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Spatial Distribution and a Retrospective Analysis of the Herpetofauna in the City of Plovdiv, Bulgaria

Ivelin A. Mollov, Iliana G. Velcheva

University of Plovdiv, Faculty of Biology, Department of Ecology and Environmental Conservation, 24 Tsar Assen Str., 4000 Plovdiv, Bulgaria
E-mail: mollov_i@yahoo.com

Abstract. The current study presents the contemporary status and distribution of the amphibians and reptiles in the city of Plovdiv. To track changes in the status of amphibians and reptiles in the research area through time, a retrospective analysis was made based on available literary data. During the past 100 years four species of amphibians (*Triturus karelinii, Lissotriton vulgaris, Bombina bombina, B. variegata*) and four species of reptiles (*Coronella austriaca, Zamenis longissimus, Elaphe sauromates, Vipera ammodytes*) probably have disappeared from the study area; one amphibian species (*Bufo bufo*) and one reptile (*Natrix natrix*) have not changed their status, one amphibian (*Pelobates syriacus*) and two reptile species (*Ablepharus kitaibelii, Podarcis muralis*) have reduced their localities and four amphibian species (*Epidalea viridis, Rana dalmatina, Pelophylax ridibundus, Hyla arborea*) and seven species of reptiles (*Mediodactylus kotschyi*, *Lacerta trilineata, Lacerta viridis, Podarcis tauricus, Emys orbicularis, Dolichophis caspius, Natrix tessellata*) have increased their localities and frequency of occurrence. The records of the two tortoise species (*Testudo hermanni* and *T. graeca*) in the city, and the presence of the Red-eared slider (*Trachemys scripta elegans*) should be considered as accidental. Important Herpetological Areas (IHA) in the study region are also identified.

Key words: amphibians, reptiles, spatial distribution, retrospective analysis, Plovdiv, Bulgaria

Introduction

The changes in the landscapes and their impact on distribution and abundance of animals are becoming more important issue for the ecologists (LUBCHENKO *et al.*, 1991). Studies of the biodiversity in urban landscapes are of particular importance because they are still poorly studied. A better understanding of the ecological processes governing the species composition and distribution of animals in an urban environment is necessary for adequate management and conservation (HUSTÉ, 2005). Under the conditions of urbanization some species undergo a process synanthropization, while other species can not adapt to new conditions and are isolated in separate fragmented populations, or pushed outside the city (VERSHININ, 1996). Adjustment and adaptation of amphibians and reptiles to urban development are probably the least studied of all classes of vertebrates in urban landscapes (GERMAINE & WAKELING, 2001).

So far there are few studies on species composition and distribution of amphibians and reptiles from various cities in Europe (HAMMER & MCDONNELL, 2008; MCKINNEY, 2008), while in Bulgaria they are extremely scarce (MILCHEV, 1985; UNDZHIYAN, 2000; DELOV *et al.*, 2005; MOLLOV, 2005a,b; MOLLOV & VALKANOVA, 2009; MOLLOV *et al.,* 2009; VALKANOVA *et al.,* 2009). The purpose of this study is to present the contemporary species composition and spatial distribution of the amphibians and reptiles in the city of Plovdiv and to trace the dynamics of their localities and frequency of occurrence in time and determine the Important Herpetological Areas in the city.

Material and methods

For the purposes of the current study a series of observations were conducted in the period from March to October 2007-2009 in the city of Plovdiv (South Bulgaria) and its surroundings. Study area covers 127 km^2, calculated from the UTM map of Bulgaria (10x10 km). The borders of the research area are identified on the basis of a 1-kilometer UTM grid (10x10 km standard quadrants are divided into 100 smaller quadrants of size 1x1 km) (LERER & DELCHEV, 1978). Thus, the study area includes the administrative boundaries of the city (53 km^2) and the surrounding areas, excluding other urban areas (Fig. 1).

The distribution of the established species of amphibians and reptiles is presented with UTM codes of the 1-kilometer grid. The logic of the codes is the same as in the formation of the 10-kilometer quadrants, and the number of each 1x1 km quadrant follows the number of the main 10x10 km quadrant.

Amphibians and reptiles were determined visually using the field guide of ARNOLD & OVENDEN (2002) and BISERKOV *et al.* (2007). For each species are given a valid Latin and common name after BISERKOV *et al.* (2007) and SPEYBROECK & CROCHET (2007). Each observed amphibian and reptile was identified at the species level and its exact position was marked using a hand-held GPS unit (Garmin Etrex Vista HCx, manufacturer specified accuracy ± 3 m). In some cases observed amphibians and reptiles were captured by hand or using a net, loops, etc. for the more precise identification and released at the same place. Some specimens were identified by the sounds they make, their eggs or larvae and skin sheds.

The Index of distribution of the species was calculated using the formula:

$$A = \frac{N}{S}.100\,,$$

where A is the Index of distribution, N is the number of squares in which the species was encountered, and S is the total number of squares in the study territory (DYAKOV, 1970; PETROV & MICHEV, 1986).

