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A REVIEW OF SPECIES DIVERSITY, DISTRIBUTION AND ECOLOGY OF FRESHWATER GASTROPOD MOLLUSCS INHABITING THE UKRAINIAN TRANSCARPATHIAN

V. V. Anistratenko[1*], Yu. I. Furyk[2], O. Yu. Anistratenko[1,3], E. V. Degtyarenko[1,4]

[1]*Schmalhausen Institute of Zoology, of NAS of Ukraine, vul. B. Khmelnitskogo, 15, Kyiv, 01030 Ukraine*
E-mail: anistrat@izan.kiev.ua
[2]*Uzhgorod National University, Narodna Square, 3, Uzhgorod, 88000 Ukraine*
E-mail: jurij1702@ukr.net
[3]*Institute of Geological Sciences of NAS of Ukraine, O. Gontchar st., 55-b, Kyiv, 01054 Ukraine*
E-mail: anistrat@rambler.ru
[4]*National University of Life and Environmental Sciences of Ukraine, General Rodimtsev st., 19, Kyiv, 03041 Ukraine*
E-mail: oomit99@ukr.net
**Corresponding author*

A Review of Species Diversity, Distribution and Ecology of Freshwater Gastropod Molluscs Inhabiting the Ukrainian Transcarpathian. Anistratenko, V. V., Furyk, Yu. I., Anistratenko, O. Yu., Degtyarenko, E. V. — The diversity of freshwater gastropods recorded in the Transcarpathian Region of Ukraine is reviewed and comments on their distribution and ecology are provided. Thirty-five species were revealed in samples collected from the lowland and mountainous parts of the Ukrainian Transcarpathia. Three species are recorded for the first time in the regional fauna: *Viviparus sphaeridius*, *Bithynia troschelii* and *Segmentina montgazoniana*. For species found in the region brief remarks on the biotopes in which they were registered and relevant taxonomic comments are given. The most distinctive features of the mollusc fauna of Ukrainian Transcarpathia are considered; the presence as well as the absence of some taxa in comparison with adjacent regions is discussed. The results of our observations confirm that the distribution of gastropod species depends on the types of waterbodies and their altitude location. The presented data contribute to the knowledge of the regional malacofauna and should help to assess the biogeographic status of the Transcarpathian Region more clearly.
Key words: freshwater molluscs, fauna, ecology, Gastropoda, Transcarpathian Region, Ukraine.

Introduction

Analysis of data on the distribution and autecology of local species is an important stage for the preparation of regional faunistic surveys. This applies in particular to invertebrates inhabiting either specific habitats (caves, wells, etc.) or areas where conditions are significantly deviade compared with adjacent regions.

The Carpathian Mountains is one of the richest biogeographical regions in Europe in terms of biodiversity indicators. This is caused by a combination of geographical position, landscape heterogeneity, relatively well-preserved environment and the low impact of Quaternary glaciations (for more details see overview Mráz, Ronikier, 2016 and references therein).

The territory of the Ukrainian Transcarpathia occupies only a small part of the Eastern Carpathians, however, there is a high diversity of habitats (including subterranean) linked to altitudinal gradients which is not present in neighbouring regions of Ukraine. In addition, the territory of the Ukrainian part of Transcarpathian is covered with a dense network of river systems and is extraordinarily rich with waterbodies of various types. This area occupies the first place in Ukraine on water supplying (Gerenchuk, 1981). Besides a great amount of large constant waterways, the Transcarpathian Region is fulled up with a lot of the small rivers, temporary existing springs, small creeks and peat bogs especially in the mountainous parts with a wide range of heights. All these factors make the Transcarpathia a hotspot of Ukrainian diversity for many groups of animals and plants that is of great biogeographic importance.

Freshwater malacofauna of the Transcarpathian has attracted the researchers´ attention long time. One of the first publications on West-Ukraininan freshwater molluscs was a key monograph (Bąkowski, Łomnicki, 1891), in which the occurrence of *Lymnaea stagnalis* (Linnaeus, 1758) and *L. auricularia* (Linnaeus, 1758) within the modern Ukrainian Transcarpathian are mentioned. Many authors were referred to the regional malacofauna later and noted its similarity in composition to European ones mentioning a certain specificity of its aquatic mollusc diversity though (Zdun, 1960; Makogon, 1972, 2014; Stadnichenko, 1984, 1990; Gural-Sverlova, Gural, 2009, 2012 and others). However, our recent publications (Anistratenko et al., 2017, 2018) indicate that even the species composition of freshwater molluscs here is not clarified yet. Correspondingly, the autoecological characteristics of the Transcarpathian molluscs are still insufficiently studied, what makes difficult assessing of the ecological spectrum of the species inhabiting other areas of Eurasia.

In this paper we present an overview of the species composition of freshwater gastropods living in the Transcarpathian Region of Ukraine with a brief description of the biotopes where they were collected. Additionally the molluscs species co-occurred at the same localities are listed. Some species are firstly recorded in the regional fauna or their existence in the Ukrainian Transcarpathian is now confirmed; relevant comments on distribution and taxonomy are given for them.

Material and methods

The present study is based on samples collected in 2015–2018 from 59 waterbodies of various types in the Transcarpathian Region, Ukraine (fig. 1, table 1). Molluscs were hand-picked from the shallow zone of water bodies mostly from the bottom, stones or macrophytes. In addition, a hydrobiological net was used for the ground scraping at depths of 0.5–1 m and subsequent washing of the molluscs with water. Samples were immediately fixed with 80 % ethanol, and after a couple of days the alcohol was replaced. Some environmental data (mainly hydrologic) were noted along with the sampling of molluscs: altitude, water temperature, pH, calcium carbonate content, and type of substrate and/or aquatic vegetation (table 1, 2).

Fig. 1. Map showing the localities of samples studied. Details for each sampling point are given in table 1.

Table 1. Examined material with some data on environmental conditions where the molluscs collected. The numbers of localities refer to the text and figures

No	Lot # IZAN	Locality	Date	N	E	a.s.l.,	water T, °C	pH	ppm $CaCO_3$	Species registered
1	448–44	Uzh River, Uzhgorod City	02.06.2015	48°37′14.69″	022°16′25.72″	107	–	–	–	*Lymnaea stagnalis* *Radix balthica*
2	446	Floodplain of Uzh River, Botanical garden in Uzhgorod City	01.07.2015	48°37′04.35″	022°18′23.06″	115	–	–	–	*R. auricularia* *R. ampla* *R. ampullacea* *R. balthica*
3		Branch of the Uzh River near Onokivtsi village, Uzhgorod Dst	09.05.2018	48°38′41.73″	022°21′01.15″	125	23.4	7.5	–	*R. intermedia*
4	445–57 447–72	Spring in the territory of the Carpathian Biosphere Reserve Headquarters, Rakhiv Dst	12.05.2017 06.11.2017	48°01′31.51″	024°09′57.42″	453	10	7.3	49	*Terrestribythinella baidashnikovi*
5	445–58 447–73	Stream in the territory of the Carpathian Biosphere Reserve Headquarters, Rakhiv Dst	12.05.2017 06.11.2017	48°01′32.05″	024°09′58.82″	443	12	7.2	271	*T. baidashnikovi* *Galba truncatula*
6	448–51	Latorytsia River, near Chop town, Uzhgorod Dst	11.05.2017	48°27′21.65″	022°12′26.66″	101	16	8	127	*Lithoglyphus naticoides* *L. stagnalis* *Stagnicola corvus* *Galba oblonga* *R. intermedia* *Physa acuta* *Planorbarius corneus* *Segmentina montgazoniana*
7	448–52	Floodplain of Latorytsia River near Chop town, Uzhgorod Dst	11.05.2017	48°27′26.63″	022°12′36.16″	101	–	–	–	*S. corvus* *R. lagotis* *P. corneus* *S. montgazoniana*
8	483	Artificial reservoir in the floodplain of Latorytsia River, near Chop town, Uzhgorod Dst	06.05.2018 20.06.2018	48°27′08.30″	022°12′39.72″	101	25.6	7.1	–	*Viviparus viviparus* *V. sphaeridius* *Bithynia tentaculata* *L. stagnalis* *S. corvus* *R. lagotis* *P. corneus*
9	484	Latorytsia River near Chop town, Uzhgorod Dst	20.06.2018	48°27′15.66″	022°12′42.36″	101	23.9	7.5	–	*B. tentaculata* *L. naticoides* *Physa acuta*

10	485	Latorytsia River in Mali Heivtsi village, Uzhgorod Dst	20.06.2018	48°28′8.14″	022°18′42.45″	103	23.5	7.5	–	*L. naticoides* *Lymnaea fragilis* *R. auricularia* *R. tumida*
11		Solotvynsky stream in Nyznje Solotvyno village, Uzhgorod Dst	05.05.2018	48°32′31.85″	022°26′40.05″	116	22.3	7.9	37	*Valvata piscinalis*
12	448–53	Stara River in Znyatsovo village, Mukachevo Dst	11.05.2017	48°29′26.88″	022°31′33.48″	107	17	7.6	59	*V. viviparus* *V. sphaeridius* *L. naticoides* *L. stagnalis* *R. intermedia* *Ancylus fluviatilis*
13	475–2	Stagnant pool by the road near Znyatsovo village, Mukachevo Dst	05.05.2018	48°29′11.21″	022°32′11.68″	108	25.6	7.2	40	*Contectiana contecta* *B.* ex gr. *troschelii* *L. fragilis* *Planorbis planorbis* *P. corneus*
14	475–1	Roadside canal between Stare Davydkovo and Ivanivtsi villages, Mukachevo Dst	05.05.2018	48°27′49.79″	022°37′53.15″	114	25.7	7.0	20	*L. stagnalis* *S. corvus* *S. nitida*
15	448–68 448–98 486	Chorna Voda (Mertse) River, Gat village, Berehove Dst	14.05.2017 20.06.2018	48°18′52.26″ 48°18′52.20″	022°38′20.41″ 022°38′22.08″	109	18 25.5	7.6 –	91 26	*V. viviparus* *C. contecta* *B. tentaculata* *V. piscinalis* *V. ambigua* *L. stagnalis* *R. ampullacea* *R. balthica* *R. intermedia* *Ph. acuta* *P. planorbis* *P. corneus*
16	448–54	Canal Babychka, Zaluzhzhya	11.05.2017	48°21′48.93″	022°51′09.36″	121	19	7.7	59	*R. parapsilia* *R. intermedia* *R. peregra* *Anisus spirorbis* *Gyraulus albus*
17	448–55	Pond in the vicinity of Horbok village, Irshava Dst	11.05.2017	48°19′25.57″	022°53′30.34″	122	–	–	–	*L. fragilis* *R. auricularia*

