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Freshwater gastropods of the western part of the Kola Peninsula and northern Karelia (northern Europe)

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ABSTRACT. The species composition and distribution of freshwater gastropods in the western part of the Kola Peninsula and northern Karelia has been studied. The explored region lies in the far north of Europe and covers several landscape zones: from the northern taiga to the tundra. In sum, seventeen species were found, for each of them the distribution maps and photographs of intraspecific forms of conchological variability are presented. The taxonomic remarks are also given when appropriate. *Gyraulus acronicus* (Planorbidae) and *Ampullacena balthica* (Lymnaeidae) are the most common species in the studied region. Two species (*Ampullacena balthica* and *Galba truncatula*) have been recorded in the Barents Sea islands off the Kola Peninsula. A single non-indigenous species, *Physella acuta* (Physidae) has been registered in the studied territory. Based on the results of a comparison of the faunas of gastropods from various areas within the whole territory studied and other regions of northern Europe and Western Siberia, it has been shown that the most dramatic reduction in the species composition occurs during the transition from taiga to tundra landscapes.

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Пресноводные брюхоногие моллюски западной части Кольского полуострова и северной Карелии (северная Европа)

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РЕЗЮМЕ. Изучены видовой состав и географическое распространение пресноводных брюхоногих моллюсков западной части Кольского полуострова и северной Карелии. Исследованный регион находится на крайнем севере Европы и включает в себя различные ландшафтные зоны: от северной тайги до тундры. Всего было отмечено семнадцать видов, для каждого из которых приведены карты распространения и фотографии форм внутривидовой изменчивости. При необходимости даны таксономические комментарии. Наиболее часто встречаемыми оказались *Gyraulus acronicus* и *Ampullacena balthica*. Два вида (*Ampullacena balthica* и *Galba truncatula*) были отмечены на находящихся недалеко от Кольского полуострова островах в Баренцевом море. На территории Кольского полуострова и северной Карелии обнаружен один инвазивный вид – *Physella acuta*. По результатам сравнения фаун брюхоногих моллюсков различных районов внутри исследуемой территории и других регионов севера Европы и Западной Сибири показано, что наиболее резкое сокращение видового состава происходит при переходе от таёжных ландшафтов к тундровым.

Introduction

Freshwater molluscs of the Arctic and subarctic parts of Eurasia had been studied for more than a century, and these studies have been especially intensified during the last decades [Frolov, 2010; Bespalaya, 2014; Bespalaya *et al.*, 2015a, 2015b, 2018; Nekhaev, 2015; Ovchankova *et al.*, 2015; Vinarski *et al.*, 2013b, 2020]. On a date, species composition has been described for many regions of the European Far North, including northeastern Europe [Leshko, 1998; Bespalaya *et al.*, 2011, 2017], Scandinavia [Esmark, Hoyer, 1886; Westerlund, 1897; Økland, 1990], and some islands [Smith, 1896; Mandahl-Barth, 1938; Bespalaya *et al.*, 2009, 2015a]. While many Arctic regions remain poorly studied mainly due to their poor accessibility, special accounts on molluscan fauna for some relatively not remote and easily available regions are still absent. Some of these regions, such as the Kola Peninsula and adjoining parts of northern Karelia, are located in the northwestern part of European Russia adjacent to the Scandinavian Peninsula.

Apparently, the first data on continental molluscs of the Kola Peninsula and northern Karelia were presented by the Swedish malacologist Carl Agard Westerlund in his report dedicated to molluscan fauna of Scandinavia and adjacent areas [Westerlund, 1897]. These faunal data were based on collections of the French traveler Charles Rabot made during his visits to the "Russian Lapland" in 1880-1886. Rabot visited a lot of places within the region including those, which are hardly accessible even now (for instance Kildin Island in the Barents Sea). In honor of Charles Rabot, Westerlund [1894] named a new variety, *Limnœa ovata* var. *raboti* from the Tuloma River in the northern part of the Kola Peninsula. However, Westerlund's papers were dedicated to the fauna of a much broader region (i.e. Scandinavia as a whole), and the data on the local species' distribution provided by him were often too general.

During the first half of the 20th century, intensive studies of freshwater malacofauna were carried out in the European part of Russia. The results of these investigations were summarized in monographs by Zhadin [1933, 1952]. However, this author described the distribution of particular species in very general terms, and it is impossible to determine which taxa included in Zhadin's monographs actually occur in the Kola Peninsula and northern Karelia.

Until the 2010s, the main sources of distributional information for molluscs in the region were numerous hydrobiological publications which typically contained species lists of all freshwater macroinvertebrates not excluding snails. The most inclusive species lists, contained in a total of 18 gastropod species, are those by Stalmakova [1974] and Yakovlev [2005]. Recently some papers with special emphasis on gastropod fauna of the northern part of the Kola Peninsula were published [Nekhaev, 2006, 2011; Vinarski *et al.*, 2013b; Nekhaev, Palatov, 2016; Schikov, Nekhaev, 2016]. However, the data presented in these papers are rather fragmentary, and the majority of species records published in them are confirmed neither by shell images nor by voucher specimens deposited in public collections.

This paper aims to provide a faunistic survey of the freshwater gastropod fauna inhabiting the western part of the Kola Peninsula and northern Karelia.

Material and methods

General description of the study area

The region under investigation embraces the western part of the Kola Peninsula and northern Karelia (northeastern Russia) between 66°08' and 69°12'N latitude (Fig. 1). The major part of the study area is located north of the Arctic circle. The climate of the region is relatively warm comparing to other areas located on the same latitudes. Summer mean temperature increases from +8°C in the northern part of the studied region to +11°C in its southern part [Yakovlev, 1961]. The majority of lakes are ice-covered from the middle of October to the middle of May (occasionally to June).

The relief of the Kola Peninsula is largely represented by low rocky mountains (up to 200-300 m) and valleys. There are several relatively high (up to 1200 m) mountain areas in the central part of the peninsula. The relief of northern Karelia is relatively flat. The studied region is located in the northern taiga, while typical tundra communities appear only in the northern part of the Kola Peninsula and on mountain tops (usually upper than 200-300 m).

Typically, waterbodies of the region have sandy, silty, or rocky bottom substrates. The main source of detritus is terrestrial vegetation. Higher aquatic vegetation, which is the main habitat for many species of freshwater molluscs in the more southern regions of Europe [Beryozkina, Starobogatov, 1988; Dillon, 2000], is poorly developed and rarely forms more or less prominent thickets [Volkova, 1974; Rautio *et al.*, 2011].

Abundant, relatively small lakes connected by small streams and rivulets are the main habitat for the freshwater fauna though several giant waterbodies like Imandra Lake (Имандра) and Verkhnetulomskoe reservoir (Верхнетуломское водохранилище) are located in the studied region.

