Species Composition of Rodents at Padang Chong Forest Reserve, Perak

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Abstract. There are at least four families of rodents identified in Peninsular Malaysia namely Muridae, Sciuridae, Hystricidae, and Rhyzomidae. Although rodents are widespread throughout Peninsular Malaysia, information on rodents at Padang Chong Forest Reserve (PCFR) is scarce. Therefore, the main objective of this study is to identify and document the species composition of rodents at PCFR. Samplings were carried out at two plots along the gradient from the border of PCFR namely Plot 1 (500m) and Plot 2 (1km). The size of the respective plot is 1ha with 10 transect lines (A-J), 100m in length separately. These plots were sampled for five times from June to November 2022. Based on this study, a total of 65 individuals from nine species of rodent were documented. These nine species were identified from two families namely, Muridae (5 spp) and Sciuridae (4 spp). Of these, *Leopoldamys sabanus* was recorded as the highest captured species (25 individuals), followed by *Maxomys whiteheadi* (19 individuals) and *Callosciurus notatus* (7 individuals). There is no significant difference in terms of species composition between these plots, Plot 1 (n=33) and Plot 2 (n=32), which further supported by t-test value result (t-test=0.928; p(value)> 0.05). However, there is a single representative of *Sundamys muelleri* captured in Plot 1 which prefers the riverine area (around 10m). *Callosciurus notatus* were captured most in Plot 2 (6 individuals) compared to Plot 1 (1 individual). Certain areas nearby to Plot 2 were opened for agricultural purposes which explained the existence of this species at Plot 2. From this information, it is hoped that further actions can be taken to conserve the area to ensure the small mammal communities are preserved.

1 Introduction

Padang Chong Forest Reserve (PCFR) is part of the Central Forest Spine Ecological Linkage located within the Bintang Hijau Forest Complex. This forest complex encompasses diverse habitats for various species of mammals, both large and small [1]. Malaysia has recorded a

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total of 307 mammal species, with more than 30 endemic species [2]. In Perak state alone, previous studies were conducted to understand the diversity, composition, behaviour and bait preference of terrestrial small mammals comprising of volant small mammals (Families: Rhinolophidae, Hipposideridae, Vespertilionidae and Pteropodidae) and non-volant small mammal (Families: Muridae and Sciuridae) [3,4, 5, 6, 7, 8]. Among small mammal groups, rodents are the most geographically widespread and possess a high adaptation level, enabling them to survive in various environments, whether natural or modified [9]. Despite the wide distribution of rodents throughout Peninsular Malaysia, there is no information on rodents at PCFR. Therefore, this study aims to generate and record the preliminary information on rodent species that reside within PCFR using live trapping. Since this is a pioneer small mammal study in PCFR, it is anticipated that the findings would help develop future conservation plans and effective management strategies for the area.

