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Malacofaunistical, ecological and shell-morphometrical observations at two castle ruins (Cetatea Şiria and Cetatea Şoimoş) in the Zărand Mountains, Romania

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Abstract: The malacofauna of the two castle ruins consisted of 25 snails species, 65 new lots, 1127 individuals. Forest dwellers were dominant (43,4%), however *Cochlodina marisi* and *Laciniaria plicata* species were constant on the ruins and nearby area. Three endemic species were detected (*Cochlodina marisi*, *Drobacia banatica* and its mut. *viridana*, *Kovacsia kovacsi*). Morphometric results for some population of the *Drobacia banatica* and *Laciniaria plicata* from the Zărand Mts. and Hungarian Lowland was also presented.

Keywords: non-calcareous region, heterotrophic elements, habitat types, geographic range, endemic species, shell-morphometry

Introduction

The Zărand Mountains is situated in the Province II. Carpathian, in the district of the Bihar Mountains (II/3) (Soós 1934) and recently the district of the Banate (II/4) too. New limes between two earlier districts was delineated by Deli (2013). Previously only few species [*Helix pomatia* Linnaeus, 1758, *Cochlodina transsylvanica* Bielz, 1861 /*Cochlodina marisi* (Schmidt, 1857)] were mentioned by Brancsik (1890–1891), as well as by Soós (1943) from Világos/Şiria, but Grossu (1981) did not cite the malacofauna from this region.

Fundamental studies on the malacofauna of the Zărand Mountains were initiated in the Dumbroviţa (2001) and the Troaş (2002) stream valley (Domokos & Vánicsa 2005). The fieldwork was organized by Mr. George Iuga, biologist at the Natural History Department of Complexul Muzeal Arad.

Later Nordsieck (1993), Fehér et al. (2009), Subai (2011) and Deli & Subai (2011) presented new information on the *Lozekia* –*Kovacsia* species group and the species of *Agardhiella* and *Vitrea* from the Zărand Mountains.

Description of the sampling sites and collecting methods

In the course of the research, eight sites were sampled between 2005 and 2013. Three samples were gathered from the ruins of castle Şiria and five samples from the ruins of castle Şoimoş. Two sampling group were on the western (Şiria) and southern (Lipova-Şoimos) parts of the Zărand Mountains. The studied areas are about 20 kilometres apart (Fig.1.). The mean annual temperature in the Mureş River Valley is 10–11°C, in the environs of fortresses approximately 9–10 °C (Vituki 1958) and the annual precipitation is 700–800 mm (Hajósy 1954).

By my knowledge the castle hills are formed by granite, in places crystalline shales, granitoid and metamorphic rocks. These rocks and mortar (layer, coat) were used as building materials for the fortresses. The malacologist folklore keeps that in volcanic and metamorphic rock formations the malacofauna in terms of species numbers and abundance is poor. This is one of the reasons why the area is studied less intensively compared to limestone regions.

Already Rotarides (1941) called the attention on the mollusc community of the ruins and castle hills, because these living places originated from fragments, gravel of limestone or mortar, from which mollusks can get at lime in non-calcareous regions (Fig. 2.)

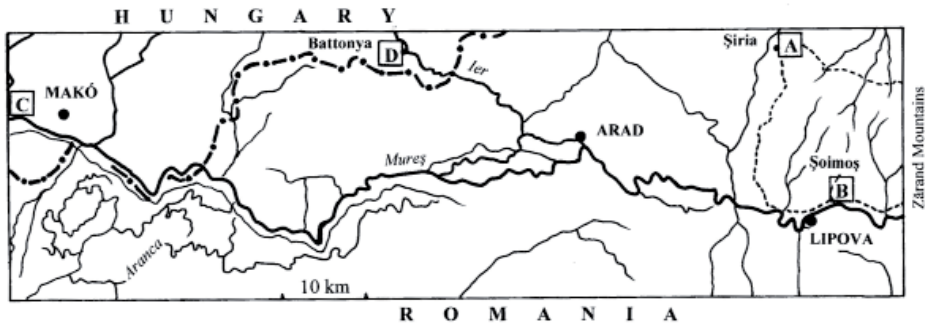


Fig.1. Hydrographic sketchmap of the Mureș River Valley between Lipova-Șoimoș and Makó. Figure explanations: A = Sampling sites of Șiria group; B = Sampling sites of Șoimoș group; C = Makó, Landor Forest (published sampling site of *Drobacia/Helicigona banatica*); D = Battonya, orchard (published sampling site of *Laciniaria plicata*). —●—●— national boundary, - - - limit of the Zărand Mountains.



