

January 2012

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New Taxa of Hydrobiidae (Gastropoda: Rissooidea) from Bulgarian Cave and Spring Waters

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Abstract: In this paper two new species of *Grossuana* Radoman 1973 were described and first information about the anatomy and morphology of the stygobite genus *Devetakia* Glöer & Georgiev 2011 was provided with a description of a new species, *Devetakia mandrica* n. sp. Anatomical studies of *Bythiospeum schniebsae* Georgiev 2011, collected from a new cave locality, revealed that this species belongs to a new genus, *Balkanospeum* n. gen.

Key words: new taxa, Hydrobiidae, gastropods, Balkans, springs, caves, taxonomy

Introduction

The genus *Grossuana* Radoman 1973 consists of minute freshwater snails inhabiting springs and streams of East Balkan Peninsula. There are species known from Serbia (*G. serbica*, Radoman 1973, type species; *G. remesiana* Radoman 1973), FYRMacedonia (*G. macedonica* Radoman 1973; *G. scupica* Radoman 1973), Greece (*G. haesitans* (Westerlund, 1881); *G. vurliana* Radoman 1966; *G. delphica* Radoman 1973), Romanian Dobrudza (*G. codreanui* Grossu 1946), and Bulgaria (*G. codreanui*, *G. thracica* Glöer & Georgiev 2009, *G. angeltsekovi* Glöer, Georgiev 2009) (RADOMAN 1983, HUBENOV 2005, ZETTLER 2008; SZAROWSKA *et al.* 2007, GLÖER, GEORGIEV 2009). It is difficult to distinguish between the species of this genus and different features were used for species identification like shell morphology and proportions (RADOMAN 1983), penis shape and structure (GLÖER, GEORGIEV 2009), and molecular analysis (SZAROWSKA *et al.* 2007).

The stygobite Hydrobiid fauna is rich but still poorly known in Bulgaria and every cave or a cave system holding running waters is a potential locality of unknown subterranean freshwater snails. Many of

the already known species in the country are with unknown anatomy, biology, ecology, and distributional range, as for example *Bythiospeum* BOURGUIGNAT 1882 and *Devetakia* GLÖER, GEORGIEV 2011.

This paper is intended to (i) expand the knowledge of Rissooidea of Bulgaria and (ii) to describe a new genus *Balkanospeum* and three new species of Hydrobiidae.

Material and methods

The living snails were collected and preserved in 75% ethanol. The shells were collected by sieving the cave river deposits by 1x1 and 2x2 mm mesh width sieves. The dissections and measurements were carried out by means of CETI stereo microscope and an eye-piece micrometer; the photographs were made with a camera system with a digital adapter. The type material is stored in the Museum für Tierkunde Dresden (= Zoological Museum of Dresden). Abbreviations used: H – Shell height, W – shell width, AH – aperture height, AW = aperture width, MTD – Museum für Tierkunde Dresden.

Results

Genus *Balkanospeum* gen. n.

Type species: *Balkanospeum schniebsae* (Georgiev 2011)

Diagnosis: The presence of an outgrowth on the left side of the penis discerns it from all the species with known anatomy till now. The shell has a characteristic morphology, similar to the genus *Bythiospeum* BOURGUIGNAT 1882.

Description: The shell is elongate-conic with relatively pointed apex, with 4.5-5 regularly to fast growing rounded whorls, shell surface shining, operculum red, the penis bears a well visible outgrowth on its left side placed below about 1/3 of all its length, considered from its apex.

Etymology: Named after the mountain where the species from this genus was collected (Stara Planina = Balkan Range) and the genus name *Bythiospeum* to which it is similar.

Balkanospeum schniebsae (Georgiev 2011)

Locus typicus: Izvora (Yantra, Padaloto) cave near village of Sulari, Stara Planina Mts.

Material examined: 28 ex. (21 ad., 7 juv., 2 males dissected, 5 shells measured) from Machanov Trap cave, near village of Zdravkovets, Stara Planina Mts., N42° 57' 59.70" E25° 13' 30.23", 10.06.2011, Liubomir Yankov leg., 3 spec. MTD, SNSD Moll S4381, rest in coll. D. Georgiev.

Description: Shell: The shell is elongate-conic with relatively pointed apex, with 4.5-5 regularly to fast growing rounded whorls, shell surface shining (GEORGIEV 2011). The shell is translucent, fragile with a red operculum. Measurements of 5 shells from Machanov Trap cave are to be found in Table 1.

