South Western Journal of Horticulture, Biology and Environment
P-Issn: 2067- 9874, E-Issn: 2068-7958

Vol.4 , No.2, 2013
pp. 137-149

SOME DATA UPON THE HERPETOFAUNA AND TERRESTRIAL ISOPODS FROM BEIUŞ TOWN, ROMANIA

Alexandra Anca BODIN[1], Sára FERENŢI[2 3], Raluca IANC[2] and Severus-Daniel COVACIU-MARCOV[2 *]

1. "Episcop Nicolae Popoviciu" Municipal Hospital, Romana str. No. 7, Beius, Romania
2. University of Oradea, Faculty of Sciences, Department of Biology, Universitatii str. 1, 410087 Oradea, Romania
3. "Iosif Vulcan" National College, Jean Calvin str. No. 3, Oradea, Romania
*Corresponding author: scovaciumarcov@yahoo.com

ABSTRACT. *In 10 sites from Beiuş town, located in western part of Romania, we identified 10 species of herpetofauna and 15 species of terrestrial isopods. In both cases, most of the species occupy natural habitats with high humidity, located on the outskirts of the city. The isopods are present in all 10 sites, whereas herpetofauna inhabits only half of them. In the highly anthropogenic affected areas from the town center there are present only common and synanthropic species of terrestrial isopods whereas those of herpetofauna lacks. In the case of both herpetofauna and terrestrial isopods the most common species in Beiuş are also common in Romania. However, in both groups we identified species related to natural areas. Due to its reduced dimensions and relative isolation, in Beiuş town we did not identified any exotic species.*

KEYWORDS*. woodlice, amphibians, reptiles, habitats, human influence, native species.*

INTRODUCTION

Herpetofauna and woodlice are two groups of terrestrial animals usually with a distribution linked to certain environmental conditions and restrictive

habitat requirements (e.g. Fuhn 1960, Fuhn and Vancea 1961, Cogalniceanu et al. 2000, Radu 1983, 1985). To our best knowledge, these two groups were not studied together before, maybe because they are extremely different anatomically as well as taxonomically. However, their association with specific local environmental conditions and limited possibilities of movement may lead to the possibility to treat them together from a zoogeographic point of view. In both groups of animals, urban studies were realized recently in Romania (Giurgincă 2006, Strugariu et al. 2007, Ghiurcă and Gherghel 2008). In the past few years, studies on the two groups were made separately, in different localities from other countries (e.g. Mollov 2005, Gardner and Jasper 2009, Purkayastha et al. 2011, Hornung et al. 2007a, Riedel et al. 2007, Vilisics and Hornung 2009, Vignoli et al. 2009, Vilisics et al. 2012). Although in western part of Romania, during the last period, many studies have been conducted on herpetofauna (e.g. Covaciu-Marcov et al. 2003, 2006, 2008, 2009, Gaceu and Josan 2013, Bogdan et al. 2011, 2013), and recently on the terrestrial isopods (e.g. Tomescu et al. 2008, Ferenţi et al. 2012a,b,c, 2013a, Ferenţi and Dimancea 2012), but none of these focused on urban habitats, despite of their extension and importance. Therefore, we aimed to analyse the distribution of these two groups in the region of Beiuș town from the western part of Romania, and also to determine to what extent they follows the distribution rules of native fauna from the area, or the rules of urban fauna established in other regions. As previously was found in other studies, in case of terrestrial isopods, the cities, or at least the large ones, shelters native species and at the same time may be a hot spot for some exotic species introduced recently (Vilisics and Hornung 2009). But is this also true for a small and relatively isolated town?

MATERIAL AND METHODS

The Beiuș town is located in the southern part of Bihor County, in western Romania, in Beiuș Depression. It is surrounded by Pădurea Craiului Mountains, Bihor Mountains, Codru Moma Mountains and Răbăgani Hill (Posea and Badea 1984). The town is located in northern part of the depression, at an altitude of

approximately 190 m a.s.l., having mostly a plan relief, only in north-east part is in contact with few low hills. The locality is crossed by Crisul Negru River and its tributary, Nimăiești Valley.

The fieldwork was conducted in early may of 2013. The study of herpetofauna implied direct observation method, of both live animals and those killed by cars, as it was done in other studies (e.g. Covaciu-Marcov et al 2006, Bogdan et al. 2011, 2013). Terrestrial isopods were collected under different shelters, directly by hand, or in case of the small-sized species with tweezers. Although in other studies the isopods from cities were collected with pitfall traps (e.g. Riedel et al. 2007, Vilisics et al. 2012), we preferred to use direct method because it is both faster and more important, because with pitfall traps are captured especially species with high mobility (e.g. Tomescu et al. 2008, Magrini et al. 2011). The diversity of terrestrial isopods assemblages was calculated with Shannon-Wiever index (Shannon-Wiever 1949), and the evenness with Pielou index (see in: Magurran 1988).

