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A Study on Animal and Vehicle Collisions in Malaysia Based on News Analysis

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ABSTRACT

Little is known about potential dangers which results from animal and vehicle collisions (AVCs) in Malaysia although such cases regularly appear in the news. In the absence of related research in Malaysia, the extent of danger from AVCs remains to be discovered. This study generally aimed to explore the prevalence of AVCs on Malaysian roads. Specifically, it investigates the traffic safety risks for road users; to the determine crash prone areas against the types of animals; and to probe the pattern of animal and vehicle conflicts. The study is based on qualitative analysis from 341 news reports in the Malay dailies from January 2010 to June 2020. For analysis, the related keywords were manually categorised, coded, and later keyed in into the statistical software SPSS v21 for further calculation. The study revealed a total of 508 road users had become victims of AVCs with 198 deaths during the 10-year period. The highest casualties involved collisions with cattle (cows and buffaloes), followed by wildlife, and pet and stray animals (cats and dogs). The study also revealed that motorcyclists were the most vulnerable road users when AVCs is concerned. It is recommended that the relevant authorities to work together to use technology such as microchip tagging and drone/app technology, road safety campaign, and heavier fines; as well as to provide wildlife crossings and install speed cameras in AVCs prone areas.

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1. Introduction

On 19th of November 2017, a young man aged 18 was killed when his motorcycle hit two cows (Figure 1) which was crossing the road in KM40, Jalan Sungai Rengit, Kota Tinggi in Johor, reported a Malay daily *Harian Metro*.

Figure 1: An animal and vehicle collision that killed a young motorcyclist and two cows in Kota Tinggi, Malaysia (Md Sani, 2017)

About three months earlier in a remote area of Merapoh – a rural route surrounded by thick forests – the same daily reported that a carcass of a nearly extinct Malayan tiger was found by the roadside, believed to have been hit by a 'heavy vehicle'.

Similar stories are occasionally repeated nationwide, although most of the crash cases between vehicle and animal remained unreported. Although incident of collisions between vehicles and animals are not something new, and it is probably a least concerned issue among road users and authorities.

The animals have roamed in this planet much longer before the human beings; in fact, they have been around for millions of years, long before people invented vehicles. While it is a well-known fact that 1.35 million human lives are lost worldwide and 50 million others were injured (WHO, 2018a) due to road crash every year, little is mentioned about the crash involving vehicles and animals all over the world.

Across the globe, a number of road users were killed or injured as a result of conflict between vehicles and animals, although the cases are believed to be underreported. Since most of the cases don't seem to be a concern despite the death from animals and vehicle conflict are noteworthy, this exploratory study attempts to investigate the extent of conflict that occurred between two on Malaysian roads.

The Malaysian Royal Police data on road crash released every year, nevertheless, does not indicate the seriousness or potential danger coming from the vehicle and animal conflicts. However, the Malaysians newspapers do occasionally report crashes involving collision between animals and vehicles. Each year, about 7,000 lives

were lost on Malaysian roads out of more than 500,000 reported road crash cases (Ministry of Transport Malaysia, 2017). In the absence of primary data, this study capitalises on the reported collisions between animals and vehicles that took place on Malaysian roads (mostly in Peninsular Malaysia) between January 2010 and June 2020 from the Malay language newspapers.

This study aimed to explore on the magnitude of the danger coming from the conflicts between animals and vehicles. This content analysis is hoped to reveal valuable information on the prevalence of occurrences of the crash and contribute to profiling of the animals and vehicles collisions (AVCs), such as the location of crash, types of road, times of crash, and types of animals involved. This could be useful for intervention plans to make road safer for both road users and animals.

2. Literature Review

During the research process, various literature searches on the AVCs that took place on Malaysian roads proved futile. Perhaps the AVCs is not considered as an alarming issue compared to other traffic safety issues such as motorcycle crash (that contributes to 60% of annual road death), or even pedestrians traffic crash that claimed around 600 lives a year (Abdul Manan & Várhelyi, 2012).

However, considering that the AVCs occurred and had claimed a number of human lives despite in much smaller percentage, it is worth investigating and writing a report to serve as future reference on AVCs issue in Malaysia. Besides, there is an urgent need to raise the alarm on AVCs issue which has long been neglected.

