
Mollov I. 2005. A study of the influence of the automobile transport on the amphibians in urban environment. – In: Yankov P. & A. Petrova (Eds.) Proceedings of Student Scientific Conference “Biodiversity conservation and protected territories management”, 17.XII.2005, Bulgarian Biodiversity Foundation, University of Sofia, Faculty of Biology, Sofia (in press) (In Bulgarian, English summary).

WARNING: This is an English translation of the paper, originally published in Bulgarian in the above mentioned proceedings!

A STUDY ON THE INFLUENCE OF THE AUTOMOBILE TRANSPORT ON THE AMPHIBIANS IN URBAN ENVIRONMENT

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Abstract: *This paper examines the effects of automobile traffic and road density on two species of amphibians – the common toad (*Bufo bufo*) and the green toad (*Bufo viridis*) inhabiting the town of Plovdiv. The results obtained from this study showed that roadways are negatively impacting amphibians inhabiting urban environment.*

Key words: *road traffic, road mortality, Amphibia, conservation, Plovdiv, Bulgaria*

INTRODUCTION

The changes in the natural landscapes, caused by the human activity lead to considerable changes in the environment of the animals (PYASTOLOVA & TRUBETSKAYA, 1989). One of these activities is the construction of roads for the needs of the automobile transport.

Roads have strong ecological effect on the environment (HAWBAKER & RADELOFF, 2004). They constitute a direct and often permanent loss of wildlife habitat; they serve as physical barriers to animal movements and are often the source of exceeding high levels of animal mortality (ERVIN & FISHER, 2001; CARR & FAHRIG, 2001; HAWBAKER & RADELOFF, 2004).

Roads and traffic mortality are ubiquitous in landscapes modified by humans. This is valid in greater scale for the cities and the urban agglomerations, where the road density reaches the highest rate. The survival of populations in such landscapes depends on the interaction between the spatial pattern of roads and dispersal characteristics of the organisms (CARR & FAHRIG, 2001). The amphibians are animals which directly depend on the habitat they use and they have limited ability for migrations. They frequently encounter roads during their movements across the landscape to reach their breeding, feeding or hibernation sites (MAZEROLLE, 2003).

Currently in Bulgaria there are no studies giving data concerning the influence of the road traffic on the amphibians, except for few separate announcements of road kills of specimens from this group.

The aim of the present study is to give preliminary data, concerning the influence of the automobile traffic and the road density on the amphibian populations, inhabiting the town of Plovdiv.

MATERIAL AND METHODS

For the purposes of the current study we conducted a series of observations with different duration in the period march-october 2002-2005 on different roads on the territory of the town of Plovdiv. The observations were conducted diurnally as well as nocturnally on roads bounded by green areas and other suitable for amphibians habitats. The established amphibians were identified visually using the field guides of BANNIKOV ET AL. (1977), ARNOLD & OVENDEN (2002).

For the roads on which amphibians were established we measured the breadth of the road (in meters) and the traffic intensity (the mean number of automobiles passing for 1 hour).

RESULTS AND DISCUSSION

For the territory of Plovdiv we established dead and alive specimens belonging to two amphibian species – the common toad (*Bufo bufo*) and the green toad (*Bufo viridis*) on 8 streets. The data for the streets is presented in Table 1. The numbers of the studied streets in Table 1 corresponds to the numbers of the streets' locations in Figure 1.

Table 1.

Characteristics of the studied streets.

No	Street	Breadth (m)	Traffic intensity (vehicles per hour)
1.	“Volga” Str.	5	40-50
2.	“Nikola Obretenov” Str.	5	10-15
3.	“Capt. G. Tzanev” Str.	3	3-5
4.	“Gocho Grozev” Str.	6	10-15
5.	“Al. Terziev” Str.	6	10-15
6.	“St. Stambolov” Blvd.	10	60-70
7.	“D. Stambolov” Str.	7	30-40
8.	“Maritsa” Blvd.	7	20-30