18	448–56	Irshava River, Siltse village, Irshava Dst	11.05.2017	48°17′13.58″	022°59′50.26″	124	15	8.3	33	*G. truncatula* *R. ampla* *R. tumida* *Ph. acuta* *A. fluviatilis*
19	447–69	Synyavka River near Osiy village, Irshava Dst	02.06.2017	48°23′15.08″	023°07′49.19″	399	–	–	–	*Bythinella* sp. *T. baidashnikovi* *R. intermedia* *A. fluviatilis*
20	445–67	Stream near Bukove village, Vynohradiv Dst	14.05.2017	48°10′53.52″	023°05′35.64″	197	13	7.4	50	*Bythinella* sp. *G. truncatula*
21	448–48	Tisa River near Mala Kopanya village, Vynohradiv Dst	15.09.2016	48°09′50.47″	023°06′33.16″	140	–	–	–	*V. piscinalis* *G. truncatula* *R. ampla* *R. balthica* *R. tumida*
22	448–49	Branch of the Tisa River near Mala Kopanya village, Vynohradiv Dst	15.09.2016	48°09′52.60″	023°06′43.85″	144	–	–	–	*V. piscinalis* *L. stagnalis* *G. truncatula* *G. subangulata* *P. corneus*
23	488	Branch of the Tisa River near Mala Kopanya village, Vynohradiv Dst	21.06.2018	48°09′56.91″	023° 6′47.29″	154	18	6.7	–	*V. piscinalis* *L. stagnalis* *L. fragilis* *P. corneus*
24	448–64	Pool in the vicinity of Sokyrnytsya village, Khust Dst	13.05.2017	48°07′12.94″	023°21′53.63″	172	16	7	89	*L. stagnalis* *L. fragilis* *L. occulta* *G. albus*
25	447–76 448–76	Apshytsya River near Hrushovo village, Tiachiv Dst	02.06.2017	47°59′56.68″	023°47′2.54″	242	–	–	–	*G. oblonga* *R. tumida* *Ph. acuta* *G. albus* *A. fluviatilis*
26	448–47	Brusturanka River, Lopukhiv village, Tiachiv Dst	16.07.2015	48°24′21.28″	024°02′20.51″	700	–	–	–	*R. balthica*
27	448–61	Puddle near artificial pond, vicinity of Bilyn village, Rakhiv Dst	12.05.2017	48°06′30.16″	024°15′12.89″	497	15	8.4	56	*G. truncatula* *R. intermedia* *R. lagotis* *G. albus*

28	448–59	Trostyanets River (tributary of Chorna Tisa River) near Kvasy village, Rakhiv Dst	12.05.2017	48°09′56.28″	024°16′35.34″	566	10	8.4	77	*T. baidashnikovi* *S. corvus* *A. fluviatilis*
29	496	Tisa River in Bilyn village, Rakhiv Dst	22.06.2018	48°06′17.25″	024°15′18.86″	484	20.1	7.7	99	*G. truncatula* *R. lagotis* *R. peregra*
30	448–60	Swampy stream near Bilyn village, Rakhiv Dst	12.05.2017	48°05′16.00″	024°14′17.70″	481	13	7.7	147	*R. intermedia* *R. peregra*
31	495	Swampy stream near Kostylivka village, Rakhiv Dst	22.06.2018	47°59′27.90″	024°11′48.80″	413	13.4	7.3	–	*T. baidashnikovi* *G. subangulata*
32	491	Boronyavka River near Khust town	13.05.2017 21.06.2018	48°09′23.82″	023°19′46.80″	165	–	–	–	*L. stagnalis* *S. corvus* *P. corneus*
33	490	Ponds in the clay quarry near Khust town	13.05.2017 21.06.2018	48°09′48.10″	023°19′31.19″	168	18 33.2	7.7 9.25	90 –	*Lymnaea* sp. *R. auricularia*
34	489	Rika River near Khust town	21.06.2018	48°11′49.48″	023°17′18.85″	165	16.2	6.8	–	*G. truncatula* *G. oblonga*
35	509	Sources of the stream 1, which flows into the Synevir-Polyanske Lake, Inner Gorgany massif, Mizhhirya Dst	04.07.2018	48°36′49.39″	023°40′58.98″	1026	6.7	7.6	–	*T. baidashnikovi*
36	510	Source of the stream 2, which flows into the Synevir–Polyanske Lake, Inner Gorgany massif, Mizhhirya Dst	04.07.2018	48°36′52.38″	23°40′58.98″	1010	9	8.0	–	*T. baidashnikovi*
37	511	Sources of the stream 3, which flows into the Synevir-Polyanske Lake, Inner Gorgany massif, Mizhhirya Dst	04.07.2018	48°36′48.67″	023°40′29.96″	1099	12.2	6.7	–	*T. baidashnikovi*
40	513	Roadside swampy stream near Synevyrs′ka Polyana village, Mizhhirya Dst	04.07.2018	48°36′8.68″	023°41′55.25″	847	24	8.2	–	*G. subangulata* *R. peregra*
41	445–63 447–74 447–75	Kuziy Stream and springs, Kuziy-Trybushany preservation massif, Rakhiv Dst	13.05.2017 06.11.2017	47°56′15.24″	024° 6′27.48″	400	10	8.1	126	*T. baidashnikovi*
42	494	Teresva River between the villages of Teresva and Bedevlya, Tiachiv Dst	21.06.2018	47°59′58.36″	023°40′32.53″	230	19.9	7.2	–	*Physa acuta*
43	492	Tereblya River near Bushtyno village, Tiachiv Dst	21.06.2018	48°02′27.37″	023°29′20.57″	199	24.6	7.8	–	*R. ampla*
44	493	Stream or branch of the Tisa River near Bushtyno village, Tiachiv Dst	21.06.2018	48°01′45.92″	023°30′40.99″	198	16.7	6.7	–	*R. auricularia* *R. intermedia*
45	487	Borzhava River near Bene village, Berehove Dst	20.06.2018	48° 9′45.17″	022°46′15.56″	116	23.3	7.0	–	*L. naticoides* *G. truncatula* *R. ampla*

46		Cattle pit near Handerovytsya village, Mukachevo Dst	28.05.2018	48°24′30.54″	022°52′50.12″	202	22.6	6.5	–	*R. intermedia*
47	480	Spring in the forest near Handerovytsya village, Mukachevo Dst	03.06.2018	48°24′49.87″	022°53′24.88″	308	13.8	7.3	–	*T. baidashnikovi*
48	481	A well in the middle of a hayfield near Handerovytsya village, Mukachevo Dst	10.06.2018	48°23′59.14″	022°52′52.15″	166	19.8	6.9	–	*R. lagotis*
49	482	Forest stream near Handerovytsya village, Mukachevo Dst	10.06.2018	48°24′48.10″	022°53′45.35″	387	18	6.9	–	*T. baidashnikovi*
51		Perekop Stream near Novoselytsya village, Mukachevo Dst	18.09.2017	48°23′57.64″	022°51′39.85″	138	–	–	–	*A. fluviatilis*
52	502	Stream above Biological base of the UzhNU, Kolochava village, Mizhhirya Dst	02.07.2018	48°24′59.33″	023°40′49.22″	661	12.2	7.3	–	*T. baidashnikovi*
53	503	Stream opposite Biological base of the UzhNU, Kolochava village, Mizhhirya Dst	02.07.2018	48°24′44.71″	23°40′57.72″	540	14.8	7.5	–	*G. oblonga* *R. parapsilia* *R. peregra*
54	504	Spring which flows into the Kvasovec Stream, Kolochava village, Mizhhirya Dst	02.07.2018	48°26′51.68″	023°41′25.91″	619	12.6	8.3	–	*T. baidashnikovi* *Anisus spirorbis*
55	505	Little pond opposite Biological base of the UzhNU, Kolochava village, Mizhhirya Dst	02.07.2018	48°24′41.80″	023°40′52.50″	537	14.8	8.4	–	*G. truncatula* *G. oblonga* *R. lagotis*
56	506	Branch of the Tereblya River opposite Biological base of the UzhNU, Kolochava village, Mizhhirya Dst	02.07.2018	48°24′42.41″	023°40′52.25″	536	15.9	7.7	–	*R. parapsilia*
57	507	Stream near to the reservoir, Mereshor village, Mizhhirya Dst	03.07.2018	48°23′26.88″	023°38′44.95″	544	12.8	7.6	–	*T. baidashnikovi*
58	508	Stream near the road, Mereshor village, Mizhhirya Dst	03.07.2018	48°24′31.25″	023°40′31.73″	549	19.5	7.5	–	*T. baidashnikovi* *G. truncatula* *A. septemgyratus* *A. fluviatilis*
59	497	Spring near to the road, Lazeshchyna village, Rakhiv Dst	22.06.2018	48°13′39.70″	024°27′7.00″	810	10.1	8.2	–	*T. baidashnikovi* *G. oblonga* *R. peregra*
60	498	Swampy ditch near the road, Lazeshchyna village, Rakhiv Dst	22.06.2018	48°13′23.99″	024°27′34.36″	831	15.3	6.7	–	*R. peregra*
61	501	Spring which flows into the Stanislav Stream, Chorna Tisa village, Rakhiv Dst	23.06.2018	48°17′59.65″	024°18′18.45″	772	12	7.4	195	*T. baidashnikovi*
62	499	Chorna Tisa River near Chorna Tisa village, Rakhiv Dst	23.06.2018	48°18′26.26″	024°19′22.26″	729	10	8.5		*G. truncatula*

Table 2. Bionomic characteristics for species found in the region studied (own data)

