

## Diversity and activity pattern of wildlife inhabiting catchment of Hulu Terengganu Hydroelectric Dam, Terengganu, Peninsular Malaysia

M. N. Nurul Adyla, Z. Ikhwan, M. Zuhairi, Ngah, and M. N. Shukor

Citation: [AIP Conference Proceedings](#) **1784**, 060038 (2016); doi: 10.1063/1.4966876

View online: <http://dx.doi.org/10.1063/1.4966876>

View Table of Contents: <http://aip.scitation.org/toc/apc/1784/1>

Published by the [American Institute of Physics](#)

---

### Articles you may be interested in

[An assessment of elephant home ranges and movement patterns during construction of Hulu Terengganu hydroelectric dam, Terengganu using GPS satellite collars](#)

[AIP Conference Proceedings](#) **1784**, 060006 (2016); 10.1063/1.4966844

[The wildlife research & rescue programme for mammals at Hulu Terengganu Hydroelectric Project \(HTHEP\), Terengganu, Peninsular Malaysia](#)

[AIP Conference Proceedings](#) **1784**, 060036 (2016); 10.1063/1.4966874

[Species composition and richness of amphibians in logged forests at Hulu Terengganu, Peninsular Malaysia](#)

[AIP Conference Proceedings](#) **1784**, 060034 (2016); 10.1063/1.4966872

[Activity pattern of selected ungulates at Krau Wildlife Reserve](#)

[AIP Conference Proceedings](#) **1571**, 325 (2013); 10.1063/1.4858677

---



**SUMMER SALE!**

**30% OFF**  
**ALL PRINT**  
**PROCEEDINGS!**

**AIP** | Conference Proceedings

ENTER COUPON CODE  
SUMMER2017

# Diversity and Activity Pattern of Wildlife Inhabiting Catchment of Hulu Terengganu Hydroelectric Dam, Terengganu, Peninsular Malaysia

M. N. Nurul Adyla<sup>1</sup>, Z. Ikhwan<sup>2</sup>, M. Zuhairi, Ngah<sup>3</sup> and M. N. Shukor<sup>1a</sup>

<sup>1</sup>*School of Environmental Science and Natural Resources, Faculty of Science and Technology, Universiti Kebangsaan Malaysia, 43600, Bangi, Selangor, Malaysia*

<sup>2</sup>*Department of Wildlife and National Park (DWNP), Km 10 Jalan Cheras, 56100 Kuala Lumpur, Malaysia*

<sup>3</sup>*TNB Research Sdn. Bhd. No. 1, Lorong Air Hitam, Kawasan Perindustrian Penyelidikan, 43000 Kajang, Selangor, Malaysia*

<sup>a</sup>Corresponding author: shukor@ukm.edu.my

**Abstract.** A series of camera trapping surveys were conducted to study the diversity and distribution of wildlife within the catchment of Hulu Terengganu Hydroelectric Dam. A total of 124 camera traps were deployed at nine study sites, continuously from June 2014 until December 2015. The total effort of camera trap surveys from all the study sites during the 18-month sampling period was 29,128 night traps, from which a total of 32 species of wildlife representing nine Orders were recorded. The most common species were Eurasian Wild Pig (*Sus scrofa*), Barking Deer (*Muntiacus muntjak*), and Malayan Tapir (*Tapirus indicus*). Camera trap data on activity patterns show that *Gallus gallus*, *Muntiacus muntjak* and *Sus scrofa* are diurnal animals, whereas *Tapirus indicus*, *Elephas maximus* and *Helarctos malayanus* are nocturnal animals.

## INTRODUCTION

Protected areas serve as the most important habitat in Malaysia that support a high diversity of mammals. Tropical forests, especially the lowland rain forests harbor the highest biological diversity. Among the most valuable assets of the forests are the wildlife, especially the large mammals that are rare and/or endangered, that are protected under the Wildlife Conservation Act (2010) in Peninsular Malaysia, such as the Sumatran Rhinoceros and Gaur. Many species of small mammals (including bats) are also rare and endangered, but not many are protected by the law.

