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# Aspects of breeding activity of *Bufo viridis* in an urban habitat: a case study in Oradea, Romania

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**Abstract**. Observations on the breeding phenology of *Bufo viridis* were carried out during 2006 in an urban park from Oradea, Romania. We noted the presence of calling males, pairs in amplexus, eggs and tadpoles in water. The reproduction period extended over five months (from April to August) with a peak in May. In every period the sex ratio was heavily male biased. Spawning always occurred after rains in the temporary and shallow water bodies thus formed, but none of the tadpoles completed development because of drying out of the ponds. We consider that is imperative the creation of some artificial (semi)permanent ponds in order to assure the long-term maintenance of this and other populations from the city.

Key words: urban habitat, *Bufo viridis*, breeding, temporary ponds, sex ratio, Romania.

## Introduction

Urbanization is rapidly expanding worldwide, the natural landscapes being increasingly restricted or undergoing serious changes. This phenomenon represents a dominant threat to amphibians generally leading to habitat loss, habitat fragmentation and isolation and degradation of habitat quality (reviewed in Hamer & McDonnell 2008). In such circumstances the study of amphibian populations living in urban landscapes holds a major importance both in planning appropriate management / conservation strategies and in generating suitable conditions for the incursion and maintenance of other species.

*Bufo* (*Epidalea*) *viridis* Laurenti, 1768 is a species with a very broad distribution area which extends from eastern France and Italy to central Asia, being also present in northern Africa and in several Mediterranean islands (Bologna & Giacoma 2006). In Romania it is one of the most common species of amphibians which can also be encountered in human settlements including urban centres. The species was reported in many European (e.g. Budapest - Puky & Kecskés 1992, Rome - Ensabella et al. 2003, Berlin - Kühnel & Krone 2003) and Romanian cities (see from example in Strugariu et al. 2007, Covaciu-Marcov et al. 2006a). It is a quick colonizer of pioneer habitats (Indermaur et al. 2009) and thus can be met in a wide variety of habitats.

The green toad belongs to anurans with prolonged breeding (sensu Wells 1977) that typically utilises for reproduction temporary and shallow water bodies (Bologna & Giacoma, 2006) which occasionally appear after rains and usually exhibit a high risk of desiccation. The variety of climates covered by the wide distribution area of *Bufo viridis* leads to a high degree of variability in its reproductive cycle (Giacoma et al. 2000). Thus, the breeding period from Central European countries generally lasts only three months, while in the Mediterranean region it was recorded an extension of it over four and a half (Kyriakopoulou-Sklavounou 2000) or even seven-nine months (Sicilia et al. 2006).

The breeding activity of *Bufo viridis* is well documented for some populations from Greece (Kyriakopoulou-Sklavounou & Alexiou 1994, Kyriakopoulou-Sklavounou 2000), Italy (e.g. Castellano et al. 2000a, Sicilia et al. 2006), Egypt (Hussein & Darwish 2000), but smaller attention was given to populations from very restricted urban areas (Ensabella et al. 2003). The aim of the study was to bring some further observations on the green toad's ecology by studying the reproductive activity of a population from an urban region, specifically an urban park.

### Materials and methods

The study was conducted in a 14,600 m$^2$ urban park situated in the north-western part of Oradea city (47°03′ N, 21°9′ E; a.s.l. 132 m), Romania. The local climate is temperate continental with a mean annual temperature of 10.3°C and a 585.4 mm of annual precipitation. Before the beginning of some construction works in autumn 2006, the park had a relatively small area with grassy vegetation, bordered on one side by a supermarket. In this area, after rains, there were temporary ponds used for breeding by the population of green toads from the park. The

ponds were shallow, with only a 20-25 centimetres depth and dried out frequently being subjected to pronounced solar exposure. No other amphibian species were present in the park.

Data were gathered from March to August 2006. Field observations were performed at least twice a week, sometimes even daily. We noted the presence of calling males, pairs in amplexus, eggs and tadpoles in water. Most of the toads were encountered during night time, but a few males were also observed in water in daylight. Some of the toads were marked by toe-clipping and their snout-vent length (SVL) was measured. Air temperatures (°C) (maximum, average and minimum) were recorded daily, based on data of Echipot station Oradea (Fig. 1).

