



Two new species of the *Bythiospeum* Bourguignat, 1882 complex (Gastropoda: Hydrobiidae) and a new locality of *Balkanospeum schniebsae* (Georgiev, 2011) from north Bulgaria

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Resum

Mostratges recents en coves del nord de Bulgària han revelat dues noves espècies del gènere *Bythiospeum* Bourguignat, 1882 i una nova localitat de mostratge de *Balkanospeum schniebsae* (Georgiev, 2011). Les noves espècies es descriuen aquí com *Bythiospeum bechevi* sp. nov. i *Bythiospeum jazzii* sp. nov.

Paraules clau: Mollusca; Estigobis; Cargols; Balkans.

Abstract

Recent samplings in caves of north Bulgaria revealed two new species of the genus *Bythiospeum* Bourguignat, 1882 and one new sampling site of *Balkanospeum schniebsae* (Georgiev, 2011). The new species are described here as *Bythiospeum bechevi* sp. nov. and *Bythiospeum jazzii* sp. nov.

Keywords: Mollusca; Stygobiotic; Snails; Balkans.

Introduction

There are seven species of stygobiotic snails from the genus *Bythiospeum* Bourguignat, 1882 in Bulgaria known until now: *Bythiospeum bureschi* (Wagner, 1927); *Bythiospeum devetakium* Georgiev et Glöer, 2013; *Bythiospeum pandurskii* Georgiev, 2012; *Bythiospeum dourdeni* Georgiev, 2012; *Bythiospeum simovi* Georgiev, 2013; *Bythiospeum kolevi* Georgiev, 2013; and *Bythiospeum stoyanovi* Georgiev, 2013. Also, with a similar shell morphology, *Balkanospeum schniebsae* (Georgiev, 2011b) was recently described from two caves in Stara Planina Mountain (Wagner, 1927; Georgiev, 2011a,b, 2012a,b, 2013; Georgiev & Glöer, 2013). In this paper, we describe two new species of *Bythiospeum*, and also report the third known locality of *Ba. schniebsae*.

Materials and methods

The studied shells were collected by sieving cave river deposits using sieves with 1x1 and 2x2 mm of mesh width. The material from the smaller-meshed sieve was then brought to the laboratory and dried. After that, it was put again into water, and the floating shells were collected with a strainer and small brush. Measurements were taken by means of CETI stereo microscope and an eye-piece micrometer, by following the criteria of Radoman (1983) and Hershler & Ponder (1984). Photographs were taken with a camera system with a digital adapter. Systematics follows Bank (2011).

Measurement abbreviations. AH, aperture height; H, shell

height; W, shell width.

Systematics

Phylum MOLLUSCA Cuvier, 1795
Class GASTROPODA Cuvier, 1795
Superfamily RISSOOIDEA J.E. Gray, 1847
Family HYDROBIIDAE Troschel, 1857
Genus *Bythiospeum* Bourguignat, 1882

Bythiospeum bechevi sp. nov.
(Figures 2C–D)

Holotype. One shell (ZMH 7966), 10/12/2011 D.G. leg., stored at the Zoological Museum of Hamburg (ZMH) in Germany. Measurements: H = 1.9 mm; W = 0.95 mm.

Paratypes. Two shells, 10/12/2011 D.G. leg., one (ZMH 79670) housed at the ZMH and another one in Glöer's collection.

Diagnosis. Conico-cylindrical shell with 4–4½ convex whorls, deep sutures and a rounded apex. Shell fragile and slender, yellowish, shiny, translucent and very fragile, with fine growth lines. Umbilicus open. Perioistome ovoid, and lip not well developed and with a slightly thickened edge. Soft anatomy and operculum unknown. Shell measurements: H = 1.65–1.90 mm (mean 1.82 mm; SD 0.14 mm); W = 0.8–1.0 mm (mean 0.92 mm; SD 0.10 mm); AH = 0.6–0.7 mm (mean 0.65 mm; SD 0.05 mm).

Differential diagnosis. The new species differs from all known Bulgarian species of the genus *Bythiospeum* (Figures 2C–D) and the similarly shell-shaped genus *Balkanospeum* Georgiev, 2012a in the slenderer shell and the open umbilicus.

Locus typicus. Rushovata cave, Stara Planina Mts., near village of Glogovo, north Bulgaria [N42° 59' 00.30" E24° 15' 71.30"], 620 m (Figure 1).