2 Materials and Methods

2.1 Study area

Padang Chong Forest Reserve (PCFR) is a tropical lowland forest located approximately 20km from the nearest town in Pengkalan Hulu, Perak (Figure 1). A pristine river with approximately 5 – 8m width runs through the forest reserve compartments. It is composed of big rocks and boulders alongside various sizes of fallen trees. In total, there were two 1-ha plots established identified as Plot 1 (P1) and Plot 2 (P2), respectively. These plots were set at 500m (P1: N 05o41'03.4", E 101o01'11.0") and 1000m (P2: N 05o41'19.1", E 101o00'58.0") from the edge of forest reserve. Both P1 and P2 have dense vegetation of shrubs and closed canopy cover with small trees and patches of bamboo. There is a small stream nearby P1 and old logged road nearby P2.
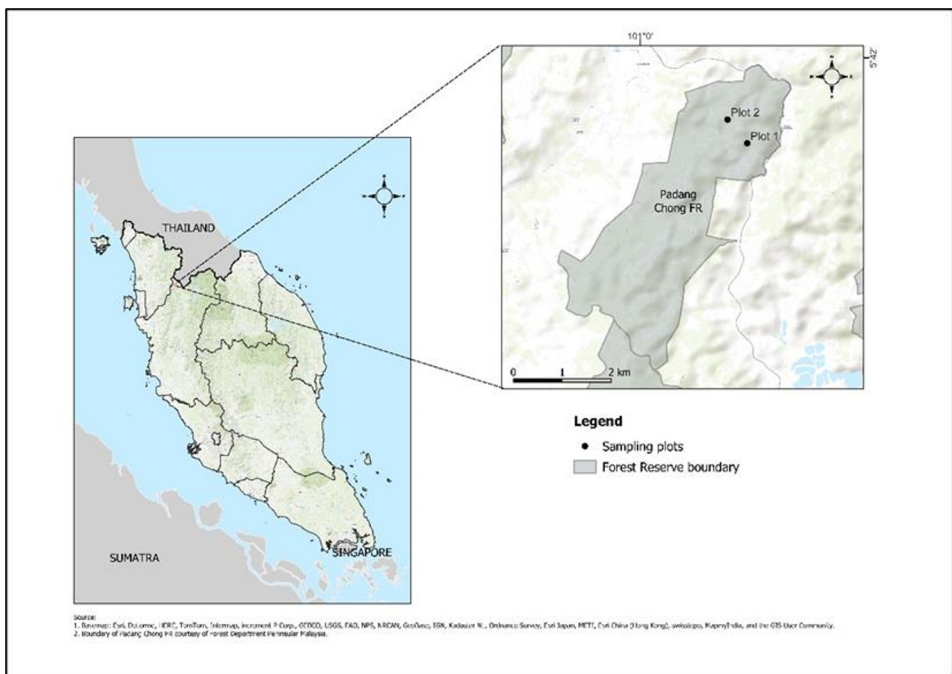

Fig. 1. Location of study sites in Padang Chong Forest Reserve (PCFR), Perak

2.2 Trapping design

Rodents of PCFR were surveyed from June to November 2022, with a total of five sampling sessions per plot. Within each plot, 10 transect lines, labelled alphabetically from Line A to Line J, were established, with each line measuring 100m. A total of 100 collapsible cage traps were deployed, 10m apart each. The traps were baited with palm oil seeds and refilled when necessary. The traps remained open for five consecutive nights for each sampling session. These traps were checked twice daily at 0800 and 1600 hour. Each trapped rodent was carefully removed from the collapsible cage trap and temporarily placed inside a cloth bag. The captured rodents were measured and identified based on key features referring to Field Guide to the Mammals of South-east Asia [10]. The trapping effort was calculated by multiplying the number of sampling days with the total number of traps deployed for five sampling sessions, therefore, the total trapping effort for both plots are the same (3000 trapping effort for each plot) [11].

2.3 Data Analysis

The Paleontological Statistics (PAST) software was used to generate the value for Shannon-Wiener Index (H'), Evenness (SI) and Dominance (D) to assess the diversity, composition and abundance of the species within PCFR [12]. To compare the diversity distinctions among the research plots, a non-parametric t-test was also computed using the PAST software. A rarefraction curve was generated using the package 'iNEXT to evaluate the effort based-species richness of both plots which were then associated with the value of Chao-1 estimator [13, 14].

3 Results and Discussion

A total of 65 individuals of rodents representing nine species from two families were identified in this study (Table 1). Five species namely *Leopoldamys sabanus, Maxomys rajah, M. whiteheadi, Niviventer cremoriventer* and *Sundamys muelleri* represent the Muridae family while four species namely *Callosciurus notatus, C. Caniceps, Rhinosciurus laticaudatus* and *Sundasciurus lowii* represent the Sciuridae family.

Table 1. Species composition, relative abundance and conservation status of rodents in Padang Chong Forest Reserve, Perak.