No	Species	Types of reservoirs							a. s. l., m
		creeks	streams/ springs	ponds and the dam	canals/ ditches	pools	mountain rivers	lowland rivers	
1	*Viviparus viviparus*			+				+	102–109
2	*V. sphaeridius*			+				+	102–107
3	*Contectiana contecta*				+			+	108–109
4	*Bithynia tentaculata*			+				+	101–109
5	*B.* ex gr. *troschelii*				+				108
6	*Lithoglyphus naticoides*							+	101–116
7	*Bythinella* sp.		+				+		197–399
8	*Terrestribythinella baidashnikovi*	+	+				+		308–1099
9	*Valvata piscinalis*		+					+	109–154
10	*V. ambigua*							+	109
11	*Lymnaea stagnalis*			+	+			+	102–172
12	*L. fragilis*			+	+			+	103–172
13	*Stagnicola corvus*			+	+			+	101–566
14	*Galba truncatula*		+	+		+	+	+	116–729
15	*G. subangulata*		+						144–847
16	*G. oblonga*	+	+	+			+		101–810
17	*Ladislavella occulta*			+					172
18	*Radix auricularia*			+				+	115–168
19	*R. parapsilia*		+		+		+		121–540
20	*R. ampla*						+	+	115–199
21	*R. ampullacea*		+					+	109–198
22	*R. balthica*						+	+	115–700
23	*R. intermedia*		+			+		+	101–497
24	*R. lagotis*			+		+		+	107–537
25	*R. peregra*		+		+		+		484–847
26	*R. tumida*							+	103–242
27	*Physa acuta*							+	101–242
28	*Planorbis planorbis*				+			+	108–109
29	*Anisus spirorbis*	+			+			+	101–619
30	*A. septemgyratus*		+						549
31	*Gyraulus albus*		+		+	+			121–497
32	*Planorbarius corneus*			+	+			+	101–165
33	*Segmentina nitida*				+				114
34	*S. montgazoniana*							+	101
35	*Ancylus fluviatilis*		+				+	+	107–566
Total		3	13	12	12	4	9	24	

Altogether over 1500 specimens of molluscs from 59 localities were examined (fig. 1). Traditional morphological characters and shell measurements were used for species differentiation. In doubtful cases identification of some species of the family Lymnaeidae was verified by Maxim Vinarsky (Saint-Petersburg State University, Russia).

Small specimens were cleaned and photographed with a digital camera under Leica M165C stereomicroscope. Large shells were photographed with digital camera Panasonic LUMIX DMC-FZ200. A MBS-9 stereomicroscope was used for shell morphology study. Most samples studied (and all specimens herein depicted) are deposited in the collection of Department of Invertebrate Fauna and Systematics, Schmalhausen Institute of Zoology of NAS of Ukraine, Kyiv (IZAN). Several voucher specimens are housed in the collection of Uzhgorod National University (UzhNU).

The sampled area abounds in various types of water-bodies. To demonstrate the diversity of environmental conditions where the molluscs studied have been found a few typical ecotopes are illustrated (fig. 2).

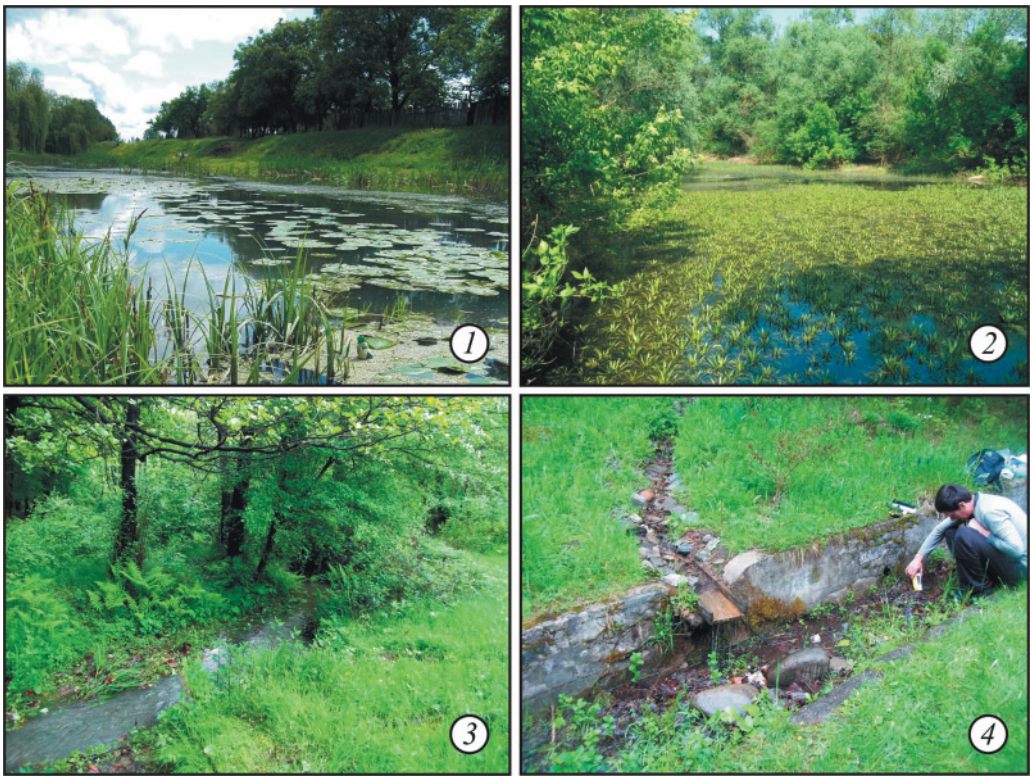

Fig. 2. Selected types of ecotopes in the region of materials sampling, Transcarpathia: *1*— Chorna Voda (Mertse) River, near the Gat village (locality 15); *2* — artificial pool in the floodplain of Latorytsia River, near Chop town (locality 8); *3* — stream near the Bukove village (locality 20); *4* — creek in the territory of Carpathian Biosphere Reserve Headquarters (locality 5).

There is no universal, commonly accepted classification of the Palearctic freshwater gastropod molluscs so far and this problem was currently discussed repeatedly (e. g., Vinarski, Kramarenko, 2015; Anistratenko et al., 2019). The Western European authors (e. g. Falkner et al., 2001; Glöer, 2002; Welter-Schultes, 2012) usually recognize a relatively low number of valid names of specific taxa. Meanwhile malacologists of the former USSR mainly use a significantly different concept recognizing many more number of "small" species (e. g. Kruglov, Soldatenko, 1997; Starobogatov et al., 2004). The molecular-genetic approach has recently become a widely-used tool in the European gastropod systematics, though some morphologically distinct species remain unstudied genetically what makes their rank and the taxonomic status still unclear. The taxonomic problems are beyond the scope of our study, and here we generally follow the classification of highter taxa elaborated by Bouchet et al. (2017). In cases where we deviate from the commonly considered species level taxonomy, references and/or comments are given therein.

Results

Sampling of molluscs was made in about 60 waterbodies of the Ukrainian Transcarpathia and yielded altogether 35 species of the Gastropoda. Three of this species appeared to be a regionally new: *Viviparus sphaeridius* (Bourguignat, 1880), *Bithynia troschelii* (Paasch, 1842) and *Segmentina montgazoniana* Bourguignat in Servain, 1881. Below we provide the appropriate comments on distribution and some ecological characteristics of the taxa found within the studied area.

Significant part of gastropod molluscs occuring in the Ukrainian Transcarpathian were already listed and illustrated in two papers earlier published (Anistratenko et al., 2017, 2018). Here we only provide the shell images for those species which were not depicted in these works. Most of bionomic information for the species under discussion is compiled in tables 1 and 2, therefore, only general remarks are given in each sketch of the species.

Class Gastropoda Cuvier, 1795
Family Viviparidae Gray, 1847
Genus *Viviparus* Montfort, 1810
Type species: *Helix vivipara* Linnaeus, 1758

The area of distribution of *Viviparus* in Europe covers almost all its territory, the eastern and southern parts of the Black Sea coast and Western Transcaucasia. River snails are only absent in the waters of the southwestern sector of the Iberian Peninsula, as well as in a part of the far north and south of Europe. No other notable gaps in the distribution of the genus have been found, and therefore, the European range of *Viviparus* can be considered completely delineated (Anistratenko et al., 2014).

Viviparus viviparus (Linnaeus, 1758) (fig. 3, *1*)

Distribution. In Ukraine *V. viviparus* is registered in all natural regions (Anistratenko, Anistratenko, 2001) including the Transcarpathian Region (Zdun, 1960; Stadnichenko, Gyrin, 2011 b; Anistratenko et al., 2018). In the Transcarpathia the species is recently recorded in three localities 8, 12 and 15 (fig. 1, table 1).

Remarks. In the Transcarpathia *V. viviparus* occurs rarely at shallow zone in small rivers and in the floodplain reservoirs associating with macrophytes.

Viviparus sphaeridius (Bourguignat, 1880) (fig. 3, *3*)

Distribution. The general distribution of *V. sphaeridius* includes lakes of south part of Alps, Danube, Dniester and Dnipro rivers basins (Anistratenko, Anistratenko, 2001). In Ukraine it occurs in the Dniester and Dnipro basins as well as in the mouth of Danube. In the Transcarpathian Region the species is recently reported for the first time (Anistratenko et al., 2018); currently it recorded in two localities: 8 and 12 (fig. 1, table 1).

Remarks. In the Transcarpathia *V. sphaeridius* occurs sporadically at same biotopes where *V. viviparus* live. The shell characteristics of *V. sphaeridius* from Transcarpathia match well the original description of *Vivipara sphaeridia* Bourguignat, 1880, syntypes as well as topotypes of this species collected in the Danube near Marten, Bulgaria (Glöer, Georgiev, 2014).

Genus *Contectiana* Bourguignat, 1880
Type species: *Cyclostoma contectum* Millet, 1813

In literature the name *Contectiana* is usually ranking as subgenus of *Viviparus* or its synonym and thus *Cyclostoma contectum* Millet, 1813 is respectively called "*Viviparus contectus*" meaning close relationships with *Viviparus viviparus* (e. g. Falkner et al., 2001; Welter-Schultes, 2012). However, "*viviparus*" and "*contectus*" clearly differentiate from each other not only in conchology (Zilch, 1955) but in morphology of embryo shell (Riedel, 1993; Ryabceva, Anistratenko, 2012; Glöer, Georgiev, 2014), caryology (Rainer, 1963; Pavluchenkova, 1997; Andriichuk, Garbar, 2015) and radula morphology (Falniowski et al., 1996; Anistratenko et al., 2013). In our opinion the data available allow to reclassify "*contecta*" into its own genus, *Contectiana*.