We identified Important Herpetological Areas (IHA) in the study area, based on number of localities and number of species detected in a given territory. Polygons were generated using the Kernel Index from Hawth's analysis tools extension for ArcGIS 9.3 (BEYER, 2004).

Results and Discussion

In the current study we identified a total of 6 species of amphibians in the study area, which represents 31.58% of the Bulgarian batrahofauna and 9 species of reptiles, which is 24.32% of the Bulgarian herpetofauna. In the literary data for the period 1905-2005, for the research area were reported a total of 10 amphibian and 17 reptile species (Table 1). For comparison, in Sofia city eight species of amphibians are recorded (MILCHEV, 1985), in Varna - 8 species of amphibians and 14 reptiles (DELOV *et al.*, 2005), for Ruse 7 species of amphibians and 13 reptile species were reported (UNDZHIYAN, 2000).

Species composition and distribution

Classis Amphibia (Amphibians)

Triturus karelinii (Strauch, 1870) - Southern Crested Newt

This species is reported for the first time by KOVACHEV (1912) for the Maritsa River in Plovdiv, and later by BURESH & TSONKOV (1941) for "Swamps along Maritsa River in Plovdiv (22.II.1930)". In December 1957 the species was discovered near Komatevo Village

near Plovdiv by ANGELOV & KALCHEV (1961). Since then, the Southern Crested Newt is not detected again in the city (it was not registered in this study as well) and in our view has disappeared from the study area.

Lissotriton vulgaris (L., 1758) - Common (Small) Newt

The common newt is reported for the first time for Plovdiv by KOVACHEV (1905, 1905b, 1912) from swamps along the Maritsa River in the city. Then this species is mentioned only in the fifties of last century by ANGELOV (1960a) and ANGELOV & KALCHEV (1961) in the area "Ostrova" (now Park "Otdih i kultura") in the outskirts of the city. After these reports the common newt was not found again in the city (it was not registered in this study either) and in our view has disappeared from the research area.

