New and little-known freshwater Mollusks of Ukrainian Transcarpathian

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Received 1 October 2017 | Accepted by V. Pešić: 6 November 2017 | Published online 9 November 2017.

Abstract
One species is new for the regional fauna (Sphaerium nucleus), another three are rare and their range is strictly limited to a few localities (Muscium lacustre, Bythinella sp. and Terrestribythinella baidashnikovi). It is discovered one additional locality of alien species Sinanodonta woodiana recently introduced into the Transcarpathian. Images of the shells, comments on taxonomy, distribution and ecology of these species are provided.

Key words: Mollusca, biodiversity, distribution, ecology, Transcarpathian, Ukraine.

Introduction
An important stage for the preparation of regional faunistic reviews is compilation and biogeographic analysis of the data on distribution of individual species. It particularly concerns to rare species or those which findings are limited by specific habitats (caves, wells, etc.).

The territory of the Ukrainian part of Transcarpathian is covered with a dense network of river systems and is exclusively rich with water bodies of different types. This area occupies the first place in Ukraine on water supplying; besides a great amount of large constant waterways, here a lot of the small rivers, springs, small creeks and peat bogs are especially in the mountainous parts of the region (Gerenchuk, 1981).

Some authors were already referred to the regional malacofauna and noted its specific character (Zdun, 1960; Makogon, 1972, 2014; Stadnichenko, 1984; Gural-Sverlova, Gural, 2009 and others). However
the analysis of available published data evidences that the species composition of fresh-water molluscs here is not clarified yet.

In the present paper we provide additional data on findings of several new, rare or little-known mollusk species which existence in the Ukrainian Transcarpathian has not been reliably confirmed so far. The comments on taxonomy, general distribution and ecological remarks of these species are provided as well.

Presented data should help hereafter to estimate more definitely the biogeographic status of the Transcarpathian malacofauna and to assess correctly a conservation status of some regionally rare species inhabiting there.

Material and Methods

The majority of samples used in the present study were collected by Yurii Furyk during the fieldwork in May 2017 in different parts of the Transcarpathian Region. One additional lot collected by Elena Degtyarenko on 02 July 2017 came from a stream in neighboring mountainous area of Ivano-Frankovsk Region (Fig. 1, Table 1). Mollusks were hand-picked from the shallow zone of water-bodies mostly from stones or macrophytes and using a hydrobiological net as well as sieve at depths of 0.5-1 m. Samples were immediately fixed with 80% ethanol, after a couple of days the alcohol was replaced.

Altogether over 250 specimens from nine localities have been examined (Table 1). For species differentiation a traditional morphological analysis and measurements of the shell were used.

![Figure 1](image-url)  
**Figure 1.** Map showing the localities of samples studied. Details for each sampling point are given in Table 1.

The small-sized shells were cleaned and photographed with digital camera under Leica M 165 C stereomicroscope. Large bivalves were photographed with digital camera Panasonic LUMIX DMC-FZ200. The MBS-10 stereomicroscope was used for shell morphology study. Specimens herein depicted are
deposited in the collection of Department of Invertebrate Fauna and Systematics, Schmalhausen Institute of Zoology of NAS of Ukraine, Kiev (IZAN).

Table 1. Examined material of mollusks from the Ukrainian Carpathian region. The numbers of localities refer to the text and figures.

| No | Locality                                                                 | Date       | N          | E          | Species name                      |
|----|---------------------------------------------------------------------------|------------|------------|------------|-----------------------------------|
| 1  | Uzh River, Uzhgorod city, Transcarpathian                                  | 13.04.2017 | 48°62.077' | 22°27.521' | Sinanodonta woodiana             |
| 2  | Stara River, Znatsovo village, Uzhgorod district, Transcarpathian         | 11.05.2017 | 48°29.448' | 22°31.558' | Sphaerium nucleus                 |
| 3  | Mertse River, Gat village, Berehove district, Transcarpathian             | 14.05.2017 | 48°18.870' | 22°38.368' | Musculium lacustre                |
| 4  | Canal Babychka, Zaluzhzhya village, Mukacheve district, Transcarpathian    | 11.05.2017 | 48°19.413' | 22°53.489' | Musculium lacustre                |
| 5  | Stream near Bukove village, Vynohradiv district, Transcarpathian          | 14.05.2017 | 48°10.892' | 23°05.594' | Bythinella sp.                   |
| 6  | Natural pool, vicinity of Sokrynnytsya village, Khust district, Transcarpathian | 13.05.2017 | 48°07.422' | 23°21.846' | Musculium lacustre                |
| 7  | Streams towards the Sokolyne Berdo, ravine Kuziy, Rakhiv district, Transcarpathian | 13.05.2017 | 47°56.254' | 24°06.458' | Terrestribythinella baidashnikovi |
| 8  | Spring and stream in the territory of Carpathian Biosphere Reserve Headquarters, Rakhiv district, Transcarpathian | 12.05.2017 | 48°02.542' | 24°16.595' | Terrestribythinella baidashnikovi |
| 9  | Stream on the Yahidna Mountain, vicinity of Mykulychyn village, Yaremche district, Ivano-Frankovsk Region, ~1000 m a.s.l. | 02.07.2017 | 48°22.083' | 24°35.719' | Terrestribythinella baidashnikovi |