Camera trapping is a useful and widely used tool to study wildlife in their natural environment. It is generally non-invasive, as it can gather information on a range of species simultaneously and continuously, over large survey areas and for several months at a time with a relatively low personnel demand. Camera-traps have the invaluable advantage of working independently of an observer once they are set up. Working day and night, camera-traps are ideally suited for detecting rare and cryptic species an observer may rarely, if ever encounter (Kawanishi 2001). For example, camera traps in Danum Valley Conservation Area, Sabah, Malaysia recorded the Bay Cat (*Catopuma badia*) seven times over 3,520 trap nights, although the same species was never directly observed by the researchers in that area (Harris et al. 2010).

The main objectives of this study were to identify the wildlife species inhabiting the catchment of Hulu Terengganu Hydroelectric Dam (HTHED) by using camera trapping, and to study the activity patterns of several selected species, which were common there. This was also part of the study to investigate the impacts of (HTHED) construction on wildlife diversity, distribution and movement. This study would shed some light on the the existing status and distribution of mammal species within the catchment area, to facilitate conservation and rescue efforts where and when required.

## MATERIAL AND METHODS

### Study Site

The Hulu Terengganu Hydroelectric Dan (HTHED) catchment areas comprise Tembat Forest Reserve (FR), Petuang FR and Sg. Deka Wildlife Reserve. The catchment of HTHED is located at the north of existing Kenyir Dam at Kuala Berang, Hulu Terengganu, Terengganu. It is about 50 km from Bandar Gua Musang –Hulu Terengganu roadway, and about 65 km west of Kuala Terengganu. Tembat FR is one of the forest reserves in Terengganu, which functions as water catchment area with a total area of 134,690.54 ha (Jabatan Perhutanan Negeri Terengganu, 2015). Sg. Deka Wildlife Reserve (SDWR) is part of Tembat Forest Reserve, degazzated to wildlife reserve in 2010 and is managed by the Department of Wildlife and National Park (DWNP) (Jabatan PERHILITAN, 2014). Puah catchment area is located in Tembat Forest Reserve, while Tembat catchment is located in Petuang Forest Reserve, which acts as a water catchment area for Tasik Kenyir.

### Camera Trap

The study was conducted continuously for one and half year to identify the presence of wildlife species at Tembat Forest Reserve. A total of 124 Bestok™ camera traps were systematically deployed in this study area (Figure 1). These camera traps were powered by 1.5 volt alkaline batteries, equipped with active infrared motion detector, and 8-GB memory stick. The delay between each consecutive photographs was set at 10 seconds. Camera traps were deployed along animal trails with high potential to capture large- and medium-sized wildlife species. Camera traps were mounted on trees, at least 0.3 m above the ground and were deployed continuously for a minimum period of one month without breaks for monitoring, changing the batteries and retrieving the images (still and video). Table 1 shows the details of installation sites of camera traps.

The activity patterns of several selected wildlife species were analyzed based on the date and time imprinted on the images. The percentage of activity (based on frequency of pictures captured within the time frame) was used to categorise whether the activity is nocturnal or diurnal. Activities recorded between 1800h and 0700h were considered as nocturnal and those between 0701 and 1759 hours were classified as diurnal (Mohd. Azlan and Engkamat 2006). One trap night is a period of 24-hour of camera in function.

**TABLE 1.** The location, total trap night and total number of images captured during the sampling period.

Study site	Study period	No. camera traps	No. traps night	No. of images
Puah (before impoundment)	29 <sup>th</sup> June - 9 <sup>th</sup> Sept 2014	46	2320	49,634
Puah catchment	15 <sup>th</sup> Jan - 23 <sup>rd</sup> April 2015	34	2117	11,789
Puah catchment 2	27 <sup>th</sup> June 2015-2 <sup>nd</sup> Jan 2016	31	1578	72,856
Downstream	13 <sup>th</sup> Aug 2014-29 <sup>th</sup> Dec 2015	13	3541	26,365
Ecological bridge	12 <sup>th</sup> May - 27 <sup>th</sup> Dec 2015	21	4123	137,446
SDWR	3 <sup>rd</sup> Aug 2014-7 <sup>th</sup> Aug 2015	35	6432	118,663
Saddle dam	12 <sup>th</sup> May - 1 <sup>st</sup> Jan 2015	18	3954	61,011
Corridor	4 <sup>th</sup> Oct 2015-7 <sup>th</sup> Jan 2016	14	1198	34,241
Tembat Dam	3 <sup>rd</sup> May - 29 <sup>th</sup> Dec 2015	48	3865	79,158

Identification of photographed animals was determined based on description and illustration by Francis, (2008). The images were sorted and analysed by using software ReNamer. A similar software was used to assess the activity patterns of selected wildlife species.

