

## *Mortalities of the Green Toad, Epidalea viridis (Laurenti, 1768) in Urban Environment: A Case Study from the City of Plovdiv*

*Miglena V. Valkanova, Ivelin A. Mollov, Bogdan N. Nikolov*

University of Plovdiv "Paisii Hilendarski", Faculty of Biology, Department of Ecology and Environmental Conservation, 24 Tsar Assen Str., BG-4000 Plovdiv  
E-mail: *miglena\_valkanova@abv.bg; mollov\_i@yahoo.com; nikolov81bg@yahoo.com*

**Abstract.** The current study analyzes the types of mortalities of the green toad (*Epidalea viridis*) in the city of Plovdiv. Among all recorded mortalities (n=42), the road kill was the most common cause of death (65 % of the cases), followed by killing by humans (usually children) - 31%. Killing of green toads by dogs (2%) and domestic cats (2%) has the lowest impact.

Both most significant factors (road kill and killing by humans) affect mainly the adult specimens. No statistically significant difference between the mortalities of the two sexes was detected.

**Key words:** mortality, urban environment, green toad, Plovdiv, Bulgaria

### **Introduction**

The green toad (*Epidalea viridis*) is widely spread across the country and according to BESHKOV & NANEV (2002) it is much more numerous in urban areas than in natural habitats. For the city of Plovdiv this species is reported by CYREN (1941), BURESH & TSONKOV (1942), ANGELOV (1960a,b), ANGELOV & KALCHEV (1961) and EUZET *et al.* (1974). These studies however are broader in nature and don't have ecological purpose. Only in 2005 two studies have been conducted, giving some

preliminary data about the ecology and the conservation problems and threats of this species in urban environment (MOLLOV, 2005 a, b). These studies advised that more detailed research on the subject is needed. Accordingly the aim of the current study is to present more detailed data concerning the types of mortalities of the green toad in the city of Plovdiv.

### **Material and methods**

In the course of the current study a series of observations were carried out in

the period from March 2007 to March 2009 in various locations in the city of Plovdiv. The observations were conducted diurnally, as well as nocturnally, on various green areas and other suitable for the green toad (*Epidalea viridis*) habitats. The recorded specimens and their larvae and eggs were determined using BISERKOV *et al.* (2007) and the systematics follows SPEYBROECK & CROCHET (2007).

When dead specimens were found we determined the sex and the age group (juvenile, subadult, adult) according to the characteristics given by ARNOLD & OVENDEN (2002) and BISERKOV *et al.* (2007), as well as the cause of death (where possible).

All mortalities were marked using a GPS receiver "Garmin eTrex Vista" and "MapSource v. 6.12" software (GARMIN LTD., 2007) on electronic topographic map "BG Topo Maps v. 2.12" (KOTZEV, 2005) with WGS84 coordinate system and visually presented with Google Earth v.4.0 on a scaled satellite photo from 2007 (GOOGLE EARTH, 2009).

The statistical processing of the data was done using the software package "Statistica v. 7.0" (STATSOFT INC., 2004). Data was compared, using the Chi-square test, when the data are not normally distributed (FOWLER *et al.* 1998). For statistically significant we accepted differences with  $p < 0.05$  [ $\alpha = 5\%$ ].

