



**ABUNDANCE OF ROADKILLS ALONG JELI-  
GERIK ROAD AND JELI-RANTAU PANJANG  
ROAD**

by

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A thesis submitted in fulfillment of the requirements for the degree of  
Bachelor of Applied Science (Natural Resources Science) with Honours

**FACULTY OF EARTH SCIENCE  
UNIVERSITI MALAYSIA KELANTAN**

2017

## DECLARATION

I declare that this thesis entitled “Abundance of Roadkills Along Jeli-Gerik Road and Jeli-Rantau Panjang Road” is the result of my own research except as cited in the references. The thesis has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

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## Acknowledgement

First of all, I give thanks to the Allah S.W.T because given the opportunity to undergo this experiment and managed to write the report as a final year student. Indeed, the journey running the experiment and writing this report not only challenge my physical but also my mental. But I remember Allah S.W.T said in Quran, 39:66 :“Rather, worship [only] Allah and be among the grateful.”

I would like to thank both of my parents for giving me support on writing the thesis. It is hard to achieve this level without their support.

Next, I would like to appreciate and give a special gratitude my supervisor, Madam Aainaa Syazwani Bt Mohamad Amir Hamzah, whose contributed in giving advices and suggestions, and encouragement, always support and help me to complete my project especially in writing this report. Then, I would like to thank Universiti Malaysia Kelantan, Jeli Campus, especially to the Faculty of Earth Science for the opportunity given to the final year students to do this project.

Futhermore, I would like to thank my fellow classmates who had accompanied me to the field before. I also would like to give special thanks to my senior and my junior, Razin Ramli and Siti Nurkhalidah Husainy for helping me sincerely by giving inspiring encouragements and support along this final project.

## Abundance of Roadkills Along Jeli-Gerik Road and Jeli-Rantau Panjang Road

### ABSTRACT

Roadways is essential in all country. It function not just for connecting one place to another but also important for socio-economic development of country. Although roadways bring good things to human, but at the same time bring negative things to nature such as forest fragmentation. When forest fragmented, it separates the animal habitat from it sources of living. This will cause the animal to roam near the roads in. The study is to identify the animal species that involves in roadkill and to compare the abundance of roadkills between Jeli-Gerik and Jeli-Rantau Panjang roads. The method was used to drive a car, with a speed of 50km / h. If there is a dead animal is detected, the researchers took the picture of the animal as well as the coordinates of the area where the animal was found. If there are dead animals in good condition, the animals were brought back and preserved. The survey on both roads were conducted from March until August 2016. There are 101 individuals consisting of 23 species were recorded. The result showed that there were 19 species were killed on Jeli-Gerik road such as *Felix catus domesticus* (Domestic Cat), *Gallus gallus domesticus* (Domestic Chicken), *Varanus salvator* (Asian Water Monitor), *Paradoxurus hermaphroditus* (Common palm civet), *Callosciurus canineps concolor* (Grey-Bellied Squirrel), *Boiga nigriceps* (Black-headed Cat Snake), *Arctictis binturong* (Binturong), *Canis lupus familiaris* (Dog), *Centropus sinensis* (Greater Coucal), *Dendrelaphis haasi* (Haas's Bronzeback Snake), *Niviventer spp* (Rodent), *Ahaetulla prasina* (Oriental Whip Snake), Owl, *Malayopython reticulatus* (Reticulated Phyton), *Trachypithecus cristatus* (Silvered Leaf Monkey), *Helarctos malayanus* (Sun Bear), *Duttaphrynus spp* (Toad), *Sus scrofa* (Wild boar) and *Martes flavigula* (Yellow-Throated Marten). While 11 species on Jeli-Rantau Panjang such as *Felix catus domesticus* (Cat), *Gallus gallus domesticus* (Chicken), *Varanus salvator* (Asian Water monitor), *Paradoxurus hermaphroditus* (Common palm civet), *Callosciurus canineps concolor* (Grey-Bellied Squirrel), *Acridotheres tristis* (Common Myna), *Echinosorex gymnurus* (Moon Rat), *Dremomys rufigenis* (Red-cheeked Squirrel), *Strix seloputo* (Spotted Wood Owl), *Ovis spp* (Sheep), *Rhinosciurus laticaudatus* (Shrew-faced Ground Squirrel) and few others unknown species. The study of roadkill is important to determine the species of animals available in the study area and population rate can be tweaked for the particular animal species if the research is extended for the longer period of time.

# Penilaian Limpahan Mangsa Jalanan Sepanjang Jalan Jeli-Gerik dan Jeli Rantau Panjang

## ABSTRAK

Jalan raya adalah penting dalam semua negara. Ia tidak berfungsi hanya untuk menghubungkan satu tempat ke tempat lain tetapi juga penting untuk pembangunan sosio-ekonomi negara. Walaupun jalan raya membawa perkara yang baik kepada manusia, tetapi pada masa yang sama membawa perkara negatif kepada alam semula jadi seperti pemecahan hutan. Apabila pemecahan hutan berlaku, ia memisahkan habitat haiwan itu daripada ia sumber hidup. Ini akan menyebabkan haiwan itu berkeliaran berhampiran dengan jalan raya. Kajian ini adalah untuk mengenal pasti bilangan spesies haiwan yang terlibat menjadi mangsa jalanan dan untuk membandingkan berapa banyak yang menjadi mangsa jalanan antara jalan raya Jeli-Gerik dan jalan raya Jeli-Rantau Panjang. Kajian di kedua-dua jalan raya telah dijalankan dari bulan Mac hingga Ogos 2016. Kaedah yang telah digunakan adalah dengan memandu kereta, dengan kelajuan 50km / j. Jika ada haiwan mati dikesan, gambar dan juga koordinat kawasan tersebut diambil dikawasan kejadian . Keadaan bangkai haiwan masih dalam keadaan baik, haiwan tersebut dibawa balik dan diawet. Terdapat 101 individu yang terdiri daripada 23 spesies telah direkodkan. Hasil kajian menunjukkan bahawa terdapat 19 spesies telah terbunuh di Jeli-Gerik seperti *Felix catus domesticus* (Kucing), *Gallus gallus domesticus* (Ayam), *Varanus salvator* (Biawak), *Paradoxurus hermaphroditus* (Musang Pulut), *Callosciurus canineps concolor* (Tupai Perut Kelabu), *Boiga nigriceps* (Ular Kucing Berkepala Hitam), *Arctictis binturong* (Binturong), *Canis lupus familiaris* (Anjing), *Centropus sinensis* (Burung But-but Carik Anak), *Dendrelaphis haasi* (Ular Tambang Gangsa belakang), *Niviventer spp* (Tikus), *Ahaetulla Prasina* (Ular Daun), burung hantu, *Malayopython reticulatus* (Ular sawa), *Trachypithecus cristatus* (Lutung Kelabu) *Helarctos malayanus* (Beruang Matahari), Kodok, *Sus scrofa* (Babi liar) dan *Martes flavigula* (Mengkira). Manakala 11 spesies di Jeli-Rantau Panjang seperti *Felix catus domesticus* (Kucing), *Gallus gallus domesticus* (Ayam), *Varanus salvator* (Biawak), *Paradoxurus hermaphroditus* (Musang Pulut), *Callosciurus canineps concolor* (Tupai Perut Kelabu), *Acridotheres tristis* (Burung Tiung), *Echinosorex gymnurus* (Tikus Ambang Bulan), *Dremomys rufigenis* (Tupai pipi merah), *Strix seloputo* (Burung Hantu Carik Kafan), *Ovis spp* (Kambing), *Rhinosciurus laticaudatus* (Tupai Tanah Muncung Runcing) dan beberapa lagi spesies yang tidak diketahui. Kajian mengenai kematian haiwan sebagai mangsa kemalangan jalan raya adalah penting untuk menentukan spesies haiwan yang terdapat di kawasan kajian dan meramal kadar populasi untuk spesies haiwan tertentu jika penyelidikan itu dilanjutkan untuk tempoh yang lebih lama.

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## LIST OF ABBREVIATION

BTFC	Belum-Temenggor Forest Complex
IUCN	International Union for Conservation of Nature
NRE	Natural Resources and Environment
MNS	Malaysian Nature Society
WWF	World Wide Fund for Nature

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# CHAPTER 1

## INTRODUCTION

### 1.1 Background of Study

At the time of the British conquered Malay Peninsula, roads were worked to set up political control and give access to the encompassing areas. In the second period of the century, tin mining turned into the main driver of progress and by 1900, business horticulture was set up, both creating incredible interest for transport administrations (Leinbach, 1989). In spite of rivalry from waterway transport, and later from rail, streets was build to be more adaptable and turned into the overwhelming method of transport in Malaysia (Olszewski & Tay, 1996).

