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Identification key of the Rissooidea (Mollusca: Gastropoda) from Bulgaria with a description of six new species and one new genus

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Abstract. New investigations of freshwater habitats in mountainous regions and caves revealed six new species of the Rissooidea in Bulgaria. The new species are described here and photos of the holotypes are provided. In addition we added photos of the type localities. An identification key of the genera of the Rissooidea of Bulgaria gives an overview of the diversity of this group. The following species are described as new: *Strandzhia bythinellopenia* sp. n., gen. n., *Grossuana slavyanica* n. sp., *G. derventica* n. sp., *Radomaniola strandzhica* n. sp., *Bythiospeum devetakium* n. sp., *Bythinella rilaensis* n. sp.

Key words: Bulgaria, Rissooidea, new descriptions.

Introduction

When Angelov (2000) summarized the freshwater molluscs of Bulgaria he listed 16 species of the Rissooidea. By the investigations of mountainous regions and caves, carried out by the senior author, now up to 58 species of the Rissooidea are known. Because the number of species of a checklist depends not only on the actual diversity, but also on the thoroughness of the investigation as well as on the taxonomical expertise, the species diversity could have been occasioned by the great number of samples that could be studied by us.

This paper is intended (i) to expand the knowledge of the molluscan biodiversity of Bulgaria, and (ii) to describe the new species.

Material and Methods

The living snails were collected by hand and preserved in 75% ethanol. The shells were collected by sieving by 1x1 and 2x2 mm mesh width sieves. The material from the smaller meshed sieve was dried in the laboratory. Later it was put into water again and the floating shells were collected by a strainer and small brush.

The dissections and measurements of the shells were carried out by means of stereo microscope and an eyepiece micrometer considering the criteria of Radoman (1983), and Hershler & Ponder (1984). The photographs were made with a camera system with a digital adapter.

The identification key of the genera of the Bulgarian Rissooidea was made with a critical overview on all published papers for Bulgaria considering new descriptions of taxa or summary works (Wagner 1927, Angelov 1959, 1965, 1967, 1972, 1976, 2000, Pintér 1968, Radoman 1983, Hubenov 2005, Glöer and Pešić 2006, Glöer and Georgiev 2009, 2011, Georgiev and Glöer 2011, Georgiev and Stoycheva, 2011, Georgiev 2009, 2011a, 2011b, 2011c, in press) and also a few summary works considering this group of aquatic snails on larger areas (Radoman 1983, Hershler and Ponder 1984, Kabat and Hershler 1993, Glöer 2002, Arconada and Ramos 2003).

The opinion of Radoman (1983) that most of the species of Rissooidea differ by their penis morphology was accepted for this paper. The female genitalia were not investigated.

IUCN criteria (2001) in evaluating the conservational status of the species were used.

Abbreviations used: H – shell height, W – shell width, AH – aperture height.

The type material was deposited in the Zoological Museum of Hamburg (ZMH, Germany).

Taxonomic descriptions

Family Hydrobiidae Troschel, 1857

Genus: ***Strandzhia* gen.n.**

Etymology: *Strandzhia* because it was found in the Strandza Mts.

Description: The conical shell is horn colored and consists of 3.5-4 whorls that are slightly rounded with a weak suture. The aperture is ovoid and slightly angled at the top, with a sharp periostome that is thickened at the columella. The penis is regularly broad, smoothly tapering distally and has an appendix shorter than the penis with a sucker-like apical part (similar to that characteristic of the genus *Bythinella* Moquin-Tandon, 1856). The penial appendix in some specimens could bear a small lobe as a brunch of its base. A flagellum is missing.

Differentiating features: The lack of a flagellum discern the new genus from the genera *Bythinella*, and the newly described *Agrafia*, Szarowska & Falniowski, 2011 (Szarowska & Falniowski, 2011) from Greece. The new genus differs from the rest of the Rissooidea by the presence of a penial appendix, similar to that of *Bythinella*.

Type species: *Strandzhia bythinellopenia* sp.n., gen.n.

***Strandzhia bythinellopenia* sp.n., gen.n.**

Material: 26.09.2009, 29 ex. from the type locality (4 males dissected), D. Georgiev leg.