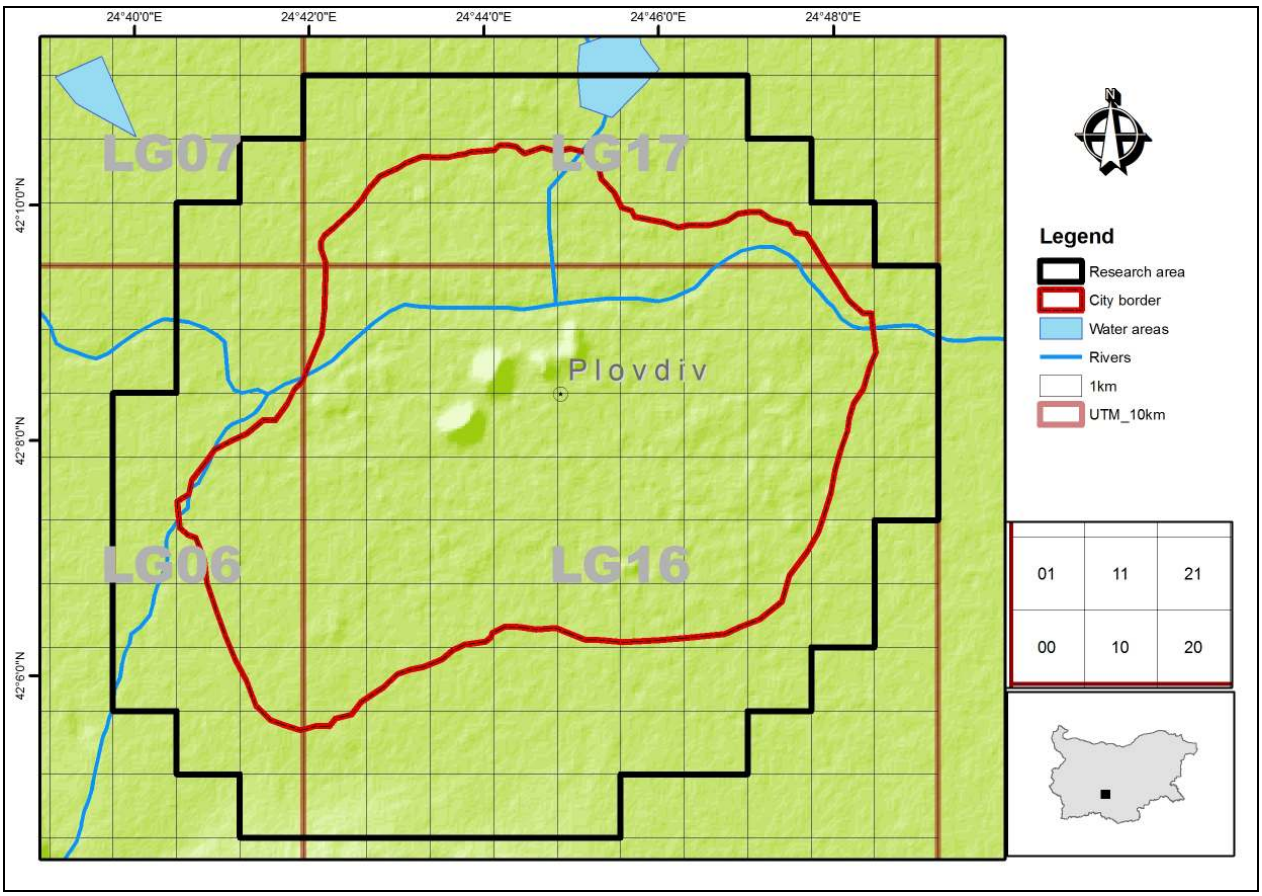

Fig. 1. UTM grid of the studied region – the city of Plovdiv and its surroundings. Scale of the UTM quadrants – 1x1 km.

Bombina bombina (Linnaeus, 1761) – Fire-bellied Toad

The species is reported for the city by KOVACHEV (1912) and later by BURESH & TSONKOV (1942) for Komatevo Village near Plovdiv (18.IV.1932). In May and October 1960 the species was found "near the village Komatevo" and "near the "Ostrova" area in Plovdiv" by ANGELOV & KALCHEV (1961). Since then the Fire-bellied Toad is not registered in the city again (and it was not found in this study). The nearest locality present to the study area is Radinovo Village - LG0754 02.VIII.2005 (Georgiev, Plovdiv, pers. comm., 2005).

Bombina variegata (Linnaeus, 1758) - Yellow-bellied Toad

The species is reported from the "Ostrova" area in Plovdiv by ANGELOV (1960a) and DONEV (1984c) and the southern suburbs of the city of ANGELOV (1960b) and ANGELOV &

Table 1. Species composition of the recorded from literary data and during the current study amphibians and reptiles in the study area.

№	Species	Species, reported by literary data (1905-2005)			Species, recorded in the current study (2007-2009)		
		N	U	A	N	U	A
Amphibia							
1.	*Triturus karelinii* (Strauch, 1870)	3	3	2.36	0	0	0
2.	*Lissotriton vulgaris* (L., 1758)	5	4	3,15	0	0	0
3.	*Bombina bombina* (L., 1761)	4	3	2.36	0	0	0
4.	*Bombina variegata* (l., 1758)	4	3	2.36	0	0	0
5.	*Bufo bufo* (L., 1758)	4	3	2.36	3	3	2.36
6.	*Epidalea viridis* (Laurenti, 1768)	12	9	7.09	150	11	8.66
7.	*Pelobates syriacus* Boettger, 1889	2	2	1.57	1	1	0.79
8.	*Rana dalmatina* Bonaparte, 1840	4	3	2.36	5	4	3,15
9.	*Pelophylax ridibundus* (Pallas, 1771)	6	4	3,15	426	54	42.52
10.	*Hyla arborea* (L., 1758)	5	4	3,15	21	11	8.66
Reptilia							
1.	*Mediodactylus kotschyi (Steindachner, 1870)*	10	10	7.87	132	16	12.60
2.	*Ablepharus kitaibellii* Bibron et Bory, 1833	1	1	0.79	0	0	0
3.	*Lacerta trilineata* Bedriaga, 1886	7	5	3.94	7	7	5.51
4.	*Lacerta viridis* (Laur., 1768)	6	4	3,15	61	31	24.41
5.	*Podarcis muralis* (Laur., 1768)	1	1	0.79	0	0	0
6.	*Podarcis tauricus* (Pallas, 1814)	7	7	5.51	38	10	7.87
7.	*Emys orbicularis* (L., 1758)	3	3	2.36	11	9	7.09
8.	*Trachemys scripta elegans* (Wied-Neuwied, 1839)	0	0	0	2	2	1.57
9.	*Testudo graeca* L., 1758	2	2	1.57	0	0	0
10.	*Testudo hermanni* (Gmelin, 1789)	2	2	1.57	0	0	0
11.	*Dolichophis caspius* Gmelin, 1789	1	1	0.79	12	11	8.66
12.	*Coronella austriaca* Laur., 1768	1	1	0.79	0	0	0
13.	*Zamenis longissimus* (Laurenti, 1768)	2	2	1.57	0	0	0
14.	*Elaphe sauromates* (Pallas, 1814)	2	2	1.57	0	0	0
15.	*Natrix natrix* (L., 1758)	5	5	3.94	5	5	3.94
16.	*Natrix tessellata* (Laur., 1768)	3	3	2.36	9	9	7.09
17.	*Vipera ammodytes* (L., 1758)	1	1	0.79	0	0	0

Legend: N – number of localities, U – number of UTM quadrants (1x1 km), A – distribution index.

KALCHEV (1961). In this study the Yellow-bellied Toad was not registered in the study area, but was found north of Parvenets Village - LG0661 and LG0662, 02.VIII.2005 (Georgiev, Plovdiv, pers. comm., 2005).