Even though the deaths from AVCs all over the world are generally low, the collisions have always been costly. In the United States, for example, crashes that involve animals struck by vehicular traffic occur throughout the nation and claimed a total of 1,353 human lives between 1991 and 2000 (Khattak, 2003). It is estimated that the loss from these fatal crashes is well over one billion dollars. (Khattak, 2003).

In a related study (Shilling & Waetjen, 2016) on wildlife and vehicle collisions in California, the state was reportedly lost about USD225 million in 2015 alone as a result of AVCs. This was equivalent to 2% of the total transportation budget for the State of California. The study revealed that there were at least 563,496 traffic incidents of all kinds across California reported to the California Highway Patrol between February 2015 and February 2016.

A total of 5950 cases from the traffic incidents involved collisions with wildlife. These included reports of animals standing next to or running across lanes, collisions with animals, and swerving to avoid collisions which eventually resulting in a crash.

In a study by the Highway Safety Information System (HSIS) in the United States between 1985 and 1991 indicated that AVCs were an issue. The study (Hughes et al., 1996) reported that for the states of Illinois, Maine, Michigan, Minnesota and Utah, the number of reported crashes in which animals were hit by vehicles increased from 21,470 in 1985 to 36,332 in 1991; and the trend was expected to increase. Most cases in these states were found to be in the rural roads which the average rate of animal crash was two to 12 times greater than the rate for urban roads. Throughout the period, a total of 112 deaths were recorded.

Although research on AVCs in Australia are not vigorously carried out, according the Australian National Transport Agency data, between 1990 and 1997 there were 94 fatal cases and 1,392 other cases required hospitalisation. This comprehensive data covered all States and Territories (Attewell & Glase, 2000) . Of the fatal crashes, 42% involved a vehicle manoeuvring to avoid hitting an animal, 80% occurred in rural areas, and 71% involved stock or a large animal such as a horse.

In a related study on AVCs in Saudi Arabia, it was revealed that there were more than 600 crashes involving vehicles and camels every year. Every one of four crashes resulted in fatalities, and the number of injuries was four times higher than those killed (Al-Ghamdi & Algadhi, 2004).

As the AVCs also posed a traffic safety issue in Spain, researchers carried out a new cooperative strategy to reduce the conflict. The issue was alarming as 6,123 animal-vehicle collisions were registered in Catalonia, Spain from 2007 to 2011 Rosell et al., 2013).

The researchers have suggested that various measures to be taken to address the issue, such as by installing suitable perimeter fences, and constructing wildlife crossings, or adapting existing structures. In addition, a cooperative strategy is essential to achieve the goal of reducing the number of accidents involving wildlife on secondary roads, where the magnitude of the conflict is greater.

In Sweden, a study on road and landscape features affecting the aggregation of ungulates (hoofed mammals) vehicle collisions concluded that the Swedish Transport Administration to employ fences and animal passages as standard measures to reduce collisions. However, such mitigation efforts would not totally solve the problems as it only shifted the collisions to new locations; therefore, the researchers suggested that speed reduction as another countermeasure to avoid AVCs (Sjölund, 2016).

Key factors that contribute to the number of AVCs were traffic volume, availability of fences, and vehicle speed (Murphy & Xia, 2016). According to 24-published papers to quantitatively analyse the influence of environmental predictors on the wildlife vehicle crash locations, it was acknowledged that increased traffic volumes, speed limits and road width, decreased visibility, flat terrain, and the presence of water sources increased the number of animal and vehicle collisions among all species (Gunson et al., 2003). There are various interventions that have been suggested in various studies.

A study in United Arab Emirates (Bashir & Abu-Zidan, 2006) suggested in order to prevent AVCs, particularly with large animals, the presence of animals on the roads should be reduced through improvement in road safety engineering, such as fencing and under passes. Besides, it also suggested that risk on the occupants – in the event of a crash – should be reduced using proper restrained devices, such as the use of seat belts and child seats. The use of fencing in the crash prone area in the United Arab Emirates (UAE) has dramatically drop the cases of collisions between vehicles and camels.