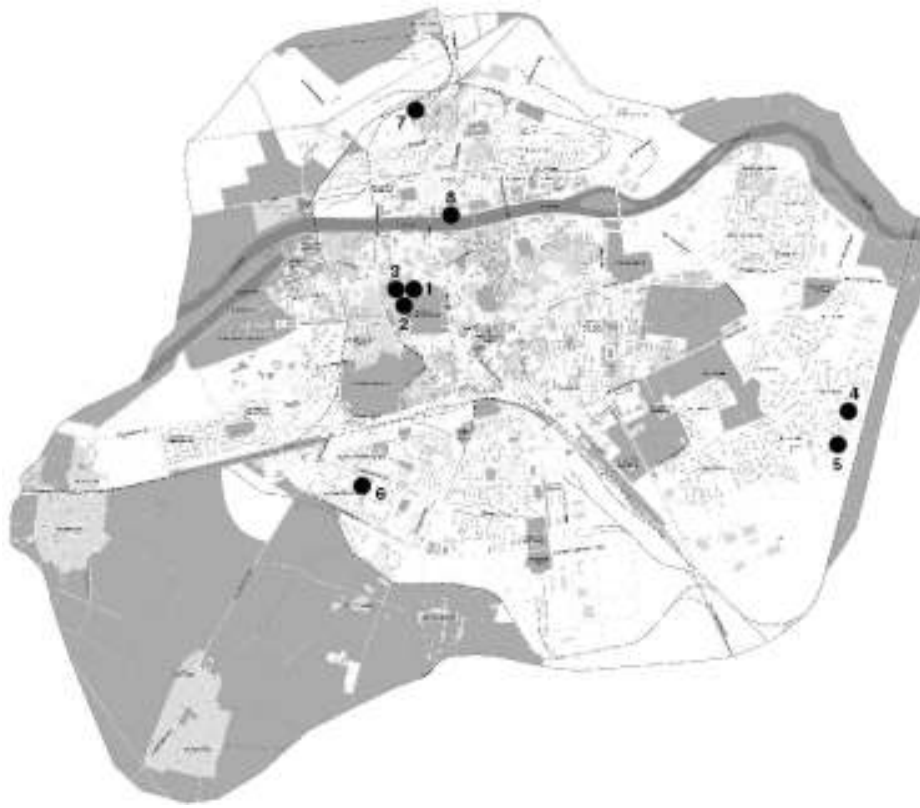


Figure 1. Locations of the studied streets.

The most common amphibian species was the green toad (*Bufo viridis*), established on 7 out of 8 studied streets. During the whole period of research for this species we established at “Volga” Str. 3 alive and 25 dead specimens; at “Nikola Obretenov” - 1 alive and 7 dead specimens; at “Capt. G. Tzanev” Str. – 4 alive and 2 dead specimens; at “Gocho Grozev” Str. in “Trakya” Complex – 3 dead specimens; at “Al. Terziev” Str. in “Trakya” Complex – 1 dead specimen; at “D. Stambolov” Str. – 1 dead specimen and at “St. Stambolov” Blvd. – 1 dead specimens.

BESHKOV & NANEV (2002) announced that the green toad prefers urbanized territories and there it is more numerous. Our study showed that in Plovdiv this species is found mainly in the house yards and the open areas between the buildings. Early in the spring (the end of march – the beginning of april) it migrates to the breeding site (usually small, temporary, water basins) and backwards. During these migrations the toads encounter roads and considerable amount of them is killed by the automobile traffic. The crossing toads are usually adult, mature specimens. They suffer the negative impact of the automobile traffic twice – when going and when returning. The newly metamorphosed toads suffer this impact on their movement from the breeding ponds to the feeding and hibernation sites.

The analysis of four of the streets where we established the green toad (we exclude the streets where we found only one dead specimen) showed that, there is a correlation between the number of dead animals and the traffic intensity (Figure 2). It seems that the road breadth doesn't influence considerably the road mortality. Similar results were announced by MAZEROLLE (2004) for the american toad (*Bufo americanus*). CARR & FAHRIG (2001) pointed out that another determining factor of the amphibian's road mortality rate is their agility. ERVIN & FISHER (2001) showed that the climate conditions also influence the road mortality rate of the amphibians, considering the fact that they are more agile at damp weather.