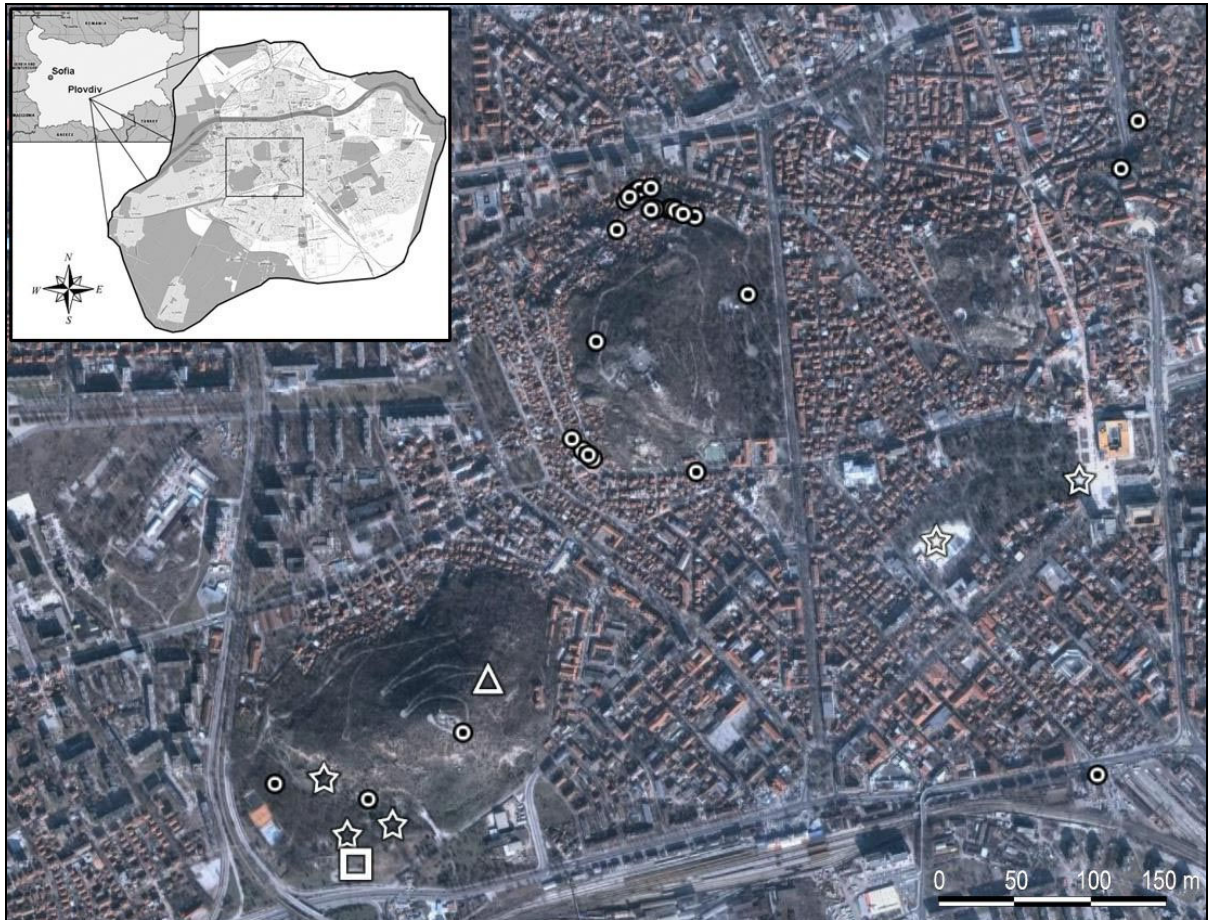
### Results and Discussion

The observed green toad mortalities (n=42) were divided into the following types: road kill, n=27, direct kill (killed by people), n=13; killed by dogs, n=1 and killed by domestic cats, n=1 (Fig. 1).