Fig. 2. Rock vegetations at foot and on wall of the castle ruin (Photo by É. D. Megyesi).

The sampling was carried out using two sampling method: via singling and via mass collection. Because of rub, inhomogeneous surfaces of different habitats, mass sampling was done without using quadrats.



Fig. 3. Ruine of the down castle Şiria (Photo by É. D. Megyesi)

Sampling sites of Şiria group (A) — ASL: 496 m

1. Outside foot of the northeastern wall ruin of the Cetatea Şiria. In this wooded biotope the soil was covered granite rubble, mortar gravel, forest litter and fine woody debris as well as broken glass. Methods: sampling via mass (2 dm^3) and one by one collecting. Date: 2005. 10. 01., 2013. 10. 23.

2. Inside foot of the northwest wall ruin. One or two dm^2 sized biotope placed to the southeast. Method: one by one collecting. Date: 2005. 10. 01.

3. Outside foot of the southwest wall ruin. Sunny and nettle rock vegetation. Methods: via mass (2 dm^3) and one by one collecting. Date: 2013. 10. 23.

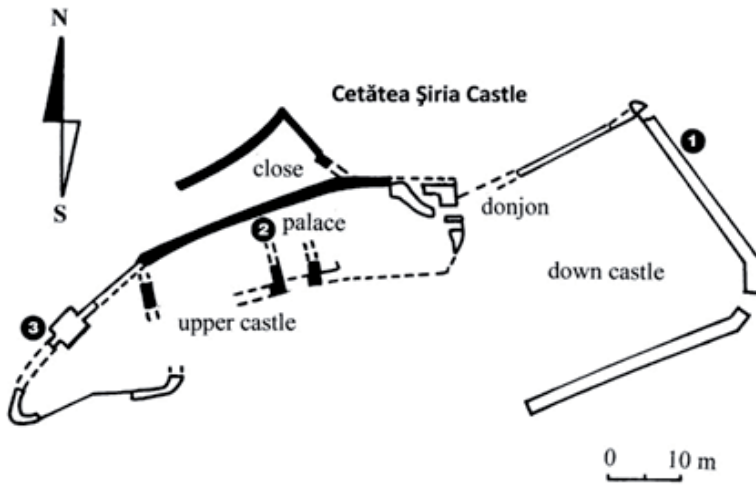


Fig. 4. The sampling sites (1–3) in sketchmap of the Siria Castle

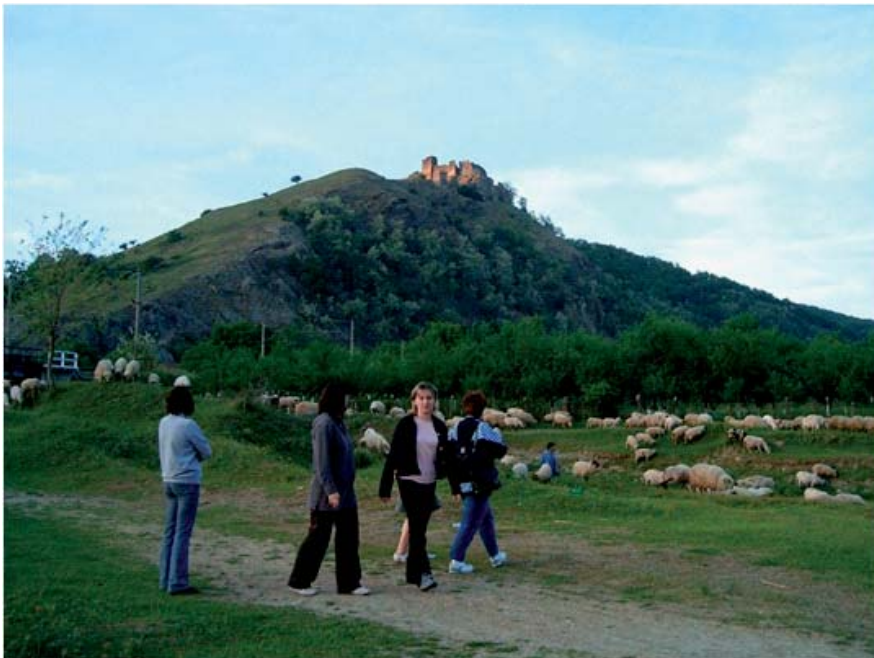


Fig. 5. Castle hill of Șoimoș with ruine of the castle in the Mureș River Valley (Photo by É. D. Megyesi)

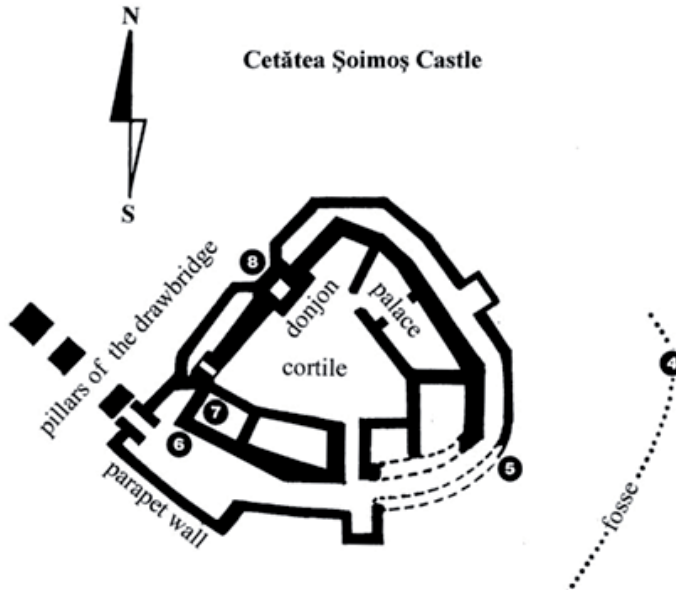


Fig. 6. Sampling sites (4–8) in sketchmap of the Șoimoș Castle

Sampling sites of Șoimoș group (B) – ASL: 252 m