Soft body: The entire body of the animal is pigmentless (with an exception of the red operculum of

the shell), and having very long tentacles (0.28 mm in preserved specimen) without any eyes (Fig. 1).

Penis morphology: The penis is situated far behind the neck and is long with broad base and thin middle part which are almost equal in length (0.25 mm each), and spindle shaped translucent apical part (0.33 mm length). Between the middle and the apical part there is a small outgrowth on the left side of the penis which is flattened laterally. **Egg capsules:** Small brown, elongate-ovoid capsules were found on the shells of some specimens, with sizes of about 0.09 mm length, and 0.05 mm broad.

Distribution: A local endemic species known from the two closely situated caves Yantra and Machanov Trap, which waters are possibly connected (Ivan Avramov and Rosen Terziev, speleological clubs 'Salamander – Stara Zagora' and 'Strinava – Drianovo', pers. comm.), Gabrovo district, Stara Planina Mnt.

Notes on ecology: Machanov Trap cave is situated higher than Yantra cave, and has a more complex shape, having a system of squeezes and plummets which reaching down to 70 m. The living *B. schniebsae* specimens were collected from small crumbly limestone stones in the cave's main stream at -200 m below surface and from its tributary at about -70 m. From more solid rocks it was not found, possibly a strongly calcareous species.

Genus *Devetakia* Georgiev, Glöer 2011

Differentiating features: GEORGIEV, GLÖER (2011) reported that the smaller number of whorls separates the representatives of genus *Devetakia* from those of *Iglica* Wagner, 1927, and the simple outer lip, and more cylindrical shell from the species of *Bythiospeum*.

Here, on the base of both, morphology and anatomy of live specimens collected, can be added

Table 1. Shell measurements of *Balkanospeum schniebsae* gen. n. from Machanov Trap cave. Abbreviations are explained in Material and Methods.

N	H	W	AH	AW	W/H	AH/H	AW/W
1	1.68	0.92	0.63	0.63	0.55	0.37	0.68
2	1.85	0.99	0.66	0.63	0.54	0.36	0.63
3	1.65	0.86	0.56	0.56	0.52	0.34	0.65
4	1.62	0.89	0.59	0.53	0.55	0.37	0.59
5	2.05	1.16	0.69	0.66	0.56	0.34	0.57
Average	1.77	0.96	0.63	0.60	0.54	0.36	0.63

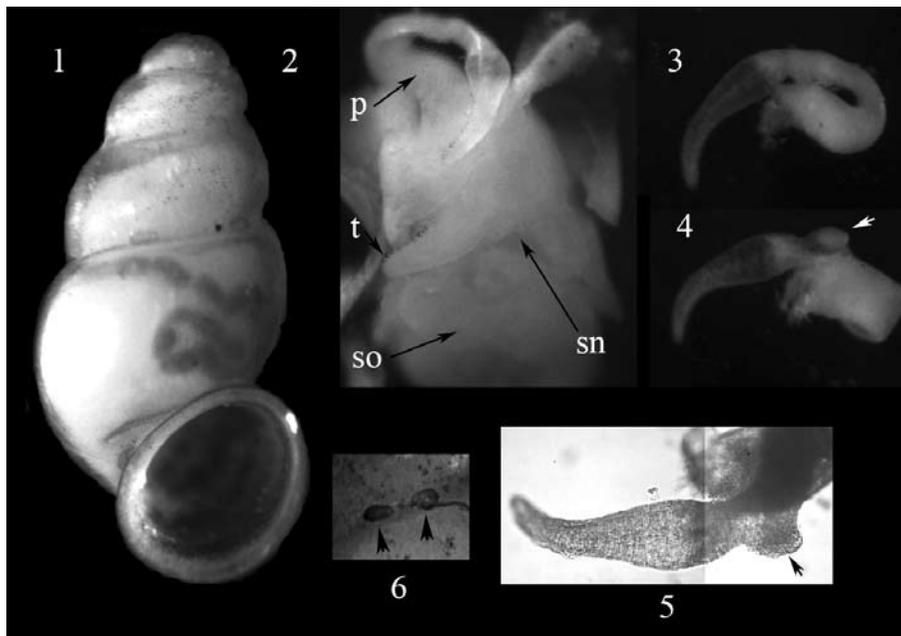


Fig. 1. *Balkanospeum schniebsae* gen. n. from Machanov Trap cave (for shell measurements see Table 1): 1 – shell, 2 – soft body, p – penis, t – tentacle, so – sole, sn – snout, 3 – dorsal view of the penis, 4 – ventral view of the penis, 5 – ventral view of the penis, light microscopic picture, the characteristic outgrowth is pointed by an arrow, 6 – egg capsules on the shell of one specimen.

