LOW NUMBER OF NON-VOLANT SMALL MAMMALS AT NUNUK-MARAI PARAI, KOTA BELUD, SABAH, MALAYSIA

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ABSTRACT

The population of small mammals in Malaysia exhibits significant variation. These creatures fulfil crucial functions within diverse ecosystems, contributing to the preservation of forest environments and the overall health of landscapes. Additionally, they play a vital role in local food chains, participating in prey-predator interactions that have a direct impact on their distribution and overall diversity. The objective of this investigation is to meticulously observe and document the non-flying mammal species that inhabit Nunuk-Marai Parai. The collection of samples was conducted over a span of seven days, employing a total of 20 cage traps and 20 pitfalls to effectively capture the small mammals. The identification of species was carried out by examining morphological characteristics, such as measuring body size, observing fur colour, and assessing tail shape. During the study, a total of six non-volant small mammals were captured. These included one species of tree shrew, *Tupaia gracilis*, and three species of rats namely *Leopoldamys sabanus*, *Maxomys surifer*, and *Maxomys ochraceiventer*. Furthermore, no shrews were captured during the duration of the study. The trapping success was found to be low, with a limited number of individuals captured during the designated sampling period. Enhancing the level of sampling effort could potentially enhance the probability of successfully capturing the animals in question. This study can serve as a valuable resource for future revisions of conservation and sustainable management plans in this specific area.

Keywords: *rats, tree shrew, biodiversity, Kinabalu Park*

INTRODUCTION

Mammals are warm-blooded vertebrate animals distinguished by their hair or fur, give birth to the young as well as the presence of mammary glands that produce milk to nourish their young (Payne et al., 2007). Small mammals are animals with a mature body weight of less than 1 kg that play important roles in maintaining the ecosystem. They are classified into two groups: volant (bats) and non-volant small mammals (Gazali et al., 2022). Thus, non-volant small mammals are those that cannot fly and are similar in size to other small mammals (Gazali et al., 2022). This study covers the area of the Nunuk-Marai Parai trail, where the elevation increases from Nunuk Camp to Marai Parai, featuring diverse forest types and rich biodiversity. Additionally, it has the potential to contribute to ecotourism, particularly with attractions like the tropical pitcher plant (*Nepenthes*). The aim of this study is to identify the species of non-volant small mammals present in the Nunuk-Marai Parai Trail area using morphological identification. The study of non-volant small mammals in this area is vital for documenting and updating their population. Furthermore, the output of this study can assist the Sabah Parks management team in improving their management strategies in this area, including species monitoring and biodiversity conservation.

METHODOLOGY

The study was conducted along the Nunuk-Marai Parai trail. Sampling was carried out within a seven-day period using random sampling method in two different areas with different elevations. Nunuk Camp is located at a middle elevation with an altitude of ~1,200 metres (6.0674°N, 116.507°E), whereas Marai Parai is at a high elevation of ~1,600 meters (6.0819°N, 116.5204°E). During sampling, two types of traps were used: cage traps and pitfalls. Cage traps were used to catch rodents like rats, squirrels, and tree shrews, while the pitfall was for shrews. A total of 20 wire mesh cage traps (28 cm × 15 cm × 12.5 cm) were randomly placed at the available area above ground surface: in front of the burrow entrance, near or on top of fallen logs, under root tangles, and along the trail. The total length of the trail where the cages were placed was approximately 2 km. Each cage trap had different baits, such as cut, ripe bananas, biscuits, and salted fish (Saarani et al., 2021). Besides, 20 bucket pitfall traps (height = 17 cm, top diameter = 21.5 cm, with 10 small holes at the bottom to allow water drainage) were also buried where the openings were the same level as the forest floor. The pitfall traps were placed at open area. The trapping stations were marked with raffia string to a nearby tree for easy

identification or navigation (Richard et al., 2022). All traps were checked once a day, between 0700 and 1700, and during the daily check, all the traps were rebaited with fresh bait.

The morphological characteristics of the non-volant small mammals used for species identification were derived by examining their fur characteristics (fur colour, texture, and hair length) as well as external body measurements such as head-body length (HB), tail length (T), hind foot length (HF), and ear length (EL) (Baharudin et al., 2023). Measurement was conducted using a standard ruler (Gazali et al., 2022). Reference books such as Payne and Francis (2007) and Yasuma et al. (2004) were used to identify the species with the guidance of illustrations and their characteristics.

RESULTS

Throughout the sampling period, a total of six individuals were captured. Based on Table 1, there was one species from the family Tupaiidae, which is the slender tree shrew (*Tupaia gracilis*), and three species from the family Muridae, such as the long-tailed giant rat (*Leopoldamys sabanus*), the red spiny rat (*Maxomys surifer),* and the chestnut-bellied spiny rat (*M. ochraceiventer*). In addition, *T. gracilis* was the most frequently recorded species, with three individuals, while the rest, all from the family Muridae, have only one species, respectively.