Though there are only a few large cities in the study area (Murmansk is the largest one) and the whole territory is sparsely populated, the environment of the region is undergoing a transformation associated with human activities. The chemical pollution caused by the mining activities in the central part of the Kola Peninsula is one the most prominent negative factors of this [Yakovlev, 2005; Moiseenko *et al.*, 2009]. Also, during the first half of the 20th century, numerous hydroelectric power plants were built, thereby regulating a significant number of waterbodies. Almost all large lakes in the studied region are in fact reservoirs, where the water level is regulated artificially.

The subdivisions of the studied region

Based on geographical position and habitat conditions, the five sampling areas have been delineated within the studied region (see Fig. 1):

The tundra zone (Fig 1, dark green) covers the northernmost part of the studied region, where only zonal (i.e. not mountain) tundra communities are represented. Most samples were collected in the vicinity of Dalnie Zelentsy settlement (Дальние Зеленцы). In addition, several more samples from the coast of the Barents Sea, Kildin (Кильдин) Island and Bolshoy Aynov (Большой Айнов) Island were analyzed.

The Kola Peninsula, the Barents Sea drainage basin (Fig. 1, dark blue)**.** This area is located in the northern part of the Kola Peninsula from the southern border of the tundra southwards to the watershed with the drainage basin of the White Sea. This is the most intensively sampled area, but only relatively small lakes, rivers, and rivulets were studied here (Fig. 2B).

The Tuloma river estuary (Fig. 1, red). This is the estuarine part of the river, inflowing into the

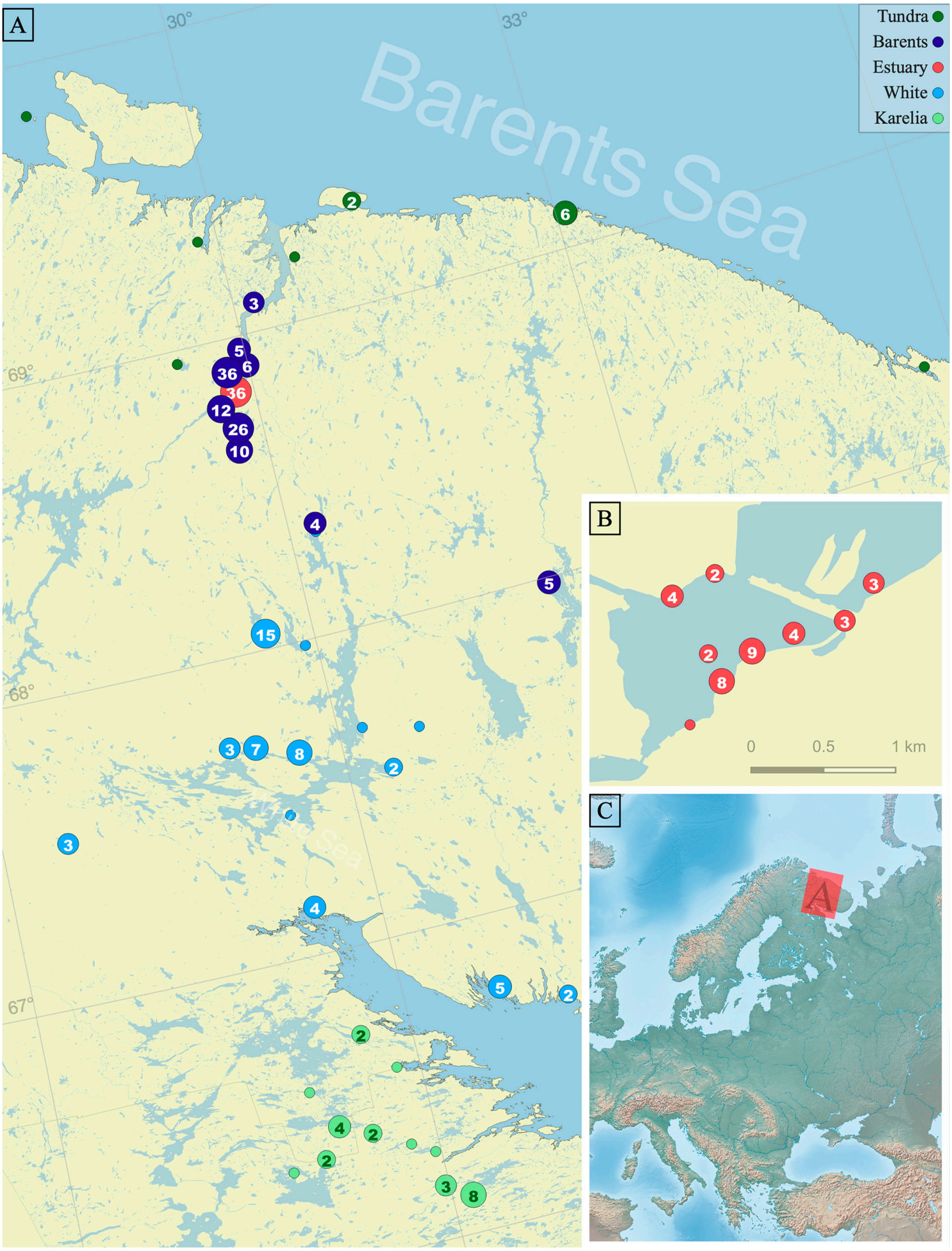

FIG. 1. Map of the studied region. **A.** Location of sampling sites. The different colors correspond to different sampling areas. **B.** Location of sampling sites in the Tuloma River estuary. **C.** General position of the studied region. The numbers within circles correspond to the numbers of samples collected in a group of very close localities.

РИС. 1. Карта изученного региона. **A**. Расположение мест отбора проб. Цветом показаны локации, отнесённые к определённым районам. **B.** Расположение мест отбора проб в эстуарии реки Тулома. **C.** Общее расположение изученного региона. В случае, когда несколько проб было собрано рядом, их общее число указано в кружочке.

Kola Inlet (Barents Sea). I consider it as a separate area due to very peculiar environmental conditions. Though the marine tides (up to 2.5–3 m) occur here twice a day, it cannot be qualified as a brackishwater habitat since salinity typically does not exceed 1-2 ‰ which allows freshwater organisms to live here [Frolov, 2009; Schikov, Nekhaev, 2016]. Freshwater molluscs occur in the tidal zone, which is unusual for this group (Fig. 2C).