4. Northern part of the castle fosse. Wooded detritic granite rocks biotope spotted with nettle. Site is humed and shady. Method: one by one collecting. 2013. 07. 01.

5. Rock vegetation placed to the east close by ramp of the castle. Method: one by one collecting. Date: 2006. 09. 30.

6. Rock vegetation is found on top of southern supporting wall of the castle. This biotope there is at foot of the south wall of ruin. Methods: via mass (2 dm³) and one by one collecting. Date: 2006. 09. 30., 2007. 03. 16

7. This is a weedy (*Urtica taxa*, *Chelidonium majus*) biotope can be found at the back of suthern wall of ruin, inside onetime castle chapel. The molluscs are hiding under detritic granite rock and mortar gravel as well as broken glass. Of late years with the growth of the tourism in this side faeces are more and more. Method: via mass (2 dm³) and one by one collecting. Date: 2006. 06. 10.

8. This biotope is composed of rock vegetation and granite rocks and mortar gravel, and exposed to west. Methods: via mass (2 dm³) and one by one collecting. Date: 2010. 10. 08.

The bibliography used for the identification of the species are: Soós (1943), Grossu (1981, 1983), Kerney et al. (1983) and Welter-Schultes (2012). For the comparative analysis I used data on the shell-morphogy of *Laciniaria plicata* and *Chilostoma banatica* (Csató & Domokos 2010; Domokos 2001).

Results and discussion

The collected and processed malacological material is presented in Tables 1. and 2., and its parameters in Figures 7–9.