The species of each individual was identified through morphological identification. For the tree shrew, *T. gracilis* was identified by their brownish underparts (Phillips and Phillips, 2018). For the rat species, *L. sabanus* has a distinctive trait of having longer tail than its body. Next, *M. surifer* has different fur trait with underparts white with soft, white spines (Yasuma et al., 2004). In terms of body size, *M. surifer* is considered similar to *M. rajah* which might lead to misidentification, but they can be distinguished by their fur collar where *M. surifer* is slightly browner (Phillips and Phillips, 2018). Lastly, *M. ochraceiventer* has been distinguished from other Maxomys species by its chestnut orange pelage (Achmadi & Suzuki, 2021).

In terms of conservation status, all species of small mammals recorded were classified as Least Concern (LC) except for one species belonging to the family Muridae (*M. ochraceiventer),* which was classified as Data Deficient (Gerrie & Kennerley, 2017).

Figure 1. Photos of non-volant small mammals: A) *Tupaia gracilis,* B) *Maxomys surifer,* C) *Leopoldamys sabanus,* D) *Maxomys ochraceiventer*

Moreover, the study found that five individuals of the small mammals were captured along the trail to Nunuk camp and within this camp area. However, only one individual was caught at Marai Parai area. Nunuk camp has a denser forest than Marai Parai. This is mostly due to difference in vegetation types and ecological characteristics at each elevation.

Table 1. Non-volant small mammals recorded in two different areas

Family/Species	Common name	IUCN status (2023)	Area/Trail	
			Nunuk Camp	Marai Parai
Tupaiidae				
Tupaia gracilis	Slender tree shrew	LC	2	1
Muridae				

Leopoldamys sabanus	Long-tailed giant rat	LC	1	-
Maxomys surifer	Red spiny rat	LC	1	-
Maxomys ochraceiventer	Chestnut-bellied spiny rat	DD	1	-

*Note: IUCN = International Union for Conservation of Nature; LC = Least Concern; DD = Data Deficient

Table 2. External body size measurement of specimens captured at SRCA

Species	Measurement (Mean ± SD, Range) (cm)				
	HB	T	EL	HF	TL
T. gracilis	17.2 ± 0.8 (16.5 – 18.0)	13.7 ± 1.1 (12.4 – 14.5)	1.5 ± 0.0 (1.4 – 1.6)	3.7 ± 0.3 (3.5 – 4.1)	30.9 ± 1.5 (28.9 – 32.5)
L. sabanus	24.5	37.6	2.7	4.9	62.1
M. surifer	17.4	20.4	2.4	4.0	37.8
M. ochraceiventer	14.5	4.5 (separated)	2.4	3.8	19.0

Note: Average ± SD (range)

DISCUSSION

The study in two different areas, Nunuk Camp and Marai Parai, successfully recorded a total of six individuals representing two families, where all individuals were captured by the cage traps. All of the species are classified by IUCN as Least Concern except for *M. ochraceiventer* as it has a Data Deficient status due to lack of information available to make a direct assessment of its risk of extinction Gerrie & Kennerley, 2017). These small mammals are usually found at lowland forest hill but have been recorded at above 1200 m a.s.l during this study. Finding them at greater elevations may imply adaptability to new settings or changes in environmental variables. The availability of food supplies has an important role in determining the existence of small mammals at higher elevations. Species like *L. sabanus* have exhibited adaptability to varied forest types, allowing them to feed well across different habitats (Abdullah et al., 2021).

Trapping success rate was highest at Nunuk Camp area, which is 14.29%, while Marai Parai is only at 2.86%, which indicates that small mammals are

more abundant at Nunuk Camp area with lower elevation than Marai Parai. Elevation is an important factor in determining population abundance as it has direct influence on vegetation characteristics, leaf litter depth, ground cover, canopy cover, and soil properties, which affect the presence and abundance of small mammals on a local scale (Leis et al., 2007). In this study, Nunuk Camp is a more forested area while Marai Parai is a plateau with a rocky landscape. Thus, Nunuk Camp's larger forested habitat area and diverse niches may have led to increased diversity of small mammals (Musila et al., 2019) due to increased food source variety and better cover compared to the rocky Marai Parai area. In fact, most of the small mammals were captured where the cages were placed near the fallen log in the forest. These small mammals are important in maintaining the ecosystem balance as they play vital roles as seed dispersal and involved in prey-predator interaction.

Trapping shrew in Borneo can be challenging as densities are low (Hawkins et al., 2019), which is relevant as no shrew was caught in this study. There might be some factors that lead to lower trapping. For example, weather has a considerable influence on shrew activity. During this study, there were rainy days during sampling period. Rainy or severely cold temperatures might limit their movement, resulting in fewer captures in pitfall traps (Stromgren, 2008). Besides, their small size and high mobility might reduce the likelihood to fall into the trap.

Lastly, this low trapping success of non-volant small mammals during the study period maybe due to several factors, such as low sampling effort at each trail including limited sampling period and bias in trap placements (Saarani et al., 2021). Bait preference might also influence the likelihood of small mammals being captured as they were used to attract the small mammals to the trap (Gazali et al., 2022).

CONCLUSION

As a conclusion, the limited number of species in Nunuk-Marai Parai may not indicate a lack of diversity particularly on small mammals, but rather a limitation of time and scope in this study. Moreover, there is a decline in small mammals' abundance as the elevation increases from Nunuk Camp to Marai Parai. A future study, particularly on non-volant small mammals, is needed in order to document and determine the overall population of such animals in the area so that it can aid in conservation management strategies.

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