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## Roadkill incidents of the leopard cat (*Prionailurus bengalensis*) in the exterior wildlife reserved: A selected plantation area case

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### Abstract

The leopard cat, *Prionailurus bengalensis* (*P. bengalensis*) is a family of *Felinae* and prominently found in the Southeast Asian countries. This species is protected under the wildlife act; Act 716, *Akta Pemuliharaan hidupan Liar* 2010 by the Malaysian government. *P. bengalensis* species were found victimized in the roadkill incidents especially on the tar-roadways but not gravelled roadways that are commonly used by the motorcar, truck, and other vehicles that pass through the plantation, buffer zones, and wildlife corridors. Until recently, studies on the roadkill incidents of *P. bengalensis* in the exterior part of the wildlife reserve are still rare in Malaysia. Since they mostly live in the wild and plantation areas, the study of this species in the roadkill is very few, particularly in the plantation zone, especially in the Jengka territory located in the central of the Pahang state. This study disclosed the roadkill incidents involving the species outside the wildlife reserve to provide a clearer understanding of the circumstance. For the research methodology, the data was recorded using a simple form while the photos were taken using a smartphone model SM-G530H Android version 4.4.4 with 8-megapixel cameras. The data then was transferred to the desktop for analysis. The result showed that 12 dead bodies of the species were found between April 2014 and January 2017. Most of the cases occurred in the mixed area (oil palm plantation, rubber plantation and bush/secondary forests) while more than half of the cases happened between January and March (the first quarter of the year). The authorized body is suggested to build an alternative route for the wildlife species that are living in the study site to preserve this species from being victims in the roadkill incidents in the future.

**Keywords:** *P. bengalensis*, roadkill incidents, plantation, conservation

### 1. Introduction

The knowledge of wild cats, especially in the South Asia, is still scanty and very limited<sup>[1]</sup> as there are very few population assessments for the small carnivores in Asian region<sup>[2]</sup>. *Prionailurus bengalensis* is a carnivore species generally found in Asia and famously around the Eastern Afghanistan, Northern Pakistan, Northern and Coastal India, Myanmar, Laos, Thailand, Indonesia, Malaysia, Vietnam, Taiwan, Sumatra, Java, Bali, Borneo, Nepal, Korea, and Cambodia, and several parts of the Philippines and Eastern China. Being nocturnal, this species rarely roam during daylight and are mostly active at night; they live in the temperate and coniferous forests, shrub land habitat, and grasslands, particularly. In Malaysia, the species is also known to the locals with other names such as the “*Kucing Batu*” and “*Rimau/Harimau Akar*”.

The leopard cat is more tolerant to habitat disturbances and can be found in the primary and secondary forests, plantations, and orchards<sup>[3]</sup>. Almost all studies focused more on the protected areas even though the habitat of this species can be everywhere and not limited to the protected areas<sup>[4]</sup>. The urbanization and agro-sector are transforming and changing their habitats into different forms such as the plantations of oil palm, rubber, cocoa, coconut, and orchard. Even though the genuine habitats have been changed, this leopard cat can still survive in these new territories, especially the oil palm plantations because food and protection for their survival are available, as well as the possibility for breeding. Unlike another family of the *Felinae*, *P. bengalensis* is also known by other names in different countries. The English name for *P. bengalensis* is the Leopard Cat, Chat Léopard Du Bengale by the French, Bengalkatze by the Germans, Gato Bengali and Gato De Bangala by the Spanish. It is also known as Chita Biral and Ban Bilar by the Bangladeshis, Jin Chien Mao, Bao Mao, Shih Hu, and Shan Mao by the Chinese, Psk Janglely by the Afghanistani, and Kucing Batu and Kucing Congkok/Kucing

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Kuwuk by the Indonesians. Meanwhile, in India and Pakistan, it is known as Chita Billi, Nam Laniao in Kachin, Huli Bekku in the Kannada part in India, Klahla by the Karen, Talain, Sua Meo, Sua Pa and Sua Nak in Laos, Wagati in Mahratti, and Ghats in parts of India. In Malaysia, it is popularly known as Kucing Batu and Rimau Akar, Kye Thit, Thit Kyuk and Kya Gyuk in Myanmar, Maral and Tamaral in the Philippines, Murskii Kot and BengalskayaKoshka in Russia, Hen Wap by the Shan, and Maew Dao in Thailand.