At the Şiria and Şoimoş castle ruins I recorded 25 species and 1127 individuals. At the sampling sites ten forest dwellers (W) were dominant (43,4%) as well as constant, i. e. *Cochlodina marisi* and *Laciniaria plicata*. A *Cochlodina marisi* preferred sunny biotopes, however *Laciniaria plicata* preferred shady biotopes (Table 1.) Number of open (O) habitat and steppe (S, X) dweller species was nine (39,1%). The forest, open and steppe dweller species groups included ~ 86% of detected species (Table 2.). According to Rotarides (1941), expressive part of biotopes are composed of „heterotrophic” elements. As Ložek (1964) has it *Drobacia banatica*, *Platyla banatica*, *Ruthenica filograna*, *Sphyradium doliolum* there are typical forest elements. Occurrence of *Drobacia banatica* on sampling sites 6. and 7. is inconsistent with Ložek’s theory. In my opinion be more correct classification would be 1W instead of 7Wf.

Some notes on three endemic species with relatively small range in the Carpathian basin

Cochlodina marisi According to Soós (1943): „Csak mészhegyeken előforduló csiga/ It can be found only on the limestone mountains”. As has an similar opinion of its habitat Welter-Schultes (2012): „often also on rocky walls and limestone rocks like *Alopi* species” In connection with occurrence Grossu (1993) remarks „*C. marisi* only in the Southern Carpathians: Deva, Cheile Turzii and northern Oltenia.” In my opinion *C. marisi* is a Carpathian endemic species and it has a much smaller geographical range, extending from western part of the Zărand Mountains to the south-east part of the Apuseni Mts. and the district Banate (Soós 1943, Grossu 1981).

Drobacia banatica is a late Pliocene endemic species (Soós 1943, Varga 2013) which occurs in Transsylvania and the fluctuational zone of the Carpathian Province, the Praecarpathian zone (Deli 1997). In the southern part of the Zărand Mountains near the Săvârşin village we found as we know the biggest *Drobacia banatica* wick was 35.6 mm width in the *Alnus-Carpinus-Fraxinus* zone, on the right banks of the Troas stream. (Domokos & Vánca 2005). The smallest *Drobacia banatica* individual – 21.8 mm width – I collected from the Dénesmajori-Csigás-erdő (Great Hungarian Lowland) situated on the flood plain (*Salicetum alba fragilis*) of the Fekete-Körös River (Domokos 2001). I found this species at the 4th, 6–8th sampling site. On the Fig. 7. are positioned the height values of the shell (axis abscissa) and frequency (axis ordinates) of *Drobacia banatica* (4th site, 7th site).

Table 1. Reduced faunistical dates of samples collected from different times with different methods (see sampling sites). In case of *Drobacia banatica* and *Laciniaria plicata* after the slash means arithmetic mean value of width (*D.b.*) or height (*L.p.*)

Species	Şiria (496 m ASL)			Şoimoş (252 m ASL)				Σ	
	Exposed to								
	1. NE	2. SE	3. SW	4. N	5. E	South wall of the castle			8. W
						6. out	7. in		
<i>Aegopinella minor</i>	2	—	—	—	—	—	—	—	2
<i>Arion circumscriptus</i>	—	—	—	—	—	—	1	—	1
<i>Arion subfuscus</i>	—	—	—	—	—	—	1	—	1
<i>Cepaea vindobonensis</i>	4	4	1	1	—	5	3	1	19
<i>Chondrula tridens</i>	—	1	2	—	—	—	—	—	3
<i>Cochlicopa lubrica</i>	—	—	—	—	—	8	—	—	8
<i>Cochlodina marisi</i>	18	41	41	—	1	62	42	21	226
<i>Deroceras agreste</i>	1	1	—	—	—	—	—	—	2
<i>Drobacia banatica</i>	—	—	—	24/ 29.5	—	25	31/ 28.2	1	81
<i>Euomphalia strigella</i>	5	1	3	3	—	—	2	1	15
<i>Helix lutescens</i>	—	—	—	—	—	1	—	—	1
<i>Helix pomatia</i>	—	—	1	1	—	—	—	—	2
<i>Kovacsia kovacsi</i>	5	2	—	1	8	11	—	2	29
<i>Laciniaria plicata</i>	104/ 14.6	21	5	—	—	18	31/ 15.5	12	191
<i>Mediterranea inopinata</i>	—	—	—	—	—	1	—	—	1
<i>Monacha cartusiana</i>	—	—	—	—	1	—	—	—	1
<i>Platyla banatica</i>	—	—	—	—	—	—	—	1	1
<i>Punctum pygmaeum</i>	—	—	—	—	—	—	—	1	1
<i>Pupilla muscorum</i>	—	—	—	—	—	144	—	1	145
<i>Ruthenica filograna</i>	1	—	—	—	—	—	—	—	1
<i>Sphiradium doliolum</i>	23	—	—	1	—	—	—	—	24
<i>Truncatellina cylindrica</i>	—	—	—	—	—	37	—	21	58
<i>Vallonia costata</i>	—	—	—	—	—	261	5	20	286
<i>Vallonia pulchella</i>	—	—	—	—	—	9	—	—	9
<i>Vitrina pellucida</i>	17	1	—	—	—	—	—	1	19
Total number (25)	180 (10)	72 (8)	53 (6)	31 (6)	10(3)	582(12)	116 (8)	83 (12)	1127

