

# Nocturnal Mammals of Segaliud-Lokan Forest Reserve, Sabah

Sze-Lue Kee<sup>1</sup>, Jephthe Sompud<sup>1#</sup>, Kurtis Jai-Chyi Pei<sup>2</sup>, Mahmud Sudin<sup>1</sup>,  
Collin Goh<sup>3</sup>, Paul Liau<sup>3</sup>, Fadzil Yahya<sup>4</sup>

<sup>1</sup> Forestry Complex, Faculty of Science and Natural Resources, Universiti Malaysia Sabah, Jalan UMS, 88400, Kota Kinabalu, Sabah, MALAYSIA.

<sup>2</sup> Department of Natural Resources and Environmental Studies, National Dong Hwa University, No 1, Sec. 2, Dahu Road, Shoufeng, Hualien 97401, TAIWAN.

<sup>3</sup> KTS Plantation Sdn. Bhd., Level 1, Blok 5, Jalan Utara Batu 4, Bandar Pasaraya, 90000 Sandakan, Sabah, MALAYSIA.

<sup>4</sup> Sandakan Forestry District Office, Sabah Forestry Department, Peti Surat (P.O. Box) 212, 90702 Sandakan, MALAYSIA.

# Corresponding author: jephthe@ums.edu.my; Tel: +6088320769

**ABSTRACT** The aim of this study is to document the population density and diversity of nocturnal mammal in Segaliud-Lokan Forest Reserve (SLFR). Vehicle spotlight survey was conducted from October – December 2017. A total distance of 1,720 km travelled along the gravel roads. There were 24 species with 14 families (195 sighting) nocturnal mammals were recorded. Many large nocturnal mammals can be found in Segaliud-Lokan Forest Reserve, including Asian elephant (*Elephas maximus*), Tembadau (*Bos javanicus*), and Clouded leopard (*Neofelis diardi*). The Shannon's diversity index and Simpson diversity index were 2.60 and 0.90, respectively. King's census method was used to estimate the population density which was 4.780 individual per square kilometer. The population density and diversity of nocturnal mammals was high, indicating that the forest operations in SLFR seemingly support the sustainability of the nocturnal mammal population there.

**KEYWORDS:** Population density; nocturnal mammal; Segaliud-Lokan Forest Reserve; Forest operations

| Received 13 January 2018 | Revised 18 April 2018 | Accepted 1 Jun 2018 | Online 28 June 2018 |