Similar to the UAE, fences and under passes are also considered as preventive methods over the AVCs issue in California. The researchers in California suggested that this would be possible after identifying stretches of highway where AVCs are more likely. They pointed out they are more than 4,000 reported cases on California highways involving wildlife (especially deer) and livestock in the state (Shilling & Waetjen, 2016). Other researchers studying the AVCs provided insights to determine the suitable interventions. For example, it was discovered that animal-vehicle collisions tend to occur more than expected, often at night, on dry road conditions and by larger vehicles (Gunson et al., 2003).

They concluded that the ability for a motorist to avoid a collision is reduced in all these situations due to reduced visibility and increased stopping distances. By reducing the speed, the motorist can compensate for the increased probability of being involved in a collision with animals. Therefore, road authorities should ensure that the existing speed limits are enforced, and consider decreasing night driving speeds for all vehicles.

The researchers also recommended spatial road-kill data to be established in determining locations of mitigation measures, such as erecting wildlife signage and crossing structures. Research findings on patterns of AVCs are useful in devising mitigation based on specific hour of day or season when collision frequencies are highest. They also suggested that public awareness and education campaigns can help reduce AVCs (Gunson et al., 2003).

Last but not least, imposing fines on animal owners, particularly those who rear cattle can also be an effective way to mitigate AVCs. In Alberta, Canada (Government of Alberta, 2010) for example, the owners faced fines or having their livestock impounded should their livestock caught for trespassing.

3. Methodology

3.1. Data Collection

This research is based on secondary data obtained from online Malaysian newspapers namely *Berita Harian, Utusan Malaysia, Harian Metro, Sinar Harian* and *Kosmo*. Google search was used to retrieve the articles with regards to the cases of animal and vehicle collisions.

The time frame for the data collection was dated from 1st January 2010, as far as the online news from the selected newspapers were available. Up to June 2020, a total of 341 cases (or related news articles) were retrieved from Google Search. The required variables or important information such as the date, time, location, injuries (or deaths) of victims, and types of vehicles involved, animals involved, and type of roads, were manually extracted from each of the cases. Unfortunately, additional information for the reasons of crash such as whether the driver was driving under influence (of drug or alcohol), the driver going 'out of control' (or lane departure), the absence of street light, the road condition, the weather condition during the crash cannot be extracted from the articles as they were not reported.

3.2. Data Analysis

The extracted variables were keyed into the SPSS version 21 software and analysed to obtain statistical analysis. Prior to the analysis, the data was accordingly coded (e.g. 'livestock' was assigned with no. 1 and 'wildlife' was assigned with no. 2). The frequencies (percentage) of the cases involving type of animals and vehicles, road categories, time of the day, type of casualties were tabulated in the analysis.

In the absence of detailed information in some of the news reports, the Google Map was used to determine the location and road type of the case. For example, for Case 129 (refer to Figure 2), the newspaper report merely mentioned that the crash occurred "on KM 100 Jalan Kuala Terengganu – Kota Bharu (near Kampung Batang Gergaji, Jabi)" without mentioning the road number.

Therefore, Google Map was consulted to determine exact type of road, whether it was a Federal Road, State Road, or Municipal Road.

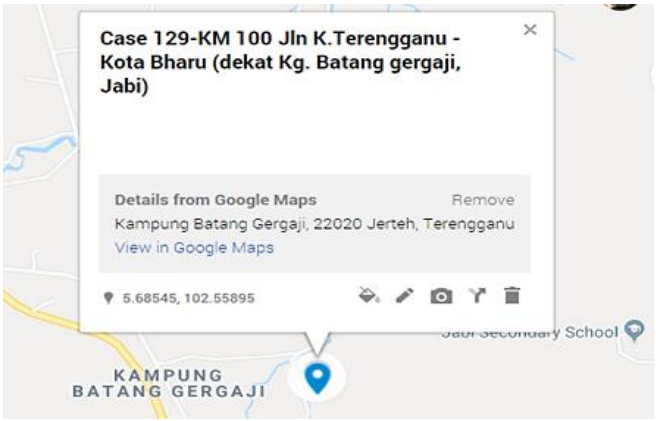

Figure 2: Google Map image used for road type classification of representative case

3.3. Scope and Limitations

A few limitations are observed in this study. Firstly, the data is merely obtained from the Malay newspapers which are available online. Secondly, the Malay dailies are chosen for this study because they give more comprehensive coverage on news in rural areas compared to English dailies which focuses on urban news to suit their readers.

