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A PRELIMINARY SURVEY OF NON-VOLANT SMALL MAMMALSIN THE UiTM NEGERI SEMBILAN FOREST RESERVE, KUALA PILAH CAMPUS

Nur Rabiatul Adawiyah Gazali, Nursyazni Abdul Rahim*, Nur Liyana Marfur, Nur Hasyimah Ramli

School of Biological Sciences, Faculty of Applied Sciences
Universiti Teknologi MARA Cawangan Negeri Sembilan, Kampus Kuala Pilah, 72000 Kuala Pilah, Negeri Sembilan

Corresponding author: syaznirahim@uitm.edu.my

Abstract

Human activities such as agricultural expansion, deforestation and excessive logging have caused a great disturbance toward composition of non-volant small mammals' communities within different types of habitats. Thus, this study is conducted to do a survey on a composition of non-volant small mammals in UiTM Forest Reserve in 2020 and 2021. Cage traps were used to capture the small mammals along the jungle trekking site by locating each trap about 20 m apart along with Capture- Recapture method. Then, the identification process and morphological measurement were conducted. As a result, only one species (six individuals) of non-volant small mammal was captured in 2020 without any sample was recorded in 2021. No sign of destruction detected in the same sampling area in 2021. Other than that, Length-Weight Regression analysis (LWRs) on *Tupaia glis* measured in 2020 shows a positive allometric (b>3) growth with the value of 'a' and 'b' is -0.581 and 3.672, respectively. These findings suggest that when the weight of the *Tupaia glis* sample increases, it gets longer. As recommendation, further study should be conducted by prolong the period of sampling and increase innumber of cage traps to ensure more samples of non-volant small mammals can be captured.

Keywords: Non-volant small mammals, UiTM Forest Reserve, sampling, *Tupaia glis*

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Introduction

Mammals are vertebrate members, which are distinguished from other species by characteristic such as give birth to young and feed their babies with their milk (Francis, 2008). The size and weights of mammals are varied and depending on their size and weight, range can be categorized into small and large mammals where small mammal is <1 kg while large mammal is >30 kg (Silvia Pineda-Munoz, 2016). Small mammals can be divided into non-volant and volant. According to Lim and Pacheco (2016), non-volant small mammals are animals that weight less than 1 kg such as rodents and marsupials.

Small mammals play a major role in maintaining the ecological balance as they influence the structureand composition of forest community (Solari *et al.*, 2002). This significant impact on the environmentof mammals contributes to vital services that contribute to human well-being, such as pollination and insect pest control (Merrick, 2012). However, anthropogenic threat such as logging, agriculture, aquaculture and pollution from factories, and climate change contribute to population of small mammals' decline.

Hence, this study is carried out to examine the effect of anthropogenic threat such as deforestation and agriculture on the populations of small mammals nearby the UiTM Forest Reserve. This study covers the area of UiTM Forest Reserve, located in UiTM Kampus Kuala Pilah. This UiTM Forest Reserve isknown as undisturbed habitat which has been served as organism variety habitats as this area consist of its own tropical rainforest, stream and freshwater which support the life of the mammals present.

Rapid deforestation such as logging activities that has undertaken at the Pelangai Forest Reserve which is connected to the UiTM Forest Reserve recently, might cause more disturbances to the habitat of small mammals in UiTM Forest Reserve compared to 2012. This threat is capable of causing the declining number of small mammals and may be caused extinction of small mammalian's diversity (Jambari *et al.*, 2019). In long run,this threat is capable of causing the whole ecosystem to be ruined as the declining of small mammals which play a fundamental role causing the balance in ecosystem to be disturbed and reduced.

The checklist of small mammals' diversity in UiTM Forest Reserve have been documented, thus this research is to compare the previous record of small mammals diversity with the current data and to determine the development of the small mammals through the analysis of Length-Weight Regression (LWRs).

Methods

Study site

The study was conducted at UiTM Negeri Sembilan, Kuala Pilah Campus (Figure 1). The study on diversity of non-volant small mammals involved UiTM Forest Reserve, site of 02˚48' N, 102˚13' E Compartment 21 which is a trails for jungle trekking.

