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## CAMERA TRAP SURVEY OF WILDLIFE IN STATE LAND FOREST, MERAPOH, PAHANG, MALAYSIA

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**Abstract :** A short camera trapping survey was conducted in the State Land Forest (SLF), Merapoh, Pahang for three consecutive months (542 total trap nights) from August 2019 until October 2019 to determine the composition of wildlife inhabiting the SLF within the Merapoh Forest Complex. There were at least 25 native species of wildlife detected and identified, which includes avians and mammals. The species detected include Asiatic brush-tailed porcupine (*Atherurus macrourus*), Asiatic golden cat (*Catopuma temminckii*), Banded linsang (*Prionodon linsang*), Barking deer (*Muntiacus muntjak*), Black-capped babbler (*Pellorneum nigrocapitatum*), Common palm civet (*Paradoxurus hermaphroditus*), Clouded leopard (*Neofelis nebulosa*), Dhole (*Cuon alpinus*), Grey-capped emerald dove (*Chalcophaps indica*), Great argus (*Argusianus argus*), Large Indian civet (*Viverra zibetha*), Leopard (*Panthera pardus*), Leopard cat (*Prionailurus bengalensis*), Long-tailed giant rat (*Leopoldamys sabanus*), Malay crestless fireback (*Lophura erythrophthalma*), Malay crested fireback (*Lophura rufa*), Malayan porcupine (*Hystrix brachyura*), Malayan sun bear (*Helarctos malayanus*), Malayan tapir (*Tapirus indicus*), Mouse-deer (*Tragulus* spp.), Otter civet (*Cynogale bennettii*), Pig-tailed macaque (*Macaca nemestrina*), Red junglefowl (*Gallus gallus*), Moonrat (*Echinosorex gymnura*) and Wild boar (*Sus scrofa*). According to the IUCN Red List of Threatened Species, within the SLF territory, there are three (3) Endangered species recorded, including the Malayan tapir, Otter civet and Dhole, five (5) Vulnerable species, including Leopard, Clouded leopard, Malay crestless fireback, Malayan sun bear, and Pig-tailed macaque, while the Asiatic golden cat, Great argus, and Malay crested fireback are listed as Nearly Threatened. This short assessment is important in highlighting the diversity of wildlife detected via camera traps in semi-disturbed areas and the role of these areas for the conservation of the species. As such, better conservation management measures can be taken to ensure their survival within this habitat.

**Key words:** Wildlife, camera tapping, State Land Forest, semi-disturbed area, conservation, Merapoh Forest Complex, Merapoh, Pahang.

### INTRODUCTION

State Land Forest included in the Central Forest Spine (CFS) for Primary Linkage 1 (PL1) also consists of Tanum Forest Reserve until Sungai Yu Forest Reserve. This CFS connects Greater Taman Negara Forest with the Main Range Forest Complex. The CFS is defined as the backbone of the Peninsular Malaysia Environmentally Sensitive Area (ESA) network, which consists of four major forest complexes, including Taman Negara-Banjaran Timur, Banjaran Titiwangsa-Banjaran Bintang-Banjaran Nakawan, Endau Rompin Park-Kluang Wildlife Reserves and South-East Pahang, Chini and Bera Wetlands. Furthermore, PL1 of the CFS is situated in the district of Kuala Lipis, Pahang, at 4° 31' 56"N latitude and 101° 59' 31"E longitude. The region covers about 4,345 ha, which contains parts from the Tanum Forest Reserve in the east and Ulu Jelai and Sungai Yu Forest Reserves in the west (Wan Abd Rahman et al. 2018).

The Central Forest Spine (CFS) initiatives is a nationwide project aiming to maintain a cohesive forest complex network through the establishment of ecological corridors that connect fragmented forest and to further aid in the conservation initiatives, especially of threatened species such as Asian elephants (*Elephas maximus*), Malayan tigers (*Panthera tigris*), Malayan tapirs (*Tapirus indicus*) and Malayan gaurs (*Bos gaurus*) (United Nations Development Programme 2009). A total of 37 linkages have been identified, including Central Forest Spine-Primary Linkages 1 (CFS-PL1). The CFS activities aimed to keep up a contiguous network of forest complex through the creation of ecological corridors to link fragmented forests (Ghazali et al. 2019).

