

Animal Road Mortality (Aves & Mammalia) from the New Section of the Maritsa Highway (South Bulgaria)

*Gradimir V. Gruychev**

University of Forestry, 10 Kliment Ohridski Blvd., 1756 Sofia, BULGARIA

* Corresponding author: gradi.val@gmail.com

Abstract. A total of 197 road kill victims were recorded in the period November 2015 - May 2017 from the new section of the Maritsa Highway in South Bulgaria. The Northern White-breasted Hedgehog (*Erinaceus roumanicus* Barret-Hamilton, 1900) - 18.6%, n=118, Eurasian Badger (*Meles meles* (Linnaeus, 1758)) - 16.9%, n=118, Golden Jackal (*Canis aureus* Linnaeus, 1758) - 15.2%, n=118 and Common Buzzard (*Buteo buteo* (Linnaeus, 1758)) - 25.3%, n=79 were the most frequently observed victims. The number of victims detected at varying traffic intensities is different and increases with increasing road traffic. There are several parts of the highway where road kill victims are concentrated.

Key words: road kills, Maritsa Highway, South Bulgaria, Aves, Mammalia.

Introduction

Bulgaria is situated at the crossroad of the Balkans. Some of the main roads between Western Europe and the Middle East pass through it. In Bulgaria, plans have been developed to expand the road network significantly. Transport corridors are one of the causes of habitat fragmentation (VAN DER GRIFT *et al.*, 2008). The last decade is characterized by intensive road building. The routes of two major highways ("Trakia" and "Maritsa") in Bulgaria have been completed. The Maritsa highway is a part of the Pan-European Transport Corridor IV (Bulgarian Road Infrastructure Agency).

The number of wildlife casualties on roads and railways has constantly grown worldwide as traffic and vehicle speeds have increased and infrastructure networks expanded (SEILER *et al.*, 2004). Victims of road traffic among various animal groups are relatively well studied in a number of

European countries. Problem sections and regularities have been identified during the different annual seasons (see HANER *et al.*, 2002; HELL *et al.*, 2005; LODÉ, 2000; HUIJSER & BERGER, 2000; HAIGH, 2012; ROIG-MUNAR *et al.*, 2012). In Bulgaria, identified problem areas with a concentration of road traffic casualties are reported by VAN DER GRIFT *et al.* (2008), data on road casualties in two types of road network give KAMBUROVA-IVANOVA *et al.* (2012), MOLLOV *et al.* (2013) and MICHEV *et al.* (2017).

The purpose of this study is to present the results of the animal road traffic victims for a 19 months period on the new section of the Maritsa highway (South Bulgaria) since it was put into exploitation.

Materials and Methods

In the period November 2015 - May 2017 the animal victims of road traffic were reported in the 70th km section of the

Maritsa highway. The start of the research area was put on the beginning of the highway (0 km), the end was the 71st kilometer of the road near Harmanli Town (Fig. 3). Surveys were conducted twice a month over a 2-week period. The number and species of killed birds and mammals were recorded by traveling with a car with a speed of less than 40km/h by searching the roadway in both directions. Only mammals and birds were reported across the width of the roadway. For each victim we recorded the exact location and by the accumulation of these points we established the sections of the road with concentrations of killed animals. All found animals were removed when it was possible to avoid double records in the next survey. Victims have been identified as accurately as possible using key features given by POPOV & SEDEFCHIEV (2003) and SVENSSON & GRAND (1999). When birds were in poor condition we also used feather keys according to HANSEN & SYNSTATZSCHKE (2015).

The intensity of road traffic was determined by counting the number of vehicles passing for one hour at 36.4 kilometers (Fig. 3). The road traffic was determined in every report. Then the traffic was classified into three categories: up to 20 vehicles – low(1); between 21 and 60 vehicles – medium(2); 61 and more vehicles – high(3).

Differences in the number of victims during different seasons, and according to different traffic intensity, were tested by the Kruskal-Wallis test. Pearson's correlation coefficient was used to determine the relationship between the number of victims and the intensity of road traffic (FOWLER & COHEN, 1987). All statistical analyses were performed using PAST (HAMMER *et al.*, 2001).

Results

The total number of victims in the survey period is 197. Their number during the first months after the start of the road was 16, mainly birds (Table 1).

The most frequently recorded road kill victims were the Northern White-breasted Hedgehog (*Erinaceus roumanicus* Barret-Hamilton, 1900) - 18.6%, n=118, Eurasian Badger (*Meles meles* (Linnaeus, 1758)) - 16.9%, n=118 and Golden Jackal (*Canis aureus* Linnaeus, 1758) - 15.2%, n=118 within the mammals, and Common Buzzard (*Buteo buteo* (Linnaeus, 1758)) - 25.3%, n=79 within the birds.