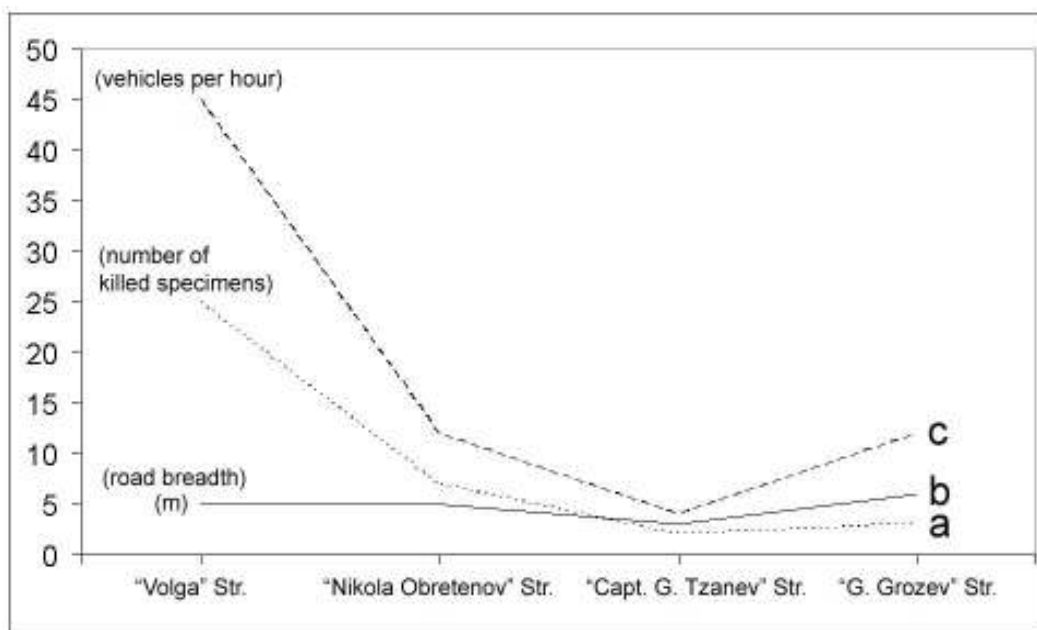


Figure 2. A correlation between the established dead green toads (*Bufo viridis*) - (a), the road breadth (in meters) – (b) and the traffic intensity (the mean number of vehicles passing for one hour) – (c) for four of the studied streets.

The common toad (*Bufo bufo*), was established with only one dead specimen at "Maritsa" Blvd., at the north side between the Gerdjika Bridge and the Pedestrian Bridge, and because of this we are unable to make detailed conclusions about the influence of the automobile traffic on this species. We assume that the road traffic influence negatively the common toad as well as other amphibian species inhabiting the town.

According to HAWBAKER & RADELOFF (2004) and JOCHEN ET AL. (2004) roads influence the animal populations in three ways:

1. Roads serve as physical barriers to animal movements; they играят ролята на полупропускливи бариери, ограничаващи придвижването в пространството;

2. Roads are often the source of exceeding high levels of animal mortality due to collision with passing vehicles;

3. Roads reduce the amount and quality of habitat.

Due to the fact that roads are physically and chemically different from the surround habitat, they serve as semi-permeable barriers, constricting the amphibian movements to the breeding, feeding and hibernation sites. In many of the cases the roads are quite wide which is difficult to overcome by species of small size, namely amphibians. Furthermore due to the intense automobile traffic a considerable amount of amphibians die killed by the passing vehicles. This constitutes a great negative impact on amphibian populations, because the killed animals are often adult, mature specimens as well as juvenile newly metamorphosed toads and frogs.

As barriers to movement, roads create smaller patches of suitable habitats and increase the isolation between them. The isolated smaller populations are at a greater risk of extinction without the demographic and genetic input of immigrants and a lower chance of recolonization after extinction. Besides the situated near the road green areas and other suitable for amphibians habitats are exposed to pollution by burned fuels and aerosols from the automobile traffic.