The Kola Peninsula, the White Sea drainage basin (Fig. 1, light blue). The sampling area is located south of the Barents Sea drainage basin (approximately along the parallel of 68°08'). The major part of the sampling area lies within the boundaries of the Lapland Nature Reserve. The largest studied lake systems (Imandra (Имандра) (Fig. 2D), Pirenga (Пиренга)) and mountain regions (Knibiny (Хибины), Volchyi Tundry (Вольчьи Тундры) and Monchetundry (Мончетундры) (Fig. 2E)) are located here. Several places from the coast of the White Sea were also sampled.

Northern Karelia (Fig. 1, light green) lies south of the Kola Peninsula and also belongs to the White Sea drainage basin. The area is a hilly plain covered with taiga forests and swamps (Fig. 2F). There are no mountain systems in the area. Several large lakes, i.e. the Tiksheozero (Тикшеозеро) Lake, the Loukhskoe (Лоухское) Lake, the Notozero (Нотозеро) Lake, and several smaller waterbodies around them were sampled in this area.

The map (Fig. 1) and the description above characterize only those areas and samples in which molluscs were found, but the real research effort was larger. The low amount of samples, containing snails, from the tundra zone is explained by the relative rarity of freshwater molluscs there. Freshwater gastropods were not found in lakes of Rybachiy (Рыбачий) (Fig. 2A) and Sredniy (Средний) peninsulas, both are in the Varangerfjorden, the Barents Sea. Similarly, no records of freshwater Gastropoda were made in the mountain lakes and rivulets located higher than 350 m, including Khibiny, Volchyi Tundry, and Monchetundry, in spite of the extensive sampling.

On the other hand, the sampling intensity in the studied large lakes, i.e. lakes Imandra, Lovozero, and Loukhskoe, was very low. Several waterbodies of this type, including the Verkhnetulomskoe (Верхнетуломское) Reservoir, the Umbozero (Умбозеро) Lake, and some others were not studied altogether.

Sample collecting and treatment

The mollusc sampling has been carried out by means of two different strategies. First, large submerged objects (stones, driftwood) on which molluscs can dwell were visually inspected, whereas the soft bottom substrates (sand, sludge) were washed through a net, and the residue after washing was also examined visually in the field. Alternatively, some soft substrates were washed through a net, and the resulting sample was fixed with 4% formalin. These samples were sorted manually in the laboratory with a stereomicroscope. Both sampling methods were used simultaneously in all areas. Since freshwater gastropods are comparatively large, the first method was the most productive, but the second one sometimes yielded rich material, especially in the case of substrates with a large amount of silt and detritus. Molluscs were sampled only in the coastal zones of the waterbodies, shallower than 1 m (usually 0.2–0.4 m).

The total material used for the present study includes more than 2621 specimens from 229 samples.

The identification of snails was performed according to numerous guidebooks [Starobogatov *et al.*, 1989, 2004; Kruglov, Starobogatov, 1991; Prozorova, Starobogatov, 1998; Kruglov, Soldatenko, 2000; Prozorova, 2003; Stadnichenko, 2004; Kruglov, 2005]. Also, some reference collections of the north European freshwater gastropods, including the type series of some taxa, stored in the Göteborg Natural History Museum (Göteborg, Sweden), Swedish Museum of Natural History (Stockholm, Sweden), Zoological Museum of Oslo University (Oslo, Norway), Zoological Museum of Bergen University (Bergen, Norway), Danish Museum of Natural History (Copenhagen, Denmark), and Zoological Institute of the Russian Academy of Sciences (Saint Petersburg, Russia), were examined. In most cases, species were identified by shell characters only; the structure of the reproductive system was studied for the representatives of Lymnaeidae and Physidae. As a rule, the snail taxonomy and nomenclature used in this paper follow that of Vinarski and Kantor [2016]. The primary results of this study are presented as an annotated check-list of species, with additional taxonomical comments given for individual taxa, when appropriate.

All shell measurements were made according to schemes suggested by Starobogatov *et al.* [2004], and Vinarski and Glöer [2009].

Data representing and analyses

In the main text of the paper only general information about records in each area is provided for the most of species. However, the detailed data on the sites of occurrence is given for rare species which have been recorded in the study region less than ten times. Information on the distribution of each species is summarized in distributional maps. In addition, detailed information about all sampling localities for each species is available as Online Supplementary Material.

The photographs of the shells show dried specimens unless otherwise specified.

Maps were made with QGIS ver. 3.4 software. Cluster dendrogram based on Dice similarity distance

FIG. 2. Examples of studied habitats. **A**. Tundra lake on Rybachiy Peninsula, no gastropods were found here. **B**. Shchuchye (Tukhtinskoe) Lake (the Barents Sea drainage), habitat of *Gyraulus acronicus, Gyraulus stroemi* and *Lymnaea stagnalis*. **C**. Tuloma River estuary during low tide, habitat of *Valvata depressa, Gyraulus acronicus*, *Gyraulus stroemi* and *Ampullaceana balthica*. **D**. Imandra Lake (White Sea drainage), habitat of *Ampullaceana balthica*. **E**. Lakes Krasnaya Lambina (right) and Pagel (left) (White Sea drainage area), habitat of *Ampullacena balthica, Gyraulus acronicus* and *Bathyomphalus contortus*. **F**. unnamed lake, northern Karelia, habitat of *Valvata sibirica*.

РИС. 2. Некоторые примеры исследованных биотопов. **A**. Тундровое озеро на полуострове Рыбачий, брюхоногих моллюсков здесь не обнаружено. **B**. Щучье (Тухтинское) озеро (водосборный бассейн Баренцева моря), место обитания *Gyraulus acronicus, Gyraulus stroemi* и *Lymnaea stagnalis*. **C**. Эстуарий реки Тулома во время отлива, место обитания *Valvata depressa, Gyraulus acronicus*, *Gyraulus stroemi* и *Ampullaceana balthica.* **D**. Озеро Имандра (водосборный бассейн Белого моря), место обитания *Ampullaceana balthica*. **E**. Озёра Красная ламбина (справа) и Пагель (слева) (водосборный бассейн Белого моря), места обитания *Ampullacena balthica, Gyraulus acronicus* и *Bathyomphalus contortus*. **F**. Безымянное озеро в северной Карелии, место обитания *Valvata sibirica*.

(also known as Sørensen-Dice or Sørensen index for binary data) [Field *et al.*, 1982] were used to compare the species lists. The expected number of species for each studied area was computed using Chao 2 non-parametric estimator with bias correction [Colwell, Coddington, 1994]. Statistical analyses were performed in PAST ver. 4 [Hammer *et al.*, 2001] and MS Excel.

Abbreviations used

Sampling areas:

Barents – the Kola Peninsula, drainage basin of the Barents Sea (Fig. 1, dark blue);

Tuloma – the Tuloma river estuary (Fig. 1, red);

Tundra – the tundra zone of the Kola Peninsula (Fig. 1, dark green);

N Karelia – northern Karelia (Fig. 1, light green);
White – the Kola Peninsula, drainage basin of the White Sea (Fig. 1, light blue).