some more features possibly characteristic for this genus. **Shell:** translucent, fragile, with a translucent and thin operculum. **Soft body:** The animal is entirely pigmentless, the tentacles are short (contrary to those of *Bythiospeum*), slightly passing over the snout length, and are without any eyes. **Penis morphology:** The penis is short, situated far behind the neck. It has a broad, cylindrical base, and a flat leaf-like distal part with sharply pointed apex (versus longer and not having such structure in *Iglica* and *Bythiospeum*).

Devetakia mandrica n. sp.

Material examined: 31 ex. (23 ad., 3 juv., 1 male dissected, 8 shells measured) from the type locality, 05.06.2011, Stanimira Deleva and Slaveya Stoycheva leg.

Holotype: H = 1.78 mm, W = 0.86 mm, AH = 0.66 mm, AW = 0.63 mm, MTD, SNSD Moll S4386.

Paratypes: 3 spec., MTD, SNSD Moll S4387, rest in coll. D. Georgiev.

Locus typicus: Mandrata cave, 2 km west of village of Chavdarts, Lovech town district, Devetashko Plateau, Northern Bulgaria, N43° 14' 32.2" E24° 58' 08.8".

Etymology: Named after the cave Mandrata where the species was found.

Description: Shell: The shell is very small, mostly cylindrical to conical in single specimens, translucent, fragile, shining, and finely striated with blunt apex. The whorls are 4-4.5, flattened, with weak suture. The aperture is round to ovoid, with a simple outer lip, umbilicus is slit like. Shell measurements (Table 2): H = 1.68-1.98 mm, W = 0.83-0.99 mm, AH = 0.63-0.73 mm, AW = 0.56-0.69 mm, H/W = 0.45-0.55, AH/H = 0.35-0.38, AW/W = 0.61-0.75. **Soft body:** The animal is entirely pigmentless, the tentacles are short, and slightly passing over the snout length (in preserved specimen), and are without any eyes. The snout is relatively short. **Penis morphology:** The penis is short, situated far behind the neck. It has a broad, cylindrical base, thinner middle part, and dorso-ventrally flattened leaf-like distal part with sharply pointed apex. **Egg capsules:** Small brown, elongate capsules were found on the shells of some specimens.

Differentiating features: The new species differs from *Devetakia krushunica* GEORGIEV & GLÖER 2011 and *Devetakia pandurskii* GEORGIEV & GLÖER 2011 by its more cylindrical shell, flatter whorls and slit-like umbilicus (versus conical shells, rounded whorls, and open umbilicus in the other species of this genus).

Notes on the ecology: Mandrata cave is 530

ms long, horizontal, branched and is developed in limestone rocks. The entrance is 12 m wide, and 7.5 m high, the cave river is 165 long, and the spring capacity is 5 L/sec (measured on 15.10.1931) (BERON *et al.* 2009).

Genus *Grossuana* RADOMAN, 1973

***Grossuana radostinae* n. sp.**

Material examined: 30 ex. from the type locality (21 ad., 9 juv., 2 males dissected, 11 shells measured), 23.04.2011, Radostina Dimitrova leg.

Holotype: H = 1.83 mm, W = 1.29 mm, AH = 0.97 mm, AW = 0.86 mm, MTD, SNSD Moll S4384.

Paratypes: 2 spec, MTD, SNSD Moll S4385, rest in coll. D. Georgiev.

Locus typicus: Small stream near the beginning of the path to 'Madarski Konnik' monument at Shumensko Plateau area, near village of Madara, 20 km from Shumen town, Northern Bulgaria, N43° 16' E27° 06', Radostina Dimitrova leg.

Etymology: Named after the student on ecology Radostina Dimitrova who collected the species.