Bufo bufo (Linnaeus, 1758) – Common Toad

The species is rare for Plovdiv. In the literature is reported by KOVACHEV (1912), ANGELOV (1960), ANGELOV & KALCHEV (1961) and MOLLOV (2005b). In the present study was found in 3 localities in 3 UTM quadrants (Appendix 1).

Epidalea viridis (Laurenti, 1768) - Green Toad

The Green Toad is one of the most common amphibian species in the city. In literature is reported by CYREN (1941), BURESH & TSONKOV (1941) ANGELOV (1960a, b), ANGELOV & KALCHEV (1961), EUZET *et al.*

(1974), MOLLOV (2005a,b) and VALKANOVA *et al.* (2009). In this study the species was recorded in 150 localities in 11 UTM quadrants (Appendix 1).

Pelobates syriacus Boettger, 1889 - Syrian Spadefoot Toad

From all identified amphibian species the Syrian Spadefoot Toad is the rarest. From the city it has been reported so far only by ANGELOV & KALCHEV (1961) for the "Ostrova" area and DŽUKIĆ *et al.* (2008) for The State Fishery Pond. Detailed examination of the distribution of the species in the city and the country has been made in our previous study (MOLLOV *et al.* 2007), which includes the only locality found in this study period - LG1629.

Pelophylax ridibundus (Pallas, 1771) – Marsh Frog

This is the most common amphibian in the city. So far, from literary data it has been reported only from the outskirts of Plovdiv by ANGELOV (1960a, b), BACHVAROV (1968), POPOV (1973, 1975), DONEV (1984, 1986). In the present study was recorded throughout the studied area with a total of 426 localities in 54 UTM quadrants (Appendix 1).

Rana dalmatina Bonaparte, 1839 – Agile Frog

The Agile Frog is a relatively rare species in the study area and currently in the literature is reported only from around the city (near the "Ostrova" are and Komatevo) by ANGELOV (1960), ANGELOV & KALCHEV (1961) and BACHVAROV (1980). In this study the species is also found only in the outskirts of the city with a total of 5 localities in 4 UTM quadrants (Appendix 1). In the Bulgarian herpetological literature there is a report for the Common Frog (*Rana temporaria*) for the city of Plovdiv from the KOVACHEV (1905b). In our opinion, this report concerns the Agile Frog or it is a mistake. Due to the low altitude of the city, finding a Common Frog in it is quite improbable.

Hyla arborea (Linnaeus, 1758) - Tree Frog

The tree frog has been reported as "common" species from the outskirts of Plovdiv by ANGELOV (1960a, b) and ANGELOV & KALCHEV (1961) and the hills of Plovdiv by MOLLOV (2005a). In this study the species was found only in the outskirts of the city and in Mladezhki Halm Hill in the city center with a total of 21 localities in 11 UTM quadrants (Appendix 1).

Classis Reptilia (Reptiles)

Testudo graeca Linnaeus, 1758 – Spur-thighed Tortoise

The Spur-thighed Tortoise has been reported for the "outskirts of Plovdiv" by BURESH & TSONKOV (1933) and the "Ostrova" Area in Plovdiv by ANGELOV (1960). The species was recorded in the city on the Halm na osvoboditelite Hill (LG1628) on 13.IV.1999 (Nikolov, Plovdiv, pers. comm., 1999) and in a open meadow near arable land and farm buildings east of Trakia Quarter (LG1687) on 21.VI.2000, (Irikov, Plovdiv, pers. comm., 2000), but was not recorded in this study. According to BESHKOV & NANEV (2002) in many places in the Thracian Valley tortoises are destroyed by the human activity. Finding tortoises in the research area in our opinion should be considered accidental because most likely these are cases of specimens collected from other places in Bulgaria, kept alive as souvenirs and then released in various places in the city.

Testudo hermanni (Gmelin, 1789) - Hermann's Tortoise

The Hermann's tortoise has been reported by SHKORPIL (1897) for Plovdiv and one indeterminate species (*Testudo sp.*) by DRENSKI (1955). The species was registered in the city of Plovdiv on 12.V.2000 in the area of The Rowing Channel – LG0697 (Kirov, Ruse, pers. comm., 2000), but not in this study. According to BESHKOV & NANEV (2002) this species is absent in many places in the lowlands of northern Bulgaria and Thrace, which was destroyed by modern agriculture and the general modification of the landscape. We assume that the recorded specimens in Plovdiv are probably released tortoises, which had previously been kept alive as souvenirs collected from other parts of Bulgaria.

Emys orbicularis (L., 1758) - European Pond Turtle

The European Pond turtle has been reported for "Maritsa River in Plovdiv" by KOVACHEV (1910), "near the "Ostrova" area in Plovdiv" by ANGELOV (1960) and State Fisheries – Plovdiv by KIRIN (2001). In the current study it was recorded with a total of 11 localities in 9 UTM quadrants (Appendix 2).