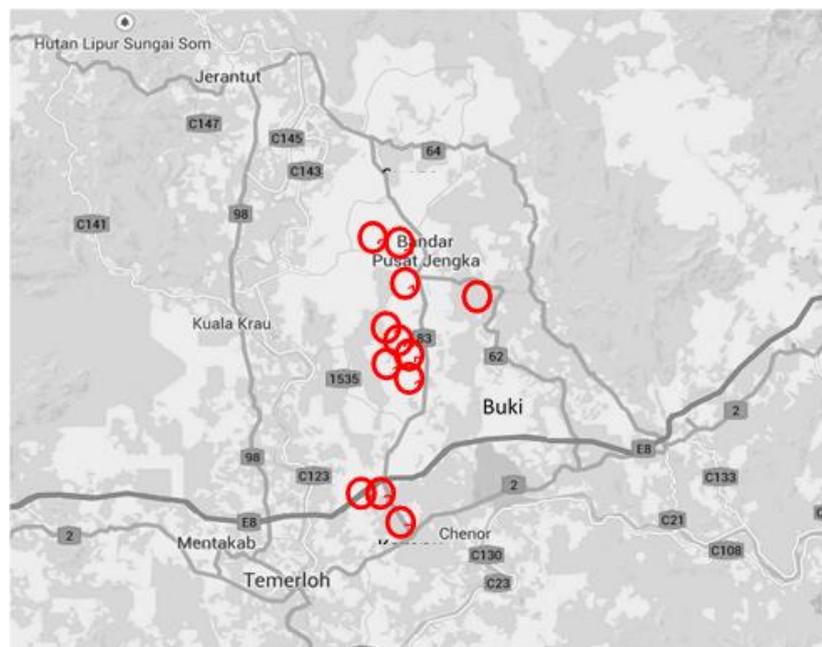
The *P. bengalensis* is a predator roaming in the plantation area [5] and in Indonesia; it is used as the biological pest control in the plantation [6]. Although leopard cat is a wild species, there are cases where this wild cat is domesticated by the pet lovers. In other cases, this wild cat is reared in a cage for hobby and trading purposes and breeding/cross breeding with the domestic cat to produce the new species famously known as the Bengal cat which is also for commercial purposes. The habitat suitability of the *P. bengalensis* is predicted to be very high in Sabah and Sarawak except for several parts due to geographical reasons [3]. The purpose of this study was to determine the casualties of the leopard cat due to road kill incidents specifically in the plantation areas of oil palm and rubber and secondary forests. Secondly, this study aimed to propose recommendation regarding the conservation and habitats of the species. The study aspects examined were 1) the number of leopard cats found in

roadkill incidents, 2) specific location and time, and weather condition, and 3) brief morphology of the dead leopard cats.

## 2. Methodology

### 2.1 Study Site

The study took place in the Jengka territory with the closet area consists of 25 FELDA (Federal Land Development) settlement sections in Jengka, Sungai Nerek, Bukit Tajau, and Sungai Tekam. FELDA is a residential and plantation scheme area developed by the Malaysian Federal Government to help the people interested in running and managing their own piece of land under the federal government supervision. Specifically, the area of study covered the tar-roadways from Bandar Jengka to Kampung Awah, Bukit Tajau, Jengka 24 (Kuala Krau), and Sungai Tekam. The tar-roadways were chosen because this study focused on the casualties caused by roadkill incidents of the *P. bengalensis* in the Jengka territory and within the closed area of Jengka. These areas are not under the supervision of the Department of Wildlife and National Parks (DWNP), Malaysia. The size of Jengka is approximately 64,117.05 hectares shared by 25 FELDA residential and plantation sections. Jengka is also surrounded by other FELDA schemes including Sungai Nerek, Bukit Tajau, and Sungai Tekam accumulating to more than 64,117.05 hectares (Figure 1).



**Fig 1:** Map showing the area of study; roadways from Bandar Jengka to Kampung Awah, Bukit Tajau, Jengka 24 (Kuala Krau), and Sungai Tekam. The circled areas show the specific locations of the dead bodies of the *Prionailurus bengalensis* found.

