the sitting category.

### Sitting

Four positions were identified in the sitting category: sit-in, sit-out, sit-in/out, and angled-sit. Sitting is a posture where the ischia, one of the three parts of the pelvis, hold most of the body weight. This position was commonly displayed by the monkeys during rest and feeding periods. While sitting, the leaf monkey will use the surrounding branches to get the best and most comfortable sitting posture. For instance, the dusky leaf monkey, *T. obscurus* leans its back on the branches in the sit-out position during feeding periods (Ch'ng & Md-Zain, 2009). This posture is the most common posture portrayed by the leaf monkey because this passive activity requires less energy although it demands lower levels of bone strain and muscle activity than locomotor activities (McGraw, 1998a; Fleagle, 1999). Similarly, Black Howler monkey, *Alouatta caraya* adopt sitting posture to conserve energy during the lower ambient temperature (Prates and Bicca-Marques, 2008). The leaf monkey mainly depends on leaves and fruit. The abundance and readily available of the food items in the habitat do not require much movement, allowing leaf monkeys to spend more time resting (McGraw, 1998b).

### Sit-in

Sit-in positions were most often encountered during feeding and rest periods (Figure 2a, Figure 3a and Figure 3b). In this position, the

body weight was mainly supported by the ischia. The hindlimbs were bent, with the hip and knee tightly flexed. The heels were very close to the ischia and often touched the base of the thigh. The feet held approximately as much weight as the ischia. The feet and ischia touched a nearly horizontal supporting stratum to support the body weight. The body curved to the front, and the forelimbs were used to grasp fruit to eat. In a resting or less active state, forelimbs were often bent and placed on the knee (Putt, 2009; Thorpe & Crompton, 2005, 2006).

### Sit-out

The sit-out position was usually observed during periods of feeding, rest, urination, and defecation. The hindlimbs were usually opened, and the ischia supported most of the body weight. The hindlimbs were opened wide with the calves and thighs extended (Figure 3c and Figure 3d). Both the feet and the ischia touched the branch, with the feet used for balance. One of the forelimbs was used to grasp onto the branch for stabilization (Rose, 1976, 1977). While feeding, one forelimb grasped the branch while the other picked fruit. This position was one of the main postures that were identified during observation.

### Sit-in or Sit-out

This position was mainly observed during rest and feeding periods (Figure 2a and Figure 3e). The hip was positioned on the stratum according to the orientation of the trunk. One of the hindlimbs was in the sit-in position while the other was in the sit-out position. One or both forelimbs often grasped the branch for balance and were sometimes found placed on the knee. The body structure was a bit curved to lower the center of gravity for a more stable support (Hunt *et al.*, 1996; Thorpe & Crompton, 2006).

### Angled-sit

The angled-sit was observed with hindlimbs close to the hip and forelimbs grasping the branch. This position is different from the sit-in position due to the substrate angle. The



