DETERMINATION OF ROAD KILLED ANIMALS ALONG THE ROUTE OF AMANJAYA FOREST RESERVE, GERIK, PERAK.

by

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

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DECLARATION

I declare that this thesis entitled “Determination of Road Killed Animals Along the Route of Amanjaya Forest Reserve, Gerik, Perak”is the result of my own research except as cited in references. The thesis has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

Signature:

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Date: 26/7/2024

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ABSTRACT

Roadways are essential in every country, not only for connecting different locations but also for driving socio-economic development. Despite their benefits to humans, roads have adverse effects on the environment, particularly through the fragmentation of forests. This fragmentation disrupts animal habitats, causing wildlife to wander near roads. This study aims to identify the most common species involved in roadkill incidents in the Amanjaya Forest Reserve, Gerik, Perak. Researchers drove a car at 30 km/h and recorded sightings of dead animals. They photographed each animal and documented its location coordinates. If the animal was in good condition, it was collected for preservation. The survey was conducted over two weeks in May 2024. In total, 41 individuals from 10 species were recorded as roadkill. These species included the Domestic Cat (*Felis catus*), Chicken (*Gallus gallus domesticus*), Common Toad (*Bufo bufo*), Banded Malayan Coralsnake (*Calliophis intestinalis*), Rodent (*Niviventer spp.*), Lace Monitor (*Varanus varius*), Bird But-but Shreds Children (*Centropus sinensis*), Banded Bullfrog (*Kaloula pulchra*), Sunda Flying Lemur (*Galeopterus variegatus*), and Squirrel (*Sciuridae*). Studying roadkill is crucial for understanding the wildlife species in the area. Extending the research over a longer period could provide insights into population trends and help in making informed decisions for wildlife conservation.

PENENTUAN HAIWAN MATI DI JALAN RAYA SEKITAR HUTAN SIMPAN AMANJAYA, GERIK, PERAK.

ABSTRAK

Jalan raya adalah penting di setiap negara, bukan sahaja untuk menghubungkan lokasi berbeza tetapi juga untuk memacu pembangunan sosio-ekonomi. Walaupun memberi faedah kepada manusia, jalan raya mempunyai kesan negatif terhadap alam sekitar, terutamanya melalui pecahan hutan. Pecahan ini mengganggu habitat haiwan, menyebabkan hidupan liar mengembara di dekat jalan raya. Kajian ini bertujuan untuk mengenal pasti spesies yang paling biasa terlibat dalam kejadian mati di jalan raya di Hutan Simpan Amanjaya, Gerik, Perak. Penyelidik memandu kereta pada kelajuan 30 km/jam dan mencatat pemandangan haiwan mati. Mereka mengambil gambar setiap haiwan dan mendokumentasikan koordinat lokasi. Jika haiwan dalam keadaan baik, ia dikumpulkan untuk dipelihara. Kajian dijalankan selama dua minggu pada Mei 2024. Secara keseluruhan, 41 individu daripada 10 spesies telah dicatat sebagai haiwan mati di jalan raya. Spesies ini termasuk Kucing Domestik (*Felis catus*), Ayam (*Gallus gallus domesticus*), Kodok Biasa (*Bufo bufo*), Ular Kaloi Malaya (*Calliophis intestinalis*), Roden (*Niviventer spp.*), Biawak Renda (*Varanus varius*), Burung But-but Carik Anak (*Centropus sinensis*), Katak Belalang (*Kaloula pulchra*), Lenggok Terbang Sunda (*Galeopterus variegatus*), dan Tupai (*Sciuridae*). Kajian kejadian mati di jalan raya adalah penting untuk memahami spesies hidupan liar di kawasan tersebut. Memanjangkan kajian ini untuk tempoh yang lebih lama dapat memberikan pandangan tentang tren populasi dan membantu membuat keputusan yang berinformasi untuk pemuliharaan hidupan liar.

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CHAPTER 1

INTRODUCTION

1.1 Background of study.

The phenomenon of roadkill, wherein animals were struck and killed by vehicles on roads and highways, was indeed a pressing global issue with profound ecological, economic, and ethical implications (Reed et al., 2008). The alarming prevalence of roadkill incidents was a consequence of the ever-expanding human populations and transportation networks, which significantly increased the likelihood of these tragic encounters between vehicles and wildlife (Seiler, 2003). It was essential to recognize that roadkill incidents were not restricted to any particular geographic region; they impacted a wide range of animals, from insects and amphibians to large mammals.

The causes of roadkill were complex and deeply rooted in the rapid expansion of road infrastructure aimed at catering to the needs of our modern world. As roads proliferated and fragmented natural habitats, they created barriers that made it increasingly challenging for animals to safely navigate their traditional territories. High-speed vehicles further exacerbated the problem, as animals often could not react swiftly enough to avoid oncoming traffic, resulting in devastating consequences (Forman and Alexander, 1998). The repercussions of roadkill extended well beyond the immediate loss of animal life. Ecologically, it disrupted food webs and could lead to imbalances in local ecosystems. It directly threatened the survival of many species, including those that were already endangered (Fahrig and Rytwinski, 2009). Economically, roadkill imposed substantial costs on society, including expenses for vehicle repairs, road maintenance, and healthcare for accident victims (Taylor and

Goldingay, 2004). Ethically, it prompted significant ethical questions about our moral responsibility for the well-being of the other creatures that share our planet (Bekoff, 2009).

In this context, comprehending the phenomenon of roadkill was not only crucial for conservationists and wildlife “enthusiasts” but for society as a whole. The ecological implications of our transport networks needed to be given more careful thought, and this problem emphasized the pressing need for long-term fixes that might lessen the negative effects of roads on animals. This introduction set the stage for a more in-depth exploration of roadkill and its multifaceted implications, urging us to reflect on our role in addressing this global challenge.