Trachemys scripta elegans (Wied-Neuwied, 1839) – Red-eared Slider

The Red-eared Slider is a decorative freshwater turtle species, sold in pet shops as a pet. Unfortunately, when the turtles become too large to be kept in captivity, owners release them in different places in the country. Because of the high ecological plasticity of the species it successfully survives in natural conditions and that is why it has become a potentially dangerous invasive species in Europe (CADI & JOLY, 2004). So far there are two records of Red-eared sliders in Plovdiv. The first one is from 2004 when a specimen was spotted on the banks of Maritsa River near the bridge of the International fair - LG1649 (Dulev, Plovdiv, pers. comm., 2004) and the second was registered in this study - 14.07.2008 – a couple (male and female), released in a fountain in the garden behind the Natural History Museum (LG1648).

Mediodactylus kotschyi (Steindachner, 1870) – Kotschyi's Gecko

This is an extremely common and widespread species in Plovdiv (SHKORPIL, 1897; KOVACHEV, 1905b; 1910; 1912; BURESH & TSONKOV, 1933; MÜLLER, 1940; MOLLOV, 2005a). In Plovdiv is spread the endemic for Bulgaria subspecies "*rumelicus*" (BESHKOV & NANEV, 2002). In the current study the species was registered with 132 localities in 16 UTM quadrants (Appendix 2).

Ablepharus kitaibellii Bibron et Bory, 1833 - European Copper Skink

The European Copper Skink was found for the first time at Mladezhki Halm Hill in Plovdiv in a previous study (MOLLOV, 2005a) with two localities of the southern part of the hill on 31.III.2003 and in eastern on 02.V.2003. Unfortunately, the species was not re-recorded in this study.

Lacerta trilineata Bedriaga, 1886 – Balkan Green Lizard

This lizard was reported in and around the city center by KOVACHEV (1907, 1912), BURESH & TSONKOV (1933), ANGELOV *et al.* (1966) and MOLLOV (2005a). In the current study it was found only in the outskirts of the city with total 7 localities in 7 UTM quadrants (Appendix 2).

Lacerta viridis (Laurenti, 1768) - Green Lizard

This is the most common lizard species in the research area. It was reported by BURESH & TSONKOV (1933), ANGELOV (1960), ANGELOV *et al.* (1966), DONEV (1984d) and MOLLOV (2005a). In this study it was recorded with total of 61 localities in 31 UTM quadrants (Appendix 2).

Podarcis muralis (Laurenti, 1768) – Common Wall Lizard

This species is a typical petrophile – it inhabits only rocky and stony terrains. Therefore in the research area it was recorded only at two of the Plovdiv hills (KOVACHEV, 1905b; MOLLOV, 2005a). It seems that this species in Plovdiv is isolated from the other populations, but it exists due to the presence of near-natural conditions at the hills. The species was not recorded in the current study.

Podarcis tauricus Pallas, 1811 – Balkan Wall Lizard

The Balkan Wall Lizard is a relatively common species both in the urban and rural parts of Plovdiv (KOVACHEV, 1912; CYRÉN, 1933; BURESH & TSONKOV, 1933; DONEV, 1984b; MOLLOV, 2005a; MOLLOV & VALKANOVA, 2009). In the present study was established with a total of 38 localities in 10 UTM quadrants (Appendix 2).

Dolichophis caspius (Linnaeus, 1758) - The Caspian Whipsnake

This is the most common snake species in the research area. In this study it was recorded with 12 localities in 11 UTM quadrants (Appendix 2).

Coronella austriaca Laurenti, 1768 – Smooth Snake

So far, the species is reported for Plovdiv only by KOVACHEV (1905b, 1912). MOLLOV (2005a) reported finding a skin-shed of a young smooth snake at Mladezhki Halm Hill, but later when re-defining the material is found that the skin-shed belongs to a Caspian Whipsnake (*D. caspius*). In our opinion the Smooth snake has disappeared from the city limits.

Zamenis longissimus (Laurenti, 1768) - Aesculapian Snake

So far, the Aesculapian snake is reported for Plovdiv only by KOVACHEV (1912) and BURESH & TSONKOV (1934). Since then, the species has not been found again. It wasn't recorded in the current study.

Elaphe sauromates (Pallas, 1814) - Blotched Snake

Up to this moment the species is reported to the outskirts of Plovdiv only KOVACHEV (1912) and BURESH & TSONKOV (1934). Since then, not been found again and was not recorded in this study.

Natrix natrix (Linnaeus, 1758) - Grass Snake

The Grass snake has limited distribution in the city. So far the species is reported for the outskirts of Plovdiv by KOVACHEV (1912), BURESH & TSONKOV (1934), ANGELOV (1960), BACHVAROV (1969) and KIRIN (1994b). In the present study it was found in a total of 5 localities in 5 UTM quadrants (Appendix 2).

Natrix tessellata (Laurenti, 1768) - Dice Snake

This species occurs more frequently than the Grass snake. So far for Plovdiv it has been reported by KOVACHEV (1912), ANGELOV (1960) and KIRIN (1994a). In the present study it was found in a total of 9 localities in 9 UTM quadrants (Appendix 2).