Table 2. Species (Falkner et al. 2001) and their habitat types after Ložek 1964. Endemic Carpathian species (Dacian-Podolian – Bába 1982) are pressed from list with bold tipe. (*) This habitat type is according to Domokos (2004) and geographic ranges after Welter-Schultes (2012). (**) In my opinion detailed geographic range is following: Hungary, Romania, Slovakia, Ukraine.

Species (CLECOM)	Habitat type	Geographic ranges
<i>Aegopinella minor</i> (STABILE, 1864)	7W	Europe to Caucasus
<i>Arion circumscriptus</i> JOHNSTON, 1828	?	NW and central Europe to N Italy
<i>Arion fuscus</i> (O.F. MÜLLER, 1774)	?	Europe to Caucasus and Ural
<i>Cepaea vindobonensis</i> (C. PFEIFFER, 1828)	4S(W)	E Europe
<i>Chondrula tridens</i> t. (O.F. MÜLLER, 1774)	4S	Europe to S Ural and N Iran
<i>Cochlicopa lubrica</i> (O.F. MÜLLER, 1774)	7M	Holarctic
<i>Cochlodina marisi</i> (A. SCHMIDT, 1857)	2W(s)*	W Romania (Banat, Apuseni Mts.)
<i>Deroceras agreste</i> (LINNAEUS, 1758)	7M	Europe to Siberia
<i>Drobacia banatica</i> (ROSSMÄSSLER, 1837)	1W	SE Europe**
<i>Euomphalia strigella</i> s. (DRAPARNAUD, 1801)	5Ws	NE Spain to Volga region
<i>Helix lutescens</i> ROSSMÄSSLER, 1837	4S	Carpathians and adjacent reg.
<i>Helix pomatia</i> LINNAEUS, 1758	2W(s)	Europe
<i>Kovacsia kovacsi</i> (VARGA & PINTÉR, 1972)	2W(s)*	E Hun., Rom. (W Apuseni Mts.)
<i>Laciniaria plicata</i> (DRAPARNAUD, 1801)	7Wf	Central Europe to central Russia
<i>Mediterranea inopinata</i> (ULICNY, 1887)	4S	SE Europe
<i>Monacha cartusiana</i> (O.F. MÜLLER, 1774)	6X	Portugal to Ukraine
<i>Punctum pygmaeum</i> (DRAPARNAUD, 1801)	7M	Europe, W and N Asia
<i>Pupilla muscorum</i> (LINNAEUS, 1758)	5O	Northern Hemisphere
<i>Platyla banatica</i> (ROSSMÄSSLER, 1842)	1W	SE Europe
<i>Ruthenica filograna</i> (ROSSMÄSSLER, 1836)	1W	Central and E Europe
<i>Sphyradium doliolum</i> (BRUGUIÉRE, 1792)	1W	Pyrenees to N Iran and central Asia
<i>Truncatellina cylindrica</i> (A, FÉRRUSAC, 1807)	5O	Eur. to c. Rus., Cau. and NW Afr.
<i>Vallonia costata</i> (O.F. MÜLLER, 1774)	5O	N Africa and c. Europe to c. Asia
<i>Vallonia pulchella</i> (O.F. MÜLLER, 1774)	5O	Northern Hemisphere
<i>Vitrina pellucida</i> (O.F. MÜLLER, 1774)	7M	Europe to central Asia