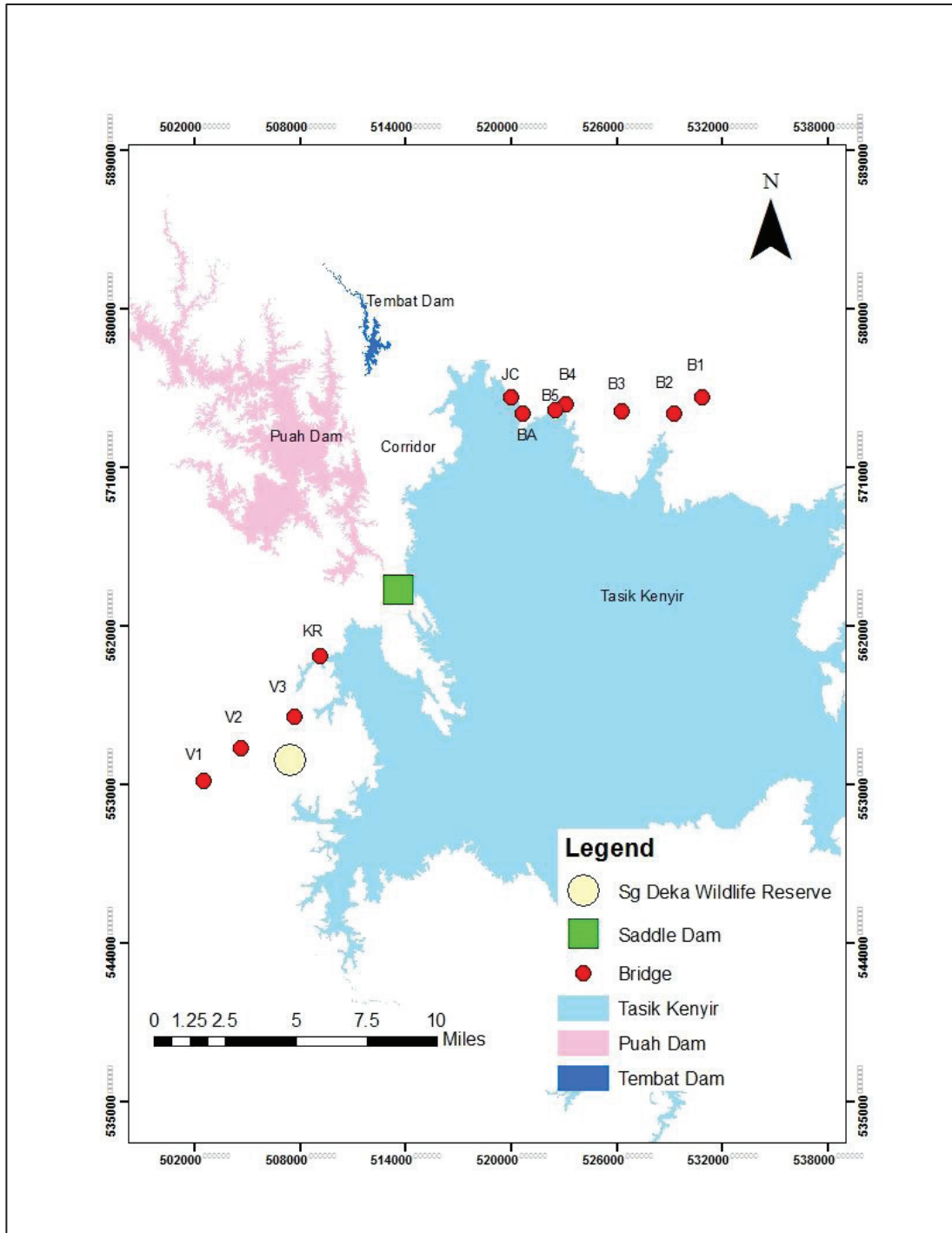


FIGURE 1. The location of the study sites, within the catchment of Hulu Terengganu Hydroelectric Dam.