Holotype: height 1.8 mm, width 1.4 mm. ZMH 79333

Paratypes: 10 ex. in ethanol from type locality. ZMH 79334, 18 excoll. Glöer, 10 excoll Georgiev.

Locus typicus: Stream below water source near Mladezhko village, Strandzha Mt, South-East Bulgaria, N42° 09' 04.6'' E27° 21' 49.3'', 129 m alt. (Fig. 2).

Differential diagnosis: The penis bears a large penial appendix but does not have a flagellum.

Description: Shell: The conical shell is horn colored and consists of 3.5-4 whorls that are slightly rounded with a weak suture. The surface is glossy with fine growth lines. The apex is very small and flattened, the umbilicus is closed. The aperture is ovoid and slightly angled at the top, with a sharp periostome that is thickened at the columella (Fig. 1). The operculum is orange-reddish. H = 1.7-1.8 mm, W = 1.4 mm, AH/H = 0.49.

Animal: The mantle is pigmented in black with a white border. The head and the bases of the snout and the sole are black with white-yellowish distal parts. The tentacles are grey with rounded apical parts.

Anatomy: The penis is regularly broad, smoothly tapering distally and has an appendix shorter than the penis with a sucker-like apical part (similar to that characteristic of the genus *Bythinella* Moquin-Tandon, 1856) (Fig. 1). The penial appendix in some specimens could bear a small lobe as a brunch of its base. A flagellum is missing. The penis color is yellowish and in some specimens with very small dark spot at its distal part.

Etymology: *Strandzhia* because it was found in the Strandza Mts., – *bythinellopenia* because it has a penis which looks at a first glance similar to the penis of *Bythinella*.

Distribution: Known only from the type locality (Fig. 13).

Ecology: The species was found on stones at the bottom of a small stream situated on a meadow on calcareous terrain, it lives together with *Bythinella margritae* Glöer & Georgiev, 2011.

Conservation status: As the spring waters of the type locality were already captured for drinking needs, we consider the species as Endangered (EN), vulnerable of any further negative anthropogenic influence on it.

Genus ***Grossuana* Radoman, 1983**

***Grossuana slavyanica* sp.n.**

Material: 10.05.2010, 38 ex. from the type locality (3 males dissected), D. Georgiev leg.

Holotype: height 2.2 mm, width 1.5 mm. ZMH 79335.

Paratypes: 10 ex. in ethanol from type locality. ZMH 79336, 27 excoll. Glöer, 5 excoll. Georgiev.

Locus typicus: Stream below water source at Goleshovo village, Slavyanka Mts, South-Western Bulgaria, N41° 25' 52.8'' E23° 35' 19.0'', 762 m alt. (Fig. 4).

Differentiating features: The *G. slavyanica* sp.n. has the slimmest shell from all known species from the genus.

Description: Shell: The slim, elongate conical shell is horn colored and consists of 4.5 regularly growing whorls that are slightly rounded with a weak suture. The surface is glossy with fine growth lines. The umbilicus is closed. The aperture is ovoid and slightly angled at the top, with a sharp periostome that is thickened at the columella (Fig. 3). The operculum is orange-reddish. H = 1.9-2.2 mm, W = 1.3-1.5 mm, AH/H = 0.43-0.45.

Animal: The mantle is black with a white border. The head and tentacle base are grey, the snout, sole and distal tentacle parts are white.

Anatomy: The penis bears a small lobe on its left side and is pointed at its apical part. A dark spot on the penis is present.

Etymology: Named after the Slavyanka Mts where the species was found.

Distribution: Known only from the type locality (Fig. 13).

Ecology: The species was found on stones at the bottom of a small stream below the water source at a village, on calcareous terrain.

Conservation status: As the spring waters of the type locality were already captured for drinking needs, we consider the species as Endangered (EN), vulnerable of any further negative anthro-

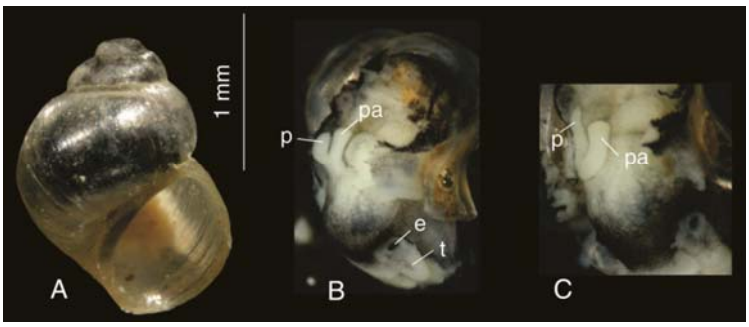

Figure 1. *Strandzhia bythinellopenia* sp.n., gen.n.: **A** – shell of the holotype, **B, C** – penes of two dissected specimens [p – penis, pa – penial appendix, e – eye, t – tentacle].

