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INSTITUTE FOR NATURE CONSERVATION OF SERBIA
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THE FRESHWATER GASTROPODS OF THE SKADAR LAKE WITH THE DESCRIPTION OF *VALVATA MONTENEGRINA* N. SP. (MOLLUSCA, GASTROPODA, VALVATIDAE)

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SUMMARY. The recent mollusc fauna of the Skadar lake was investigated and compared with former research. On this occasion we could detect a total of 7 species unknown in Montenegro so far. Because 12 of the recently found species are endemic to the Skadar Lake, these are 27 % of its total gastropod fauna, so we have to rank the lake as an ancient lake, although one of the younger ones, but its importance for evolutionary research should not be underestimated. Besides, were able to identify a new species, *Valvata montenegrina* n. sp.

KEY WORDS. Freshwater gastropoda, Skadar lake, ancient lake, Montenegro

1 – INTRODUCTION

Historical investigations on the mollusc fauna of the Skadar Lake are widely unknown. Wohlberedt (1909) dealt with the mollusc fauna of Montenegro and gave a detailed account of the publications of the 19th Century after the first paper of Küster (1843). Küster described in 1852 *Viviparus mamillatus*, which lived in a brook (Crnojevica, after WOHLBEREDT, 1909: 110) flowing into the Skadar lake (KÜSTER, 1852). But Wohlberedt only mention six species living in Skadar lake (*Theodoxus fluviatilis* f. *scutarensis*, *Viviparus mamillatus*, *Valvata piscinalis*, *V. cristata*, *Radix ovata* and *Stagnicola palustris*). The main part of all malacological expeditions of that time was concerned with terrestrial snails, because it was known that there were numerous endemic species not known so far, which had to be described as new. The most extensive work of the 20th Century was carried out by Jaeckel, Klemm and Meise (1958) who mentioned 20 limnic gastropod molluscs for Montenegro, but unfortunately they gave no sampling sites which would us to draw conclusions as to the occurrence of these species in Skadar Lake. At first, however, papers from e.g. Dhora (1975, 2002), Jacobi (1981) und Jovanović (1997) gave an overview of the recent mollusc fauna of Skadar Lake. In the end the major work of Radoman (1983), who is the outstanding expert on hydrobioids of the Balkan and who described several new species of the Skadar Lake, too, must not be forgotten.

2 – Material and methods

In 2005-2006, the recent mollusc fauna of Skadar lake were studied from the 12 sampling sites (fig. 1). The snails where gathered with a sieve from the water banks. The samples were put into ethanol (75 %). All found species were dissected to compare the anatomy with the known species to guarantee the definite determination of these species.

3 – Study area

The Skadar Lake drainage basin is located between 18° 41' and 19° 47' East and between 42° 58' and 40° 10' North. The Skadar lake, located in a karstic area in the outer part of the southeastern Dinaric Alps, is the largest of the Balkan lakes and has a surface area which fluctuates seasonally from approximately 370 to 600 km^2.

The lake's water level also varies seasonally from 4.7 to 9.8 m above sea level. The lake extends in the NW-SE direction, and it is approximately 44 km long. The Bojana River connects the lake with the Adriatic Sea, and the Drim River provides a link with the Ohrid Lake. The exact origin of the lake is unknown but it probably originated by solution and tectonic processes during the Pleistocene (Stanković, 1957).

The Southern and southwestern sides of the lake are rocky, barren and steep, having bays in which the sublacustrine springs, so called "okos", are usually to be found. On the northern side there is an enormous inundated area, the boundaries of which change as water levels fluctuate. The climate at the Skadar lake drainage basin is typically Mediterranean, with a long, hot summer at lower and medium altitudes and a short winter with heavy and abundant rainfalls.

4 – Results

4-1 – List of species of Gastropods in the Skadar lake

The species-list (table I) is, concerning the systematics, adapted from the list of Fauna europaea (Bank, 2007), except some nomenclatural variations after Glöer & Zettler (2005). We take into consideration the former papers of Dhora (1975, 2002), Dhora & Welter-Schultes (1996), Jovanović (1997), and Jacobi (1981). Species marked by an asterisk are recently found species which are new for Montenegrian fauna.

Some necessary critical annotations are to be made to the species-list. Jaeckel *et al.* (1958) mentioned *Theodoxus danubialis* of Montenegro, but they meant *Th. fluviatilis* var. *danubialis*, we think, because *Th. danubialis* does not live in Montenegro, but the shells of many specimens of *Th. fluviatilis* show a zigzag drawing, a little similar to *Th. danubialis*, so a confusion is highly probable. Furthermore Jaeckel *et al.* (1958) mentioned *Viviparus viviparus* besides *V. mamillatus*, too, a species name in former times called after Ehrmann (1933), but the International Commission on Zoological Nomenclature (IZCN, opinion 573) decided in 1959 to use the name *V. contectus* instead of *V. viviparus*, a species which could recently not be found by us. *Bithynia tentaculata* (Linnaeus 1758), repeatedly mentioned in all species-lists, is not conspecific with *B. tentaculata*, widely distributed in Europe, it is the distinct species *B. radomani* Glöer & Pešić, 2007. Concerning the distribution of this species in Southeast Europe we cannot say anything about that, because the countries Albania, Greece, and Turkey are hardly ever investigated for molluscs. We do not know the distribution of *Radix ampla* (Hartmann, 1821), which was mentioned by Dhora (2002), in the Balkan region. This distinct species,