## Results

Observations on the reproductive activity are summarized in Table 1. In March we did not manage to identify any individual of *Bufo viridis* in water due to the low temperatures recorded during this period and we did not encounter toads in the herbaceous vegetation near the ponds either, being possible that they were still hibernating. A similar situation was recorded in the first half of April; the temperatures were relatively low in this period too, ranging between 6-20°C during the day, but between 1.11-11°C at night. The first movements took place on the 18th of April when there were caught 7 toads, of which 6 were males and one a female (SVL=92.9 mm) in amplexus with one of the males. On April 20 we identified the first eggs laid by 3-4 females. A new pair was observed in April 23, being important to mention the fact that the female was the same that we met on April 18 but now it was in amplexus with another male. The sex ratio in this month was heavily male biased (9:1). The lack of rains and the high temperatures during the day (22.22-26.11°C) led to the drying out of the ponds and hence to larval death in April 27.

**Table 1.** Breeding phenology of the studied population of *Bufo viridis*

| Period | Mating calls | Pairs in amplexus | Eggs | Larvae |
|---|---|---|---|---|
| 16-30 April | x | x | x | x |
| 1-15 May | x | - | x | - |
| 16-31 May | x | x | x | x |
| 1-15 June | - | - | x | x |
| 16-30 June | - | - | - | x |
| 1-31 July | - | - | - | - |
| 1-15 August | - | x | x | x |
| 16-31 August | - | - | - | x |

In May eggs were identified on 15 and 19. Very few mating calls could be heard. By the end of this month the number of tadpoles from water had reduced drastically due to the almost complete drying of ponds. Nevertheless, a small number of larvae managed to survive and spread all over in the pond which was restored by the rains from the last days of May and first days of June. In this period the sex ratio remained male biased (3:1) but it was lower only because there were fewer males present.

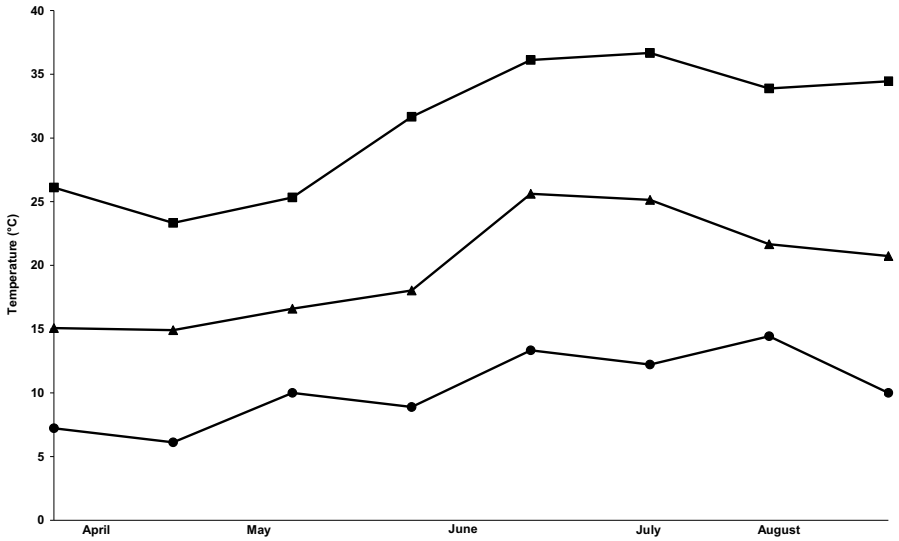


**Figure 1.** Variation of the minimum (●), average (▲) and maximum (■) temperatures during the breeding period of the studied population of *Bufo viridis*

Eggs of *Bufo viridis* were identified in June too (on June 8) but in a very special place represented by the water covering the edge of a footpath. This was an interesting situation given the fact that the larvae hatched from these eggs did not have anything to feed on as there was no vegetation on the asphalt substrate. In July rains were recorded only in three days quite distanced in time (2, 9 and 30). The reduced amount of rainfalls combined with the high temperatures (25-36°C) of this period did not allow the establishment not even of ponds that persist a few days. In the first half of August there were identified tadpoles hatched from eggs laid at the beginning of this month. Following the rains from the first days of August the toads returned to the newly established ponds and laid eggs again.

**Discussion**

Breeding of the studied population started in April which is characteristic for Romanian populations (Cogălniceanu et al. 2000), although in the thermal waters from north-western Romania spawning may occur earlier, at the beginning of March (Covaciu-Marcov et al. 2006b). The reproduction period extended over five months (from April to August) with a peak in May by this resembling more with the populations from Mediterranean region as those from Sicily, where the reproductive activity covered seven non-consecutive months or even nine months but its duration varied between populations in a certain year and between different years for the same population (Sicilia et al. 2006). A similar flexible breeding strategy was previously reported in Romania for *Bombina variegata* with a partition of the breeding season in several spawning periods along April-August (Hartel et al. 2007a).