Figure 2. The type locality of *Strandzhia bythinellopenia* sp.n., gen.n. near village of Mladezhko, Strandzha Mts.

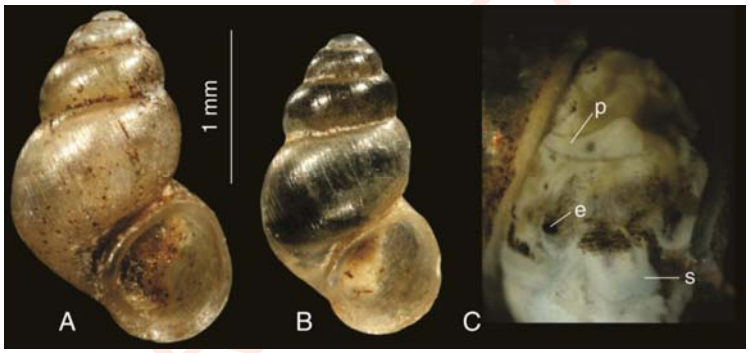

Figure 3. *Grossuana slavyanica* sp.n.: **A** – shell of the holotype, **B** – paratype, **C** – penis and head [p – penis, e – eye, s – snout].

Figure 4. The type locality of *Grossuana slavyanica* sp.n. from two views, at village of Goleshovo, Slavyanka Mt.

pogenic influence on it.

***Grossuana derventica* sp.n.**

Material: 25.09.2009, 42 ex from the type locality, D. Georgiev leg.

Holotype: height 1.8 mm, width 1.3 mm. ZMH 79337.

Paratypes: 10 ex. in ethanol from type locality. ZMH 79338, 31 excoll. Glöer, 7 excoll Georgiev.

Locus typicus: Dratchi Dupka cave, near village of Melnitsa, Derventski Heights, South-Eastern Bulgaria, N42° 02' 52.8" E26° 32' 17.9" (Fig. 6).

Differentiating features: *G. derventica* sp.n. is most similar with *G. thracica* Glöer & Georgiev, 2009 but its shell is smaller and its penis is broader distally. Also the last species was never found to live in caves, even at their entrance parts, and inhabit only the well lighted outer stream (the type locality of *G. thracica* is also a cave spring, Chirpan Bunar cave) in contrast with *G. derventica* which had a numerous population in Drantchi Dupka cave. In addition the soft body of the new species has a specific pigmentation not known from any of the other species from the genus.

Description: Shell: The conical shell is horn colored and consists of 3.5-4 whorls that are slightly rounded with a weak suture. The surface is silky with fine growth lines. The apex is very small and flattened, the umbilicus is closed. The aperture is ovoid and slightly angled at the top, with a sharp periostome that is thickened at the columella (Fig. 5). The operculum is orange-reddish. H = 1.7-1.8 mm, W = 1.3 mm, AH/H = 0.5.

Animal: The soft body of the new species has a specific pigmentation not known from any of the other species from the genus. The mantle is black with a white border. The other soft parts are grey-white and yellowish, and black pigment is concentrated only around the eyes, making a specific look of the animal.

Anatomy: The penis has a broad base, thinner middle part and broad distal part which is sharply tapered, and bearing a small single outgrowth on its left side. A dark spot on the penis is well visible.

Etymology: Named after the Derventski Heights where the species was found.

Distribution: Known only from the type locality (Fig. 13).

Ecology: Found on stones in the cave lake of Dratchi Dupka cave, which sink-hole is about 15 meters deep, and the outer stream. Troglophilous species.

Conservation status: We consider the species as Endangered (EN).