## RESULT AND DISCUSSION

A total of 591,163 photographic images from 29,128 nights traps were obtained during the study periods. From these images, there were 32 species of wildlife from nine Orders, and 18 families (Table 2). Felidae and Viverridae were the most common families.

Ghost photos (or pictures without any image of wildlife or human) were the highest independent images recorded with 89.7% from the total. *Sus scrofa* was the most dominant species captured at Puah catchment. However, for sampling at SDWR, the highest independent images was *Muntiacus muntjak*. Other wildlife species recorded at the study sites included *Panthera tigris*, *Cuon alpinus*, *Tapirus indicus* and *Elephas maximus*, which are categorized as Endangered by IUCN Red List (2015). There were six vulnerable species of wildlife, namely *Arctictis binturong*, *Helarctos malayanus*, *Lophura erythrophthalma*, *Pardofelis marmorata* and *Lutrogale perspicillata*. There were also near threatened species, such as *Catopuma temminckii*, *Argusianus argus* and *Panthera pardus*.

**TABLE 2.** The species of the wildlife inhabiting the catchment of HTHED recorded by the camera traps.

Family	Species	English name	IUCN status
Cervidae	<i>Muntiacus muntjak</i>	Red muntjak	LC
Suidae	<i>Sus scrofa</i>	Eurasian wild pig	LC
Tragulidae	<i>Tragulus kanchil</i>	Lesser mousedeer	LC
Canidae	<i>Cuon alpinus</i>	Dhole	EN
Felidae	<i>Pardofelis marmorata</i>	Marbled cat	VU
Felidae	<i>Panthera pardus</i>	Leopard	NT
Felidae	<i>Catopuma temminckii</i>	Asian golden cat	NT
Felidae	<i>Panthera tigris</i>	Tiger	EN
Felidae	<i>Prionailurus bengalensis</i>	Leopard cat	LC
Mustelidae	<i>Martes flavigula</i>	Yellow-throated marten	LC
Mustelidae	<i>Lutrogale perspicillata</i>	Smooth-coated otter	TP
Prionodontidae	<i>Prionodon linsang</i>	Banded linsang	LC
Ursidae	<i>Helarctos malayanus</i>	Sun bear	VU
Viverridae	<i>Viverra zibetha</i>	Large Indian civet	NT
Viverridae	<i>Viverra megaspila</i>	Large spotted civet	NT
Viverridae	<i>Viverra tangalunga</i>	Malay civet	NT
Viverridae	<i>Arctictis binturong</i>	Binturong	VU
Viverridae	<i>Arctogalidia trivirgata</i>	Small-toothed palm civet	LC
Cercopithecidae	<i>Macaca fascicularis</i>	Long-tailed macaque	LC
Cercopithecidae	<i>Macaca nemestrina</i>	Southern pig-tailed macaque	LC
Cercopithecidae	<i>Trachypithecus obscurus</i>	Dusky langur	NT
Sciuridae	<i>Rhinosciurus laticaudatus</i>	Shrew-faced ground squirrel	LC
Muridae	<i>Rattus rattus</i>	House rat	LC
Sciuridae	<i>Sundasciurus lowii</i>	Low's squirrel	LC
Hystriidae	<i>Hystrix brachyura</i>	Malay porcupine	LC
Tapiridae	<i>Tapirus indicus</i>	Asian tapir	EN
Elephantidae	<i>Elephas maximus</i>	Asian elephant	EN

Accipitiformes	<i>Accipiter trivirgatus</i>	Crested goshawk	LC
Phasianidae	<i>Argusianus argus</i>	Great argus	NT
Phasianidae	<i>Gallus gallus</i>	Red junglefowl	LC
Phasianidae	<i>Lophura erythrophthalma</i>	Crestless fireback	VU
Varanidae	<i>Varanus salvator</i>	Asian water monitor	LC

Camera trap data on the activity patterns suggest that *Elephas maximus*, *Helarctos malayanus* and *Tapirus indicus* are nocturnal, while *Gallus gallus*, *Muntiacus muntjak* and *Sus scrofa* are considered diurnal (Table 3 and Figure 1). A total of 94 independent still images of *Elephas maximus* was taken, indicating that the elephant is nocturnal with 68.1% of the total images were captured at night, compared to only 31.9% during the day. Elephants were found most active between 1700h to 0200h (Figure 1 a).