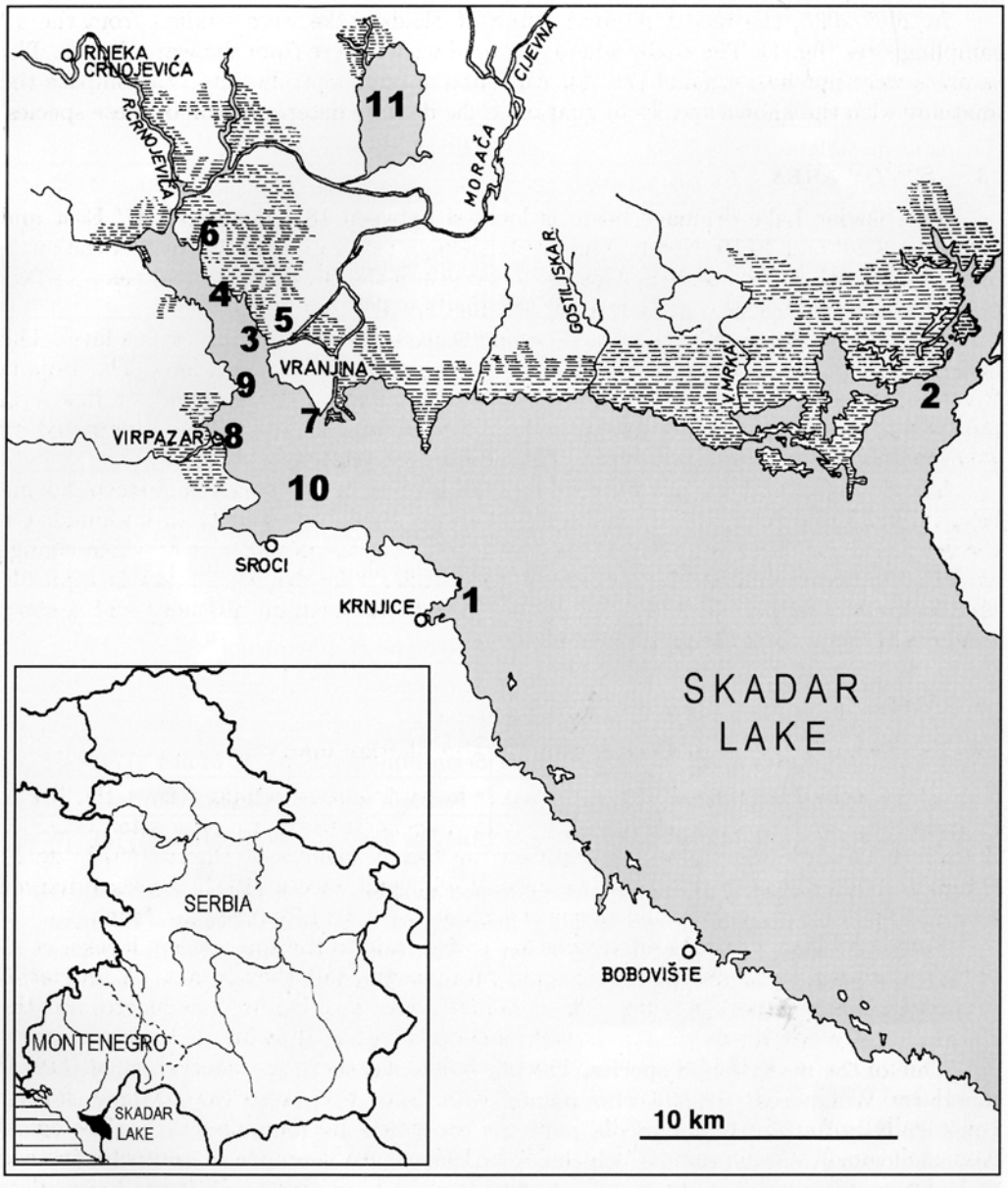

Figure 1. Skadar Lake with sampling sites: 1 = Krnjice; 2 = Podhum; 3 = mouth of River Morača; 4 = island Kom; 5 = village Vranjina; 6 = sublacustrine spring Karuč; 7 = Vranjina island, spring near Monastir; 8 = Virpazar town; 9 = Tanki Rt; 10 = island Grmožur; 11 = Malo Blato, village Bobija; 12 = Plavnica.

which differs in some conchological (e.g. it has no columellar fold) and anatomically features from *R. auricularia*, was often confused with amploid forms of *R. auricularia* in former times.