There are no statistically significant differences in bird deaths by months for the study period (Kruskal-Wallis Chi square = 7.887, p>0.05). However, there was a slight increase in May-June and December. Although mammalian victims are slightly more in March-April, June and December, there are no significant differences in road kills between months (Kruskal-Wallis Chi square = 22.14, p>0.05) (Fig. 1).

The number of victims detected at varying traffic intensities is different and grows when the road traffic increases (Kruskal-Wallis Chi square = 13.91, p<0.001) (Fig. 2). There is a moderate positive correlation (r=0.45, p<0.001) between the number of passing vehicles per hour and the number of reported victims.

There are several areas where the victims are concentrated: 7th - 8th km (pointer 1), 21st - 22nd km (pointer 2), 26.5th - 27.5th km (pointer 3), 42.5th - 43.5th km (pointer 4), about 54th km (pointer 5), 59th km (pointer 6) and 70th kilometer (pointer 7) (Fig. 3).

Discussion

In the present study, White-breasted Hedgehog and Eurasian Badger are the predominant victims within the mammals. Our results are in agreement with those from similar surveys (HAIGH, 2012). The number of dead Hedgehogs increased from April to July and gradually decreased to single individuals in November-February. Most of the losses reported in June. Some studies explain these facts by the growing of the home range of males in this period and correspondingly increasing the road casual-

Table 1. Species composition and number of road traffic victims of the Maritsa Highway for the period November 2015 - May 2017.

Species	Number of individuals (2015)	Number of individuals (2016)	Number of individuals (2017)	Total	Number per km
Mammalia					
<i>Erinaceus roumanicus</i> Barret-Hamilton, 1900	0	20	2	22	0.32
<i>Lepus europaeus</i> Pallas, 1778	0	1	3	4	0.06
<i>Canis lupus familiaris</i> L., 1758	0	9	1	10	0.15
<i>Canis aureus</i> L., 1758	0	15	3	18	0.26
<i>Vulpes vulpes</i> (L., 1758)	1	5	4	10	0.15
<i>Meles meles</i> (L., 1758)	1	17	2	20	0.29
<i>Mustela nivalis</i> L., 1766	0	1	0	1	0.01
<i>Mustela putorius</i> L., 1758	0	5	1	6	0.09
<i>Mustela</i> sp.	0	4	0	4	0.06
<i>Martes foina</i> (Erxleben, 1777)	1	9	4	14	0.21
<i>Felis silvestris</i> Shreber, 1777	0	5	1	6	0.09
<i>Felis silvestris catus</i> L., 1758	0	3	0	3	0.04
Subtotal Mammalia	3	94	21	118	1.74
Aves					
<i>Buteo buteo</i> (L., 1758)	6	13	1	20	0.29
<i>Falco tinnunculus</i> L., 1758	0	1	0	1	0.01
Falconiformes unind.	1	0	0	1	0.01
<i>Larus michahellis</i> J. F. Naumann, 1840	0	3	0	3	0.04
<i>Streptopelia turtur</i> (L., 1758)	0	1	0	1	0.01
<i>Tyto alba</i> (Scopoli, 1769)	2	6	0	8	0.12
<i>Athene noctua</i> (Scopoli, 1769)	0	2	0	2	0.03
<i>Merops apiaster</i> L., 1758	0	3	2	5	0.07
<i>Delichon urbicum</i> (L., 1758)	0	1	0	1	0.01
<i>Motacilla alba</i> L., 1758	0	1	0	1	0.01
<i>Turdus merula</i> L., 1758	1	1	1	3	0.04
<i>Pica pica</i> (L., 1758)	0	2	0	2	0.03
<i>Sturnus vulgaris</i> L., 1758	3	0	4	7	0.10
<i>Passer hispaniolensis</i> (Temminck, 1820)	0	1	0	1	0.01
<i>Passer montanus</i> (L., 1758)	0	1	0	1	0.01
<i>Fringilla coelebs</i> L., 1758	0	0	6	6	0.09
<i>Carduelis carduelis</i> (L., 1758)	0	2	0	2	0.03
<i>Emberiza melanocephala</i> Scopoli, 1769	0	1	0	1	0.01
<i>Emberiza calandra</i> L., 1758	0	4	1	5	0.07
Passeriformes unind.	0	6	2	8	0.12
Subtotal Aves	13	49	17	79	1.16
Total	16	143	38	197	2.90