No.	Family	Common Name	Scientific Name	No. of Individuals		Total No. of Individuals	Relative Abundance (%)	CS
				Plot 1	Plot 2			
1.	Muridae	Long-Tailed Giant Rat	*Leopoldamys sabanus*	14	11	25	38.5	LC
2.	Muridae	Brown Spiny Rat	*Maxomys rajah*	1	4	5	7.7	VU
3.	Muridae	Whitehead's Rat	*Maxomys whiteheadi*	9	10	19	29.2	VU
4.	Muridae	Dark-Tailed Rat	*Niviventer cremoriventer*	3	-	3	4.6	LC
5.	Muridae	Muller's Rat	*Sundamys muelleri*	1	-	1	1.5	LC

6.	Sciuridae	Plantain Squirrel	*Callosciurus notatus*	1	6	7	10.8	LC
7.	Sciuridae	Grey-bellied Squirrel	*Callosciurus caniceps*	2	-	2	3.1	LC
8.	Sciuridae	Shrew-Faced Ground Squirrel	*Rhinosciurus laticaudatus*	2	-	2	3.1	NT
9.	Sciuridae	Low's Squirrel	*Sundasciurus lowii*	-	1	1	1.5	LC
		Total Individual				65		
		Total Species				9		

Note: CS – Conservation Status; LC – Least Concern, VU – Vulnerable, NT – Near Threatened

Relatively, Muridae shown to be more abundance in both sampling sites. In Muridae, *Leopoldamys sabanus* was the most abundant species (38.5%, n=25) followed by *Maxomys whiteheadi* (29.2%, n=19) and *M. rajah* (7.7%, n=5). Species, *L. sabanus* was recorded at both sampling sites. This generalist species is nocturnal by nature that has the ability to climb up to 3m above ground which makes this species known as scansorial [10, 15]. The highest capture rate of *L. sabanus* were also recorded in studies by William-Dee *et al*. (2019) at Ulu Gombak Forest Reserve (UGFR) and Abdullah *et al*. (2021) at Ulu Jelai Forest Reserve (UJFR) [8,16]. Both UGFR and UJFR are secondary forest that has been logged over and comprised of dipterocarp forest [16, 17]. Considering PCFR itself is a secondary forest the availability and abundance of *L. sabanus* in both plots is inevitable. Though their presence suggests the habitat structure of PCFR might promote a vegetation suitability for foraging and locomotion. Nonetheless, it is a conventional understanding that this species is widely distributed and well adapted to diverse structure of forest either logged or unlogged [18, 19].

Table 2. Species abundance, richness and diversity values estimated of rodents in Padang Chong Forest Reserve, Perak.

Sites	Species (S)	Individuals (n)	Dominance (D)	Shannon (H')	Evenness (SI)	Chao-1
Plot 1	8	33	0.2727	1.594	0.6153	9
Plot 2	5	32	0.2676	1.413	0.8214	5

The total number of individuals per species captured varied among the plots. P1 listed a higher number of species (S = 8) compared to P2 (S = 5). Although H' value reflected that P1 (H'=1.594, n=33) is richer than P2 (H'=1.413, n=32), the species distribution of P2 is more even (SI=0.8214) compared to P1 (SI= 0.6153). The deviation of the result is reflected by the abundance of individuals that each species represents per plot. While P1 recorded a higher species number, there is a huge gap between the number of individuals captured the most (*L. sabanus*, n=14) and the least captured individuals (*Maxomys rajah*, *Sundamys muelleri* and *Callosciurus notatus,* n=1). Nevertheless, the diversity t-test score indicates no significant difference in terms of species diversity composition between these plots (t-test=0.928; p(value) > 0.05).

Most of the species were recorded in P1, except for one species namely *Sundasciurus lowii*. Based on our observation, there is no distinct variation in term of vegetation type for

both plots, however, it was seen that P2 have taller canopy level compared to P1. Besides, during the 3rd sampling session onwards, an area closer to P2 were opened up for other land-use activity. Therefore, this might have influenced on occurrence of another species, *Callosciurus notatus*. Although this species was recorded in both of the sampling sites, it was captured more in P2 (n=6) compared to P1 (n=1). *C. notatus* and *S. lowii* are widely distributed in a forest influenced by the availability of food resources [20]. A study shown that both *C. notatus* and *S. lowii* primarily feed on fruits and barks [21]. The clearing on the sites nearby that provide barks from fallen trees suggest that the abundance of these two species at P2 might be prompt by an easily accessible food resource.