Theodoxus fluviatilis (Linnaeus, 1758)	eur	*Stagnicola corvus* (Gmelin 1791)	pal
Viviparus mamillatus Küster 1852	din	* *Stagnicola* sp.	end
Amphimelania holandrii (C. Pfeiffer 1828)	SEalp	*Radix auricularia* (Linnaeus 1758)	pal
* *Bithynia* sp1.	end	*Radix labiata* (Roßmässler 1835)	pal
* *Bithynia radomani* Glöer & Pešić, 2007	din?	*Radix balthica* (Linnaeus 1758)	pal
* *Bithynia* sp2. (= leachii)	*end	*Radix ampla* (Hartmann, 1821)	eur
Radomaniola curta curta (Küster 1852)	mon	* *Radix* sp.	end
Radomaniola lacustris (Radoman 1983)	end	*Lymnaea stagnalis* (Linnaeus 1758)	hol
Radomaniola elongata (Radoman 1973)	end	*Physella acuta* (Draparnaud 1805)	hol
Radomaniola montana (Radoman 1973)	mon	*Planorbarius corneus* (Linnaeus 1758)	eu-si
Anagastina scutarica (Radoman 1973)	end	*Planorbis planorbis* (Linnaeus 1758)	hol
Anagastina gluhodolica (Radoman 1973)	mon	*Planorbis carinatus* O. F. Müller 1774	eur
Anagastina matjasici (Bole 1961)	mon	*Gyraulus albus* (O. F. Müller 1774)	hol?
Antibaria notata (Frauenfeld 1865)	mon	*Gyraulus* sp.	end?
Litthabitella chilodia (Westerlund 1886)	din	* *Gyraulus* cf. *piscinarum*	?
Pyrgula annulata (Linnaeus 1767)	S-eur	*Anisus vortex* (Linnaeus, 1758)	eu-si
Valvata cristata O. F. Müller 1774	pal	*Hippeutis complanatus* (Linnaeus, 1758)	euras
* *Valvata montenegrina* n. sp.	mon	*Segmentina nitida* (O. F. Müller 1774)	pal
Valvata piscinalis (O. F. Müller, 1774)	pal	* *Ferrissia wautieri* (Mirolli 1960)	?
Galba truncatula (O. F. Müller 1774)	hol	*Ancylus fluviatilis* (O. F. Müller 1774)	W-eur

Table 1: species list of the freshwater gastropod molluscs of the Skadar Lake with the zoogeographical range of the species. hol = holarctic, pal = palaearctic, euras = European-W-Asiatic, eu-si = European-Sibirian, W-eur = West-European, S-eur = South-European, din = Dinaric, SE-alp = South-East-alpine, mon = Montenegra, end = endemic. * = recently found in Skadar lake.

One of the newly found species, *Valvata montenegrina* n. sp., was probably already found by Wohlberedt (1909) who pointed out that *V. piscinalis* in Montenegro is conspicuously flattened. *Stagnicola palustris* could not be found by us but we found a conchologically similar species, which turned out to be a new species by examination of the anatomy. Because the original description has not been published, there is no validly published name, so it can be mentioned here as *Stagnicola* sp. only. The same applies to *Radix* sp., which looks at first sight like a juvenile *R. auricularia*. Dhora (1975) lists *Bithynia leachii* (?) for the Skadar Lake, but when we checked the morphology of the penis very carefully it turned out that this was also a distinct species in fact, *Bithynia zeta*, additional to two other *Bithynia* sp., *B. radomani* and *B. skadarskii*, which look similar to a small *B. tentaculata* an *B. mostariensis*, but are clearly distinct from them