Genus ***Radomaniola* Szarowska, 2006**

***Radomaniola strandzhica* sp.n.**

Material: 45 ex from the type locality, 26.09.2009, D. Georgiev leg.

Holotype: height 1.8 mm, width 1.4 mm. ZMH 79339.

Paratypes: 10 ex. in ethanol from type locality. ZMH 79340, 34 ex. coll. Glöer.

Locus typicus: In the spring emerging from the Izvora cave, west of Mladezhko village, Strandzha Mt., N 42° 09' 03.7" E 27° 21' 27.3", 215 m alt.

Differentiating features: The new species is most similar with *Radomaniola rhodopensis* Glöer & Georgiev, 2009 from which it differs by its smaller size and the ratio of the aperture height to shell height (which is 0.43-0.45 in the species mentioned).

Description: Shell: The globular conical shell is horn colored and consists of 3.5-4 fast growing whorls that are slightly rounded with a weak suture. The surface is silky with fine growth lines. The apex is very small and flattened, the umbilicus is closed. The aperture is ovoid and slightly angled at the top, with a sharp periostome that is thickened at the columella (Fig. 7). The operculum is orange-reddish. H = 1.8 mm, W = 1.4-1.5 mm, AH/H = 0.5.

Animal: The mantle is black with white border. The head, tentacles and snout are pigmented mainly in black. The other soft parts are predominantly white-yellowish.

Anatomy: The penis is regularly broad, smoothly tapering distally with two outgrowths on its left side. A triangular dark spot is well visible.

Etymology: Named after the Strandzha Mts where the species was found.

Distribution: Known only from the type locality (Fig. 13).

Ecology: Collected from stones only in the spring area at the Izvora cave entrance, and possibly a calciphilous species. Lives together with *Bythinella izvorica* Glöer & Georgiev, 2011.

Conservation status: We consider the species as Endangered (EN).

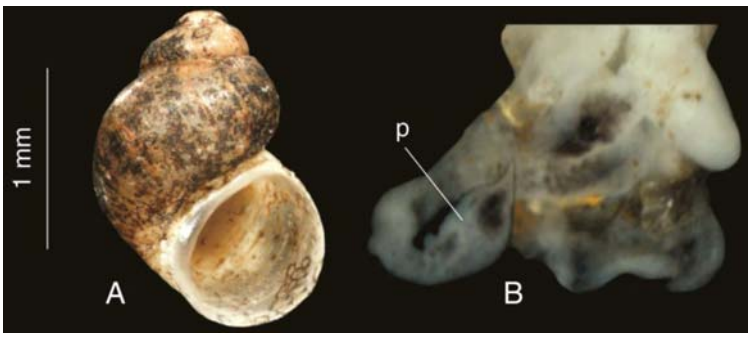

Figure 5. *Grossuana derventica* n. sp.: **A** – shell of the holotype, **B** – head with penis [p – penis].

Figure 6. The type locality of *Grossuana derventica* sp.n. from two views, the entrance of Drantchi Dupka cave (left) and the outer stream (right), near village of Melnitsa, Derventski Heights.

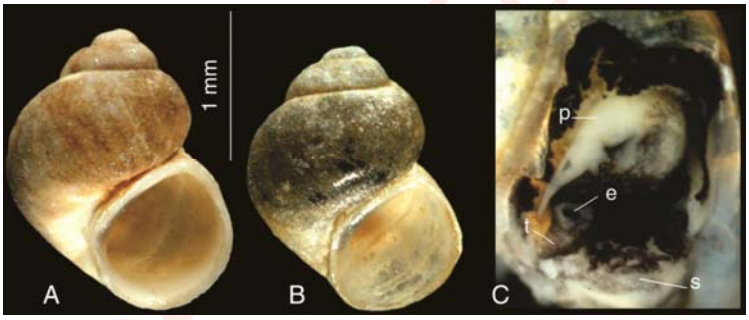

Figure 7. *Radomaniola strandzhica* sp.n.: **A** – shell of the holotype, **B** – paratype, **C** – penis and head [p – penis, e – eye, t – tentacle, s – snout].

Genus ***Bythiospeum*** **Bourguignat, 1882**

Bythiospeum devetakium **sp.n.**

Material: 8 ex. from type locality (1 dissected), 31.10.2009, 5 ex. from Brashlianskata cave, near village of Aleksandrovo, 18.10.2009, Dilian Georgiev leg.

