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MALAYAN TAPIR ROADKILL: ASSESSMENT TOWARDS ROAD USER AND MITIGATION STRATEGIES

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Abstract

Biodiversity conservation has become one of the key components in the Sustainable Development Goals (SDGs) agenda. In line with Goal 11 towards sustainable cities and communities and Goal 15 for life on land, the conflict between animals and humans must be reduced. Persisting the development of infrastructure and urbanization, animals, particularly the Malayan Tapir, have been on the brink of extinction as their numbers have been depleted due to roadkill. These animals need to migrate in search of food and shelter. However, deforestation and land conversion into highways and buildings make it challenging for them to survive. This study investigated the road user awareness and perception of Malayan tapir roadkill and strategies for mitigation among villagers in Felda Bersia, Perak. From the results, deforestation and illegal logging are the leading causes of roadkill, with a mean value of 4.36. Later, road user attitudes and awareness are the most significant factors, as 95.3% of respondents need more understanding of preserving the Malayan Tapir from roadkill, by which the preservation methods scored an overall mean value of 4.19. Therefore, it evaluated the effectiveness of the management approaches in reducing roadkill, focusing on road users' viewpoints and preferences. Mitigation options included identifying roadkill hotspots and maintaining more fences. These findings will aid in guiding the conservation efforts and upgrading the development of targeted strategies to protect the Malayan tapir population. Moreover, by engaging with local communities and incorporating road user perspectives, this outcome would later promote a collaborative approach to safeguarding this endangered species from becoming extinct.

Keywords*: Extinction; Biodiversity Conservation; Malayan Tapir; Roadkill; Road-user; Mitigation measure*

Introduction

Malaysia's rapidly developing urban and suburban environment has affected the fauna space and other aspects of the environment. Urbanization is one of the major causes of habitat destruction, where a large population practices agriculture or industries that affect the natural environment, thus reducing the size of this region. Animals moving around to find shelters and

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food will find it difficult due to the expansion and development in their niche or habitat [1]. This urban expansion increases the likelihood of encounters between animals and people due to increasing traffic and road users. This has particularly impacted the wildlife species, especially the Malayan tapir, which has been known to be endangered since 1986 [2] and is protected under Schedule 2 of the Wildlife Conservation Act 2010. The International Union for Conservation of Nature Red List of Threatened Species classifies it as "Endangered" [3].

Malaysia's Department of Wildlife and National Parks (PERHILITAN) reported that 26 tapirs were killed by vehicles in 2017 and 2,444 wild animals died due to roadkill between 2012 and 2017. Forest fragmentation disrupts large mammals like elephants, Malayan gaurs and Malayan tapirs and roads impede animal mobility through collisions and habitat fragmentation. Preserving the Malayan tapir species is challenging due to their slower reproduction and pregnancies lasting up to 14 months. According to PERHILITAN data, the highways connecting Pekan, Kuantan in Pahang and Kuala Terengganu data showed that Terengganu has the highest frequency of Malayan tapir roadkill [2]. Most of the Malayan tapir roadkill occurred at night. The Malayan tapir is mostly nocturnal, with most of its activities occurring at night. Studies show that Malayan tapirs are most active between 8p.m. and 4a.m., with peak activity occurring around midnight. During the day, Malayan tapirs usually relax in lush vegetation or wallow to avoid the heat, thus increasing the possibility of being hit by vehicles at night. According to [3], determining the exact time of the collision at night was difficult due to the report or roadkill evidence being mostly discovered the next day. However, the number of Malayan tapirs killed differs according to the wet and dry season. The figures were higher during the dry season than the wet season, though this was not statistically significant due to limited data [4]. A higher rate of Malayan tapir roadkill in Peninsular Malaysia during the dry season is related to Malayan tapir movement in search of water during the dry season [5]. It has been discovered by [6] that the season significantly impacted the number of reptiles killed on the road, with more being killed during the wet season compared to the dry season. It contrasts with the Malayan tapir as different species have diverse behaviours in finding food and shelter.