© Transactions on Science and Technology 2017

## INTRODUCTION

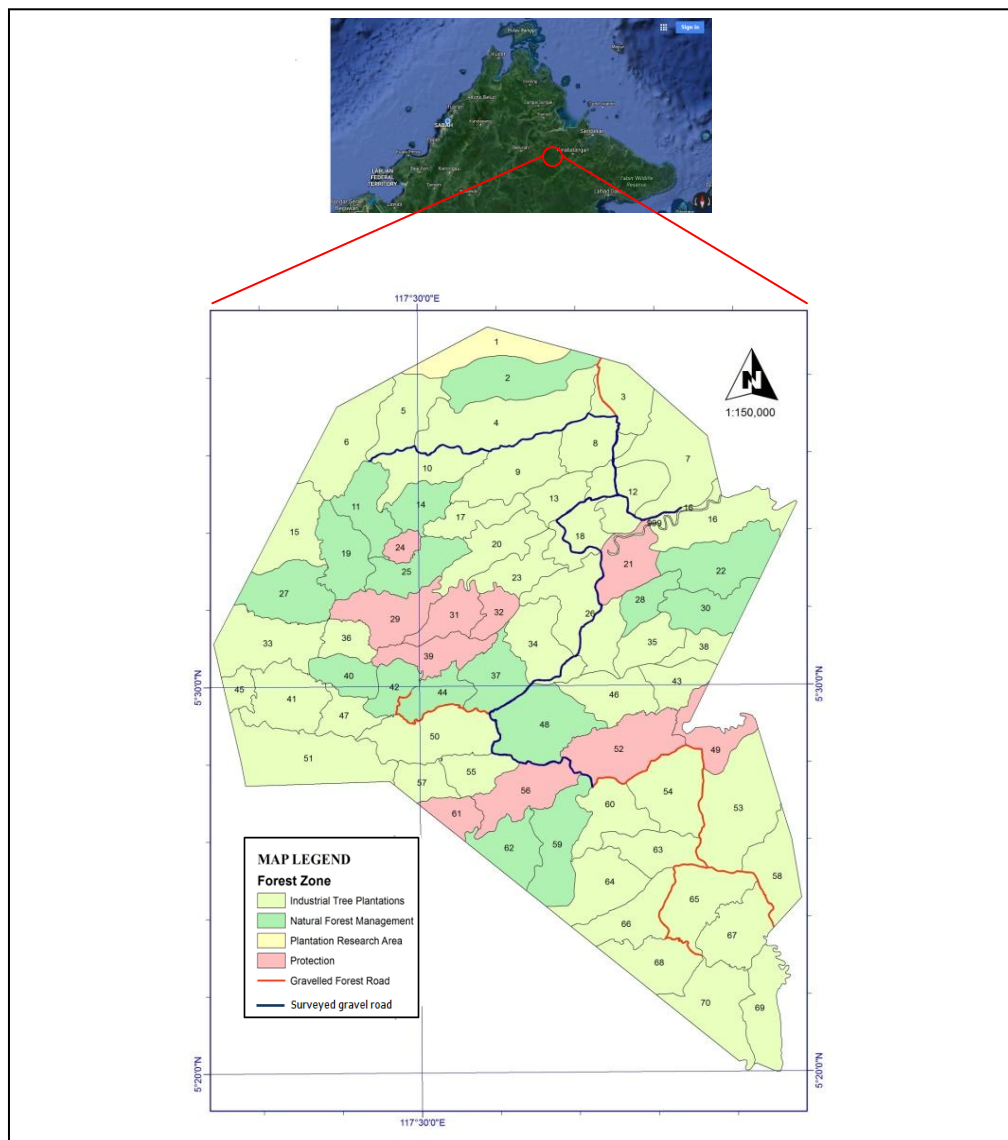
Mannan and Awang (1997) and Gunggut *et al.* (2014) have reported that 90% of forest loss in Sabah were lost due to the intensive logging activities without appropriate plan and conversion of natural forest to cash crops, particularly oil palm (Fitzherbert *et al.*, 2008). Virgin forest provides natural habitat for wildlife. The loss of virgin forest causes the decline of wildlife to population (Sodhi *et al.*, 2010). According to International Union for Conservation of Nature (IUCN), approximately 2,000 mammals in the world have been affected by habitat loss (WWF, 2017). The alteration of forest structure from natural forest to plantation significantly affects the distribution of mammals (Sodhi *et al.*, 2010). The purpose of this study is to document the population density and diversity of nocturnal mammal in SLFR.

## METHODOLOGY

### Study Area

The study area was located in SLFR (FMU 19b) that currently being managed by KTS Plantation SDN BHD (KTSP). SLFR (5°20' N and 5°27' N; 117°23' E and 117° 39' E) is located at the north-east of Deramakot Forest Reserve in the Sabah District of Sandakan (**Figure 1**). Total area of SLFR is around 57, 247 ha (SIRIM QAS International Sdn. Bhd., 2015). The forest functional zones in SLFR was categorized into Protection Area (6, 447 ha), Natural Forest Management (12, 603 ha), Industrial Tree Planting (37, 420 ha), and Research Area (777 ha). KTSP has been awarded with both Malaysian Criteria and Indicators for Forest Management Certification (Natural Forest) and Environmental Management System ISO 14001:2004 (SIRIM QAS International Sdn Bhd, 2015). KTSP was the first private company that voluntarily implemented Reduced Impact Logging (RIL) system since 1998 in

Natural Forest Management (NFM) and Industrial Timber Plantation (ITP) (SIRIM QAS International Sdn. Bhd., 2015) to reduce negative impact to vegetation and wildlife (Boltz *et al.*, 2003).



**Figure 1.** Map of Segaliud-Lokan Forest Reserve, Sabah (KTS Plantation Sdn Bhd, 2017)

#### *Vehicle spotlight survey*

Vehicle spotlight survey is commonly used to monitoring of nocturnal mammals in dense vegetation forest (Driessen & Hocking, 1992). The data derived from vehicle spotlight survey was collected for 42 days that elapsed from October 2017 until December 2017. Survey was conducted between the time period of 7.00 pm and 12.00 am (Azlan & Sharma, 2006; Grassman *et al.*, 2005) along gravel road (blue line) as shown **Figure 1**. The survey was conducted by two observers (Snape *et al.*, 2015) using a handheld 50W yellow spotlight (1200mA, 4.0V). The vehicle speed during the survey was maintained between 16-24 km/h (Roberts *et al.*, 2006). All field observation was recorded systematically using a standard survey form. Data that was recorded for each sighting were, GPS coordinates of sighted mammal, the bearing and perpendicular distance from the observer to the animal, animal species, time, and any additional notes.