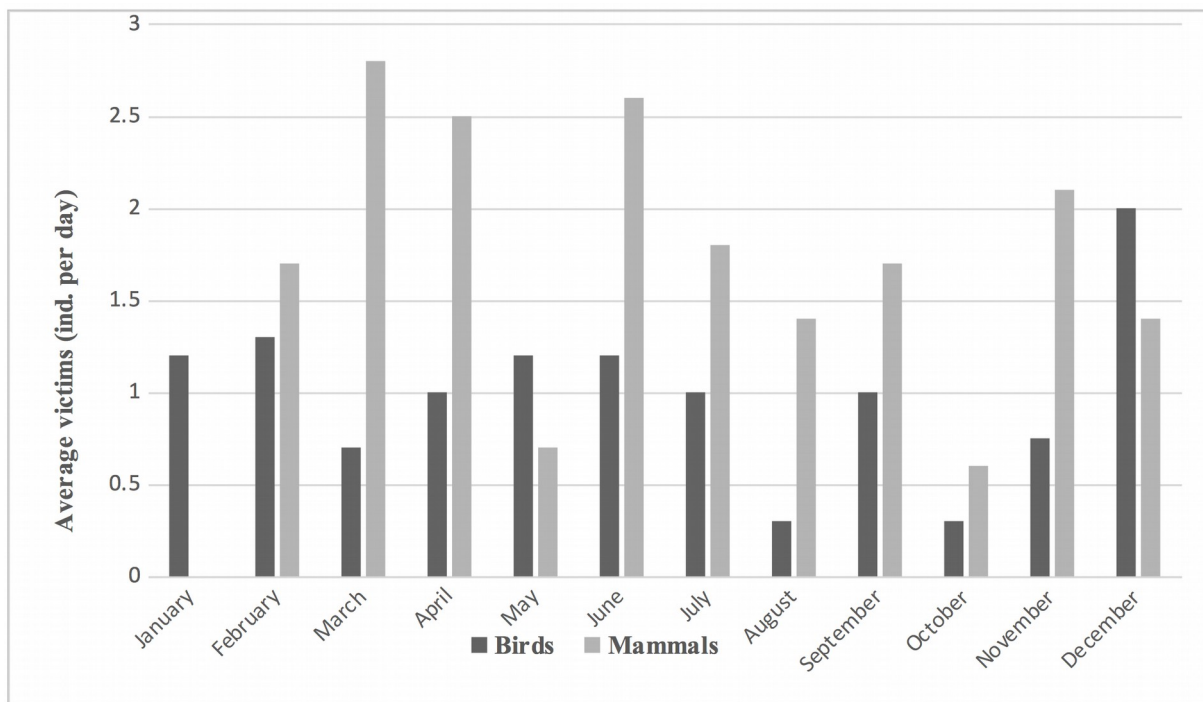


Fig. 1. Average number of victims by months for the study period.