Nowadays, roads become the most essential in all country. The function of roads are not only limited for connecting from one place to another, but roads are also important for sosio-economic development of a country. Despite the construction of roads may bring good fortunes and developments for human, it will also bring the adverse effect which are loss of habitat, forest fragmentation, introduction of invasive species and loss of biodiversity as results of roadkill (Trombulak & Frissell, 2000).

The development of motorway can interfere with the development of natural life due to of pulverization of territory. It causes annihilation in the biological system, for example, the decline of indomitable life, the corruption of biodiversity (Kim & Choi, 1998). In addition to dissimilar to the basic street, the interstate has produced a

substantial discontinuity through the forest to rectify the express line, later impacts between species and species influences the development of fracture of territory and circulation of the species (Brotons & Herranto, 2001).

Roads, in specific, are physical indications of the social associations and the monetary and political choices that lead to land use change. The discussion of the level directed on whether scene change is a cause or impact of the advancement of the street system gives a false representation of multifaceted nature of associations between the social and organic domains that ultimately create these systems. Their presence relies on upon social structures, and their physical attributes depend halfway on scene structure (Coffin, 2007).

The natural impacts of transportation frameworks are important to transportation geographers, yet are consigned to the edges of the field, leaving room for further research. Transport geographers from the mid to late twentieth century who inspected the structure of transportation frames focused on their system properties, and their impacts on land use, the distribution, and the rivalry between, manufactures, traders and the buyers (Garrison et al., 1962; Beckman, 1967; Taaffe & Gauthier, 1973; Lowe & Moryadas, 1975).

Recent issues which happened this year in 2016, where a pregnant tigress was hit by car on East-Coast Expressway. To fight wildlife crime, Malaysia need to have strong legislation inside the country (Bigcatrescueorg. 2009). To aware public that Malaysia is eager to improve protecting tiger and its prey, the government should enforce amendments in Wildlife Protection Act 1972 immediately (Bigcatrescueorg. 2009).

This study had been conducted along East-West Highways (Jeli-Gerik) which was developed in the 1970s by the government amid the Malaysian Communist Party's control of the locale (Lim, 2010) and Route 196 of federal road in Kelantan that connects Jeli and Rantau Panjang via Panglima Bayu. It is an optional course to Tumpat and Pengkalan Kubor from Rantau Panjang, (Statistik Jalan, 2013). The study covered 50 kilometers from Jeli to Gerik and another 50 kilometers from Jeli to Rantau Panjang respectively.

The condition of Jeli-Gerik road are partially populated by human. There are only several villages along the road. After passing the village area, researcher entered the highway surrounded with forest area. Moreover, the road heading to Gerik is hilly area and also steep because researchers are entering the Titiwangsa Range. Moreover, after crossing the border of Kelantan and Perak, researcher will entering Belum Temenggor Forest Complex. There are many heavy vehicles traveling in and out on both roads to transport merchandise from other north and south like Penang and Perak.

While on the Jeli-Rantau Panjang road, the area along the road mostly populated by human. Although there are some part that are surrounded with forest and near the border of Thailand, there are still people occupied in that area. The road condition mostly flat and have much turns. Furthermore, this road is often used, especially on weekends. This is because this area is duty-free zone for shopping and being a great tourist attraction for the locals and local visitors.

## 1.2 Problem Statement

Jeli-Gerik and Jeli-Rantau Panjang road are both frequently travelled routes by motorized vehicles. One of the road connects Kelantan and Perak while the other one connects Jeli and Rantau Panjang. The construction of the road inside forest territory causes forest fragmentation. When forest fragmentation occur, some animals tend to cross the road in order to survive. Even though roadkill may look so awful and the death maybe very tragic, but the data is important to researchers to identify the species and find a way to mitigate the problem.

## 1.3 Objectives

- 1) To identify animal species that involves in roadkill between Jeli-Gerik and Jeli-Rantau Panjang roads.
- 2) To compare the abundace of roadkills between Jeli-Gerik and Jeli-Rantau Panjang roads.

## CHAPTER 2

### LITTERATURE REVIEW

#### 2.1 Malaysia Forest Profile

Malaysia is enriched with unlimited measure of organic assorted qualities, lovely scenes, one of a kind societies and lavish biological systems. Located on the green belt, this nation is honored with rich tropical biological communities that overflow with numerous characteristic reflections that have not been yet investigated (Williams et al., 2001). Ministry of Natural Resources and Environment (NRE) stated that there are approximately 15,000 species of trees, 229 species of mammals, 742 species of birds, 242 species of amphibians, 567 species of reptiles, more than 290 species of freshwater fish and marine living in Malaysia (NRE, 2009).

While in term of wildlife, there are estimated 1000 of species of vertebrates and around 20,000-80,000 of invertebrates. The natural environment in Malaysia are place for the many habitat. These natural habitat usually forested and heterogenous. Geographical region, altitude, topography, soil profile and water runaway are the factors that influence type of forest (Forestry Department, 1990).

In Peninsular Malaysia, large lowland forest of are converted into agriculture farm. The forest on hill or mountain area are remained untouched by human. For instance, the forest that located on the Titiwangsa Range in Peninsular Malaysia (Menon, 1976).

Although some have thought, people can make fortunes by cutting down the trees. But there are some people who have consciousness about the importance of forest. The forest actually protect the wildlife within the area as well securing the biodiversity in it, providing a good quality of water and water catchment area, helps protect the soil, provide recreational area and promote a research facilities in the area (Menon, 1976).

## **2.2 Wildlife in Malaysia**

The quantity of species in Malaysia is not known with assurance particularly the littler living beings, for example, insect and worms. It is estimated that there are more than 170,000 species in Malaysia. This is probably going to be a preservationist to evaluate, as there are still numerous species that have not been found and have detailed study. The large number of species is because of the wet tropical atmosphere, good conditions for the development and advancement of plants and creatures, and additionally the nearness of incredible assorted qualities of living spaces in Malaysia. These territories including the oceans, rivers, forest and mountains. Another component is the immense age of the timberlands, which have existed ceaselessly for more than 130 million years thus allowing for evolutionary diversification (NRE, 2006).

## **2.3 Belum-Temenggor Forest Complex**

Belum-Temenggor Forest Complex with a total area 300,000 hectares located near Kelantan forest. It is second biggest staying persistent tract of ensured zone in Peninsular Malaysia after Taman Negara National Park Pahang. Belum-Temenggor Forest Complex (BTFC) consists of three parts of the forest which are the lower Belum forest reserve, the Temenggor forest reserve and finally Royal Belum forest reserve.



The BTFC scene is submerged significantly under the man-made Temengor Lake which stretches 15,200 hectares due to repression of a few streams in 1970 for force era (Yong, 2006). The Belum-Temenggor Forest Complex is rich of biodiversity, plus it comprises of a beautiful landscape on mountain area, the formation of lime stones, waterfall, and distinct river pattern (Azreen, Weng & Ahmad, 2011).

The fundamental wellspring of water originates from the Temengor River, one of the Perak River tributaries. From a study done along Sungai Perak by Zainudin, 2005, the discoveries demonstrate that there are a sum of 92 animal groups containing 12 orders, 33 families and 63 classes from 4733 examples of individuals.

Despite with the beautiful nature surrounding the place, it also have problems. According to WWF Wildlife Protection Unit as stated in Bulbal (2009), they have spotted 37 illegal entry point of poaching along the highway. Agarwood, elephant tusk, tiger parts, rhinoceros horns, pangolins, sambar and barking deer are the common items that poachers look for. The most expensive item is the agarwood. Although its main usage is for traditional medical purposes, but the tree itself worth RM 1 Million for one kilogram if the quality is high (Rosli, 2010). The tiger costs USD\$50,000 if sold in the black market (DWNP, 2008).

This poaching activity already killed 55 tigers in the past decade according to The Wildlife Monitoring Report (TRAFFIC) in Malaysia as stated in Tan (2010). While elephant worth USD\$700 to USD\$30,000 for one kilogram (DWNP, 2008). Furthermore, rhinoceros are listed as critically endangered by IUCN (2008). Although this animal are protected by the law under Malaysia Wildlife Protection Act 1976, the number keep decreasing since 1984 from 70 to 50, to 20 species left (Flynn & Abdullah, 1984).

Second problem is logging. As known before, high quality of wood produced in the Belum-Temenggor Forest Complex. Although the Belum-Temenggor Forest Complex is protected by the state government, in other parts of Perak logging is still operating (The New Straits Time, 2006).

