



New Insight on the Presence of Several Freshwater Gastropod Species Considered Rare in Serbia

Vukašin Gojšina*, Vanja Marković & Tamara Karan Žnidaršič

University of Belgrade, Faculty of Biology, Belgrade 11000, Serbia

Abstract: The freshwater gastropod fauna of Serbia can be considered understudied compared to the neighbouring countries. This is especially true for the species that frequently occur in smaller and transient habitats such as *Aplexa hypnorum* (Linnaeus, 1758), *Physa fontinalis* (Linnaeus, 1758), *Anisus (Disculifer) vorticulus* (Troschel, 1834), *Hippeutis complanatus* (Linnaeus, 1758) and *Segmentina nitida* (O.F. Müller, 1774). Our survey of various smaller habitats in the Pannonian part of Serbia took place in 2021 and 2022 and included 11 sites. One or more of the above-mentioned snail species were found at nine of these sites. Of particular interest are the findings of *A. hypnorum*, the species whose last and only confirmed finding dated back to the beginning of the 20th century. In total, we present three new localities of *A. hypnorum* and *S. nitida*. The number of known localities of *A. vorticulus* and *H. complanatus* has doubled (now seven and eight localities respectively). *Physa fontinalis*, a native species once quite common in the Pannonian areas, is with a declining frequency. During our survey, an abundant population of *P. fontinalis* was found at a new site. The results presented suggest that a comprehensive survey focusing on smaller and neglected habitats is necessary to fill the gaps in our knowledge of the occurrence and distribution of the freshwater gastropod fauna in Serbia.

Key words: Physidae, Planorbidae, distribution, neglected small habitats

Introduction

Although studies based solely on the biology and distribution of freshwater snails of Serbia are not numerous, these snails are unavoidable part of many hydrobiological publications. The data on freshwater snails in Serbia were summarized in a recent checklist (MARKOVIĆ et al. 2021). Freshwater gastropods can be considered as understudied group in Serbia. The most speciose family is Planorbidae and many planorbid species are poorly known and recorded only from few localities (MARKOVIĆ et al. 2021). Species such as *Hippeutis complanatus* (Linnaeus, 1758), *Segmen-*

tina nitida (O.F. Müller, 1774) and some *Anisus* and *Gyraulus* species are found only sporadically and their distribution in Serbia is far from well known. Regarding the family Physidae, *Physella acuta* (Draparnaud, 1805) is well-documented invasive species and widespread in Serbia (ZORIĆ et al. 2020). Other two known physids, *Physa fontinalis* (Linnaeus, 1758) and *Aplexa hypnorum* (Linnaeus, 1758), are far less known. *Physa fontinalis* is known from several localities (for references, see MARKOVIĆ et al. 2021) but, nowadays, it is very rarely found. *Aplexa hypnorum* has been found only once, more than a hundred years ago (TOMIĆ 1959). Previously published

*Corresponding author: vukasin.gojsina@bio.bg.ac.rs, mr.gojsinavukasin@gmail.com

data clearly show that there is a lack of data for many species inhabiting temporary waters, ponds, oxbow lakes and ditches, which are usually overlooked in the field. Therefore, it is possible that these species are considered as rare only because their habitats are not frequently visited. Recording and monitoring these species of interest can be valuable to assess their conservation status. Here, we provide new data and new insights into status and distribution of several species inhabiting such habitats in Serbia.

Materials and Methods

Samples were collected from eleven localities. The sampling was performed by standard FBA net (25 cm frame, 500 µm mesh size) and by hand. Collected material was preserved in 70% ethanol and further processed in the laboratory of the Institute of Zoology (Faculty of Biology, Belgrade). Photographs of specimens were taken with a stereomicroscope Nikon SMZ800N equipped with a Nikon DS-Fi2 camera. The scale bars were created with Nikon DS-L3 control unit. Distribution map was made using Google Earth Pro application. Studied taxa were identified using available identification guides (WELTER-SCHULTES 2012, GLÖER 2019). Nomenclature follows MolluscaBase.