The State Land Forest (SLF) is located within the larger landscape of the Merapoh Forest Complex, which consists of multiple land-use with different levels of governance. This includes the Central Forest Spine-Primary Linkages 1 (CFS-PL1), considered as one of the most crucial linkages connecting two of the main forest complexes in Peninsular Malaysia; the Greater National Park Forest and the Main Titiwangsa Range (Wan Abd Rahman et al. 2018). Here, both the Sungai Yu Forest Reserve and Tanum Forest Reserve are connected with ecological viaducts, known as the Sungai Yu Wildlife Corridor. Previous studies on wildlife surveys mainly focused on the diversity of mammals within the protected area and forest reserve (William-Dee et al. 2019; Munian et al. 2020). Other studies carried out in CFSs are Labis Timur (Ghazali et al. 2019), Belum-Temengor (Shahfiz et al. 2019), and Merapoh (Muhammad et al. 2019). This study was undertaken to determine the composition of wildlife inhabiting the SLF within the Merapoh Forest Complex based on camera trap information. The importance of studying wildlife in SLF is to find out which animals are capable of staying in the semi-disturbed area, thus promoting conservation initiatives.

MATERIAL AND METHODS

Study Area

The study was conducted at SLF situated on the CFS. CFS is located in the district of Kuala Lipis, Pahang at 4° 31' 56"N latitude and 101° 59' 31"E longitude. The study area is situated along the Sungai Yu Forest Reserve and also the railway of Kuala Lipis - Gua Musang. The land-use of the study area consists of overgrown secondary forest that is interconnected to several selectively logged lowland dipterocarp forest, including the Sungai Yu Forest Reserve, Persit Forest Reserve and Tanum Forest Reserve at the altitude of 20-538 m a.s.l (Figure 1). The majority of the study area is connected to the greater Titiwangsa Range, which is from Negeri Sembilan at the most southern part and extending all the way to Hulu Perak in the northern side, while a fraction of it is on the east side of the road which is connected to the Greater Taman Negara Landscape. A few small villages are located around the study area, which includes Kampung Merapoh, Kampung Gua Lima, Kampung Persit, Kampung Berhamah, Kampung Gua Kalong, Kampung Kubang Rusa, Kampung Teluk Gunung, and Kampung Sungai Yu. Villagers predominantly grow fruits in orchards and small rubber plantations which are also interconnected to the study area.

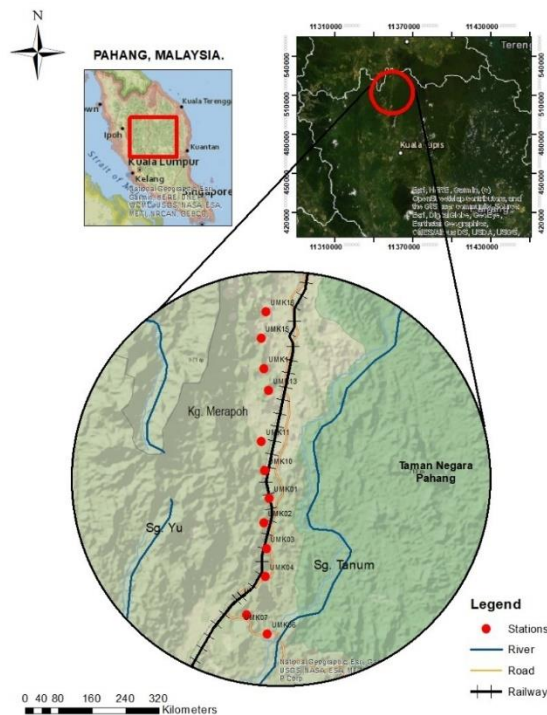


Figure 1. Camera trap locations based on the study area of State Land Forest, Merapoh, Pahang.

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### Camera Trapping

The observation data on wildlife was collected using the camera trap, Browning Spec Ops Advantage Trail Camera and Reconyx HC500 Hyperfire Semi-Covert Camera since it is frequently used in most research about the terrestrial animal (Tobler et al. 2008). The camera traps allow high capture rates of wildlife species that otherwise are rarely detected in the wild by human observers (Foster & Harmsen 2012). All camera traps were equipped with 32GB memory card and batteries to ensure the sufficient operating duration of camera traps in the field.

Camera traps were deployed in 12 different locations in high wildlife traffic areas covering a wide variety of habitat types and areas that are potentially used by animals, including logging roads, ridges and forest trails to maximise capture probabilities. Camera-trap stations are placed at random, approximately 2 km of each other and all coordinates were recorded by using a Global Positioning System (GPS). Cameras were fixed at the best average height from the ground (approximately 0.5 m) to enable the capture of smaller to large animals (Kelly 2008; Tobler et al. 2008; Mugerwa et al. 2012; Jansen et al. 2014). The date and time for each image captured were also recorded. All camera traps were deployed for three months, with 542 total trap nights starting from August 2019 until October 2019.