Description: Shell: The shell is conical to elongated conical, whorls are 3.5-4.5, relatively rounded, glossy, with fine growth lines, and weak suture. The aperture is slightly angled at the top, ovoid to pyriform, with sharp periostome thickened at the columella, umbilicus is closed. The operculum is brown (Fig. 1). Shell measurements (Table 1): H = 1.6-2.2 mm, W = 1.1-1.6 mm, AH = 0.1-1.0 mm, AW = 0.7-0.9 mm, W/H = 0.63-0.77, AH/H = 0.44-0.57, AW/W = 0.50-0.67. **Soft body:** The mantle is black with very thin white border. Tentacles are equal in length or slightly passing over the snout (in preserved specimens), with black base or entirely black, same variation of the pigmentation was ob-

served and for the snout. The head is black, and the sole white-yellow. **Penis morphology:** The penis is slim and tapered at the distal part with patches of black pigment along it and a big black triangular spot in the middle. It is bearing well visible bi-lobed outgrowth on the left side (Fig. 1).

Differentiating features: The new species discerns from all known Bulgarian representatives of the genus by its brown operculum and the small patches of dark pigment along the penis (versus red, orange or red-brown operculum, and white penis with only a small black spot in the rest of the species). It differs from *G. angeltsekovi* and *G. thracica* and by the presence of a bi-lobed well visible outgrowth on the left side of the penis, compared to a small, hardly visible single one in the species discussed (Fig. 5). In *G. angeltsekovi* the proportion AH/H is 0.40-0.42 while in *G. radostinae* it is 0.44-0.57. From *G. codreanui* (when using the descriptions of SZAROWSKA *et al.* 2007 of topotypes from Romania) it discerns by its partly or entirely pigmented tentacles and snout (versus pigmentless in *G. codreanui*) and also the angled aperture top. From the other species of the genus described in this paper (*G. aytosensis* sp. n.), *G. radostinae* differs by its glossy shell surface, shorter tentacles, and larger and darker spot on the penis (versus rough shell surface, long tentacles, and a small pale spot on the penis).

Notes on ecology: The species was collected from stones in a small slow running stream flowing through a limestone area.

***Grossuana aytosensis* n. sp.**

Material examined: 81 ex. from the type locality (4 males dissected, 15 shells measured), 25.08.2011, Dilian Georgiev leg.

Table 2. Shell measurements of *Devetakia mandrica* n. sp. from the type locality. Abbreviations are explained in Material and Methods.

N	H	W	AH	AW	W/H	AH/H	AW/W
1	1.91	0.92	0.73	0.56	0.48	0.38	0.61
2	1.85	0.89	0.66	0.59	0.48	0.36	0.67
3	1.82	0.92	0.73	0.69	0.51	0.40	0.75
4	1.88	0.99	0.69	0.63	0.53	0.37	0.63
5	1.98	0.89	0.69	0.63	0.45	0.35	0.70
6	1.68	0.83	0.63	0.56	0.49	0.37	0.68
7	1.82	0.99	0.69	0.63	0.55	0.38	0.63
Average	1.85	0.92	0.69	0.61	0.50	0.37	0.67

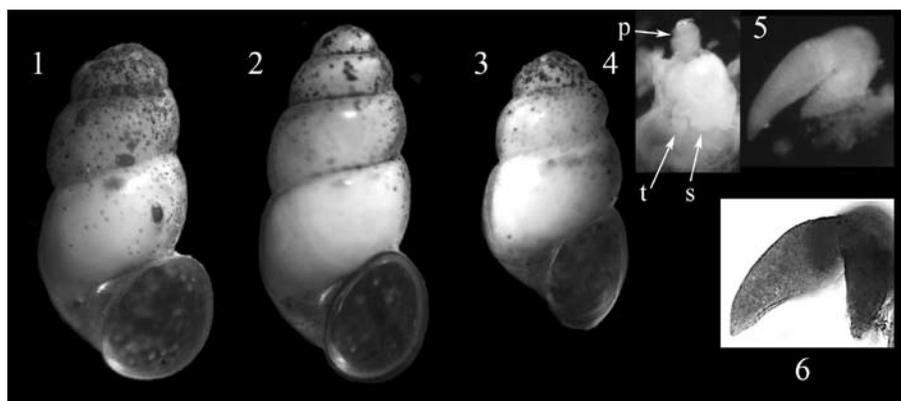


Fig. 2. *Devetakia mandrica* n. sp. (for shell measurements see Table 2): 1 – shell with egg capsules on the surface, 2 – a specimen with relatively conical shell, 3 – shell of a juvenile specimen, 4 – soft body, p – penis, t – tentacle, s – snout, 5 – penis, 6 – light microscopic picture of the penis.