Field method

Field sampling of small mammals was held on every weekend (Saturday and Sunday) for three weeks from 29th February - 15th March 2020 and 7th-13rd March 2021. Cage trap and Capture-Recapture method were used in this study. Capture-Recapture method was done by marked the captured animals with an indian ink on the ears or feet and were left to regain conciousness before released back to the forest (Wilson *et al.*, 2007). This is the most recommended method for the study of small mammals' communities and populations, especially for those small mammals with a cryptic or elusive way of life (Romairone *et al.*, 2018). A total of 10 cage traps were located randomly along the jungle trekking trails. About five cage traps were placed on the ground for capturing small mammals on the forest floor (Jayaraj *et al.*, 2012). The other five traps were fastened on the tree at 3-5 m from the ground (Nurul Khaleeda *et al.*, 2018).

The distance between each live trap was about 20 m apart. The cage traps were baited with different types of baits such as banana, papaya, jack fruit and ground peanut (Norfahiah *et al.*, 2012). The cage traps were checked four times daily between 7.00 a.m. until 7.00 p.m. The cage traps were then rebaited twice per day, once in the morning around 8.00 a.m and once in the afternoon around 1.00 p.m (Norfahiah *et al*., 2012). The captured animals were placed in a container with chloroform soaked cotton and left to faint.

Figure 1. 'X' remarks the sampling site UiTM Forest Reservesite of 02˚48' N, 102˚13' E Compartment 21

Small mammals' measurement

The captured non-volant small mammals were measured for its weight (g) using spring scale, tail length (T), head-body length (HB) and hind foot (HF) length (mm) by using measuring tape and ruler. Head-and-body length was measured by placing the measuring tape next to the samples' length of body without the tail length included. This was done by direct reading which small mammals were laid flat along the measuring tape and then head-and-body length was acquired by subtracting tail length (Ansell, 2015).

After that, hind foot (HF) length was measured from the heel to the end of the longest digit including the longest claw by using ruler (Seddon *et al.,* 2014). The sex of the captured small mammals was also determined. They can be distinguished using a variety of sexual dimorphic features. This includes genitalia, bodily size, and behaviour variances. Males are identified by the existence of testicles and penis, while females are differentiated by the presence of a vaginal opening and nipples (Eymann *et al.,*2010). Then, the small mammals were placed in a cloth bag and weighed by using spring scale (Nurul Khaleeda *et al.,* 2018). Lastly, the small mammals were marked with an indian ink on the ears or feet and were left to regain conciousness before released back to the forest (Wilson *et al.,* 2007). All the data were recorded accordingly.

Species identification

All the captured non-volant small mammals were identified from the order to its families and species by capturing their picture and referring to Francis (2008). All the data were recorded in word and usedfor statistical analysis.

Length-Weight Regression (LWRs)

By referring to Le Cren (1951), length-weight relationship can be expressed as $W = aL^b$, the logarithmic transformation of which gives the linear equation as $LogW = loga + b logL$, where W = weight in gram,L= length in cm, a = a constant being the initial growth index, and b = growth coefficient. Constant 'a' represents the point at which the regression line intercepts the y-axis and 'b' the slope of the regression line. If ‘b’ is larger than 3, there is a positive allometric growth shown by the samples measured (Hossain and Sultana, 2016).

Result and Discussion

Small Mammals’ Data Collection

Throughout the sampling period, only six individuals of *Tupaia glis* were recorded in 2020 while no samples recorded in 2021. As shown in Table 1, the small mammals that were captured in 2020 are commonly known as common tree shrew or *Tupaia glis* (Scandentia:Tupaiidae). During this study was conducted, the weather was in a good condition and this one of the factors why the *Tupaia glis* active hence increase the chance to capture it. Other than that, according to this study banana is the most preferred bait compared to the others bait because based on the observation every of them that were captured choose to eat banana bait rather than other baits. Forest Reserve UiTM Kuala Pilah also never undergo severe flooding or drought that alter the quality of habitat.

They were identified through their long snout, short tail, and laterally-oriented eyes. They can be distinguished from squirrels by absence of long whiskers. They also have a dense and dark brown pelage on the dorsal body region and orange-rufous ventrally with presence of a pale stripe on the shoulder. All digits have long, sharp claws and small ears (Francis, 2008). This species is listed as Least Concern with decreasing trend in population in the IUCN Red List of Threatened Species (Sargis and Kennerly,2017).