Contectiana contecta (Millet, 1813) (fig. 3, *2*)

Distribution. The species inhabits the waters of almost all Europe, excepting its northern and southern regions, from the south of England to the Urals and penetrates to the south of Western Siberia to the right bank of the Ob River (Anistratenko et al., 2014). In Ukraine *C. contecta* lives in rivers, lakes and ponds up to small permanent waterbodies of all natural regions, including the Crimea (Anistratenko, Chernogorenko, 1989; Anistratenko, Anistratenko, 2001). In the Transcarpathia its populations are rarely occurred (Zdun, 1960; Stadnichenko, Gyrin, 2011 b; Anistratenko et al., 2018) in the lowland area. We only recorded this species in 2 localities: 13 and 15 (fig. 1, table 1).

Remarks. In the Transcarpathian Region *C. contecta* inhabits shallow, slowly current or stagnant, even artificial, mostly warm (up to 25.6 °C) waters. In the locality 13 molluscs were found on the macrophytes.

Family Bithyniidae Gray, 1857
Genus *Bithynia* Leach, 1818
Type species: *Helix tentaculata* Linnaeus, 1758

Bithynia tentaculata (Linnaeus, 1758) (fig. 3, *4*)

Distribution. Global range of *B. tentaculata* covers the Europe and Western Siberia. In Ukraine the species is the most common bithyniid species in all regions except the mountainous areas of Carpathians and Crimea (e. g. Anistratenko, Stadnichenko, 1995). In the Transcarpathia its populations are rarely occurred (Zdun, 1960; Anistratenko et al., 2017, 2018) in the lowland area. Altogether we only recorded this species in 3 localities: 8, 9 and 15 (fig. 1, table 1).

Remarks. In the Transcarpathian region *B. tentaculata* inhabits shallow, slowly current and mostly warm (up to 25.6 °C) waters of rivers and their floodplains; it sometimes occurs in small artificial ponds (locality 8). Molluscs are usually associ-

Fig. 3. Shells of Transcarpathian gastropod molluscs: *1 — Viviparus viviparus* (locality 12); *2 — Contectiana contecta* (locality 15); *3 — Viviparus sphaeridius* (locality 12); *4 — Bithynia tentaculata* (locality 15); *5 — Valvata* (*Cincinna*) *ambigua* (locality 15); *6 — Bithynia troschelii* (locality 13); *7 — Valvata* (*Cincinna*) *piscinalis* (locality 22); *8 — Lithoglyphus naticoides* (locality 9); *9–11 — Planorbis planorbis* (locality 15); *12*, *13 — Planorbarius corneus* (locality 15). Scale bars are given for *1–3*, *4–8*, and *9–13* correspondingly.

ating with macrophytes at depths of 0.1–1.5 m at various bottom sediments (silty, sandy, stony, etc.).

Bithynia troschelii (Paasch, 1842) (fig. 3, *6*)

Distribution.The species is distributed throughout Europe and almost all West Siberia (Beriozkina et al., 1995). In some parts of its range it is rare or very rare (e. g. in Poland, Falniowski et al., 2004). In Ukraine the species is known from limited number of locations in the west part and in Steppe zone of the country (e. g. Anistratenko, Chernogorenko, 1989; Anistratenko, Stadnichenko, 1995). Recently it was mentioned as regionally new species for the Transcarpathian Region of Ukraine (Anistratenko et al., 2018). Since *B. troschelii* is recorded here only one time (locality 13) we suggest it is rare species in the Ukrainian Transcarpathia.

Remarks. Some authors (e. g. Welter-Schultes, 2012) use the name *Bithynia transsilvanica* (Bielz) for this species while others (Glöer, 2002; Falniowski et al., 2004) consider the valid name is *B. troschelii*. In 1995 Beriozkina et al. (1995) established a distinct generic name *Opisthorchophorus* for *Paludina troschelii* Paasch, 1842 and few others nominal species with peg-top-shaped shell having convex whorls separated by a deep suture. By the shell shape the specimens we found in Transcarpathia (fig. 3, *6*) demonstrate a close resemblance to '*O. hispanicus*' sensu Beriozkina et al. (1995: fig. 4, E). However we are not sure if '*O. hispanicus*' might represent a distinctinct species or is just a morphotype and prefer name the snails found as *B. troschelii*. As in the whole area of its distribution the species lives in Transcarpathia in temporary and semipermanent waterbodies, e.g. in small shallow artificial pools.

Family Lithoglyphidae Tryon, 1866
Genus *Lithoglyphus* C. Pfeiffer, 1828
Type species: *Paludina fusca* C. Pfeiffer, 1828

Lithoglyphus naticoides (C. Pfeiffer, 1828) (fig. 3, *8*)

Distribution. Native range of *L. naticoides* covers the Central and Eastern Europe. In the Ukraine the species inhabits all regions including the Transcarpathia (Anistratenko, Stadnichenko, 1995; Stadnichenko, Gyrin, 2011 b; Anistratenko et al., 2017). Recently we found populations of this snail in 5 localities: 6, 9, 10, 12 and 45 (fig. 1, table 1).

Remarks. Some authors (e. g. Falkner et al., 2001; Welter-Schultes, 2012) recognize within the genus *Lithoglyphus* a single species, *L. naticoides*, while others consider 2–3 (Alexenko et al., 1990; Anistratenko, Stadnichenko, 1995; Glöer, 2002) or even more distinct species (Bank, 2014). It can not be excluded that some findings of *L. fuscus* from the middle sector of the Danube basin (e. g. Cioboiu, 2013) actually concerned to *L. naticoides*. In the Transcarpathia *L. naticoides* inhabits small and large rivers; preferable biotops for the species are the silty or clayish substrates, molluscs are often associated with macrophytes in shallow zone of rivers at depths of 0.15–1.3 m. In the Middle Danube this species occupies mostly biotopes with sandy-clayish bottom sediments (Cioboiu, 2013). In the Latorytsa River (localities 6, 9 and 10) these molluscs coexist with *Bithynia tentaculata* and numerous pulmonate species (table 1).

Family Bythinellidae Locard, 1893
Genus *Bythinella* Moquin-Tandon, 1856 [non 1855]
Type species: *Bulimus viridis* Poiret, 1801

Bythinella sp.

Distribution. Spring snails of *Bythinella* occur throughout continental Europe (e. g. Wilke et al., 2010). Two nominal species of the genus are reported in Ukraine from the Transcarpathian and Ivano-Frankivsk Regions so far: *B. austriaca* (Frauenfeld, 1857) and *B. hungarica* Hazay, 1881 (e. g. Zdun, 1960; Anistratenko, Stadnichenko, 1995),

however, these identifications need additional confirmation. The data available suggest the distribution of *Bythinella* in Transcarpathia is strictly limited to a few localities. We recently found individuals of *Bythinella* with no clear specific determination in small stream flowing into the Synyavka River near Osiy village (Anistratenko et al., 2017: shell image is given in fig. 3, G, H) and later it was recorded also in the stream near Bukove village (fig. 1, localities 19 and 20 correspondingly).

Remarks. Identification of spring snails of the genus *Bythinella* is usually difficult due to lack of conchological characteristics which can serve as the reliable features for species distinguishing. For instance, several species of *Bythinella* were recently revealed in Ignis Mountains, the region of Rumania adjacent to the Ukrainian Transcarpathia (Falniowski et al., 2009), clearly distinguishing genetically though are very similar to each other in shell morphology. Moreover, the representatives of *Bythinella* can hardly be distinguished from conchologically similar and somewhere in the Transcarpathian area sympatric occurring species of the genus *Terrestribythinella* (Anistratenko et al., 2017). No doubts that current taxonomy of these groups and study of their relationhips requires involving of a combination of morphological and genetic evidences. Populations of *Bythinella* in Transcarpathia occur in the altitude range of 200–400 m a. s. l. (table 2) in the rapid flow cold water with a stone bottom, which is typical for the preferred living conditions of these snails. Together with *Bythinella* sp. also *Terrestribythinella baidashnikovi* and some species of pulmonate were sampled in the biotopes (table 1).

Family Terrestribythinellidae Sitnikova, Starobogatov & V. Anistratenko, 1992
Genus *Terrestribythinella* Sitnikova, Starobogatov & V. Anistratenko, 1992
Type species: *Terrestribythinella baidashnikovi* Sitnikova, Starobogatov & V. Anistratenko, 1992

The group is under the ongoing study aimed to re-assess the diversity, taxonomic rank and position of this group basing on combination of morphological and genetic approaches (Anistratenko et al., unpublished data). It is required since the shell morphology as well as bionomy of all three species currently attributing to *Terrestribythinella* show striking similarities with *Bythinella*. Untill this study is completed, we still considering terrestribythinellid as a distinct genus and family of Carpathian spring snails.

Terrestribythinella baidashnikovi Sitnikova, Starobogatov & V. Anistratenko, 1992

Distribution. This regionally endemic species for a long time was known from a few localities in the Transcarpathian Region (Sitnikova et al., 1992). The only one population recently found extra — in the adjacent Ivano-Frankivsk Region (Anistratenko et al., 2017: shell image is given in fig. 3, I–K). By now *T. baidashnikovi* is recorded in 17 localities of Transcarpathia: 4, 5, 19, 28, 31, 35–37, 41, 47, 49, 52, 54, 57–59 and 61 (fig. 1, table 1).

Remarks. Judging by the number of records the species is one of the most widespread snails in the region occuring in the altitude range between 300 and 1100 m a. s. l. (table 2), although they produce the populations of a very low density. Our observations confirm these small gastropods inhabit here in quite particular biotopes: they live rather under and among the litter leaves on banks of water flows than in the water. Riverine biotopes are not characteristic for the species. Few findings in the rivers were made at the mouths of streams, and these molluscs were not observed upstream and downstream of the rivers. *Terrestribythinella* hold an intermediate position between terrestrial and freshwater environments and apparently do not require significant amounts of liquid water for their existence. It seems they are neither strictly terrestrial, nor strictly water molluscs. This hidden under the leaves biotope is actually amphibiotic and therefore is usually poorly explored by malacologists who collect either freshwater molluscs or land snails. 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; Anistratenko et al., 2017). Interestingly, *Terrestribythinella*, inhabiting mostly springs and streams, sometimes forms a monospecific mollusc community. This can be proved by finding the caddisfly *Crunoecia irrorata* (Curtis, 1834) larva with a case built entirely of beech leaves and 22 living snails of *Terrestribythinella* (Martynov et al., 2018).