Holotype: height 2.3 mm, width 1.1 mm. ZMH 79341.

Paratypes: 3 ex. in ethanol from type locality. ZMH 79342, 4 ex. coll. Glöer. 1 ex. coll. Georgiev.

Locus typicus: Urushka Maara cave, near village of Krushuna, Devetashko Plateau, Northern Bulgaria, N43° 14' 41.7'' E25° 02' 45.4'', 191 m alt. (Fig. 9).

Differential diagnosis: From all Bulgarian species from this genus *B. devetakium* n. sp. is most similar with *Bythiospeum copiosus* (Angelov, 1972) but it has a more developed aperture lip and flatter whorls with a weaker suture.

Description: Shell: The shell is elongate conical, translucent, horn colored. The whorls are 5-5.5, relatively flat, with a clear suture, the apex is

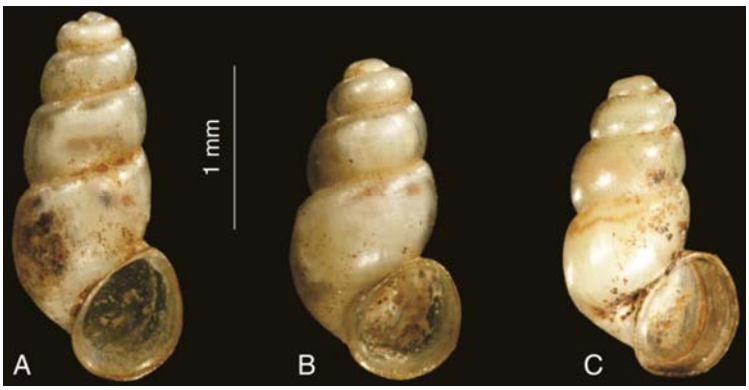

Figure 8. *Bythiospeum devetakium* sp.n.: **A** – holotype, **B** – paratype, **C** – specimen from Brashlianskata cave.

Figure 9. The type locality of *Bythiospeum devetakium* sp.n. from two views, entrance of Urushka Maara cave (left) and the inner stream (right), at village of Krushuna, Devetashko Plateau.

obtuse. The aperture is ovoid, angled at the top, the umbilicus is closed (Fig. 8). The operculum is translucent. H = 2.0-2.3 mm, W = 1.1 mm, W/H = 0.36-0.37.

Animal: The entire animal is colorless and has no eyes.

Etymology: The species was named after the Devetashko Plateau where it was found.

Distribution: Found in two caves on Devetashko Plateau, Northern Bulgaria: Urushka Maara (village of Krushuna) and Brashlianskata (village of Aleksandrovo) (Fig. 13).

Habitat and Ecology: The Urushka Maara cave is 1600 m in length, and Brashlianskata cave is 680 m, both cave rivers are with varying capacity, and are deep, forming a lot of pools and siphons which can be investigated only by experienced divers. At Urushka Maara cave it lives together with *Belgrandiella pandurskii* Georgiev, 2011, and *Devetakia krushunica* Georgiev & Glöer 2011.

Conservation status: We consider the species as Endangered (EN).

Family Amnicolidae Tryon, 1863

Genus ***Bythinella*** **Moquin-Tandon, 1856**

Bythinella rilaensis **sp.n.**

Material: 19 ex. from type locality, 05.05.2010, Dilian Georgiev leg.

Holotype: height 2.6 mm, width 1.5 mm. ZMH 79343.

Paratypes: 5 ex. in ethanol from type locality. ZMH 79344, 8 excoll. Glöer, 5 excoll Georgiev.

Locus typicus: Water source near the road between Belovo and Golyamo Belovo, granite rocks, Rila Mnt., Bulgaria. N 42° 09' 15.2'' E 23° 57' 59.5'', 737 m alt. (Fig. 11).

Differentiating features: The only species of which the shells look similar is *B. srednogorica* Glöer & Georgiev 2009. The shells of *B. rilaensis* are slimmer, the flagellum is longer and broader at the distal part.