## RESULT

A total of 1,720 kilometers of vehicle spotlight counts were conducted in SLFR from 16 October 2017 – 24 December 2017. There were 24 species with 14 families (195 sighting) nocturnal mammals

were recorded (**Table 1**). The sighting frequency per 10 km along the gravel road was 1.11. The calculated Shannon's diversity index and Simpson diversity index were 2.60 and 0.90, respectively. The estimated population density using king's Census was 4.78 individual/km<sup>2</sup>. There were 11 species (nearly 50%) that were recorded as Endangered, Vulnerable or near threatened out of the 24 species (**Table 1**). Common palm civet (*Paradoxurus hermaphroditus*) was the most commonly seen (21.5%), followed by Leopard cat [*Felis bengalensis*] (14.4%) and Malay civet [*Viverra zangalunga*] (12.8%), Slow loris [*Nycticebus coucang*] (9.7%), Sambar deer [*Cervus unicolor*] (8.7%), Lesser mouse-deer [*Tragulus kanchil*] (7.2%), and Thomas's flying squirrel [*Aeromys thomasi*] (6.7%).

**Table 1.** Recorded nocturnal mammals during vehicle spotlight survey in SLFR

Order	Family	Common name	Scientific name	IUCN	Survey type	
Carnivora	Felidae	Leopard cat	<i>Felis bengalensis</i>	LC	S	
		Marbled cat	<i>Felis marmorata</i>	VU	S	
		Clouded leopard	<i>Neofelis diardi</i>	VU	S	
	Viverridae	Common palm civet	<i>Paradoxurus hermaphroditus</i>	LC	S	
		Malay civet	<i>Viverra zangalunga</i>	LC	S	
		Otter civet	<i>Cynogale bannettii</i>	EN	S	
		Small-toothed palm civet	<i>Arctogalidia trivirgata</i>	LC	S	
		Banded palm civet	<i>Hemigalus derbyanus</i>	NT	S	
		Binturong	<i>Arctictis binturong</i>	VU	S	
		Masked palm civet	<i>Paguma larvata</i>	LC	O	
	Artiodactyla	Mephitidae	Banded linsang	<i>Prionodon linsang</i>	LC	O
			Malay badger	<i>Mydaus javanensis</i>	LC	S
		Cervidae	Sambar deer	<i>Cervus unicolor</i>	VU	S
Tragulidae			Lesser mouse-deer	<i>Tragulus kanchil</i>	LC	S
			Greater mouse-deer	<i>Tragulus napu</i>	LC	S
Suidae	Bearded pig	<i>Sus barbatus</i>	VU	S		
Bovidae	Tembadau	<i>Bos javanicus</i>	EN	S		
Proboscidae	Elephantidae	Borneo pygmy elephant	<i>Elephas maximus</i>	EN	S	
Insectivora	Erinaceidae	Moonrat	<i>Echinosorex gymnurus</i>	LC	S	
Scandentia	Ptilocercidae	Pentail treeshrew	<i>Ptilocercus lowii</i>	LC	S	
Rodentia	Hystricidae	Common porcupine	<i>Hystrix brachyura</i>	LC	S	
		Sciuridae	Thomas's flying squirrel	<i>Aeromys thomasi</i>	LC	S
	Sciuridae	Red giant flying squirrel	<i>Petaurista petaurista</i>	LC	S	
		Horsfield's flying squirrel	<i>Iomys horsfieldi</i>	LC	S	
Primate	Lorisidae	Slow loris	<i>Nycticebus coucang</i>	VU	S	
	Tarsiidae	Western Tarsier	<i>Tarsius bancanus</i>	VU	S	

Note: IUCN, Red list of globally threatened species status, EN=Endangered, VU=Vulnerable, NT=Near threatened, LC=Least concern. **Survey type**, S=Standard survey, O=Opportunity survey.

## DISCUSSION

The study on nocturnal mammals in one of the Acacia forest plantations in Sabah by Sompud *et al.* (2016) recorded only two species throughout their 21 days of survey. Wilting and Mohamed (2010) reported that 15 species of nocturnal mammals in logged-over forest throughout 350 km of vehicle spotlight survey. Ragai and Tuen (2007) suggested that plantation area or logged forest may conserve the communities of mammals if there is a better plantation design and forest management which could provide the essential element to mammal.