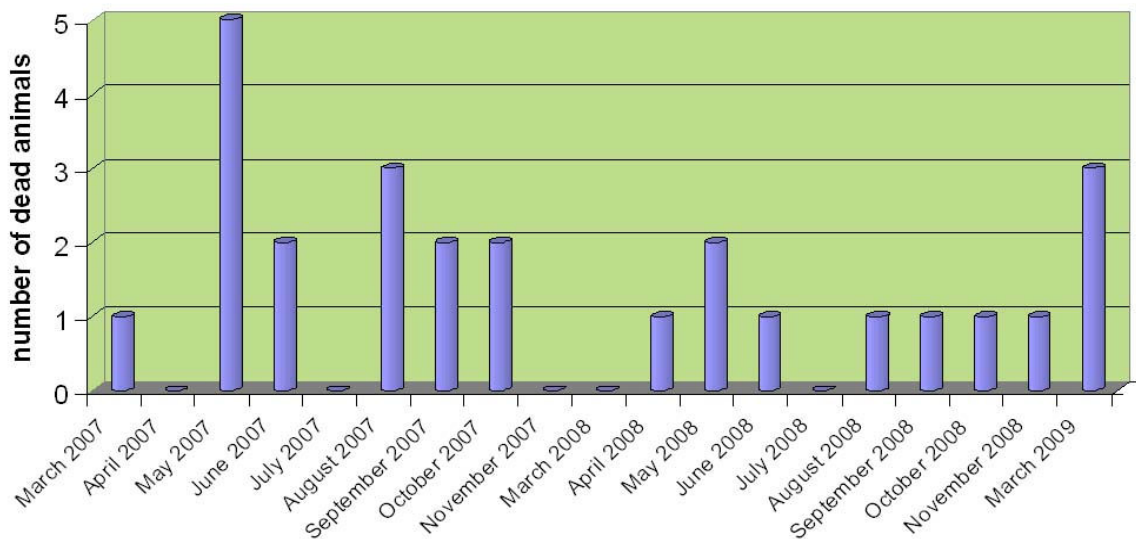
Most of the mortalities were caused by the automobile traffic - 65% from all recorded cases ( $\chi^2 = 43.71$ ,  $df = 3$ ,  $p < 0.05$ ). The majority of the recorded dead

specimens were on the streets and alleys on the periphery of nature monuments (NM) "Halm na osvoboditelite" (Hill of the liberators) and NM "Mladezhki halm" (Hill of youth). Single dead specimens were discovered on the streets of the Old Town (Trihalmie Hill) and Stochna Gara Station. According to MOLLOV (2005b) in the city of Plovdiv the Green Toad inhabits mainly the gardens and yards of the houses and the open green spaces between buildings. In early spring (March-May) it migrates to the places of reproduction (usually small, temporary, standing water basins) and vice versa. During these migrations the green toads need to cross roads and considerable amount of toads get killed by the traffic (Fig. 2). From our data, three "hot zones" can be distinguished, where the most of the mortalities are recorded - the middle part of "Volga" Str. (n=8), "Capt. G. Tsanev" Str. (n=6) and "Nikola Obretenov" Str. (n=4), all located in the periphery of NM "Halm na osvoboditelite". On the same spots a large number of dead green toads were recorded in a previous study, conducted in the period 2002-2005 (MOLLOV, 2005b). In relation to sexes, no statistically significant difference was detected between the dead males and females -  $\chi^2 = 0.28$ ,  $df = 1$ ,  $p = 0.59$ . However, it is noteworthy that for a large number of the road killed toads (n=13) the sex could not be determined, due to the heavy damage of the toads' bodies. Some authors report that the mortality caused by the automobile traffic on the amphibian populations could lead to unequal sex ratio (COOKE, 1995; FAHRIG *et al.*, 1995). Unfortunately our data could not neither confirm nor reject this statement.

On the other hand there is a significant predominance of the



**Fig. 1.** Localities of the recorded mortalities of the Green Toad in the city of Plovdiv.  
**Legend:** ● - road kill mortalities; ☆ - mortalities caused by humans (direct kill); □ - mortalities caused by dogs; △ - mortalities caused by domestic cats.



**Fig. 2.** Seasonal distribution of the recorded dead green toads, killed by automobile traffic, for the whole period of study.

recorded road killed adult specimens in comparison with the subadult and juvenile ( $\chi^2=33.56$ ,  $df=2$ ,  $p=0.0003$ ). It seems that the larger size of the adult animals makes them more vulnerable for collision with the automobile traffic in comparison with the subadult and the juvenile. Similar observations were made by PUKY (2005), who points out that during most of the conducted similar studies, more road killed specimens are recorded from species with larger size (*Bufo bufo*, *Rana temporaria*), in comparison with the these with smaller size (*Lissotriton vulgaris*). It is also possible that small, dead specimens are more unlikely to be preserved on the road to be recorded.