### 2.2 Data Collection and Equipment Used

The data for this study were photos of the *P. bengalensis* found dead in the roadkills incidents on the study site. The photos were taken during the researcher's personal trip on the roadways using a Samsung Galaxy Prime Smartphone (model SM-G530H) Android version 4.4.4 with 8-megapixel cameras. The pictures were stored in the Smartphone memory and copied to the desktop later. The study took place between April 2014 and January 2017 and during this period, 12 casualties due to the roadkill incidents were recorded. During the trips, if there was a cat body found on or next to the roadway, the researcher would promptly stop the vehicle and investigate the condition of the cat whether it was still alive or already dead. Secondly, the data were also collected through

informers who provided information on the incidents involving this wild cat in the study site. The informers are particularly the local people living in the FELDA settlement area. Most of the time, the cat was found dead because of serious injuries as shown in the captured images in Figure 2.

### 2.3 Specimen identification and morphology

Leopard cats famously known as "Kucing Batu" or "Rimau Akar" by the local people in the Jengka territory particularly were commonly found dead caused by the road kill incidents. Twelve subspecies were identified within the area stretching from India and Southeast Asia to Russia [7] and 11 of the subspecies were documented in India, Thailand, and the adjacent China [8]. This cat has dark eyes and is quite similar

to the large domestic cats in the form of size, cranial, mandibular, and dental characteristics. This species has the size of large housecats and can weigh between 3 and 7 kg or a small felid between 1.7 kg and 7.1 kg [9 - 12]. The weight can be differed by the locations and area where the species are found. In a common form and view, the cats have pale, tawny pelage with a white belly while the body and tail are covered with rosettes and the tail is often ringed at the tip. There are four longitudinal bands running from their foreheads to their necks. The body length is ranged from 44.5 to 107 cm measured from the head and their tail from 23 to 44 cm. The cats have a small head with a short muzzle and round ears. There are differences in the pelage length and colour based on the local environmental conditions. At the further northern latitudes, the fur of the wild cats is longer and paler and they typically weighed more. Their coloration varies with their habitats. The cats in a snowy habitat have lighter pelage than those in the heavily forested habitats, which tend to have a dark-tawny pelage. As the cats are carnivorous, their diets include small mammals, insects, poultry, lizards, and murids, while grass, eggs, and aquatic lives are also parts of their consumption. These species consume all kinds of mammalian prey including bamboo rats, squirrels, tree shrews, gymnures, fruits bats, hare, hog badger, and chevrotain [13]. A study in Pakistan found rodents to be the highest probability in the leopard cat diet [14]. During the wet season, this species will take frogs and other amphibians as its diet [15], while rats are commonly found in the plantation making it very much suitable for the leopard cats to live there [16]. As the habitat is

very much suitable in the forest, farmland, rice field and wetland, this leopard cat also consumes other small mammals, birds, reptiles, amphibians, and insects. As the food is aplenty in its habitat and the plantation zone, the survival of this species is very strong and tolerance with any changes.

### 3. Result

The result showed that most road kill incidents were recorded in the morning which indicates the time of the incidents to usually occur at dawn or sometimes between midnight and dawn, accordingly. This is based on the condition of the body of the wild cat upon discovery to most likely have been dead around two to six hours. During the period between April 2014 and January 2017, 12 dead bodies were found and recorded. Some of the dead bodies were found still in perfect condition while many others were impaired badly and seriously injured. The brief detail of individual roadkill incidents is shown in Annex 1. Based on Annex 1, the number of dead female leopard cats was found more than the male (eight out of twelve) in the roadkill incidents even the male home ranges are about 3.5 km<sup>2</sup> which is larger than female at 2.5 km<sup>2</sup> [17]. The study also found that eleven of them were adults while one was a young female. Table 1 shows the composition of the dead bodies of leopard cat by gender and area. There was no case of road kill reported in the rubber plantation and secondary forests. Most of the cases were found in the mixed area of oil palm, rubber, and the secondary forests.