If the same news (case) happened to be reported in two or more newspapers, this study picks only one the reports which contained more details in its reporting. Finally, the data appeared to be Peninsular-centric because the generally little coverage is given to 'unimportant news' from the state of Sabah and Sarawak in East Malaysia. Besides, the exact location cannot be determined from the retrieved news.

4. Results and Discussion

Figure 3 shows that a total of 508 road users turned out to be casualties of AVCs throughout the study period between January 2010 and June 2020. Of these, 198 road users were killed; 90 were seriously injured, and 220 were slightly injured**.** This shows that there have been 39 human deaths out of 100 reported AVC cases. However, there was no clear information from the media reports with regards to casualties of the animal side.

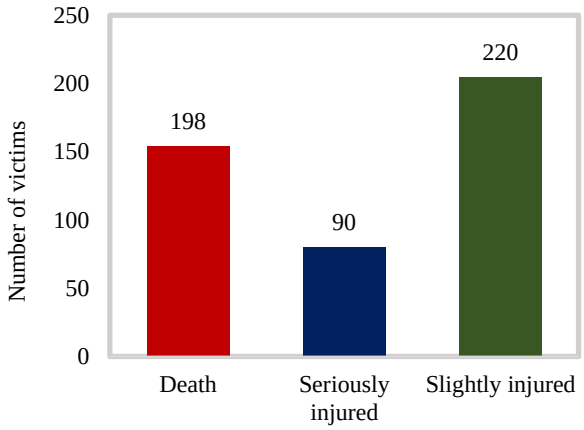

Figure 3: Casualties of all cases

With regards to the types of vehicles used by the victims as shown in Table 1, the study found the highest number of deaths came from collisions between motorcycles and animals. A total of 117 motorcycle riders/pillions were killed (23.0% of all total casualties), while 39 were seriously injured and 31 were slightly injured.

The car / four-wheeler drivers and occupants formed the second highest number of killed with 64 passengers/occupants. Another and 35 were seriously injured and 126 had slight injuries. This is followed heavy vehicles which recorded 15 deaths. Another two deaths from unspecified vehicles in the news.

The average number of humans killed in AVC involving motorcycles was 11.7 per year compared to 6.4 for four-wheelers. Therefore, this suggests that motorcyclists are more vulnerable to death and serious injury in the event of a crash with animals due to the nature of motorcycles having less passive safety features compared to cars. Details are tabulated as per Table 1.

Table 1: Human casualties against type of vehicles

		Human Casualties			Total	Percent
		Death	Seriously Injured	Slightly Injured		
Vehicle Type	Car	64	35	126	225	44.30%
	Motorcycle	117	39	31	187	36.80%
	Heavy Vehicle	15	16	63	94	18.50%
	Unspecified Vehicle	2	0	0	2	0.40%
					508	100%

This study also investigates the types of animal which are mostly likely to cause death to road users in the event of a collisions. Of 22 types of animal – from three different categories namely livestock,

wildlife and strays – cows appeared to be the most lethal as they killed 78 people while causing 38 to be seriously injured and 75 lightly injured. The cows contributed to 37.60% of all casualties coming from AVCs in Malaysia. Water buffaloes appeared to be the next dangerous animals to roads users as shown by the statistic.

A total of 36 road users were killed in collisions with water buffaloes; 12 were seriously injured; and 22 were slightly injured. As for the wildlife, the wild boars seemed to be the most dangerous to motorists as the collisions between the two have killed 34 road users. This is followed by pet and strays which have caused death to 25 road users. A crash with an owl has also been reported to have killed one road user during the period of the study. As for the tiger, there was no reported casualties on the road user although the carcass was found. For details, refer to Table 2:

Table 2: Human casualties against category of animals

		Human Casualties			Total Casualties
		Death	Seriously Injured	Slightly Injured	
Animal Category	**Livestock**	**118**	**51**	**101**	**270**
	Cow	78	38	75	191
	Buffalo	36	12	22	70
	Duck	0	1	1	2
	Chicken	1	0	0	1
	Horse	3	0	0	3
	Goat	0	0	3	3
	Wildlife	**45**	**25**	**58**	**128**
	Pig	34	23	44	101
	Tapir	0	0	6	6
	Monkey	4	0	5	9
	Elephant	0	0	1	1
	Snake	0	1	1	2
	Monitor Lizard	3	0	0	3
	Tiger	0	0	0	0
	Sun Bear	0	0	1	1
	Leopard Cat	0	0	0	0
	Crocodile	0	0	0	0
	Slow Loris	0	0	0	0
	Fox	1	0	0	1
	Otter	2	0	0	2
	Owl	1	1	0	2
	Pet & Strays	**25**	**6**	**36**	**67**
	Dog	19	3	30	52
	Cat	6	3	6	15
	Unspecified Animal	**10**	**8**	**25**	**43**
					508

To determine the types of road where the AVCs are most prevalent, the study investigated crashes on four types of road, namely the expressway (interstate / tolled highway), the federal roads (Malaysia's toll-free interstate roads), the state roads (roads within a state in Malaysia) and the municipal roads (the road in urban area / cities in Malaysia).

As displayed in Figure 4, the highest casualties were recorded in the Federal road with 260 casualties (109 deaths; 42 serious injuries; 109 light injuries). This is followed by the state roads with 131 casualties (59 deaths; 27 serious injuries; 45 light injuries). On the expressway, 20 people have been killed; 21 seriously injured and 62 had light injuries. The data appeared to be reliable as the federal and state roads are much longer in total length and usually meanders through residential (rural areas and villages), as well as forested areas. On the other hand, chances for crash to occur along the expressway is lower, though not uncommon, due to the presence fence erected by the authorities.

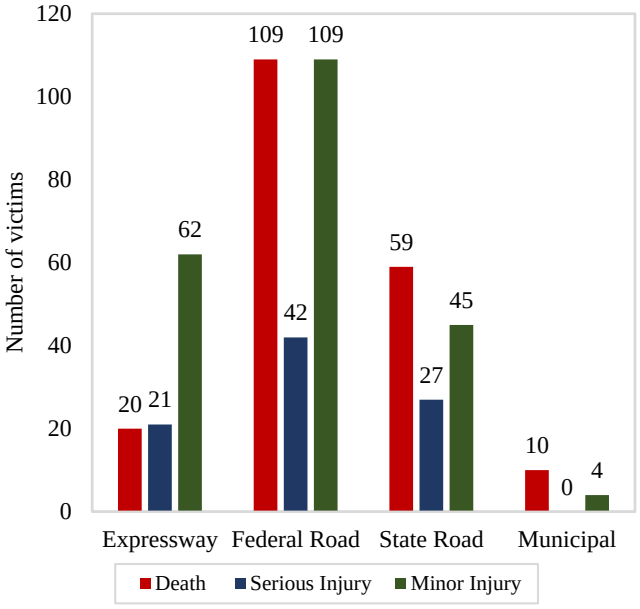

Figure 4: Casualties against road type

To establish the frequency of collision between the type of road against the animals, a cross tabulation analysis was carried out. The results showed that along the federal roads, most of the animals involved in the collisions were livestock, particularly cows and buffaloes with 85 cases. The livestock also involved in 51 collisions, and 21 cases of which took place along the expressways.

In addition, the study also indicated collisions with wildlife mostly occurred along the federal roads (60 cases), followed by state roads (30 cases) and the expressways (15 cases). Details of others animal category involved in different road type are as in Table 3.

Table 3: Animal category against road type

		Road Type			
		Expressway	Federal Road	State Road	Municipal Road
Animal Category	Livestock	21	85	51	8
	Wildlife	15	60	30	0
	Pet & Strays	5	25	22	7
	Unspecified	3	8	1	0
		44	**178**	**104**	**15**

The analysis also zoomed into the frequency of AVCs in relations to category of animals (livestock, wildlife, and pets & stray animals) in all Malaysian 13 states and the Federal Territory of Kuala Lumpur. The results indicated that most of the AVCs occurred in the state of Terengganu with 71 cases (20.80%), followed by Perak with 45 cases (13.20%), Negeri Sembilan with 41 cases (12.0%), and Pahang with 33 cases (9.70%).