1.2 Objective.

1. To Determine the most common species involved in roadkill incidents at Amanjaya Forest Reserve,Gerik, Perak.

1.3 Problem statement.

The Amanjaya Forest Reserve area was home to several road-kill occurrences that citizens witnessed, but which were not well documented or analyzed. This was a result of people's ignorance of the significance of road-kill analysis. In response, a study was carried out in the Amanjaya Forest Reserve area to accurately document the incidences of road-kill.

1.4 Scope of study.

This research aimed to examine incidents of animal-vehicle collisions in the Amanjaya Forest Reserve region. Simultaneously, it sought to contribute to the development of targeted road-kill prevention strategies for the particular species inhabiting that specific area.

1.5 Significance of study.

Analyzing roadkill data was crucial to comprehending how roads affected wildlife and enhancing road safety. This research involved collecting data on animals killed on roads, identifying mortality patterns and vulnerable species, and using the information to develop mitigation strategies like wildlife corridors and public awareness campaigns. The ultimate goal was to promote coexistence between wildlife and road infrastructure.

CHAPTER 2

LITERATURE REVIEW

2.1 Wildlife in Malaysia

Exact number species found in Malaysia is still unknown, particularly when it comes to tiny creatures like worms and insects. More than 170,000 species are thought to exist in the nation, according to an estimate. Nevertheless, this is probably a modest estimate, given the possibility of many unidentified species that have not yet been thoroughly investigated. Due to the country's moist tropical climate, which supports the growth and evolution of plants and animals, as well as the variety of its ecosystems, which include rivers, forests, mountains, and seas, Malaysia is home to a large number of species. The woods are quite old; they have been around for about 130 million years, which has allowed for even more evolutionary diversification (NRE, 2006).

2.2 Roadkill

In simpler terms, the issue revolves around animals that have been hit and killed on roads. According to Michael (2004), he emphasizes that larger animals like chimpanzees, tigers, gorillas, and lions are at risk of becoming victims on the roads due to our close interactions with them. Therefore, the concept of roadkill serves as a significant way to understand the intricate dynamics involving humans, animals, and technology (Michael, 2004).

Roadkill incidents are a prevalent issue worldwide, encompassing a wide range of animals from small vertebrates to larger species. In the United States, it has been reported that approximately 500,000 deer fall victim to road accidents each year

(Romin & Bissonette, 1996). This data holds significant importance for researchers delving into animal diversity. The occurrence of roadkill serves as a succinct indicator of the uncertainties within our ecosystems. Nevertheless, the reduction in the scope of coexistence is likely to result in increased adverse consequences (Cronon, 1995).

2.3 Causes of Roadkill

The significant development and human-induced activities have a negative impact on the flora and fauna of the natural ecosystem (Mader, 1984). Animals often face displacement from their natural habitats as a result of human activities and extensive construction projects. Since the 1970s, substantial research has been carried out to examine the impact of constructing transportation networks on wildlife in North America and various European countries. More recent studies have emerged in Spain. Governmental agencies, groups, and environmental associations have all begun to recognise and investigate the significance of these phenomena (Velasco et al., 1992).

Some animals become stuck among human constructions, resulting in the formation of what is referred to as a "habitat island." These creatures have to look for their vital resources in other areas of the forest in order to survive. As such, they frequently pass through areas with roads and wander outside of the forest. According to Rumbulak and Frissel (2000), crashes involving swiftly moving automobiles are the main reason for their deaths on the roads. Larger animals are not the only creatures affected by this threat; small mammals, reptiles, amphibians, birds, and other species are also at risk from car and train accidents (Hodson, 1966).

2.4 Pattern and Distribution

Roads can affect nearby ecosystems in a variety of ways, most notably by changing the make-up of plant communities and the fauna that coexists with them in wetland areas (Atkinson & Cairns, 1992). The most commonly known effect of roads and human transportation is the collision of wildlife (Forman & Alexander, 1998). The act of dividing the natural animal habitats into separate areas due to road construction is referred to as "habitat fragmentation." Furthermore, as highways get wider, animal habitats become even more isolated and population sizes decline.

In addition to seasonal and natural landscapes, the animal patterns and distribution are influenced by environmental factors, impacting composition, abundance, and species mobility, consequently shaping spatial patterns of roadkills throughout different seasons (Miller & Cale, 2000). For instance, moderate temperature regions, during specific seasons, animals may exhibit group behavior or concentrate in particular areas along roads. On the flip side, temperate forests show a documented rise in bird carcasses during the springtime (Taylor & Goldingay, 2004).

2.5 Roadkill Management

The construction of roads can have significant repercussions on wildlife, particularly in the context of roadkill incidents where unintentional collisions with animals occur, creating barriers on road surfaces (Malo et al., 2004).

A thorough comprehension of the underlying reasons for roadkill, based on past incidents, is essential for successful management. This knowledge not only guides governmental expenditure on addressing roadkill issues but also serves as a foundation for preventing future human-animal interactions. Implementing mitigation measures is essential, and these measures should be well-organized, pertinent, and adaptable, facilitating regular monitoring by authorities. Strategies devised should be flexible to accommodate unforeseen circumstances (Briassolis, 1989).

Drawing from past research, several strategies have been identified to alleviate the problem. These include the construction of drains and the clearance of vegetation alongside roads, the implementation of rumble strips, the use of brightly colored pavement, the development of appropriate road alignment, the installation of effective signage, and the initiation of community awareness programs (Lester, 2015).

2.5.1 Applying Rumble Strip

In addition to slowing down vehicles passing through the road, rumble strips also serve to warn nearby animals to stay away from the area and to slow down when they approach a wildlife zone (Lester, 2015). Installing rumble strips on the road leads to a loud sound when vehicles traverse the roadway.