Third problem is management issues. In National Physical Plan Malaysia (NPP), Belum-Temenggor Forest Complex is the in Rank I under the Environmental Sensitive Area (ESA). Unfortunately, the state government pun it in Rank II because there logging activities occurred in the forest (The News Straits Time, 2009).



Figure 2.1 Belum-Temenggor Forest Reserve Map (BTFC) Map  
(Source: Royal Belum State Park, 2007)

## 2.4 Roadkill

In simple term, it is about dead animal on the road. Specifically, it is a group of animal that were killed on roadways (Michael, 2004). From his point of view, the so-called mega fauna, for example, the chimpanzee, tiger, gorilla, and lion, cannot be in danger to the road. They are best described as victims because of our solid individual relationship with them. In this way, the roadkill has the ability to clarify in crucial ways of human, animal and technologies in detail specification (Michael, 2004).

There are many cases of roadkills occurred around the globe. From the small vertebrates to large animals, it can be anything. In United States where they indicated that 500,000 deers killed annually (Romin & Bissonette, 1996). Anyway this data is crucial for researcher that study about animal diversity. Roadkill is a brief indication of the unclear of our orders. However, the contraction of the size of the co-existence is prone to generate more losses (Cronon, 1995).

## 2.5 Causes of Roadkills

The flora and fauna in the natural habitat are currently being harm due to human anthropogenic activities and mass development (Mader, 1984). When a development is conducted in the area, some animal are being pushed away from their original habitats. This is called the habitat loss. The impact of building transport system on fauna had been seriously examined in North America and distinctive European nations since the 1970s. In Spain, these studies have been all the more as of late created. Standard specialists, the association and normal affiliations have been able to be aware of its importance and investigation has increased (Velasco et al., 1992; Asociacio´n Te´cnica de Carreteras., 1999; Rosell & Velasco, 1999).

Some of animal were stranded in between human constructions. It is called 'habitat island'. In order to survive, they need to continue searching their necessities on other place of the forest. These animal tend to be wandering around outside of the forest area and crossing the road area. Animal that hit by fast moving vehicle is the main factor why these animal died on the road (Trumbulak & Frissel, 2000). Not only animal that are large in size, but also endangering small mammals, reptiles, amphibians (Hodson, 1966; Adam & Geis, 1983; Ashley & Robinson, 1996), birds and others are mostly hit by cars and trains.

## **2.6 Pattern and Distribution**

Roadways can have a wide assortment of effects on adjacent biological systems. Roadways can significantly modify the structure of plant groups and their related fauna in wetland territories (Atkinson & Cairns, 1992; Sriyariaj and Shutes, 2001; Houlahan et al., 2006).

The collision of wildlife are the most famous effect from roadkills and human transportation (Forman & Alexander, 1998; Forman et al., 2003). When the road was built, it separated the natural animal habitat into several sections. This is called habitat fragmentation. Either way, the expansion of road will reduce the size of population and separating animal habitat into isolation.

Besides, seasonal and natural landscape also plays role in determining the animal pattern and distribution. These will affect the composition, abundance, and species mobility, and resulting the seasonal and roadkills spatial patterns (Miller & Cale, 2000; Erritzoe et al, 2003; Keller & Yehner, 2007; Trombulak & Frissell 2002).

In certain season, the example in moderate temperature nation. The patterns are either in group or centered in one spot along the road (Clavenger et al, 2003; Erritzoe et al, 2003; Smith & Dodd, 2003). Meanwhile in the temperate forest, the bird carcasses were recorded high during spring season (Taylor & Goldingay, 2004; Coelho et al, 2012).

## **2.7 Roadkill Management**

There will be great impact on roadkill, especially for wildlife. The building of road can disturb the wildlife populations, especially when we accidentally hit the animal and eventually will make barriers on the road surface. (Malo et al., 2004; Hobday & Mintrell, 2008).

Understanding the causes of roadkill and cases happened before should have showed how to properly manage it. It is also one of the way for the government expanses on roadkill. As a result, it can avoid any human animal interaction in the future. Mitigation measures should be organized, relevant and flexible. It will ease authorities to monitor time by time. Any strategies come out should be adjustable, in case there are conditions that need to be taken care of (Briassolis, 1989).

From the previous research, the researchers have listed several ways to minimize the problem. Firstly, by building drains and clearing plant along the road. Next, the applying rumble strip on the road. Moreover, the use of bright coloured pavement. Another way is by developing proper road alignment. Furthermore, installation of appropriate sign board. Lastly, making awareness program to community (Lester, 2015).

### **2.7.1 Building Drains and Clearing Plant Along The Road**

There are grass growing along the road. By eliminating the grass, it should prevent the animal to come near to the road. The grass area along the road should be replaced by cement or asphalt to avoid the to grass grow in the area. Moreover, by building the drains it should decrease water from accumulating on the street. It also should keep the small mammal from crossing the road. This will decrease the probability of vegetation growth and avoid the attraction of animal to road (Lester, 2015).

### **2.7.2 Applying Rumble Strips**

The application of rumble strips on the road produces loud noise when there were vehicles passing through the road. At the same time, the sound produces by the rumble strips can warn the animal nearby to stay out from nearing the road. The rumble strips also function to slow down vehicles passing through the road. It also tells the driver that they are entering wildlife zone and need to slow down within the area. (Lester, 2015).

### **2.7.3 Light Coloured Pavement**

The collision between wildlife and vehicles were usually occurred at night. It is because the human eye sight have limited vision especially at dark and foggy places. There are animals that wandering around the area, mistakenly think it is a forest area, but actually on the road. This due some animals have poor eye sights that cannot differentiate road surface and jungle floor (Jones, 2000; Magnus, Kriwoken, Mooney & Jones, 2004 & Hobday, 2010).

By coloring the asphalt with light hued colour it may decrease the collision between animal and vehicles, because the colour are obviously different. So the animal would not mistakenly entering the road. This method was used to mitigate the Tasmanian wildlife, to avoid mistakenly that there were on wrong side area (Magnus, 2006; Jones, 2000; Magnus, Kriwoken, Mooney & Jones, 2004).

#### **2.7.4 Road Alignment Development**

Although this method is still in evaluation stage, but this mitigation propose is to develop proper road alignment to avoid the collision between vehicles and wildlife within the area have blind spots. By developing this mitigation, it should be able to avoid blind spots on the road. In addition, it will ensure that the vehicles have enough time to react in case the vehicles runs into wildlife (Lester, 2015).

#### **2.7.5. Sign Boards Installation**

The goal for installing sign boards along the roadways is to inform the driver that the vehicles is about entering wildlife crossing territory. Any vehicles that enter wildlife crossing area should slow down and drive at 45km/h (Lester 2015).

#### **2.7.6 Community Awareness Program**

The purpose of making an awareness program is to educate and promote people about awareness towards roadkill. The awareness can be spread either by social media, newspapers or broadcast the awareness on the radio. Another approach is by educating the people in nearby education institution such as school, university or college (Lester 2015).

## 2.8 Importance of Road

There are many purposes why road was made, examples to ease people to go their job places, for business trips and transporting cargo. In a simple term, road was made to connect one place to another places. In business sectors, road is very crucial because road is the pulse of development in a country. Transporting using road is way less pricy, more convenient and safe. (SIKA, 2000a, b).

Roadways can work as hindrances regardless of the fact that there is no immediate mortality since a few creatures dodge the unsettling influences made by moving vehicles (e.g. noise disturbutaion, lights, and wind flows), or in light of the fact that roadways change the nearby microclimate around them making threatening situations. (Mader, 1984).

In spite of the fact that these impacts have vital outcomes, maybe the best concern is that roadways may work as hindrances just in light of the fact that they can be a wellspring of high mortality for species not able to keep away from direct crashes with engine vehicles. Whether the impacts of roadways are through evasion, direct mortality, or both; for some species, they can possibly diminish populace sizes and section (Forman et al., 2003).

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## CHAPTER 3

### MATERIAL AND METHODS

#### 3.1 Study Site

This study had been conducted along East-West Highways, which are covering 50 kilometers from Jeli to Gerik and another 50 kilometers from Jeli to Rantau Panjang. The data collection commence in March 2016 until August 2016. However, preliminary survey had been done from 1<sup>st</sup> February until 30 February 2016.

##### 3.1.1 Rantau Panjang

Golok River territorial is located 29.9 kilometers from Pengkalan Kubor, Tumpat and Rantau Panjang, Kelantan became the main border that separates the Kelantan (Malaysia) and Narathiwat (Thailand). There were many agencies that are managing both Malaysian and Thailand border. There are challenges faced by the security force of particular organizations that managing those outskirts along the waters of Sungai Golok. Moreover, Rantau Panjang is place where it is a free trade zone. As far as outskirts implementation in the waters about Sungai Golok and Rantau Panjang obligation free zone is found there are different challenges faced by security faculty from particular organizations (Fauzi Norehan, Hussin & Salemah, 2013)

Even though there are securities monitor the area such as Anti-Smuggling unit (UPP), customes unit (the enforcement), also military (replacing the general operations compel task) that controls those entrance, there are also passageway from claiming unlawful merchandise that go through the Sungai Golok waters.