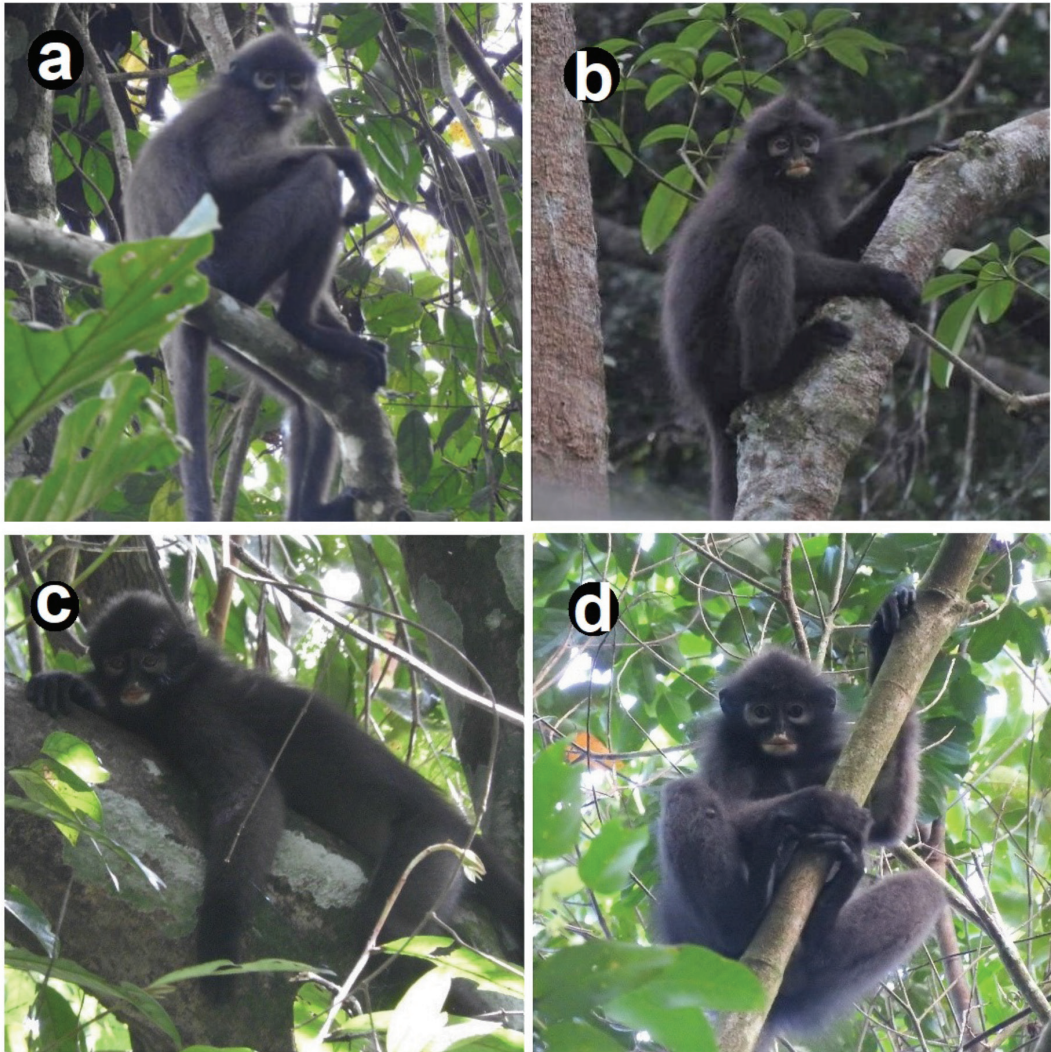


Figure 2: a) sit-in/out posture. b) angled-sit posture c) sprawl lying posture d) clinging position

forelimbs grasp the branch to support some of the body weight and distribute support due to friction (Fleagle, 1978; Hunt *et al.*, 1996). The hip and hindlimbs touch the substrate (Figure 2b and Figure 3f, *P. f. robinsoni* photo was taken from Kuala Kangsar's population). This position was displayed by *P. f. robinsoni* on tree branches that angled between  $90^\circ$  and  $180^\circ$ .

### Lying Down

Two types of lying were identified in this study: sprawl (back lie) and lateral lie. These positions were usually shown by *P. f. robinsoni*

when resting or sleeping, with the elbows often supporting the upper part of the body. The leaf monkey preferred to lie down during rest time, as it is a more comfortable and relaxing posture for them. The male monkeys displayed the lying posture more than females. This posture is static and frequently observed among living primate postural patterns (Chatani, 2003). The sprawl position makes the leaf monkey body more balanced in the branches as both arms may embrace the branches. This position is mainly observed at lower canopy level than the upper canopy level. In China, this posture is often