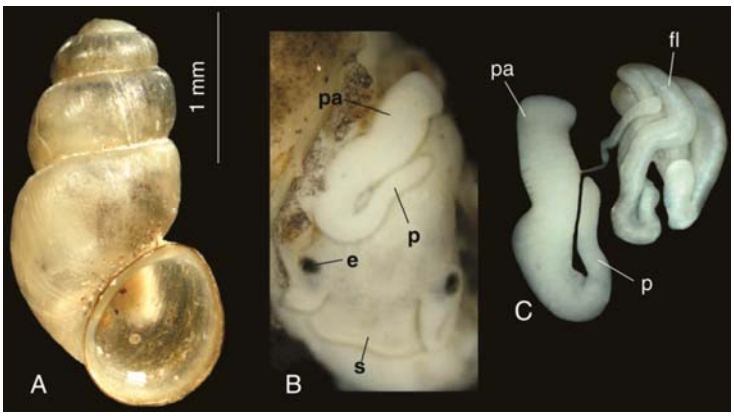

Figure 10. *Bythinella rilaensis* sp.n.: **A** – holotype, **B** – head and penis in situ, **C** – male genitalia [p – penis, pa – penial appendix, fl – flagellum, e – eye, s – snout].

Figure 11. The type locality of *Bythinella rilaensis* sp.n., water source near the road between Belovo and Golyamo Belovo, Rila Mts.

Description: The whitish, translucent shell is cylindrical and consists of 4–4.5 whorls, which are slightly convex with a deep suture. The surface is silky and finely striated. The apex is obtuse, the umbilicus closed. The aperture is oval with a sharp periostome which is thickened at the columella (Fig. 10). H = 2.5–2.9 mm, W = 1.5–1.6 mm, AH/H = 0.38–0.40.

Animal: Mantle light to dark grey with a broad white border. The other soft body parts are whitish with weak grey pigment.

Anatomy: Penis shorter than the penial appendix, flagellum relatively long and thickened at the distal end, the proximal end is very thin.

Etymology: Named after the Rila Mountain where the species was found.

Distribution: Known only from the type locality (Fig. 13).

Ecology: Found under wooden materials in a spring at the edge of a broad leaf forest on granite rocks, possibly not a calciphilous species.

Conservation status: As the spring waters of the type locality were already captured for drinking needs, we consider the species as Endangered (EN), vulnerable of any further negative anthropogenic influence on it.

As a result of our synopsis on the literature considered the Bulgarian Rissooidea, and our new findings we suggest an identification key to the genera assigned to this superfamily:

Identification key to the Bulgarian genera of Rissooidea

1. Shell flat, planispiral, valvatiform ..... ***Hauffenia* Pollonera, 1898**
— Shell cylindrical, conical or sphaerical **2**
2. Shell conical with a well developed aperture lip **3**
— Shell conical or elongate-conical, with simple aperture lip **4**
— Shell ovate-conical **5**
— Shell ovate-cylindrical **7**
— - Shell elongated conical, apex pointed **11**
3. Shell without an axial sculpture **12**