For diminution of the high road mortality on the amphibian populations, there are few safety measures taken all over the world (JACKSON, 1996):

- Setting-up warning signs. These signs are placed on the hotspots, where there are frequent amphibian migrations, depending on the driver's alertness and responsibility.
- Fencing. According to JOCHEN ET AL. (2004) however, the use of fences is a subject of controversy in traffic-planning institutions and among nature conservationists because fences also represent a barrier to animal movement. They turn the semi-permeable barriers (namely the roads) into non-permeable barriers. This way fences in most of the cases inflict greater damage on the animal populations than the road itself.
- Construction of tunnels under the roads. This method is much more widespread over the world. Such tunnels are constructed at hotspots, where frequent animal migrations are established. This way the interrupted by the roads connection between the populations is restored and assures the safe movement of the animals to the breeding, feeding or hibernation sites.

CONCLUSIONS

Based on the conducted study we consider that:

1. In the conservation action plans and the safety measures taken for protection of rare and endangered amphibian species, the road density and the automobile traffic should be considered as an important factor influencing negatively their populations. On the spots where the roads divide the breeding sites from the feeding and the hibernation sites, the road mortality represent a great threat to the populations of many amphibian species (JACKSON, 1996).
2. A suitable safety measures for decreasing the road mortality of the populations of amphibians and other small slow-moving animals (reptiles, mammals, invertebrates) should be included in the management plans of various protected territories as a top priority.
3. The organization of further, more serious and thorough studies on the influence of the automobile traffic on the amphibian populations in the country is needed.

ACKNOWLEDGEMENTS

The author would like to express his gratitude to Assoc. Prof. Dr. Iliana Velcheva (University of Plovdiv „Paisii Hilendarski“, Faculty of Biology, Department of Ecology and Environmental Conservation) for her advice and notes on the manuscript and to Dilian Georgiev (PhD student) and Bogdan Nikolov (MCs) for the data from their observations.

REFERENCES

- ARNOLD N., D. OVENDEN. 2002. A field guide to the Reptiles and Amphibians of Britain and Europe. - Harper Collins Publishers, 288 p.
- BANNIKOV A., I. DAREVSKII, V. ISHTENKO, A. RUSTAMOV, I. SHERBAK. 1977. A field guide of the amphibians and the reptiles of the fauna of USSR. - "Prosveshtenie" Publ., Moscow, 414p. (In Russian).
- BESHKOV V., K. NANEV. 2002. Amphibians and reptiles in Bulgaria, Pensoft, Sofia, 120 p. (In Bulgarian).
- CARR L., L. FAHRIG. 2001. Effect of Road Traffic on Two Amphibian Species of Differing Vagility. – Conservation Biology, 15(4): 1071-1078.
- ERVIN E., R. FISHER. 2001. Factors Influencing Road-related Amphibian Mortality In Southern California, Road Ecology Center, September 24, 2001, Paper Ervin2001a. This paper is posted at a Scholarship Repository, University of California, <http://repositories.cdlib.org/jmie/Ervin2001a>.
- HAWBAKER T., V. RADELOFF. 2004. Roads and Landscape Pattern in Northern Wisconsin Based on a Comparison of Four Road Data Sources. – Conservation Biology, 18(5): 1233-1244.
- JACKSON S. 1996. Underpass systems for amphibians. In: Evink G., P. Garrett, D. Zeigle, J. Berry (eds.), Trends in Addressing Transportation Related Wildlife mortality, Proceedings of the Transportation Related Wildlife Mortality Seminar. State of Florida Department of Transportation, Tallahassee, FL. pp. 58-61.
- JOCHEN A., G. JAEGER, L. FAHRIG, 2004. Effects of Road Fencing on Population Persistence. – Conservation Biology, 18(6): 1651-1657.
- MAZEROLLE M. 2004. Amphibian Road Mortality In Response To Nightly Variation in Traffic Intensity. – Herpetologica, 60(1): 45-53.
- PYASTOLOVA O., E. TRUBETSKAYA. 1989. Some morphological and cytological peculiarities of the liver of juvenile *Rana arvalis* in conditions of anthropogenic landscape. – Russian Journal of Ecology, 5: 57-63 (In Russian).

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