2.5.2 Light Colored Pavement

The majority of wildlife-vehicle crashes happen at night because of the human eye's poor sight, particularly in gloomy and foggy situations. Because they incorrectly believe that the areas next to roads are forests, animals may stray into these areas. This misconception is sometimes ascribed to the fact that some animals have low vision, which makes it difficult for them to distinguish between the forest floor and the road surface (Jones, 2000). One tactic to reduce these crashes is to paint light colors on the asphalt. This will make the road stand out from the surrounding area and possibly make it easier for animals to distinguish between the two. In an effort to stop wildlife from unintentionally wandering into undesirable places, Tasmania has implemented this strategy (Magnus, 2006).

2.5.3 Sign Boards Installation

To provide valid reasons or evidence to support an action, decision, or recommendation. In this context, it means explaining why it is necessary for vehicles to reduce speed to 45 km/h when entering wildlife crossing areas, based on the benefits such as increased safety for both wildlife and drivers, reduced collision impact, and improved reaction time.

2.6 Importance of Road

Roads serve multiple functions, such as making daily commutes to work easier, aiding business travel, and allowing for the transportation of goods. Essentially, roads are built to connect various locations, and they are crucial for a country's development, especially in the business sector. Road transport is often cost-effective, convenient, and safe, making it a vital component of economic growth (SIKA, 2000a, b).

Despite the absence of immediate mortality, roads can function as obstacles for wildlife. Some creatures avoid the disturbances created by moving vehicles, such as noise, lights, and wind flows, while others may face challenges due to alterations in the local microclimate caused by roads, leading to hazardous conditions (Mader, 1984).

While these impacts have significant consequences, the primary concern is that roads can act as barriers, resulting in high mortality for species unable to evade direct collisions with motor vehicles. Whether the effects of roads stem from avoidance behaviors, direct mortality, or a combination of both, they have the potential to diminish population sizes and connectivity for certain species (Forman et al., 2003).

CHAPTER 3

MATERIAL AND METHOD

3.1 Study Area

I carried out this investigation within the Amanjaya Forest Reserve to gather information on roadkill incidents involving animals. Amanjaya Forest Reserve was a protected area located in the Perak state of Malaysia. Spanning "18,866 hectares", the reserve was part of the Central Forest Spine initiative, which aimed to establish a continuous forest network in the central region of Peninsular Malaysia. Figure 3.1 shows the link between the Temenggor Forest Reserve and Royal Belum through this reserve, serving as an ecological corridor facilitating the migration of specific fauna.

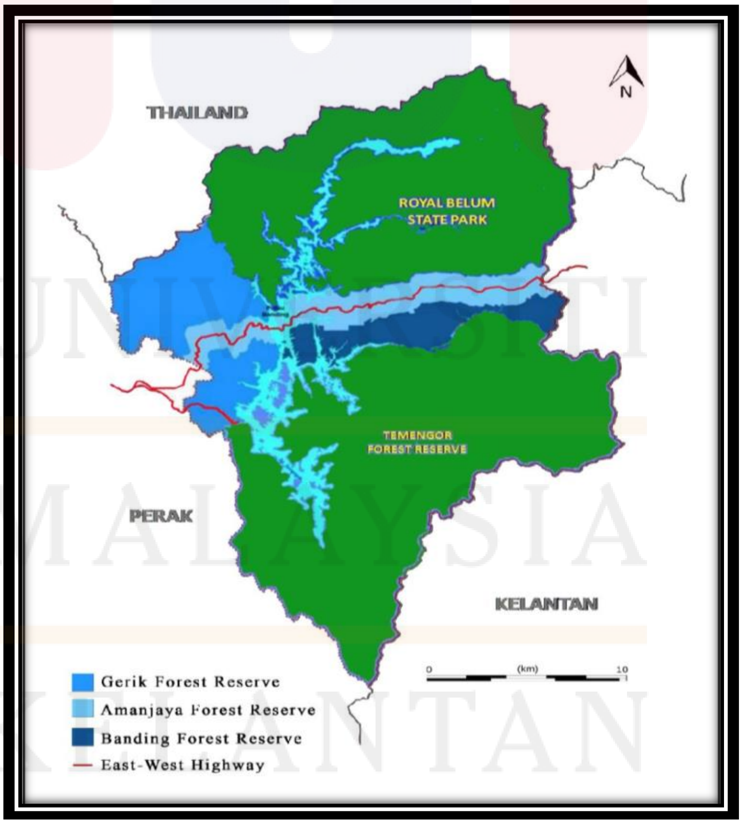

Figure 3.1: Amanjaya Forest Reserve Area

(Source: Google, 2018)

3.2 Material

Researching and mitigating animal roadkill events can benefit greatly from the use of Google Maps. It makes detailed, crowdsourced data collection easier by enabling users to report sightings with exact locations, coordinate, and times. By identifying hotspots and trends through data analysis, tailored mitigation solutions like animal crossings, better signage, and lowered speed limits can be implemented. Using Google Maps extensively makes it possible to gather data continuously and widely. This data may then be used to inform politicians and urban planners when designing infrastructure that takes wildlife safety into account, ultimately lowering the number of animal-vehicle collisions.

3.3 Method

3.3.1 Data Collection

Data collection observations were carried out throughout 2024. During a two-week period, surveys were conducted twice daily, from 8 to 10 A.M. and from 5 to 7 P.M. The surveys involved traveling on a motorcycle at speeds of up to 30 km/h along an 80 km stretch of road.

Upon detecting a roadkill object, we utilized the google maps to record the precise location coordinates. The recorded data included information on non-domesticated reptiles, amphibians, birds, and mammals, detailing both the probable cause of death and the specific location on the road. To prevent double-counting and facilitate identification, photographs of the roadkill victims were taken, and the carcasses were removed from the road surface.