The study points out a major gap in research, which has led to the Malayan Tapir roadkill as Malaysia's rapid urbanization has fragmented forests, affecting the biodiversity of the forest ecosystem. It has led to the loss of natural habitats for flora and fauna, some of which are endangered or on the extinction list, specifically Malayan tapir. The authorities must protect this endangered Malayan tapir species and conserve the forest biodiversity ecosystem. This development, combined with illegal poaching, significantly threatens wildlife populations, particularly the Malayan tapir, which has seen a rise in roadkill incidents.

For example, a study indicated that roadkill incidents involving tapirs have increased by over 50% in the last decade [4]. As a result, animal-vehicle collisions have steadily increased over the decades, posing a threat to the critically endangered Malayan tapir population. Wildlife roadkill can cause huge losses, especially for endangered creatures like the Malayan tapir and Malayan tiger, which can only be found and available in Malaysia [7].

The most obvious detrimental impact of roads on wildlife is casualties caused by wildlife-vehicle collisions (WVCs), which occur because of forest fragmentation for agricultural and infrastructure purposes. Human-wildlife conflict (HWC) is anticipated to rise due to population growth and habitat disturbance [8]. It is already prevalent in urban, suburban and rural regions [9]. About 475 million animals die from roadkill in Brazil each year, underscoring the seriousness of the problem globally [10]. Hence, it is vital to safeguard endangered animal species and conserve forest biodiversity. Forest fragmentation, road construction and illegal poaching threaten wildlife populations, particularly the Malayan tapir, leading to increased roadkill incidents and threats to wildlife.

PERHILITAN recorded between 2016 and 2021 about 2,562 occurrences of wildlife roadkill overall, whereas Pahang had the largest animal roadkill, with 755 incidents, accounting for 29.5% of all cases [11]. A lack of knowledge among road users and insufficient involvement of stakeholders hinders Malaysia's efforts to protect Malayan tapir species from roadkill. Furthermore, more research must be done on Malayan tapir species' roadkill incidents in Malaysia [12]. Roadkill studies for wildlife-endangered species in Peninsular Malaysia still need to be improved because there is no specific data on the remaining populations of these wildlife-endangered species in Peninsular Malaysia, particularly the Malayan tapir. There has yet to be any publication of scientific information about animal roadkill in Malaysia or the causes that may have triggered the incidents [4,5]. Such data is typically presented in the form of monthly or annual reports. Several research studies have published articles on wildlife roadkill occurrences in Peninsular Malaysia over the last five years [3-5].

It can be denoted that the total number of Malayan tapir roadkills was 68 from 2012 to 2017 [5]. Primarily, wildlife crossings in Malaysia are situated in Hulu Terengganu in Terengganu, Kuala Lipis in Pahang, Seremban in Negeri Sembilan and mostly in Hulu Perak, Perak [5]. Therefore, this research was conducted to investigate the road user awareness and perception of Malayan tapir roadkill and strategies for mitigation among villagers in Felda Bersia, Perak, because the wildlife crossing is mainly situated in Hulu Perak. Moreover, the study aims to address the problem among road users and highlight the mitigation options. Later, identifying roadkill hotspots and maintaining more fences aided conservation efforts to protect the Malayan tapir population.

Materials & Methods

Study location

This study investigates road users in Kampung Felda Bersia, near the Gerik-Jeli Highway, in preserving Malayan tapirs from roadkill. The village, located 12 kilometres from Gerik town, has an estimated population of around 2500 people. The study aims to understand road users' perceptions and awareness of the matter at hand. The area was chosen due to the Malaysian Wildlife Department's report on animal sightings.