Results

Among the numerous widespread snail species, during our survey we have found some species that are rarely reported from Serbia. These are the physid species *Aplexa hypnorum* (Linnaeus, 1758) and three planorbid species: *Anisus (Disculifer) vorticulus* (Troschel, 1834), *Hippeutis complanatus* (Linnaeus, 1758) and *Segmentina nitida* (O.F. Müller, 1774). Besides these rare species, we have included another physid snail, *Physa fontinalis* (Linnaeus, 1758), in our survey. Base on the literature data (MARKOVIĆ et al. 2021), this species is not as rare as the above-mentioned four species but we decided to include it because it is nowadays much rarely found than earlier. Data of the places where the species of interest have been recorded are listed in Table 1.

Family Physidae Fitzinger, 1833

Subfamily Aplexinae Starobogatov, 1967

Genus *Aplexa* J. Fleming, 1820

Aplexa hypnorum (Linnaeus, 1758)

Material examined: Locality 1, April 2020, leg. V. Gojšina, 13 specimens. Locality 2, May 2022, leg. V. Gojšina & M. Vujić, 1 specimen. Locality 3, May 2022, leg. V. Gojšina & K. Stojanović, 2 specimens.

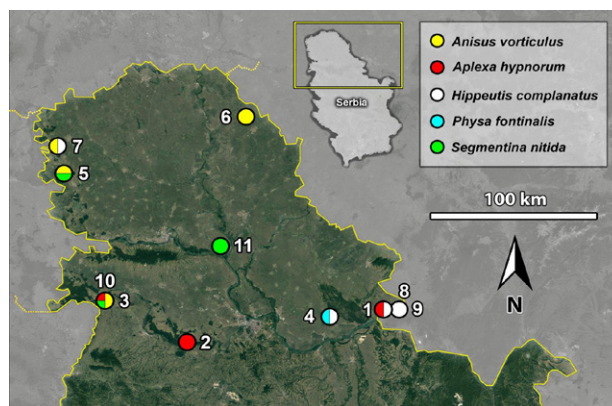


Fig. 1. Map of sampling sites. Locality numbers correspond with those in Table 1.

Remarks: A single published record of this species on the territory of Serbia (Vojvodina, N Serbia) dated from 1910 (TOMIĆ 1959). Three additional new records are presented here. Of them, a finding near Bela Crkva settlement (Nera River) was mentioned by MARKOVIĆ et al. (2021) but without further details.

Subfamily Physinae Fitzinger, 1833

Genus *Physa* Draparnaud, 1801

Physa fontinalis (Linnaeus, 1758)

Material examined: Locality 4, May and September 2021, leg. V. Marković & V. Gojšina, 21 specimens.

Remarks: Found in several lakes, ponds and larger rivers such as Danube around the Iron Gate (SIMIĆ & SIMIĆ 2004) and Ram (MARTINOVIĆ-VITANOVIĆ et al. 2013), Sava (PAUNOVIĆ et al. 2008), Velika Morava (MARKOVIĆ et al. 2015). Known also from several localities near Belgrade (MARKOVIĆ et al. 2013). One new locality is presented here.

Family Planorbidae Rafinesque, 1815

Subfamily Planorbinae Rafinesque, 1815

Tribe Planorbini Rafinesque, 1815

Genus *Anisus* S. Studer, 1820

Subgenus *Disculifer* C.R. Boettger, 1944

Anisus (Disculifer) vorticulus (Troschel, 1834)

Material examined: Locality 5, May and September 2021, leg. V. Marković & V. Gojšina, 5 specimens. Locality 6, May and September 2021, leg. V. Marković, 14 specimens. Locality 7, September 2021, leg. V. Marković & V. Gojšina, 5 specimens. Locality 8, September 2021, leg. V. Marković, 1 specimen.