Both in terms of the herpetofauna as well as the terrestrial isopods we studied a number of 10 sites, represented in general by habitats with different characteristics. From these, three were natural and relatively natural and seven were strongly affected and anthropogenically modified. The first category includes Delani forest, an oak forest located east of the city boundaries, Nimăiești valley from upstream of the city, represented by a stream with rocky substrate surrounded by river meadows with alder and the habitat from under the bridge, situated on the Crisul Negru river bank, surrounded by willows and poplars. Out of the seven anthropogenically modified habitats, one is represented by an adjacent area to a school, two graveyards (one abandoned and the other one trimmed), a train station, the regulated and concreted banks of Nimăiești Valley inside the town and two different streets (one from the town center and the other one from its outskirts).

RESULTS

In the region of Beiuș town we identified 10 species of herpetofauna (*Triturus cristatus, Bombina variegata, Epidalea viridis, Hyla arborea, Rana dalmatina, Pelophylax ridibundus, Lacerta agilis, L. viridis, Natrix natrix, N. tessellata*) and 15 species of terrestrial isopods (*Trichoniscus sp., Hyloniscus riparius, H. transsilvanicus, Haplophthalmus danicus, Cylisticus convexus, Porcellium collicola, Protracheoniscus politus, Trachelipus arcuatus, T. nodulosus, T. ratzeburgii, Porcellionides pruinosus, Porcellio*

scaber, P. spinicornis, Armadillidium vulgare, A. versicolor). Unfortunately, from the Genus Trichoniscus we captured only one female, so the species could not be determined exactly. The distribution of these two groups is, at least apparently different, species of herpetofauna being present in only 5 from the 10 studied sites, while the isopods were found all over. However, important differences were recorded between isopods assemblages from different habitat types (Table 1).

In the case of both groups the most favorable habitat, where we identified most of the species, was Nimăiești Valley upstream of the city (Table 1). This has a high humidity level and is the most natural of the investigated habitats. At least in the case of herpetofauna, almost all populated habitats presents permanent water. Generally, herpetofauna is missing from anthropogenically modified habitats, but also from some natural ones. In some cases, in natural habitats as well as in the anthropogenic modified ones, the terrestrial isopods presents the same number of species, but not the same species. Nine of the 15 terrestrial isopods species were identified only in one from the 10 studied sites. Whereas, in case of the herpetofauna, 8 from the 10 identified species were found in only one sit.

The most common species of herpetofauna from Beiuș town is *P. ridibundus* and the most common species of terrestrial isopods is *T. nodulosus*, which records both the highest frequency as well as the highest percentage abundance (Table 2). In the case of terrestrial isopods, we collected 205 individuals, thus the average number of individuals/sit was 20,5. From the total of 205 collected individuals, 45 were males, 98 females and 62 juveniles. The diversity of terrestrial isopods assemblages was: H=1,69 and the evenness was: E=0,62.

DISCUSSIONS

Within the herpetofauna as well as terrestrial isopods, the best represented species in the region of Beiuș are common and widespread in Romania.

Table 1 Species` presence in the 10 studied sites (1-under the Crisul Negru bridge, 2-school, 3-new graveyard, 4-old graveyard, 5-upstream Nimăiești Valley, 6-Nimăiești Valley in the town, 7-outlying streets, 8- Delani forest, 9-center streets, 10-train station, T-total).

Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**T**
Herpetofauna											
Triturus cristatus	-	-	-	-	X	-	-	-	-	-	1
Bombina variegata	-	-	-	-	X	-	-	-	-	-	1
Epidalea viridis	-	-	-	-	-	-	X	-	-	X	2
Hyla arborea	-	-	-	-	-	-	-	-	-	X	1
Rana dalmatina	-	-	-	-	X	-	-	-	-	-	1
Pelophylax ridibundus	X	-	-	-	X	X	-	-	-	X	4
Lacerta agilis	-	-	-	-	-	X	-	-	-	-	1
Lacerta viridis	-	-	-	-	X	-	-	-	-	-	1
Natrix natrix	-	-	-	-	X	-	-	-	-	-	1
Natrix tessellata	X	-	-	-	-	-	-	-	-	-	1
Total species / site	**2**	**-**	**-**	**-**	**6**	**2**	**1**	**-**	**-**	**3**	**-**
Terrestrial isopods											
Trichoniscus sp.	-	-	-	X	-	-	-	-	-	-	1
Hyloniscus riparius	-	-	X	-	X	-	-	-	-	X	3
Hyloniscus transsilvanicus	-	-	-	-	X	-	-	-	-	-	1
Haplophthalmus danicus	-	-	-	X	-	-	-	-	-	-	1
Cylisticus convexus	-	-	-	-	X	X	-	-	-	-	2
Porcellium collicola	-	-	-	-	X	-	-	-	-	-	1
Protracheoniscus politus	-	-	-	-	-	-	-	X	-	-	1
Trachelipus arcuatus	-	-	-	-	X	-	-	-	-	-	1
Trachelipus nodulosus	X	X	X	-	X	X	X	-	X	-	7
Trachelipus ratzeburgii	-	-	-	-	-	-	-	X	-	-	1
Porcellionides pruinosus	-	-	-	-	X	-	-	-	-	-	1
Porcellio scaber		X	-	-	X	X	X	-	X	-	5
Porcellio spinicornis	-	X	-	-	-	-	-	-	-	-	1
Armadillidium vulgare	-	X	X	-	-	-	X	-	X	X	5
Armadillidium versicolor	X	-	-	-	X	X	X	X	-	-	5
Total species / site	**2**	**4**	**3**	**2**	**9**	**4**	**4**	**3**	**3**	**2**	**-**

Table 2. The percentage abundance and frequency of terrestrial isopods from Beiuș

Species	Percentage abundance (%)	Frequency of occurrence (%)
Trichoniscus sp.	0.488	10
Hyloniscus riparius	5.366	30
Hyloniscus transsilvanicus	0.488	10
Haplophthalmus danicus	2.439	10
Cylisticus convexus	2.927	20
Porcellium collicola	0.976	10
Protracheoniscus politus	2.439	10
Trachelipus arcuatus	0.488	10
Trachelipus nodulosus	53.17	70
Trachelipus ratzeburgii	0.976	10
Porcellionides pruinosus	0.488	10
Porcellio scaber	9.268	50
Porcellio spinicornis	0.976	10
Armadillidium vulgare	7.805	50
Armadillidium versicolor	11.71	50

Therefore, *P. ridibundus* along with *P. esculentus*, are the best represented amphibians from the country (see in: Cogalniceanu et al. 2013a). The wide distribution of this species in Beiuș may be due to its tolerance even to polluted habitats (Sils 2010). Furthermore, the species` tolerance is also indicated by the large number of populations from thermal habitats (see in: Sas et al. 2012), and by its recent discover in marine environment (Natchev et al. 2011) or in sulfurous waters (Iftime and Iftime 2012). Among the isopods, *T. nodulosus* is a relatively common species in Romania (Radu 1985). In recent years it was frequently identified in different habitat types

from north-western part of the country (Tomescu et al. 2008, Ferenţi et al. 2012a,b, 2013a, Ferenţi and Dimancea 2012). Moreover, this is a xerophilous species typical for open areas (see in: Farkas 2010), being frequently recorded near thermal waters from north-western Romania, generally in anthropogenically affected habitats (Ferenţi et al. 2013b). Therefore, the presence of *T. nodulosus* in Beiuș, in both natural as well as anthropic altered habitats, is not unexpected. Also, the majority of the other species from the town are common in Romania.

All 10 species of herpetofauna were recorded before in Beiuș Depression (Covaciu-Marcov et al. 2003). In the case of isopods only seven species were recorded previously in this region (Tomescu et al. 2008). This may be a result of the fact that in the area was conducted only one study on terrestrial isopods and even that one was done with pitfall traps installed only in natural habitats in vicinity of three localities (Tomescu et al. 2008). However, in the case of isopods, according to specialty literature from Romania (e.g. Radu 1983, 1985) most of the species are common and widespread all over the country. Thus, the effect of homogenization can be observed, which seems to be characteristic to urban fauna, like in the case of isopods from others cities (see in: Vilisics et al. 2012). Nevertheless, at least in case of isopods from Beiuș, inside the town we also identified species that are typical for natural moist areas, such as *H. transsilvanicus* or *P. collicola* (Radu 1983, 1985). Both species were frequently recorded before in natural and humid areas from north-western Romania (Ferenţi et al. 2012a, 2013a). The fact may suggest that a small town, less industrialised and concreted, still harbors native fauna, at least in case of small-sized species. Whereas, in case of herpetofauna the fact is not verified as the species with an important conservative value are present only on town outskirts. Probably, the terrestrial isopod species, that are typical for moist and natural areas, are advantaged not only by the water courses that crosses the city, but also by the depression climate of the region (Mândruţ 2006).