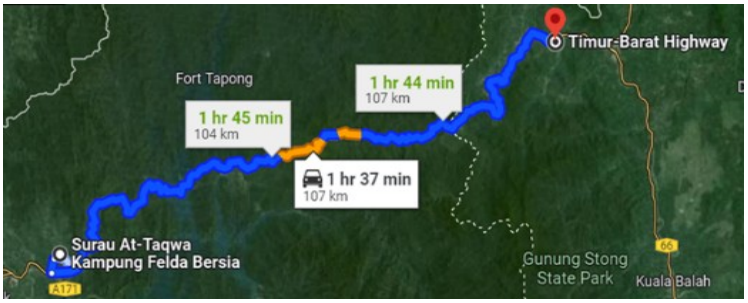

Fig. 1. Gerik-Jeli Highway (East-West Highway) from Kampung Bersia with a total of 107km

Participation of Target Respondents

This study targets road users in Felda Kampung Bersia who use the Gerik-Jeli highway to complete a survey using Google Forms. It will apply quantitative and qualitative methods, such as creating questionnaires in Google Forms. The aim is to determine respondents' awareness level in protecting the Malayan tapir population, thus deciding the optimum

approach to minimize roadkill for this species. About 106 respondents answered the survey questions using the Google Form data extracted in Excel.

Research instruments and procedures

This research study focuses on the Malayan tapir, a wildlife-endangered species and their extinction. A four-week survey was conducted to gather data on road users' awareness of preserving the species and their perceptions of factors contributing to its extinction. The questionnaire used dichotomous survey questions and the 5-point Likert scale to assess respondents' knowledge and awareness.

The questionnaire consists of four sections: A, which asks respondents about their background, education level, occupation and occupation sector; B, which questions respondents about their knowledge of the Malayan tapir species and their awareness of the need to protect it; and C, which questions respondents about factors influencing the death rate of Malayan tapir due to roadkill and their best method to reduce it.

The chi-square was used to identify the relationship between road user awareness and factors contributing to roadkill. The study aims to comprehensively understand road users' compliance behaviour in preserving the Malayan tapir. The Chi-square test is a non-parametric statistic used to test a hypothesis about the distribution of a categorical variable. It is used when the data is measured at the nominal or ordinal level, the sample sizes are unequal, the original data violates parametric test assumptions, or the data is compacted into a small number of categories. The test is particularly useful in determining if road user awareness in protecting Malayan tapir endangered species contributes to roadkill.

Thematic Analysis

Thematic analysis is a method of analyzing qualitative data, which is usually applied to a set of texts, such as an interview or transcripts. Therefore, researchers closely examine the data to identify common themes. Conducting thematic analysis, which is mostly a common form, follows a six-step process: familiarization, coding, generating themes, reviewing themes, defining and naming themes and writing them up [13].

Results and discussion

This section represents the results on the Malayan tapir, focusing on demographic profiles, knowledge of the species, factors contributing to wildlife roadkill and measures to reduce it, using statistical descriptions and inferential analysis.

Demographic profile

The study reveals a gender distribution of 71.7% females and 28.3% males (table 1), with a majority aged between 18-25. The education level distribution is 2.8%, with 21.7% having a diploma, 67% having a degree and 8.4% having a master's degree. The job sector distribution is 34.9% in the government sector and 65.1% in the private sector. The occupational requirement to travel is 54.7%, with 45.3% not required. The frequency of travel requirements varies, with 34% requiring travel often, 19.8% intermediate and 12.3% rare.

Road-user knowledge about the endangered Malayan tapir species

The study reveals that 91.5% of respondents know the Malayan tapir is an endangered species, while 73.6% recognize its significant role in the ecosystem (table 2). This high awareness is crucial for conservation efforts, leading to greater support for protective measures. Public awareness is a key factor in the success of conservation efforts, as well-informed individuals are more likely to engage in activities that contribute to preserving endangered species. For instance, *Keller et al*. [14] notes that awareness campaigns can significantly enhance public understanding and attitudes towards endangered species, leading to more robust conservation actions.