The Red Jungle fowl, *Gallus gallus* was among the most common species found during the sampling. From 47 independent images, 91.5% of the images were captured during the day, which categorized this species as diurnal (Figure 1 b). This species seemed to be most active in the morning from 0700h until 1000h. However, no image of *Gallus gallus* was recorded between 2000h and 0600h. Most of the images was recorded with only one individual in them. Other wildlife species identified as nocturnal was the Sunbear (*Helarctos malayanus*). A total of 62.8% out of 24 independent images recorded suggest that this species is nocturnal. The most active time recorded by the Sunbear was between 1800h and 1900h (Figure 1 c).

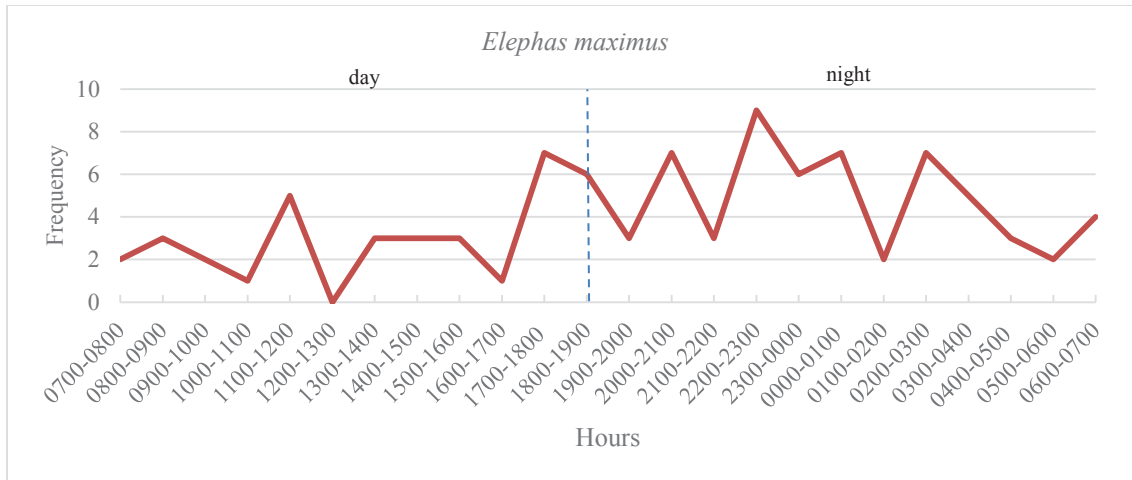
The Red Muntjac (*Muntiacus muntjak*) was always captured as singletons in the images. This species was mainly diurnal, especially active in the morning until late evening (0600h-1700h) as reported by Mohd Sanusi et al. (2013), Magintan et al. (2010), Novarino (2004, 2005) and Ahmad Zafir et al. (2006). The findings from this study suggest that from 232 independent still images recorded, 62.1% of the images were captured during the day, which categorized this species as diurnal. Most active time was in the morning, at 0900h with 29 images (Figure 1d).

The Eurasian Wild pig (*Sus scrofa*) was the most common species photographed in this study, with 329 independent images. From the data, it can be concluded that *Sus scrofa* was diurnal, with 72.6% images captured during the day and 27.4% captured at night. The most active time was between 0900h and 1700h (Figure 1e) when the images captured during this period exceeded 20 images for every hour. However, the study by Mohd Sanusi et al. (2013) suggested that *S. scrofa* was active both day and night, whereas Ahmad Zafir et al. (2006) found out that this species was most active between 0700h and 1800h.

