

*On the Road Mortality of the Northern White-Breasted Hedgehog (*Erinaceus roumanicus* Barrett-Hamilton, 1900) in Bulgaria*

*Atanas M. Mikov**, *Dilian G. Georgiev*

University of Plovdiv "Paisii Hilendarski", Faculty of Biology, Department of Ecology and Environmental Conservation, 24 Tzar Assen Str., BG-4000 Plovdiv, BULGARIA

* Corresponding author: a_mikov@abv.bg

Abstract. The mortality of the northern white-breasted hedgehog (*Erinaceus roumanicus*) was studied, counting the killed hedgehogs (number/10 km) at 85 km section from "Trakia" Highway (from Plovdiv City to Stara Zagora Town) and the 16-kilometer second-class road from the village of Hristeni to the same highway, in all seasons of 2017. The smallest number of hedgehogs were killed on the highway in the winter, and the largest number of individuals were killed in the spring both on the highway and on the second-class road. The summer was the only season when there are more deadly hedgehogs on the highway than on the second class road, with no killed individuals found there. In the autumn again, as in both winter and spring, more hedgehog deaths were recorded on the second class road than on the highway. The number of individuals killed on the highway ranks third in number after those in the spring and summer.

Key words: road mortality, Northern white-breasted hedgehog, *Erinaceus roumanicus*, Bulgaria.

Introduction

Hedgehogs are one of the most common mammalian road fatalities in Europe. Between April 2008 and November 2010, two stretches of road measuring 227 km (Cork City to Caherlistrane, Co. Galway) and 32.5 km (Cork City to Bandon, Co. Cork) respectively were surveyed for hedgehog road kills. Over the three years, the majority of the 133 carcasses sighted were located beside pasture, which was the most prominent habitat along both routes. Arable land was the only habitat used in a greater proportion than what was available. K-function analysis detected clustering along the surveyed roads, with fatalities clustering annually at several locations. This would suggest that

hedgehogs may use specific crossing points which would be important for the implementation of management strategies and underpass construction (HAIGH *et al.*, 2014a).

ORLOWSKI & NOWAK (2004) explored the mortality of hedgehogs *Erinaceus* spp. on roads in the agricultural landscape of Lower Silesia (south-west Poland). The research they conduct in 2001–2003 on a 48.8 km road network. Ninety three percent of all casualties (n = 70) was documented in built-up areas. The average number of victims per 1 km road in built-up area was 37 times greater than in undeveloped area (5.4 *vs.* 0.14 casualties/1 km road).

BROCKIE *et al.* (2009) compared the number of medium-sized animals

(between rat and dog-size) killed on repeated counts along the same 1660 km of North Island highways in 1984, 1994 and 2005 with other counts going back to 1949. Counts of possums (*Trichosurus vulpecula*), hedgehogs (*Erinaceus europaeus*) and rabbits (*Oryctolagus cuniculus*) ranged between 0.7 and 89 corpses/100 km, and changed dramatically over six decades. A possible irruption of hedgehogs is reported in 1988–89, followed by an 82% decline in their numbers between 1994 and 2005.

HAIGH *et al.* (2014b) found that among the killed on the road hedgehogs, 54 % of hedgehogs were 1-year-old or less. The majority of hedgehogs (87 %) were between 0–3-years-old, the oldest females were nine ($n=2$), and the oldest males were eight years old ($n=2$), respectively. Road kill hedgehogs had an average longevity of 1.94 years, and the mean age of females was higher (2.10 years) than males (1.87 years).

HUIJSER & BERGERS (2000) studied the effect of roads and traffic on hedgehog population density by comparing relative densities in 15 paired road and control plots matched for landscape parameters. There were about 30% fewer tracks in road plots when compared to control plots and the P -values were marginally insignificant at the $p \leq 0.05$ significance level. These results suggest that roads and traffic are likely to reduce hedgehog density by about 30%, which may affect the survival probability of local populations.

The mortality of the northern white-breasted hedgehog (*Erinaceus roumanicus*) on the roads in Bulgaria has not been studied so far. There is only partial data about the traffic mortality of another closely related species - *Erinaceus concolor*, presented in the study of KAMBOUROVA-IVANOVA *et al.* (2012). The automobile traffic in some areas is a significant factor for the hedgehog mortality (PESHEV *et al.*, 2004). We believe the census of the hedgehogs killed on the road is a useful method for collecting information on the

distribution and relative abundance of the species at local or national level, as well as providing data on its seasonal activity.

