

Data of herpetofauna-vehicle collisions in the region of Burgas city, SE Bulgaria

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The study reports data from a four year monitoring of the herpetofauna-vehicle collisions in the region of Burgas city, Bulgaria. The investigated region is inhabited by 26 species of amphibians and cold blooded amniotes. The traffic induces road mortality in some of the investigated species. We provide information concerning the hot spots with increased herpetofauna-vehicle collision concentration and comment on the targeting driving behavior we have detected.

Key words: urban herpetology, road ecology, wildlife-vehicle collision (WVC), drivers' attitudes to herpetofauna, intentional killing, animal conservation

INTRODUCTION

Burgas city is a fast growing settlement at the Black Sea coast of Bulgaria. It is the largest city in the south-eastern part of the country and the fourth largest city in Bulgaria [1]. The city administration plans a massive reorganization and development of the urbanized area and the road network until 2020 [1]. Near (and at times even within) the city borders [see 2] are located seven NATURA 2000 sites [3] and a number of protected sites, including three large permanent limnic basins with high conservation status, including one managed reserve – “Atanasovsko Lake”. The region of Burgas is inhabited by dense populations of various amphibian species, as well as cold blooded amniotes - snakes, lizards and turtles [4].

Worldwide, the fast urbanization in the last 40 years caused an impact on the local herpetofauna [for overview see 5]. A main factor for herpetofaunal decline is related to construction of roads and the increase of the traffic [5, 6, 7, 8, 9, 10, 11]. The way roads impact different herpetofaunal populations is not understood completely, because the collected data are at times insufficient for general assessment [see 8, 12, 13]. The mechanisms of road surface avoidance and attraction, noise and car avoidance, wildlife-vehicle collisions (WVC), and the resulting edge- and barrier effects show very dynamic and rather complicated interrelations [14]. Unfortunately, here we have to add some factors of human psychology such as negative attitudes towards animals, intentional killing, and intentional targeting driving [11, 15, 16, 17, 18], which additionally impact herpetofauna.

Having in mind the presence of optimal habitats for a variety of species from the Bulgarian herpetofauna in the region of Burgas [3, 4], we planned a long term field research. Our main aim was to collect reliable information *in situ*, to establish a checklist and to form a georeferenced database of the species present in the region of Burgas. We provided also monitoring of the mortality of the species on the regional road network. We analyzed the geographic related information and identified hot spots with increased herpetofauna-vehicle collision concentration. According to the established database we analyzed the difference in road mortality rate of every single species from the region of Burgas. In addition we discuss the intentional killing behavior of car drivers.

MATERIALS AND METHODS

Our field research spanned from spring 2012 to the beginning of August 2016. Field visits were made in intervals of 3 to 18 days from 15 March to 15 November every year (except 2016). At the beginning, we identified potentially suitable sites for the different species to aid in confirming their presence. We traveled the roads in proximity of suitable habitat sites to identify conflict sections with increased WVC rates. Using handheld GPSs (Garmin Etrex 10, 30; error rate ± 5 m) we georeferenced every finding, every road-kill and summarized that information in a database. On the base of literature data and our own expertise, we provide an assessment of the locomotory performance and the risk to be hit on a paved road for every identified species (Table 1, Results and Discussion). We termed an “intentional road-kill” the result of targeting driving – cases in which the drivers changed their trajectory with the purpose to hit and run over animals.

RESULTS AND DISCUSSION

In the region of Burgas we detected eight amphibian species, four turtle species and fourteen squamates (Table 1). Our results are in line with the distribution models of the herpetofauna proposed for the region [3].

Species	<i>Ablepharus kitaibelii</i>	<i>Podarcis muralis</i>	<i>Podarcis tauricus</i>	<i>Lacerta viridis</i>	<i>Lacerta trilineata</i>	<i>Mediodactylus kotschy</i>	<i>Pseudopus apodus</i>	Sauria	
Found hit				+			+		
speed	2	4	4	4	4	2	1		
Species	<i>Trachemys scripta</i>	<i>Emys orbicularis</i>	<i>Testudo graeca</i>	<i>Eurotestudo hermanni</i>	Testudines				
Found hit		+							
speed	2	2	2	2					
Species	<i>Dolichopis caspius</i>	<i>Natrix natrix</i>	<i>Natrix tessellata</i>	<i>Coronella austriaca</i>	<i>Zamenis longissimus</i>	<i>Vipera ammodytes</i>	<i>Elaphe sauromates</i>	Serpentes	
Found hit	+	+	+				+		
speed	4	3	3	3	3	3	3		
Species	<i>Pelophylax esculentus complex</i>	<i>Bufo viridis</i>	<i>Bufo bufo</i>	<i>Triturus ivanbureschi</i>	<i>Lissotriton vulgaris</i>	<i>Hyla orientalis</i>	<i>Bombina bombina</i>	<i>Pelobates syriacus</i>	Amphibians
Found hit	+	+	+						
speed	3	2	2	1	1	2	2	2	

Table 1. Checklist of the herpetofauna in the region of Burgas with indication of detected road-kills and assessment of the locomotory performance of the species on asphalt: 1-very slow, 2-slow, 3-fast, 4-very fast.