**Table 2.** Comparison of population diversity and sighting frequency of nocturnal mammal in Segaliud-Lokan Forest Reserve (SLFR) and Sabah Forest Industries (SFI).

Study site	Forest type	Population diversity	Sighting frequency (per 10 km)	Studies
Segaliud-Lokan Forest Reserve (SLFR)	Forest plantation	2.60	1.11	Current study
Sabah Forest Industries (SFI)	Forest plantation	0.56	0.19	Sompud <i>et al.</i> (2016)

The population diversity and sighting frequency of this study (SLFR) was compared with Sompud *et al.* (2016) unpublished data that done in Sabah Forest industries (SFI) as above **Table 2**. The sighting frequency and population diversity of nocturnal mammal in SLFR (sighting frequency per 10 km = 1.11; Diversity Index = 2.60) was higher than SFI (sighting frequency per 10 km = 0.19; Diversity Index = 0.56) (Sompud *et al.*, 2016). The Mann-Whitney U Test shows a significant different in term of sighting frequency between SLFR and SFI ( $N = 199$ , Mann-Whitney  $U = 54.0$ ,  $z = -2.949$ ,  $p = .003^{**}$ ). SFI has critically low population diversity and sighting frequency of nocturnal mammal as compared to SLFR probably due to the hunting pressure (Sompud *et al.*, 2016; Davies & Payne, 1982; Payne & Andau, 1991). Sompud *et al.* (2016) reported that the hunting activity in SFI was very active where the hunters or poachers even bring along hunting dog during hunting. Hunting is one of the main factors that cause the decline the population diversity of nocturnal mammal (Arroyo & Beja, 2002). Hunting activity in SLFR is strictly prohibited as listed in Forest Management Planning (FMP) (KTS Plantation Sdn Bhd, 2017). Patrolling was conducted from time to time to avoid intruders from outside SLFR boundary (Tama Stain, 2018). As such, SLFR has low hunting pressure as compared to SFI due to the limited access to the general public.

High percentages of endangered and vulnerable mammal were found in this study. This suggests that SLFR provide essential elements such as space, shelter, water and food sources, as the fundamental requirements for their survival as underlined by Creighton & Baumgartner (1997). SLFR also has several existing natural salt lick areas that were maintained throughout its forest operations (SIRIM QAS International Sdn. Bhd., 2015). Natural salt lick contains of essential mineral like sodium which help in absorption of toxin, and pH adjustment of gut (Montenegro, 2004; Matsubayashi *et al.*, 2007).

## CONCLUSION

The population density and diversity of nocturnal mammals was high, indicating that the forest operations in SLFR seemingly support the sustainability of the nocturnal mammal population there.

## ACKNOWLEDGEMENTS

This research was funded by National Geographical Society (WW-112ER-17) and KTSP. We thank Mohamad Jefli Bin Jamal, Basri Latif, Lee Woon Jah, Peter Tiong, Andreas Apoi Ak Tama Stain, Sanchez Vincent John, Darrysie Salapan, Mohd Arshad Bin Marasad, Wong Ken Min, and Sahrul Sangkala for their help throughout the study.