Vipera ammodytes (Linnaeus, 1758) – Long-nosed Viper

The Long-nosed viper has been reported for Plovdiv only by KOVACHEV (1905b, 1912). It was not recorded in this study.

Retrospective analysis of the batraho- and the herpetofauna in the study area

The results of our study on the species composition and distribution of amphibians and reptiles in Plovdiv show a significant change in the last 100 years when comparing them with existing literary data.

From a total of 10 species of amphibians reported for the city of Plovdiv, in this study were found only 6. For the reptiles of 17 species reported for the city in this study were found only 9. In both groups, occurred around 50% reduction in the number of species. To trace the changes in the frequency of occurrence of amphibians and reptiles in the study area in time, we conducted an analysis of available data from the available literature sources (Table 2), using the calculated index of distribution. This enables us to gain even a vague idea about the state of the species of amphibians and reptiles in the past and compare it with their present condition. From the analysis of these data we could make some predictions for the future existence of the amphibians and reptiles in urban environment.

Of all recorded amphibian species four are increasing their frequency of occurance (Table 2), but only two were distributed almost throughout the whole study region and are relatively numerous - *Pelophylax ridibundus* and *Epidalea viridis*. One of the positive circumstances, which encouraged the widespread of the Marsh Frog, is the species' preference to the slow flowing waters. The presence of the Maritsa River and Parvenetska River and a dense network of irrigation canals in the outskirts of the city have played a peculiar role of corridors for the distribution of species in the urban area. Moreover, the high ecological plasticity of the species is well known and unlike most species of amphibians *Pelophylax ridibundus* can be found even in highly polluted water (LEONTEVA & SEMENOV, 1999). The Green Toad on the other hand is relatively drought-loving species and it uses for breeding small temporary ponds, which also abundant in the city. These circumstances and the fact that it is "explosive" breeding species and unlike the Common Toad (*Bufo bufo*) is not attached to the place of the laying of the eggs (KÜHNEL & KRONE, 2003), further

contributes to the prevalence of this species in the city.

Aside from both newt species and yellow- and fire-bellied toads both considered missing from the study area, the state of the remaining amphibian species remained relatively unchanged.

Table 2. Retrospective analysis of the batracho- and herpetofauna in the studied area

Species	Distribution index (A) - past state (1905-2005)	Dynamics	Distribution index (A) - current state (2007-2009)
Amphibia			
Triturus karelinii	2.36	disappearing	0
Lissotriton vulgaris	3,15	disappearing	0
Bombina bombina	2.36	disappearing?	0
Bombina variegata	2.36	disappearing?	0
Bufo bufo	2.36	no change	2.36
Epidalea viridis	7.09	increasing	8.66
Pelobates syriacus	1.57	decreasing	0.79
Rana dalmatina	2.36	increasing	3,15
Pelophylax ridibundus	3,15	increasing	42.52
Hyla arborea	3,15	increasing	8.66
Reptilia			
Mediodactylus kotschyi	7.87	increasing	12.60
Ablepharus kitaibelii	0.79	decreasing?	0
Lacerta trilineata	3.94	increasing	5.51
Lacerta viridis	3,15	increasing	24.41
Podarcis muralis	0.79	decreasing?	0
Podarcis tauricus	5.51	increasing	7.87
Emys orbicularis	2.36	increasing	7.09
Trachemys scripta	0	accidental	1.57
Testudo graeca	1.57	accidental	0
Testudo hermanni	1.57	accidental	0
Dolichophis caspius	0.79	increasing?	8.66
Coronella austriaca	0.79	disappearing	0
Zamenis longissimus	1.57	disappearing	0
Elaphe sauromates	1.57	disappearing	0
Natrix natrix	3.94	no change	3.94
Natrix tessellata	2.36	increasing	7.09
Vipera ammodytes	0.79	disappearing	0

Seven species of reptiles (*Mediodactylus kotschyi, Lacerta viridis, Lacerta trilineata, Podarcis tauricus, Emys orbicularis, Dolichophis caspius* and *Natrix tessellata*) are widely available in town and are in stable condition (Table 2). It should be noted that the distribution of the Balkan gecko in the city of Plovdiv is probably much wider than the recorded in this study, because the species occupied buildings, which are not accessible and it is difficult to record its presence.

The situation with the Grass snake (*Natrix natrix*) and the Dice snake (*Natrix tessellata*) in the city is interesting. In the current study, we record no change of the localities and frequency of occurrence of the

Grass snake and increase in the Dice snake. This may be due to the fact that *Natrix natrix* requires relatively large portions of unfragmented habitats and stable food base - mainly fish and frogs (LEONTEVA & SEMENOV, 1999), which are available mainly along Maritsa River and some parts in the outskirts of the city. This limits the speacie's distribution within the city, while the Dice snake occurs in irrigation canals and other more unsuited water bodies and it seems it has a higher ecological plasticity than the Grass snake.