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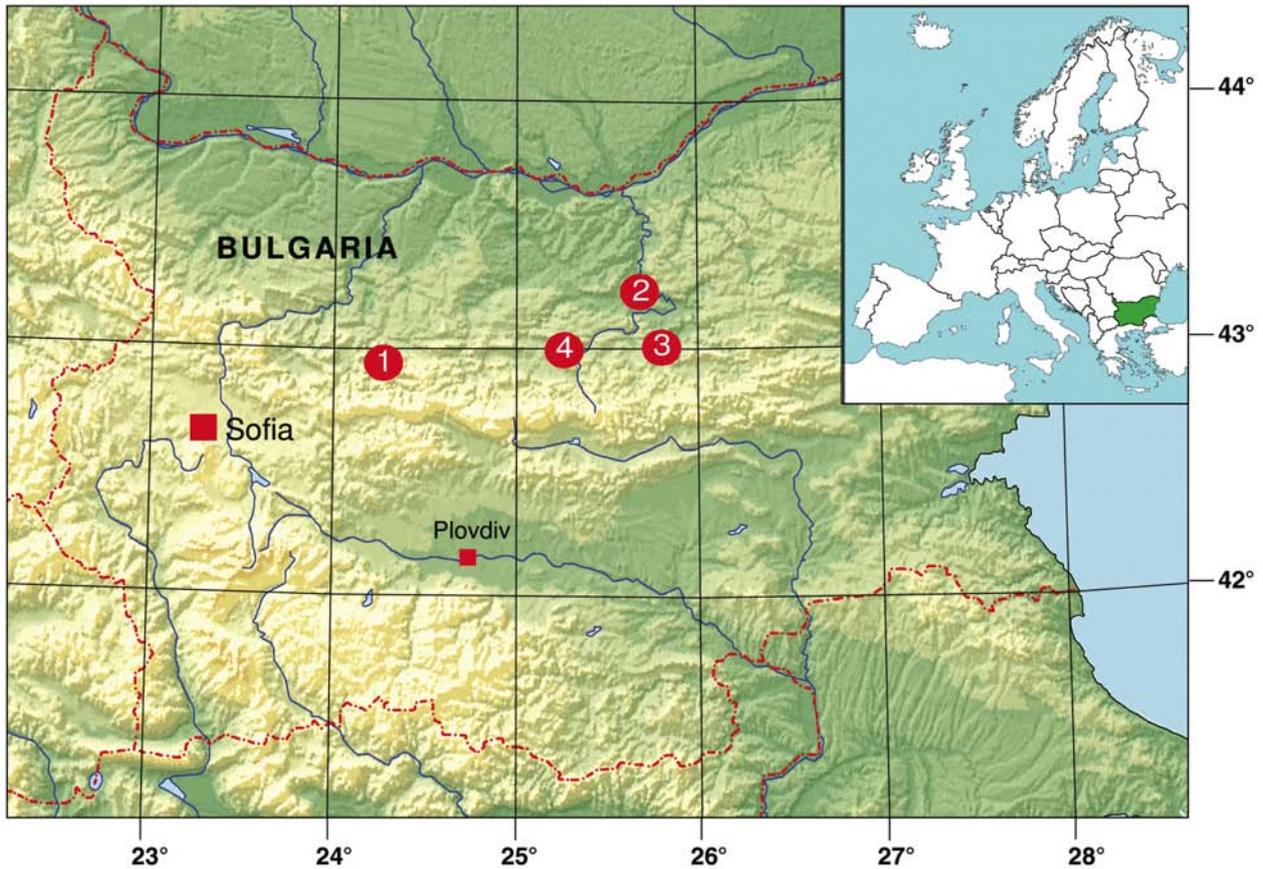


Figure 1. Situation map showing the sampling sites of the species discussed in this paper. Legend: 1, *Bythiospeum bechevi* sp. nov.; 2, *B. jazzi* sp. nov.; 3, new sampling site of *Balkanospeum schniebsae*; 4, type locality of *Ba. schniebsae*.