Holotype: H = 1.60 mm, W = 1.14 mm, AH = 0.84 mm, AW = 0.69 mm, MTD, SNSD Moll S4382.

Paratypes: 4 spec., MTD, SNSD Moll S4383, rest in coll. D. Georgiev.

Locus typicus: Water source in a park forest north of Aytos town, East Stara Planina Mts., Southern Bulgaria, N42° 42' 52.3" E27° 16' 08.9", 122 m, D. Georgiev leg. (Fig. 4).

Description: Shell: The shell is conical, elongated conical to cylindrical and almost 'Bythinella-like', whorls are 3.0-4.0, relatively rounded, with silky, relatively rough surface, with well visible growth lines, and weak suture. The aperture is angled to rounded at the top, ovoid to pyriform, with sharp peristome strongly thickened at the columella, umbilicus is closed. The operculum is reddish-brown. Shell measurements (Table 2): H = 1.4-2.1 mm, W = 1.0-1.5 mm, AH = 0.8-1.0 mm, AW = 0.7-0.9 mm, W/H = 0.68-0.76, AH/H = 0.48-0.57, AW/W = 0.55-0.66. **Soft body:** The mantle is black with white border. The snout and tentacles are with black bases and grey distal parts, the head is black, and the neck grey-white. The tentacles (in preserved specimens) are quite longer than the snout. **Penis morphology:** The penis is pigmentless with only one, pale grey spot, and is bearing a small single or bi-lobed outgrowth on its left side (Fig. 5).

Etymology: Named after Aytos town at which surroundings the species was found.

Differentiating features: The rough shell surface and the extreme almost cylindrical shells of some forms of *G. aytosensis* discern this species from the rest ones from the genus known to live in Bulgaria

and Romania. The closest known *Grossuana* populations are those of *G. codreanui*, *G. thracica*, and *G. radostinae* n. sp. From the first species (when using the descriptions of SZAROWSKA *et al.* 2007 of topotypes from Romania) except the features mentioned the new species differs by its pigmented head, and partly pigmented tentacles and snout, and the angled aperture top in some specimens. *G. thracica* also like *G. aytosensis* has a non-glossy shell surface but while in the first species the penis is sharply tapered and bears a single very small outgrowth on the left side, in the second it is more gradually tapering and has larger and sometimes bi-lobed outgrowth (Fig. 5). From *G. radostinae* n. sp. this species differs by its relatively long tentacles, and non pigmented penis (except one pale dark spot). *G. aytosensis* n. sp. has a proportion AH/H of 0.48-0.57 which is quite higher than this one of the far away living in the West Rhodopes *G. angeltsekovi* (AH/H = 0.40-0.42).

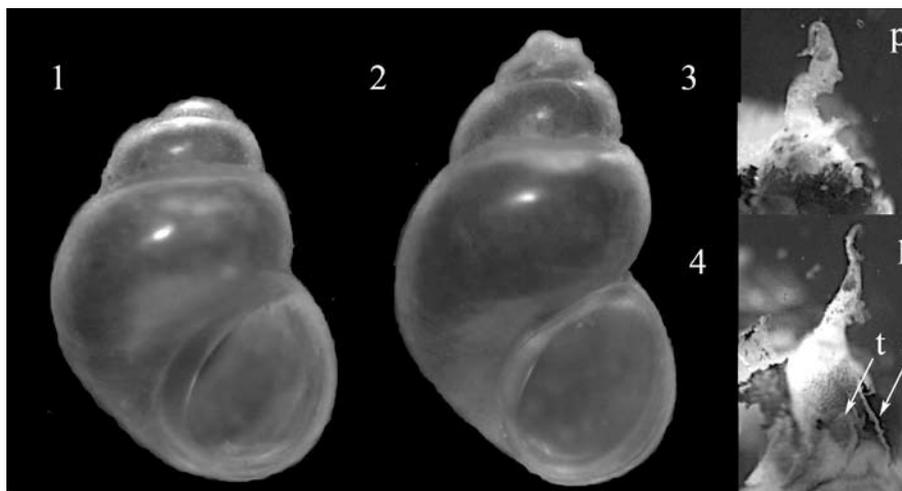
Notes on ecology: Found in water source in a broad leaf forest in a park at the foot hills of Stara Planina Mts. During collection the species was quite abundant, mainly on stones, and only at the area of the spring running water.