Museum acronyms:

GNHM – Göteborg Natural History Museum (Göteborg, Sweden);
ZMO – Zoological museum of Oslo University, Oslo, Norway.

Shell measurements:

AH – aperture height;
AW – aperture width;
BWH_2, – height of the body whorl above aperture;
IWa – inner whorls width measured from apical side;
IWb – inner whorls width measured from basal side;
LWa – last whorl width measured from apical side;
LWb – last whorl width measured from basal side;
LWH – last whorl height;
PWH – height of the penultimate whorl;
PWW – width of the penultimate whorl;
SH – shell height;
SpH – spire height;
SW – shell width.

Results

An annotated checklist of freshwater Gastropoda of the studied region

Subclass Heterobranchia
Grade "Lower Heterobranchia"
Family Valvatidae Gray, 1840
Genus *Valvata* O.F. Müller, 1774

Valvata sibirica Middendorff, 1851 (Figs 3A-B, 4A).

Valvata cristata var. *sibirica* Middendorff, 1851: 299.
Valvata frigida Westerlund, 1873: 436.
Cincinna frigida – Kijashko *et al.*, 2016: 386-387, plate 5, fig. 63.
Valvata sibirica – Welter-Schultes, 2012: 45.

Material studied: Barents: 77 specimens in 30 samples; **White:** 89 specimens in 5 samples; **N Karelia:** 10 specimens in 6 samples.

Habitat. The species is usually found in eutrophic habitats like bogs and detritus-rich zones of lakes.

Remarks. Several authors suggested that the European representatives of *Valvata sibirica* belong to a distinct species, *Valvata frigida* Westerlund, 1873, which can be distinguished from *V. sibirica* by slight differences in shell proportions [Prozorova, Starobogatov, 1998; Kijashko *et al*., 2016]. The preliminary phylogenetic studies [Clewing *et al*., 2014; Saito *et al*., 2018], as well as the examination of the type material of *Valvata frigida* [Vinarski *et al*., 2013a] do not support this separation. So, both forms are considered here as conspecific.

Valvata sibirica is the only species of Valvatidae with almost planispiral shell found during the present study. Several authors also reported *Valvata cristata* O.F. Müller, 1774 and *Valvata macrostoma* Mörch, 1864 from the Kola Peninsula [Stalmakova, 1974; Yakovlev, 2005], however, neither shell images nor descriptions of specimens were provided to support the species identification. Most likely, these records referred to *Valvata sibirica*. The species is characterized by the presence of frequent axial periostracal ribs, while the shell surface of *Valvata cristata* bears only low axial striature [Zhadin, 1952; Kijashko *et al.*, 2016].

Valvata depressa C. Pfeiffer, 1821 (Figs 3 C-E, 4A)

Valvata depressa C. Pfeiffer, 1821: 100, pl 4. fig. 33.
Cincinna depressa – Kijashko *et al.*, 2016: 387, plate 5, fig. 65.

Material studied: Barents: 62 specimens in 5 samples; **Tuloma:** 18 specimens in 9 samples; **White:** 23 specimens in 5 samples.

Habitat. The species lives on sandy and silty substrates, often on leaf litter and dead wood.

Remarks. The name *Valvata depressa* is used for the species conchologically similar to *Valvata piscinalis* (O.F. Müller, 1774). However, shells of *Valvata depressa* have a deep, wide, and rounded umbilicus, while the umbilicus of *Valvata piscinalis* is rather narrow [Starobogatov *et al*., 2004; Kijashko *et al*., 2016]. All studied specimens correspond to *Valvata depressa sensu* Starobogatov *et al.* [2004].

Infraclass Euthyneura
Family Acroloxidae Thiele, 1931
Genus *Acroloxus* Beck, 1838

Acroloxus lacustris (Linnaeus, 1758) (Figs 3F, 4A)

Patella lacustris Linnaeus, 1758: 783.
Acroloxus lacustris – Kruglov, Starobogatov, 1991: 69, fig. 2(1), 3(1); Welter-Schultes, 2012: 46; Kijashko *et al.*, 2016: 391-392, pl. 6, fig. 74.

Material studied: N Karelia: river between Nizhnie Kachany (Нижние Качаны) Lake and Lopskoe (Лопское) Lake, 66°34.3386'N, 32°3.9486'E, 23.07.2009 (1 specimen).

Habitat. The species was found on the rapids of the river on stony bottom with algae.

Family Planorbidae Rafinesque, 1815
Genus *Armiger* Hartmann, 1843

Armiger crista (Linnaeus, 1758) (Figs 3G, 4B)

Nautilus crista Linnaeus, 1758: 709.
Armiger crista – Kijashko *et al.*, 2016: 412, pl. 7, fig. 111;
Gyraulus crista – Welter-Schultes, 2012: 62.

Material studied: White: Trestozero (Трестозеро) Lake, 66°44.1336'N, 33°50.097'E, 21.06.2013 (8 specimens).

FIG. 3. The species of Valvatidae, Acroloxidae and Planorbidae from the Kola Peninsula and northern Karelia. **A, B.** *Valvata sibirica*, Pirenga Lake, 67°42.105'N, 32°4.126'E, 28.08.2012. **C-E.** *Valvata depressa*, Chunozero Lake, 67°41.873'N, 32°17.472'E, 23.08.2012. **F**. *Acroloxus lacustris*, river connecting the Nizhnie Kachany and Lopskoe lakes, 66°34.339'N, 32°3.949'E, 23.07.2009. **G.** *Armiger crista*, Trestozero Lake, 66°44.134'N, 33°50.097'E, 21.06.2013. **H-I.** *Bathyomphalus contortus*; **H**. Vaykis River, 68°3.5148'N, 32°35.033'E, 03.08.2014; **I.** Swamp near Porya Guba village, 66°46.522'N, 33°45.589'E, 20.06.2013; Scale bar = 5 mm.

РИС. 3. Раковины Valvatidae, Acroloxidae и Planorbidae с Кольского полуострова и северной Карелии. **A, B.** *Valvata sibirica*, озеро Пиренга, 67°42.105'N, 32°4.126'E, 28.08.2012; **C-E**. *Valvata depressa*, Чунозеро, 67°41.873'N, 32°17.472'E, 23.08.2012; **F**. *Acroloxus lacustris*, протока между озёрами Нижние Качаны и Лопское, 66°34.339'N, 32°3.949'E, 23.07.2009. **G.** *Armiger crista*, Трестозеро, 66°44.134'N, 33°50.097'E, 21.06.2013. **H-I.** *Bathyomphalus contortus*; **H**. река Вайкис, 68°3.5148'N, 32°35.033'E, 03.08.2014. **I.** Болото рядом с деревней Порья Губа, 66°46.522'N, 33°45.589'E, 20.06.2013; Шкала = 5 мм.