Alternatively, a single representative of *Sundamys muelleri* from Muridae family was recorded in P1. This species prefers riverine areas where they can forage on plants and animal matter [10]. P1 is located near a small stream of river that narrowed down leading to the research plot establishment. In a distribution comparison study of rodents by Paramasvaran *et al.* (2013) that was conducted on four different habitats, the presence of *S. muelleri* is the most predominant in forested areas compared to rice field, coastal or urban [22]. The placement of the traps also plays major role in capturing this species. Paramasvaran *et al.* (2013) also mentioned that the traps were deployed along the river of UGFR, which is a foraging ground for *S. muelleri* in search for snails and land crabs [22, 23]. As P1 is closer to river area compared to P2, this explained the single representative of *S. muelleri* at P1.
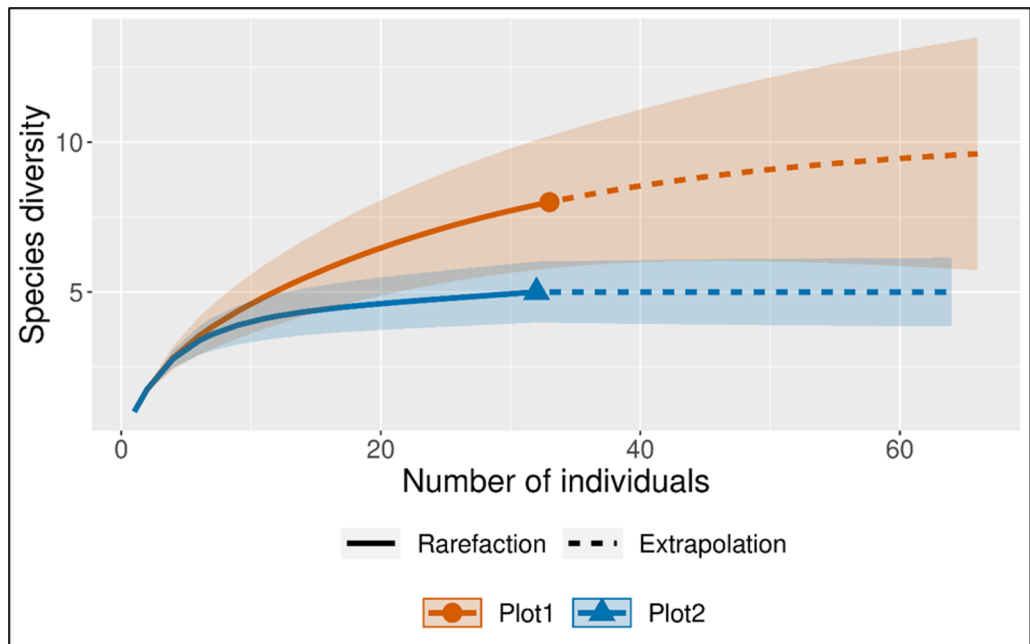

Fig. 2. The species richness rarefraction curve on estimation number of individuals caught for rodents in Padang Chong Forest Reserve, Perak.

Through species richness estimation Chao-1 (Table 2), the species collected are equivalent to the total species estimated to be in P2 (Chao-1 =5, S= 5). Whereas P1 recorded almost 89.0% of the estimated species diversity (Chao-1 =9, S= 8). The species rarefraction curve (Figure 2) provides additional support for this finding. The curves depict that P2 has hit the plateau and P1 is also on the edge of reaching the asymptote. Therefore, the estimation diversity of the plots is approximately accurate. Since Chao-1 estimator is the least biased non-parametric approaches in predicting lower bound of species richness, it is almost certain that the trapping efforts on each research site is adequate [24, 25].