Discussion

The knowledge about the anatomy of genus *Bythiospeum* (GIUSTI, BODON 1983, GLÖER 2002, ARCONADA, RAMOS 2003, SZAROWSKA 2006) allows to define a new genus group for *Balkanospeum schniebsae* gen. nov. because of the morphology of the penis. Already RADOMAN (1983) showed that most of the

Table 3. Shell measurements of *Grossuana radostinae* n. sp. Abbreviations are explained in Material and Methods.

N	H	W	AH	AW	W/H	AH/H	AW/W
1 (holotype)	1.83	1.29	0.97	0.86	0.71	0.53	0.67
2	2.14	1.55	0.97	0.86	0.73	0.45	0.56
3	2.16	1.36	0.95	0.82	0.63	0.44	0.60
4	1.60	1.12	0.91	0.67	0.70	0.57	0.60
5	1.86	1.42	1.04	0.84	0.77	0.56	0.59
6	1.92	1.32	0.93	0.69	0.69	0.48	0.52
7	1.77	1.34	0.95	0.80	0.76	0.54	0.60
8	2.16	1.55	1.01	0.88	0.72	0.47	0.57
9	1.94	1.34	0.99	0.84	0.69	0.51	0.63
10	1.62	1.19	0.86	0.73	0.73	0.53	0.62
11	1.73	1.29	0.91	0.65	0.75	0.53	0.50
Average	1.88	1.34	0.95	0.79	0.72	0.51	0.59

**Fig. 3.** *Grossuana radostinae* n. sp. (for shell measurements see Table 3): 1 – holotype, 2 – paratype, 3, 4 – penes of the two dissected males, p – penis, t – tentacle, s – snout.

genus groups of Hydrobiidae can be distinguished by the penis morphology. Considering the various shell shapes of *Bythiospeum* spp. described from Europe, Africa and Caucasus (BOURGUIGNAT 1882, WAGNER 1927, SCHÜTT 1970, RADOMAN 1983, BOETERS 1998, GLÖER 2002, ARCONADA, RAMOS 2003) suggests that this taxonomic group consists of possibly more hidden genera, and needs a revision. However the underground way of life of these snails makes this task very difficult for a global project, and every data collected from occasional studies is of interest.

Considering some pictures of the shells in some papers published on the complex genera *Paladilhiopsis* Pavlović, 1913 or *Bythiospeum* (WAGNER 1927, SCHÜTT 1970, GLÖER 2002) it can be supposed that the genus *Devetakia* is more widely

distributed and is not endemic only for Devetashko Plateau in Bulgaria, or there are some undetected genera closely related to it. For example in Plate 15, Fig. 18 of the paper of SCHÜTT (1970) the species *Paladilhia (Paladilhiopsis) thessalica* SCHÜTT 1970 (Greece) looks very similar to Bulgarian *Devetakia* and has nothing in common neither with *Paladilhiopsis* nor with *Bythiospeum*.

Delimitation of species from the genus *Grossuana* is still under progress. There are two constant characteristic features for *G. codreanui* from Romanian population at the type locality (SZAROWSKA *et al.* 2007) which were not recorded in any known Bulgarian *Grossuana* – the pigmentless tentacles and snout, and the very small shell (about 1 mm in height). Also on the base of molecular studies SZAROWSKA *et*

Table 4. Shell measurements of *Grossuana aytosensis* n. sp. Abbreviations are explained in Material and Methods.

N	H	W	AH	AW	W/H	AH/H	AW/W
1 (holotype)	1.60	1.14	0.84	0.69	0.72	0.53	0.60
2	2.05	1.45	0.99	0.91	0.71	0.48	0.63
3	1.55	1.12	0.82	0.71	0.72	0.53	0.63
4	1.68	1.21	0.86	0.78	0.72	0.51	0.64
5	1.66	1.23	0.86	0.76	0.74	0.52	0.61
6	1.94	1.40	0.93	0.78	0.72	0.48	0.55
7	1.51	1.12	0.80	0.71	0.74	0.53	0.63
8	1.53	1.12	0.80	0.69	0.73	0.52	0.62
9	1.70	1.25	0.91	0.76	0.73	0.53	0.60
10	1.68	1.14	0.88	0.76	0.68	0.53	0.66
11	1.45	1.12	0.82	0.69	0.78	0.57	0.62
12	1.40	1.01	0.78	0.67	0.72	0.55	0.66
13	1.62	1.17	0.86	0.76	0.72	0.53	0.65
14	1.60	1.19	0.91	0.73	0.74	0.57	0.62
15	1.64	1.25	0.88	0.78	0.76	0.54	0.62
Average	1.64	1.20	0.86	0.74	0.73	0.53	0.62