## REFERENCES

- [1] Arroyo, B. & Beja, P. (2002). *Impact of hunting management practives on biodiversity. Reconciling Gamebird Hunting and Biodiversity (REGHAB)*. Ciudad Real, Spain: Instituto de Investigación en Recursos Cinegéticos.
- [2] Azlan, J. M. & Sharma, D. S. K. (2006). The diversity and activity patterns of wild felids in a secondary forest in Peninsular Malaysia. *Oryx*, **40**(1), 1-6.
- [3] Boltz, F., Holmes, T. P. & Carter, D. R. (2003). Economic and environmental impacts of conventional and reduced-impact logging in Tropical South America: a comparative review. *Forest Policy and Economics*, **5**, 69-81.
- [4] Creighton, J. H. & Baumgartner, D. M. (1997). *Wildlife Ecology and Forest Habitat*. Washington: Cooperative Extension, Washington State University.
- [5] Davies, G. & Payne, J. (1982). *A Faunal Survey of Sabah*. Kota Kinabalu: WWF Malaysia.
- [6] Driessen, M. M. & Hocking, G. J. (1992). *Review and Analysis of Spotlight Survey in Tasmania: 1975-1990*. Hobart: Department of Parks, Wildlife and Heritage.
- [7] Fitzherbert, E. B., Struebig, M. J., Morel, A., Danielsen, F., Bruhl, C. A., Donald, P. F., & Phalan, B. (2008). How will oil palm expansion affect biodiversity? *Trends in Ecology and Evolution*, **23**(10), 538-545.
- [8] Grassman, Jr. L. I., Tewes, M. E., Silvy, N. J. & Kreetiyutanont K. (2005). Ecology of three sympatric felids in a mixed evergreen forest in north-central Thailand. *Journal of Mammalogy*, **86**, 29-38.
- [9] Gunggut, H., Ag Mohd Saufi, D. S. N. S., Zaaba, Z. & Liu, S. M. (2014). Where have all the Forests Gone? Deforestation in land below the wind. *Procedia-Social and Behavioral Sciences*, **153**, 363 – 369.
- [10] KTS Plantation Sdn Bhd. (2017).
- [11] Mannan, S. and Awang, Y. (1997). 'Sustainable Forest Management in Sabah'. *Paper presented at the Seminar on Sustainable Forest Management*. 22 November, 1997. Kota Kinabalu, Sabah.
- [12] Matsubayashi, H., Lagan, P., Majalap, N., Tangah, J., Abd. Sukor, J. R. & Kitayama, K. (2007). Importance of natural licks for the mammals in Bornean inland tropical rain forest. *Ecological Research*, **22**(5), 742-748.
- [13] Montenegro, O. L. (2004). *Natural licks as keystone resources for wildlife and people in Amazonia*. PhD thesis, University of Florida, America.
- [14] Payne, J. & Andau, M. (1991). The sate of nature conservation in Malaysia. In Kiew, R. (eds.). *Large mammals in Sabah* (pp. 177-183). Kuala Lumpur: United Selangor Press.
- [15] Ragai, R., and Tuen, A. A. (2007). A small mammal survey within the planted forest zone, Bintulu, Sarawak. *Regional Conference of Biodiversity Conservation in Tropical Forests in Southeast Asia*. Pp. 160-166.
- [16] Roberts, C. W., Pierce, B. L., Braden, A. W., Lopez, R. R., Silvy, N. J., Frank, P. A. & Ransom, Jr. D. (2006). Comparison of Camera and Road Survey Estimates for White-Tailed Deer. *The Journal of Wildlife Management*, **70**(1), 263-267.
- [17] SIRIM QAS International Sdn Bhd. (2015). *Public summary second surveillance audit (Second cycle) on the Segaliud-Lokan FMU for forest management certification*. (<http://www.sirim-qas.com.my/sirim/core-files/uploads/2017/05/Public-Summary-FMC-of-Segaliud-Lokan-Forest-Management-Unit-2nd-Surveillance-2nd-Cycle.pdf>). Audit date: 23-27 February 2015.
- [18] Snape, M., Stevenson, B. & Evans, M. (2015). *Arboreal mammal spotlight survey 2014*. Technical Report No. 30. Canberra: Environment and Planning Directorate.
- [19] Sodhi, N. S., Koh, L. P., Clements, R., Wanger, T. C., Hill, J. K., Hamer, K. C., Clough, Y., Tschamtker, T., Posa, M. R. C. & Lee, T. M. (2010). Conserving Southeast Asian forest biodiversity in human-modified landscapes. *Biological Conservation*, **143**, 2375-2384.

- [20] Sompud, J., Lu, S. H., Pamin, D., Sompud, C. B. & Mojiol, A. R. (2016). Nocturnal Terrestrial Mammals Population in Sabah Forest Insustries (SFI) Forest Plantation, Sipitang. *Transactions on Science and Technology*, 3(1-2), 123-129.
- [21] Tama Stain, A. A. (January 2, 2018). Personal communication.
- [22] Wilting, A. and Mohamed, A. (2010). *Wildlife surveys in Segaliud-Lokan Forest Reserve. Final Report*. ([http://www.forest.sabah.gov.my/tangkulap/PDF/KTS\\_Final\\_report\\_ConCaSa.pdf](http://www.forest.sabah.gov.my/tangkulap/PDF/KTS_Final_report_ConCaSa.pdf))
- [23] WWF. (2017). *What impacts do human activities have on habitats and wildlife* [Fact sheet]. Access on 23 May 2017. (<http://www.wwf.org.au/ArticleDocuments/355/pub-fact-sheet-what-impacts-do-human-activities-have-on-habitats-and-wildlife23may17.pdf.aspx>)