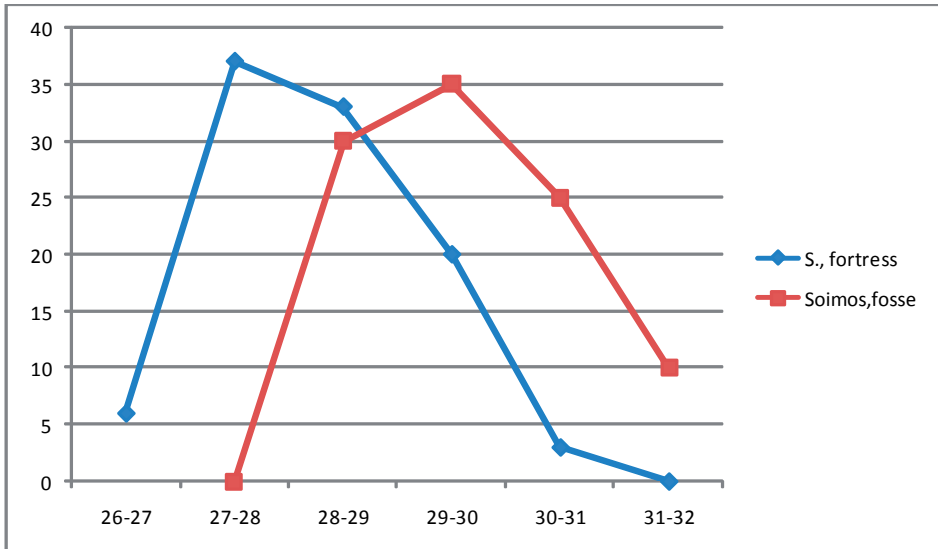


Fig. 7. Frequency (%) distribution curves of shell width (26–32 mm) of *Drobacia banatica* (diamond – Şoimoş, 7th site, number of samples: 30; square – Şoimoş, 4th site, number of samples: 20)

It can be ascertained that due to different climate conditions of the 4th and 7th sampling sites frequency distribution curves differ from one another. By my opinion in the fosse values of the climatic elements are dissimilar, namely temperature is lower however humidity is higher. In the Landor Forest (Fig.1. C, ASL \geq 79 m), which is situated on the Great Hungarian Lowland, ~100 air kilometres apart from Şoimoş fortress ruin (Fig.1. B) the arithmetic mean value of width is lower 26.3–27.7 mm (1986-1991) according to warmer and more arid climate of the Lowland (Domokos 2001, 2012). Landor forest is situated in fluctuational zone of the Mureş/Maros River which is extended down to Szeged (Deli 1997). Kimakowicz 1890 wrote in its volume, in page 186 from *Campylaea (Eucampylaea) Banatica* Rossmässler/ according to Clecom *Drobacia banatica* Rossmässler „Ich sammelte auf Piatra Sipurului im Strellgebirge mut. *viridana* in einem Exemplar.” This sampling site situated in the Southern Carpatians, in the Munţii Şureanu ~150 air kilometres from Şoimoş. At the Şoimoş fortress ruin to my great surprise came to light in some specimen of *Drobacia banatica* mut. or var. *viridana*. In my opinion these species and its habitat absolutely deserve the protection.

Kovacsia kovacsi (earlier *Hygromia kovacsi*). Carpathian endemism was found in the south-easter part of the Great Hungarian Plain and Zemplén Mts.(North-east

Hungary) as well as western part of the Apuseni Mts. (Varga & Pintér 1972, Varga 1981, Domokos & Lennert 2007, Fehér et al. 2009, Domokos, Lennert & Venczel 2010). It is known still from the Zărand Mts.: Troaş, Roşia Nouă (Fehér et al. 2009). *Kovacsia kovacsi* can be found on the list of the protected and the Natura 2000 species in Hungary (Domokos 2004). This is a strictly protected species in Hungary.

Laciniaria plicata.