Rantau Panjang is one of free trade zone area in Kelantan besides Pengkalan Kubor as shown in figure below. Rantau Panjang is a tourist attraction place where anyone can buy shop with cheaper price compared to non-free trade zone. Since various sorts about products and souvenirs need aid to be sold clinched alongside free zone areas, the need for aid not subject with at whatever assessment on merchandise (Fauzi et al., 2013). Figure 3.1 below show the map of Rantau Panjang.

Due to situated near the border of Thailand, it brings negative impact on country economic development. This is because most of the item that brought in and out our country is illegitimate and the effort to decrease the smuggling merchandises activities are less is effective even though Malaysia already enforced the law and establish agencies such as Royal Customs and Excise Department, Anti-Smuggling Unit, Immigration Unit and Royal Malaysian Police to control the activities (Fauzi et al., 2013).

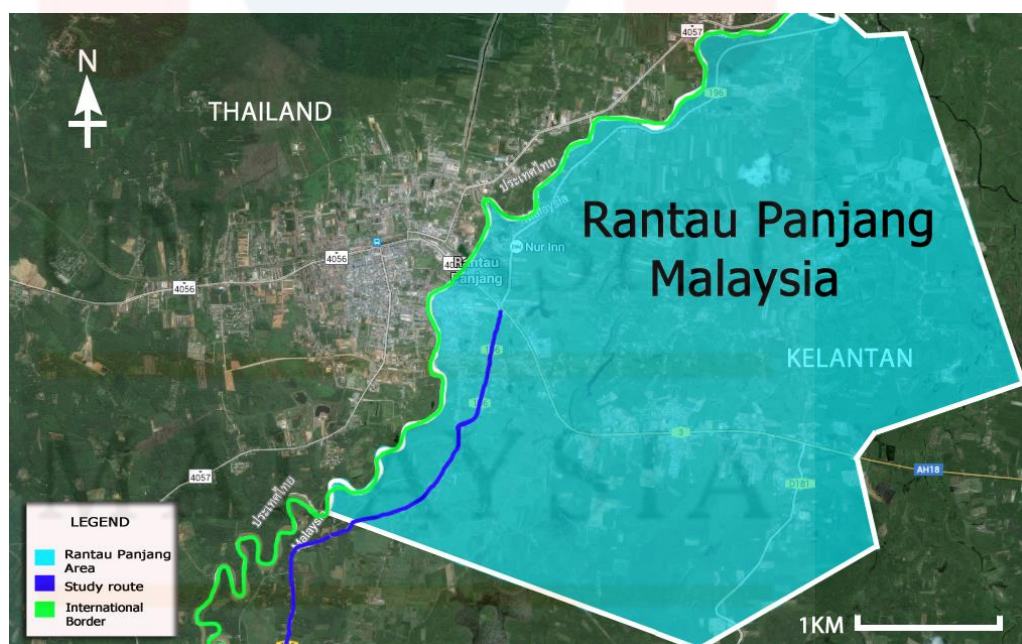


Figure 3.1: Rantau Panjang Map Area

(Source: Google Earth, 2016a)

### 3.1.2 Jeli

Jeli is the smallest region circumscribing Thailand in the north, Tanah Merah in the east, Kuala Krai and Gua Musang in south and Perak in the west. The primary access street to Jeli is through the Federal Road 66 (Gua Musang - Jeli) and crossed by the East West Highway.

From the part of organization, the Jeli colonies has three regions comprising of Jeli, Batu Melintang, Kuala Balah and covers seven districts by physical and 15 regulatory areas where Kuala Balah area is the most exhaustive examination. Another zone, Jeli area comprises of six sub-areas, in particular, Jeli, Gemang, Ayer Lanas, Sungai Satan, Berdang, and Legeh. While the zone Batu Melintang comprises of three sub-areas, to be specific, Batu Melintang, Kalai, and Pendok. In the interim, Kuala Balah area involving from six areas to be specific, Lubok Bongor, Kubor Datu, Bukit Selar, Bukit Jering, Jerimbong and Kuala Balah (Town and Country Planning Department Peninsular Malaysia, 2010). Figure 3.2 below shows the map of Jeli.



Figure 3.2: Jeli map area  
(Source: Google, 2016b)

Route 196 is an east west highway connecting the two states of Kelantan and silver. Although the highway was built to facilitate communication between the two states, but there are some areas the speed limit is should be given attention. The speed limit in Jeli area is shown in Table 3.1.

Table 3.1: Speed limit area in Jeli, Kelantan

Area	Coordinates	Speed limit
Sekolah Kebangsaan Ayer Lanas	5.783464, 101.886544	30 Km/h
Kampung Gemang	5.758223, 101.863666	70 Km/h
Maktab Rendah Sains Mara Jeli	5.750113, 101.861846	30 Km/h
Univeriti Malaysia Kelantan Jeli	5.744688, 101.861447	30 Km/h
Kampung Lakota	5.726101, 101.859477	60 Km/h
Politeknik Jeli Kelantan	5.711209, 101.849929	30 Km/h
KM 8 East-West Highway	5.706089, 101.775317	80 Km/h
Kampung K.Long	5.713017, 101.781752	80 Km/h
Kampung Salor	5.708181, 101.764557	70 Km/h
Kampung Bechah Pulau	5.713516, 101.754908	60 Km/h
Kampung Batu Melintang	5.699030, 101.736340	60 Km/h
East-West Highway (KM18)	5.672664, 101.723076	50 Km/h
East-West Highway(KM26.6)	5.631297, 101.711551	50 Km/h
East-West Highway (KM 34.8)	5.614660, 101.658731	60 Km/h
East-West Highway (KM 34.8)	5.614375, 101.658373	30 Km/h

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### 3.2 Data Collection

The data collection had been conducted once a week in total of six month. Sampling began as early as 0800 h. Researcher had conduct the sampling by using a car and drive with a speed limit of 50 km/h. When the dead animal was spotted the researcher had took the coordinates and photos of dead animal. Figure 3.3 below shows the overall study site map.

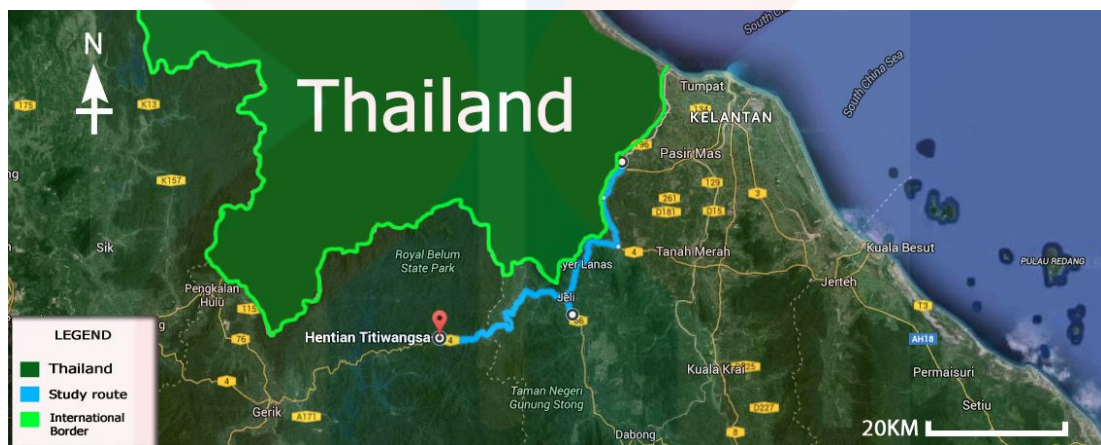


Figure 3.3 Study Site Gerik-Jeli-Rantau Panjang

(Source: Google Earth, 2016c)

### 3.3 Data Management

All the data gathered had been recorded. The roadkill animal had been identified until species level if possible by referring to A Field to Guide to The Mammals of Southeast Asia (Charles Francis, 2008), A Field Guide to the Bird of Peninsular Malaysia and Singapore (Allen Jeyarajasingam & Alan Pearson, 2012) and A Field Guide To The Reptiles Of South-East Asia (Indraneil Das, 2010) .The frequency of dead animal had been recorded. The data were presented according to months. The data for both roads will also be compared according of elevation.