Remarks: Known from Special Nature Reserve “Zasavica” (KARAMAN & KARAMAN 2007), Plazović

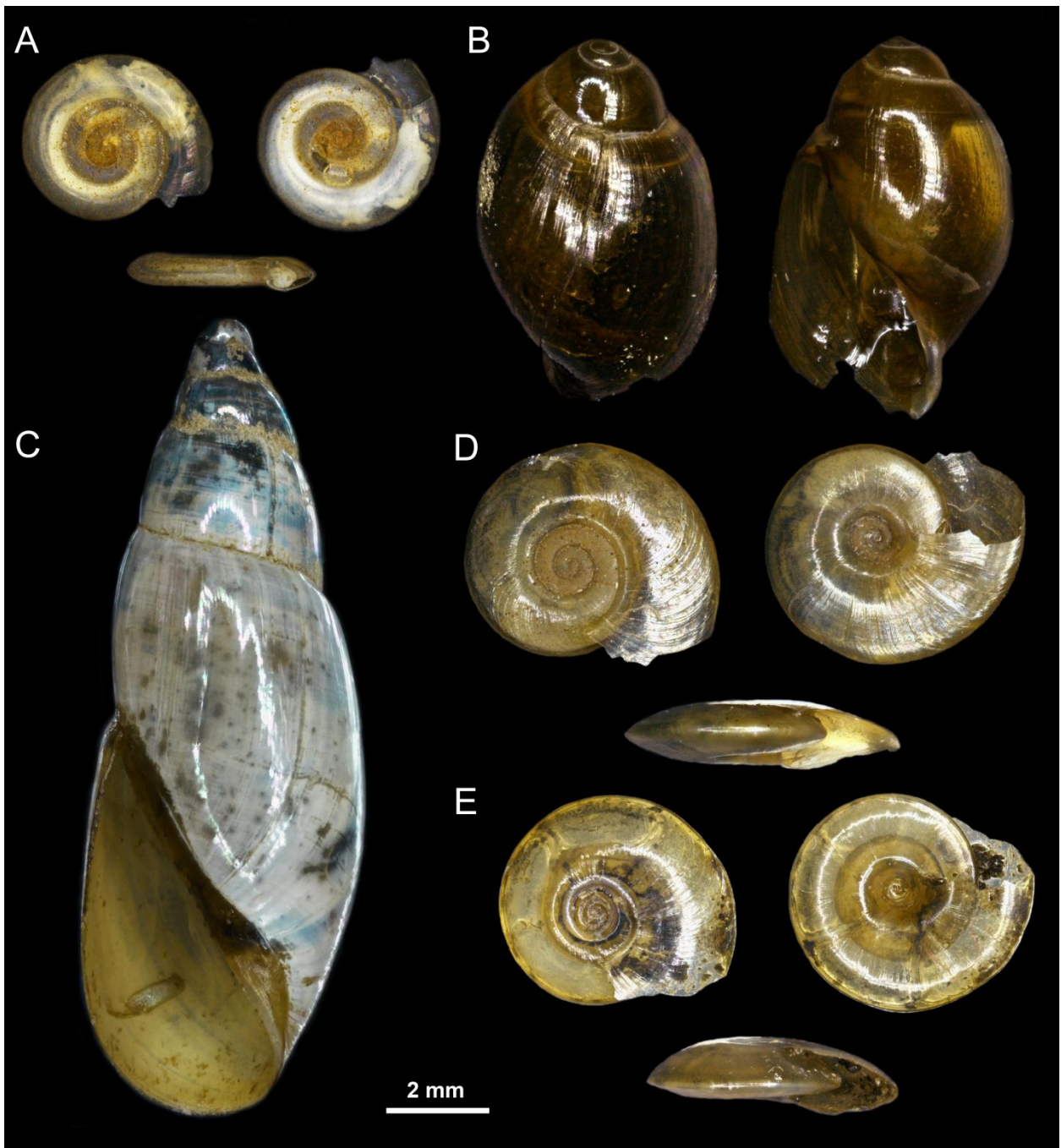


Fig. 2. Species of interest. A. *Anisus (Disculifer) vorticulus* (Troschel, 1834). B. *Physa fontinalis* (Linnaeus, 1758). C. *Aplexa hypnorum* (Linnaeus, 1758). D. *Hippeutis complanatus* (Linnaeus, 1758). E. *Segmentina nitida* (O.F. Müller, 1774).

River and Koviljski Rit wetlands (KARAMAN 2001, MARKOVIĆ et al. 2021). Its recent presence at one locality (Zasavica) has been confirmed and three new localities are reported for the first time.