Although the statistic results depict the sufficient amount of sampling efforts, the species diversity representations of this study should not be considered as absolute. This is because the research outcomes can be further enhanced by expanding the research areas covering all habitat types of PCFR to represent the species diversity as a whole. In addition, this study manages to record two species listed as Vulnerable (VU) namely *Maxomys rajah* and *M. whiteheadi* (Table 1). The major threat affecting these species' populations is habitat loss caused by anthropogenic activities including land conversion for agricultural and industrial development purposes. Thus, this preliminary research of rodents at PCFR will serve as a guideline for further findings and future mitigation measures to maintain the existing ecosystem.

4 Conclusion

This study highlights the composition and distribution of the rodent species in PCFR are affected by various factors, including the distance of the study sites from the forest's edge, canopy level, vegetation types and food resources. Long term monitoring and extensive research on the ecological aspects of the rodent species will further assess the depth of the factors influencing the distribution and habitat preference of the species. The presence of vulnerable species, *Maxomys rajah* and *M. whiteheadi* indicate that PCFR serves as an important habitat for diverse and threatened species. Therefore, the conservation and management of this site are very crucial to preserve these under-explored and sensitive sites.

5 Acknowledgement

References

1. PlanMalaysia, PIRECFS, Putrajaya, Jabatan Perancangan Bandar dan Desa (2022)

2. MyBIS, Published on the Internet https://www.mybis.gov.my/, NRECC, Malaysia Biodiversity Centre & Forest Research Institute Malaysia (2023)

3. N. Ruppert, A. Mansor, S. M. Anuar, Diversity and biomass of terrestrial small mammals at a Malaysian primary rainforest reserve (Segari Melintang Forest Reserve, Peninsular Malaysia), *J. Trop. Life Sci* **5**(1), 35-44 (2015)

4. N. Ruppert, A. Mansor, S. M. Anuar, One year mark-and-recapture study on small terrestrial mammals at Segari Melintang Forest Reserve, Perak: assessing trap height and bait preferences and efficiency of different tagging methods for long-term identification, In *Seminar on LTER-EAP-region*, 4 July (2012)

5. N. A. M. Tamrin, M. R. A. Rahman, M. H. R. M. Daud, N. Hassan, M. T. Abdullah, A survey on small mammals in the Royal Belum Park, Perak, Malaysia, In *Proceeding of National Biodiversity Seminar* (pp. 7-14) (2008)

6. F. S. Mohd-Taib, M A Yusoff, R. Ali, A. R. Yaacob, A Note on Non-Volant Small Mammals of Pulau Pangkor, Perak, Malaysia, *J. Malays. For* **82**(1), 301-304 (2019)

7. V. K. Jayaraj, A. Roslan, F. S. M. Taib, M. M. Faiz, M. A. Yusof, R. Ali, M. T. Abdullah, Rodent diversity in Pulau Pangkor underestimated due to complex taxonomic descriptions, *J. Malays. For* **82**(1), 305-310 (2019)

8.   J. William-Dee, F. A. A. Khan, Q. Rosli, M. A. Morni, I. Azhar, L. S. Lim, R. C. T. Tingga, M. R. A. Rahman, Comparative distribution of small mammals diversity in protected and non-protected area of Peninsular Malaysia, *J. Trop. Life Sci* **30**(2), 131-147 (2019)

9.   F. A. Azhar, M. A. A. Abu Bakar, The roles, threats and distribution of rodents in Malaysia, *Borneo Akademika*, **5**(1), 52-59 (2021)

10. C. Francis, Field guide to the mammals of South-east Asia, Bloomsbury Publishing (2019)

11. S. A. Jamaluddin, M. R. Abd Rahman, N. Othman, H. Haris, F. N. A. Zahari, M. Faudzir M, Diversity of Non-Volant Small Mammals In Pulau Tinggi, Johor, Malaysia, *J. Sustain. Sci. Manag* **17**(11), 121-129 (2022)