**Table 1:** Composition of the dead bodies of *Prionailurus bengalensis* by gender and area

Gender & category	Oil Palm Plantation	Rubber Plantation	Bush/Secondary Forest	Mixed Area (Oil Palm Plantation, Rubber Plantation & Bush/Secondary Forests)
Male				
Adult	No cases	No cases	No cases	4
Young	No cases	No cases	No cases	No cases
Female				
Adult	1	No cases	No cases	6
Young	1	No cases	No cases	No cases
Total	2	No cases	No cases	10

Table 2 shows the day gap duration between the first death and the next of the leopard cats in the scene in accordance with the area (oil palm plantation and mixed areas) and quarter of the year. From Table 2, it was found that 58.4% of the death occurred in the first quarter (between January to March), 8.3% in the second quarter (between April to June) and third quarter (between July to September) and 25% in the fourth quarter (between October and December). It was recorded that in the first quarter, the discovered cases of the dead bodies of the leopard cats was the highest followed by

the fourth quarter, while in the second and third quarters, the discovered cases were equivalent. The highest number in the first quarter probably was due to the Malaysian east coast climate where in between January and June is the dry season while in between July and December is the wet season when there is frequent rain. During the dry season probably these species are roaming quite far in finding their food and water, especially for the female leopard cats in order to get the synergy and fully survival in feeding her off-springs.

**Table 2:** Composition of the death of *Prionailurus bengalensis* by duration.

Area/Death	Oil Palm Plantation				Mixed Area			
	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q
1D		X			X			
2D	X						X	
3D								X
4D					X			
5D					X			
6D					X			
7D					X			
8D								X
9D								X
10D					X			

1Q=1<sup>st</sup> quarter, 2Q=2<sup>nd</sup> quarter, 3Q=3<sup>rd</sup> quarter, 4Q=4<sup>th</sup> quarter; D=death

**4. Discussion**

In this study, 80% of the dead species cases were recorded in the mixed area of oil palm plantation, rubber plantation, and bush/secondary forest. While only two cases or less than 20% were found solely in oil palm areas. This is due to the mixed area that is able to provide a good habitat to this species and also a good location for resting and breeding because the bush/secondary forests can become a good camouflage and shelter to this wild cat and its babies, accordingly. At the same time, the oil palm plantation area provides enough food for the species to survive and feed their offspring particularly.

This study also found that more than half (58.4%) of the species were found dead between January and March while 8.3% were found in between April and June. It can be presumed that in the six-month time between January and June, the death of the species was recorded higher (66.7%). This trend shows that the leopard cat searches for the food aggressively between January and June every year because of the changing climate. Due to this, the factor that this species crosses the tar-roadways in searching for the food cannot be repudiated.



**Fig 2:** Signboards found along the Genting Sempah roadway to Gombak notifying road users to be concerned of the wildlife

**Annex 1:** Detail of *Prionailurus bengalensis* Death April 2014 to January 2016



Date recorded : April 6<sup>th</sup>, 2014  
 Time recorded : 6.30 a.m.  
 Weather : Sunny-daylight  
 Location : Km 19.3, Kg Awah-Bandar Jengka  
 Area : Felda Jengka 18  
 Gender : Female  
 Category : Young Cub  
 Weight (+/-) : 1.5 kg



Date recorded : February 8<sup>th</sup>, 2015  
 Time recorded : 7.25 a.m.  
 Weather : Cloudy-daylight  
 Location : Km 29, Kg Awah-Bandar Jengka  
 Area : Sungai Nerek  
 Gender : Female  
 Category : Adult  
 Weight (+/-) : 3.0 kg



Date recorded : March 24<sup>th</sup>, 2015  
 Time recorded : 08.33 a.m.  
 Weather : Sunny-daylight  
 Location : Km 01, Jerantut-Bandar Jengka  
 Area : Bandar Jengka  
 Gender : Male  
 Category : Adult  
 Weight (+/-) : 3.2 kg



Date recorded : September 4<sup>th</sup>, 2015  
 Time recorded : 09.40 a.m.  
 Weather : Sunny-daylight  
 Location : Km 14.8, Bukit Tajau-Bandar Jengka  
 Area : Felda Jengka 2  
 Gender : Male  
 Category : Adult  
 Weight (+/-) : 2.8 kg



Date recorded : October 21<sup>st</sup>, 2015  
 Time recorded : 07.32 a.m.  
 Weather : Foggy-daylight  
 Location : Km 11.2, Kg Awah-Bandar Jengka  
 Area : Felda Jengka 16  
 Gender : Female  
 Category : Adult  
 Weight (+/-) : 3.0 kg



Date recorded : January 3<sup>rd</sup>, 2016  
 Time recorded : 8.36 a.m.  
 Weather : Sunny-daylight  
 Location : Km 29.8, Kg Awah-Bandar Jengka  
 Area : Sungai Nerek  
 Gender : Male  
 Category : Adult  
 Weight (+/-) : 3.0 kg