Material and Methods

The mortality of the northern white-breasted hedgehog (*Erinaceus roumanicus*) has been studied by traveling by car at a speed of less than 40 km/h counting the killed hedgehogs (number/10 km) at a 85 km section from “Trakia” Highway (from Plovdiv City to Stara Zagora City) and the 16-kilometer second-class road from the village of Hristeni to the same highway, in the winter, spring, summer and autumn of 2017. The data was processed statistically using descriptive statistics and Kruskal-Wallis test. All statistical analyses were performed using PAST (HAMMER *et al.*, 2001).

Results and Discussion

The smallest number of killed hedgehogs on the highway was in the winter. In our opinion the reason for this is because at the time the hedgehogs fall into hibernation, and the dead were found at the end of winter when the weather begins to warm up and the hedgehogs become active. Those who were killed on the road were also found at the end of the winter and their number is smaller than the hedgehogs killed on the road in the spring and autumn (Table 1).

Our records showed that the highest number of hedgehogs were killed in the spring, both on the highway and on the second-class road (Table 1). We think this is due to the fact that during this period the hedgehogs have just awakened from a hibernation and they disperse to find food. As a result, their activity is higher and therefore they die more often on the roads this season. Some studies explain these facts by the growing of the home range of males in this period and correspondingly increasing the road casualties of this species (HOLSBEEK *et al.*, 1999; JACKSON, 2006; HAIGH, 2012). We found that in the

spring there are more hedgehogs killed on the second class road than on the highway. The relationship between road-kill and traffic volume indicates that roads carrying more than 3000 vehicles per day act as barriers to larger mammals, while vehicles on less busy roads are more dangerous for crossing animals (BROCKIE *et al.*, 2009). In addition, there are fences on the side of the highway which prevent animals from passing through. Also in some places there are underpasses through which animals can safely cross while they are missing on the second class road.

In the summer, the number of hedgehogs perished on the highway is second, after that of hedgehogs killed on the highway in the spring. This is the only season when there are more dead hedgehogs on the highway than on the second class road. In our opinion, this is due to a reduction in the intensity of automobile traffic on the second class road. No killed hedgehogs were found on the second-class road (Table 1). We believe that this is due to the weaker activity of

hedgehogs this season, as they have already recovered their lost food reserves during hibernation, and on the other hand they still do not accumulate intensive food reserves for their next hibernation.

In autumn again, as in the winter and spring, more hedgehog deaths were recorded on the second class road than on the highway. The number of individuals killed on the highway ranks third in number after those in the spring and summer. The number of hedgehogs killed on the road ranks second after those in the spring (Table 1). We think this is due to the fact that hedgehogs in this period are re-increasing their demand for food in order to build up enough reserves for their hibernation.

There are no statistically significant differences in hedgehog deaths by seasons for the study period (Kruskal-Wallis test, $p > 0.05$). The box and whiskers plot of the number of road kill hedgehogs on the "Trakia" highway and the second class road in the different seasons in 2017 is presented on Fig. 1.