Table 1. Demographic profiles of the respondents

Gender	**Frequency**	**Percentage (%)**
Male	30	28.3
Female	76	71.7
Age	**Frequency**	**Percentage (%)**
18-25 Years Old	15	14
25-35 Years Old	63	59.4
36-45 Years Old	16	15.1
46-60 Years Old	12	11.3
61 Years Old	1	0.9
Education Level	**Frequency**	**Percentage (%)**
Highschool	3	2.8
Diploma	23	21.7
Degree	71	67.0
Master and above	9	8.4
Working status	**Frequency**	**Percentage (%)**
Yes	89	84
No	17	16
Job Sector	**Frequency**	**Percentage (%)**
Government	37	34.9
Private	69	65.1
Occupation travelling status	**Frequency**	**Percentage (%)**
Yes	58	54.7
No	48	45.3
Frequency of travel required while working	**Frequency**	**Percentage (%)**
Often	38	36
Intermediate	21	19.8
Rarely	13	12.3

Table 2. Knowledge of road users about the endangered Malayan Tapir species

Do you know is an endangered species in Malaysia		
	Frequency	**Percentage (%)**
Yes	97	91.5
No	9	8.5
Do you know that Malayan tapir plays a significant role in our ecosystem?		
	Frequency	**Percentage (%)**
Yes	78	73.6
No	28	26.4

Factors contributing to the Malayan tapir roadkill

Table 3 reveals factors contributing to wildlife roadkill, with the highest mean being excessive deforestation and illegal logging, with a value of 4.36. Rapid infrastructural development and agricultural land use also contribute to deforestation and illegal logging (4.23). The increasing number of vehicles on the road and road-user attitudes also contribute to wildlife roadkill (3.87 and 3.77). These factors align with various studies and contribute to the decline of the Malayan tapir species. Excessive deforestation and illegal logging, rapid infrastructural development and land use for agriculture, the increasing number of vehicles on the road and road-user attitudes all contribute to wildlife roadkill factors, aligning with various studies.

It has been emphasized by *E. Berenguer et al.* [1] that deforestation alters natural wildlife habitats, which can alter species' migration patterns and make them more vulnerable to the risk of extinction or road collisions due to land manipulation. Loss of forest cover reduces the preferred habitat for tapirs and causes other animals to be trapped in more encroached areas and high human densities, leading to a higher risk of human-wildlife conflicts. Previous studies have also shown that infrastructure projects and agricultural expansion are common causes of

deforestation, impacting wildlife movement patterns and the likeliness of roadkill for animals [8, 9, 15].

Deforestation for agriculture and urbanization interfere with natural habitats, driving up the likelihood that native wildlife will be hit by vehicles. Additionally, road networks and vehicle traffic also contribute to wildlife-vehicle collision risks, which have impacts globally; with many species suffering from habitat loss and fragmentation, the expansion of road networks and vehicle use increases wildlife-vehicle collision risks, impacting wildlife populations globally due to habitat loss, fragmentation and direct mortality [16]. A study by *A. Norshaqinah et al*. [17] highlights that road-user attitudes and behaviours significantly influence wildlife mortality on roads. It also highlighted that the best way to decrease wildlife-vehicle incidents is for drivers to be more courteous and adjust their driving habits [17].

Table 3. Factors contributing to the Malayan tapir roadkill

Items	Mean	Std. Deviation
Do you agree that excessive deforestation and illegal logging are the biggest threats to this Malayan tapir species?	4.36	1.053
Do you agree that rapid infrastructural development and land use for agriculture contribute to deforestation and illegal logging?	4.23	1.054
Do you agree that increasing the number of vehicles on the road contributes to this Malayan tapir roadkill?	3.87	0.916
Do you agree that road-user attitudes contribute to this Malayan tapir roadkill?	3.77	0.998
Total	4.06	0.834

Road-User view on awareness and method to preserve the Malayan tapir species

Table 4 shows that 61.3% of respondents have not heard of any awareness campaign to conserve the Malayan Tapir species. Most respondents saw the campaign through articles, malls, news, road signs, schools and website ads. Despite this, 95.3% of respondents believe road users still need to be more understanding about preserving the Malayan Tapir from roadkill. Raising awareness among public road users is also considered necessary.