According to our results, the second major factor for the green toad mortality in the city of Plovdiv is the direct killing by humans (31% from all observed cases). Dead specimens, killed by humans were recorded only at the places heavily visited by people, namely the park area of NM "Mladezhki halm" and the main city park - Gradska Gradina Park (Fig. 1).

Due its "unpleasant" for most people looks and due to some superstitions, the green toads are often killed by humans, especially children. They kill not only the adult specimens, but the juvenile and the larvae as well. Occasionally they also take out the cords with eggs of the green toad out of the water and they eventually dry out. Despite this the adult specimens are the group that are most commonly subjected to this kind of anthropogenic pressure ( $\chi^2=14.80$ ,  $df=2$ ,  $p=0.0006$ ). In relation to sexes we did not record any statistically significant difference between the males and females killed by humans ( $\chi^2=0.08$ ,  $df=1$ ,  $p=0.78$ ).

Our study showed that weakest impact on the green toad mortalities in the city of Plovdiv is the killing by dogs and domestic cats (2% of all recorded cases, respectively).

For the whole period of study we observed only one attack of an adult green toad by a dog and one of a subadult specimen by a domestic cat. Both observations took place in NM "Mladezhki halm". The dogs and the domestic cats don't use the green toads for food, but occasionally they attack them in the form of a game, which usually leads to the death of the toad.

For the period of study in the city of Plovdiv we couldn't record any other types of green toad mortalities. It seems this species is not used for food by the birds of prey inhabiting the city, because it is not registered so far in their pellets (Georgiev, Plovdiv, pers. comm., 2009) and the carnivore mammals which use it for food are not inhabiting the city of Plovdiv. There are also few several factors influencing the recording of dead green toads. Probably a fair amount of green toads are perhaps eaten or carried away by other animals, removed from the road and the other searched habitats during the cleaning of the city parks, or just decomposed.

## Conclusion

The most significant cause of death of the Green Toad (*Epidalea viridis*) recorded by us in the city of Plovdiv is the automobile traffic and the direct killing by humans. Despite the considerable amount of recorded mortalities, in our opinion this species is not seriously threatened. As eventual conservation measures for the green toad in the city of Plovdiv we could recommend the organization of educational campaigns (lectures, presentations) within the citizens (especially pupils) about the biology, ecology and conservation significance of the green toad, as well as the installing of information plates (boards) in the parks and park areas, where the toads are reproducing and occurs with higher abundance.

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*Смъртност при зелената крастава жаба *Epidalea viridis* (Laurenti, 1768) в гр. Пловдив*

**Миглена В. Вълканова, Ивелин А. Моллов, Богдан Н. Николов**

ПУ "Паисий Хилендарски", Факултет по биология, Катедра "Екология и ООС", ул. „Цар Асен“ №24, 4000 Пловдив, E-mails: miglena\_valkanova@abv.bg; mollov\_i@yahoo.com; nikolov81bg@yahoo.com

**Резюме.** Настоящото проучване разглежда типовете източници на смъртност при зелената крастава жаба (*Epidalea viridis*) в гр. Пловдив. От всички установени смъртни случаи (n=42), автомобилният трафик е най-значимата причина за смъртността (65 % от всички случаи), следван от прякото убиване от хора (обикновено деца) – 31%. Убиването на зелени крастави жаби от кучета (2%) и домашни котки (2%) има най-малко въздействие.

И двата най-значими фактора (автомобилен трафик и убиване от хора) повлияват основно възрастните екземпляри. Не бяха установени статистически значими разлики между смъртността при мъжките и женските екземпляри.

Въпреки немалкия брой установени смъртни случаи, по наше мнение този вид не е сериозно застрашен. Като евентуални консервационни мерки за опазването на вида в града бихме препоръчали провеждане на образователни кампании сред гражданите за консервационната значимост, биологията и екология на вида, както и поставянето на информационни табели в парковете, където вида се размножава и среща в по-голяма численост.

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