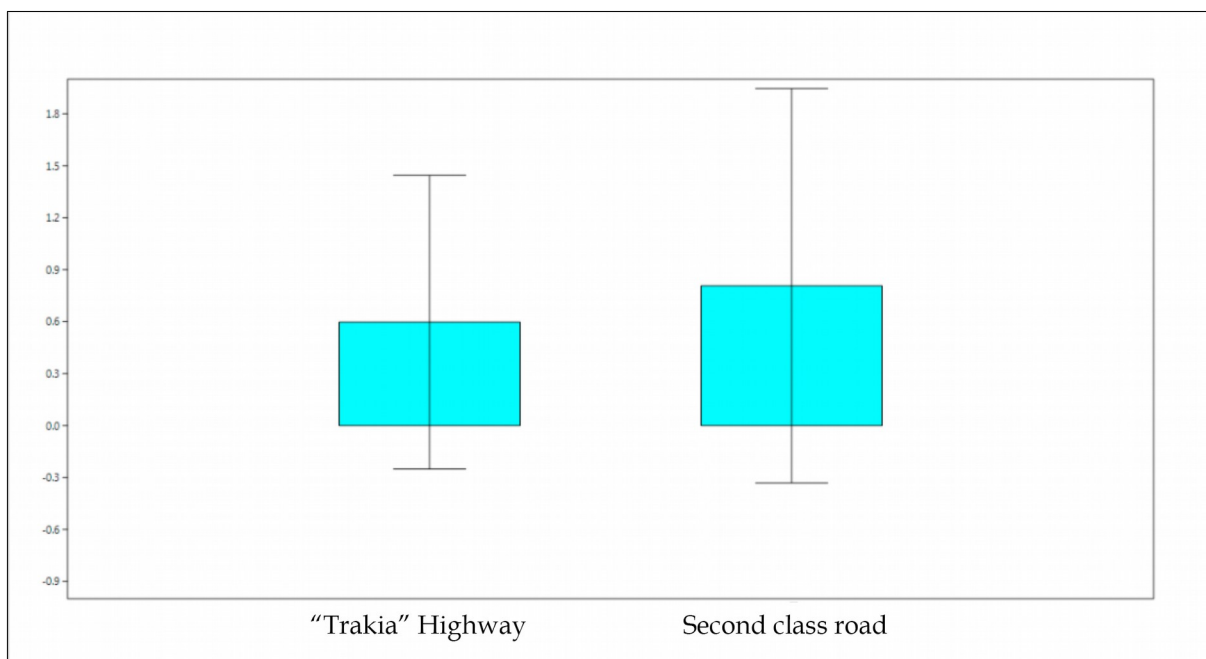


Fig.1. Box and Whiskers plot of the number of road kill hedgehogs on the "Trakia" highway and the second class road in the different seasons in 2017.

Table 1. Number of hedgehogs per 10 km killed on the “Trakia” Highway and the second class road in the different seasons in 2017.

Season	“Trakia” Highway individuals/10 km	Second class road individuals/10 km
Winter	0.04	0.10
Spring	1.88	2.50
Summer	0.35	0.00
Autumn	0.12	0.63

The main disadvantage of this study is the surveying of the victims from moving vehicle. Although the vehicle is moving slowly, some of the victims may remain 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 survey.

Conclusions

Results show that most hedgehogs perish on the highway and on the second class road in the spring. In all seasons, except summer, there are more deadly hedgehogs on the second class road than on the highway.

References

- BROCKIE R., R. SADLEIR, W. LINKLATER. 2009. Long-term wildlife road-kill counts in New Zealand. - *New Zealand Journal of Zoology*, 36(2): 123-134.
- ERRITZOE J., T. MAZGAJSKI, R. LUKASZ. 2003. Bird casualties on European roads – A review. - *Acta Ornithologica*, 38 (2): 77-93. [DOI].
- HAIGH A. 2012. Annual patterns of mammalian mortality on Irish roads. - *Hystrix*, 23(2): 58-66. [DOI].
- HAIGH A., R. O’RIORDAN, F. BUTLER. 2014a. Hedgehog *Erinaceus europaeus* mortality on Irish roads. - *Wildlife Biology*, 20(3): 155-160.
- HAIGH A., M. KELLY, F. BUTLER, R. O’RIORDAN. 2014b. Non-invasive methods of separating hedgehog (*Erinaceus europaeus*) age classes and an investigation into the age structure of road kill. - *Acta Theriologica*, 59(1): 165-171.
- HAMMER O., D. HARPER, D. RYAN. 2001. PAST: Paleontological Statistic Software Package for Education and Data Analysis. - *Paleontologia Electronica*, 4 (1): 1-9.
- HOLSBEEK L., J. RODTS, S. MUYLDERMANS. 1999. Hedgehog and other animal traffic victims in Belgium: results of a countryside survey. - *Lutra*, 42: 111-119.
- HUIJSER M., P. BERGERS. 2000. The effect of roads and traffic on hedgehog (*Erinaceus europaeus*) populations. - *Biological Conservation*, 95(1): 111-116.
- JACKSON D. 2006. Factors affecting the abundance of introduced hedgehogs (*Erinaceus europaeus*) to the Hebridean island of South Uist in the absence of natural predators and implications for nesting birds. - *Journal of Zoology*, 271(2): 210-217. [DOI].
- KAMBOUROVA-IVANOVA N, Y. KOSHEV, G. POPGEORGIEV, D. RAGYOV, M. PAVLOVA, I. MOLLOV, N. NEDIALKOV. 2012. Effect of Traffic on Mortality of Amphibians, Reptiles, Birds and Mammals on Two Types of Roads Between Pazardzhik and Plovdiv Regi-

- on (Bulgaria) – Preliminary Results. – *Acta Zoologica Bulgarica*, 64(1): 57-67.
- ORLOWSKI G., L. NOWAK. 2004. Road mortality of hedgehogs *Erinaceus* spp. in farmland in Lower Silesia (south-western Poland). – *Polish Journal of Ecology*, 52(3): 377-382.
- PESHEV C., D. PESHEV, V. POPOV. 2004. [Fauna of Bulgaria]. Vol. 27 Mammalia. Sofia, BAN. Publ. "Marin Drinov", 97 p. (In Bulgarian).

Received: 17.05.2018

Accepted: 27.06.2018