The larger and easier to spot, thus more frequently becoming victims of humans, representatives of the snakes like *Coronella austriaca, Zamenis longissimus, Elaphe sauromates* and *Vipera ammodytes,* which have more specific habitat requirements are missing from the territory of the city.

The occurance of the two tortoise species and the Red Eared Slider in the city should be considered as accidental.

Important herpetological areas in the study region

Based on the number of localities and number of species detected, using the Kernel Index we identified the Important Herpetological Areas in the study region (Fig. 2).

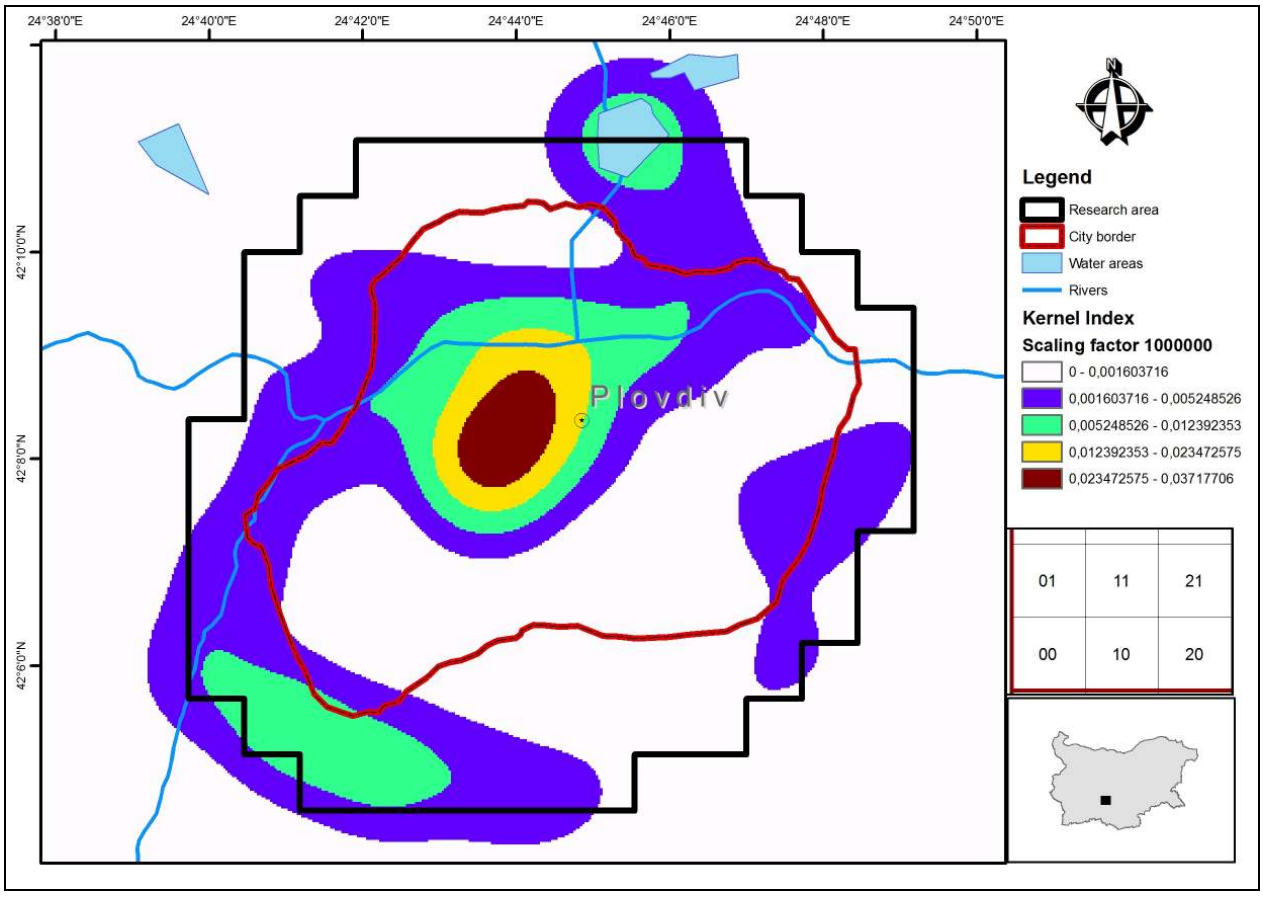

Fig. 2. Important Herpetological Areas in the study region.

Contrary with most urban studies on amphibian and reptile fauna, where the species richness declines form the rural parts of the city to its center (HAMMER & MCDONNELL, 2008; MCKINNEY, 2008), we identified the most number of species with the largest number of localities in the center of the city of Plovdiv. This is due to the position of the Hills of Plovdiv – areas which resemble natural conditions more closely which are in fact in the center of the city (MOLLOV, 2005). Along with that the center section of Maritsa River and the lower section of Parvenetska River offer good conditions for the spread of

amphibians and some reptiles. The irrigation cannals in the southern and eastern part of the city along with the State Fishery Ponds in the north are also playing significant role in the distribution of the amphibians and reptiles in the urbanized territory.