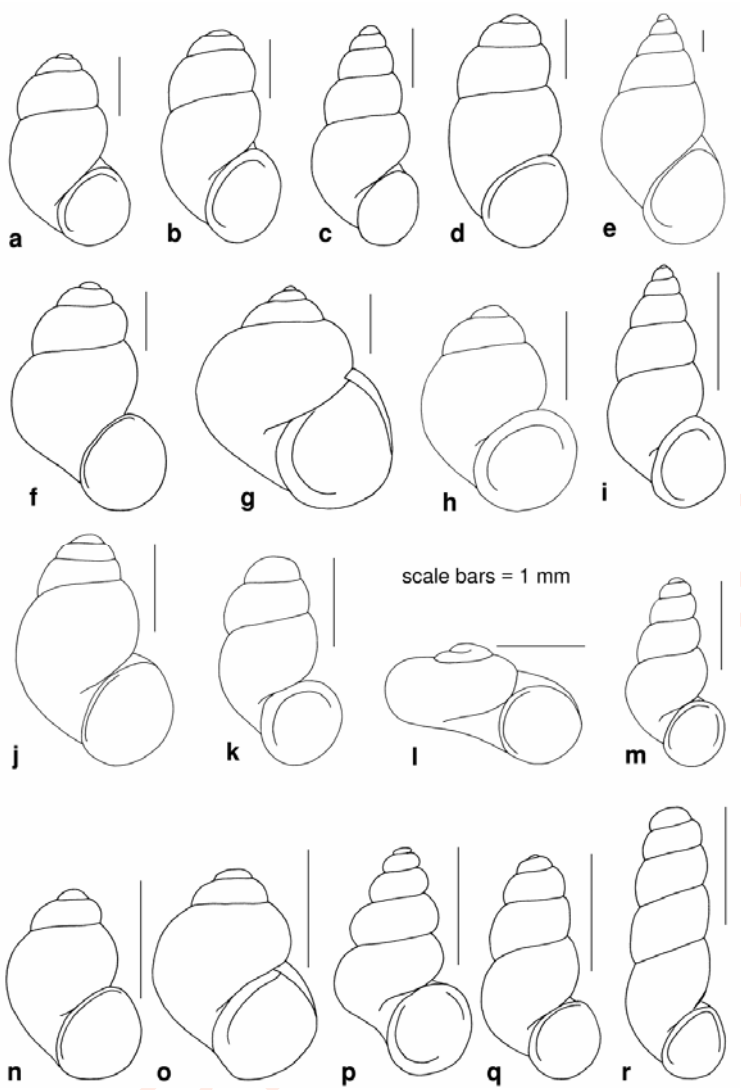

Figure 12. Shell shapes of the Bulgarian genera from the superfamily Rissooidea: **a:** *Belgrandiella*, **b:** *Bythinella*, **c:** *Hydrobia*, **d:** *Pontobelgrandiella*, **e:** *Potamopyrgus*, **f:** *Cavernisa*, **g:** *Sadleriana*, **h:** *Balkanica*, **i:** *Bythiospeum*, **j:** *Radomaniola*, **k:** *Insignia*, **l:** *Hauffenia*, **m:** *Balkanospeum*, **n:** *Grossuana*, **o:** *Strandzhia*, **p:** *Plagigeyeria*, **q:** *Devetakia*, **r:** *Iglica*.

– Shell with an axial sculpture ..... ***Plagigeyeria* Tomlin, 1930**

4. Shell elongated conical to nearly cylindrical with more than 5 flat whorls ..... ***Iglica* Wagner, 1927**

– Shell conical, less than 5 whorls more convex ..... ***Devetakia* Georgiev & Glöer, 2011**

5. Aperture lip simple **6**

– Aperture lip well developed ..... ***Balkanica* Georgiev, 2011**

6. Penis simple without any outgrowths ..... ***Sadleriana* Clessin, 1890**

– Penis with two outgrowths crowded together ..... ***Radomaniola***

– Penis with a single outgrowth, sometimes branched with two lobes ..... ***Grossuana***

– Penis with a long appendix similar to this of *Bythinella* ..... ***Strandzhia* gen. n.**

7. Shell very small, H < 1.30 mm, whorls 3-3.5 ..... ***Insignia*, Angelov 1972**

— Shell larger **8**
8. Penis with long tubular appendix and a flagellum ..... ***Bythinella***
- Penis without an appendix and flagellum **9**
9. Penis with two small glandular fields far from each other ..... ***Pontobelgrandiella*** **Radoman, 1978**
— Penis simple or with one outgrowth **10**
10. Penis simple or with an appendix having a narrow base ..... ***Belgrandiella*** **(Wagner, 1927)**
— Penis with a triangular outgrowth with a broad base ..... ***Cavernisa*** **Radoman, 1978**
11. Whorls convex with a clear suture, umbilicus open ..... ***Hydrobia*** **Hartmann, 1821**
— Whorls flatter, umbilicus closed ..... ***Potamopyrgus*** **Stimpson, 1865**
12. Penis simple ..... ***Bythiospeum***
— Penis with one outgrowth ..... ***Balkanospeum*** **Georgiev, 2012, in press**

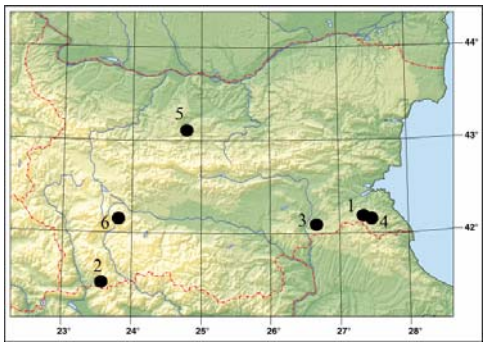

Figure 13. Map of localities of the new species: 1 - *Strandzhia bythinellopenia* sp.n., gen.n., 2 - *Grossuana slavyanica* sp.n., 3 - *Grossuana derventica* sp.n., 4 - *Radomaniola strandzhica* sp.n., 5 - *Bythiospeum devetakium* sp.n., 6 - *Bythinella rilaensis* sp.n.