Remarks. Stalmakova [1974] recorded this species from the Senyozero (Сеньозеро) Lake (approximately 66°56'N, 34°52'E) lying relatively close to the locality reported here.

Genus *Bathyomphalus* Agassiz in Charpentier, 1837

Bathyomphalus contortus (Linnaeus, 1758) (Figs 3 H-I, 4B).

Helix contorta Linnaeus, 1758: 770.
Planorbis dispar Westerlund, 1871: 131.
Planorbis contortus f. *labiatus* Westerlund, 1875: 109.
Anisus agardhi Starobogatov *et al*., 2004: 347, pl. 153, figs 4-6.
Anisus agardhi – Nekhaev, 2006: 794-797; Vinarski *et al*., 2013a: 93-94, fig 5G.
Anisus contortus – Zhadin, 1952: 189, fig. 93.
Anisus dispar – Vinarski *et al*., 2013a: 93-94, figs 5 H-I.
Bathyomphalus dispar – Kijashko *et al*., 2016: 425, pl. 8, fig. 123.
Bathyomphalus contortus – Welter-Schultes, 2012: 60; Kijashko *et al*., 2016, pl. 8, fig. 125.

Material studied: Tundra: 1 specimen; **Barents:** 18 specimens in 8 samples; **White:** 30 specimens in 6 samples; **N Karelia:** 17 specimens in 4 samples.

Habitat. This species is usually found in small lakes on detritus, dead wood and vegetation.

Remarks. Russian authors [Prozorova, 2003; Starobogatov *et al*., 2004; Kijashko *et al*., 2016] recognized five species of the genus *Bathyomphalus* in northern Europe on the basis of minor differences in quantitative (morphometric) characters. Apart from the unjustified approach to species delimitation based on slight differences in shell proportions, the morphology of the type specimens [see Vinarski *et al*., 2013a] of at least two species, *Bathyomphalus dispar* (Westerlund, 1871) and *Bathyomphalus agardhi* (Prozorova in Starobogatov, Prozorova, Bogatov et Saenko, 2004), do not correspond to their diagnoses proposed in Russian literature [Vinarski *et al*., 2013a]. E.g. according to Prozorova [2003], the main distinguishing feature for *Bathyomphalus dispar* is that its SH varies from 1.2 to 1.4 mm; whereas this value in *Bathyomphalus agardhi sensu* Prozorova [2003] does not exceed 1.15 mm. However, SH of syntypes of both species exceed 1.5 mm [Vinarski *et al*., 2013a]. Therefore, the broad concept of the species *Bathyomphalus contortus* [Zhadin, 1952; Welter-Schultes, 2012] is accepted here.

Genus *Gyraulus* Agassiz in Charpentier, 1837

In the recent Russian literature, seven European species of *Gyraulus* s. str. (without (sub)genera *Armiger* Hartmann, 1843 and *Choanomphalus* Gerstfeldt, 1859) – *Gyraulus acronicus* (Férussac, 1807), *G. albus* (O.F. Müller, 1774), *G. borealis* (Lovén in Westerlund, 1875), *G. concinnus* (Westerlund, 1881), *G. stroemi* (Westerlund, 1881), *G. draparnaudi* (Sheppard, 1823), and *G. stelmachoetius* (Bourguignat, 1860) have been recognized based on minor differences in the shell sculpture and proportions [Kruglov, Soldatenko, 2000; Prozorova, 2003; Kijashko *et al*., 2016]. Unfortunately, none of the aforementioned authors provided the data on the inter- and intraspecific variability of these traits, which could confirm the correctness of their taxonomic conclusions. In addition, the descriptions of the same species provided by different authors often contradict each other and sometimes are not consistent with the morphology of the type specimens (see comments for each species). In this work, I accept as valid only those species, for which diagnoses based on the study of representative samples and/or type material specimens are available, i.e. *Gyraulus albus*, *Gyraulus acronicus*, and *Gyraulus stroemi* [Meier-Brook, 1983; Glöer, Vinarski, 2009; Welter-Schultes, 2012]; the rest of the aforementioned species names considered here as synonyms. I also provide morphometric characteristics for several *Gyraulus* populations (Table 1) to make my data more comparable with identifications by Russian malacologists.

Gyraulus albus (O.F. Müller, 1774) (Figs 4B, 5 A-C, Table 1)

Planorbis albus O.F. Müller, 1774: 164.
Helix draparnaudi Sheppard, 1823: 158-159.
Gyraulus albus – Meier-Brook, 1983: 27-34, figs 35-45; Welter-Schultes, 2012: 61; Kijashko *et al*., 2016: 430, pl. 8, fig. 130.
Anisus albus – Kruglov, Soldatenko, 2000: 114-115, figs 2A, 3A, 4A, 4B.
Anisus draparnaldi – Kruglov, Soldatenko, 2000: 115, figs 2B, 3B, 4C, 4D.
Planorbis albus – Nekhaev *et al*., 2015: 56-59, figs 11-12.

Material studied: Barents: Kolozero (Колозеро) Lake, 68°20.0622'N, 33°13.9566'E, 10.06.2012 (91 specimens).

Habitat. A large population of *Gyraulus albus* was found near the outflow of a small river from Lake Kolozero; the snails were living on sand, silt, dead plants and water horsetails.

Remarks. The species can be distinguished from *Gyraulus acronicus* and *Gyraulus stroemi* by the presence of evident spiral sculpture (see also remarks to the former species). Kruglov and Soldatenko [2000] suggested that one more species of the genus with strong spiral sculpture and lacking periostracal keel, *Gyraulus draparnaudi* (Sheppard, 1823), occurs in Europe. The authors proposed to use the ratio between the inner whorls diameter of spire and the last whorl width as a diagnostic character for *Gyraulus albus*. In the lectotype shell of *Gyraulus albus,* this ratio is equal to 1.57 [Nekhaev *et al*., 2015], which corresponds to *Gyraulus draparnaudi sensu* Kruglov and Soldatenko [2000]. Similar values of this character were observed in the studied population of *Gyraulus albus* from Kolozero Lake.