Table 1**.** External body measurements of the specimen recorded in 2020 and 2021

Year	**Species**	**Weight(g)**	**Head-body length (mm)**	**Tail length (mm)**	**Hind foot length (mm)**	**Sex**
2020	*Tupaia glis*	160	155	195	45	Male
	Tupaia glis	169	160	199	47	Male
	Tupaia glis	163	157	197	45	Male
	Tupaia glis	161	156	195	46	Male
	Tupaia glis	159	155	195	44	Male
	Tupaia glis	120	145	195	43	Male
2021			No samples recorded			

Similar findings was collected by Ruppert *et al.* (2015) which the most dominance species recorded in Segari Melintang Forest Reserve, Peninsular Malaysia is common treeshrew (*Tupaia glis*) with 25.8 individuals ha^{-1}. All of captured samples are males. This is likely due to males moves around over greater distances as compared to female (Bantihun and Bekele, 2015). *Tupaia glis* was also recorded found in Pulau Perhentian Besar, Terengganu, Malaysia (Noor Aisyah *et al.,* 2016). Furthermore, *Tupaiaglis* were recorded captured in fragmented forests in Terengganu State and constituted to the high abundance of small mammals (Nurul Khaleeda *et al.,* 2018).

The small mammal is found foraging along the beach and coastal areas on the ground. There are also another species found includes *Callosciurus notatus* (Plantain squirrel), *Maxomys surifer* (Red Spiny rat), *M. whiteheadi* (Whitehead’s spinyrat) and *Sundamys muelleri* (Muller’s rat) (Nurul Khaleeda *et al.,* 2018). However, all these species are unable to be captured in UiTM Forest Reserve, Kuala Pilah Campus. This may be due to the forest ecosystem is not the most suitable or favorable habitat for the survival of all those species. This opinian can be supported by Luza *et* al. (2016) which stated that habitat preference among small mammals are influenced by their needs and this results in their random pattern of distribution.

However, there is not even one individual of small mammal was captured in 2021. It is because the rainy season that occurred during this study made the bait wet and less appealing to the non-volant small mammals. Baits are essential in determining the capture success rate of non-volant small mammals as the usage of bait can increase the likelihood of encountering with the target species within the capture range (Peris *et al.,* 2019). It is important to ensure that the bait used is always fresh and of high quality. Apart from that, in UiTM reserved forest, it showed several obvious signs of pig damage. These have an impact on the capture of non-volant small mammals because behavioural responses to predation risk signals might include avoidance, inhibition of foraging and other non-defensive activities, and overall decreased activity levels (Bengsen *et al.,* 2010).

Based on observation, the forest area is not heavily degraded as it is similar with the condition of previous study in 2020. According to Ruppert *et al.* (2015), the composition of small frugivorous mammals in West-Malaysian forests is still not much known eventhough their importance for the rainforest ecosystem is greatly discussed. The species richness of small mammals in Malaysia is very high which very impactful to the Malaysia's rainforest ecosystem. However, they have still not received much public or conservational attention (William-Dee *et al.,* 2019) and only little adressed in literature (Syed-Arnez and Mohd Zain, 2006). In future, the study on abiotic parameters and biotic interaction such as predation should be conducted to determine the other factors that can lead to a decrease in the number of small mammals in UiTM Forest Reserve. It is because this forest is protected from any form of destruction due to its status as a forest reserve. Although in disturbed forest like Kenaboi Forest Reserve, Jelebu, Negeri Sembilan, small mammals such as *Tupaia glis* and rodent can still be found (Ramli and Hashim, 2009).

Other than habitat destruction and deforestration, there are several factors affect the diversity and abundance of small mammals. Metropolitan development that is close by natural environments cause uneven and diverse landscapes (Zakaria *et al.,* 2016). Consequently, this factor directly contributed to the loss of biodiversity and ecosystem services (Brook *et al.,* 2003). The remnants of vegetation and open forests in metropolitan landscapes hence become new boundaries for invasive and native species (Magintan *et al.,* 2017). Due to that, it is hard to identify which species of small mammals will survive under intensely urbanization scenarios and the conversion of rich natural environments such as tropical forests to urban areas (Chung and Corlett, 2006).

Figure 2. *Tupaia glis* captured at study sites (Nur Rabiatul Adawiyah, 2020)

The limited species and number of small mammals captured are affected by short period of sampling. Longer period of sampling could increase the capture number of small mammals and provide more richness species found. Furthermore, several raining days during the sampling period also could affect the limited capture (Weldy *et al.,* 2019). However, some of studies have shown that rainfall cause the increase in rodent population during the wet season (Bantihun and Bekele, 2015). According to Stanley *et al.* (2014), the weather, which was impacting the availability of the shrew, had an impact on the successful sampling of the samples.