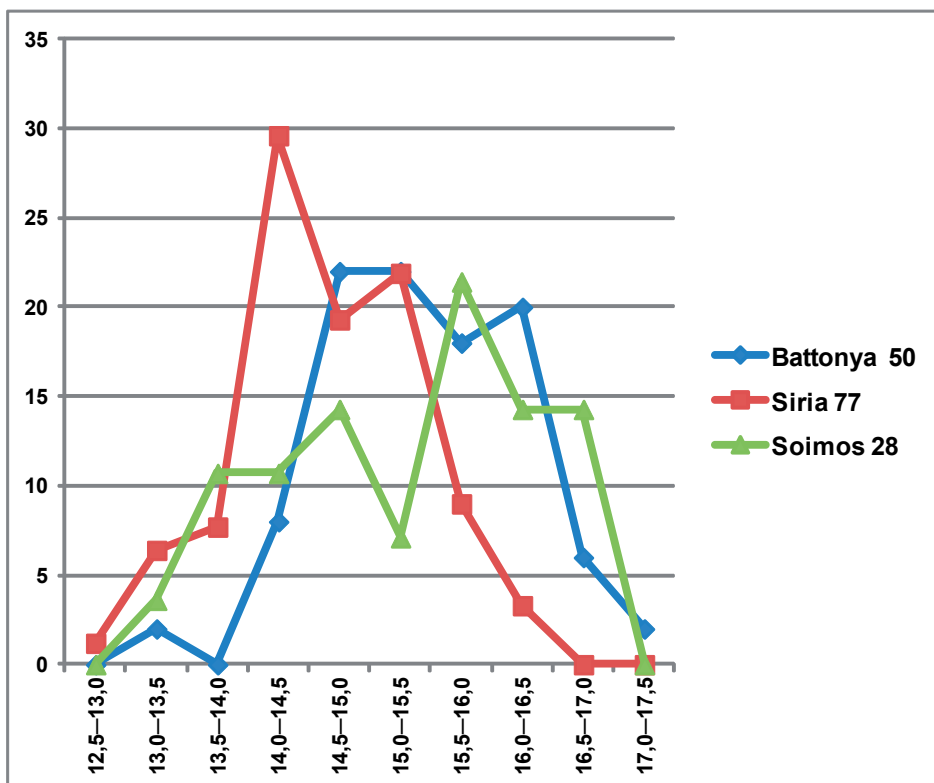


Fig. 8. Frequency (%) distribution curves of height (12.5– 17.5) of the *Laciniaria plicata* in the three sampling sites [diamond – Battonya (Hungary – by Csátó & Domokos 2010), number of samples: 50; square – Şiria, 1th site, number of samples: 77; triangle – Şoimoş, 7th site, number of samples: 28]

Ascending order on the basis of frequency distribution curves (Fig.8. ,9.) as well as arithmetic mean value of height (Table 1., Csátó & Domokos 2010) is Şiria (14,6 mm) – Battonya (15,3 mm) – Şoimoş (15,5 mm). In 1th sampling