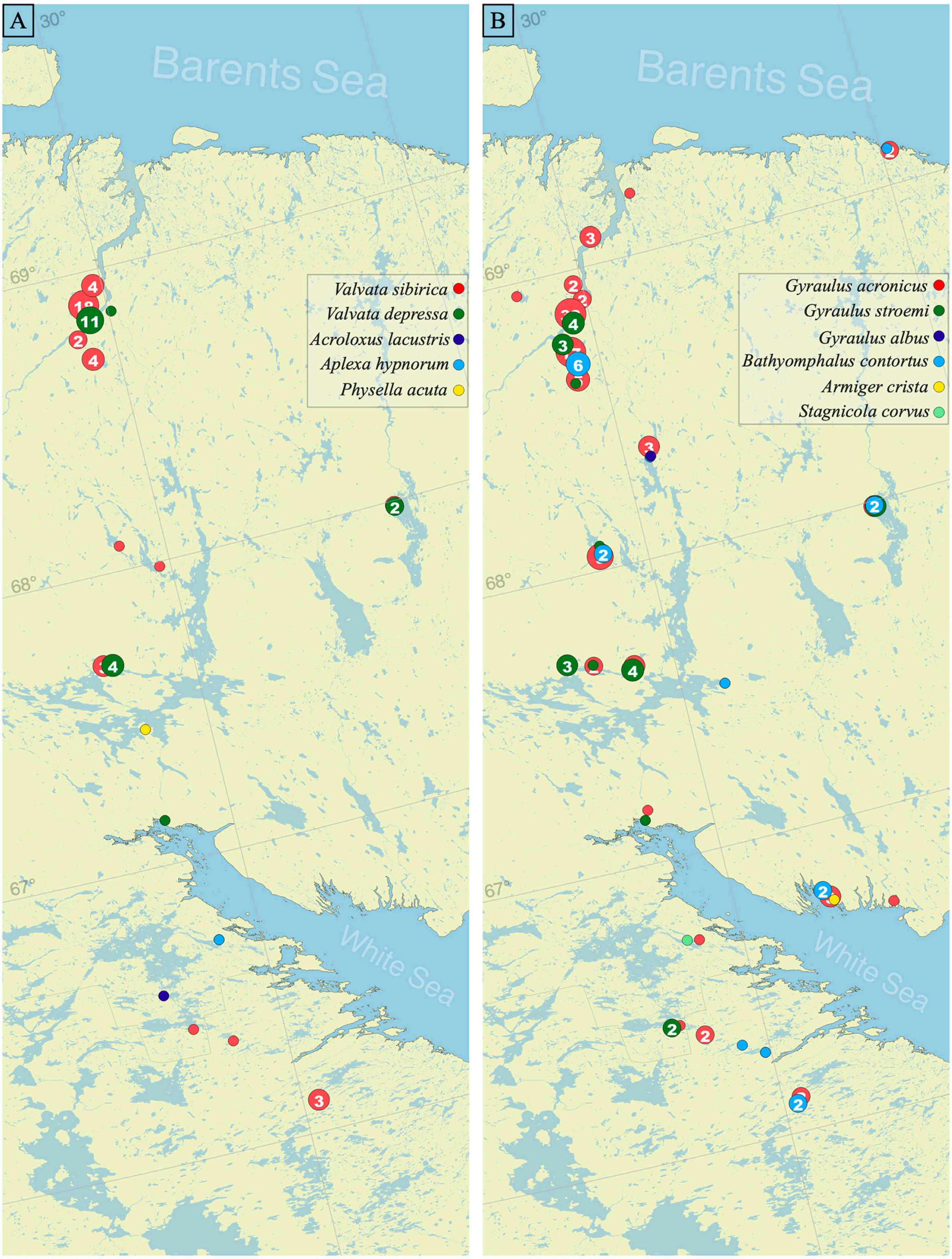

FIG. 4. Localities of some freshwater gastropod species on the Kola Peninsula and northern Karelia. **A.** *Valvata sibirica, Valvata depressa, Acroloxus lacustris, Aplexa hypnorum* and *Physa acuta.* **B.** *Gyraulus acronicus, Gyraulus stroemi, Gyraulus albus, Bathyomphalus contortus, Armiger crista* and *Stagnicola corvus.* If several samples were collected in very close localities, then the number of samples is indicated in a circle.

РИС. 4. Места находок некоторых видов брюхоногих моллюсков на Кольском полуострове и в северной Карелии. **A.** *Valvata sibirica, Valvata depressa, Acroloxus lacustris, Aplexa hypnorum* и *Physella acuta.* **B.** *Gyraulus acronicus, Gyraulus stroemi, Gyraulus albus, Bathyomphalus contortus, Armiger crista* и *Stagnicola corvus.* В случае, когда несколько проб было собрано рядом, их общее число указано в кружочке.

Table 1. Shell measurements (in mm) and proportions of *Gyraulus* species from the Kola Peninsula.

Таблица 1. Промеры (в мм) и пропорции раковин видов рода *Gyraulus* с Кольского полуострова.

	S	LWa	IWa	LWb	IWb	SH	AW	IWa/LWa	IWb/LWb	S/SH
					Gyraulus albus, n=34					
				Kolozero Lake, 68°20.0622’N, 33°13.9566’E, 10.06.2012 (Barents)						
Av	3.4	1.09	1.49	1.35	1.12	1.5	1.3	1.36	0.8	2.3
σ	0.5	0.17	0.29	0.2	0.24	0.1	0.2	0.17	0.1	0.3
Min	2.1	0.78	0.75	0.9	0.56	1.3	0.9	0.95	0.6	1.5
Max	4.5	1.38	2.05	1.72	1.68	1.9	1.7	1.68	1.1	2.9
					Gyraulus acronicus, n=35					
				Smal lake near Vaykis River, 68°1.53’N, 32°38.834’E, 04.08.2014 (White)						
Av	2.9	0.95	1.29	1.11	1.06	1	1.1	1.39	1	2.8
σ	0.3	0.14	0.19	0.13	0.14	0.1	0.1	0.38	0.1	0.3
Min	2.2	0.45	0.9	0.86	0.82	0.8	0.8	1.04	0.7	2.2
Max	3.5	1.16	1.64	1.34	1.38	1.3	1.3	3.33	1.4	3.7
					Gyraulus acronicus, n=34					
				Vaykis River, 68°2.467’N, 32°28.644’E, 05.08.2014 (White)						
Av	1.9	0.64	0.82	0.7	0.71	0.8	0.7	1.28	1	2.5
σ	0.2	0.06	0.11	0.08	0.1	0.1	0.1	0.17	0.2	0.3
Min	1.7	0.49	0.63	0.56	0.45	0.5	0.6	0.95	0.6	1.9
Max	2.4	0.78	1.04	0.93	0.93	1.3	0.9	1.62	1.3	3.5
					Gyraulus acronicus, n=25					
				rivulet near Vaykis River, 68°3.565’N, 32°34.906’E, 03.08.2014 (White)						
Av	4.2	1.28	1.85	1.56	1.54	1.5	1.4	1.47	1	2.7
σ	0.5	0.16	0.36	0.25	0.19	0.2	0.3	0.29	0.1	0.3
Min	3.4	0.9	1	1.2	1.25	1	1	0.69	0.8	2.3
Max	5.5	1.6	2.85	2.2	2	2	2	1.95	1.3	4
					Gyraulus stroemi, n=8					
				Lebyazhye Lake, 68°4.907’N, 32°35.592’E, 08.08.2014 (White)						
Av	3.6	1.04	1.65	1.32	1.37	1.2	1.2	1.6	1	3.1
σ	1	0.08	0.36	0.19	0.3	0.2	0.1	0.4	0.2	0.5
Min	2.2	0.9	1.12	1.12	1.01	1	1	1.11	0.8	2.2
Max	4.9	1.12	2.05	1.68	1.87	1.4	1.3	2.08	1.2	3.7

Av. – average value, σ – standard deviation, Min. and Max. – minimal and maximal values respectively.