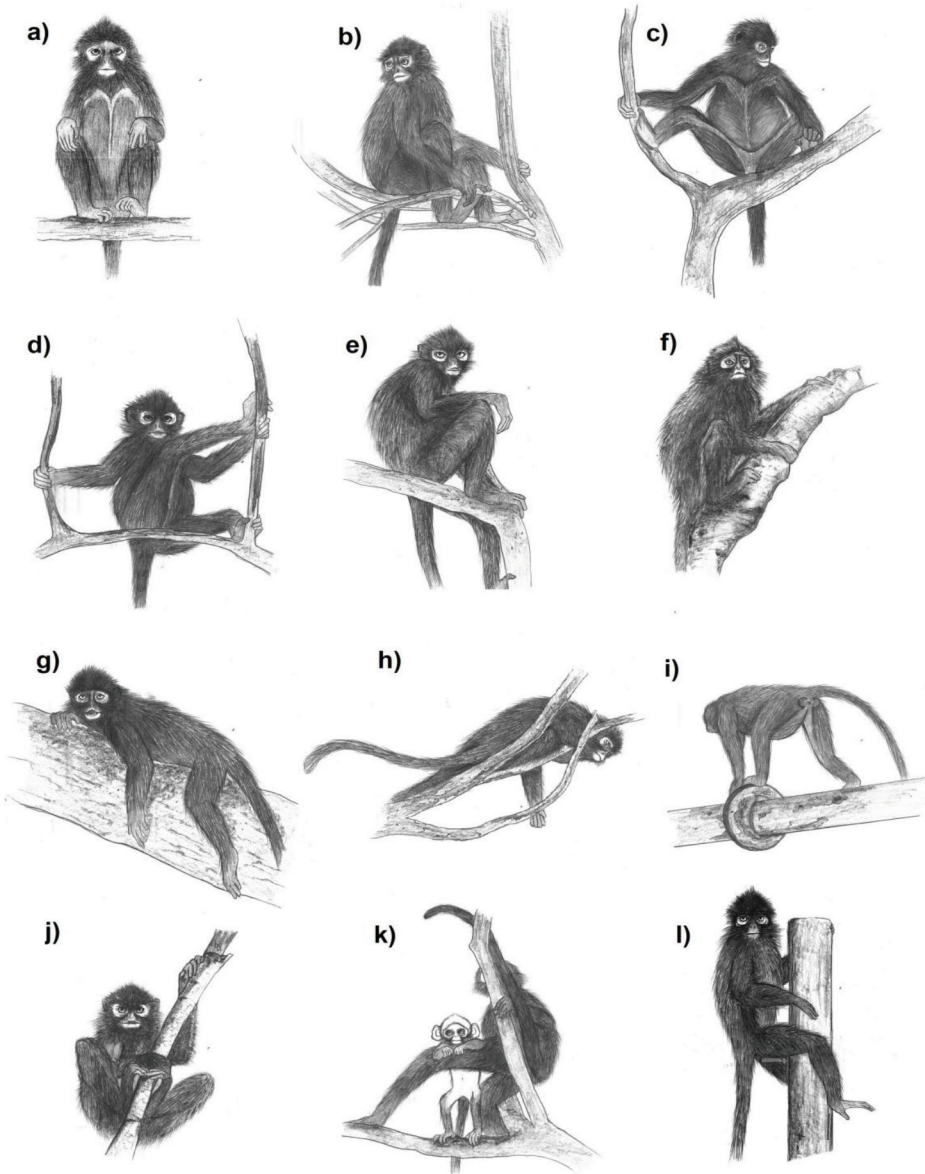


Figure 3: Varieties of positional modes in *P. f. robinsoni*: a) sit-in (front), b) sit-in (side), c) sit-out (front), d) sit-out (side), e) sit-in/out, and f) angled sit g) sprawl, h) lateral lie, i) quadrupedal, j) clinging, k) bipedal stand, and l) forelimb suspension

exhibited by the Snub-nosed Sichuan monkey (*Rhinopithecus roxellana*) in the lower canopy to avoid exposure to raptors (Li, 2007). McGraw (1998a) suggests that lying is a strategy by which heat can be dissipated from the body during periods of high temperature.

**Sprawl (Back Lie)**

This position was displayed during rest and sleep (Figure 2c and 3g). The hindlimbs and left forelimb hung while the right forelimb held the branches as the monkey readjusted its position (Hunt *et al.*, 1996). When it fell asleep, all limbs,

including the tail, were left hanging, and the head touched the substrate.