3.4 Data Analysis

3.4.1 Correlation Analysis

Correlation serves as a statistical methodology designed to elucidate the strength and nature of connections between pairs of variables, specifically independent and dependent variables. A robust correlation implies a close association, while a weak correlation suggests a less pronounced relationship. Essentially, it entails examining the vigor of this association through the analysis of relevant statistical data.

3.5 Statistical Analysis

This analysis aims to compare the mean number of animals killed on the road during daytime and evening observations along a specific route within the Amanjaya Forest Reserve, the t-test had been performed. The t-test determined if the data were statistically distinct from one another. The alpha-level is set at 0.05 in order to test the significance.

CHAPTER 4

RESULT AND DISCUSSION

4.1 Categorizing Roadkill Animals by Injury Severity

Roadkill animals can be categorized based on their injuries into three groups: minimal damage, where the animal is largely intact with only minor injuries; severely injured but still recognizable, where the animal has significant injuries but retains recognizable features; and severely damaged and unidentifiable, where the animal is so extensively injured that it's difficult or impossible to identify the species. This classification helps with conservation efforts and facilitates the evaluation of roadkill's effects on animals.

Figure 4.1 shows the example of an animal with the least amount of damage is the Bird But-but Shreds Children (*Centropus sinensis*), which was gathered on May 15, 2024.

Figure 4.2 depicts a severely damaged but still identifiable chicken (*Gallus gallus domesticus*) that was gathered on May 16, 2024.

Figure 4.3 illustrates the animals that were gathered on May 18, 2024, but were so severely damaged that they could not be identified.

4.2 Roadkill Found Along Amanjaya Forest Reserve Road

Table 4.1: Amanjaya Forest Reserve Road's roadkill list

Common Name	Scientific Name	Frequency (morning)	Frequency (evening)	IUCN Status
Cat	*Felis catus domesticus*	1	2	Least Concern
Chicken	*Gallus gallus domesticus*	2	4	Least Concern
Common Toad	*Bufo bufo*	5	8	Least Concern
Banded Malayan coralsnake	*Calliophis Intestinalis*	2	1	Least Concern
Rodent	*Niviventer spp*	2	1	Unknown
Lace monitor	*Varanus Varius*	1	1	Least Concern
Bird But-but Shreds Children	*Centropus Sinensis*	1	0	Least Concern
Sunda Flying Lemur	*Galeopterus variegatus*	1	0	Least Concern
Squirrel	*Sciuridae*	0	2	Least Concern
Banded Bullfrog	*Kaloula pulchra*	2	4	Least Concern
Unknown	Unknown species	1	0	Unknown
Total		18	23	

A total of 10 species were found throughout the survey, including one species that cannot be identifid. The Domestic Cat (*Felis catus domesticus)*, Chicken (*Gallus gallus domesticus*), Common Toad (*Bufo bufo*), Banded Malayan Coralsnake (*Calliophis intestinalis*), Rodent (*Niviventer spp.*), Lace Monitor (*Varanus varius*), Bird But-but Shreds Children (*Centropus sinensis*), Banded Bullfrog (*Kaloula pulchra*), Sunda Flying Lemur (*Galeopterus variegatus*), and Squirrel (*Sciuridae*) are some of these species.

Among the recorded species, Sunda Flying Lemur (*Galeopterus variegatus*) was identified as a rare species. Although it is listed as Least Concern on the IUCN Red List, a carcass of this species was found in May, illustrating that it is still vulnerable to roadkill. Several factors contribute to the Sunda Flying Lemur's susceptibility to road accidents. Habitat fragmentation caused by deforestation and urban development forces these animals to cross roads more often in search of food or suitable living areas. Roads that cut through forests disrupt their natural habitat and increase their exposure to traffic (Clements et al., 2014). Even though Sunda Flying Lemurs are mainly nocturnal, their gliding movements between trees can unintentionally bring them into the path of vehicles, especially in areas where trees are close to roads.

During their nocturnal foraging or dispersal activities, they might not avoid vehicles effectively, particularly when gliding at low heights near roadsides (Rainey et al., 2009). Seasonal behaviors and movements may also play a role in their vulnerability. The carcass found in May suggests there could be seasonal patterns in their movements, possibly linked to breeding or food availability, increasing their chances of crossing roads during certain times of the year (Laurance et al., 2009). In conclusion, the roadkill incident involving the Sunda Flying Lemur highlights the impacts of habitat fragmentation and the challenges these arboreal mammals face due to human-induced environmental changes. Their nocturnal and arboreal nature, combined with expanding road networks in their habitats, raises their risk of roadkill, despite their Least Concern status on the IUCN Red List.

Figure 4.4: Carcass of Sunda Flying Lemur (*Galeopterus variegatus*) was collected on 15 May 2024