From all amphibians inhabiting the region of Burgas we were able to identify only two species killed on the road – frogs from *Pelophylax esculentus* complex (Green frogs) and *Bufo viridis* (Green toad). Every spring we registered numerous dead juvenile, subadult and adult specimens of *P. esculentus* complex at the road section between the downtown of Burgas and the district Kraimorie in the region of “Poda” Protected site. The mass collisions were registered each year for a prolonged period of about twelve weeks starting in the end of March. The road section near “Poda” is splitting one large limnic water basin (from Protected Side BG 000271 “Mandra-Poda”) in two parts, which are both densely inhabited by frogs. The four-lane road is rather wide and the animals need prolonged time to cross it. In this section of the road, the

traffic is increased in the warm periods of the year, because this is the main road to the resorts southern from Burgas. The frogs migrate actively and cross the road during the mating period and after metamorphosis [4]. In summer, the intensity of the road-killing is relatively lower, but freshly killed specimens can be found until the end of the active period of the species.

We often found individuals of *B. viridis* to walk on the streets of the city and to be occasionally hit by vehicles. It is possible that toads of the *B. viridis* complex accidentally become victims of WVC, however we were not able to identify particular sites with increased concentration of road kills.

The other amphibians of the region were registered in sites in proximity to roads, but it seems that they avoid appearance on the asphalt due to particular mechanisms (e. g. road and noise avoidance) [see 14].

Among the cold blooded amniotes inhabiting the region of Burgas, at least six species suffer from high WVC rates. Specimens of *Emys orbicularis* (European pond turtle) are among the most often registered victims of the traffic. A high concentration of WVC accidents was found in the same road section reported for the Green frogs. The European pond turtles from all post-hatchling stages migrate over the road and are often killed by vehicles. In the section around the "Poda" Protected site, we also registered an increased rate of car accidents with young and adult Dice snakes (*N. tessellata*) and Grass snakes (*N. natrix*). Intriguingly, in 2016 we captured many specimens of *Elaphe sauromates* (Blotched snake) in the vicinity of the particular road section, but we did not found a single overrun specimen. It is possible that the local population has developed mechanisms of road surface or noise avoidance (*sensu* [14]), but this ecological aspect needs further investigation. For other regions in Burgas we made numerous records of WVC involving *E. sauromates*. Three specimens of the Blotched snake were registered even on the streets in the downtown of Burgas. Similar urban registration of the species was recently made in the neighboring town of Aytos [19]. Concerning *Dolichophis caspius* (Caspian whipsnake), it was also recorded to be often hit by vehicles even in the downtown area of the city. For this species this is not surprising, because the snakes often live and hunt near the roads – potentially because of suitable habitat's characteristics found in the road vicinity (e.g. basking sites, availability of small mammals).

Two lizard species suffer from increased mortality on the road. The only lacertid lizard who was often found to become a victim of WVC is *Lacerta viridis* (European green lizard). This fact can be explained by the habitat preferences of the lacertids inhabiting the region of Burgas. Among them, the only species with pronounced affinity to road surfaces is *L. viridis* (and eventually *P. muralis*). It is possible that the other lacertids avoid the roads.

Pseudopus apodus (Sheltopusic) is the other lizard that is often registered as road-kill. This species does not show habitat preferences toward the paved elements of roads, however, during its migration, it has to cross roads. Having in mind the body construction of *P. apodus*, we propose that this species has a limited locomotion potential on asphalt in particular and low-friction substrates in general (see Table 1). Further investigations are necessary to verify this hypothesis.

There are also some species considered as slow moving, but not considerably affected by road mortality. In assessing risk from increased traffic we have to consider two main factors: the locomotory performance and the habitat preferences of the particular species. Both land turtles included in our checklist were not found among the traffic victims. This can be explained with the low density of their

population in Burgas - in the neighboring regions the land tortoises are often killed by vehicles.

Our list of killed species differs from that provided for other ecologically sensitive regions [see 20]. This may be due to the fact that the study in "Srebarna" treats newly constructed roads and we have investigated long existing linear infrastructure.

The most alarming tendency that we detect in our field surveys is the tendency of intended killing of herpetofauna and targeting driving [see 18, 21]. We have registered cases of an intentional change of direction by the drivers aiming to overrun snakes or frogs (Fig. 1). Here we have to stress that this behavior is not only fatal for the animal, but also rather dangerous, because of the risk of severe vehicle accidents. Education and information campaigns improve the attitude of the public towards the herpetofauna and may influence driving behavior [18].



Figure 1. Road section between downtown of Burgas and the district Sarafovo. The red circle indicates the blood spot under the head of a Dice snake (*N. tessellata*), which was intentionally hit by a driver.

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