Discussion

We did not dissect the specimens of *Bythiospeum devetakium* sp.n. because of scarce materials. Thus we cannot be sure if this species belongs to the genus *Bythiospeum* or any other genus group. *Paladilhiopsis* is a similar genus known from this region but the species of which have a different morphology of the aperture. On the other hand no *Bythiospeum* spp. are know from the Balkans, thus the classification is provisional.

The discussion concerning whether *Radomaniola* and *Grossuana* are distinct genus groups is in progress. We follow Radoman (1983) that *Radomaniola* (= *Orientalina* Radoman, 1978) has a bilobed outgrowth and *Grossuana* has a simple outgrowth on the left side of the penis.

Including this paper there were a total of 58 known nominal species of minute Rissooidea from Bulgaria. The most diverse genera are *Bythinella* with 20 nominal species, *Belgrandiella* with 11, and *Grossuana* with 7 nominal species. All the rest of the genera were presented with only 1 to 3 known nominal species (Fig. 14). Considering the literature data we can outline the Rilo-Rhodopian massif, and especially its western part as a possible center of species radiation for the genus *Bythinella* from where 11 species were found, for the genus *Belgrandiella* it is possibly the chain of Stara Planina Mt. with the Pre-Balkan area, with 8 species, and for *Grossuana* – all the lower country parts and hilly areas below 500 m a.s.l. From all the species more than 95% were endemics, with 7 endemic genera known (*Pontobelgrandiella*, *Cavernisa*, *Insignia*, *Devetakia*, *Balkanica*, *Balkanospeum* and *Strandzhia* gen. n.), all of them, except the new genus

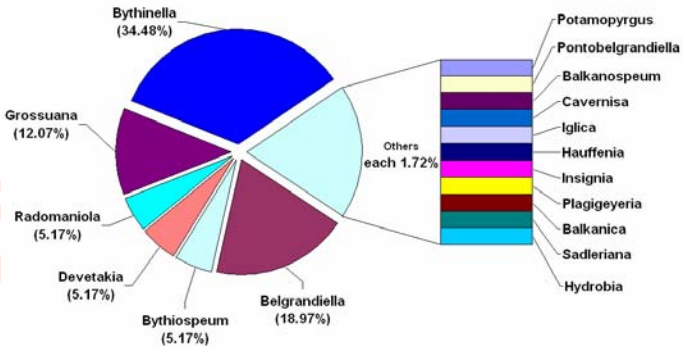

Figure 14. The known species diversity of the genera of the Bulgarian Rissooidea.

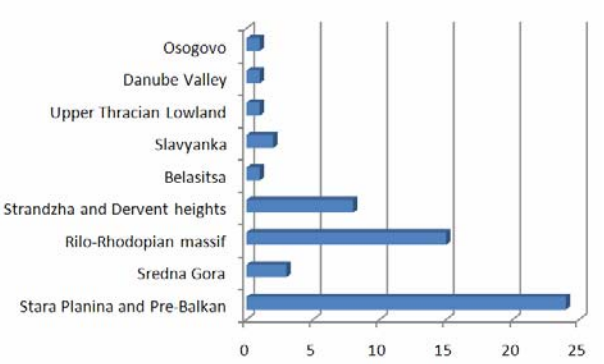

Figure 15. Known species diversity in different geographic areas of Bulgaria, where minute Rissooidea were registered, including some unpublished data of the authors.

described in this paper, occur in Stara Planina Mt. or its pre-mountain areas. In this mountain occurs the richest fauna of Rissooidea species (24) known in Bulgaria (Fig. 14). So this mountain could be noted as a very old center of taxonomical radiation, with great species diversity and endemism.

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