It was hypothesised that xeric environments, unpredictable rainfalls and absence of severe winter temperatures can be responsible for an extended breeding period of green toads (Sicilia et al. 2006). Some of these factors are comparable to those encountered along our study and, in addition, climate change can also affect the breeding phenology of amphibians (see Carroll et al. 2009 and references cited therein). Green toads were trying to take advantage of any given situation in order to attain successful reproduction, which unfortunately did not happen in the studied population as ponds always dried put before metamorphosis of the larvae (Fig. 2). Nevertheless, in ponds with unpredictable hydrology flexibility in timing breeding periods lead to a more constant breeding success (Jakob et al. 2003). Besides, if the reproductive effort is limited to a short period, the risk of failure would be even higher (Sicilia et al. 2006).

It is known that temperature and rainfall are the major factors related with the initiation and duration of reproductive activity (Kyriakopoulou-Sklavounou 2000, Castellano et al. 2000a, Todd & Winne 2006). Spawning always occurred after rains, which is a normal fact, as it was described at the green toads an intermittent breeding, i.e. after a mating period both males and females leave the water and begin the terrestrial life but they return to the ponds after heavy rains (Kowalewski 1974).

The selection of breeding habitats by amphibian species was debated in several studies being identified differences in the distribution of species in ponds caused by the response to a complex of biotic and abiotic variables (e.g. Laurila 1998, Aragón et al. 2000). The surveyed green toad population live in a city where the number of adequate ponds for spawning is low or even missing, they being forced to use any kind of available pond. However, in Rome the presence of breeding green toads at ponds was negatively affected by the presence of *Bufo bufo* and fishes, and pollutants like high concentrations of chlorides and nitrates (Ensabella et al. 2003).

Females of *Bufo viridis* spend only a few days at the breeding habitat just as necessary to mate and spawn (Castellano et al. 2000b, Sinsch et al. 2007) and arrive asynchronously, which is typical when breeding period is prolonged (Wells 2007). Thus, probably the female that we identified in amplexus with two different males in two different dates did not lay all the eggs at the first time. In high male density conditions females may be forced to mate (Castellano et al. 2000b). At female water frogs it was shown a laying of a certain percent of eggs when they cannot avoid mating with an unwanted male, the remaining amount of eggs being hold for a second copulation or it will be resorbed assuring a larger clutch size in the next year (Reyer et al. 1999). The females of green toads can also be selective in choosing mate preferring males that release loud and long calls (Castellano et al. 2000b). Very few mating calls were heard during the study suggesting that this population comprises a low number of individuals, a situation which was expected as a result of the strong anthropic influence on the habitat (see Kovács & Sas 2009 for a short discussion about the size of this population). In addition, the value of mean SVL 84.63 mm (SD=3.35 mm) suggests that the population mainly consists of older individuals as longevity is size-dependent (Sinsch et al. 2007) and body size was found to be correlated positively (though weakly) to age (Castellano et al 1999).

The number of observed females was low, but at many prolonged breeding anuran the number of males at breeding site is greater than that of females (e.g. Alcantara et al. 2007, Eggert & Guyétant 2003) and males spend there a longer time giving them the opportunity to obtain multiple mating (Wells 2007). Several


**Figure 2.** Aspect of a breeding pond before and after desiccation (up); Eggs of *Bufo viridis* (down)

factors may be involved in male biased sex ratio (see in Hartel et al. 2007b) and this may lead to intense male-male competition, however males of *Bufo viridis* are only occasionally aggressive (Castellano et al. 2000b) and at prolonged breeders direct competition among males are rare (Wells 2007). We did not either recorded any aggressive interactions.

The extension of the reproductive period over five (though non-consecutive) months confirms once again that *Bufo viridis* is an opportunistic breeder with a large variability of annual reproductive cycle which was expectable since it is a species with quite wide ecological adaptability (Andreone & Luiselli 2000). The long-term existence of the population depends on the maintenance of temporary ponds till larvae metamorphosis but on local human perturbations too, such as pond or feeding habitat degradation (Husté et al. 2006) along with possible recolonization with individuals from other surrounding parks. Further, long-term studied on the urban populations are needed; nevertheless, the main conservation measure that should be taken is the creation of some artificial (semi)permanent ponds.

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