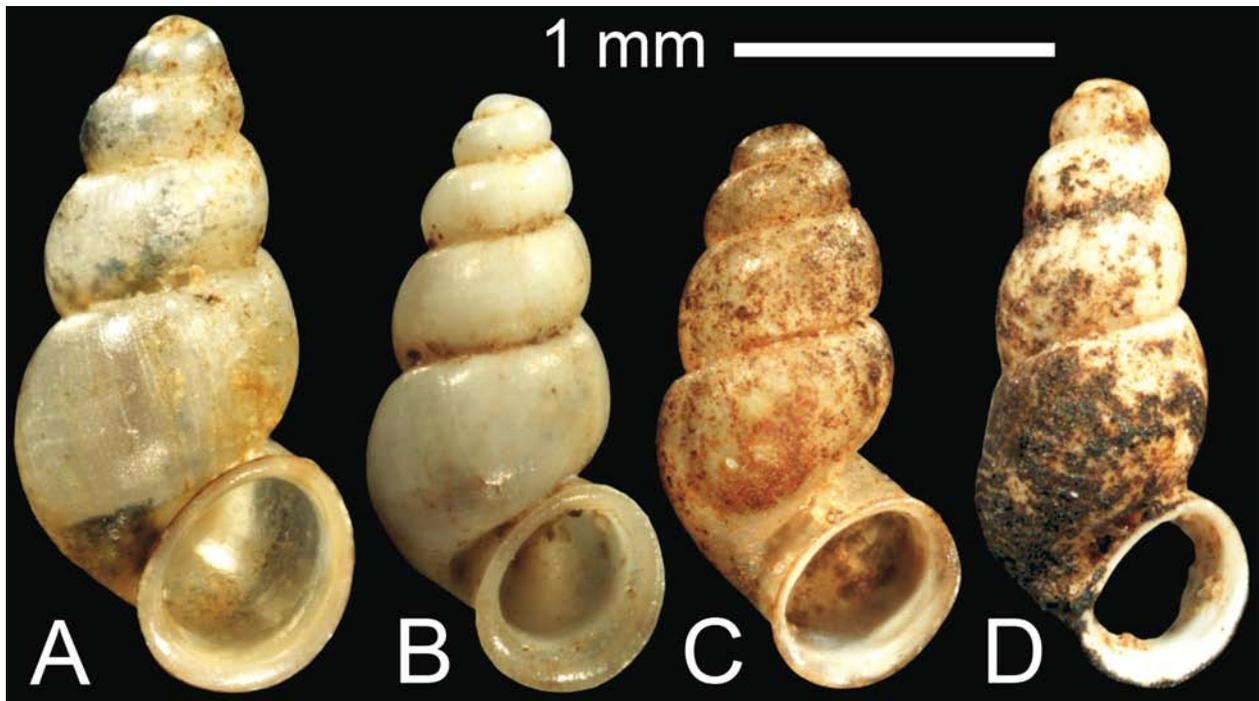


Figure 2. Stygobiotic snails collected from caves of north Bulgaria: A, Specimen of *Balkanospeum schniebsae* from Andaka cave, Dryanovski Monastery area; B, Holotype of *Bythiospeum jazzi* sp. nov. (ZMH 79671) from Vodnata cave near the village of Musina; C–D, Holotype (C, ZMH 7966) and paratype (D, ZMH 79670) of *Bythiospeum bechevi* sp. nov. from Rushovata cave near the village of Gradeshnitsa.

Etymology. Named after Prof. Dimitar Bechev (Plovdiv University), an expert on zoogeography who helped the senior author with many literature sources and material collections.

Distribution. Species known only from the type locality. Possibly it could be found in the other water caves in the same mountain massif, which are connected underground. Also,

empty shells can be expected in the sand deposits of the springs below the same mountain slope.

Habitat and ecology. Rushovata cave is 908 m long, formed in Triassic limestone. It is a horizontal water cave with some small branches at its most inner parts. Another stygobiotic species found in the cave river is the amphipod *Niphargus*