**Fig. 4.** The type locality of *Grossuana aytosensis* sp. n. in the park forest north of Aytos town.

al. (2007) found that in a phylogram calculated for the CO1 *G. codreanui* from Bulgaria (Yasenovo) does not cluster with *G. codreanui* from its type locality. The photographs of two specimens from Avren and Balchik in the paper of ZETTLER (2008) show partly black pigmented tentacles, head and snout. On the base of such facts it could be supposed that some localities of *G. codreanui* published for the country possibly refer to other species. RADOMAN (1983) reports of two localities: the spring 'Manastir' by the

south bank of Beloslavsko Lake, and the spring in Buchin Prohod, near the road Berkovitsa-Sofia (the second far away from the type locality of the species). WAGNER (1927) described '*Pseudamnicola consociella euxina*' on shell morphology from the spring of Devnya River and Aladza Manastir (Varna district), and as ZETTLER (2008) stated, it can be a *Grossuana* species. These specimens had quite large shells: H = 2.7 mm, and W = 1.5 mm. In addition all records of '*P. c. euxina*' reported for Bulgaria (ANGELOV, 2000)

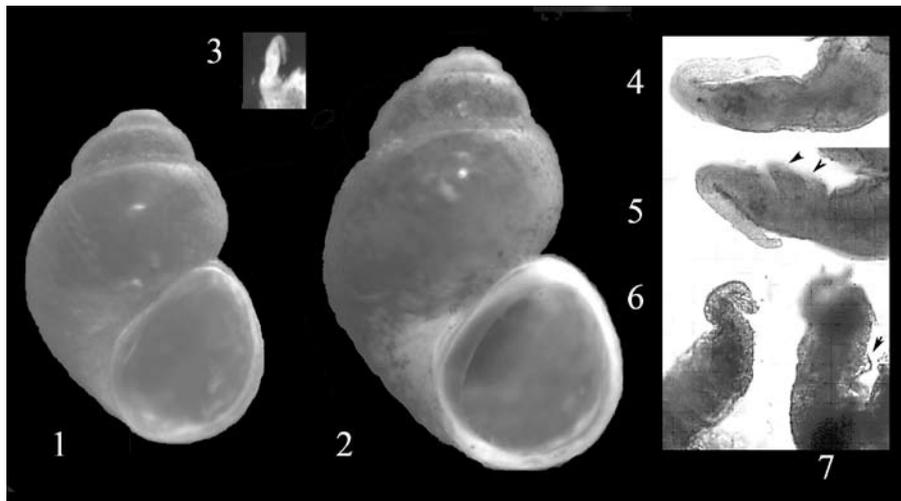


Fig. 5. *Grossuana aytosensis* n. sp. (for shell measurements see Table 4): 1 – shell of the holotype, 2 – paratype, 3 – penis, 4, 5 – dorsal and ventral view of the penis, light microscopic picture, the bi-lobed outgrowth is pointed by arrows; 6 – right and left side of the more sharply pointed penis of *Grossuana thracica* for comparison, light microscopic picture, the single small outgrowth is pointed by an arrow (40x).

could refer to some other *Grossuana* species (or similar in shell morphology other genera as *Radomaniola*, SZAROWSKA, 2006).

At the same time, the presence of *G. codreanui* in Bulgaria could not be excluded. Much more frequent passive dispersal by migrating birds which follow the Black Sea coastal line during spring and autumn (the so called Via Pontica migration way) can be supposed in the region where the species lives.

The findings showed that the diversity of this East Balkan genus (SZAROWSKA *et al.* 2007) is high in Bulgaria, and that possibly the country is a center of

species radiation. As *Grossuana* has better chances for dispersal than many other Hydrobiids, because they are abundant at its localities of surface springs, enhancing the chance for passive transportation. It can be supposed that the species of this genus are being more often regional than local endemics.

Acknowledgements: I am grateful to the cavers Liubomir Yankov, Ivan Avramov club 'Salamander – Stara Zagora' and Rosen Terziev club 'Strinava – Drianovo' for the information about Machanov Trap cave, to all the collectors of material, and to Peter Glöer (Hetlingen, Germany) for the pictures of some *Grossuana* specimens, the literature and the critical notes on the manuscript.

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Received: 07.09.2011
Accepted: 27.01.2012