Tribe Segmentinini F.C. Baker, 1945

Genus *Hippeutis* Charpentier, 1837

Hippeutis complanatus (Linnaeus, 1758)

Material examined: Locality 4, September 2021, leg. V. Marković & V. Gojšina, 3 specimens.

Locality 7, September 2021, leg. V. Marković & V. Gojšina, 1 specimen. Locality 9, January 2021, leg. V. Gojšina, 3 specimens. Locality 10, September 2021, leg. V. Gojšina & V. Marković, 10 specimens.

Remarks: Known from the Danube (1260–863.5 rkm, RAKOVIĆ 2015); near Smederevo (HESSE 1929), Jezava and Plazović rivers. This species is considered rare in Serbia (KARAMAN & KARAMAN 2007, MARKOVIĆ et al. 2021). Four additional localities are presented by the present study. Of them, the

Table 1. Details of the sampling sites.

Locality No.	Locality name	Longitude	Latitude	Altitude
1	Bela Crkva, temporary pond	44°52'37.67"N	21°25'17.88"E	81 m
2	Kupinovo, Obedska bara oxbow lake	44°44'04.55"N	19°59'11.60"E	73 m
3	SNR "Zasavica", Prekopac	44°55'37.37"N	19°25'05.90"E	75 m
4	Deliblato, nearby ditch	44°49'08.61"N	21°01'26.14"E	75 m
5	Sonta, nearby ditch	45°34'41.21" N	19°03'14.53" E	77 m
6	Mokrin, nearby ditch	45°58'03.28" N	20°18'58.18" E	74 m
7	Kupusina, nearby ditch	45°44'45.95" N	18°59'47.05" E	77 m
8	Bela Crkva, pool next to the Nera River	45°52'22.67" N	21°25'34.12" E	80 m
9	Kusić, nearby ditch	44°52'36.90" N	21°28'07.65" E	88 m
10	Zasavica, Batar, pond	44°57'28.74" N	19°31'39.93" E	74 m
11	Lok settlement, Titelski breg	45°13'19.55" N	20°13'07.49" E	77 m

record near Bela Crkva settlement (Nera River) was mentioned by MARKOVIĆ et al. (2021) but without further details.

Genus *Segmentina* J. Fleming, 1818

Segmentina nitida (O.F. Müller, 1774)

Material examined: Locality 5, September 2021, leg. V. Gojšina, 1 specimen. Locality 8, June and September 2021, leg. V. Marković, 13 specimens. Locality 11, May 2022, leg. M. Vujić, 2 specimens.

Remarks: Protected species at the regional and national levels (OFFICIAL GAZZETE OF THE REPUBLIC OF SERBIA 2016). Found in water bodies in Dolovo (near Pančevo) and Hajdukovo (near Subotica) (KARAMAN & KARAMAN 2007) as well as in the Danube (1260–863.5 rkm, see RAKOVIĆ 2015) and the Plazović River (MARKOVIĆ et al. 2021). Three further localities have been added here, with one of them in the protected area Zasavica.

Discussion

Snails are commonly found during numerous hydrobiological investigations in Serbia (e.g. Živić et al. 2000, PAUNOVIĆ et al. 2006, MARTINOVIĆ-VITANOVIĆ et al. 2013, NOVAKOVIĆ 2014, MARKOVIĆ et al. 2015, ZORIĆ et al. 2020). During several field trips, a number of freshwater snail species were recorded; of them, only those species rarely reported from the territory of Serbia were singled out. In addition, snails were found in more localities than mentioned but only as shells that were damaged and in poor condition; thus, their presence, at least in some cases, is uncertain. The lack of data for a certain species on a certain territory could be a result of poor research or reflecting the fact that this species is either rare

or absent. Therefore, it is not possible to assess the presence of species in a certain territory if that territory has not been properly investigated. Of eleven sampling sites, nine contained at least one species of interest. This suggested that the lack of previous data might be because these type of habitats have been generally overlooked.