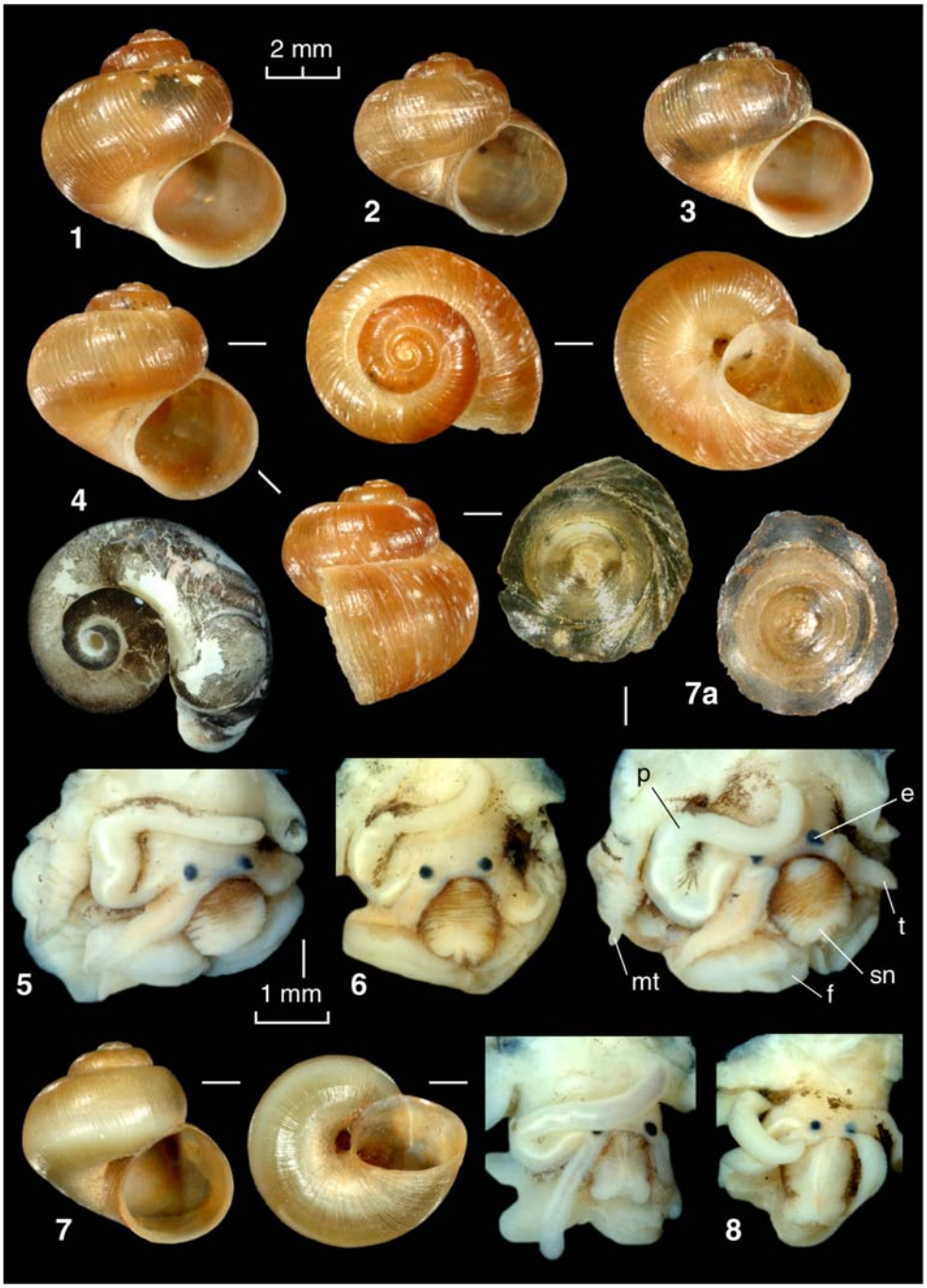

Figure 2. 1-6: *Valvata montenegrina* n. sp. (Skadar Lake, Karuč). 4: holotypus (ZMHU No. 37584). 7-8: *Valvata piscinalis* (Hamburg, Germany). 7a = Operculum of *Valvata piscinalis* - e = eye, f = foot, mt = mantel tentacle, p = penis, sn = snout, t = tentacle.

by their penis morphology, too (GLÖER & PEŠIĆ, 2007). Because *B. skadarskii* could not be found outside the Skadar Lake, we have to consider these species as endemic. By molecular phylogenetic analysis carried out by Pfenninger *et al.* (2003), they found out that *Ancylus fluviatilis* (O. F. Müller, 1774) in Montenegro is probably *Ancylus recurvus* Küster 1855. Unfortunately Pfenninger *et al.* (2003) did not examine topotypes of this species, so they could list this species only as *Ancylus* sp. in their paper. More precise investigations remain to be waited upon.

New to the fauna of the Skadar Lake is furthermore *Gyraulus piscinarum* (Bourguignat, 1852). The anatomy of this species corresponds to the description given by Meier-Brook (1983), on the other hand, the anatomical conditions within the genus *Gyraulus* are not always suitable to determine a species in fact, so we list this species temporarily as *G.* cf. *piscinarum*. The next findings of this species are known from Turkey (locus typicus) and Iran, but the real distribution is uncertain according to Meier-Brook (1983). Besides we found a *Gyraulus* sp. unknown so far.

The genus *Orientalina*, as far as nomenclature is concerned, is problematic. First Radoman, 1972, described this genus as *Orientalia* Radoman, 1972, but afterwards he recognised that this genus name was preoccupied by Bykova (1974) (Foraminifera) and changed the genus name to *Orientalina* Radoman, 1983. Bouchet & Rocroi (2005) found out that the genus name *Orientalina* was preoccupied by *Orientalina* Kolosnitsyna (1973) (Ostracoda) and therefore is not valid, so Szarowska (2006) renamed this genus as *Radomaniola* Szarowska, 2006.

Altogether the check-list of the Skadar Lake could be enlarged by the recent investigations about 10 species: 2 undescribed species of *Bithynia*, 2 undescribed species of lymnaeid, as well as *Valvata montenegrina n. sp.*, *Gyraulus* cf. *piscinarum*, *Gyraulus* sp., *Hippeutis complanatus*, and *Ferrissia wautieri*.

4-2 – Description of the new taxon

Valvata montenegrina n. sp.

MATERIAL EXAMINED. 32 ex.: Mareza canals, Podgorica; 6 ex.: Mareza pool, Podgorica; 2 ex.: Skadar lake, Podhum (fig. 1 station 2); 9 ex.: Skadar lake, Karuč, (fig. 1, station 6), 2 ex.: Skadar Lake, Malo Blato, village Bobija (fig. 1 station 11).

HOLOTYPE. 6.1 mm high and 6.4 mm broad, (ZMHU No. 37584) (fig. 2.4).

PARATYPES. 3 specimens in ZMHU No. 37584 and collection of the senior author.

LOCUS TYPICUS. Mareza pond near Podgorica.

HABITAT. This species lives in canals between the emergent (*Phragmites communis)* vegetation (Mareza). Also in littoral part of lake between vegetation consisting of *Ceratophyllum* and *Myriophyllum*, which covers partially decomposed organic matter and red clay (Karuč) or in emergent (*Scirpus lacuster*, *Phragmites communis*, *Typha angustifolia*) and floating (*Nymphaea alba*, *Nuphar luteum*, *Trapa natans*) vegetation (Malo Blato, Podhum).