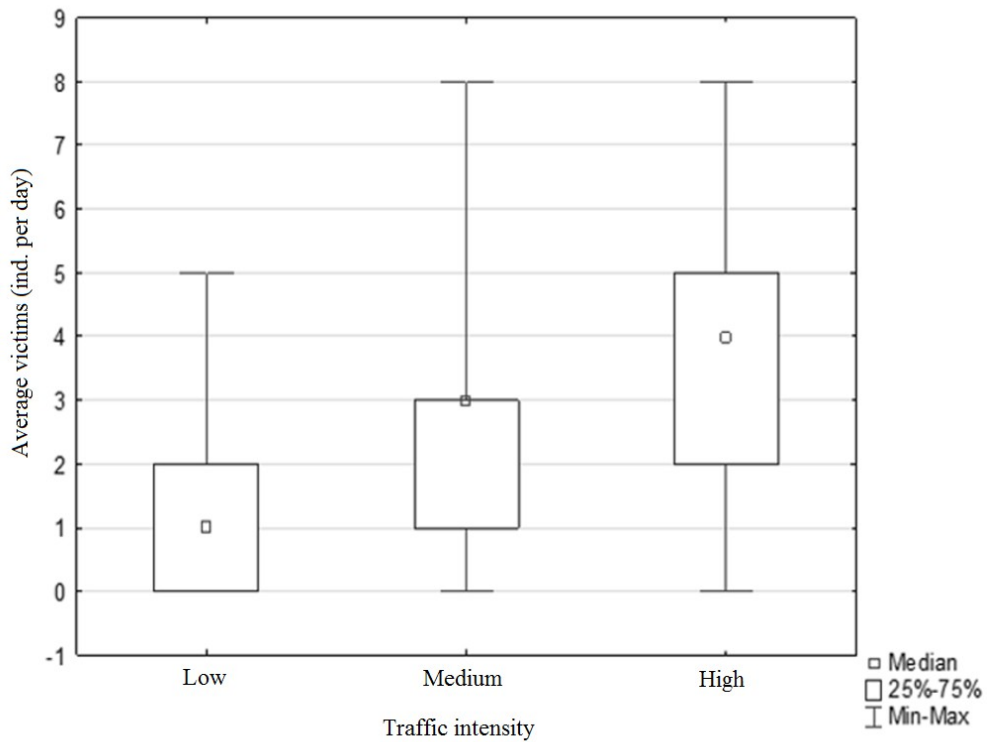


Fig.2. Box and Whiskers plot of the number of road kill victims by different traffic.

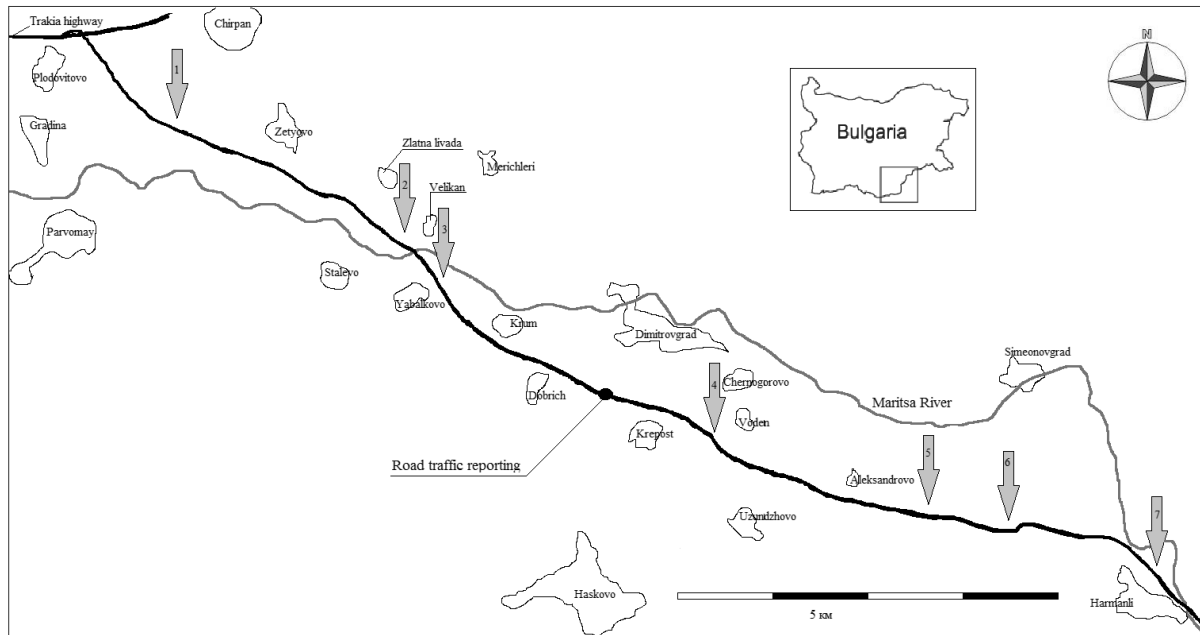


Fig.3. Study area and places with concentrations of victims in the period November 2015-May 2017.

ties of this species (HOLSBECK *et al.*, 1999; JACKSON, 2006; HAIGH, 2012).

Badger is the second most frequently recorded victim in this study. The peak of the reported victims was observed in the spring. This species is also reported as a victim of road traffic in other studies in Britain and Ireland (DAVIES *et al.*, 1987; HAIGH, 2012). The mortality peaks in this study can be explained by the increased activity of the badgers before the breeding season. The results are obtained consistent with those of DAVIES *et al.* (1987), SMIDDY (2002) and HAIGH (2012) and are similar to those from the latest study in Bulgaria (KAMBUROVA-IVANOVA *et al.*, 2012).

Another victim with high loss in our study is the Golden Jackal. It has a higher incidence of reported deaths compared to previous studies for Bulgaria. KAMBUROVA-IVANOVA *et al.* (2012) reported 4.3% of the number of victims in mammals, while in this study, the road killed Golden Jackals were 15.2% of the mammalian losses. We assume that this is due to the likely higher density of the jackals in the studied area. In Bulgaria, it is estimated to occupy about 72% of the

territory. Our research region falls into one of the highest density areas for this species (about 15 ind./10km²) of the species according to STOYANOV (2012). Our data does not allow the definition of the peaks of the loss of jackals, although in November 2016 we recorded the biggest number of dead individuals (6 ind.). Probable cause for losses in this case is due to the fact that jackals have gone out on the highway to feed with other dead animals. The Golden Jackal is an opportunist and moves easy to affordable food, the breadth of the food niche depends mostly on the supply in the area (STOYANOV, 2012).