Length-Weight Regression (LWRs) of *Tupaia glis*

All of the captured small mammals' morphological measurements collected on 2020 are approximatelythe same in range of; weight (120-169 g), head-body length (145-160 mm), tail length (195-199 mm) and hind foot length (43-47 mm). Figure 3 shows the Length-Weigth Regression (LWRs) analysis of *Tupaia glis* captured on 2020. For linear regression models, R-squared is a goodness-of-fit models. R-squared (R^2) quantifies the correlation strength between the model and the dependent variable on a convenient 0 – 100% scale (Yu, 2016). According to (Ramli *et al.*, 2021), high value of R^2 indicate a good relationship fitted with the range of value is between 0 to 1.0. Higher R^2 values indicate less difference between the observed data and the fitted values for the same set of data (Bewick *et al.*, 2003). The data for R^2 of *T. glis* is 0.97 or 97% and recorded a good fit as the value is the nearest to 1.0 (Figure 3).

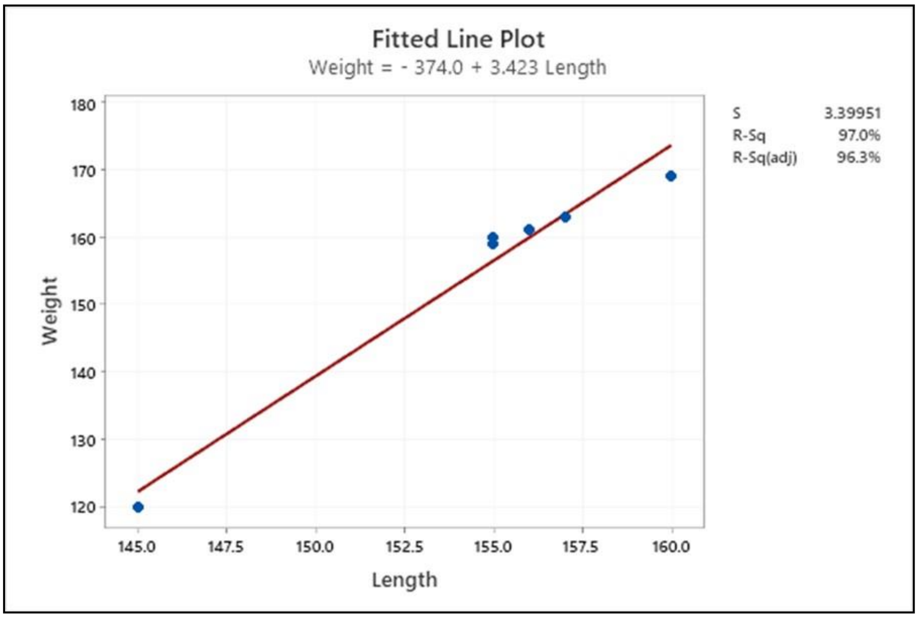

Figure 3. Length-weigth regression pattern of *Tupaia glis* in UiTM Forest Reserve, Kuala Pilah

Based on result, the value of 'a' and 'b' is -0.581 and 3.672, respectively. The data analysis of 'b' in this study is higher than 3 and it is a positive allometric growth meaning that its growth is an optimum rate. As a result, it can be shown that the weight of *T. glis* increases as the length increases. This is because the environment in the UiTM Kuala Pilah forest reserve is favourable for this species. The forest ecosystem in the research area provides numerous components that help them live, including as food, space and shelter. As they are semiarboreal species, they spend half of their live on the tree. The existence of numerous vertical big tree trunks allowed them to climb from one tree to another in order to hunting for food and to avoid from predators (Gheler-Costa *et al.,* 2012).

Conclusion

In conclusion, the only species captured in this study was *Tupaia glis*. The low diversity and richness of small mammals recorded in this study are affected by the limited number of small mammals species captured due to short period of sampling. Based on the results obtained, it cannot be concluded that the diversity and composition of non-volant small mammals in UiTM Forest Reserve were affected by the anthropogenic occurrence nearby. Therefore, more species of small mammals need to be captured in the future study in order to observe the effect of anthropogenic activities on small mammals' diversity and composition in UiTM Forest Reserve.

However, various study has shown that both protected forest and non-protected forest have the ability to provide different habitat for different small mammals species. Undisturbed forest that is located at disturbed landscape also provide an area of enhanced habitat quality for certain small mammals communities. The composition of small mammals communities found in continuous forest is slightly different from the fragmented forest. Furthermore, human activities such as logging, human settlement and agricultural expansion should be monitored to ensure the continuous quality of habitat provided for small mammals.

