 Assessing the Influence of the Automobile Traffic on the Amphibians and Reptiles in the Buffer Zone of Biosphere Reserve “Srebarna” (NE Bulgaria)

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Introduction

Building roads for the needs of automobile transportation greatly affects the environment (HAWBAKER, RADELOFF 2004), because they serve as barriers or filters to some animal movement. Road width and traffic density are major determinants of the barrier effects, whereas road surfacing (asphalt or concrete) is generally a minor factor (FAHRIG et al. 1995, FORMAN 1998). Existing road network with high intensity of traffic is virtually insurmountable barrier for small terrestrial animals, which include amphibians and reptiles. Particularly critical are road sections adjacent to ponds or wetlands crossed by rivers without the necessary equipment to protect small animals (BISERKOV et al. 2005). A growing literature suggests that roads by wetlands and ponds commonly have the highest roadkill classes (FAHRIG et al. 1995, ASHLEY, ROBINSON 1996, VOS 1997). Reptiles and amphibians are among the fauna most negatively affected by poor transportation planning associated with wetlands alteration and their mortality can be significant (ASHLEY, ROBINSON 1996, CLEVENGER et al. 2001, SMITH, DODD 2003).

In Bulgaria amphibians and reptiles inhabiting and passing through the buffer zone of the Biosphere Reserve “Srebarna” (NE Bulgaria) are listed under the category of species under national protection by National Law (1999). The main road (National Road 7E) through the buffer zone was reconstructed in 2003, and the question is whether this has an impact on the actual population density of amphibians and reptiles. In this study the authors have investigated the roadkill rate on the main road through the buffer zone of the reserve (Fig. 1). The main aims of the study were to establish the impact of the main road on the densities of amphibians and reptiles, and their distribution along the road.

Material and methods

For purposes of the current study a series of observations were carried out in the period from March to October 2004-2006, in three road sections within the buffer zone of the biosphere reserve “Srebarna” (Fig. 1): 1. Anti-freeway road in the western part of the buffer zone of the reserve (AFR-BZ-W); 2. Anti-freeway road in the eastern part of the buffer zone of the reserve (AFR-BZ-E); 3. Section of the main road Ruse-Silistra (MRS). Surveying of road sections was done on flat areas in order not to miss any specimens (BLATTER 2002). Observations were carried out mainly during the day from 9:30 am to 17:00 pm. Every recorded dead animal was determined visually using the field guide of ARNOLD, OVEN-DEN (2002). For each species is given a valid Latin and common name after BISERKOV et al (2007) and SPIEPER, BRIEGEL, CROCKETT (2007). Probable cause of death of recorded road specimens was established in the following way - the animals with daily activity presumed to have been killed in the day when we found them, and for animals with nocturnal activity - the day or night before. After recording each dead specimen it was removed from the road to avoid double counting. The differences in the number of killed amphibians and reptiles on the three types of roads were examined using t-test for independent samples. Because the data didn’t have normal distribution it was normalized using the arcsine transformation (FOWLER et al. 1993). The Spearman correlation was used to find any dependence between number of killed animals and average 1-hour traffic intensity (number of vehicles per hour) by month. For the statistical processing of the data we used the software package “Statistica 7.0”.

Results and Discussion

For the entire period of study in the three studied road sections a total of 15 dead specimens of amphibians belonging to 4 species (Domenica forcipata, Hyla arborea, Bufo bufo, Bufo viridis) and 70 dead specimens of reptiles belonging to 8 species (Eryx orbiculatus, Aiolienhalsus Montelii, Lacerta viridis, Podarcis liolepis, Podarcis muralis, Natrix natrix, Gloydius auadi and Calaphora capazia) were recorded (Table 2). From the results displayed at Table 2 is evident that the majority of the dead animals in the buffer zone of the reserve were recorded at the western anti-freeway road (AFR-BZ-W) – 18 amphibians and 31 reptiles, followed by the main road Ruse-Silistra (MRS) with 4 dead amphibians and 25 reptiles and the least cadavers were recorded at the eastern anti-freeway road (AFR-BZ-E) – 0 amphibians and 18 reptiles. The only statistically significant difference was registered comparing the mortality of the amphibians between the two fires roads (Table 4). This did not show any statistically significant differences. The majority of the studies on this topic so far show that the highest mortality among amphibians and reptiles is recorded at high intensity traffic roads (MOLLOV 2005: KAMBOUROVA-IVANOVA et al. 2012). Our results did not confirm this pattern. The reason for this is that we encountered several important factors, which were not taken into account in previous studies. These factors are the weather conditions and the seasonality (described in the following section). Namely on these “hot spots” most of the mortalities were recorded. There are 3 such hot spots on AFR-BZ-W, 2 at MRS and none at AFR-BZ-E. Furthermore, the road for the registered low mortality at AFR-BZ-E is the mounting of a barrier on this road in 2004. Only certain authorized vehicles had access to this road from that point on. The recorded areas, where regular amphibian and reptile migration on the three studied roads are (Fig. 4). There is no correlation between the number of road-killed amphibians and reptiles on AFR-BZ-E overall and average 1-hour traffic intensity by month. The correlation coefficient is positive very strong, statistically significant correlation between the number of dead amphibians and traffic volume (rSpearman=0.81) and low positive correlation for the dead reptiles (rSpearman=0.34), but it wasn’t statistically significant, so we discard it as accidental. For MRS again we recorded a positive strong, statistically significant correlation between the number of dead amphibians and traffic volume (rSpearman=0.67) and no correlation for the dead reptiles (rSpearman=0.04).

According to MOLLOV (2005) the amphibian mortality in the buffer zone of the Biosphere Reserve correlates with the intensity of the traffic although the author did not process its results statistically. KAMBOUROVA-IVANOVA et al. (2012) on the other hand did not register any correlation between the traffic intensity and the dead vertebrates animals (amphibians and reptiles included). As shown on Fig. 3 the majority of the found dead animals were recorded in sunny weather at air temperature between 23-28°C (x2=61.04, df=13, p<0.05). The species recorded in cloudy weather were Podarcis liolepis, Natrix natrix and Bufo bufo. The only species recorded dead in rainy weather were Podarcis muralis, Lacerta viridis and Natrix natrix. Among all reptiles, especially the lizards are more active in sunny weather and that’s why there are more casualties from the traffic. However, some amphibians like the toads are active and migrating in cloudy and rainy weather sometimes during such migrations more casualties occurred. Usually the data is not continuous in space or time and it is not possible to observe them. The monthly dynamic of the traffic induced mortality of the amphibians and reptiles (Fig. 4) shows that most of the cadavers are recorded in the spring time (April-May) and in the late summer – early autumn (July-September) (x2=463.01, df=11, p<0.05). These results make perfect sense since in the spring all amphibians migrate to the lake from their hibernation sites for breeding and some of the reptiles migrate in the search of food.