### Data Analysis

Wildlife photographs were identified based on Francis and Barrett (2008). The detection list was summarised in Microsoft Excel datasheets. Images with one or more individuals of the same species were considered as one event (Grassman et al. 2006; Mugerwa et al. 2012). Nevertheless, images that did not contain any wildlife, damaged or difficult to identify due to poor image quality and weather conditions were constantly being discarded.

## RESULTS AND DISCUSSION

### Wildlife Species Detection

Three families of aves detected are from the families Columbidae, Phasianidae, and Pellorneidae. Great argus (*Argusianus argus*) and Malay crested fireback (*Lophura rufa*) have been identified as Near Threatened according to the International Union for Conservation of Nature (IUCN) Red List, while Malay crestless fireback (*Lophura erythrophthalma*) is listed as Vulnerable. The other three species of aves detected from the camera traps are listed as Least Concern (Table 1).

Among the 19 recorded species of mammals, Malayan tapir (*Tapirus indicus*), Otter civet (*Cynogale bennettii*), and Dhole (*Cuon alpinus*) have been listed as Endangered according to the IUCN Red List while Leopard (*Panthera pardus*), Clouded leopard (*Neofelis nebulosa*), Malayan sun bear (*Helarctos malayanus*), and Pig-tailed macaque (*Macaca nemestrina*) are listed as Vulnerable. Only one species, the Asiatic

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golden cat (*Catopuma temminckii*) is listed as Near Threatened while the rest are listed as Least Concern (Table 1).

**Table 1.** Wildlife species in SLF

No.	Scientific Name	Common Name	Family Name	IUCN Status
<b>A. Aves</b>				
<b>Columbiformes</b>				
1	<i>Chalcophaps indica</i>	Grey-capped emerald dove	Columbidae	LC
<b>Galliformes</b>				
2	<i>Argusianus argus</i>	Great argus	Phasianidae	NT
3	<i>Lophura rufa</i>	Malay crested fireback	Phasianidae	NT
4	<i>Lophura erythrophthalma</i>	Malay crestless fireback	Phasianidae	VU
5	<i>Gallus gallus</i>	Red junglefowl	Phasianidae	LC
<b>Pesseriformes</b>				
6	<i>Pellorneum nigrocapitatum</i>	Black-capped babbler	Pellorneidae	LC
<b>B. Mammals</b>				
<b>Carnivora</b>				
7	<i>Prionodon linsang</i>	Banded linsang	Prionodontidae	LC
8	<i>Paradoxurus hermaphroditus</i>	Common palm civet	Viverridae	LC
9	<i>Viverra zibetha</i>	Large Indian civet	Viverridae	LC
10	<i>Cynogale bennettii</i>	Otter civet	Viverridae	EN
11	<i>Panthera pardus</i>	Leopard	Felidae	VU
12	<i>Neofelis nebulosa</i>	Clouded leopard	Felidae	VU
13	<i>Prionailurus bengalensis</i>	Leopard cat	Felidae	LC
14	<i>Catopuma temminckii</i>	Asiatic golden cat	Felidae	NT
15	<i>Helarctos malayanus</i>	Malayan sun bear	Ursidae	VU
16	<i>Cuon alpinus</i>	Dhole	Canidae	EN
<b>Cetartiodactyla</b>				
17	<i>Sus scrofa</i>	Wild boar	Suidae	LC
18	<i>Muntiacus muntjak</i>	Barking deer	Cervidae	LC
19	<i>Tragulus</i> spp.	Mouse-deer	Tragulidae	LC

Table 1. (Continued).