### 3.4 Statical Analysis

To compare the means of roadkills between two roads, the t-test had been performed. The t-test assessed whether there are statistically different from each other or not. To test the significance, the alpha-level is set at 0.05



## CHAPTER 4

### RESULT AND DISCUSSION

#### 4.1 Condition of Roadkill

There are 3 types of roadkill condition were found on the road which are shown below with minimum damage (Figure 4.1), badly damaged but can be identified (Figure 4.2) and badly damaged cannot be identified (Figure 4.3) based on researcher observation.



Figure 4.1: Example of organism that has minimum damage roadkill, the Spotted Wood Owl (*Strix seloputo*) which was collected on 23 March 2016.



Figure 4.2: Example of organism that was badly damaged but still can be identified, the Reticulated Python (*Malayopython reticulus*) which was collected on 28 July 2016.



Figure 4.3: Example of organism that badly damaged and cannot be identified, which was collected on 28 August 2016.



## 4.2 Places of Roadkill

Figure below shows is the overall map of Rantau Panjang-Jeli-Gerik area with marked data (Figure: 4.4) where the roadkill found on the road. There are total of 101 individuals of roadkill found along both side of the road.

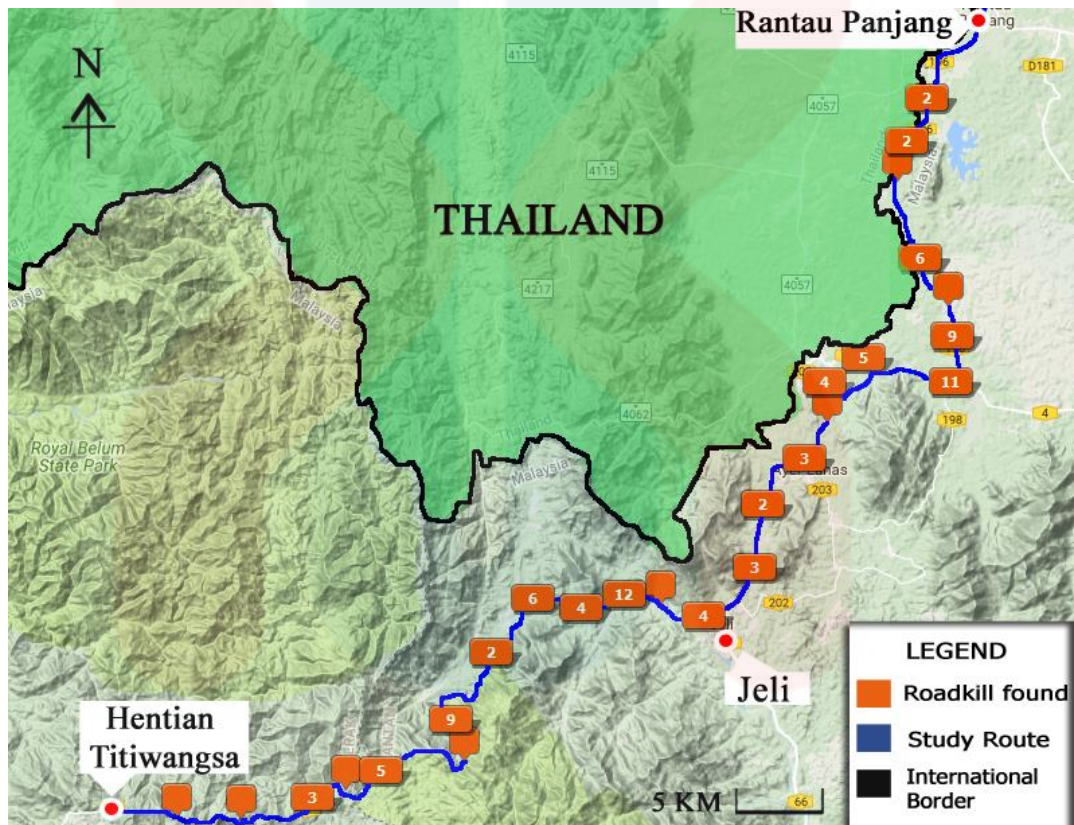


Figure 4.4: Marked roadkill data in overall site

Roadkill occurs when vehicles collide with wildlife. Based on the Figure 4.4, the survey shown that both road do have signs of roadkill on the Jeli- Rantau Panjang road and Jeli- Gerik road after six months of survey. Both side of the road have different amount of roadkill. The survey showed that small mammal, reptiles, amphibians and birds are involved in the roadkill. Some of the animal were severely damaged after the collision with vehicles. While some of the roadkill have minimum of damage.

### 4.3 Roadkills Found Along Jeli-Gerik Road

Along Jeli-Gerik road, there are total of 50 individuals of animals that involved in the collision with the vehicles and marked where the roadkill found (Figure 4.5).

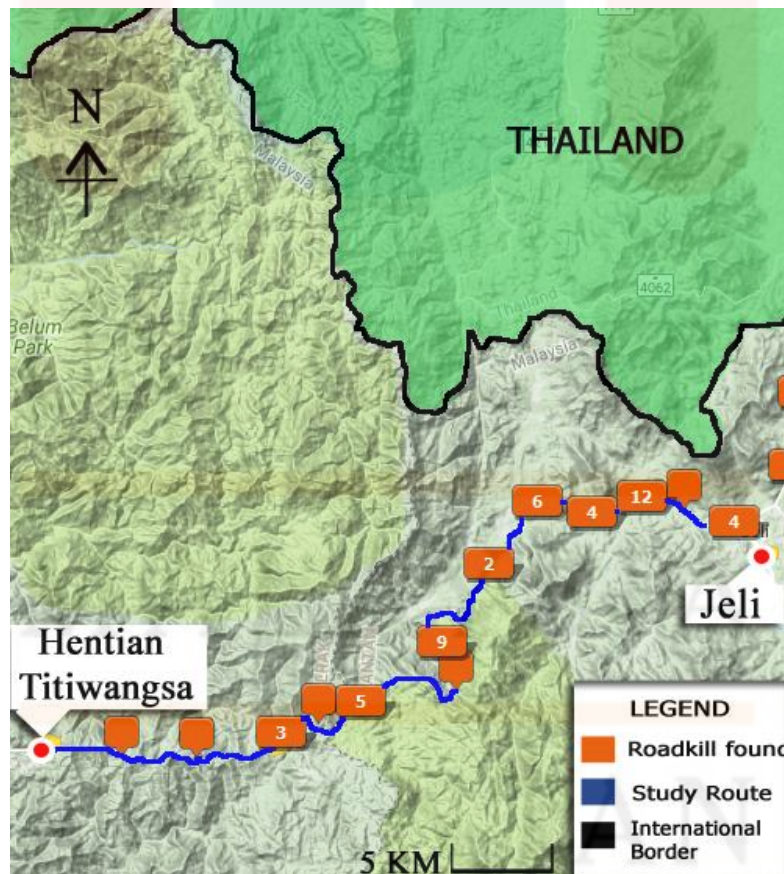


Figure 4.5: Marked roadkill data along Jeli-Gerik road

Based on the Figure 4.5, the sample consist of 19 species of animal, which are *Varanus salvator* (Asian Water Monitor), Owl, *Arctictis binturong* (Binturong), Toad, *Boiga nigriceps* (Black-headed Cat Snake), *Felix Catus* (Cat), *Gallus gallus domesticus* (Chicken), *Paradoxurus hermaphrodites* (Common Palm Civet), *Canis lupus familiaris* (Dog), *Trachypithecus cristatus* (Silvery Lutung), *Sus Scrofa* (Wild Boar), *Callosciurus canineps concolor* (Grey-Bellied Squirrel), *Centropus sinensis* (Greter Coucal), *Dendrelaphis haasi* (Hass's Bronzeback Snake), *Niviventer spp* (Rodent), *Ahaetulla prasina* (Orietal Whip Snake), *Malayopython reticulatus* (Reticulated Phyton), *Helarctos malayanus* (Sun Bear) and *Martes flavigula* (Yellow-throated Marten).

Among all the species that were found, there were two species that are vulnerable according to IUCN Redlist 2016 (Table 4.1) shown below, which are *Arctictis binturong* (Binturong) and *Helarctos malayanus* (Sun Bear). Besides there are one species that was categorized near threaten by IUCN Red List which is *Trachypithecus cristatus* (Silvered Leaf Monkey) However, there is one species that not was not mention in IUCN Conservation status, which is *Malayopython reticulatus* (Reticulated Phyton).