Most of the identified IHAs are with the boundaries of the three protected territories in the center of the city and with NATURA2000 sites. Nevertheless conservation measures concerning the amphibians and reptiles within the city of Plovdiv should be applied with priority for these areas.

Conclusions

In summary, from the data from retrospective analysis of the batraho- and the herpetofauna in the research area can be drawn the following conclusions:

- 4 species of amphibians (*Triturus karelinii, Lissotriton vulgaris, Bombina bombina, B. variegata*) and 4 reptiles (*Coronella austriaca, Zamenis longissimus, Elaphe sauromates, Vipera ammodytes*) probably have disappeared from the research area for the past 100 years;

- 1 species of amphibians (*Bufo bufo*) and 1 reptile species (*Natrix natrix*) have not changed their status over the past 100 years;

- 1 amphibian species (*Pelobates syriacus*) and 2 reptile species (*Ablepharus kitaibelii, Podarcis muralis*) have reduced their frequency of occurrence and the last 100 years;

- 4 amphibian species (*Epidalea viridis, Rana dalmatina, Pelophylax ridibundus, Hyla arborea*) and 7 reptile species (*Mediodactylus kotschyi, Lacerta trilineata, Lacerta viridis, Podarcis tauricus, Emys orbicularis, Dolichophios caspius, Natrix tessellata*) have increased their localities and frequency of occurrence for the past 100 years.

- The finding of the two tortoises in the city, and the presence of Red-eared Slider should be considered as accidental.

In our opinion, monitoring of the status and distribution of the batraho- and the herpetofauna in Plovdiv, and in other cities in the country is an important aspect of environmental studies as the results of such studies could help to take appropriate conservation measures for these species in urban environments.

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Appendix 1. Amphibian distribution in the city of Plovdiv and its surroundings, registered in the current study based on UTM grid 1x1 km.

Bombina bombina - LG0754; *Bombina variegata* - LG0661, LG0662; *Bufo bufo* - LG1732, LG1608, LG1676; *Bufo viridis* - LG1730, LG1624, LG1626, LG1627, LG1628, LG1636, LG1637, LG1638, LG1648, LG1674, LG1675; *Pelobates syriacus* - LG1629; *Pelophylax ridibundus* - LG0790, LG1700, LG1710, LG1720, LG1750, LG1760, LG1770, LG1741, LG1751, LG1761, LG1752, LG1762, LG0693, LG0697, LG0698, LG0683, LG0684, LG0685, LG0686, LG0687, LG0688, LG0689, LG0674, LG0675, LG0676, LG1602, LG1603, LG1608, LG1609, LG1612, LG1613, LG1617, LG1618, LG1619, LG1622, LG1623, LG1629, LG1632, LG1639, LG1642, LG1649, LG1659, LG1663, LG1664, LG1669, LG1674, LG1675, LG1676, LG1679, LG1686, LG1687, LG1689, LG1697, LG1698; *Rana dalmatina* - LG0674, LG0675, LG1685, LG1686; *Hyla arborea* - LG0697, LG0674, LG0675, LG1621, LG1627, LG1686, LG1697, LG1700, LG1733, LG1743, LG1751.

Appendix 2. Reptilian distribution in the city of Plovdiv and its surroundings, registered in the current study based on UTM grid 1x1 km.

Testudo graeca - LG1628, LG1687; *Testudo hermanni* - LG0697; *Emys orbicularis* - LG1710,

LG1720, LG1762, LG1783, LG1607, LG1608, LG1619, LG1629, LG1649; *Trachemys scripta elegans* - LG1649, LG1648; *Mediodactylus kotschyi* - LG1616, LG1617, LG1626, LG1627, LG1628, LG1629, LG1636, LG1637, LG1638, LG1639, LG1649, LG1658, LG1659, LG1665, LG1676, LG1678; *Lacerta trilineata* - LG0674, LG0675, LG0687, LG1607, LG1608, LG1676, LG1686; *Lacerta viridis* - LG0692, LG0693, LG0697, LG0698, LG0683, LG0684, LG0687, LG0673, LG0674, LG0675, LG0676, LG1602, LG1603, LG1607, LG1612, LG1613, LG1622, LG1627, LG1629, LG1638, LG1639, LG1643, LG1649, LG1667, LG1675, LG1686, LG1697, LG1700, LG1741, LG1751, LG1760; *Podarcis tauricus* - LG0687, LG1616, LG1617, LG1625, LG1626, LG1627, LG1628, LG1667, LG1675, LG1678; *Dolichophis caspius* - LG0693, LG0694, LG0695, LG0696, LG1608, LG1612, LG1617, LG1627, LG1656, LG1657, LG1659; *Natrix natrix* - LG0689, LG0674, LG1629, LG1686, LG1752; *Natrix tessellata* - LG0675, LG0689, LG1602, LG1608, LG1611, LG1619, LG1629, LG1639, LG1752.

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