No.	Scientific Name	Common Name	Family Name	IUCN Status
<b>Perissodactyla</b>				
20	<i>Tapirus indicus</i>	Malayan tapir	Tapiridae	EN
<b>Primates</b>				
21	<i>Macaca nemestrina</i>	Pig-tailed macaque	Cercopithecidae	VU
<b>Rodentia</b>				
22	<i>Leopoldamys sabanus</i>	Long-tailed giant rat	Muridae	LC
23	<i>Hystrix brachyura</i>	Malayan porcupine	Hystricidae	LC
24	<i>Atherurus macrourus</i>	Asiatic brush-tailed porcupine	Hystricidae	LC
25	<i>Echinosorex gymnura</i>	Moonrat	Erinacidae	LC

Note in the abbreviation of IUCN status (VU = Vulnerable; LC = Least Concern; EN = Endangered; NT = Near Threatened; CR = Critically Endangered)

### Species Composition

The 542 trap nights yielded a total of 2,606 photo images, with only 449 occasions recorded throughout the study period. From 2,606 photo images, 129 photo images (44 occasions) of humans were excluded comprising 9.8% of the total occasions. An occasion is defined in accordance with WWF-Malaysia (2012), indicating a species that is photographed either once or consecutively within 30 minutes at the same camera-trap location. All unidentifiable images have also been excluded from the species composition analysis, which mostly comprises of small non-volant mammals with 23.83% from the total occasions, reptiles (2.67%), and also some unidentifiable species (1.33%) due to blurry images which occurred as a result of the camera traps being too far or only capturing certain parts of the body. Thus, in total, only 25 species of wildlife photo images were positively identified (except Mouse-deer), including six species of avians and 19 species of mammals.

A total of 2,287 (83.73%) images were selected with 279 occasions after discarding 320 (12.27%) unwanted images. The most frequently photographed species based on total occasions was a Wild boar (*Sus scrofa*) with 114 occasions (40.86%) followed by Mouse-deer (*Tragulus* spp.) with 66 occasions (23.66%), Barking deer (*Muntiacus muntjak*) with 20 occasions (7.17%), Pig-tailed macaque (*Macaca nemestrina*) with 18 occasions (6.45%), Red junglefowl (*Gallus gallus*) with 12 occasions (4.30%), Large Indian civet (*Viverra zibetha*) with 10 occasions (3.58%), Malayan sun bear (*Helarctos malayanus*) with six occasions (2.15%), Malay crestless fireback (*Lophura erythrophthalma*), Malayan porcupine (*Hystrix brachyura*) and Malayan tapir (*Tapirus indicus*) with four occasions (1.43%) respectively, Common palm civet (*Paradoxurus hermaphroditus*) and Asiatic brush-tailed porcupine (*Atherurus macrourus*) with three occasions (1.08%) respectively, Great

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argus (*Argusianus argus*) and Grey-capped emerald dove (*Chalcophaps indica*) with two occasions (0.72%), respectively while Asiatic golden cat (*Catopuma temminckii*), Banded linsang (*Prionodon linsang*), Black-capped babbler (*Pellorneum nigrocapitatum*), Malay crested fireback (*Lophura rufa*), Clouded leopard (*Neofelis nebulosa*), Dhole (*Cuon alpinus*), Leopard (*Panthera pardus*), Leopard cat (*Prionailurus bengalensis*), Moonrat (*Echinosorex gymnura*), Otter civet (*Cynogale bennettii*) and Long-tailed giant rat (*Leopoldamys sabanus*) with one occasions (0.36%) respectively (Table 2).

**Table 2.** Species detected from the camera trap in the study site and the percentage of species from photo occasions.

No.	Species	Occasion	Percentage (%)	PCRI
1	<i>Sus scrofa</i>	Wild boar	40.86	21.03
2	<i>Tragulus</i> spp.	Mouse-deer	23.66	12.18
3	<i>Muntiacus muntjak</i>	Barking deer	7.17	3.69
4	<i>Macaca nemestrina</i>	Pig-tailed macaque	6.45	3.32
5	<i>Gallus gallus</i>	Red junglefowl	4.30	2.21
6	<i>Viverra zibetha</i>	Large Indian civet	3.58	1.85
7	<i>Helarctos malayanus</i>	Malayan sun bear	2.15	1.11
8	<i>Lophura erythrophthalma</i>	Malay crestless fireback	1.43	0.74
9	<i>Hystrix brachyura</i>	Malayan porcupine	1.43	0.74
10	<i>Tapirus indicus</i>	Malayan tapir	1.43	0.74
11	<i>Paradoxurus hermaphroditus</i>	Common palm civet	1.08	0.55
12	<i>Atherurus macrourus</i>	Asiatic brush-tailed porcupine	1.08	0.55
13	<i>Argusianus argus</i>	Great argus	0.72	0.37
14	<i>Chalcophaps indica</i>	Grey-capped emerald dove	0.72	0.37
15	<i>Catopuma temminckii</i>	Asiatic golden cat	0.36	0.18
16	<i>Prionodon linsang</i>	Banded linsang	0.36	0.18
17	<i>Pellorneum nigrocapitatum</i>	Black-capped babbler	0.36	0.18
18	<i>Lophura rufa</i>	Malay crested fireback	0.36	0.18
19	<i>Neofelis nebulosa</i>	Clouded leopard	0.36	0.18
20	<i>Cuon alpinus</i>	Dhole	0.36	0.18
21	<i>Panthera pardus</i>	Leopard	0.36	0.18
22	<i>Prionailurus bengalensis</i>	Leopard cat	0.36	0.18
23	<i>Echinosorex gymnura</i>	Moonrat	0.36	0.18
24	<i>Cynogale bennettii</i>	Otter civet	0.36	0.18
25	<i>Leopoldamys sabanus</i>	Long-tailed giant rat	0.36	0.18