ETYMOLOGY. Named after the country Montenegro where this species lives.

DIAGNOSIS. The reddish-brown and ribbed shell has 4.5 whorls with a deep suture, while the body whorl is prominent. The spire is slightly tall to squad. The umbilicus is open and deep but a little covered up by the body whorl. The aperture is nearly circular, weakly angular apically, and the concave operculum is paucispiral with 2.5 whorls, while

these are accompanied by tangential growth lines. The shell is 6-7 mm high and 6.2-6.8 mm wide.

THE ANIMAL. The mantle is greyish brown, the head is light with a brown pigmented broad and a slightly bifid snout. The S-shaped penis is very long and arises at the basis of the right cephalic tentacle.

ANATOMY. The albumen gland is short and sacciform.

DISTRIBUTION. This species was found up to now only in a few places: Mareza canals and pools (Podgorica) and the Skadar Lake (Malo Blato, Podhum and Karuč).

DIFFERENTIAL DIAGNOSIS. The ribs of the shell are more prominent than in *Valvata piscinalis*, the operculum is more concave and has less whorls (in *V. piscinalis* up to 4) and has in contrast to *V. piscinalis* tangential growth lines. The snout of *V. piscinalis* is clearly bifid and more slender than in *V. montenegrina* n. sp., mostly light. The albumen gland is sacciform, while it is tubular in *V. piscinalis* (FALNIOWSKI, 1989: 69).

5 – DISCUSSION

Altogether 7 of the 40 mentioned species (table 1) are endemic to Skadar Lake, so we can say that 20 % of the snails in this lake are endemic. If we consider some more species (*Lanzaia vjetrenicae* Kuščer, 1933, *Plagigeyeria montenegrina* Bole, 1961, *Saxurinator hadzii* Bole, 1961, *Bracenica spiridoni* Radoman, 1973) listed by Dhora (2002) from the Albanian part of the Lake, we can say that 27 % of the lake's gastropod mollusc fauna is endemic. The majority of these endemic species (82 %) belongs to the prosobranch molluscs, which is characteristic of ancient lakes. Ancient lakes have an endemicity between 76 % (e.g. Ohrid) and 37 % (Biwa, Japan) (BOSS, 1978), 32 % (lake Prespa), and 24 % (lake Trichonis), respectively (ALBRECHT & GLÖER, in prep.). The endemicity of Skadar Lake will possibly be higher, if all molluscs found by us are clearly identified or described as new species and it seems to be the northernmost ancient lake, because in none of the Central European lakes endemic species are known to occur so far. Therefore, more research, management, and conservation efforts are necessary since ancient lakes are among the most vulnerable and threatened ecosystems on earth.

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THREE NEW HYDROBIOID SPECIES FROM SERBIA (MOLLUSCA, GASTROPODA, HYDROBIIDAE)

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SUMMARY. During investigations of the fauna of Serbia three new hydrobioid molluscs, *Bythinella nonveilleri* n. sp., *B. serbica* n. sp., and *Belgrandiella pesterica* n. sp. were found. These newly described species are distinct from all other *Bythinella* spp. as well as *Belgrandiella* spp. known so far.

KEY WORDS. *Bythinella*, *Bythinella nonveilleri* n. sp., *Bythinella pesterica* n. sp., *Belgrandiella serbica* n. sp., Serbia.

1 – INTRODUCTION

The hydrobioid snails of Serbia are well studied by Radoman (1983), but given the number of springs and caves in the area, there are possibly many more species than those mentioned by him. So Dragan Pavićević and Predrag Lazarević (Institute for Nature Conservation of Serbia, Belgrade) as well as Siniša Ognjenovic (Belgrade) investigated the fauna of some springs in Serbia and they placed the molluscs at my disposal for identification. In these samples I found two new *Bythinella* species and one *Belgrandiella* species, which are distinct from all *Bythinella* and *Belgrandiella* spp. known so far.

2 – MATERIAL AND METHODS

The snails were collected by hand, and the samples were put into 75% ethanol. The dissections and measurements of the genital organs and the shells were carried out using a stereo microscope (Stemi SV 6, Carl Zeiss, Germany); the photographs were made with a digital camera (Nikon D70). The whole type material is stored in the Zoological Museum of Hamburg (ZMHU) and the Institute for Nature Conservation of Serbia (INCS).

3 – THE SAMPLING SITES

Three sampling sites were investigated:

a - Rtanj Mt. limestone mountain situated in eastern Serbia (the highest peak, called Šiljak, is 1570 meters high) which belongs to the Carpato-Balkanid mountain system. The Vrmdža Gorge is situated in the south part of the mountain and through the Gorge flows Pakleš creek. The Gorge is named for the village Vrmdža, not a river!

b - Pešter Plateau situated in western Serbia is the highest (1100 m) karst field in the Balkan Peninsula and the biggest in Serbia. (50 km^2).