Apparently, the data from Sabah and Sarawak – the two most forested states in Malaysia – obviously appeared to be underrepresented due to lack of news coverage on these two East Malaysian states by the Malay dailies. For details, refer to the Table 4.

Table 4: AVC Data based on animal category among states in Malaysia

Malaysia States	Animal Category				Total Case	%
	Live-stock	Wild-life	Pet & Strays	Unspecified		
Terengganu	43	22	6	0	71	20.8
Perak	24	12	5	4	45	13.2
N. Sembilan	17	10	12	2	41	12.0
Pahang	17	12	1	3	33	9.7
Johor	9	18	5	1	33	9.7
Kedah	17	8	5	0	30	8.8
Selangor	12	9	9	0	30	8.8
Kelantan	10	6	1	1	18	5.3
Melaka	9	5	3	0	17	5.0
Sarawak	2	0	6	0	8	2.3
Sabah	2	1	3	0	6	1.8
Perlis	3	1	1	0	5	1.4
P. Pinang	0	1	1	1	3	0.9
Kuala Lumpur	0	0	1	0	1	0.3
					341	**100.0**

The tabulation of the AVC locations are shown in the Figure 5. It obviously indicates that the crash occurred along heavy traffic stretches such as along the federal roads, state roads and expressway that link north and south of the Peninsular; the roads along the east coast, particularly the state of Terengganu; the federal road that links Kuala Lumpur and Kota Bharu, Kelantan; and along the roads that link Kuala Lumpur and Kuantan.

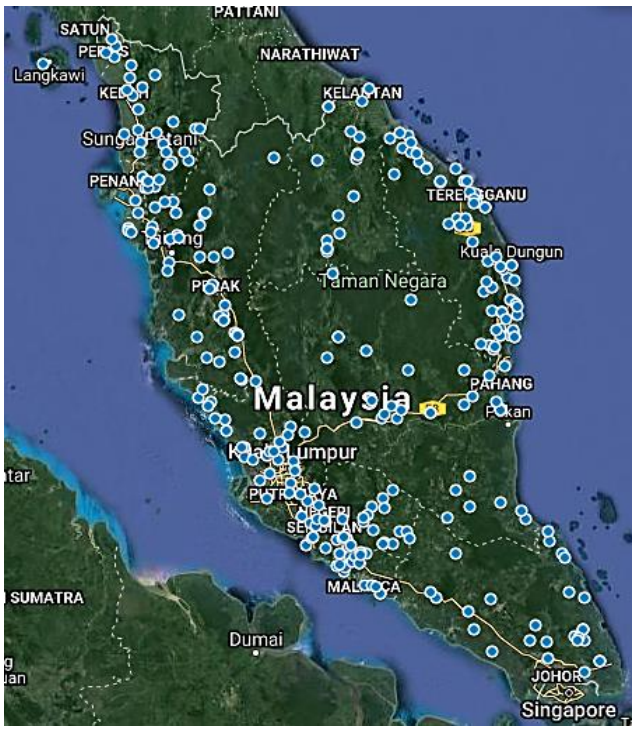

Figure 5: Mapping of AVC cases location

Since the data were obtained from newspaper coverage, it is not surprising that the state of Selangor and Negeri Sembilan appear to have high concentration of AVCs for two factors: Firstly, the volume of vehicles in these areas is high and secondly, most of the newspaper headquarters are concentrated in the Klang Valley. Therefore, the news coverage around this region have always been higher, compared to the remote areas of the Peninsular, and the state of Sabah and Sarawak in particular.

With regards to the type of vehicles against the animals involved in collisions, it was discovered that motorcycles had the highest representation with 150 cases (44.0%), followed by cars/four-wheelers with 139 cases (40.80%), and heavy vehicles with 39 cases (11.40%). The remaining cases were left unspecified by the news. Of these, 53 cases involved cars hitting livestock (cows and water buffaloes); 91 case of motorcyclist hitting livestock; 19 cases of motorcyclist hitting pets/stray animals; and, 39 cases of motorcyclist hitting wildlife. The rest of cases is tabulated in Table 5.