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\*Picture-capture rate index (PCRI) was calculated as the ratio of occasion photo of the species to the number of trap days and multiplied by 100.

In order to ensure the survival of wildlife in this region which is a part of the ecological corridor that links Taman Negara and Titiwangsa Range, the forest conversion to agricultural land, logging and poaching activities must be managed. Based on the results obtained, at least 19 identifiable mammals were recorded. Mammals generally need a substantial space to roam and to meet their biological needs. The importance of the ecological corridor is to meet the long-term viability of wildlife especially large mammals, through the availability of huge contiguous forested areas to be connected by this corridor. Thus, from this study, fresh data collection is provided from SLF in Merapoh for the authorities, researchers, and decision-makers for better management recommendations, planning, gazettement to forest reserve (if possible), and any other positive initiatives towards conservation of this area. An SLF site in Merapoh is under the IC-CFS project.

The Sungai Yu Ecological Corridor, which is situated within SLF is reported to have higher species of mammals than CFS2:PL1 (Labis Timur Ecological Corridor, Johor). There are three species classified under the IUCN Red List as Near Threatened consisting of Great argus (*Argusianus argus*), Malay crested fireback (*Lophura rufa*), and Asiatic golden cat (*Catopuma temminckii*).

Belum-Temengor Ecological Corridor, previously known as an SLF, has been gazetted to Amanjaya Forest Reserve. A total of 22 species of mammals were identified in the Belum-Temengor Ecological Corridor region, where *Muntjac* is the most identified species with 800 total detections followed by 208 total detections of Wild boars and 177 total detections of Asian elephants (WWF-Malaysia 2012). In Belum-Temengor Ecological Corridor, the least total detections were Large Indian civet with one total detection followed by Dhole and Crab-eating mongoose with two total detections (WWF-Malaysia 2012). In comparison to the study sites, Wild boar is the most commonly observed animal, followed by Mouse-deer, Barking deer and Pig-tailed macaque. The disparity between the areas of most identified species may be due to the forest types between those two areas of study. Both areas were logged, but the fragmentation of the forest in Merapoh is higher than in Belum-Temengor. Most of the SLF in Merapoh is private land and developed for agriculture and human settlements. There are 58 detections of the Malayan tiger in Belum-Temengor, whereas the Malayan tiger is not detected during this study. There is also no presence of Asian elephant (*Elephas maximus*), Gaur (*Bos gaurus*), Sambar deer (*Sambar unicolor*), Southern Serow (*Capricornis sumatraensis*), Binturong (*Arctictis binturong*), Masked palm civet (*Paguma larvata*), Crab-eating mongoose (*Herpestes urva*), and Yellow-throated marten (*Martes flagivula*) in SLF, Merapoh compared to Belum-Temengor Ecological Corridor.

Although there were 24 species of mammals found in the other ecological study in Labis Timur Ecological Corridor by Ghazali et al. (2019), Wild boar was the most common animal in Labis Timur Ecological Corridor, followed by Pig-tailed macaque and Barking deer. Among the species identified were the Sunda pangolin

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(*Manis javanica*), Bearded pig (*Sus barbatus*), Asian elephant (*Elephas maximus*), Long-tailed macaque (*Macaca fascicularis*), Dusky langur (*Trachypithecus obscurus*), Marbled cat (*Pardofelis marmorata*), Crab-eating mongoose (*Herpestes urva*), Yellow-throated marten (*Martes flagivula*), Binturong (*Arctictis binturong*), Small-toothed palm civet (*Arctogalidia trivigata*) and Banded palm civet (*Hemigalus derbyanus*) compared to SLF, Merapoh. However, the Malayan tiger is not present in the Labis Timur Ecological Corridor. From these three study sites, Belum-Temengor Ecological Corridor has had the most extensive 3-months camera trapping time survey with 78 total locations compared to Labis Timur Ecological Corridor with 3-months surveys of 34 locations. Nevertheless, this study only utilised camera traps at 12 locations with 3-months of a survey at the sites.