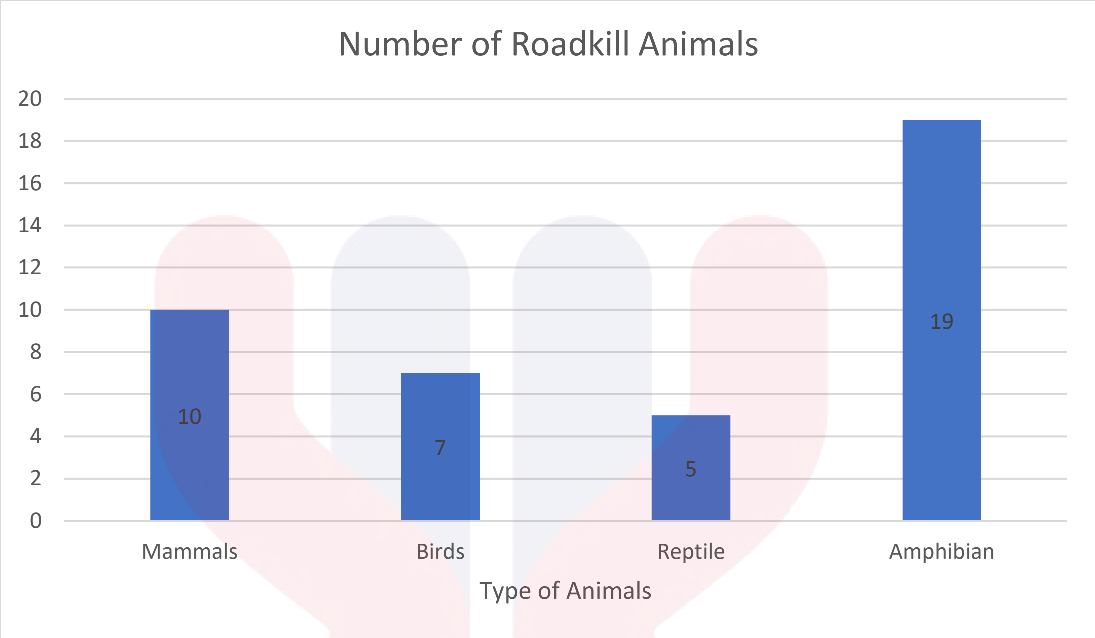

Figure 4.5: Number of roadkill individuals based on animal type

Based on our sampling, a total of 41 roadkill accident cases were detected and recorded. According to the kinds of animals or carcasses discovered on the road, Figure 4.5 displays cases of roadkill. Roadkill numbers are higher in amphibians because of their movement and behaviour habits. During wet seasons, they frequently migrate in huge groups to mating places, greatly increasing their risk of being struck by cars. Their propensity to linger on highways and move slowly make them more vulnerable to roadkill. Roadkill incidents often affect birds since they fly at low altitudes near roadways, particularly during migrations or foraging, and may not be able to quickly alter their flight route to escape swiftly moving automobiles. Despite having different movement patterns, mammals are more visible and easier to avoid than smaller animals because of their bigger size. They are also frequently active during dawn and twilight, when vision is reduced for vehicles. Although reptiles, like snakes and lizards. Typically, reptiles bask on warm road surfaces to maintain body warmth, they are less likely to be involved in traffic accidents since they rarely travel in large groups and rarely cross highways.

The closeness of their habitat significantly influences the rate of roadkill for several animal groups. Road fragmentation is a common habitat for amphibians, who must cross highways frequently to migrate between ponds and marshes on different sides of the roadways. roadways can cross the natural flight patterns of birds, which draw them to the sides of roadways in search of food supplies like insects or small animals. Mammals are better accustomed to avoiding or swiftly crossing highways than humans are, even though they usually reside close to them, especially in grassland or woodland regions. Because their preferred habitats are normally less disrupted by road infrastructure, reptiles are seen near roads less frequently and typically live in locations that receive less vehicle activity.

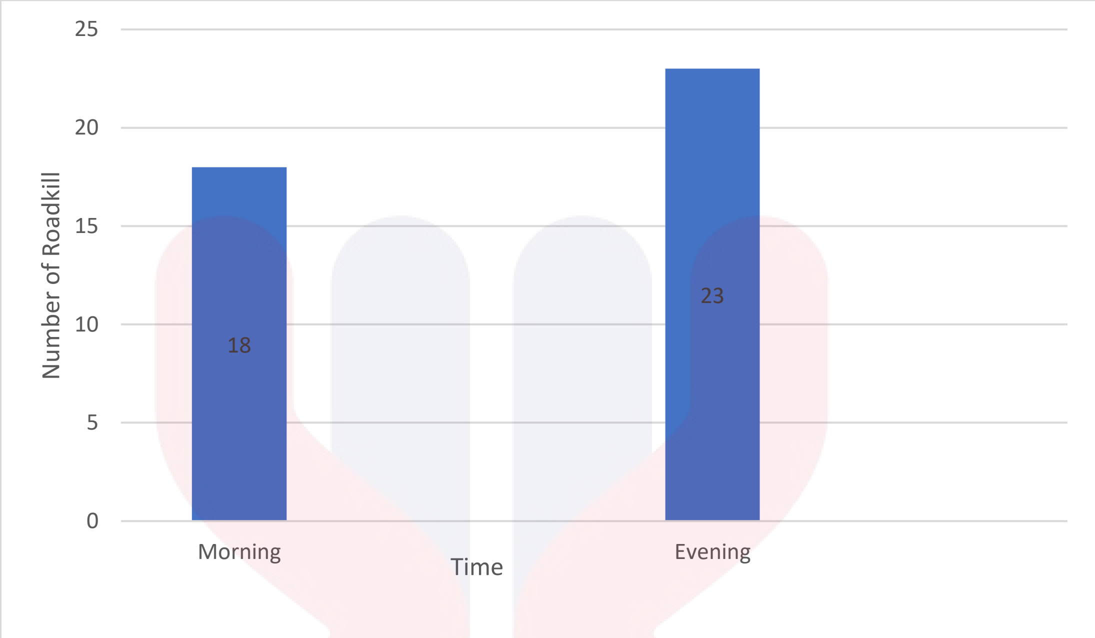

Figure 4.6: Number of roadkill animals in the difference time frame

Figure 4.6 displays the quantity of animals killed by roads in various time periods.There are other reasons connected to animal behaviour and patterns of human activity that can account for the difference in the quantity of roadkill between morning (18) and evening (23). Many animals are crepuscular, meaning they are most active between dawn and dusk. Examples of these creatures are amphibians and mammals. Increased nocturnal activity in animals raises the likelihood of them crossing roads in search of food or during migration, thereby increasing their risk of being hit by cars. Moreover, nighttime rush hour traffic usually consists of more people, which raises the possibility of car and animal collisions. Poor visibility in low-light conditions exacerbates the risk of driving, making it harder for drivers to spot animals on the road, thus heightening the risk of collisions.