12. Ø. Hammer, D. A. Harper, P. D. Ryan, PAST: Paleontological statistics software package for education and data analysis, *Palaeontol. Electron* **4** (1): 4 (2001)

13. C. Ricotta, S. Pavoine, G. Bacaro, A. T. Acosta, Functional rarefaction for species abundance data, *Methods Ecol. Evol* **3**(3), 519-525 (2012)

14. A. Chao, N. J. Gotelli, T. Hsieh, E. L. Sander, K. Ma, R. K. Colwell, A. M. Ellison, Rarefaction and extrapolation with Hill numbers: a framework for sampling and estimation in species diversity studies, *Ecol. Monogr* **84**(1): 45-67 (2014)

15. K. Wells, M. Pfeiffer, M. B. Lakim, K. E. Linsenmair, Use of arboreal and terrestrial space by a small mammal community in a tropical rain forest in Borneo, Malaysia, *J. Biogeogr* **31**(4), 641-652 (2004)

16. N. I. Abdullah, N. F. Khodri, N. A. T. Arifin, M. R. A. Rahim, S. H. A. Razali, N. D. A. Darbis, S. M. Nor, Small Mammals of Tekai Tembeling Forest Reserve (TTFR), Jerantut, Pahang, Peninsular Malaysia, *J. Sustain. Nat. Resour* **2**(2), 12-21 (2021)

17. K. W. Sing, K. Syaripuddin, J. J. Wilson, Changing perspectives on the diversity of bats (Mammalia: Chiroptera) at Ulu Gombak since the establishment of the Field Study Centre in 1965, *Raffles. Bull. Zool* 29, 211-217 (2013)

18. N. F. M. Fauzi, M. A. Shahfiz, N. A. Ruzman, K. Munian, M. S. Baharudin, M. A. Azahar, A. S. A. Ahmadani, F. Mohamad, Notes on small mammals diversity at Perlis State Parks, Wang Kelian, Perlis, Malaysia. In *IOP Conf. Ser.: Earth Environ. Sci* (Vol. 842, No. 1, p. 012024), IOP Publishing (2021)

19. K. Munian, M. A. Shahfiz, N. A. Ruzman, N. F. M. Fauzi, A. N. Zakaria, Diversity and composition of volant and non-volant small mammals in northern Selangor State Park and adjacent forest of Peninsular Malaysia. *Biodivers. Data J* 8 (2020)

20. A. A. Saiful, A. H. Idris, Y. N. Rashid, N. Tamura, F. Hayashi, Home Range Size of Sympatric Squirrel Species Inhabiting a Lowland Dipterocarp Forest in Malaysia, *Biotropica*, **33**(2), 346-351 (2001)

21. S. A. Abdullah, N. Yusoff-Rashid, A. H. Idris, Niche segregation among three sympatric species of squirrels inhabiting a lowland dipterocarp forest, Peninsular Malaysia, *Mamm. Study* **26**(2), 133-144 (2001)

22. S. Paramasvaran, S. N. Mohd Zain, J. Jeffery, S. Selvanesan, L. Hassan, R. A. Sani, Krishnasamy, I. Latifah, M. S. Rahmat, R. L. Santhana, N. M. Amal, Distribution and morphological measurements of wild and urban rodents from four habitats in the states of Selangor and Negeri Sembilan, Malaysia, *Malays. J. Vet. Res* **4**(2), 1-12 (2013)

23. N. Baker, Muller's rat, Published on the Internet https://www.ecologyasia.com.my/, Ecology Asia: Vertebrate fauna of Southeast Asia (2023)

24. A. Chao, C. H. Chiu, Species richness: estimation and comparison. *Wiley StatsRef: statistics reference online,* 1, 26 (2016)

25. F. Y. Shen, T. S. Ding, J. S. Tsai, Comparing avian species richness estimates from structured and semi-structured citizen science data. *Sci. Rep* **13**(1), 1214 (2023)