In this study, Wild boar was the most common species with 114 images captured throughout the study area. Their ability to adapt to the diversity of foods has allowed them to live in almost every habitat they have been introduced to (Ballari & Barrios-Garcia 2013). Therefore, it is not possible for them to have a large presence due to the wide variety of food in the SLF, Merapoh. This is further supported by the presence of fruit orchards there. This is supported by Ickes and Williamson (2000), who stated that the high density of Wild boars was due to the abundance of food and also lack of predators. Wild boars have been reported to be hyper-abundant in a lowland dipterocarp rain forest of Peninsular Malaysia (Ickes 2001). They can act as a principal food item in the diets of several carnivorous species (Eisenberg & Lockhart 1972, Rabinowitz 1989, Karanth & Sunquist 1995) that were recorded in this study, including Leopard, Clouded leopard, and the Asiatic golden cat. However, it is believed that the presence of large numbers of them is due to the low number of predators, and this can be clearly seen in the number of predators recorded during this study (Table 2).

Mouse-deer and Barking deer were found to be less widespread when compared to Wild boars as villagers have been after them during the hunting season (Azlan & Sharma 2006, Farida et al. 2006, pers. obs. 2019). Elsewhere, Barking deers are also being hunted in Thailand due to their high quality meat (Lekagul & McNeely 1977). These species have been dispersed through the primary and secondary forests in Southeast Asia. The habitat distribution for both Mouse-deer and Barking deer needs to be understood in greater depth as their food resources are crucial for maintaining these species' existence (Farida et al. 2006).

The Malayan tapir was the least abundant species with five images captured among the large ungulate throughout the study area and found in the forest trail, logging road, and old logging road. The Malayan tapir has been discovered in many habitats, for example, mountain, swamp, lowland, secondary forest, hill forest, oil plantation, and dense scrub (Novarino 2005). However, the survival of this animal is under threat in its ranges due to forest conversion to agriculture and habitat loss (Khan 1997). Land conversion into agriculture such as oil palm plantation, construction of highways, human settlements, and logging activities have led to forest fragmentation which declines the habitat of Malayan tapirs (Magintan et al. 2009, 2010). Malayan tapirs were rarely hunted for consumption by locals but were often victims of snares

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that have been set up to catch tigers (Campbell et al. 2019). In addition, the threat to the Malayan tapir that was often seen nowadays is wildlife roadkill. According to PERHILITAN (2017), a total of 22 tapirs died after being hit by vehicles. This may indicate that their habitat is being disturbed. Furthermore, Malayan tapir usually has a slow reproduction rate (Santiapillai & Ramono 1990) and is late to adapt to the environmental changes, making it worse for their populations. Therefore, Malayan tapir must be protected due to their role as food disperser to maintain plant species diversity (Abdul-Ghani 2009).

Compared to other studies in the ecological corridor, this camera trapping study managed to detect Malay crested fireback (*Lophura rufa*) and Malay crestless fireback (*Lophura erythrophthalma*). The Malay crested fireback (*Lophura rufa*) is listed as Near Threatened in the IUCN Red List while Malay crestless fireback (*Lophura erythrophthalma*) is listed as Vulnerable. There are also detections of Great argus (*Argusianus argus*), which is listed as Near Threatened according to IUCN Red List. These detections show the advantage of using camera trapping in monitoring wildlife without affecting their behaviour. The use of camera trapping studies has been utilised to monitor Galliformes ecology, behaviour, distribution and conservation status (Fischer et al. 2017). Thus, the use of camera trapping technology can be further extended to study large terrestrial birds, especially involving the family of Phasianidae (Pheasants and partridges).

## CONCLUSION

The SLF, Merapoh is still rich with a diversity of wildlife even though the area is partially altered anthropogenically. It is found that the SLF still provides a safe place for wildlife to roam and hunt for food. The data from this study is important in informing relevant authorities such as PERHILITAN for the management and conservation of the species, especially those that are currently under threat. It is recommended that the study is to be continued by increasing the study period and also increasing the number of camera trap stations. On-going research is necessary to understand the species living in the SLF and to provide a good conservation management strategy.

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