Family Valvatidae Gray, 1840
Genus *Valvata* O. F. Müller, 1773
Type species: *Valvata cristata* O. F. Müller, 1774

Subgenus *Cincinna* Mörch, 1864

Type species: originally not specified. The authorship of this (sub-)generic name is usually attributed to Hübner (1810 — his letter was not published). However, Haszprunar (2014) argued that only Mörch (1864) first used the name *Cincinna* with a reliable diagnosis and thus made it available (more nomenclatural details see in Haszprunar, 2014). According to original classification (Mörch, 1864) the name *Cincinna* is subgenus of *Valvata*. Mörch (1864: 321–322) included in this taxon *Valvata piscinalis*, *V. pusilla* and *V. antiqua* though the type species was not specified. Most authors regarded *Nerita piscinalis* O. F. Müller, 1774 as the type species of *Cincinna*.

Valvata* (*Cincinna*) *piscinalis (O. F. Müller, 1774) (fig. 3, *7*)

Distribution. General distribution range of *V. piscinalis* covers the Europe, Caucasus (Armenia) and Western Siberia. In the Ukraine the species is widely-distributed in the Dnipro basin and in the mouth part of the Danube (Anistratenko, Anistratenko, 2001). Also *V. piscinalis* is reported in the Ukrainian part of Transcarpathia (Zdun, 1960; Stadnichenko, Gyrin, 2011 b; Anistratenko et al., 2018). We found these mollusc populations in 5 sites located mainly within the Tisa River basin: 11, 15, 21–23 (fig. 1, table 1).

Remarks. In the Transcarpathian this species inhabits slow-flowing waters within the lowland zone of the region in the altitude range between 100 and 150 m a. s. l. (table 2), Accordinig to our observations, *V. piscinalis* prefers hard (stony or sandy) substrates in shallow zone of rivers or, rarely, springs. In the Chorna Voda River (locality 15) these snails co-occurred with highly diverse community of gastropod molluscs (table 1).

Valvata* (*Cincinna*) *ambigua Westerlund 1873 (fig. 3, *5*)

Distribution. The species inhabits rivers of Europe and south of Western Siberia (Anistratenko, Anistratenko, 2001; Vinarski et al., 2013). In Ukraine *V. ambigua* inhabits lotic waters in the middle and lower part of Dnipro basin (Anistratenko, Chernogorenko, 1989). A population of this species of low density was recently recorded also in the Latorytsia River basin, Transcarpathia (Stadnichenko, Gyrin, 2011 b). We found a few individuals of *V. ambigua* at a single locality (15) together with many others gastropod molluscs (fig. 1, table 1). Available data and our observations suggest this is apparently a regionally rare species.

Remarks. European authors mostly attribute this taxon to a synonymy of *Valvata piscinalis* (e. g. Welter-Schultes, 2012). Recently the problem was considered on the basis of studying the type material of *Valvata ambigua* (Vinarski et al., 2013) — its specific status is strongly argued because of the lower shell, the wider umbilicus of the type specimens. Shell morphology of snails collected in Transcarpathia (fig. 3, *5*) corresponds well to the syntype of this species illustrated by Vinarski et al. (2013: fig. 1, A–C).

Family Lymnaeidae Rafinesque, 1815
Subfamily Lymnaeinae Rafinesque, 1815
Genus *Lymnaea* Lamarck, 1799
Type species: *Helix stagnalis* Linnaeus, 1758

Lymnaea stagnalis (Linnaeus, 1758)

Distribution. In Ukraine *L. stagnalis* is registered in all regions (Anistratenko, Chernogorenko, 1989; Stadnichenko, 2004) being recorded also in Transcarpathia (Zdun, 1960; Stadnichenko, Gyrin, 2011 a; Anistratenko et al., 2017). The species is one of the most common and widespread pond snails in the region — we found its populations in 9 localities: 1, 6, 12, 14, 15, 22–24 and 32 (fig. 1, table 1).

Remarks. The image of snail from the Transcarpathia is provided by Anistratenko et al. (2018: fig. 3, A). In the Transcarpathian Region this species inhabits both hard and soft substrates in shallow zone of rivers, former riverbeds, lakes, natural and artificial ponds. We recorded *L. stagnalis* in the altitude range between 100 and 170 m a. s. l. where it is associated mostly with macrophytes at depths of 0.5–1.0 m (table 2).

Lymnaea fragilis (Linnaeus, 1758)

Distribution. In Ukraine *L. fragilis* is registered in all regions including the Transcarpathian (Anistratenko, Chernogorenko, 1989; Stadnichenko, 2004; Stadnichenko, Gyrin, 2011 a). The species is recorded in five localities of the Transcarpathian Region: 10, 13, 17, 23 and 24 (fig. 1, table 1); the shell is illustrated by Anistratenko et al. (2018: fig. 3, B).

Remarks. In the Transcarpathian this species occurs sporadically, inhabiting mainly natural and artificial ponds and associating with macrophytes at depths of 0.5–1.0 m. We recorded *L. fragilis* in the same altitude range as previous species (table 2). Although the taxonomic status of "*fragilis*" is not commonly accepted (Vinarski, Kantor, 2016), we treat this form as a conchologically distinct "morphospecies" (Anistratenko et al., 2018).

Genus *Stagnicola* Leach in Jeffreys, 1830
Type species: *Buccinum palustre* O. F. Müller, 1774

Stagnicola* (*Corvusiana*) *corvus (Gmelin in Linnaeus, 1791)

Distribution. In Ukraine the species inhabits basins of the Dnipro Bug River and Pripyat Polissia zone (Anistratenko, Chernogorenko, 1989; Stadnichenko, 2004). In the Transcarpathian Region *S. corvus* has been recently recorded ror the first time at only a single locality (Anistratenko et al., 2018: shell depicted in fig. 3, C). Currently populations of this snail found in few additional localities: 6-8, 14, 28 and 32 (fig. 1, table 1).

Remarks. In the Transcarpathian Region this species inhabits usually warm (T = 16.0–25.7 °C), mainly small even periodically dried waterbodies, natural ponds and roadside canals within the altitude range between 100 and 165 m a. s. l., occacionally — up to 560 m a. s. l. (table 2). *S. corvus* prefer clay-silty bottom sediments though are associating with macrophytes (e. g. *Iris pseudacorus* L.) too. These pond snails are relatively rare in terms of number of populations we found in the region.

Genus *Galba* Schrank, 1803
Type species: *Buccinum truncatulum* O. F. Müller, 1774

Galba truncatula (O. F. Muller, 1774)

Distribution. In Ukraine the species is registered in all regions including the Transcarpathian (Zdun, 1960; Stadnichenko, 2004; Stadnichenko, Gyrin, 2011 a; Anistratenko et al., 2017, 2018: shell illustrated in fig. 3, D). According to our data, this is one of the most widespread and abundant lymnaeid species in the region — we found its populations in 12 localities (table 1).

Remarks. In the Transcarpathia area this species inhabits cool to warm (T = 10.0–23.3 °C) waterbodies of various types: rivers, streams, lakes, ponds and marshes from 115 up to 730 m a. s. l., see table 2. Usually the populations of *G. truncatula* characterize by a high dencity — hundreds individuals per m^2. Sometimes snails are occurred in amphibiotic conditions due to their ability to still alive in temporarily dried waterbodies (Anistratenko et al., 2018).

Galba subangulata (Roffiaen, 1868)

Distribution. The species found at 3 localities: 22, 31 and 40 (fig. 1, table 1); it has been recently recorded from Transcarpathian Region for the first time (Anistratenko et al., 2018) though some reports of *G. ventricosa* (Moquin-Tandon, 1855) might be referred to *G. subangulata* (Stadnichenko, Gyrin, 2011 a). In Ukraine the species is distributed in the Steppe and Forest-Steppe zones (Anistratenko, Chernogorenko, 1989; Stadnichenko, 2004).

Remarks. In the studied area *G. subangulata* inhabits hard substrates in shoreline zone of moderately warm (T = 13.4–24.0 °C) small rivers or swamped streams in the altitude range 145–850 m a. s. l. (table 2) occasionally together with *G. oblonga* (see below). This (morpho)species differs from *G. truncatula* by ovate-conical shell with a shorter spire and visibly inflated body whorl than in latter species (Anistratenko et al., 2018: fig. 3, E).

Galba oblonga (Puton, 1847)

Distribution. The species is recorded in 6 localities: 6, 25, 34, 53, 55 and 59 (fig. 1, table 1). According to Stadnichenko and Gyrin (2011), and newly-obtained data it might be suggested that *G. oblonga* is a species rarely occurred in the Transcarpathian. In Ukraine it is known also from the Forest-Steppe and the Carpathian regions (Anistratenko, Chernogorenko, 1989; Stadnichenko, 2004).

Remarks. In the Transcarpathian *G. oblonga* inhabits hard substrates in shoreline zone of stagnant and low-flowing reservoirs from 100 up to 810 m a. s. l. (table 2). The shell of this (morpho)species differs from the *G. truncatula* by the turriculate shell shape and oblong and narrow spire; shell image is given in Anistratenko et al. (2018: fig. 3, F).

Genus *Ladislavella* B. Dybowski, 1913
Type species: *Ladislavella sorensis* B. Dybowski, 1913 = *Ladislavella terebra* (Westerlund, 1885)

Ladislavella terebra (Westerlund, 1885)

Distribution. The species was recently found (Anistratenko et al., 2018: shell images are given in fig. 3, G, H) at a single locality 24 (fig. 1, table 1) close to the site where it has being recorded earlier by Korniushin (1999). Available data suggest the area of distribution of *L. terebra* in the Transcarpathian Region is restricted to the Khust district. In addition it was mentioned in the adjacent Ivano-Frankivsk and Lviv regions (Stadnichenko, 1968) under the name *Galba occulta* Jackiewicz, 1959; the latter is a junior synonym for *Limnaea palustris* var. *terebra* Westerlund, 1885 (see Vinarski, Glöer, 2008). Actual distribution of this species in Ukraine needs to be clarified by means of new samplings.

Remarks. In the Transcarpathian *L. terebra* inhabits hard substrates in shallow natural stagnant reservoirs and artificial ponds in lowland zone about 170 m a. s. l. (table 2).