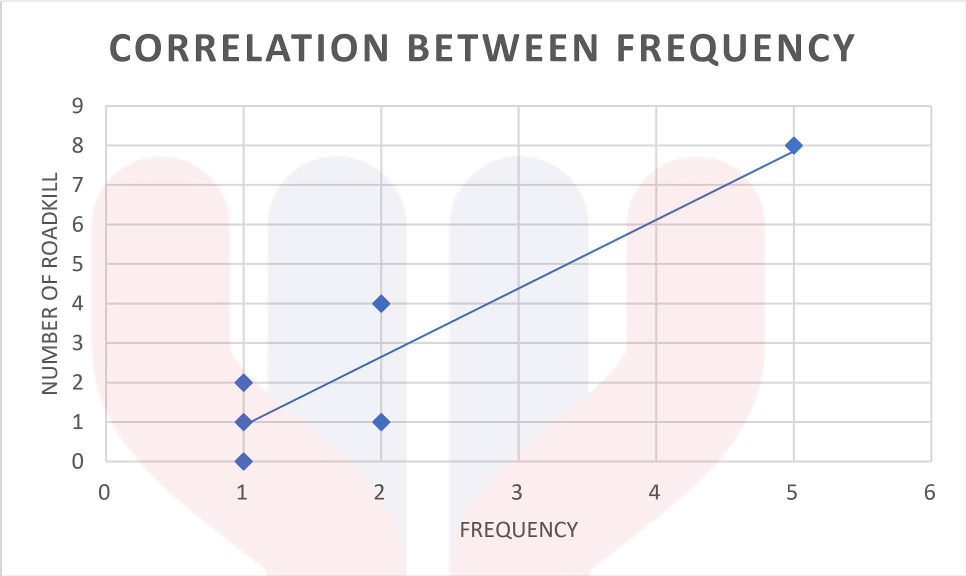

Figure 4.7: correlation between frequency morning and evening

The correlation analysis of the observed species morning and evening frequencies resulted in a coefficient of approximately 0.870049409. This indicates a strong positive correlation between two-time periods, suggesting that these species are commonly observed both in the morning and evening. The strong correlation implies consistent daily activity patterns. This result highlights the close relationship between the species' behaviors at different times of day, providing important insights into their ecological rhythms. Understanding these patterns is essential for developing effective management and conservation strategies, ensuring that these actions are in sync with the species' natural activity cycles. Further investigation into the underlying factors of these activity patterns could offer deeper understanding of the species' behaviors and their interactions with their environments.

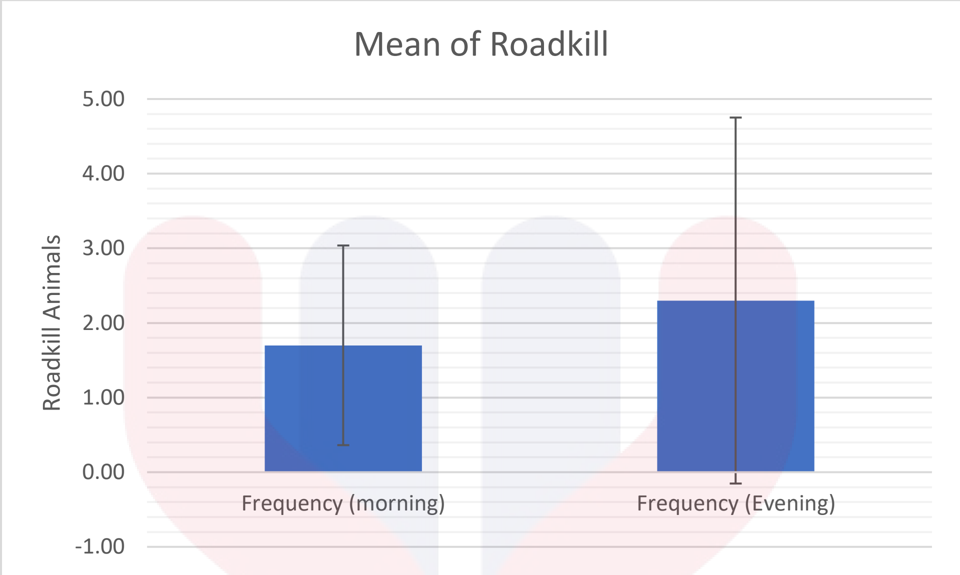

Figure 4.8: Comparing mean of Roadkill Animals

The T-test conducted to compare mean roadkill incident frequencies during morning and evening yielded a p-value of 0.505548941, suggesting that there is no significant difference between two-time periods. This implies that temporal factors alone may not adequately explain the variations in roadkill occurrences. Rather, a deeper understanding of additional factors such as animal behavior, habitat fragmentation, and vehicular traffic patterns is necessary. These results emphasize the importance of conducting comprehensive analyses to uncover the complex factors contributing to roadkill incidents. Such insights are crucial for developing targeted strategies to mitigate roadkill and protect wildlife populations in areas affected by human development. By adopting a holistic approach that integrates ecological research and conservation efforts, we can promote sustainable coexistence between human activities and wildlife habitats while preserving biodiversity in our ecosystems.

4.3 Locations of Roadkill

The roadkill incidents are indicated on the map of the Amanjaya Forest Reserve (Figure 4.9), which is shown in the figure below. There have been 41 cases of roadkill on both sides of the street.