Table 5 shows the awareness of the preservation of Malayan tapir species, with an overall mean of 4.19. The highest mean value is for government awareness campaigns, government intervention and the use of AI. The respondents' level of agreement and awareness of measures to preserve the species is high, with a mean of 4.31 and a standard deviation of 0.844. Government intervention, awareness campaigns towards public and road and AI (artificial intelligence) assistance are all important measures that help raise public awareness to preserve Malayan tapir species; these findings align with previous studies.

Studies by *V. Gopalakrishnan et al*. [18] emphasize the importance of getting effective governance and policy frameworks for biodiversity conservation. Government support can supply the tools and regulations needed to operationalize conservation strategies, ensuring long-term success. Government and public support through awareness campaigns are also necessary to encourage behaviour change toward conservation aspirations.

Research by *S. Keller et al*. [14] further highlights the capacity of awareness campaigns to influence public knowledge, attitudes and behaviours about conservation. These campaigns can mobilize public support and action for wildlife protection. It highlighted that using several media channels, education programs and campaigns focused on community outreach can gain public support for wildlife conservation efforts.

Integrating AI technologies in conservation efforts has also shown promise in enhancing monitoring, data analysis and predictive modelling for wildlife management [19]. It can help to track wildlife movements, identify habitat threats and even predict potential conflict in roads where tapirs are at risk of being hit by vehicles. According to *A. Raihan* [20], AI and machine

learning algorithms allow for analyzing big data sets, providing real-time information on ecological trends and threats. AI can automate habitat mapping and species monitoring, allowing conservationists to apply the best practices.

Table 6 outlines methods to preserve Malayan tapirs in Malaysia, including increasing public road-user awareness, identifying roadkill hotspots, increasing signage, installing fencing, implementing wildlife overpasses and increasing camera trapping to monitor movement. 51.9% of respondents agreed.

Table 4. Awareness level for the conservation of the Malayan tapir species

Have you ever heard of or seen awareness campaigns on preserving the Malayan tapir from roadkill in Malaysia?		
	Frequency	Percentage (%)
Yes	41	38.7
No	65	61.3
If your answer to the above question is YES, please state where you have seen the awareness campaign		
	Frequency	Percentage (%)
Article	2	1.9
Mall	8	7.5
News	14	13.2
Road sign	1	0.9
Scholl/institution	4	3.8
Website Ads	13	12.2
Is there still a lack of understanding among road users about preserving the Malayan tapir from roadkill?		
	Frequency	Percentage (%)
Yes	101	95.3
No	5	4.7
Is raising awareness among public road users necessary to protect the Malayan tapir species?		
	Frequency	Percentage (%)
Yes	102	96.2
No	4	3.8

Table 5. Awareness to preserve Malayan tapir species.

Awareness to Preserve Malayan tapir Species		
	Mean	Std. Deviation
Do you agree that government intervention is needed to raise road users' awareness of the need to conserve the Malayan tapir species?	4.26	0.898
Do you agree that the government and local authorities should conduct more awareness campaigns for the public and road users to preserve the Malayan tapir species?	4.31	0.844
Do you agree that AI (artificial intelligence) can help raise awareness among the public and road users?	4.03	0.871
Total	4.19	0.777

Table 6. Methods to preserve Malayan tapir.