Subfamily Amphipepleinae Pini, 1877
Genus *Radix* Montfort, 1810
Type species: *Radix auriculatus* Montfort, 1810 = *Helix auricularia* Linnaeus, 1758

Radix* (*Radix*) *auricularia (Linnaeus, 1758)

Distribution. We recorded the species in 4 localities: 2, 10, 17 and 33 (fig. 1, table 1); shell image is given in Anistratenko et al. (2018: fig. 3, I). It was reported in the region

earlier by other authors (Zdun, 1960; Stadnichenko, Gyrin, 2011 a). In Ukraine this snail is known from all regions (Anistratenko, Chernogorenko, 1989; Stadnichenko, 2004). General distribution — Palaearctic, introduced into North America (Vinarski, Kantor, 2016).

Remarks. In the Transcarpathia *R. auricularia* inhabits shoreline zone of lowland (from 110 up to 170 m a. s. l.) rivers, reservoirs in their floodplain area and ponds associating mostly with macrophytes at depths up to 0.5 m (table 2).

***Radix* (*Radix*) *ampla* (Hartmann, 1821)**

Distribution. The species was recently listed and illustrated as new species for the regional malacofauna (Anistratenko et al., 2018: fig. 3, O). Currently populations of *R. ampla* are registered in the Transcarpathia in 5 localities: 2, 18, 21, 43 and 45 (fig. 1, table 1). In Ukraine the species sometimes was mentioned under the name *L. monnardi* (Hartmann, 1844) from the Forest-Steppe and Polissya zones (Anistratenko, Chernogorenko, 1989; Stadnichenko, 2004). General distribution — Europe and Siberia (Vinarski, Kantor, 2016).

Remarks. In the Transcarpathia this species is found only in lowland (from 110 up to 200 m a. s. l.) rivers among vegetation at depths up to 0.5 m (table 2). Though some authors do not accept the validity of name *R. ampla*, a combination of features of shell morphology, proportions of the copulatory apparatus and molecular taxonomy confirm it is a distinct species (more details in Anistratenko et al., 2018).

Radix* (*Radix*) *parapsilia Vinarski et Glöer, 2009

Distribution. The species is recently found at a single locality and was declared as formally new species for the Transcarpathian malacofauna (Anistratenko et al., 2018: shell illustrated in fig. 3, J, K). At the same time some records of *R. peregra* (O. F. Müller, 1774) in there as well as in adjacent Ivano-Frankivsk Region (Stadnichenko, 2004) might be treated as *R. parapsilia*. Currently only three localities of this species are discovered in the region: 16, 53 and 56 (fig. 1, table 1). Distribution of *R. parapsilia* in Ukraine is also not clearly studied and needs more extensive field samplings. General distribution — Northern Eurasia (Vinarski, Kantor, 2016).

Remarks. In the Transcarpathia the species is found in shallow zone of rivers, streams and canals from 120 up to 540 m a. s. l. (table 2). Long time this species had been known in the Russian literature as *Lymnaea* (*Radix*) *psilia* (Bourguignat, 1862). However, Vinarski and Glöer (2009) showed that the syntypes of *L. psilia* represent juvenile specimens of *L. stagnalis* and thus a substitute name was created to replace *L. psilia* sensu Kruglov, 2005 non Bourguignat, 1862. The specimens of *R. parapsilia* differ from the typical *R. auricularia* by its higher spire and less inflated body whorl (Anistratenko et al., 2018: compare fig. 3, I and fig. 3, J, K).

Radix* (*Peregriana*) *ampullacea (Rossmässler, 1835)

Distribution. The species is only found in three localities (2, 15 and 44, see fig. 1, table 1) in the Transcarpathian Region. In Ukraine *R. ampullacea* inhabits all regions (Anistratenko, Chernogorenko, 1989; Stadnichenko, 2004). General distribution — Europe and Siberia (Vinarski, Kantor, 2016).

Remarks. The Transcarpathian populations of the species are characterized by low density; the snails occur here only in rivers or, rarely, in streams from 110 up to 200 m a. s. l. (table 2) at depths up to 0.5 m. Some malacologists (e. g. Glöer, 2002; Welter-Schultes, 2012) do not recognize *R. ampullacea* as a valid species name considering it as a synonym of *R. balthica*. However some others (e. g. Chernogorenko, 1989; Stadnichenko, 2004) define this taxon as a distinct species having almost spheroid shell and very low spire; the body whorl is much more inflated in comparison to *R. balthica* — compare shell images given in Anistratenko et al. (2018). Its identity needs to be verified with using of molecular data.

Radix* (*Peregriana*) *balthica (Linnaeus, 1758)

Distribution. The species is recently found in the Transcarpathian Region for the first time (Anistratenko et al., 2018: shell illustrated in fig. 3, M). Currently five localities of *R. balthica* are revealed in the region: 1, 2, 15, 21 and 26 (fig. 1, table 1, 2); one of which (26) is located in a mountainous area, 700 m a. s. l. representing one of the highest place of occurrence of lymnaeid snail here. In Ukraine the species is registered in various regions, excluding Steppe zone and Carpathians (Anistratenko, Chernogorenko, 1989; Stadnichenko, 2004). General distribution — Palaearctic (Vinarski, Kantor, 2016).

Remarks. *R. balthica* is one of the widespread and common species of the subgenus *Peregriana* in the fauna of Europe. Its populations in the Transcarpathia are characterized by high density. According to our observations, *R. balthica* occurs here only in rivers and prefers cold and fast-running water conditions. Relevant remarks on taxonomic identity of *R. balthica* from the Transcarpathia are given in Anistratenko et al. (2018).

Radix* (*Peregriana*) *intermedia (Lamarck, 1822)

Distribution. This is one of the widespread pond snails in Forest-Steppe and Polissia zones of Ukraine (Stadnichenko, 2004) as well as in the Transcarpathian region (Stadnichenko, Gyrin, 2011 a; Anistratenko et al., 2018). General distribution — Palearctic (Vinarski, Kantor, 2016).

Remarks. Shell of specimen from the Transcarpathia is illustrated by Anistratenko et al. (2018: fig. 3, N). In the Transcarpathia this species is the common snail inhabiting shallow zone of rivers and canals up to 500 m a. s. l. mostly associating with macrophytes; it also occurs in small natural or even artificial ponds: localities 3, 6, 12, 15, 16, 19, 27, 30, 44 and 46 (fig. 1). Environmental conditions for the recorded populations of *R. intermedia* are presented in tables 1 and 2. This species shows close resemblance to *R. balthica* and can be distinguished from the latter by its higher spire and more oblong shell. The validity of name *R. intermedia* is accepted in Russian literature (e. g. Kruglov, 2005), while the Western European malacologists usually consider it as a synonym of *R. balthica*.

Radix* (*Peregriana*) *lagotis (Schrank, 1803) (fig. 4, *2*)

Distribution. According to our data, *R. lagotis* is widespread and quite common species of pond snails in the Transcarpathia. It was formally listed in the regional fauna long time ago (Zdun, 1960) though it still unclear whether or not a determination of snails was correct. Currently populations of the species are found in 6 localities: 7, 8, 27, 29, 48 and 55 (fig. 1, table 1). In Ukraine *R. lagotis* is registered in all regions (Anistratenko, Chernogorenko, 1989; Stadnichenko, 2004). General distribution — Northern and Central Palearctic (Vinarski, Kantor, 2016).

Remarks. In the Transcarpathia *R. lagotis* occurs in the similar biotopes as *R. peregra* living in slowly running rivers, temporary or semi-permanent waterbodies in the altitude range from 110 up to 540 m a. s. l. (table 1, 2). In shell shape *R. lagotis* differs from *R. peregra* by its lower spire and more wide body whorl.

Radix* (*Peregriana*) *peregra (O. F. Müller, 1774) (fig. 4, *1*)

Distribution. The species is common in the Transcarpathia (e. g. Zdun, 1960) and currently found in 7 localities: 16, 29, 30, 40, 53, 59 and 60 (fig. 1, table 1). According to Stadnichenko (2004) *R. peregra* is known in Ukraine from all regions. General distribution — Europe and southern part of the Western Siberia (Vinarski, Kantor, 2016).

Remarks. Our observations suggest that in the Transcarpathia *R. peregra* inhabits rivers, temporary or semi-permanent waterbodies and wetlands, preferring the swampy biotopes in the altitude range from 480 up to 850 m a. s. l. (table 1, 2). Stadnichenko and Gyrin (2011 a) recorded these molluscs in shallow zone of Lake Synevir-Polyanske (984 m a. s. l.).

Radix* (*Peregriana*) *tumida (Held, 1836)

Distribution. The species is recently found in the Transcarpathian Region for the first time (Anistratenko et al., 2018: shell illustrated in fig. 3, P). Currently only four localities of *R. tumida* are discovered in the region: 10, 18, 21 and 25 (fig. 1, table 1). In Ukraine the species registered in all regions (Anistratenko, Chernogorenko, 1989; Stadnichenko, 2004). General distribution — Northern Palearctic (Vinarski, Kantor, 2016).

Remarks. In the Transcarpathia *R. tumida* only inhabits well warmed up water of rivers of altitude zone in between 100 and 240 m a. s. l. (table 2) usually associating with vegetation. Shell of *R. tumida* resembles *R. ampla* differentiating by higher spire and less inflated aperture; some differences in the proportions of the copulatory organs of these two species exist too (see Anistratenko et al., 2018).