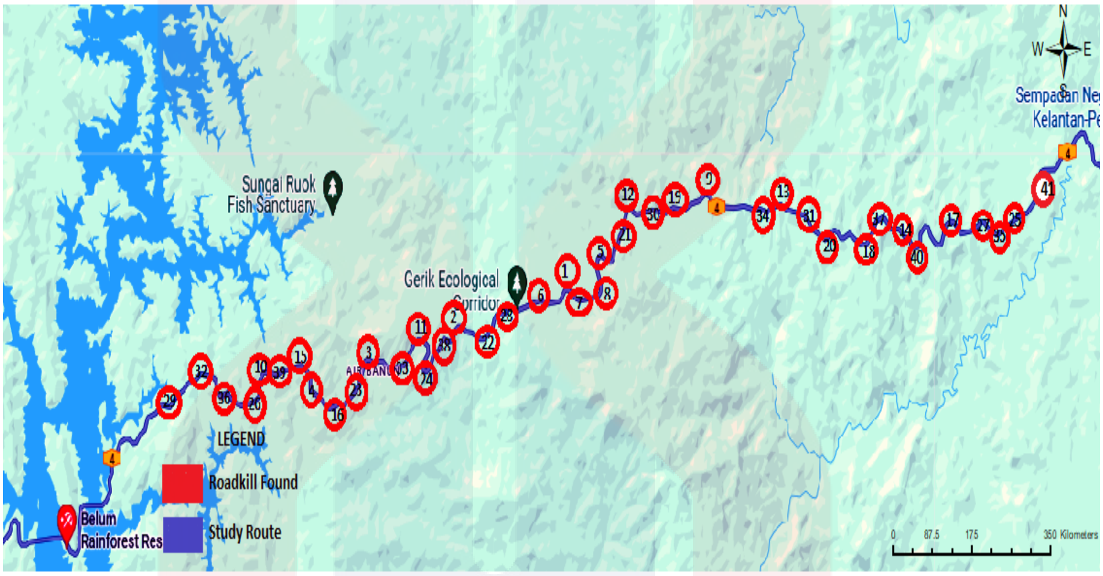

Figure 4.9: Recorded roadkill data on Amanjaya road

The roadkill data recorded on Amanjaya Road shows a notable effect on local wildlife, with 41 incidents reported on both sides of the road. Such a high number of roadkill events can disrupt local ecosystems and endanger various species. Repeated collisions with vehicles may lead to declines in animal populations and disturb ecological balance. Furthermore, these incidents present safety risks for drivers, potentially causing accidents or damage to vehicles. This data highlights the broader implications of road infrastructure on wildlife and emphasizes the need to understand these impacts for improved management and conservation strategies.

Table 4.2: Coordinate Roadkill Animals in Amanjaya Forest Reserve

No	Species	Coordinate
1	Common Toad (*Bufo bufo*)	5.590718, 101.491467
2	Chicken (*Gallus gallus domesticus*)	5.584297, 101.458913
3	Squirrel (*Sciuridae*)	5.577875, 101.431638
4	Cat (*Felis catus domesticus*)	5.572621, 101.414334
5	Rodent (*Niviventer spp*)	5.597140, 101.501439
6	Common Toad (*Bufo bufo*)	5.588383, 101.480909
7	Chicken (*Gallus gallus domesticus*)	5.588967, 101.494693
8	Bird But-but Shreds Children (*Centropus Sinensis*)	5.590135, 101.500852
9	Banded Bullfrog (*Kaloula pulchra*)	5.609107, 101.532820
10	Rodent (*Niviventer spp*)	5.575540, 101.400550
11	Common Toad (*Bufo bufo*)	5.581378, 101.446008
12	Sudan flying Lemur (*Galeopterus variegatus*)	5.606188, 101.510237
13	Banded Malayan coralsnake (*Calliophis Intestinalis*)	5.607356, 101.555110
14	Rodent (*Niviventer spp*)	5.602394, 101.590597
15	Banded Bullfrog (*Kaloula pulchra*)	5.576708, 101.412281
16	Chicken (*Gallus gallus domesticus*)	5.568826, 101.419906
17	Common Toad (*Bufo bufo*)	5.603853, 101.605848
18	Common Toad (*Bufo bufo*)	5.599183, 101.580625
19	Banded Bullfrog (*Kaloula pulchra*)	5.606188, 101.523435
20	Chicken (*Gallus gallus domesticus*)	5.600059, 101.568307
21	Banded Bullfrog (*Kaloula pulchra*)	5.600059, 101.507011
22	Common Toad (*Bufo bufo*)	5.581670, 101.466245

23	Common Toad (*Bufo bufo*)	5.571454, 101.428118
24	Banded Bullfrog (*Kaloula pulchra*)	5.575540, 101.449528
25	Cat (*Felis catus domesticus*)	5.604437, 101.626377
26	Lace monitor (*Varanus Varius*)	5.570286, 101.398203
27	Chicken (*Gallus gallus domesticus*)	5.603561, 101.615819
28	Common Toad (*Bufo bufo*)	5.585776, 101.472779
29	Lace monitor (*Varanus Varius*)	5.569064, 101.371989
30	Squirrel (*Sciuridae*)	5.605967, 101.516527
31	Banded Malayan coralsnake (*Calliophis Intestinalis*)	5.604600, 101.562533
32	Common Toad (*Bufo bufo*)	5.575215, 101.381258
33	Banded Bullfrog (*Kaloula pulchra*)	5.577948, 101.443400
34	Chicken (*Gallus gallus domesticus*)	5.605284, 101.551203
35	Cat (*Felis catus domesticus*)	5.601183, 101.620211
36	Common Toad (*Bufo bufo*)	5.571456, 101.387095
37	Common Toad (*Bufo bufo*)	5.604258, 101.584849
38	Banded Malayan coralsnake (*Calliophis Intestinalis*)	5.581707, 101.454386
39	Common Toad (*Bufo bufo*)	5.574873, 101.404604
40	Common Toad (*Bufo bufo*)	5.598450, 101.596178
41	Unknown (*Unknown*)	5.612543, 101.633977

4.4 Hot Spot of Roadkill

Hot spots are areas of a road where there is a higher average frequency of roadkill. Below, Figure 5.0 displays the hot places on the road.