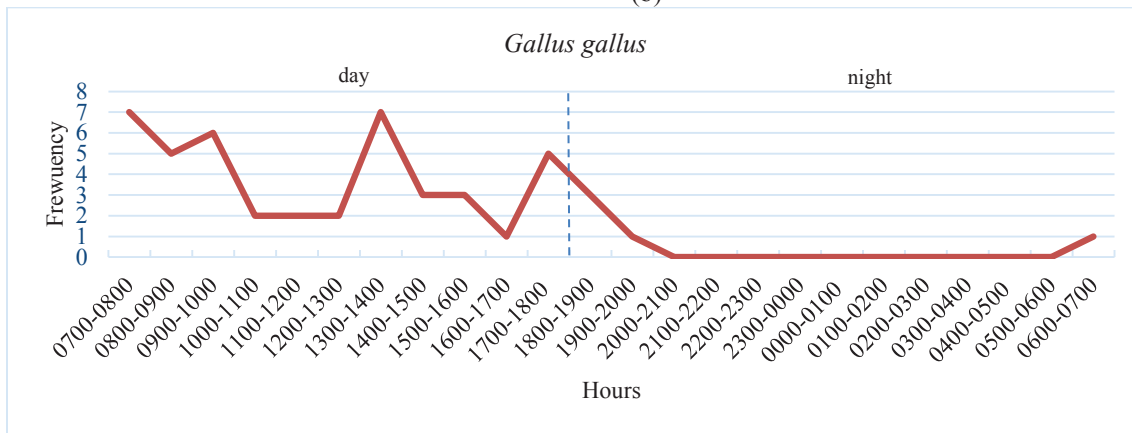
*Tapirus indicus* or Asian Tapir is another common species recorded at the study area represented by 137 independent images. About 79.6% of the images was recorded during the night, suggesting that this species is nocturnal. *Tapirus indicus* was most active from 0100h until 0600h hours (Figure 1f). Novarino (2005) found out that *T. indicus* was also active at night, between 1800h and 0800h.

**TABLE 3.** Percentage of activity during the day (nocturnal) and night (diurnal) categorized based on the time of images captured.

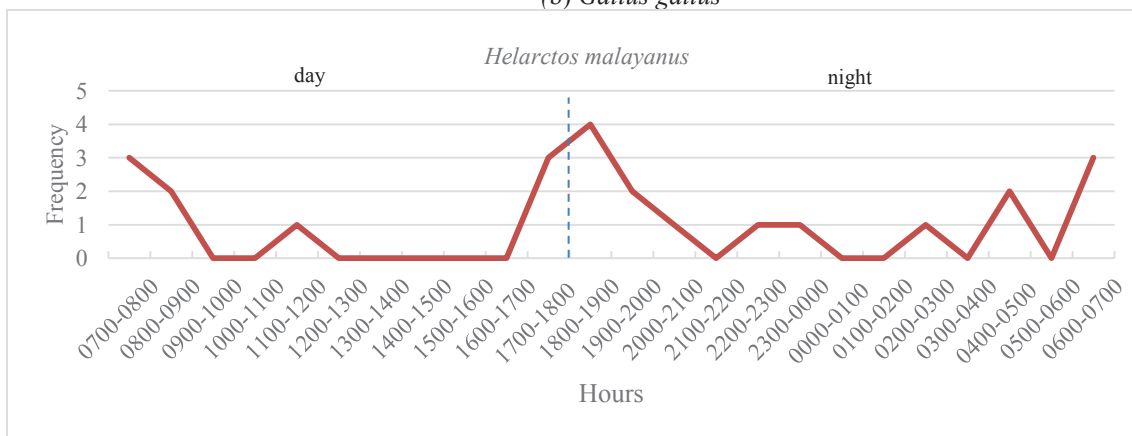
Selected Wildlife	Number of visit	% Diurnal	% Nocturnal	Status
<i>Elephas maximus</i>	94	31.92	68.08	Nocturnal
<i>Gallus gallus</i>	47	91.49	8.51	Diurnal
<i>Helarctos malayanus</i>	24	37.20	62.80	Nocturnal
<i>Muntiacus muntjak</i>	232	62.07	37.93	Diurnal
<i>Sus scrofa</i>	329	72.64	27.36	Diurnal
<i>Tapirus indicus</i>	137	20.44	79.56	Nocturnal