Family Physidae Fitzinger, 1833
Genus *Physa* Draparnaud, 1801
Type species: *Bulla fontinalis* Linnaeus, 1758

Physa acuta (Draparnaud, 1805) (fig. 4, *3–5*)

Distribution. This species was described from France and occurs in many European countries. However, some data evidence *Ph. acuta* is a species of Nearctic origin that apparently invaded other continents in Europe, Asia, Africa, Australia, and South America. Therefore it is considered as one of the most successful invaders among freshwater snails (for more details see Vinarski, Kantor, 2016; Vinarski, 2017). In Ukraine the species is widespread through almost the entire country being registered sometimes as *Costatella integra* (Haldeman, 1841) (Stadnichenko, 1990), *Ph. taslei* Bourguignat, 1860 (Anistratenko, Chernogorenko, 1989) or *Physa skinneri* Taylor, 1954 (Degtyarenko, Anistratenko, 2011). In the Transcarpathian Region *Ph. acuta* has been recorded several

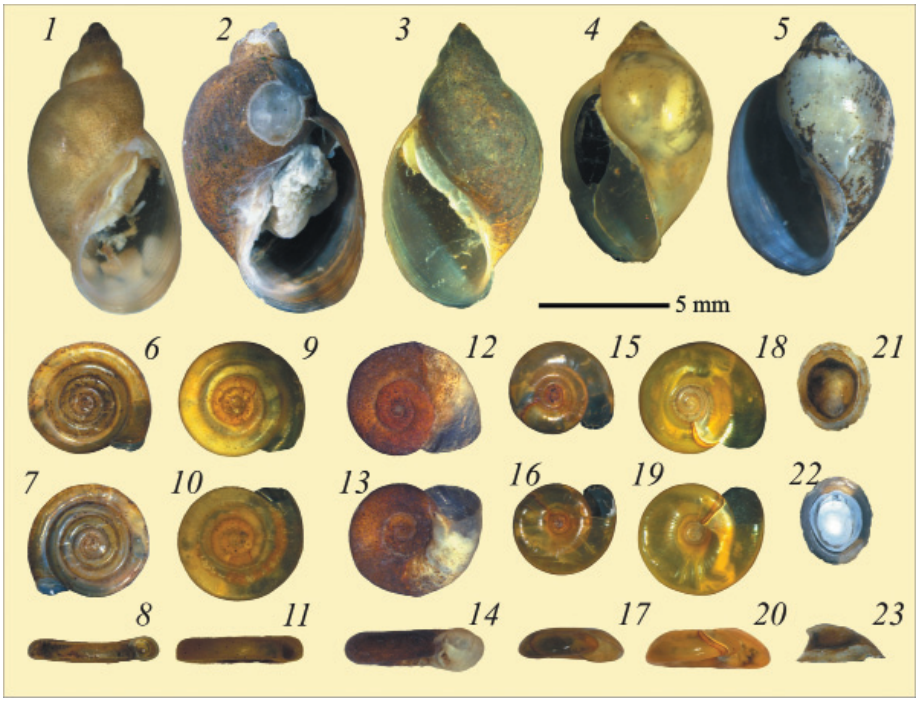

Fig. 4. Shells of Transcarpathian gastropod molluscs: *1 — Radix peregra* (locality 55); *2 — R. lagotis* (locality 48); *3–5 — Physa acuta* (*3*, *4*—from locality 6; *5* — locality 15); *6–8 — Anisus septemgyratus* (locality 58); *9–11 — Anisus spirorbis* (locality 16); *12–14 — Gyraulus albus* (locality 16); *15–17 — Segmentina nitida* (locality 14); *18–20 — S. montgazoniana* (locality 7); *21–23 — Ancylus fluviatilis* (locality 58).

times (Stadnichenko, 1990; Anistratenko et al., 2018). Currently we found populations of this snail in few additional localities: 6, 9, 15, 18, 25 and 42 (fig. 1, table 1). It could not be excluded that findings of "*Physa fontinalis* (Linnaeus, 1758)" reported by Zdun (1960) from the Transcarpathia in reality are belonging to *Ph. acuta*.

Remarks. The shell shape of *Ph. acuta* from Transcarpathia is highly variable, ranging from broadly to elongately conical (fig. 4, *3–5*). However, at least some specimens (e. g. fig. 4, *3*) match well the holotype of this species illustrated by Vinarski (2017). Some European authors use the genus name *Physa* for this species (Falkner et al., 2001; Glöer, 2002) while *Physella* is also in use (e. g. Vinarski, 2017). In the Transcarpathia this species inhabits shallow zone of both current and stagnant waterbodies. Snails usually occur in macrophytes associations at depths of 0.05–0.5 m, preferring warm area of the reservoir within the altitude range between 100 and 240 m a. s. l. (table 1, 2).

Family Planorbidae Rafinesque, 1815
Subfamily Planorbinae Rafinesque, 1815
Tribe Planorbini Rafinesque, 1815
Genus *Planorbis* O. F. Müller, 1774
Type species: *Helix planorbis* Linnaeus, 1758

Planorbis planorbis (Linnaeus, 1758) (fig. 3, *9–11*)

Distribution. According to our data, the species is one of the rarely recorded pulmonate snails in the region — we found its populations in only two localities: 13 and 15 (table 1). In Ukraine *P. planorbis* is registered in all regions (Anistratenko, Chernogorenko, 1989; Stadnichenko, 1990) including the Transcarpathia (Zdun, 1960; Stadnichenko, Gyrin, 2011 b; Anistratenko et al., 2018). Global distribution — Europe, Northern Africa, and Siberia (Vinarski, Kantor, 2016).

Remarks. In the studied region *P. planorbis* inhabits stagnant (even temporary or semi-permanent) and running waters usually occurring in- and under stones or macrophytes. We recorded *P. planorbis* only in lowland part of the region at a depth of 0.3–0.5 m (table 1, 2).

Genus *Anisus* Studer, 1820
Type species: *Helix spirorbis* Linnaeus, 1758

Anisus spirorbis (Linnaeus, 1758) (fig. 4, *9–11*)

Distribution. Like the previous species, *A. spirorbis* represents a rarely recorded pulmonate snail in the studied region — we found its populations in two localities: 16 and 54 (table 1). In Ukraine *A. spirorbis* occurs in all regions (Anistratenko, Chernogorenko, 1989; Stadnichenko, 1990) including the Transcarpathia (Stadnichenko, Gyrin, 2011 b; Anistratenko et al., 2018). Global distribution — Europe, Northern Africa, Middle Asia, Siberia (Glöer, Meier-Brook, 2008; Vinarski, Kantor, 2016).

Remarks. In the Transcarpathian Region snails live in small temporary ponds, canals and wetlands at a depth of 0.1–0.3 m; sometimes molluscs can be found in streams up to 620 m a. s. l. (table 1, 2). The specimens from Transcarpathia match well the images of *A. spirorbis* provided by Glöer and Meier-Brook (2008).

Anisus septemgyratus (Rossmässler, 1835) (fig. 4, *6–8*)

Distribution. In the studied region the species found at a single locality (58 — table 1). In the rest part of Ukraine *A. septemgyratus* the populations are also not abundant although occur in all regions (Anistratenko, Chernogorenko, 1989; Stadnichenko, 1990). Global distribution — Europe (Glöer, Meier-Brook, 2008; Vinarski, Kantor, 2016).

Remarks. In the Transcarpathian Region mollusc is recorded in various types of waterbodies (Stadnichenko, Gyrin, 2011 b); we found it only in streams in the highland zone (550 m a. s. l.) along with *Terrestribythinella baidashnikovi*, *Galba truncatula* and *Ancylus fluviatilis* (table 1, 2). The shell characteristics of *A. septemgyratus* from Transcarpathia match well the fully-grown specimen illustrated by Glöer and Meier-Brook (2008) who clearly argued distinctness of this species from others similar *Anisus*.

Genus *Gyraulus* Agassiz in Charpentier, 1837
Type species: *Planorbis albus* O. F. Müller, 1774

Gyraulus albus (O. F. Müller, 1774) (fig. 4, *12–14*)

Distribution. In the Transcarpathian Region is rarely registered species (Zdun, 1960; Stadnichenko, Gyrin, 2011 b; Anistratenko et al., 2018); currently we found its populations in four localities: 16, 24, 25 and 27 (fig. 1, table 1). In Ukraine *G. albus* is registered in all regions (Anistratenko, Chernogorenko, 1989; Stadnichenko, 1990). Global distribution — Northern Palearctic (Vinarski, Kantor, 2016).

Remarks. In Transcarpathia *G. albus* live on vegetation in lakes, natural ponds and artificial canals within the altitude range between 120 and 500 m a. s. l. at a depth up to 1.5–2.0 m (table 1, 2).

Tribe Coretini Gray, 1847
Genus *Planorbarius* Duméril, 1805
Type species: *Helix cornea* Linnaeus, 1758

Planorbarius corneus (Linnaeus, 1758) (fig. 3, *12*, *13*)

Distribution. In the Transcarpathian Region *P. corneus* is apparently one of the common and widespread species — we found its populations in 8 localities: 6–8, 13, 15, 22, 23 and 32 (fig. 1, table 1). In Ukraine *P. corneus* is registered in all regions (Anistratenko, Chernogorenko, 1989; Stadnichenko, 1990); it was listed also in Transcarpathian (Zdun, 1960; Stadnichenko, Gyrin, 2011 a; Anistratenko et al., 2018). Global distribution — Europe and the Western Siberia (Vinarski, Kantor, 2016).

Remarks. In the Transcarpathia this species usually inhabits shallow zone of permanent lotic and lentic waterbodies within the altitude range 100–170 m a. s. l. mostly associating with macrophytes; it also occurs in small natural and artificial ponds (table 1, 2). Apart the *P. corneus*, Stadnichenko and Gyrin (2011a) reported in the Transcarpathia fauna also *P. purpura* (O. F. Müller, 1774) and *P. grandis* (Dunker, 1850). Conchologically both *P. purpura* and *P. grandis* can be differentiated from *P. corneus*; however, Western European malacologists do not recognize the former taxa as distinct species and regard them as junior synonyms of *P. corneus* (Glöer, 2002; Welter-Schultes, 2012).

Tribe Segmentinini F. C. Baker, 1945
Genus *Segmentina* J. Fleming, 1818
Type species: *Nautilus lacustris* Lightfoot, 1786 = *Planorbis nitidus* O. F. Müller, 1774

Segmentina nitida (O. F. Müller, 1774) (fig. 4, *15–17*)

Distribution. Global range of this species covers Europe and the Western Siberia (Vinarski, Kantor, 2016). In Ukraine *S. nitida* is known from the Polissya, Forest-Steppe, Steppe zones and Crimea (Anistratenko, Chernogorenko, 1989; Stadnichenko, 1990). It was recently registered in the Transcarpathian Region (Anistratenko et al., 2018). Additionally in the malacological collection of State Museum of Natural History in Lviv are found two lots labeled as *S. nitida* which sampled in Transcarpathia in 2004 (Furyk, 2018).

Since the records of *S. nitida* are limited in Ukrainian Transcarpathia by a very few locations, we assume that it is a regionally rare species; at least we found *S. nitida* in only one locality (14).

Remarks. We found the population of *S. nitida* in a roadside canal (table 1) with warm water (T = 25.7 °C) located in lowland area, (110 m a. s. l.); density of this community was about 20–30 individuals per m^2. Molluscs were crawling among the stalks and leaves of *Iris pseudacorus* L.