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References

Ansell, W. F. H. (2015). Standardisation of field data on mammals. *Zoologica Africana, 1*(1), 97-113.

Bantihun, G. and Bekele, A. (2015). Diversity and habitat association of small mammals in Aridtsy forest, Awi Zone, Ethiopia. *Dong wu xue yan jiu = Zoological Research*, *36*(2), 88-94.

Bengsen, A. J., Leung, L. K. P., Lapidge, S. J., & Gordon, I. J. (2010). Artificial illumination reduces bait-take by small rainforest mammals. *Applied Animal Behaviour Science*, *127*(1–2), 66–72.

Bewick, V., Cheek, L., & Ball, J. (2003). Statistics review 7: Correlation and regression. *Critical Care*, *7*(6), 451–459. https://doi.org/10.1186/cc2401.

Brook, B. W., Sodhl, N. S., and Ng, P. K. L. (2003). Catastrophic extinctions follow deforestation in Singapore. *Nature*, 424(6947), 420–423.

Chung, K. P. S., and Corlett, R. T. (2006). Rodent diversity in a highly degraded tropical landscape: Hong Kong, South China. *Biodiversity and Conservation*, 15(14), 4521–4532.

Eymann, J., Monje, J. C., Samyn, Y., & Vandenspiegel, D. (2010). Volume 8 - Manual on Field Recording Techniques and Protocols for All Taxa Biodiversity Inventories. *Techniques*, *8*, 13–18.

Francis, C. M. (2008). *A Field Guide to the Mammals of South-east Asia.* (1st ed.). New Holland, London. 392 pp.Frost, J. M. 2021. How to Interpret R-squared in Regression Analysis. https://statisticsbyjim.com/regression/interpret-r-squared-regression/ [20 May 2021]

Gheler-Costa, C., Vettorazzi, C. A., Pardini, R. And Verdade, L. M. (2012). The distribution and abundance ofsmall mammals in agroecosystems of Southeastern Brazil. *Mammalia*, *76*(2), 185-191.

Hossain, M., & Sultana, N. (2016). Morphometric characters and length-weight relationship of Bele, (Glossogobius giuris) from Mithamoin haor, Kissorgonj, Bangladesh. *Journal of the Bangladesh Agricultural University*, *12*(2), 389–395. https://doi.org/10.3329/jbau.v12i2.28699.

Jayaraj, V. K., Nurul Farah Diyana. A. T., Noor Amirah, U., Noor Farahin, K. B., Siti Katijah, I. and Siti Noor Azwa, Z. (2012). Species diversity of small mammals at Gunung Stong State Park, Kelantan, Malaysia. *Journal of Threatened Taxa*, *6*(4), 2617–2628.

Le Cren E.D. (1951). The length-weight relationship and seasonal cycle in gonad weight and condition in perch (*Perca fluviatilis*). *J. Anim. Ecol*., 20: 201-219.

Lim, B. K., and Pacheco, V. R. (2016). Small Non-volant Mammals. Biodiversity Sampling Protocols. https://www.researchgate.net/publication/301220115_Small_nonvolant_mammals. Retrieved December 3, 2019.

Luza, A. L., Gonçalves, G. L., Pillar, V. D. and Hartz, S. M. (2016). Processes related to habitat selection, diversity and niche similarity in assemblages of non-volant small mammals at grassland–forest ecotones. *Natureza & Conservação, 14*(2), 88-98.

Magintan, D., Mohd Nor, S., Ean, T. P., Lechner, A. M., and Badrul, A. (2017). The conservation value of unlogged and logged forests for native mammals on the East Coast of Peninsular Malaysia. *Journal for Nature Conservation,40*, 113-119.

Merrick, M. (2012). Why we should care about small mammals: A global perspective. https://mjmerrick.wordpress.com/. Retrieved December 3, 2019.

Noor Aisyah, A. R., Nur Izzah Izzati, A., Amirah Azizah, Z., Pesiu, E., Muhammad Razali, S., Mazrul Aswady, M. and Mohd Tajuddin, A. (2016). Brief survey of non-volant small mammals on Pulau Perhentian Besar, Terengganu, Malaysia. *Journal of Sustainability Science and Management*, (1), 19-25.

Norfahiah, M., Azema, I., Marina, M. T., & Zakaria, M. (2012). Status and Distribution of Non-volant Small Mammals in Universiti Putra Malaysia, Bintulu Sarawak Campus (UPMKB). *Pertanika Journal TropicalAgriculture Science*, *2*(35), 363 - 369.