Table 5: AVC data based on animal category and vehicle type

Animal Category	Vehicle Type					Total Cases
	Car	Motorcycle	Heavy Vehicle	Unspecified	Multiple Vehicle	
Livestock	**53**	**91**	**17**	**2**	**2**	**165**
Cow	35	58	12	2	1	108
Buffaloes	14	30	5	0	1	50
Chicken	0	1	0	0	0	1
Duck	2	0	0	0	0	2
Horse	1	2	0	0	0	3
Goat	1	0	0	0	0	1
Wildlife	**42**	**39**	**16**	**8**	**1**	**106**
Pig	22	27	7	0	1	57
Tapir	8	0	2	7	0	17
Monkey	4	3	1	1	0	9
Elephant	2	0	4	0	0	6
Snake	1	2	0	0	0	3
Monitor Lizard	1	1	1	0	0	3
Tiger	2	0	1	0	0	3
Sun Bear	0	2	0	0	0	2
Leopard Cat	0	1	0	0	0	1
Crocodile	1	0	0	0	0	1
Slow Loris	1	0	0	0	0	1
Fox	0	1	0	0	0	1
Otter	0	1	0	0	0	1
Owl	0	1	0	0	0	1
Pet & Strays	**37**	**19**	**2**	**0**	**0**	**58**
Dog	23	18	2	0	0	43
Cat	14	1	0	0	0	15
Unspecified Animal	**7**	**1**	**4**	**0**	**0**	**12**
Total	**139**	**150**	**39**	**10**	**3**	**341**

An analysis was also carried out to the determine the frequency of AVCs against the time of the day. The results showed that 247 (72.4%) cases happened at night (in the absence of light). Specifically, the collision mostly occurred just before sunrise (6am- 8am) with 45 cases, followed by past midnight (between 12am – 2am) with 42 cases. Besides, 81 cases were recorded between 6pm-10pm.

As the night happened to be the most dangerous time to travel due to high number of AVCs, this study attempted to further investigate the category of animals involved. The analysis showed that in the

absence of the light, there were 137 cases (40.2%) involved collisions with livestock (mostly cows and buffaloes) and followed by wildlife with 64 cases (18.8%). For details, refer to Table 6.

Table 6: Animal category and time of collisions

Time of Day	Animal Category				Total Cases
	Livestock	Wildlife	Pet & Strays	Unspeci -fied	
Early Night (12am – 2am)	27	5	8	1	**41**
Mid Night (2am – 4am.)	14	4	5	2	**25**
Late Night (4am – 6am)	14	4	3	1	**22**
Early Morning (6am- 8am)	15	18	8	1	**42**
Mid-Morning (8am-10am)	6	13	2	0	**21**
Late Morning (10am – 12am)	3	4	`6	0	**13**
Early Afternoon (12pm- 2pm)	2	3	1	0	**6**
Mid Afternoon (2pm – 4pm)	2	1	2	3	**8**
Late Afternoon (4pm-6pm)	6	7	6	1	**20**
Early Evening (6pm-8pm)	21	9	5	1	**36**
Mid Evening (8pm-10pm)	28	11	6	0	**45**
Late Evening (10pm-12am)	18	13	5	0	**36**
Unspecified	9	13	2	2	**26**
					341

5. Conclusion and Recommendation

The study concludes AVCs is a threat to the traffic safety that cannot be ignored. With 198 deaths and scores of injuries in a span of ten years (2010 - 2020) from this study alone (which can be safely said to be underreported), more casualties for both animals and human would continue to rise if no intervention is carried out. Although the cases of AVCs seem to be isolated compared to other types of traffic crash (such as collisions among vehicles, or with pedestrians), an average of about 20 deaths a year or about 2 cases a month from AVCs must be addressed accordingly.

The reason being that some of these cases, such as collisions with livestock are preventable should the cows and buffaloes, especially, are properly kept in captive instead of being allowed to roam freely either on the roads or by the road sides. Although there were AVCs involving wildlife and pets & stray animals, the study shows that the statistic of casualties is leaning heavily towards livestock.

The study indicated the main threat for road users comes from collisions with cows and buffaloes and that most of these cases happened at night involving mostly motorcyclists in rural areas. Therefore, it is timely for the authorities to raise the alarm on this death trap which awaits road users. This study recommends for a few measures to address the issues with livestock, such as tagging (microchip planting); use of drone technology and app; awareness campaigns; and, stricter fines for offenders.