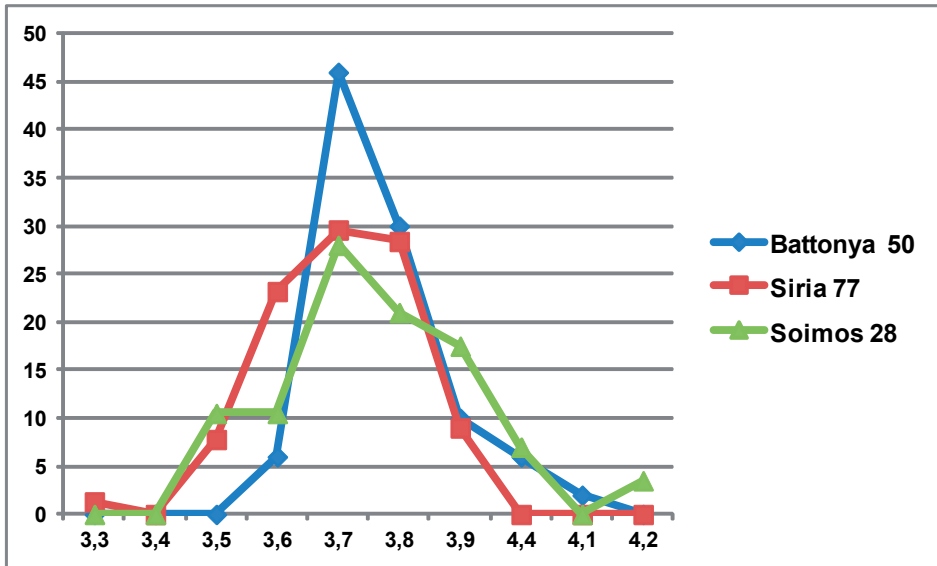


Fig. 9. Frequency (%) distribution curves of width (3.3–4.3 mm) of the *Laciniaria plicata* in the three sampling sites [diamond – Battonya (Hungary – Csátó & Domokos 2010), number of samples: 50; square – Şiria, 1st site, number of samples: 77; triangle – Şoimoş, 7th site, number of samples: 28]

sites of Şiria at calculation the arithmetic mean value is smaller than waited by me based on the annual mean temperature and annual precipitation (In Şiria and Şoimoş: approximately 9–10°C, 700–800 mm, in Battonya: 12–13 °C, 650–700 mm). In my opinion in Battonya there is tremendous difference between macro- and microclimate. Owing to values of climatic elements is larger arithmetic mean value of height in Battonya.

According to Soós (1943) to be distinguished prototype *Laciniaria plicata* Draparnaud, 1805: 13.5–21 x 3.5–4.5 mm; (subsp. *transsylvanica* Kimakowicz, 1883.: 12.5–19 x 3.3–4.5; f. *costata*; f. *laticosta*; var. *elongata*; var. *biharica*: 16–21 x 4–4.5 mm; var. *pseudostabilis*: 13.5–16 x 3.5–3.8 mm; f. *implicata*; var. *minor* 12.5–13.3 mm; var. *eremitella*).

Mentioned by Grossu (1981) following taxa: prototype *Laciniaria plicata*: 15–19, 3–4 mm; (subsp. *plicata plicata*: 14–16 x 3–5 mm, f. *implicata*: 15–16 x 4–4.2, f. *minor*: 12–13.5 x 3 mm; subsp. *plicata costata*: 14 x 3.8; subsp. *plicata transsylvanica*: 15–19 x 3.2–3.8 mm; subsp. *plicata biharica* 16–18 x 4.2 mm).

In Die Landschnecken Nurd- und Mitteleuropas (Kerney et al. 1983) to be found height x width of the prototype *Laciniaria plicata*: 15–18 x 3.3–3.6 mm. As Welter-Schultes 2012 has height x width of the prototype *Laciniaria plicata*:

15–18 x 3.3–3.6 mm. The above mentioned numerical values of prototypes show distinctly visible similarity, only Soós's measuring range is somewhat larger. My extreme values of height are smaller (12.5–17.5 mm), but extreme values of width are larger (3.3–4.3 mm).

Platyla banatica is a terrestrial prosobranch gastropoda, which has a relatively small geographical range in SE Europe. One or two notes which refer to its Romanian presence: Romanian part of area in the S Carpathian Mts. is stretched from Pasul Turnu Roşu (gorge of the Olteţ River, ASL: 325–360 m) to the Cerna River (Soós 1943). According to Deli 2013 this territory approximately coincides with the Banaticum subregion extended its eastern and northern borders to the Olteţ river and to the Mureş river/the Zărandului Mts., respectively. In humid dead leaves on the forest ground; in Banat (Grossu 1993). It is living in subterranean habitats in rocky environments, usually limestone (Welter-Schultes 2012).

On the basis of the references this species can be found in eastern (Bihar Mts.) and southern (Zărand Mts.) part of the Apuseni Mts. (Bába & Sárkány-Kiss 1999, Domokos & Vánca 2006, Lengyel & Páll-Gergely 2009–2010, Deli & Domokos 2011). On the basis of paper of Varga 2013 it is a known fact the Apuseni Mts. one of Würm-glacial extra-mediterranean forest refuge of Europe.

Acknowledgments

I owe thanks to George Iuga biologist of the Museum of Arad directed attention to research of the Zărand Mountains, to Miklós Szekeres for the revision of the Family Clausiliidae, and to János Tamás Kovács for *Drobacia banatica* specimen gleaned by him. I would like to thank Péter Sólymos for his helpful comments and proposals.

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