Methods to Preserve Malayan tapir		
	Frequency	Percentage (%)
Local authorities need to increase awareness among public road-user	55	51.9
Identify roadkill hotspot for Malayan tapir in Malaysia	67	63.2
Increase more Malayan tapir signage on specific roads that often been used by them	61	57.5
Installing more and maintaining fencing to preserve this wildlife species	59	55.7
Implement more wildlife overpasses in Malaysia	32	30.2
Increasing more camera trapping to monitor Malayan tapir movement	21	19.8

The relationship between road user perception and awareness in preserving Malayan tapir roadkill

Table 7 reveals no significant relationship between road user perception and awareness in preserving Malayan tapir roadkill, $p > 0.05$. As no correlation between road user knowledge of the Malayan tapir's role in the ecosystem and factors contributing to roadkill, with a p-value of 0.569, indicating limited association concerning to the variables being studied. It can be further explained by behavioural science models such as the Theory of Planned Behaviour, which shows that behaviour is determined by attitudes, subjective norms and perceived behavioural control rather than knowledge alone [16, 17]. Road users may have different attitudes towards wildlife pursuits, subjective norms that contribute to pressures created by societal expectations, or perceived control over their driving behaviour to wildlife crossing areas [17]. The need for more relationship between drivers' knowledge about the conservation status of Malayan tapir and their role in roadkill provides an example of how difficult it is to explain human-wildlife interaction issues on roads.

Table 7. The relationship between road user perception and awareness in preserving Malayan tapir roadkill

Relationship between road user knowledge of "Malayan tapir is an endangered species in Malaysia" and factors contributing toward roadkill.			
	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	8.496a	13	0.810
Likelihood Ratio	9.123	13	0.764
Linear-by-Linear Association	.045	1	0.831
N of Valid Cases	106		
a. 20 cells (71.4%) have an expected count of less than 5. The minimum expected count is .08.			
	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	11.503a	13	0.569
Likelihood Ratio	14.278	13	0.355
Linear-by-Linear Association	.380	1	0.537
N of Valid Cases	106		
a. 19 cells (67.9%) have an expected count of less than 5. The minimum expected count is .26.			

Methods of raising awareness among road users to protect Malayan tapir species

Using thematic analysis of the qualitative data, a few sub-themes of methods for raising awareness among road users to protect Malayan tapir species have been identified. Infrastructure solutions involve physical interventions to enhance road safety and security for tapirs crossing. These include wildlife overpasses, natural landscape corridors and road safety measures like speed bumps and better lighting on rural roads (Table 8). The study by *L. Brennan et al*. [21] proved that constructing wildlife overpasses effectively reduces wildlife-vehicle collisions and enhances habitat connectivity for various species.

Moreover, *Kuldeep et al*. [22] state that speed-calming measures like speed bumps and rumble strips effectively reduce vehicle speeds on rural highways, especially in critical areas where speed reduction is crucial; this will significantly help to avoid wildlife-vehicle collisions on the road. Besides, the study suggests a focus on public awareness and education about conserving tapirs, with a preference for digital campaigns, billboards and influencers and integrating conservation issues into school curricula.

The study by *S. Shan et al*. [23] has proved that social media campaigns have significantly influenced the public's wildlife awareness as social media somewhat affects reader behaviours. Social media plays a significant role in raising awareness among the public due to its widespread influence on reader behaviour and its ability to reach a wide and diverse audience quickly.

Moreover, education is important to developing children's knowledge of wildlife. According to *G. Rehman et al*. [24], awareness and understanding of wildlife enrichment should be provided from the initial stages. A lack of awareness of its wildlife resources may lead to losing one of its richest biological treasures. Doing so will indirectly educate future generations at a very young age about wildlife conservation by creating habits to connect to the natural environment. The finding emphasizes the need for increased law enforcement and proactive measures to protect road safety and minimize wildlife-vehicle conflicts, such as increased speed limits and road signs warning drivers of potential tapir crossings. It can be found that reflective wildlife crossing signs have shown a significant reduction in speed in the area. Moreover, installing the reflective wildlife crossing sign showed that the number of wildlife-vehicle collisions decreased [21].