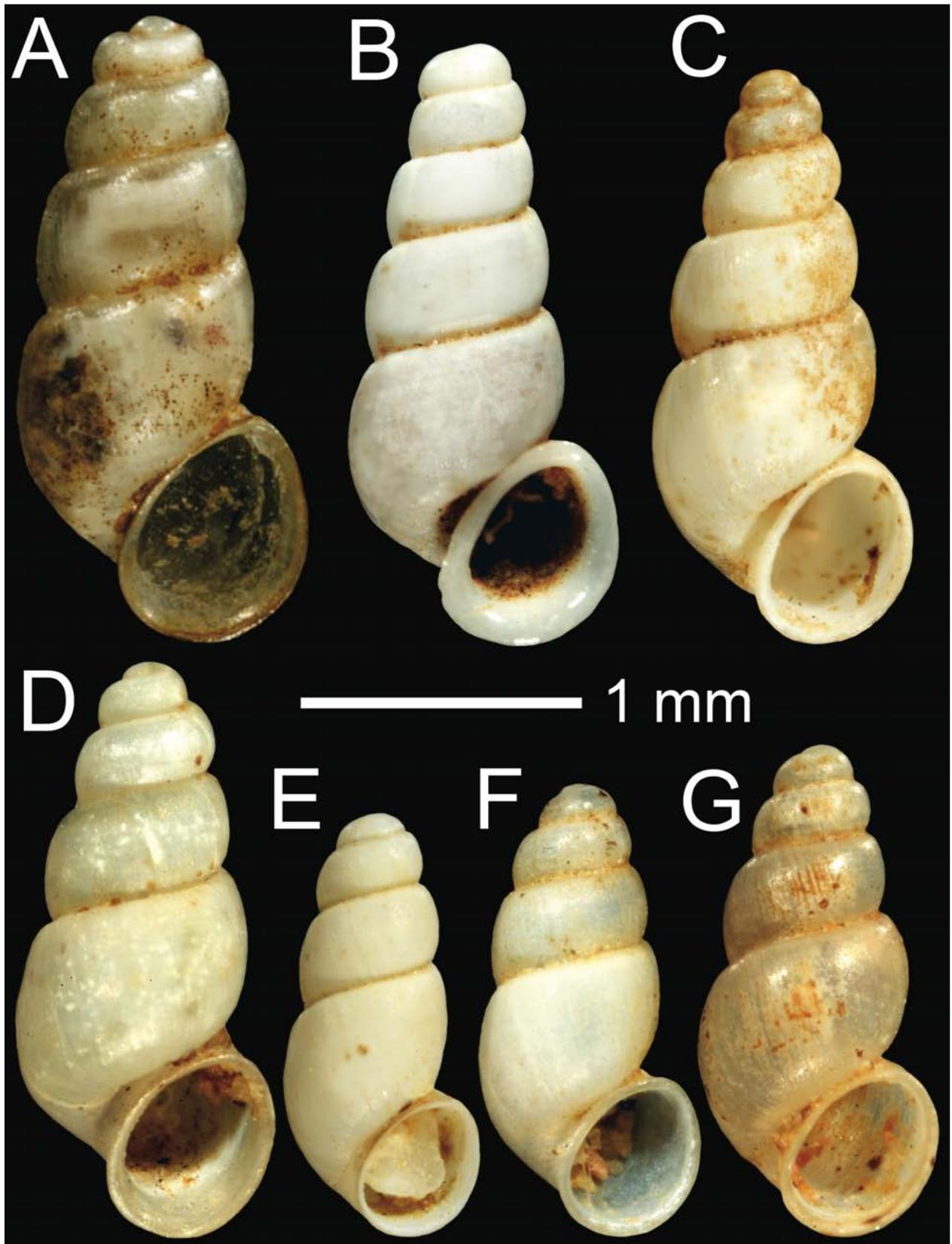


Figure 3. Other species of *Bythiospeum* from Bulgaria: A, *Bythiospeum devetakium* (holotype, ZMH 79341); B, *B. buretschi* (topotype); C, *B. stoyanovi* (paratype); D, *B. simovi* (paratype); E, *B. dourdeni* (paratype); F, *B. pandurskii* (paratype); G *B. kolevi* (paratype).

ablaskiri (see Beron et al., 2009). We also found shells of unknown species of valvatiform hydrobiids.

Bythiospeum jazzi sp. nov.
(Figure 2B)

Holotype. One shell (ZMH 79671), 9/3/2013 D.G. leg., stored at the ZMH. Measurements: H = 1.78 mm; W = 0.83 mm.

Paratypes. Six shells, 9/3/2013 D.G. leg., three (ZMH 79672) housed at the ZHM and three in Glöer's collection.

Diagnosis. Shell conical with $4\frac{1}{2}$ convex whorls, deep sutures and a rounded apex. Shell white, translucent and shiny, with a smooth surface. Umbilicus slit-like. Periostome ovoid to slightly pyriform, and lip well developed and with a thickened edge bent to the outside. Soft body and operculum unknown.

Shell measurements: H = 1.62–1.78 mm (mean 1.72 mm; SD 0.062 mm); W = 0.83–0.92 mm (mean 0.88 mm; SD 0.038 mm); AH = 0.59–0.63 mm (mean 0.62 mm; SD 0.015 mm); W/H = 0.46–0.54 (mean 0.51 mm; SD 0.030 mm); AH/H = 0.35–0.37 (mean 0.36 mm; SD 0.006 mm).