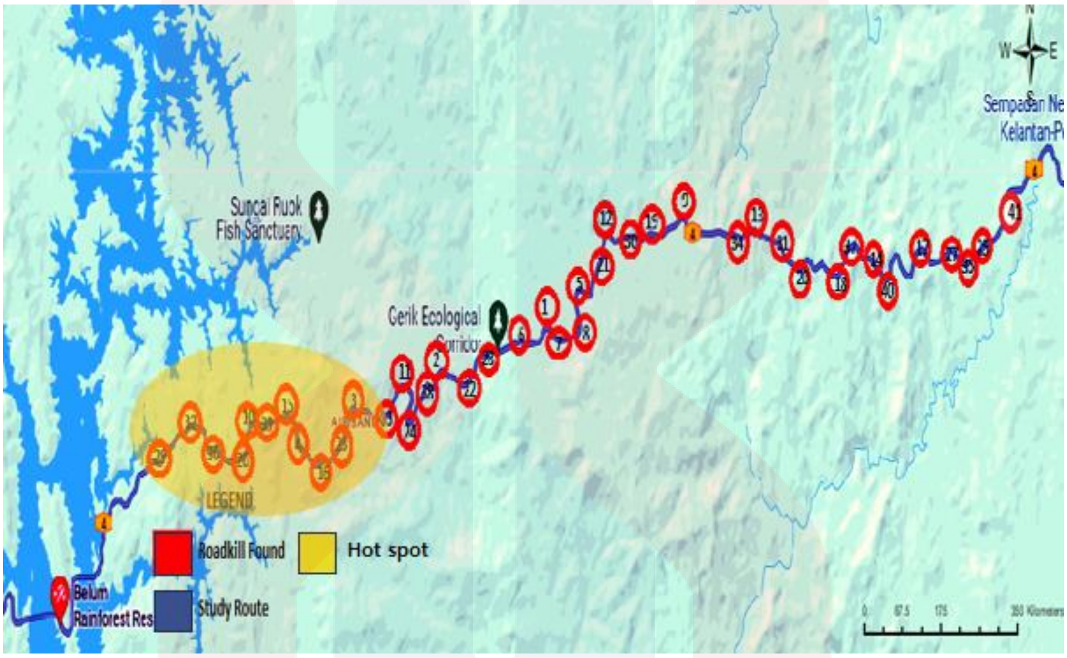

Figure 5.0 Hot spot of roadkill

After the survey is over, hotspots where roadkill has been found have been identified. There is one primary hot spot position on either side of the road, as depicted in figure 5.0. There were four primary.The area's hot spots are caused by a number of factors, including heavy traffic, dense habitation, a deficiency of street lights along the roads, and proximity to wetland areas.

Animals attempting to cross the road in a hot spot area are more likely to be struck by oncoming traffic in both directions. Furthermore, there will be a higher likelihood of collisions involving vehicles and animals if certain areas of the roadways lack street lights.

CHAPTER 5

CONCLUSION AND RECOMMENDATION

5.1 Conclusion

Investigating roadkill incidents are vital for understanding the species inhabiting a region and tracking their population changes. Through short-term data collection, effective conservation measures can be tailored for the impacted species. During a 14-day observation on the Amanjaya Forest Reserve road, researchers recorded roadkill involving ten different animal species, amounting to 41 fatalities. Morning counts totaled 18, while 23 were recorded in the evening. Importantly, this study discovered that the common species, Common Toad (*Bufo bufo*), was among the most frequently killed by cars. Despite being classified as a Least Concern species by the IUCN Red List, this species' existence as a roadkill victim is remarkable. Among the roadkill was also a rare species, the Sunda Flying Lemur (*Galeopterus variegatus*), which is classified as Least Concern on the IUCN Red List.

Several factors contribute to roadkill incidents in this area. The road traverses the Titiwangsa Range and forests flank it, increasing wildlife encounters. Additionally, the Amanjaya Forest Reserve area, being close to settlements and tourist attractions, sees domestic animals like cats, common toads, and chickens on the road. Human behaviors, such as reckless driving, inattention, and speeding, further exacerbate the issue. Moreover, road development disrupts and "Fragments: Habitats", hindering animal movement and increasing wildlife mortality. A comprehensive approach, including better road design and traffic regulations, is necessary to reduce the impact on local wildlife.

5.2 Recommendations

There exist multiple recommendations that can be implemented to mitigate the frequency of animal collisions with motorised vehicles. First, raise public awareness of the dangers of striking wildlife by posting information online and airing radio ads. This could potentially alter how drivers behave when driving. Certainly, the authorities should prioritize installing more rumble strips and signs, especially in high-traffic areas where animals frequently traverse, such as the Amanjaya Forest Reserve. Furthermore, as nocturnal animals are probably scared to cross in bright areas, the authorities ought to put lampposts along the road. Furthermore, putting up electric fences on hotspots may discourage wildlife from crossing the road. The Amanjaya Forest Reserve has a lot of wildlife crossings, especially at night, therefore the authorities also need to construct wildlife for large animals, underpasses, and escape routes for small animals. Perhaps there are more strategies that might be mentioned in order to lessen the amount of roadkill. Authorities and analysts should make use of the data generated by investigating the causes and locations of roadkill in order to reduce the issue of roadkill. We must comprehend the where, when, and how of roadkill in order to conduct study and develop better mitigation measures till sufficient data is available.

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