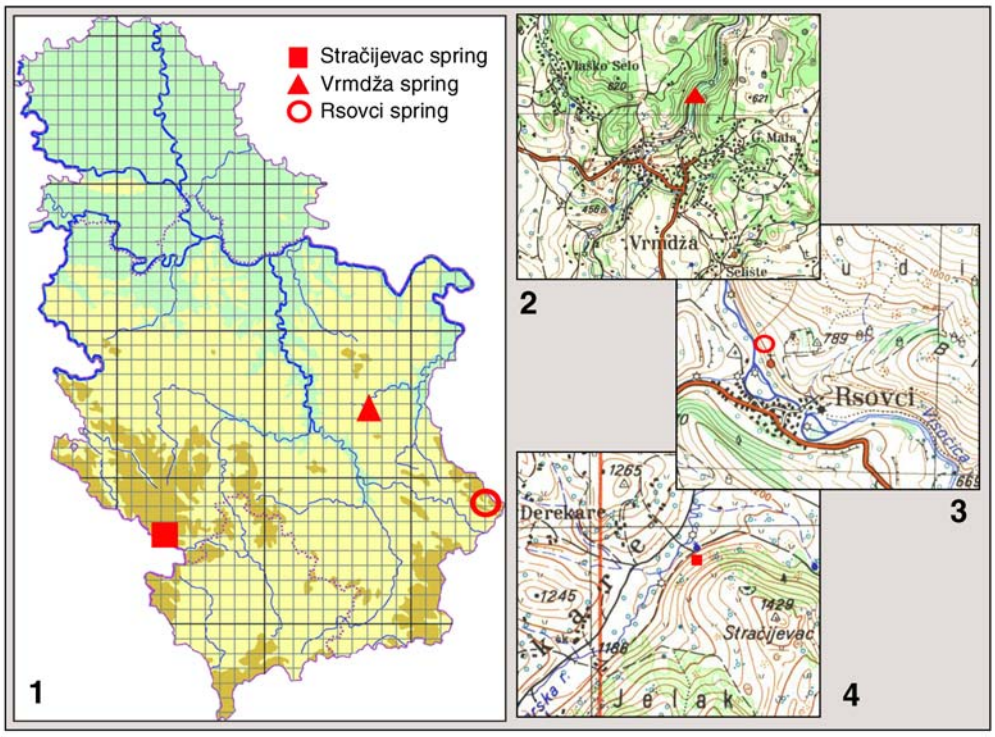


Figure 1. The sampling sites. 1: map of Serbia with the sampling sites. 2: Vrmdža spring, type locality of *Bythinella nonveilleri* n. sp. 3: Rsovci spring, type locality of *Belgrandiella serbica* n. sp. 4: Stračijevac spring, type locality of *Bythinella pesterica* n. sp. (P. Lazarević)

c - Stara Mt. situated in eastern Serbia, at the border with Bulgaria, belongs also to the Carpato Balkanid mountain system. The small south part of mountain, the region called Visok (including the village Rsovci), is a karstic region, The biggest part of this mountain geologically belongs to a sandstone area.

4 – Diagnosis

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

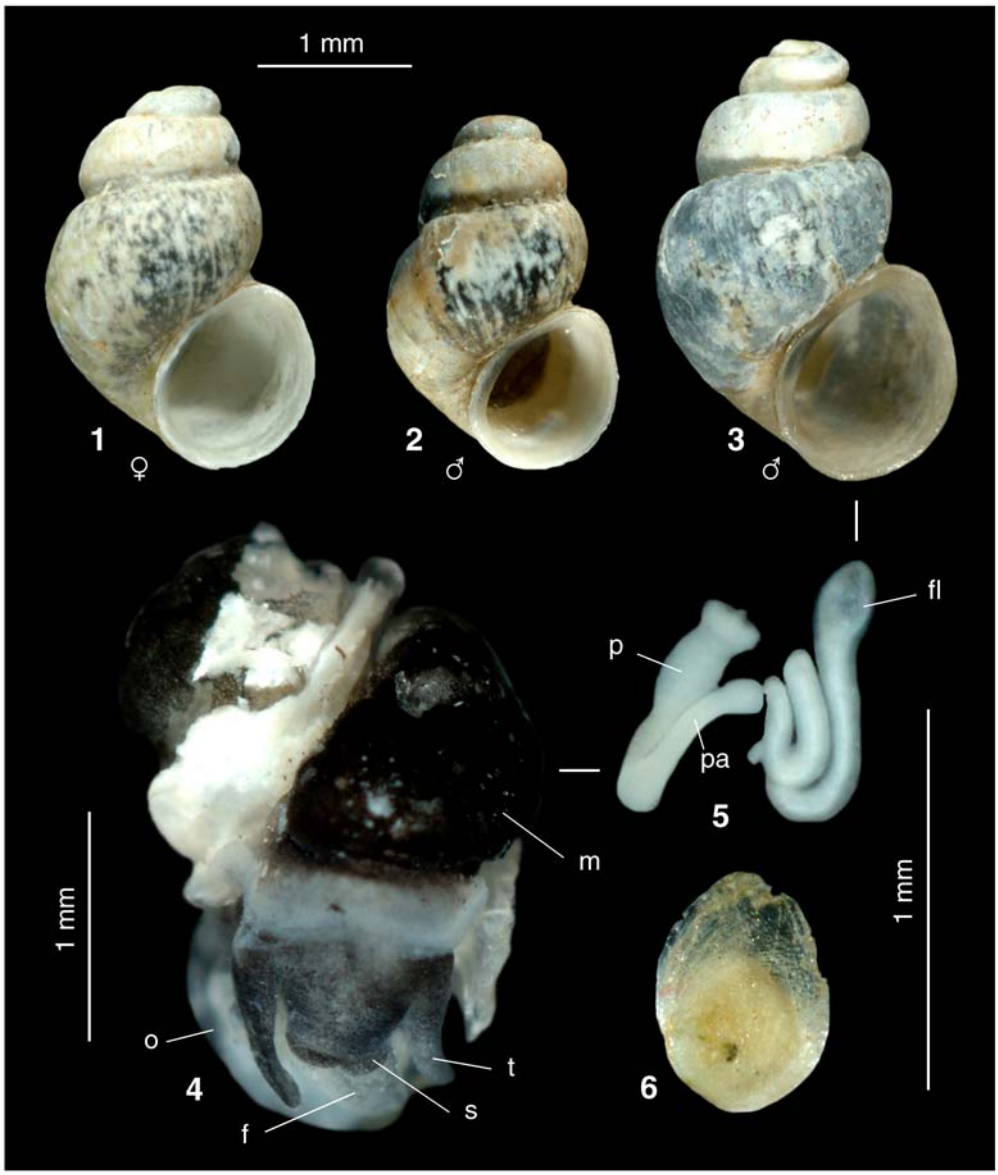
Description. Shell cylindric, apex blunt with an oblique embryonic whorl. Penis with penial appendix and flagellum. The species inhabits springs in mountain regions.