### ***Lateral Lie***

Similar to the sprawl, the lateral lie was seen during rest or sleep (Figure 3h). All lateral parts touched the substrate, though sometimes one of the forelimbs grasped onto the branch for stabilization (Hunt *et al.*, 1996; Philips, 2011; Sugardjito & Van Hoof, 1986).

### ***Quadrupedal Stand***

The quadrupedal stand is a position that involves standing with four limbs on a horizontal or sub-horizontal surface. The knee and elbow are straight or do not bend, while the body is in a horizontal position (Fleagle, 1980; Hunt *et al.* 1996). This position was mainly observed on the ground or at the canopy level (Figure 3i). *P. f. robinsoni* displayed this position when it stopped moving. During this posture, the palms are completely in contact with a substrate compared to the great apes, most of which that exhibit fist or knuckle forms (Richmond *et al.*, 2001). As Huang and Li (2005) indicated that white-headed langur (*Trachypithecus leucocephalus*) locomotor patterns varied according to the substrate, however, their terrestrial quadrupedalism accounted for more than 50% of locomotion time. Similarly, the terrestrial quadrupedalism was dominant in *P. f. robinsoni* as compared to arboreal terrestrial quadrupedalism, however, it is not accountable for overall locomotion time due to lack of data.

### ***Clinging***

Vertical clinging was seen when a monkey climbed tall trees and stopped suddenly to rest (Figures 2d and 3j). In this position, *P. f. robinsoni* looked as if it were hugging the tree as its four limbs held a substrate (Hunt *et al.*, 1996). Primate clinging is dependent on the ability of a species to hold onto small curved surfaces because they have nails instead of claws. Vertical clinging has only been observed in primates, primarily in prosimians such as

lemurs, lorises, and tarsiers (Larson, 2018). This posture is also exhibited by other colobine species, such as the dusky leaf monkey (Ch'ng & Md-Zain, 2009). This position is often shown at both lower and middle canopies because the branch diameter is much greater than the upper canopy which allows the leaf monkey to hold and grasp the branch.

### ***Bipedal Stand***

*P. f. robinsoni* often displayed this position before jumping from one point to another. It was also seen when the one infant played with his mother (Figure 3k). This posture is similar to human standing and occurs briefly. Many primates can stand upright on their hind legs without any support, such as chimpanzees, bonobos, gibbons, baboons, and orangutans (Kamaluddin *et al.*, 2019; Rose, 1976; Vereecke *et al.*, 2006).

### ***Forelimb Suspension***

This position was observed when an individual suddenly dropped down from a substrate. Three limbs grasped the substrate while the fourth was used to stabilise the body before dropping (Figure 3l). One or both forelimbs supported more than half the body weight. The other half of the body weight was supported by a bipedal stand pattern. The knee and hip may or may not have been bent. The body was at a 45° angle (Fleagle, 1976; Hunt *et al.*, 1996).

### **Conclusion**

This preliminary study recorded six types of positional behaviour exhibited by *P. f. robinsoni*, namely sitting, lying down, quadrupedal standing, bipedal standing, clinging, and forelimb suspension. The sitting position was most often shown by *P. f. robinsoni*. The findings of this study describe main postures of *P. f. robinsoni* in low dipterocarp forest providing knowledge on the positional behaviour of *P. f. robinsoni* in its natural habitat. In the future, more detail positional behaviour studies such as comparison in the natural forests and in



human settlements are needed to elucidate the differences of positional behaviour in changing landscape and closer affinity to human beings. As much is not yet known about this species in the wild, other behavioural ecology are crucial to be studied to contribute to the understanding of the species for future ex-situ conservation program especially for natural enrichment program in ex-situ conservation facilities such as zoo, wildlife rescue center and many others. This study is of paramount importance to alert the presence of this near-threatened langur in the SSRF for the site's ecotourism prospects and Malaysian langur conservation management and action.

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