Segmentina montgazoniana Bourguignat in Servain, 1881 (fig. 4, *18–20*)

Distribution. In the Transcarpathia *S. montgazoniana* is registered for the first time and is a formally new species for the regional fauna. Currently its populations are found in two localities: 6 and 7 (fig. 1, table 1). In Ukraine *S. montgazoniana* is known from the Polissya and Forest-Steppe zones (Anistratenko, Chernogorenko, 1989; Stadnichenko, 1990). Global distribution — Europe (Vinarski, Kantor, 2016).

Remarks. In the Transcarpathia *S. montgazoniana* occur in shallow permanent waterbodies (rivers and their floodplains) on vegetation within the lowland area (ca. 100 m a. s. l.) (table 1, 2). European authors usually consider diversity of *Segmentina* as confined to one morphologically variable species, *S. nitida* (Falkner et al., 2001; Glöer, 2002; Welter-Schultes, 2012). However, some anatomical and conchological differences allow distinguishing among this group several separate species (Kruglov, Soldatenko, 1997) of which *S. montgazoniana* is recorded in the studied region.

Subfamily Ancylinae Rafinesque, 1815
Genus *Ancylus* O. F. Müller, 1773
Type species: *Ancylus fluviatilis* O. F. Müller, 1774

Ancylus fluviatilis O. F. Müller, 1774 (fig. 4, *21–23*)

Distribution. In Ukraine *A. fluviatilis* is registered in all regions except Crimea (Anistratenko, Chernogorenko, 1989; Stadnichenko, 1990). This river limpet was repeatedly recorded in the Transcarpathian Region (Zdun, 1960; Stadnichenko, Gyrin, 2011 b; Anistratenko et al., 2018) where it appears to be one of the most common and widespread pulmonate species — we found its populations in 7 localities: 12, 18, 19, 25, 28, 51 and 58 (table 1). Global distribution — Europe, Northern Africa and north-western Asia (Vinarski, Kantor, 2016).

Remarks. According to our observations in Transcarpathia, this species inhabits shallow (up to 0.2 m) zone of springs and rivers in both lowland and mountainous areas in the altitude range 110–570 m a. s. l. (table 2). Limpets prefer clean and oxygen-rich conditions with hard, mostly rocky substrates on the surface of which they are firmly adhere.

Discussion and conclusion

The data obtained show that fauna of freshwater gastropod molluscs in the Ukrainian Transcarpathia is quite diverse (accounting 35 species) and has a clear specificity in comparison with whole-European malacofauna. Occurring of several species in the studied region is restricted to only few locations, the snails produce here populations of very low number of specimens and thus we suggest considering them as regionally rare: *Contectiana contecta*, *Bithynia troschelii*, *Valvata ambigua* and *Segmentina nitida* (table 1).

One of the bright features of regional mollusc fauna is that sertain groups of molluscs that are widely represented in the neighboring countries are totally absent in the Transcarpathian. For example, no species of the family Neritidae is found there during our field work 2015–2018. However, some lots containing *Theodoxus* sp. are deposited in the malacological collection of Ivan Franko Zhytomyr State University, and the Zoological Department of the National Museum of Natural History, NAS of Ukraine

(Kyiv) (Furyk, 2018). On the other hand only in the Transcarpathia spring snails of the genus *Terrestribythinella*, a potential endemic taxon to the region occur (Anistratenko et al., 2017). Also in the Ukrainian Transcarpathia we recorded several rare species, unknown from other regions of Ukraine (Anistratenko et al., 2017).

There is a series of nominal species that we did not find in our samples, but they are listed in the literature (Stadnichenko, Gyrin, 2011 a, b): *Anisus vortex* (L., 1758), *A. vorticulus* (Troschel, 1834), *A. leucostoma* (Millet, 1813), *A. dazuri* (Mörch, 1868), *Bathyomphalus contortus* (L., 1758), *Gyraulus laevis* (Alder, 1838), *G. acronicus* (Férussac, 1807). Not many but some of above mentioned species are listed in the catalogues of museum collections from the region (Furyk, 2018).

It should be noted that some species are rarely occur in the region studied although in the rest territory of Ukraine they are common: *P. planorbis*, *A. spirorbis*, *A. septemgyratus*, etc. Apart this, *Paladilhiopsis carpathica* (L. Soós, 1940), needs to be mentioned as a specific snail

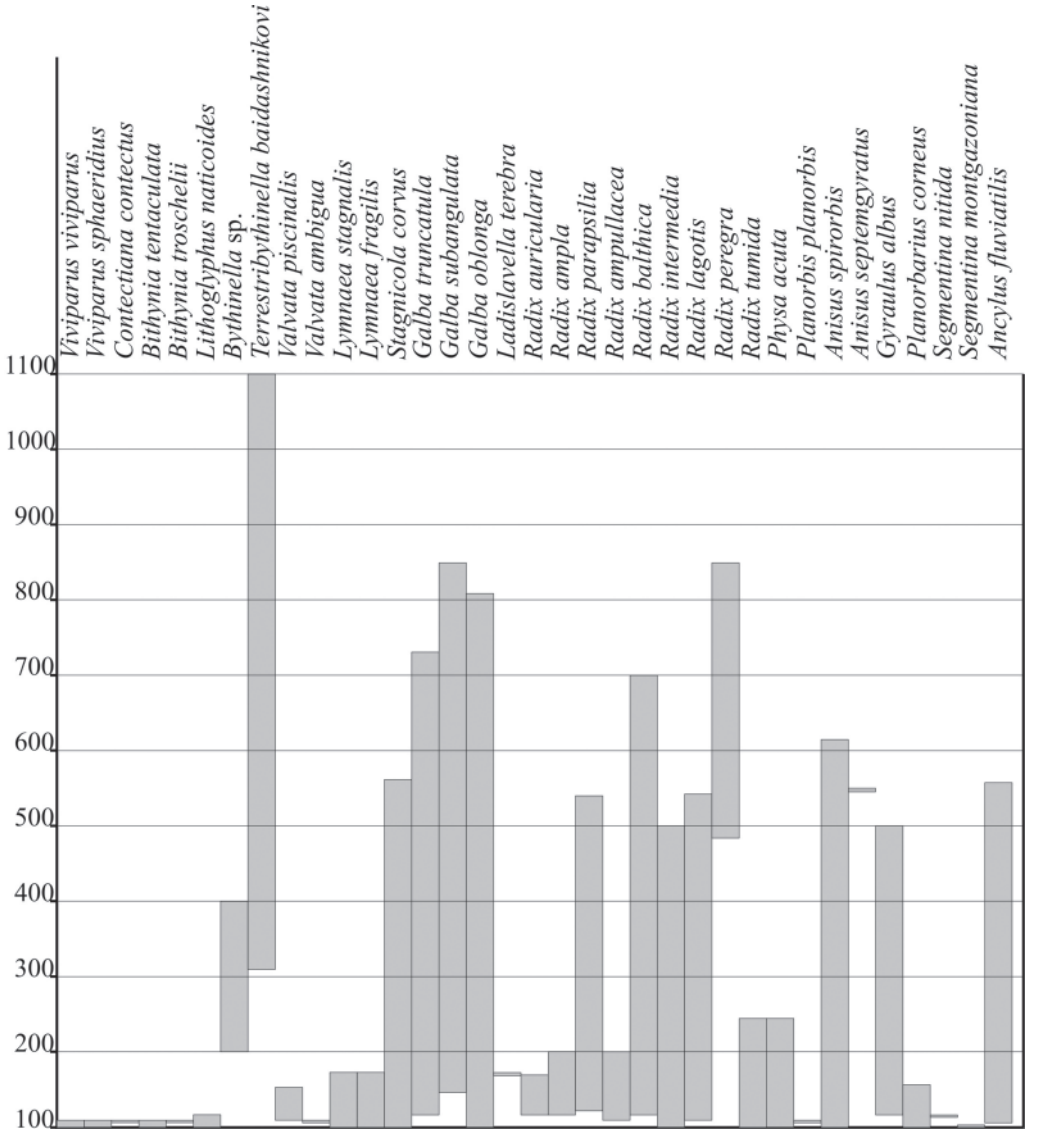

Fig. 5. Altitude distribution of freshwater gastropod species found in the Transcarpathia. Height above the sea level (in m) is shown in vertical line.

inhabiting the Ukrainian Transcarpathia. It was described from the cave in Hoverla Mountain (Soós, 1940) located in the border between Ivano-Frankivsk and Transcarpathian Regions. Although the species has never been found here since time of its description (Anistratenko, 1998) but was recorded in Vadu Crisul Cave, Romania (Szarowska, 2006) it might be also considered as a potential endemic or subendemic gastropod mollusc to the region.

Majority of mollusc species occurred in the region live in various types of waterbodies (table 2) while some prefer fast-flowing cold water of springs and streams (e. g. *Bythinella*, *Terrestribythinella*) and some, in contrary, — warm stagnat waters of canals and ponds (*Contectiana*, *Bithynia*, *Lymnaea*).

According to data obtained, the lowland part of the Ukrainian Transcarpathian (below the 200 m a. s. l.) maintains the major part of mulluscan fauna of the region (table 2). To illustrate an altitude distribution of freshwater gastropods living in Transcarpathia, we presented the available data in fig. 5. It can be seen that almost all prosobranchiate molluscs, known in the region, inhabit the altitude zone less than 150–200 m a. s. l. Only *Bythinella* and *Terrestribythinella* are occuring higher (fig. 5). On the contrary, the majority of pulmonate species have a wide range of altitude preferences and some (e. g. *Radix peregra* and *Anisus septemgyratus*) are recorded only in relatively highland areas. Interestingly, that in the mountain lakes of the studied region we found only small bivalve molluscs (Pisidiidae and Sphaeriidae) though Stadnichenko and Gyrin (2011 a) reported pond snail *Radix peregra* in the Lake Synevir as well.

The Carpathians as a whole are considered as an important diversity hotspot for many groups of invertebrates and, especially for those with relatively limited dispersal ability, the mountain areas are also a centre of endemism (e. g. Pop et al., 2010). Although this should be true also for the Ukrainian Transcarpathia it remains, unfortunately, the least studied from the faunistic point of view region in Ukraine so far. The review presented contributes to the knowledge of regional malacofauna and should help to assess the biogeographic status of the Transcarpathian Region more clearly. Newly-collected data on autecology of freshwater gastropod molluscs should also be used in the accurate estimation of a conservation status for some regionally rare species.

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