Date recorded : February 10<sup>th</sup>, 2016  
 Time recorded : 8.38 a.m.  
 Weather : Sunny-daylight  
 Location : Km 33.5, Kg Awah-Bandar Jengka  
 Area : Kg Awah  
 Gender : Female  
 Category : Adult  
 Weight (+/-) : 3.0 kg



Date recorded : February 11<sup>th</sup>, 2016  
 Time recorded : 6.55 p.m.  
 Weather : Sunny-daylight  
 Location : Km 9.1 Kuala Krau-Bandar Jengka  
 Area : Felda Jengka 9  
 Gender : Female  
 Category : Adult  
 Weight (+/-) : 3.2 kg



Date recorded : March 08<sup>th</sup>, 2016  
 Time recorded : 7.55 a.m.  
 Weather : Sunny-daylight  
 Location : Km 9.8 Kg Awah-Bandar Jengka  
 Area : Felda Jengka 16  
 Gender : Female  
 Category : Adult  
 Weight (+/-) : 3.2 kg



Date recorded : Oct 21<sup>st</sup>, 2016  
 Time recorded : 11.50 p.m.  
 Weather : Clear sky-night  
 Location : Km 3.7 Kg Awah-Bandar Jengka  
 Area : Felda Jengka 14  
 Gender : Female  
 Category : Adult  
 Weight (+/-) : 3.2 kg



Date recorded : November 13<sup>th</sup>, 2016  
 Time recorded : 10.02 a.m.  
 Weather : Sunny-daylight  
 Location : Km 11.1 Kg Awah-Bandar Jengka  
 Area : Felda Jengka 16  
 Gender : Male  
 Category : Adult  
 Weight (+/-) : 3.3 kg



Date recorded	:	January 02 <sup>nd</sup> , 2017
Time recorded	:	9.58 a.m.
Weather	:	Cloudy-daylight
Location	:	Km 10.2 Kg Awah-Bandar Jengka
Area	:	Felda Jengka 16
Gender	:	Female
Category	:	Adult
Weight (+/-)	:	3.1 kg

## 5. Conclusion

Mammalian carnivores are vulnerable towards extinction due to habitat destructions and over-hunting<sup>[18]</sup>, and the number of carnivores depreciates speedily as compared to other mammal species<sup>[17, 19, 20]</sup>. With the habitat loss, conflict with humans, and losing prey, this wild cat is getting alarmingly threatened<sup>[21]</sup>. In this study, the casualties in the roadkill incidents of the leopard cat *P. bengalensis* in the plantation area will probably escalate the number of fatal incidents and contribute to the extinction of the species in future. Even though this species is not classified as endangered in Malaysia, there is a tendency for this species to face extinction in the future due to the increasing cases of roadkill incidents, pet trading, cross breeding, and body part hunting, and habitat changing for commercial and residential areas for urbanization purposes, and other unpredictable conditions which can harm this leopard cat species in the wild. It is highly recommended to build and organize wildlife corridor and crossings in order to reduce the number of roadkill incidents. Another precautionary action that can be taken in preventing the species from being the victims in roadkill incidents is by putting a signboard to notify road users about wildlife crossing the road (examples in Figure 2). This precautionary measure is important in order to save this leopard cat for the future as its average lifespan in the wild is only four years. Another alternative effort is to gazette this plantation area as a conservation area for the leopard cat by the authorized body. As the species is very effective in controlling the number of rodents, especially in the oil palm plantation area<sup>[22]</sup>, building the wildlife corridor and crossings properly could at least save this species from being killed and at the same time enhance its function as a biological controller in the oil palm plantation, accordingly. Further studies are recommended in order to determine the exact number of leopard cats in this area and also other wildlife species such as *Viverra* and *Varanus* that are commonly found dead in the roadkill. *Viverra* is a common civet species found in the study site while *Varanus* is a family of the komodo dragon eventually found roaming in the study area. As this study area is shared with other small mammals from different species, it has a potential to be developed as conservation sites and can also encourage the eco-tourism activities in the future. Another option to protect the species, especially from being traded by the local poacher is by having the area gazetted. Further study also should be conducted in order to explain the survival of the leopard cats in the oil palm plantations and use of the non-forests areas as a new habitat or just for hunting as proposed by Mohammed *et al.*<sup>[3]</sup>.

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