In comparison to other cities, in Beiuș is present a lower number of isopod species than, for example, in Budapest (Vilisics and Hornung 2009). However, in Beiuș we identified with a species more than in Bucharest

(Giurginca 2006). This fact is surprising, taking into consideration the differences between these two localities. A relatively low number of species was also recorded in other cities where isopods were collected with pitfall traps (e.g. Riedel et al. 2007, Vilisics et al. 2009). In the case of herpetofauna there are differences comparing to other cities from Romania, due to low altitude and flat relief. Mountain species, such as *R. temporaria,* is absent from Beiuș (Fuhn 1960), but was recorded before in Suceava (Strugariu et al. 2007), a city with a colder climate and Scandinavian-Baltic influences (Mândruţ 2006).

In comparison to large cities such as Budapest, from Beiuș completely lacks numerous invasive species of exotic isopods, which were recently introduced in Budapest from regions with warmer climate (Vilisics and Hornung 2009). This is a consequence of reduced dimensions of Beiuș town, in which the public or private gardens and greenhouses are absent, but in Budapest, in these places were introduced those isopod species (Vilisics and Hornung 2009). At the same time, the relative isolation of the city in the middle of a depression as well as the undeveloped economy, have reduced the transports and thus the opportunity for these species to be introduced. However, it may be considered that some isopods were introduced in the past and naturalized, becoming afterwards common species with a wide distribution. Probably, this is the case of the species introduced in a large part of the Europe, as well as *A. vulgare, P. pruinosus* and *P. scaber* (see in: Cochard et al 2010). The absence of the recent introduced exotic species seems to be an obvious difference between the large, economically and recreationally developed, cities, and small, relative isolated towns. The last ones harbor only terrestrial isopod assemblages, which are characteristic to the neighboring natural areas.

In contrast to isopods, the herpetofauna from Beiuș is not only poorer in species, but also these species can not use the most of habitats used by terrestrial isopods. Probably, the small number of herpetofauna species from Beiuș is a consequence of the low number of species from Romania (Cogălniceanu et al. 2013a,b), comparing with isopods species (Radu 1983, 1985). The herpetofauna lacks from the strongly affected habitats from the town, where are present isopod species as: *T. nodulosus*, *P.*

scaber and *A. vulgare*. In contrast to herpetofauna, the isopods are able to use those habitats both because of their feeding on detritus (Radu 1983), as well as their small size and nocturnal lifestyle that makes them avoid the contact with humans. Actually, in those areas, some times is present only the amphibian *E. viridis*, a species commonly observed in cities (Cogălniceanu et al. 2000, Kovács and Sas 2010).

Although, at the first sight in Beiuș the herpetofauna distribution differs to that of terrestrial isopods, there is an obvious common fact. Namely, in case of both groups the best habitat is the one located on Nimăiești Valley upstream the town, which is the most natural and moist habitat. Therefore, even though these two groups relates different to anthropogenic modified areas, their connection with natural areas is the same. In natural habitats there are species that lacks from the other habitats, native species that are sensitive to the aspect and quality of the habitat. Although, some terrestrial isopod species may get into the town along with certain habitats, in natural areas were also identified some other species. If isopod species linked to moist areas can reach the city along the water streams, the species characteristics to forests are more vulnerable to human activities, as a result they was identified only in this type of habitat. Namely, the sylvan species *P. politus* and *T. ratzeburgii* (Radu 1985) were identified only in city outskirts, in Delani forest.

The majority of herpetofauna species from Beiuș are protected by law, while the isopods are not mentioned in Romanian environmental legislation (O.U.G. 57 / 2007). The species with high conservative value are present in the area of Nimăiești Valley upstream the town. Unfortunately, even in its vicinity, on a paved road with low traffic we found road killed amphibians of protected species such as *T. cristatus.* Much more affected by road killing is *E. viridis,* a species identified in some areas of the town, in each one the individuals being killed by cars. The vulnerability of the species to road mortality was indicated in others region from Western Romania (Bogdan et al. 2013). The conservation of the herpetofauna from Beiuș should include the protection of aquatic habitats. The positive influence of aquatic habitats on urban herpetofauna was also observed in other localities (Vignoli et al. 2009).

ACKNOWLEDGEMENTS

The authors are grateful to anonymous referees for useful advice and suggestion on the previous version of the manuscript as they contributed much to improve it.

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