For example, *Anisus hypnorum* prefers temporary aquatic habitats with plenty of vegetation (GLÖER 2019). Such habitats are usually overlooked during common hydrobiological investigations in our country. Thus, not surprisingly, the only data on this species date back to 1910. The same record (and not a new record) was mentioned by TOMIĆ (1959). As this physid species has a very characteristic shell, misidentification is unlikely. Although it cannot be claimed with certainty that this species is extremely rare on the territory of Serbia, as it could be expected from having only one confirmed record during a period of 100 years, it is likely that it is rarer than the majority of the other freshwater snail species. Our assumption is because on the fact that there are currently few habitats or localities in Serbia where this snail can thrive. Most of those localities are parts of protected areas, which presumably should be investigated better than unprotected areas of lower interest. In view of this, our data provide substantial knowledge of the distribution of *A. hypnorum* in Serbia and the region.

Contrary to the above-mentioned species, identification of *Anisus (Disculifer) vorticulus* can be very challenging. It is often confused with *Anisus (Disculifer) vortex*, which is more frequent. They can be separated by the position of the keel and the appearance of the shell surface. The shell surface is usually covered with debris from the habitat and, therefore, observing the reticulate pattern can be dif-

ficult (ROWSON et al. 2021). This species is already known from Zasavica, though it has not been reported for 20 years. In addition, it is now registered from several other localities, which greatly increases a total number of known localities in Serbia.

The only two representatives of the tribe Segmentinini from Serbia are *Segmentina nitida* and *Hippeutis complanatus*. Because of their specific lenticular shape, the presence of the peripheral keel and shiny shell surface, it is unlikely that the lack of data for these species is a result of misidentification. Only living specimens were counted. The presence of these species at other localities, where only corroded shells have been found, is also possible.

The invasive physid *Physella acuta* (Draparnaud, 1805), originating from North America, is now widespread in Serbia (ZORIĆ et al. 2020, MARKOVIĆ et al. 2021). It inhabits various habitats, from natural waters to greenhouses (HORSÁK et al. 2013, GLÖER 2019). In Serbia, this species is undoubtedly the most common physid now (ZORIĆ et al. 2020). On the other hand, there are not so many records of *Physa fontinalis* from this country. During our study, at the places where the invasive *P. acuta* was found, the native *P. fontinalis* was absent; generally, these two species are rarely found at the same localities in Serbia. Having in mind the continuous decline in numbers of the reports of *P. fontinalis*, which corresponds to spreading of *P. acuta* in recent years, the native taxon could be classified as endangered in near future. We also have noted that some of the previously published records of this species may actually refer to the widespread *P. acuta*. Therefore, it can be recommended *P. fontinalis* to be protected, at least at the national level. Apart from previous findings (MARKOVIĆ et al. 2021), we found this species at one additional locality, i.e. the ditch near Deliblato settlement. Considering that *P. acuta* is very common in the area around the ditch where *P. fontinalis* was found (especially in the nearby lake Kraljevac), it would be of interest to monitor situation regarding newly found and, probably, isolated population of the native physid surrounded by the invasive competitor. At the same habitat, the predatory leech *Glossiphonia complanata* (Linnaeus, 1758) was also found. It is important to be noted because KRUPSKI et al. (2018) have mentioned that *P. acuta* is much more vulnerable to this predator than *P. fontinalis*; this is due to the presence of long finger-like mantle extensions in *P. fontinalis*, which helps in initial recognition of the predator (KRUPSKI et al. 2018). Furthermore, FRÜH et al. (2016) have shown that *P. acuta* was a stronger competitor on higher temperatures. The measured temperature of

the water in the brook was 18°C and 13°C during May and September, respectively, which still might not be high enough for *P. acuta* to become dominant.

Another rare snail taxon in Serbia is *Gyraulus crista* Linnaeus, 1758. This species has only recently been reported (MARKOVIĆ et al. 2021). During our study, this species was found at three localities in total but every time only as an empty shell, usually in a very bad condition. Therefore, we did not include those findings as relevant for reporting new localities. Yet, as mentioned above, there is possibility that *G. crista* populations are present, at least at some of those localities with only empty shells. Further investigations are needed to verify this hypothesis.

We believe that further investigations of similar design will shed more light on the snail diversity at important but neglected habitats such as those we have investigated here. We expect that further rare and interesting species will be discovered in them.

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