1. ***Bythinella nonveilleri*** n. sp.

Type material. Holotype: 3 mm high and 2 mm broad, 4.5 whorls; ZMHU 37593, (fig. 2.3). Paratypes: 3 ex. ZMHU 37594, Paratypes + penis in ethanol (fig. 2.5), 5 ex. (INCS).

Type locality. Serbia, Rtanj Mt., Vrmdža Gorge, Vrmdža spring, 600 m.

Material examined. 39 specimens from the type locality (leg. Siniša Ognjenović).



Figures 2 to 6. 2: *Bythinella nonveilleri* n. sp. 1: ♀ (height 2.6 mm); 2: ♂ (height 2.5 mm); 3: ♂ (height 3.0 mm); 4: shell removed; 5: male copulatory organ: 6: operculum. f = foot, fl = flagellum, m = mantle, o = operculum, p = penis, pa = penial appendix, s = snout, t = tentacle

Figure 3. Stračijevac hill on Pester Plateau (photo P. Lazarević).

HABITAT. Gravitacion karst spring with periphyton on stones.

ETYMOLOGY. Named in honour of the late Prof. Dr. Guido Nonveiller from Zemun (Serbia), the famous world specialist in mutilid wasps as well as in the Balkan endogaeous and cavernicolous beetle fauna.

DIAGNOSIS. The 4-4.5 whorls of the cylindrical shell are slightly convex with a deep suture. The shells are brownish to grey. The umbilicus is closed. The shell is 2.5 - 3 mm high and 1.5 - 2 mm wide.

THE ANIMAL. The mantle is black with small white sprinkles, the mantle edge is grey, the snout is dark grey pigmented.

ANATOMY. The penial appendix is as long as the penis, the flagellum is 3.5 times longer than the penis. The proximal end of the flagellum is lessened. The distal end of the penis is rounded.

DISTRIBUTION. This species is only known from the type locality and seems to be endemic.

Figure 4. *Bythinella pesterica* n. sp. in its natural habitat (photo: P. Lazarević).

Figure 5. Stračijevac spring, a karst spring on the Pester Plateau (photo: P. Lazarević).

2. ***Bythinella pesterica*** n. sp.

TYPE MATERIAL. Holotype: 2.9 mm high, 1.8 mm wide, 4.5 whorls; ZMHU 37595, (fig. 6.1). Paratypes: 3 ex. + penis in ethanol (fig. 6.2) ZMHU 51066, 5 ex. INCS and collection of the senior author.

TYPE LOCALITY. Serbia, Pester Plateau, the village of Djerekare, foothill of Stračijevac hill, Stračijevac spring (figs. 3, 4).

MATERIAL EXAMINED. 62 specimens from locus typicus, leg. 26. VII. 2006. (leg. D. Pavićević & P. Lazarević)

HABITAT. Gravitacion karst spring with periphyton on stones.

ETYMOLOGY. Named after the region Pester Plateau where this species lives.

DIAGNOSIS. The cylindrical shell has 4.5 whorls with a deep suture. The Apex is blunt. The shells are brownish to grey. The umbilicus is closed. The shell is 2.9 3.1 mm high, and 1.75 1.85 mm broad.

THE ANIMAL. The mantle is unicoloured black and whitish marginated.

ANATOMY. Penial appendix of the same length up to double length of penis, flagellum very thick. The distal end of the penis is tapered.

DISTRIBUTION. This species is only known from the locus typicus and seems to be endemic.

Genus ***Belgrandiella*** A. J. Wagner, 1927

DESCRIPTION. Shell ovate, periphery of the aperture thickened. Penis simple with a small swollen knob but no flagellum. The species of this genus inhabit springs in mountain regions (BOETERS, 1998).