Wildlife habitat preservation involves maintaining or restoring natural habitats for wildlife, such as tapirs, through reforestation and safe passage. It also involves protecting areas prone to tapir accidents by installing fences along roads. Protecting wildlife habitat is very important because habitat loss and damage are significant causes of species loss. Wildlife species need habitats because they provide food, water, protection and breeding places [24].

Community engagement and public campaigns support conservation initiatives involving local populations, NGOs and government agencies to safeguard animals and reduce habitat destruction. A study from *M. Camara and N.R. Jamil* [25] also highlighted that public awareness campaigns enhance knowledge and attitudes towards conservation efforts. According to *M. Camara and N.R. Jamil* [25], there is a positive relationship between the knowledge and attitude toward conservation among the public.

Regarding contemporary media and technological advancements, it focuses on educating the public and improving safety measures, with AI-powered systems highlighting the need for wildlife alerts. It has been proven by *R. Maity et al*. [26] that AI-enabled detection systems can alert drivers about nearby wildlife, reducing animal collisions. It has been stated that the proposed V2X system has enhanced highway safety by leveraging AI for pedestrian and animal detection [26].

Moreover, the findings also emphasized the importance of using social media technology to raise public awareness. By leveraging various media channels, such as television, internet videos and documentaries, the public can be educated about Malayan tapirs' challenges and the importance of their conservation. Moreover, social media raises public awareness of the need to protect animals through messages, funding and policy change, highlighting how important it is to drive social change [27].

Table 8. Awareness to preserve Malayan tapir species

Thematic Analysis Results		
Main Theme	Code	Theme
Methods in raising awareness among road users to protect Malayan tapir Species	Wildlife Overpasses	Infrastructure Solutions
	Road Safety	
	Digital Campaigns	Awareness and Education
	Education	
	Law Enforcement	Regulatory Measures
	Signage	
	Vegetation and Habitat	Habitat Preservation
	Preservation	
	Community	Community and Public Engagement
	Engagement	
	Technological	Technological and Media Innovations
	Innovations	

Conclusions

This study focuses on the factors contributing to roadkill among Malayan tapir and other endangered species in Malaysia. Deforestation is the most significant factor, with road users agreeing it is the main cause. Deforestation and illegal logging have led to the fragmentation of forests, causing mammal species like Malayan tapir to move towards other forests for food and shelter. Road users also neglect animals, cross signboards and speed limits and increase roadkill. Results show no significant relationship between road user perception and awareness of preserving Malayan tapir roadkill. The high prevalence of roadkill among tapirs is due to their weak eyesight, difficulty recognizing them due to their black-and-white colour, deforestation and habitat fragmentation. Efforts to improve public awareness through warning signs were ineffective in reducing tapir roadkill instances. The findings suggest that addressing physical traits and habitat loss may be more important for tapir conservation than increasing road user education alone. Respondents agree on three methods to reduce roadkill among Malayan tapir: identifying potential roadkill areas, increasing signage for wildlife crossings and installing fencing. However, local authorities must revise their actions by implementing more awareness campaigns, wildlife overpasses and camera trapping to observe wildlife movement [28]. Moreover, artificial intelligence (AI) can protect the Malayan tapir, an endangered wildlife species, by implementing real-time notifications about potential wildlife crossing zones, improved animal tracking and protection and installing wildlife passages and speed limit areas. AI can also help raise awareness about the need for Malayan tapir conservation and the problem of roadkill. Local authorities can work to assess data and detect hotspot roadkills and wildlife crossing areas. They can also implement smart lighting systems to detect motion and trespassing of animals during nighttime, reducing roadkill for Malayan tapir and other animal species and collaborating with accessible NGOs specializing in preserving wildlife species to execute a widespread awareness campaign for secondary school students. Government authorities and NGOs can also educate and raise awareness among the population [29]. To protect and restore tapir habitat, the government must halt deforestation, restore degraded forests and enforce laws against poaching and illegal wildlife trade. Eco-friendly eco-viaducts can be constructed as bridges with a green concept, attracting more animals to use them instead of accessing the main road.

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