Differential diagnosis. The new species is most similar to *Bythiospeum bureschi* (Fig. 3B), described from Temnata Dupka cave near Lakatnik town, about 167 km to the west. *Bythiospeum jazzi* sp. nov. differs from the latter species in the more conical shell, the sharper apex and the not so well developed aperture lip.

Locus typicus. Vodnata cave, near the village of Musina, north Bulgaria [N43° 13' 14.9" E25° 25' 39.6"], 198 m (Figure 1).

Etymology. Named after the speleologist Rumen Doychev – “Jaza” (“the Jazz”), who helped D.G. in cave investigations during the biospeleological expedition on 9-10/3/2013 in north Bulgaria.

Distribution. Species known only from the type locality.

Habitat and ecology. Stygobiotic species found only as empty shells in the river deposits at the entrance of Vodnata cave, near the village of Musina. Shells of *Belgrandiella* sp. were also found. The cave can be explored only by boat and experienced divers to search for living snails on the bottom substrate of the inner stream.

Genus *Balkanospeum* Georgiev, 2012a
***Balkanospeum schniebsae* (Georgiev, 2011b)**
(Figures 2A)

Studied material. Five adult shells (one fragmented, four entire, one with operculum) and one juvenile shell from the type locality, 19/1/2013 Mintcho Zhelev leg.

Description of the collected specimens. The collected shells were compared with materials from the two previously known localities of the species (the caves Jantra and Machanov Trap), and turned out to be identical to them. The conical shell consists of 4½ convex whorls with deep sutures and a relatively sharp apex. The shell is colorless and translucent, with a shiny and smooth surface. The umbilicus is slit-like to semi-open in some specimens. The periostome is ovoid, and the lip is relatively well developed with a slightly thickened edge. The operculum is red, paucispiral. The soft anatomy is unknown. Shell measurements: H = 2.01–2.11 mm (mean 2.05 mm; SD 0.057 mm); W = 0.99–1.12 (mean 1.06 mm; SD 0.066 mm); AH = 0.69–0.76 (mean 0.73 mm; SD 0.047 mm); W/H = 0.47–0.56 (mean 0.52 mm; SD 0.045 mm); AH/H = 0.34–0.38 (mean 0.36 mm; SD 0.023 mm).

Remarks. According to Georgiev (2011b, 2012a, 2013) this species differs from all the rest of the similar in shell morphology species described from Bulgaria (assigned to the genus *Bythiospeum*, most of them with uncertain generic status) with its regularly rounded whorls, strictly ovoid aperture and its red operculum.

Distribution. Species currently known from the Bulgarian caves, situated not farther than 10 km from each other (Figure 1): the type locality, Jantra (Izvara, Padaloto) [N42° 57' 23.1" E25° 18' 52.3"]; Machanov Trap [N42° 57' 59.7" E25° 13' 30.2"]; and the new locality reported in this paper, Andaka cave near the town of Dryanovo, Stara Planina Mts. [N42° 56' 52.5" E25° 25' 54.1"], 280 m.

Habitat. Andaka cave is 4000 m long, horizontal, with large chambers through which an underground stream runs (minimum outflow of 15 l/s). Three streams with different water temperature come from the left side and join the main

cave river. It is the natural spring of the Andaka River, an inflow of Dryanovska River. Proven, but yet unpenetrated, is the connection with Vodnata (Kazana) cave in Dolni Varpishta village. It is also connected with a cave near the village of Donino, and with another one near the village of Kostenkovtsi. The existence of a large underground river system is presumed by speleologists (Beron *et al.*, 2009).

Discussion

Recent samplings in caves of north Bulgaria revealed two new species of the genus *Bythiospeum* and one new sampling site of *Balkanospeum schniebsae* (Georgiev, 2011b).