Av. – среднее значение, σ – стандартное отклонение, Min. и Max. – минимальные и максимальные лимиты соответственно

Gyraulus albus can be distinguished from *G. acronicus* by the presence of strong spiral sculpture, often evident for a naked eye. The specimens of *Gyraulus. albus* studied by me had relatively thick periostracum visible on dried shells (Fig. 5 C-C’).

Stalmakova [1974] also reported this snail from the lakes Kitenyavr (Китеньявр), approximately 68°54’N, 34°12’E (the Barents Sea drainage basin), Seydozero (Сейдозеро), approximately 67°48’N, 34°54’E, and Senyozero (Сеньозеро), approximately 66°56’N, 34°52’E (the Barents Sea drainage basin).

Gyraulus acronicus (Férussac, 1807) (Figs 4B, 5 D-F, 6 D-F, Table 1)

Planorbis acronicus Férussac, 1807: 105.

Planorbis borealis Westerlund, 1875: 112-113, pl. 2, figs 23-25.

Planorbis concinnus Westerlund, 1881: 63.

Anisus borealis – Nekhaev, 2006: 794-797, fig. 1; Vinarski *et al.*, 2013a: 94-96. fig. 6, C, F.

Anisus concinnus – Kruglov, Soldatenko, 2000: 116-117, figs 2C, 3C, 4E, 4F; Vinarski *et al.*, 2013a: 97, fig. 7A.

Gyraulus acronicus – Meier-Brook, 1983: 45-46, figs 61-64; Welter-Schultes, 2012: 61; Kijashko *et al.*, 2016: 430, fig. 131.

Gyraulus borealis – Kijashko *et al.*, 2016: 430, plate 8, fig. 133.

Material studied: Tundra: 4 specimens in 4 samples; **Barents:** 165 specimens in 51 samples; **Tuloma:** 77 specimens in 22 samples; **White:** 336 specimens in 21 samples; **N Karelia:** 30 specimens in 5 samples.

Habitat. The species was found in almost all types of studied habitats, excluding temporary waterbodies and swamps [Nekhaev, 2006]. Usually, it lives in lakes on stones and dead wood. In the tundra zone, it was found in rivulets under the submerged stones.

Remarks. Two more nominal species of *Gyrau-*

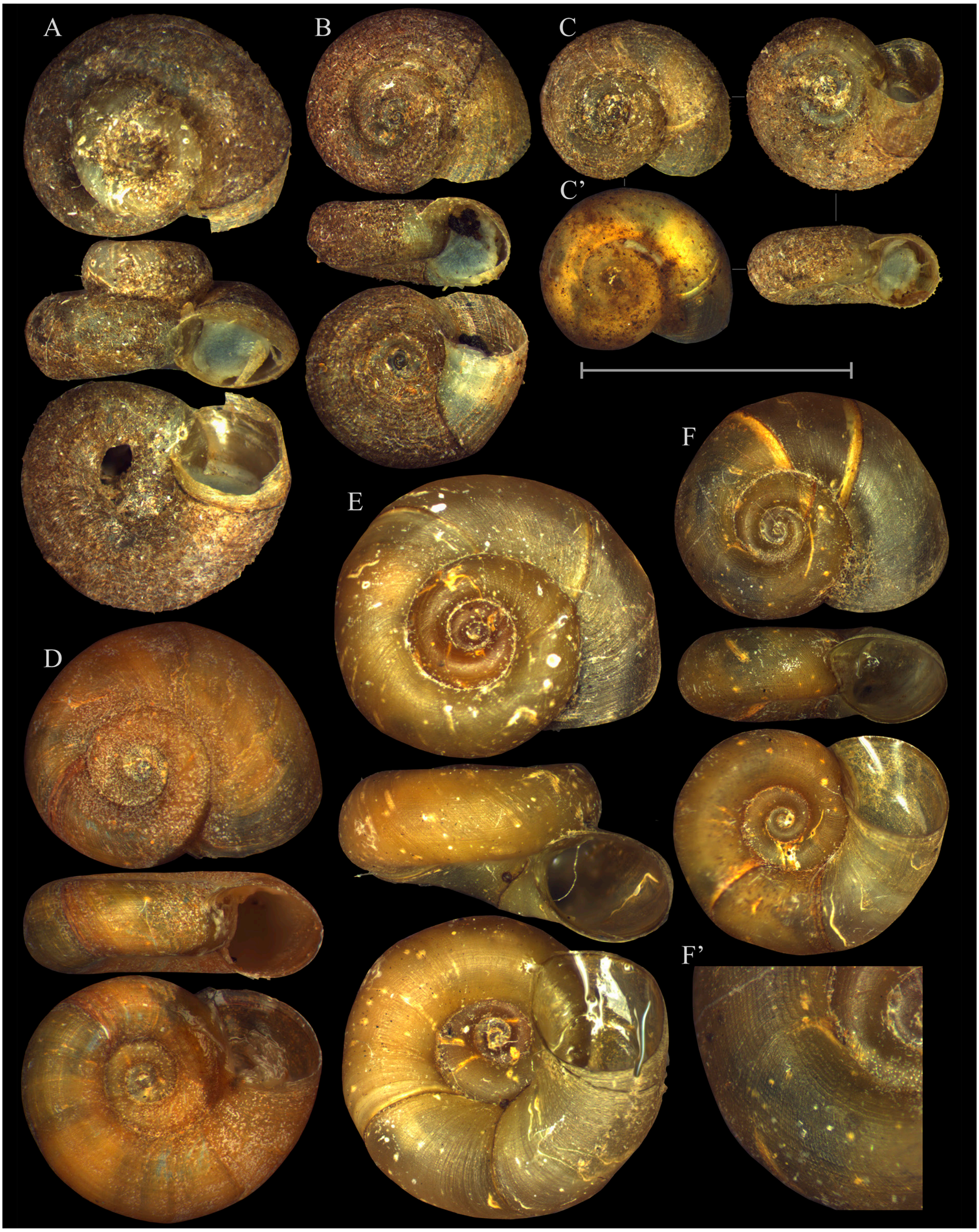

FIG. 5. Shells of *Gyraulus* spp. from the Kola Peninsula and northern Karelia. **A-C.** *Gyraulus albus*, Kolozero Lake, 68°20.062'N, 33°13.957'E, 10.06.2012; **A.** aberrant shell**; C'** – the same specimen with **C** photographed in ethanol. **D-F.** *Gyraulus borealis*; **D**. unnamed lake near Kovda railway station, 66°42.866'N, 32°38.102'E, 27.07.2009; **E, F.** Small lake near Vaykis River, 68°1.531'N, 32°38.834'E, 04.08.2014; **F'** magnified from **F.** Scale bar = 5 mm.