From the bird victims the most common is the Common Buzzard. Our results confirm similarities in previous studies in Bulgaria (KAMBUROVA-IVANOVA *et al.*, 2012). We have seen a concentration of victims of this species in November and December and their gradual reduction from January to March. These results are also in agreement with MEUNIER *et al.* (2000) and KAMBUROVA-IVANOVA *et al.* (2012). According to these authors, Common buzzards use roads for hunting mainly during the winter and this is

one of the reasons for the increased number of casualties in this period.

This study does not reveal significant differences in the number of victims by month. Similar results have been observed in other studies (HAIGH, 2012). Peaks in the number of road traffic victims were reported in a number of studies (GRYZ & KRAUZE 2008; KAMBUROVA-IVANOVA *et al.*, 2012). The absence of such peaks in this study is due to the relatively small number of dead animals. A small number of victims and their relatively even distribution throughout the survey period do not allow a clear distinction between seasons with maximum and minimum casualties. A disadvantage of this study is the reporting of victims by vehicle. Although the vehicle is moving slowly, some of the victims may be unreported. The analysis of data showed that the manner of surveying (car, bicycle or foot) significantly affected the number of casualties found (ERRITZOE *et al.*, 2003). In Bulgaria there are restrictions on the movement on the highways by bicycle or on foot. It is also possible that some victims are not counted because other predatory mammals and birds have removed them before the report.

The growing number of losses with the increasing of road traffic is logical, because it changes the probability of crashes (ERRITZOE *et al.*, 2003). However, there are various results on the number of victims at different traffic intensities (see also BRUUN-SCHMIDT, 1994; FUELLHAAS *et al.*, 1989). Our results are consistent with those of GOŁAWSKI & GOŁAWSKA (2002) and GLISTA *et al.* (2008), according to whom the number of victims is increased as traffic increases. The reduction in road deaths while traffic increases is explained by other authors with a decrease in the density of the victims' populations (HANSEN, 1982) or the so-called "learning affects" (ERRITZOE *et al.*, 2003). The new highways may have a higher rate of road deaths than the old ones, but similar results could also be due to a reduction in the size of the species populations. (HAVLIN, 1987;

ERRITZOE *et al.*, 2003). Our results show fewer victims per kilometer than the number of victims of Trakia highway (KAMBUROVA-IVANOVA *et al.*, 2012). We do not have data on the size of the victims' populations in the area around the Maritsa highway. Therefore, we cannot claim that the small number of established victims is due to the low density of their populations.

A total of seven points with the accumulation of casualties were found in this study (Fig. 3). Two of them are near to wetlands (pointer 3 and 7), one is in a section with deciduous forest – pointer 5, and this is the only point with a concentration of casualties where the highway is below ground level. The last place with a concentration of victims (pointer 7) is due to the discovered dead individuals of the Common Starling (*Sturnus vulgaris* Linnaeus, 1758) and Common Chaffinch (*Fringilla coelebs* Linnaeus, 1758) on 02.01.2017. In winter, flocks of Common Starling, Common Chaffinch and Eurasian Jackdaw (*Corvus monedula* Linnaeus, 1758) around the 70th kilometer which landed on the roadway were observed. In several studies, habitats around the road are mentioned as an important factor for the victims (ERRITZOE *et al.*, 2003). Traffic victims do increase at places situated near forests, wetlands or hedges (BROWN *et al.*, 1986; BOSH, 1989; JOHNSON, 1989). If the road is at the ground level around it or slightly higher, the number of victims increases (BRUUN-SCHMIDT, 1994). This explains to a great extent our results with regard to the places where victims are concentrated.

Conclusions

This study identified the Northern White-breasted Hedgehog (*Erinaceus roumanicus* Barret-Hamilton, 1900), Eurasian Badger (*Meles meles* (Linnaeus, 1758)), Golden Jackal (*Canis aureus* Linnaeus, 1758), and Common Buzzard (*Buteo buteo* (Linnaeus, 1758)) as the main victims of road traffic on the Maritsa Highway. There are no differences in the number of casualties by

months, but they grow up with the increasing of the road traffic. There are seven sections with a concentration of losses and it is probably related to the type of habitats and the situation of the road to the surrounding environment. There are several sectors with nets to prevent collisions with birds and this may be one of the reasons for the less number of casualties than other similar surveys in Bulgaria.

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