Table 4.1: List of roadkill found on Jeli-Gerik road

Common Name	Scientific Name	Frequency	IUCN Conservation Status
Cat	<i>Felix catus domesticus</i>	11	Least Concern
Chicken	<i>Gallus gallus domesticus</i>	10	Least Concern
Asian Water Monitor	<i>Varanus salvator</i>	8	Least Concern
Common Palm Civet	<i>Paradoxurus hermaphroditus</i>	5	Least Concern
Gray-Bellied Squirrel	<i>Callosciurus canineps concolor</i>	2	Least Concern
Black-headed Snake	Cat <i>Boiga nigriceps</i>	1	Least Concern
Binturong	<i>Arctictis binturong</i>	1	Vulnerable
Dog	<i>Canis lupus familiaris</i>	1	Least Concern
Greater Coucal	<i>Centropus sinensis</i>	1	Least Concern
Haas's Snake	Bronzeback <i>Dendrelaphis haasi</i>	1	Least Concern
Rodent	<i>Niviventer spp</i>	1	Unknown
Oriental Whip Snake	<i>Ahaetulla prasina</i>	1	Least Concern
Owl	Unknown species	1	Unknown
Reticulated Python	<i>Malayopython reticulatus</i>	1	Not Mentioned
Silvered Leaf Monkey	<i>Trachypithecus cristatus</i>	1	Near threaten
Sun Bear	<i>Helarctos malayanus</i>	1	Vulnerable
Toad	<i>Duttaphrynus spp</i>	1	Unknown
Wild Boar	<i>Sus scrofa</i>	1	Least Concern
Yellow-Throated Marten	<i>Martes flavigula</i>	1	Least Concern
Total		50	

On the Jeli-Gerik road, there are 19 species were found on dead on road. There were numbers of wildlife many species found on this side of the road maybe because of the road were surrounded by forest. This roadway was near to the protected forest of Belum-Temenggor Forest Complex.

Among of the species recorded, there were two rare species of wildlife which are *Arctictis binturong* (Binturong) and *Helarctos malayanus* (Sun Bear). Both of the species were listed as vulnerable under the IUCN Redlist 2016. While *Trachypithecus cristatus* (Silvered Leaf Monkey) listed as Nearly Threatened under IUCN Red List.

The sun bear carcasses was found on August, where at that time it was season of durian. This sun bear probably was looking for food out from its territory but unfortunately been hit by vehicles, probably heavy vehicles. There were some villagers in Kampung Batu Melintang have seen this animal wandering around in the near forest, searching for food. There are cases recorded where this animal attacked a rubber tapper in Kuala Balah, Jeli (Suganthi, 2010). *Helarctos malayanus* (Sun Bear) behavior may assault people, especially whenever harmed or when with its cubs (Harrisson, 1949; Medway, 1969). Due to its poor eyesight, the sun bear probably can charge without any warning if there are sudden threat approaching (Fetherstonhaugh, 1940). Figure 4.6 below shows the carcass of Sun bear.



Figure 4.6: Carcass of Sun Bear was collected on 14 August 2016 (*Helarctos malayanus*)

According to IUCN, *Helarctos malayanus* (Sun Bear) is listed as vulnerable category because the population of this animals were drastically declining every year due to deforestation and poaching activity. The worldwide population is thought to have declined by more than 30% in the course of the last three generation. (Fredriksson et al, 2008). These Sun bear can be found in some part in Kelantan forest.

Next is *Arctictis binturong* (Binturong), otherwise called bear cat. It is the biggest civet living in the forest of Southeast Asia. It had the same diet as sun bear, fruits especially figs but Binturong also consumes small animal. The carcass of this animal was found on March, couples kilometres from Hentian Titiwangsa. This animal probably was searching for food around the area, but unfortunately got hit by vehicles while to crossing the road. Figure 4.7 shows the carcass of Binturong.



Figure 4.7: Binturong Carcass (*Arctictis binturong*) was collected on 28 May 2016

*Arctictis binturong* (Binturong) is a nocturnal animal, it only active at night time. Although this species had never been concentrated for any specific research, but the researcher do convinced this species live reliant in the forest. Due to human activity such as poaching, deforestation and land degradation, these activities make the animal lost its habitat and cause this species categorized as vulnerable according to IUCN Red List 2016 (Widmann et al., 2008).

Besides than mentioned above, there was a *Trachypithecus cristatus* (Silvered Leaf Monkey) also found dead on Jeli-Gerik road. This species probably fall from the trees or try to migrate to other area and hit by car while try to cross the road. It was listed as Near Threatened under IUCN Red List 2016. This *Trachypithecus cristatus* (Silvered Leaf Monkey) are available in Southeast archipelago. They can be discovered on Malay Peninsula, Borneo and neighbouring island (IUCN, 2010). Figure 4.8 shows the carcass of Silvered Leaf monkey.



Figure 4.8: Silvered Leaf Monkey (*Trachypithecus cristatus*) carcass was collected on 4 May 2016

This *Trachypithecus cristatus* (Silvered Leaf Monkey) population decreases at fast rates within 20 years (Mittermeier et al., 2007; Nadler et al., 2007). It is because lack of food quality (Gupta and Chivers 1999) and forest density (Johns, 1985). Futhermore, this species were hunted by local tribal people (Chivers and Davies 1979).

There one species that are not mentioned by IUCN Red List, which was *Malayopython reticulatus* (Reticulated python). This is probably, there were no specific study or research on that species by IUCN researchers. Eventhough the forest in Kelantan have plenty of wildlife, there are a lot of works to do in order to conserve the wildlife. Especially animals that listed in IUCN Redlist and facing population decline.

#### 4.4 Roadkill Along Jeli-Rantau Panjang Road

Along the Jeli-Rantau Panjang road based on Figure 4.9 shown below, there are 51 individual of animals spotted dead on the road.



Figure 4.9: Marked roadkill data along Jeli-Rantau



There are consisted of 11 species found in the survey, which are *Varanus salvator* (Asian Water Monitor), *Felix Catus* (Domestic Cat), *Gallus gallus domesticus* (Domestic Chicken), *Acridotheres tristis* (Common myna), *Paradoxurus hermaphrodites* (Common Palm Civet), Sheep, *Echinosorex gymnurus* (Moon Rat), *Dremomys rufigenis* (Red-cheeked Squirrel), *Strix seloputo* (Spotted Wood Owl), *Callosciurus canineps concolor* (Grey-bellied Squirrel) and *Rhinosciurus laticaudatus* (Shrew-faced Ground Squirrel).

Among the roadkill found in Table 4.2 below, there was one species that is categorized under nearly threatened according to IUCN Red List 2016, which is *Rhinosciurus laticaudatus*, (Shrew-faced Ground Squirrel), while other species were listed under the least concern species.

Table 4.2: List of roadkill found on Jeli-Rantau Panjang road.

Common Name	Scientific Name	Frequency	IUCN Conservation Status
Cat	<i>Felix catus domesticus</i>	15	Least Concern
Chicken	<i>Gallus gallus domesticus</i>	14	Least Concern
Asian water monitor	<i>Varanus salvator</i>	7	Least Concern
Gray-Bellied Squirrel	<i>Callosciurus canineps concolor</i>	4	Least Concern
Common palm civet	<i>Paradoxurus hermaphroditus</i>	3	Least Concern
Unknown	Unknown species	2	Unknown
Common myna	<i>Acridotheres tristis</i>	1	Least Concern
Moon rat	<i>Echinosorex gymnurus</i>	1	Least Concern
Red-Checked Squirrel	<i>Dremomys rufigenis</i>	1	Least Concern
Spotted Wood Owl	<i>Strix seloputo</i>	1	Least Concern
Sheep	<i>Ovis spp</i>	1	Unknown
Shrew-faced Ground Squirrel	<i>Rhinosciurus laticaudatus</i>	1	Near threatened
Total		51	

There are 11 species found on Jeli-Rantau Panjang road, including two species that cannot be identified because of the sample severely damaged. Although there are forest alongside of the road, the road are quite heavy with traffic especially weekends or public holidays. Rantau Panjang is the tourist attraction place for shopping as this place offer cheaper price due to free zone area. Tourists and local visitors love to shop here because of an easy access of Thailand product.

Contrast with Jeli-Gerik road, most of the species found killed were domestic animal. However, there was one species *Rhinosciurus laticaudatus* (Shrew-faced Ground Squirrel) recorded under Nearly Threatened by IUCN Redlist. This species was found dead on the road, probably hit by light vehicles while trying to cross the road. Figure 4.10 below shows the carcass of Shrew-faced Ground Squirrel.



Figure 4.10: Shrew-faced Ground Squirrel (*Rhinosciurus laticaudatus*) carcass was collected on 21 April 2016

*Rhinosciurus laticaudatus* (Shrew-faced Ground Squirrel) are available in tropical forest such as Thailand, Peninsular Malaysia, Singapore, Sumatera, Borneo and nearby island. This species listed as Nearly Threatened by IUCN Red List because of deforestation in the area.