Nurul Khaleeda, A. K., Nur Juliani, S., Hasrulzaman, H. B., Nelson, B.R. and Mohd Tajuddin, A. (2018). Non-volant small mammal data from fragmented forests in Terengganu State. *Data Brief, 21*, 1514-1520.

Peris, A., Closa-Sebastià, F., Marco, I., Serrano, E., & Casas-Díaz, E. (2019). Baiting improves wild boar population size estimates by camera trapping. *Mammalian Biology*, *98*, 28–35.

Pineda-Munoz, S., Evans, A., & Alroy, J. (2016). The relationship between diet and body mass in terrestrial mammals. *Paleobiology, 42*(4), 659-669. doi:10.1017/pab.2016.6.

Ramli, R. and Hashim R. (2009). Diversity of small mammals inhabiting disturbed forest: A Case Study on Kenaboi Forest Reserve, Jelebu, Negeri Sembilan, Malaysia. *Malaysian Journal of Science*, 28 (4): 481-490

Romairone, J., Jiménez, J., Luque-Larena, J. J. and Mougeot, F. (2018). Spatial capture-recapture design and modelling for the study of small mammals. *PloS ONE*, *13*(6).

Ruppert, N. B., Asyraf, M., and Shahrual, M. A. (2015). Diversity and biomass of terrestrial small mammals at Malaysian Primary Rainforest (Segari Melintang Forest Reserve, Peninsular Malaysia). *The Journal of TropicalLife Science*, *5*(1), 35-44.

Sargis, E. and Kennerley, R. (2017). The IUCN Red List of Threatened Species. *Tupaiaglis*.www.iucnredlist.org. Retrieved June 14, 20210.

Seddon, P., Knight, M., Mallon, D., Monadjem, A., Steenkamp, G., Budd, J., Budd, K. and May, S. (2014). Wildlife reintroductions, small mammal survey techniques and captive carnivore care. *Proceedings of the 15th Annual Conservation Workshop for the Biodiversity of Arabia*, Knight, M., (ed.) Sharjah, UAE 3-6 February 2014. EPAA, Sharjah, United Arab Emirates, 31 pp.

Solari, S., Rodriguez, J. J., Vivar, E., & Velazco, P. M. (2002). A framework for assessment and monitoring of small mammals in a lowland tropical forest. *Environmental Monitoring and Assessment*, *76*(1), 89–104.https://doi.org/10.1023/A:1015272905263.

Stanley, W. T., Rogers, M. A., Kihaule, P. M. and Munissi, M. J. (2014). Elevational distribution and ecology ofsmall mammals on Africa's Highest Mountain. *PloS ONE*, 9-11.

Syed-Arnez, A. S. K., & Mohd Zain, S. N. (2006). A study on wild rats and their endoparasite fauna from the Endau Rompin National Park, Johor. *Malaysian Journal of Science*, *25*(2), 19–39.

Weldy, M. J., Epps, C. W., Lesmeister, D. B., Manning, T., Linnell, M. A. and Forsman, E.D.(2019).Abundance and ecological associations of small mammals. *The Journal of Wildlife Management*, *83*(4), 902-915.

William-Dee, J., Faisal Ali, A.K., Qhairil, R., Muhd Amsyari, M., Isham, A., Lim, L. S., Tingga, R. C. T. and Mohd Ridwan, A. R. (2019). Comparative distribution of small mammals diversity in protected and non - protected area of Peninsular Malaysia. *Tropical Life Sciences Research*, *30*(2), 131-147.

Wilson, D. J., Efford, M. G., Brown, S. J., Williamson, J. F., & Mcelrea, G. J. (2007). New Zealand Ecological Society Estimating density of ship rats in New Zealand forests by capture-mark-recapture trapping Linked references are available on JSTOR for this article: forests by capture. *New Zealand Ecological Society*, *31*(1), 47–59.

Yu, J.-Y. (2016). *Analysis of Relationship Between Two Variables*. https://www.ess.uci.edu/~yu/class/ess210b/lecture.3.regression.all.pdf.

Zakaria, M., Rajpar, M. N., Ozdemir, I., and Rosli, Z. (2016). Fauna Diversity in Tropical Rainforest: Threats from Land-Use Change. *Tropical Forests - The Challenges of Maintaining Ecosystem Services While Managing the Landscape*, *421*(January), 530–533. https://doi.org/10.5772/64963.