As for the solution, microchip tagging must be introduced in Malaysia. A task force involving road authorities (such as the Malaysian Royal Police and the Road Transport Department) and the Department of Veterinary must be set up to regulate microchip tagging that contains data of the livestock. This would not only be useful in monitoring and keeping data on the livestock's growth rate or whereabouts, but also for the enforcement officer to identify its owner in the event of the crash with a vehicle. The owners with tagged livestock would definitely be reluctant to allow their livestock to freely graze by the roadsides for fear being involved in a collision and subjected to fines. Currently, in the absence of microchip tagging, no owner would admit if his or her cattle was involved in a collision.

Secondly, the livestock monitoring can be effectively carried out by the use of drone by the enforcement team. Drone technology can be very highly cost-effective and the eventually outcome would be tremendously positive. Furthermore, crowdsourcing data collection is also possible by rewarding members of the public to use drones and a mobile device application (apps) which can give a real time livestock presence and their locations. This would allow the enforcement parties to act immediately and hence, reduce the risk of crash with vehicles.

Since most of the crash happened at nights between livestock and motorcyclists in rural areas, another possible option is to embark on awareness campaigns in AVCs prone areas. The campaign should be targeting at motorcyclists in rural areas; perhaps by encouraging them to avoid unnecessary travel, or if possible, avoid riding motorcycles at night. Besides, they must be encouraged to check the motorcycle headlights and to reduce speed along dark stretch with high concentration of livestock. Signboards, banners and poster should be erected the crash prone area, in addition to reminder during the Friday prayer sermon.

Finally, the government should impose stricter penalties such as heavy fines on owners who let their cattle to roam free on the road to avoid unnecessary event of collisions as practised in many countries around the world. If implemented, this would create a safer road environment.

This is not in any way to discourage livestock rearing, but just to protect the safety and interest of road users. Imposing penalty and stricter enforcement also do not involve cost on behalf of the government compared to lighting up the roads. As some of the cases of AVCs were recorded to have taken place along tolled highways, the highway authorities are duty-bound to ensure that no livestock penetrated the fence alongside the expressway. This can be done with regular checks and maintenance of the fence.

Furthermore, it would be worth for the road authorities to consider lowering the speed limit along the AVCs prone stretch areas. At least, in the event of a collision with an animal, the impact on road users could be lessen.

As for the wildlife in forested areas, providing safe crossings (or passageways) cannot be discounted, especially in AVCs prone stretches. There have been cases whereby Malaysia's endangered wildlife species such as Malayan tiger, elephants, sun bears, and tapir, to name a few, have been involved in the collisions with vehicles.

For big mammals, collision with vehicles not only driving them closer to extinction, but also the risk of serious injury or death to road users. Nevertheless, this requires accurate spatial data, probably through police data, if available. The reason being that engineering interventions to avoid the wildlife from entering roads or expressways, such as through fencing and providing passageway require a huge investment that cannot be wasted.

More road signs on animal crossing and speed reduction are certainly attainable to reduce conflict between wildlife and vehicles. Besides, the presence of speed cameras in identified wildlife crash zones would be useful. In order to address this, the Department of Wildlife and National Parks of Malaysia should work closely with the PDRM and JPJ.

Besides, 25 deaths involving road users who collided with pets and strays (mostly cats and dogs) in a span of a decade must not be taken

lightly. It is timely for the authorities to regulate pet ownership, such as to make sure their pets licensed and micro-chipped for accountability.

Considering limitations in this study, a thorough research with better data of crash location (possibly from the police or/and hospital) would be useful in establishing better evidence for AVCs interventions. It is safe to conclude that the cases of AVCs in Malaysia (as of cases of AVCs worldwide), including deaths and injuries on the motorists is very much underreported in the media. The complete data lies with the police and hospitals. As for the newspaper coverage on the death for AVCs, some of occurrences were not given the coverage due to the remoteness of the events, or simply not considered as newsworthy.

In conclusion, this exploratory study managed to reveal some fundamental knowledge related to AVCs in Malaysia. Should the quality data available, better findings can be expected from future research.

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