#### 4.5 Overall Roadkills

A total of 101 individuals of roadkills found were dead along Rantau Panjang-Jeli-Gerik road. Based on the Figure 4.11, there were total of 51 individuals of roadkill recorded along Jeli-Rantau Panjang while 50 individuals of roadkill recorded along Jeli-Gerik. T-test was used to calculate difference of individuals between of individual. There are significantly difference ( $t = -3.81, p \leq 0.45$ ) of individuals between Jeli-Gerik and Jeli-Rantau Panjang.

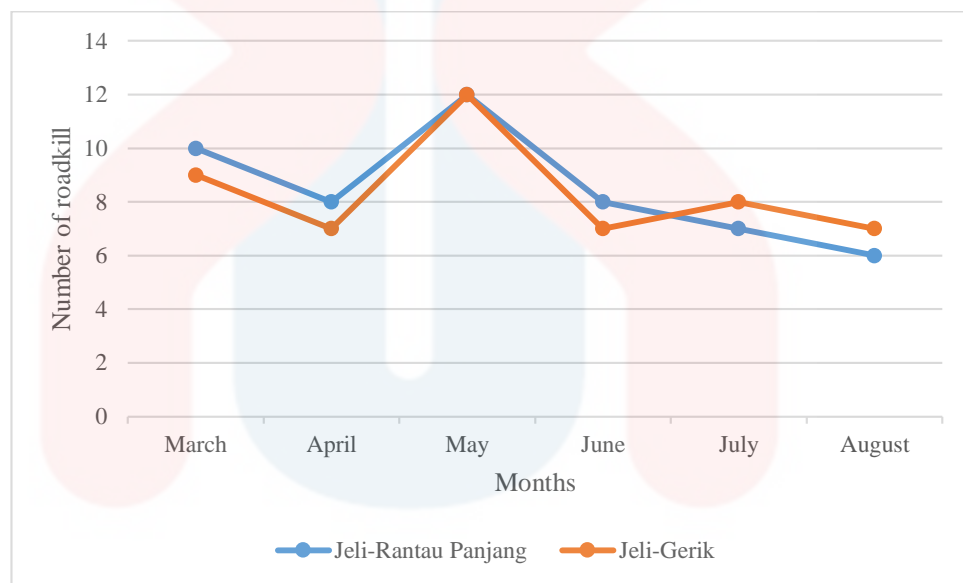


Figure 4.11: Number of individuals according month

According to the Figure 4.11, the data showed that there are difference in number of roadkill between both roadways. The highest data were recorded in May with the total of 24 roadkills observed on both side of the road. There were 12 roadkills were recorded on each side of the road. On March, there were 19 roadkills were recorded on both road while Jun and July recorded the same number of roadkills. On the April, there 14 were roadkills recorded and the least was on August with 13

roadkills were recorded. The mean for Jeli-Gerik road was 8.17 cases of roadkills while Jeli-Rantau Panjang was 8.50 cases of roadkills.

The highest roadkills cases were recorded on May, due to public holiday. Most of the day on that month were public holiday, such as Labour Day, Israk and Mikraj, and Wesak Day. So based on direct observation, there are numerous of vehicles were passing through the Jeli-Gerik road, either entering or exiting Kelantan. Due to holiday season, the Rantau Panjang were visited by visitor from in and out of Kelantan. The Jeli-Rantau Panjang road were often used by the light or heavy vehicles to reach Rantau Panjang. Similar with the March, the school holiday happened on that month, so there were many vehicles used on both road to reach their preferred destination.

However on April, June and July recorded have the lower cases of roadkills compared to May and March. Normally, most animals especially wildlife tend to cross the road during night time, this is due to the dark streets in some parts of the road. Nocturnal animal feel safer crossing in the dark maybe because the darkness can protect them from becoming prey from predator. The condition of the road in the early morning was dark and foggy, causing a low visibility while driving. The minimum amount of vehicles at that time also encourage the driver to drive faster to reach their destination.

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The t-test was used to compare the differences of species on both side of roadways by month. Figure 4.12 shows the difference.

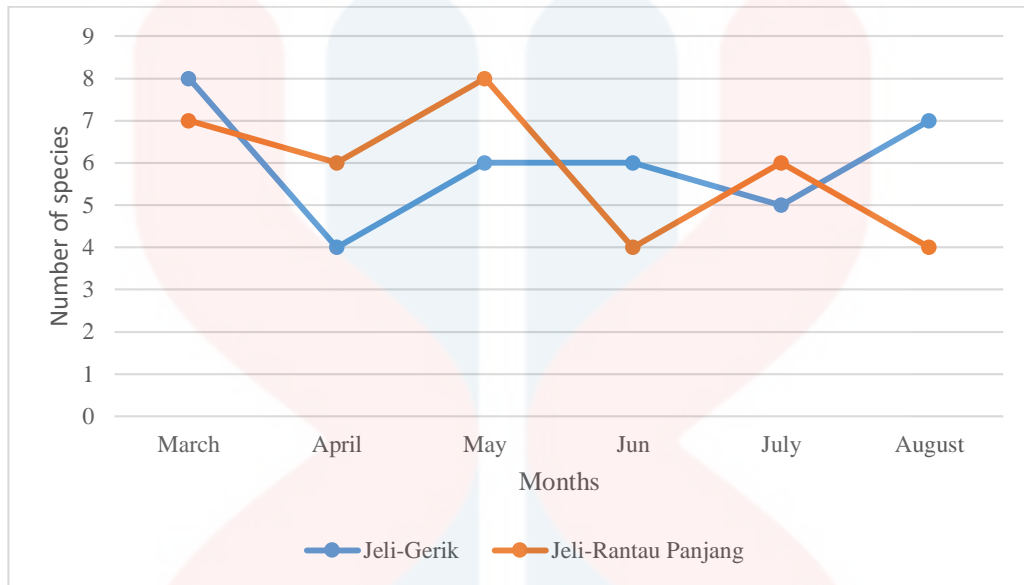


Figure 4.12: Difference of species according to month

There are significantly difference ( $t=0.191, p \leq 0.0017$ ) of species between Jeli-Gerik and Jeli-Rantau Panjang. The total number species found in the Jeli-Gerik road were 19 species while 11 species were found on Jeli-Rantau Panjang road. In Jeli-Gerik, there are a lot of wildlife species recorded such as sun bear, wild boar, marten, silvered-leaf monkey and snakes. This maybe because this road is crossing the Titiwangsa Range and surrounded by forest. However in Jeli-Rantau Panjang, domestic animals were usually recorded such as cats, rats, goat and chicken because this site is a settlement and heading to the tourist attraction place.

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#### 4.6 Hot Spot of Roadkill

Hot spots is where there are more frequency of roadkill on the certain point of the road. Figure 4.13 below show the hot spots in both roads.

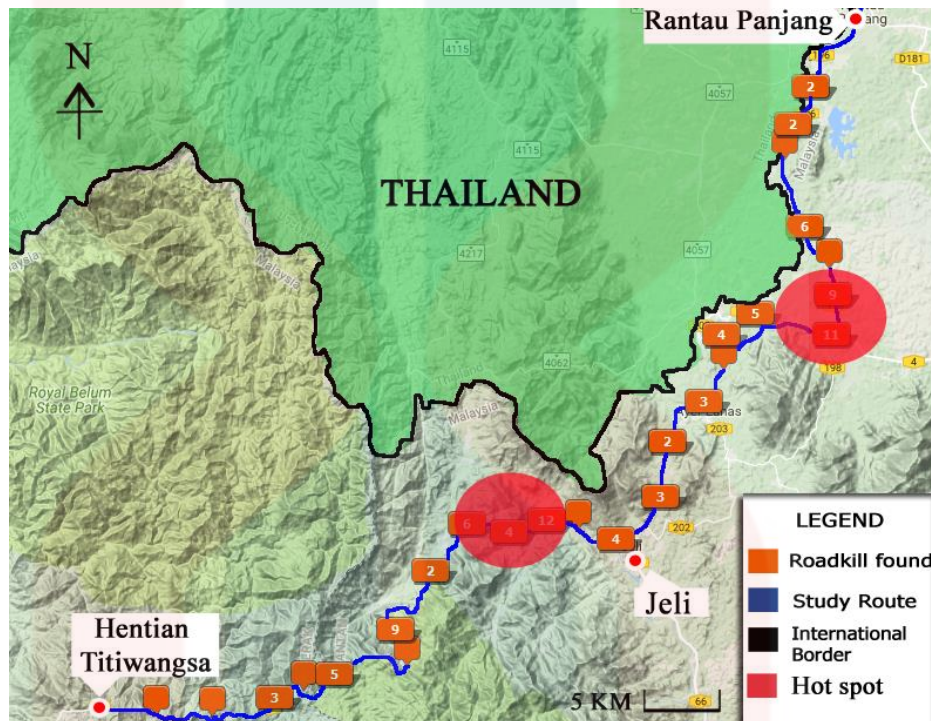


Figure 4.13 Hot spot of roadkill

There are several hot spots location of roadkill were detected after the survey ends. Both side of the roads do have hot spots. As shown in the figure 4.13, there are two main hot spots location, located on each side of the road. There were three main causes that make the hot spots region within the area, which are high vehicle traffic, a lot of settlement around the area and lack of street lights along the roadways.