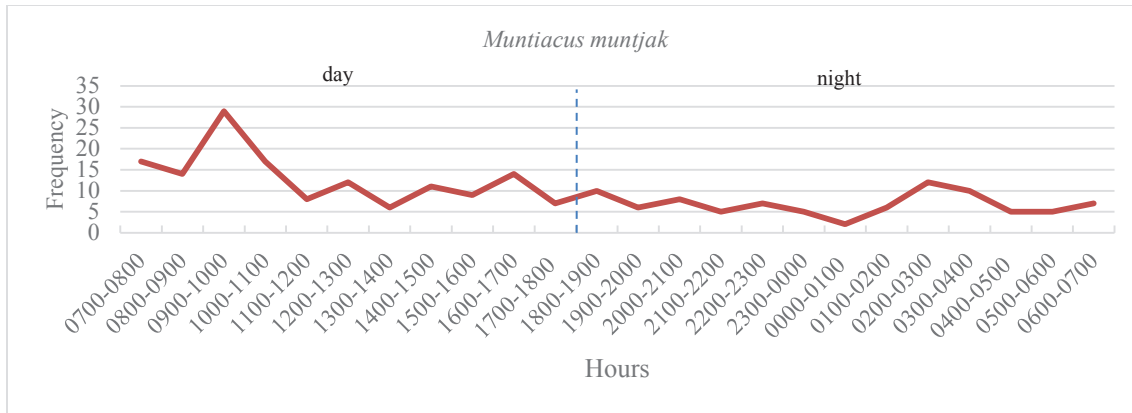
(a) *Elephas maximus*  
(b)