1. ***Belgrandiella serbica*** n. sp.

TYPE MATERIAL. Holotype 1.9 mm high, 1.3 mm broad, 4.5 whorls; ZMHU 51000 (fig. 7.1). Paratypes: 2 ex. + penis in ethanol (fig. 7.3) ZHM 51001, 2 ex. INCS and collection of the senior author.

TYPE LOCALITY. Serbia, Pirot, Stara Mt., village of Rsovci, Rsovci spring, 600 m.

MATERIAL EXAMINED. 10 specimens from the type locality (leg. S. Ognjenović)

HABITAT. Gravitacion karst spring with periphyton on stones.

ETYMOLOGY. Named after the country where the species lives.

DIAGNOSIS. The transparent cylindrical-conical shell has 4-5 whorls, with a deep suture. 1.9 2.4 mm high 1.28 1.48 mm broad. The operculum is reddish.

THE ANIMAL. The mantle is black.

ANATOMY. Penis simple with a small swollen part.

DISTRIBUTION. This species is only known from the locus typicus and seems to be endemic.

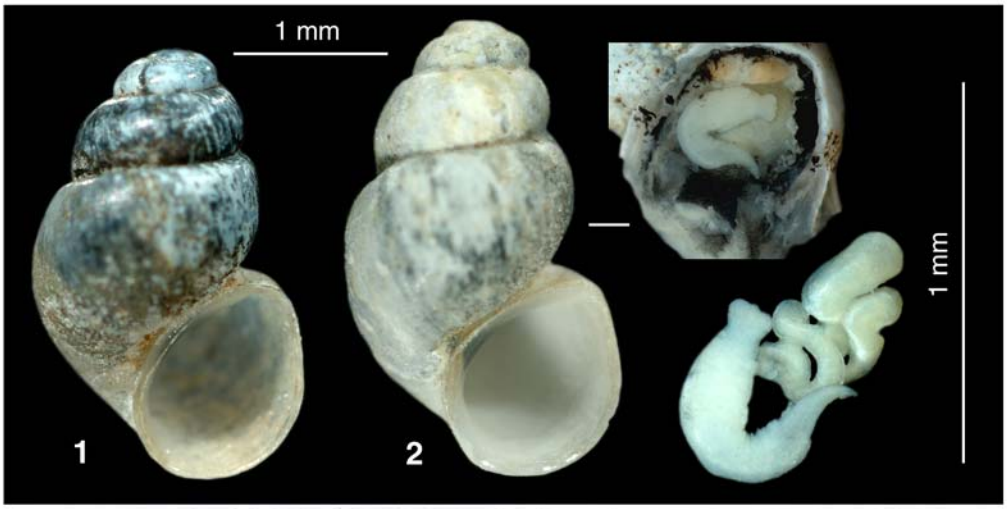


Figure 6. *Bythinella pesterica* n. sp. - 1: holotype, 2: paratype.

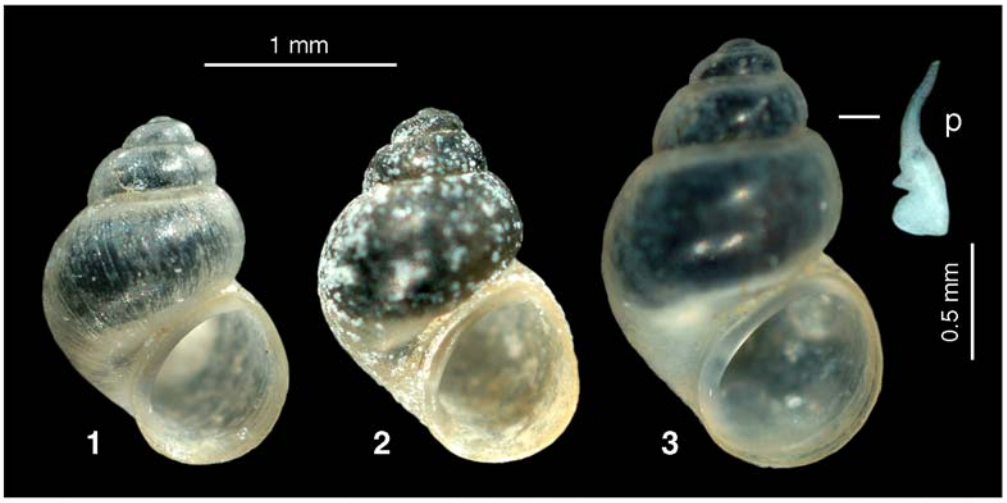


Figure 7. *Belgrandiella serbica* n. sp. - 1: holotype; 2-3: paratypes.

5 – Differential diagnosis

Bythinella nonveilleri and *B. serbica* are in relation to the height broader in comparison to *B. serborientalis* Radoman, 1978, *B. austriaca* (v. Frauenfeld, 1857), *B. opaca* (Gallenstein, 1848), living in the neighbouring regions (Radoman, 1983; Angelov, 2000). *B. nonveilleri* n. sp. is the only *Bythinella* species which has a grey mantle edge. *B. pesterica* can be distinguished from *B. nonveilleri* by the penis morphology and the mantle edge. The shells of both *Bythinella* species are very similar and the weak differences between them justifying the divide in two species remain to be further investigated.

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