Since the Transcarpathian Region abounds in various types of water-bodies we only select a few typical ecotopes to characterize a diversity of environmental conditions where the mollusks studied occurred (Fig. 2).
Results and Discussion

From the faunistic point of view the most productive are samples collected in the middle part of small rivers stream. One regionally new and one rare species of the family Sphaeriidae are discovered there in the localities 2, 3, 4 and 6 (Fig. 1, Table 1). Three others sampling points were abounding in amphibiotic gastropod species with extremely narrow range only known so far from a very few localities (7-9). One more
rarely occurring bythinellid species is found in the locality 5. Exclusively in the locality 1 plenty individuals of alien Unionidae species are registered. Below we provide the appropriate comments on taxa revealed.

Class Bivalvia Linnaeus, 1758

Family Unionidae Rafinesque, 1820

Genus Sinanodonta Modell, 1945

Type species: Symphynota magnifica Lea, 1834, by typification of a replaced name

Sinanodonta woodiana (Lea, 1834)

(Fig. 3, A, B)

Distribution: We found the nonindigenous mussel S. woodiana within the Transcarpathian Region in the Uzh River near Uzhgorod city (locality 1). Earlier the species was already registered here in the Latorytsa River – right tributary of the Tisa River (Yanovych, 2013). In the Transcarpathian it inhabits only fast-flowing water while in the Danube Delta it occurs both in the current waters as well as in canals, oxbow lakes and standing or slow-flowing waters (Yurishinets & Korniushin, 2001; Pavlyuchenko et al., 2007). This is the additional Ukrainian record of the East Asian species last decades introduced to several countries of West and Central Europe, as well as to Central Asia. Within the Ukraine S. woodiana was recorded firstly in the Danube-Sasyk canal in the South-West Ukraine (Yurishinets & Korniushin, 2001) and then in the other waterbodies of the Danube Delta (Pavlyuchenko et al., 2007). In the neighbor European countries it has been registered earlier: in Hungary, Slovak Republic (Falkner et al., 2001) and Poland (Protasov et al., 1994).

Remarks: A high ecological plasticity of S. woodiana shell characteristics is mentioned by many authors (Protasov et al., 1994; Yurishinets & Korniushin, 2001; Pavlyuchenko et al., 2007 and others). Material sampled in the Uzh River represented with only about 10 middle-aged specimens and we couldn’t evaluate the limits of their shells morphological variability. Nevertheless, presence of some conchological features in the individuals studied (e.g. apical part of valves sculptured by rough corrugated wrinkles) confirms belonging of the sampled unionids in Uzhgorod to Sinanodonta (Fig. 3, A, B). In the locality 1 also numerous individuals of Unio pictorum (Linnaeus, 1758) have been revealed.

Family Sphaeriidae Deshayes, 1855

The most common sphaeriid in the Transcarpathian Region and in entirely of Ukraine is Euglesa casertana (Poli, 1791) (Makogon, 1972; Stadnichenko, 1984). It inhabits springs and mountain streams as well as artificial ponds of the trout farms, producing there the populations accounting hundreds and thousands of individuals per square meter (Makogon, 1972). In our samples E. casertana found in Stara River and in natural pool close to the Sokymntsya village (localities 2 and 6). According to Makogon (1972, 2014) in the shallow zone of Synevir Lake (987 m a.s.l., Transcarpathian) are registered Neopisidium conventus (Clessin, 1877) – a typical inhabitants of oligotrophic alpine lakes, Euglesa (Tetragonocyclas) milium (Held, 1836) and Musculium terverianum (Dupui, 1834) which is probably M. lacustre.

Genus Sphaerium Scopili, 1777

Subgenus Nucleocyclas Alimov et Starobogatov, 1968

Type species: Cyclas nucleus Studer, 1820, by original designation
Figure 3. Shells of mollusks found. A, B – *Sinanodonta woodiana* from locality 1: A – interior view of valves, B – exterior view; C, D – *Sphaerium nucleus* from locality 2: C – top view, D – view from left side; E, F – *Musculium lacustre* from locality 6: E – top view, F – view from right side; G, H – *Bythinella* sp. from locality 5; I, J – *Terrestribythinella baidashnikovi* from locality 8; K – *T. baidashnikovi* from locality 9.