The genus *Paladilhiopsis* Pavlović, 1913, reported by Radoman (1983) from the Balkans and by Angelov (2000) from Bulgaria, is according to Bole & Velkovrh (1986) and Boeters (1998) a junior synonym of *Bythiospeum* Bourguignat, 1882. The latter includes more than 100 species distributed from The Netherlands and Spain to the Balkans, Asia Minor, Caucasus, and Uzbekistan in the east (Bole & Velkovrh, 1986; Haase, 1995; Arconada & Ramos, 2003). Although the database of *Fauna Ibérica* (Ramos, 2013) lists *Bythiospeum gloriae* Rolán et Martínez-Ortí, 2003 from Spain, in more recent check-lists this species is listed as *Spiralix?* (*Spiralix?*) *gloriae* (Rolán et Martínez-Ortí, 2003) (see Bank, 2011) or as *Spiralix gloriae* (Rolán et Martínez-Ortí, 2003) (see Cuttelod *et al.*, 2011). Therefore, it cannot be currently considered that this genus has any known species distributed in Spain. The same situation could be expected in other areas in which species of the *Bythiospeum* complex have been described.

These snails are exclusively stygobiont species, most of them described only on the basis of shell morphology (Haase, 1995). The shells of true *Bythiospeum* species are elongate-conical (some almost cylindrical), varying in height from 1.8 up to 4.9 mm, and the penis is simple without any outgrowths (Bernasconi, 1990). According to the latter author, *Paladilhiopsis* would differ from *Bythiospeum* by the shell microsculpture constituted by spiral lines crossing the growth striae. We studied the shell surface of all known Bulgarian species from the *Bythiospeum* complex, and found that spiral lines are lacking. It can be therefore concluded that, even if *Paladilhiopsis* is considered a distinct genus, until now there is no any evidence of its occurrence in Bulgaria. In Table 1, we provide an identification key for currently known species of the *Bythiospeum* complex in Bulgaria.

Further taxonomic clarification of the *Bythiospeum* complex is hindered by the lack of live specimens to be studied anatomically for most species. In particular, the penis morphology is only known in two Bulgarian species of this complex, one of them assigned to the genus *Balkanospeum* (type and only species, *Ba. schniebsae*). The latter differs from *Bythiospeum* in possessing a flat, wing-like outgrowth on the left side of the penis (Georgiev, 2012a). The other species, *Bythiospeum stoyanovi*, is very similar to species from Central Europe attributed to *Bythiospeum* because of its conical, short and simple penis without any outgrowths (Georgiev, 2013). It can be therefore supposed the view that, on the Balkans, there is a complex of species with similar, *Bythiospeum*-like shell morphology, including species belonging to *Bythiospeum* in a strict sense, and others belonging to an uncertain number of still undescribed genera. Given the lack of anatomical data, the possibility cannot be discounted that the two new species described in this paper belong to a genus conchologically similar to, but anatomically distinct from *Bythiospeum*.

Knowing the localities with stygobiotic species such as those described in this paper is important not only for a better knowledge on the biodiversity of a particular region or for solving particular taxonomical problems, but also from a hydrogeological viewpoint. The shells deposited by cave waters

Table 1. Identification key to the currently known species of the *Bythiospeum* complex from Bulgaria based on shell characters.

1. Apex wide, obtuse.....	<i>Bythiospeum devetakium</i>
Apex narrow, rounded or pointed.....	2
2. Umbilicus open.....	<i>Bythiospeum bechevi</i> sp. nov.
Umbilicus closed or slit-like	3
3. Aperture ovoid-pyriform, with well-developed lip bent to the outside	4
Aperture ovoid, lip not bent to the outside.....	5
4. Aperture edge thick, H > 2.0 mm, AH/H < 0.35 mm	<i>Bythiospeum bureschi</i>
Aperture edge not very thick, H < 1.8 mm, AH/H > 0.35	<i>Bythiospeum jazzi</i> sp. nov.
5. H > 1.8 mm	6
H < 1.8 mm	7
6. Aperture situated under the spire aligned with shell main axis, umbilicus closed.....	<i>Bythiospeum dourdeni</i>
Aperture in normal position, umbilicus slit-like	<i>Bythiospeum pandurskii</i>
7. W/H < 0.42	<i>Bythiospeum simovi</i>
W/H > 0.42	8
8. Operculum yellowish	9
Operculum red.....	<i>Balkanospeum schniebsae</i>
9. Umbilicus slit-like, H > 1.85 mm, W > 0.89 mm, AH/H < 0.34	<i>Bythiospeum stoyanovi</i>
Umbilicus closed, H < 1.85 mm, W < 0.89 mm, AH/H > 0.34	<i>Bythiospeum kolevi</i>

provide useful information to geologists and speleologists on the underground connections between caves and the formation of karstic systems. For example, the finding of the same species in different caves within a single or a few neighboring massifs may led to hypothesize the current existence of subterranean connections between them or at least their relatively recent split in geological terms.

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