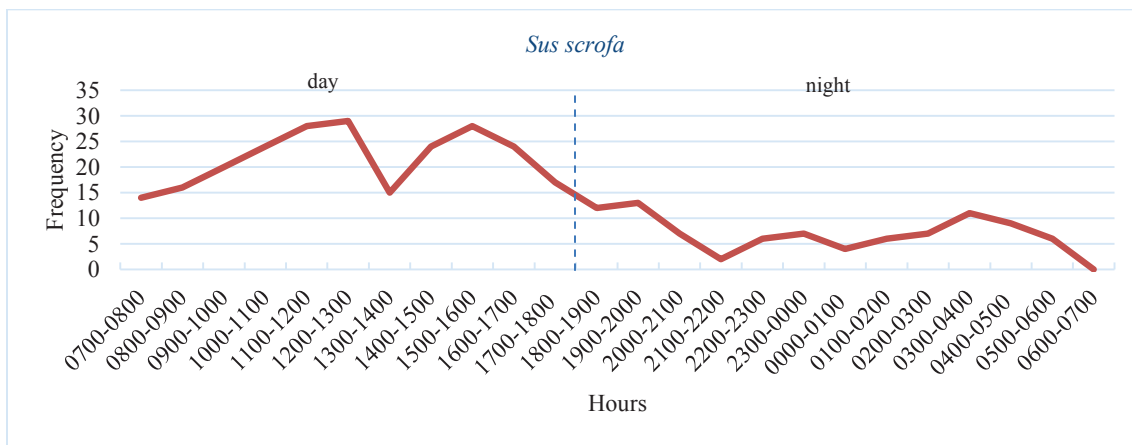
(b) *Gallus gallus*



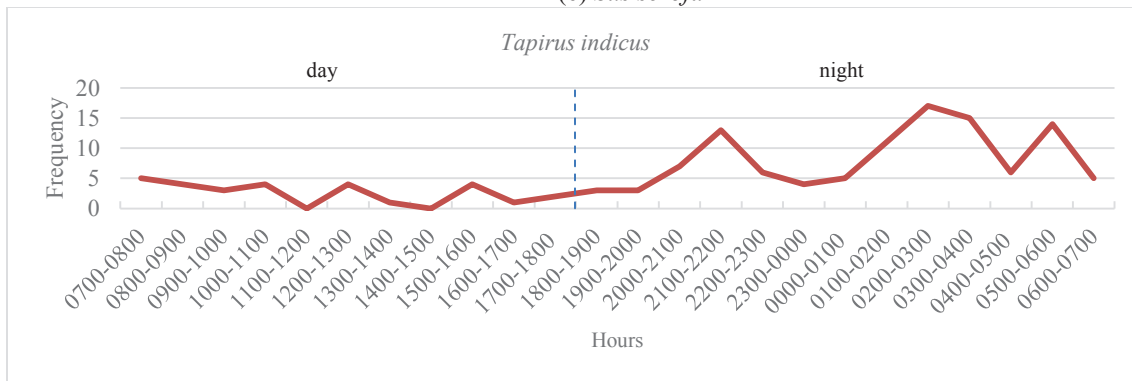
(c) *Helarctos malayanus*



(d) *Muntiacus muntjak*



(e) *Sus scrofa*



(f) *Tapirus indicus*

**FIGURE 2.** The activity pattern of (a) *Elephas maximus*, (b) *Gallus gallus*, (c) *Muntiacus muntjak*, (d) *Helarctos malayanus*, (e) *Sus scrofa* and (f) *Tapirus indicus*.

## ACKNOWLEDGMENTS

We would like to thank the Department of Wildlife and National Parks, Peninsular Malaysia for granting permission to conduct this study. We appreciate the staff at Wildlife Rescue Centre (WildReC) for their assistance in the field. The research funding for this study was acquired from TNBR as part of the Wildlife Research and Rescue Program (WildReP).



## REFERENCES

- Ahmad Zafir A. B., Lee B. M. S., S. K. S. Dionysius and J. M. Azlan, *Tiger Ecology Study in FELDA Jerangau Barat, Peninsular Malaysia*, Petaling Jaya: WWF for a Living Planet, (2006).
- Francis C. M., *A Field Guide to The Mammals of South-East Asia*. Sydney, Australia. 2008. Harris, G., Thompson, R., Childs, J.L., Sanderson, J.G, Automatic storage and analysis of camera trap data, *Bulletin of the Ecological Society of America* **7**, 352-360 (2010).
- IUCN 2015. The IUCN Red List of Threatened Species Version 2013.2 Accesible at <http://www.iucnredlist.org>. Captured on 23 October 2015
- Jabatan Perhutanan Negeri Terengganu. <http://trgforestry.terengganu.gov.my/> [10 June 2014].
- Kawanishi K., Standardized data management for camera trapping studies in Malayasia. *Journal of Wildlife and Parks*. **19**, 75-88 (2001).
- Mohd. Azlan, J. and Engkamat, L. *The Raffles Bulletin of Zoology*. **54**(2): 469 – 475 (2006).
- Magintan, D., Rufino, M.B.M. and Cosmas, N., Activity Pattern on Malayan Tapir (*Tapirus indicus*) in Temenggor Forest Reserve, Perak, through the use of the camera trapping technique. *Journal of Wildlife and Parks*. **25**, 1-4 (2010).
- Mohd Sanusi, M.A., Shukor, M.A., Wan Juliana, W. A. and Traeholt, C. *AIP Conference Proceedings* 1571, 325 (2013) pp 325-330.
- Novarino, W. *Population Monitoring and study of daily activities of Malayan Tapir (Tapirus indicus ) through the use of the camera trapping technique in Taratak Forest Reserve, Sumatera* : Rufford Small Grant (for Nature Conservation), (2005).
- Novarino, W., Karimah, S.N., Jarulis, Silmi, M. and Suafri, M., Habitat Use by Malay Tapir (*Tapirus indicus*) in West Sumatra, Indonesia. *Tapir Conservation* **13**(2), 14 – 18 (2004).
- PERHILITAN 2015. Kuala Lumpur.
- Rufino, M.B.M., Abdul Kadir, A.H., Choon, D.T., Magintan, D., Ngau, C., Abu Zahraim, I., Hamidi, J., Zainal, A.M., Idran, R. and Fauzul Azim, Z. A.,. A study on activity pattern of clouded leopard and marbled cat in Temenggor Forest Reserve, Hulu Perak. *Journal of Wildlife and Parks*. **26**, 59-66 (2010).
- Wildlife Conservation Act 2010. Kuala Lumpur.