*Sphaerium* (Nucleoclylas) *nucleus* (S. Studer, 1820)
(Fig. 3, C, D)

**Distribution:** Within the Transcarpathian Region the species is registered for the first time (locality 2). In the other parts of Ukraine *Sph. nucleus* was mentioned also in Polesye and Forest Step Zone (Makogon, 1972; Stadnichenko, 1984). It inhabits water-bodies of the West, North and Central Europe states; the closest to Ukraine sites are known in Hungary and Slovak Republic (Falkner *et al.*, 2001).

**Remarks:** It the locality where *Sph. nucleus* revealed some other sphaeriid *Sph. corneum* (Linnaeus, 1758), *Euglesa* sp. and gastropods, e.g. *Lithoglyphus naticoides* (Pfeiffer, 1828), *Lymnaea stagnalis* (Linnaeus,
1758) co-occurred. An additional species of the same genus *Sph. ovale* (A. Férussac, 1807) is listed in the catalogue of Zoological Museum of L’viv National University – it was sampled from the canal near Khmelnik village, Irshava district, Transcarpathian, 07.07.2004 [leg. N. Sverlova, catalogue # B506]. This is close relative to *Sph. nucleus* but distinct species of the subgenus *Nucleocyclas*, with comparatively narrower range of distribution. In the Transcarpathian region *Sph. nucleus* inhabits rivers, while their finding in Europe associated mostly with swamps, wet meadows, small lakes and even ditches (Stadnichenko, 1984; Korniushin, 1996).

**Genus *Musculium* Link, 1807**  
*Type species:* *Tellina lacustris* O.F.Müller, 1774, by monotypy

**Musculium lacustre** (O.F.Müller, 1774)  
*(Fig. 3, E, F)*

**Distribution:** In Transcarpathian malacofauna region *M. lacustre* is registered in the localities 3, 4, 6. According to Stadnichenko (1984) it is known within Ukraine also in Polesye reported under the name *M. hungaricum* (Hazay, 1881).

**Remarks:** Numerous individuals of *Euglesa (Casertiana)* sp., *Sphaerium corneum* and some gastropods, e.g. *Bithynia tentaculata* (L., 1758), *Lymnaea* spp., physids and planorbids have been sampled together with *M. lacustre* in the localities 4 and 6. In the catalogue of Zoological Museum of L’viv National University is also listed *M. lacustre* sampled from swamped alder forest near Shalanky village, Vynohradiv district, Transcarpathian, 08.07.2004 [leg. N. Sverlova, catalogue # B559]. Judging from our samples in the Transcarpathian, *M. lacustre* is rarely occurring though ecologically tolerant species – we found its populations in rivers, small ponds, artificial canals and ditches (Table 1).

**Class Gastropoda Cuvier, 1795**

**Family Bythinellidae Kobelt, 1878**

**Genus *Bythinella* Moquin-Tandon, 1856**  
*Type species:* *Bulimus viridis* Poiret, 1801 by subsequent designation

Spring snail of the genus *Bythinella* is the widespread and species-rich European gastropod taxon. The distribution area of the 83 species and subspecies currently recognized ranges from western France to the Ukraine; they also occur on some Mediterranean islands and in the Asian part of Turkey (Wilke et al., 2010).

The representatives of *Bythinella* were attributing either to the family Hydrobiidae Stimpson, 1865 or Amnicolidae Tryon, 1863 (e.g. Anistratenko & Stadnichenko, 1995; Falkner et al., 2001; Fehér et al., 2008). Analysis of the phylogenetic data in combination with morphological/anatomical evidence this group appears to be distinct from the Amnicolidae (as well as from Hydrobiidae) and thus is treating as a separate family Bythinellidae (see Wilke et al., 2013).

Two nominal species of the genus are reported in Ukraine so far: *B. austriaca* (Frauenfeld, 1857) and *B. hungarica* Hazay, 1881 (e.g. Anistratenko & Stadnichenko, 1995) though these identifications need additional confirmation. Mature individuals of *Bythinella* can be distinguished from conchologically similar and somewhere sympatric occurring species of the genus *Terrestribythinella* by approx. 1.3 time’s bigger shell and comparatively higher ratio of last whorl height to entire shell height.