Animal that try to cross the road within the hot spots area, more likely will be hit by the moving vehicle on both direction of road. Moreover, the lack of street lights on some part along the roadways will increase the chances of collision between animal and vehicles.

There are two location of hot spots located on Jeli-Gerik road. Figure 4.14 below shows that the hot spots location within Jeli-Gerik roadways.

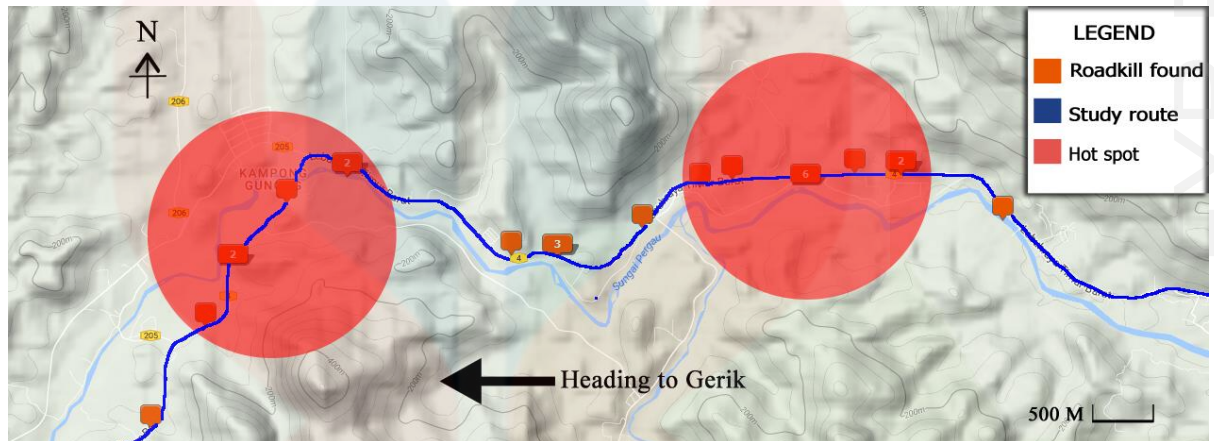


Figure 4.14 Hot spot on Jeli-Gerik road

One of the hot spot is located at Kampung Gunung and the other one is near to a construction site area. These two hot spot location areas are the most frequent collision occurrence between the animal and the vehicle. It is due to the high traffic either during daylight or night time in the village area. Small vehicles are also not excluded in this case because this transport frequently being used by villagers. Moreover, there are heavy vehicles that coming in and out from the construction site area thus make it danger for animal to cross the road.

Furthermore, there are speed limit listed in Table 3.1 along Jeli-Gerik road. When there are less vehicles on the road, some vehicles tends to drive faster more than the speed limit given in the area. This usually happened either in the early morning or late night. This also increasing the chances animal getting hit by moving vehicles.

Figure 4.15 below shows that the hot spot location within Jeli-Rantau Panjang roadways. On the other side of the road, Jeli-Rantau Panjang road. There was one hot spot located on this side of road, located at the junction of the Panglima Bayu area that heading to Rantau Panjang and Tanah Merah. This become a hot spot area because there were many cars coming in and out from Rantau Panjang and Tanah Merah. Although this road leads to the tourist attraction area, Rantau Panjang, it is also frequently being used by the vehicles to travel to Kota Bharu as an alternative route.

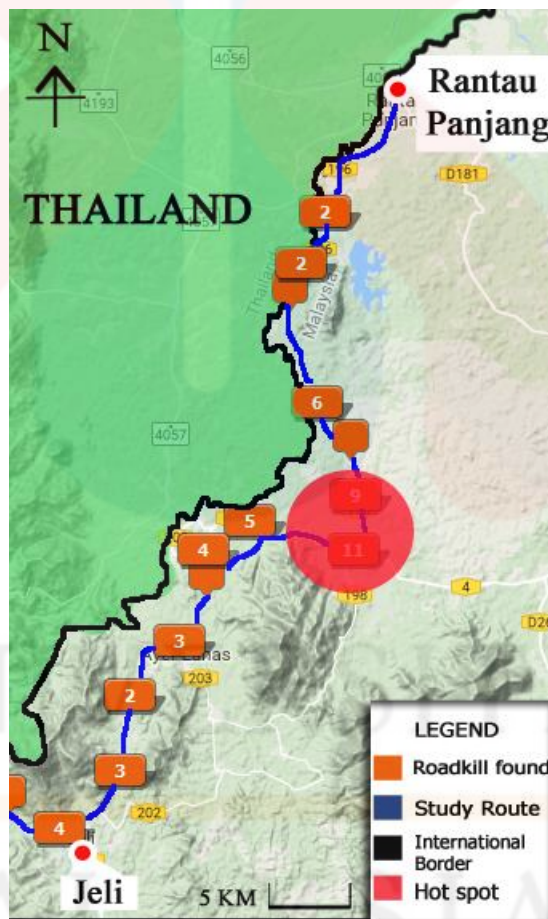


Figure 4.15: Hot spot on Jeli-Rantau Panjang road



Furthermore there were also a residential area located near to the road, so the area were quite populated with people lived there. As the population of people increasing number within the area, the area will crowded with the vehicles used by the people. Increasing of people causes the number of vehicles being used thus increase the chance of collision between the animal and the vehicles.



## CHAPTER 5

### CONCLUSION AND RECOMMENDATION

#### 5.1 Conclusion

The study of roadkill is important to determine the species of animals available in the study area and population decline can be tweaked for the particular animal species if the research is extend for the longer period of time. From six month of data collection, there are 19 species were found dead on Jeli-Gerik while on Jeli-Rantau Panjang, there are 11 species were found dead on the road. The total of roadkills were 101 individuals with 50 individuals dead on Jeli-Gerik while 51 individuals on Jeli-Rantau Panjang.

In this study, on Jeli-Gerik road, the researcher found two rare species which are *Arctictis binturong* (Binturong) and *Helarctos malayanus* (Sun bear) are among the roadkill victim. On IUCN Redlist, both of these animal are catogorized as vulnerable. In Jeli-Rantau Panjang, the researcher found *Rhinosciurus laticaudatus* (Shrew-faced Ground Squirrel), which are listed as nearly threatened species under the IUCN Red List 2016 were among the victim.

There are several factors that may lead to this situation. First, the road surrounding. This maybe because this road is crossing the Titiwangsa Range and surrounded by forest. However in Jeli-Rantau Panjang, domestic animals were usually recorded such as cats, rats, goat and chicken because this site is a settlement and heading to the tourist attraction.

Apart from the time factor, driving recklessly without paying attention to the road and other vehicle, plus driving at high speeds could result fatality. Road development also affects wildlife by altering and isolate the habitat and populations, deterring the movement of wildlife, resulting in a high mortality of wildlife.

## **5.2 Recommendations**

There are several recommendation that can be apply to reduce the rate of wildlife being hit by motorized vehicle. First, make public awareness by posting online and air on radio about the dangerous of hitting wildlife. This could somehow can change the driver behaviour on the road. Moreover, the authorities should make more signage and rumble-strips especially on hot spots where animal tends to cross on the area especially on Jeli-Gerik. Futhurmore, the authorities should install lamp posts along the road because nocturnal animal are likely afraid to cross on bright area. In addition, the installation of electric fences on hot spots could reduce the wildlife to cross the road. The authorities also need to build wildlife for large animal, underpasses and escape routes for small animal corridor on Jeli-Gerik due to many wildlife crossing especially at night.

Maybe there are another more ways to reduce the roadkill that could be listed down. Whatever mitigation measures need to reduce roadkill issue, authorities and analysts ought to use the data created through looking into the reasons and areas for roadkill. It is important for us to understand why, where and how roadkill happened so that research can be done until satisfactory data is accessible to create better mitigation measure.

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