**Bythinella sp.**  
*(Fig. 3, G, H)*

**Distribution:** *Bythinella* occur throughout continental Europe (e.g. Wilke et al., 2010). In Ukraine *Bythinella* is known from the Transcarpathian and Ivano-Frankovsk Regions (Anistratenko & Stadnichenko, 1995). We found individuals of this genus (with no clear specific determination) in the stream near Bukove village, Vynohradiv district of Transcarpathian (locality 5).
Recently (Falniowski et al., 2009) in the adjacent region of Rumania (in Ignis Mountains), species of Bythinella, conchologically similar to B. austriaca were recorded: B. molcsanyi H. Wagner, 1941, B. grossui Falniowski, Szarowska et Sirbu, 2009 and B. viseuiiana Falniowski, Szarowska et Sirbu, 2009.

Remarks: Four subspecies currently recognized in European fauna (Falkner et al., 2001; Glöer, 2002; Fehér et al., 2008). B. austriaca as all Bythinella species is a freshwater snail that adapted to cold-temperate springs and rivulets with presumably stable conditions. Together with B. sp. also Lymnaea lagotis (Schrank, 1803) and L. truncatula (O. F. Müller, 1774) have been sampled in the locality 5.

Family Terrestribythinellidae Sitnikova, Starobogatov et Anistratenko, 1992
This group was introduced as a family by Sitnikova et al. (1992) basing on anatomical distinction of these snails, e.g. lacking of seminal receptacle in female reproductive system. Bouchet and Rocroi (2005) affiliated this taxon with Amnicolidae Tryon, 1863. Rank, systematic position and relationship of this group still uncertain, pending re-examination with using of additional morphological and molecular data.

Genus Terrestribythinella Sitnikova, Starobogatov et Anistratenko, 1992
Type species: Terrestribythinella baidashnikovi Sitnikova, Starobogatov et Anistratenko, 1992, by original designation

Snails of this genus are small gastropods that live under the litter of deciduous forests near the streams in an intermediate position between terrestrial and freshwater environments. This hidden under the leaves biotope, commonly named amphibiotic and is poorly exploited by malacologists yet.

Terrestribythinella baidashnikovi Sitnikova, Starobogatov et Anistratenko, 1992
(Fig. 3, I-K)

Distribution: By now all three nominal species of Terrestribythinella are known only from Tiachiv and Irshava districts of Transcarpathian Region (Sitnikova et al., 1992; Anistratenko, 1995; Anistratenko, Stadnichenko, 1995; Gural-Sverlova, Gural, 2009). Recently we found Terrestribythinella individuals living among the litter leaves on banks of a small stream in the territory of Carpathian Biosphere Reserve Headquarters and in Kuziy ravine (localities 7 and 8), Rakhiv district, Transcarpathian. These specimens well conform to the type series of T. baidashnikovi in main diagnostic features of shell. Also we sampled this species for the first time from the eastern side of the Carpathian chain of mountains – in a stream in the vicinity of Mykulychyn village, Yaremcha district, Ivano-Frankovsk Region (locality 9).

Remarks: In the locality 9 besides T. baidashnikovi were found terrestrial gastropods Carychium tridentatum (Risso, 1826) and Aegopinella pura (Alder, 1830). Additionally in the locality 8 were determined Lymnaea (Galba) truncatula (O.F. Müller, 1774), Vestia turgida (Rossmässler, 1836), Cochlicopa lubrica (O.F. Müller, 1774), Vallonia pulchella (O.F. Müller, 1774), Vitrea crystallina (O.F. Müller, 1774). Judging from ecotopes where the snails live they are neither strictly terrestrial, nor strictly water molluscs. Occurring of Terrestribythinella snails sympatric with terrestrial gastropods on the wet litter leaves or stones reflect their putative amphibiotic ecological preferences (Sitnikova et al., 1992; Anistratenko, 1995). These amphibious creatures apparently do not require significant amounts of liquid water for their existence.

Conclusion

Presented data enrich our knowledge on the regional malacofauna. Further analysis of the species diversity in combination with geographical and ecological characteristics of the region will likely push us to consider the Transcarpathian in Ukraine as a particular region representing a separate biogeographic unit. Estimating of the rank and faunal specificity of this unit requires further investigations with intensive field work for mollusk sampling.
Acknowledgements

A field-campaign in May 2017 was performed by Yuriy Furyk in cooperation with Alexander Martynov and Yulia Kanana (IZAN). To these persons as well as to Administration of Carpathian Biosphere Reserve (Rakhiv, Transcarpathian, Ukraine) we are grateful for their assistance during the fieldwork. We express our sincere thanks to anonymous reviewers gave helpful comments on the manuscript. Authors kindly thank Igor Balashov (IZAN) for identification of terrestrial mollusks. Vitaliy Anistratenko thanks the IDEA WILD organization for the field equipment donated in 2017.

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