РИС. 5. Раковины *Gyraulus* spp. с Кольского полуострова и из северной Карелии. **A-C.** *Gyraulus albus*, Колозеро, 68°20.062'N, 33°13.957'E, 10.06.2012; **A**. Дефективная раковина; **C'**. тот же экземпляр, что и на картинке **C,** сфотографированный в этаноле. **D-F.** *Gyraulus borealis*; **D.** Безымянное озеро рядом со станцией Ковда, 66°42.866'N, 32°38.102'E, 27.07.2009; **E-F.** Небольшое озеро рядом с рекой Вайкис, 68°1.531'N, 32°38.834'E, 04.08.2014; **F'** – увеличено с **F**. Шкала = 5 мм.

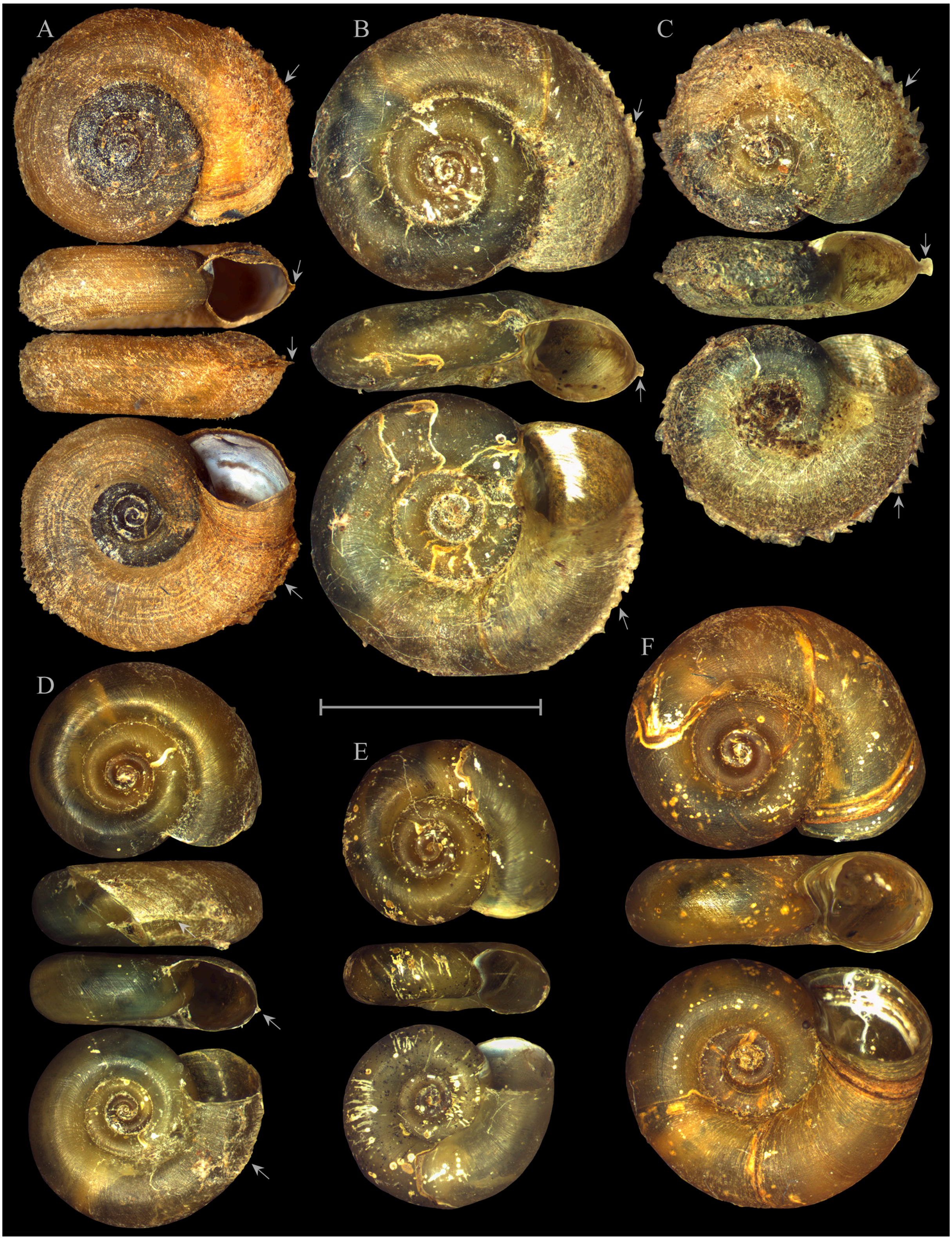

FIG. 6. Shells of *Gyraulus* spp. from the Kola Peninsula and northern Karelia. **A-C.** *Gyraulus stroemi*; **A.** Unnamed lake on the lower part of the Niva river, 67°8.9333′N, 32°25.3167′E, 23.08.2020. **B-C.** Lebyazhye Lake, 68°4.907’N, 32°35.592’E, 08.08.2014. **D-F.** *Gyraulus borealis*; **D, E.** Rivulet near Vaykis River, 68°3.566’N, 32°34.906’E, 03.08.2014; **F.** Small lake near Vaykis River, 68°1.531’N, 32°38.834’E, 04.08.2014. White arrows indicate position of periostracal keel. Scale bar = 5 mm.

РИС. 6. Раковины *Gyraulus* spp. с Кольского полуострова и северной Карелии. **A-C.** *Gyraulus stroemi*; **A**. Безымянное озеро в нижнем течении реки Нива, 67°8.9333′N, 32°25.3167′E, 23.08.2020; **B-C.** Озеро Лебяжье, 68°4.907’N, 32°35.592’E, 08.08.2014. **D-F.** *Gyraulus borealis*; **D, E.** Ручей рядом с рекой Вайкис, 68°3.566’N, 32°34.906’E, 03.08.2014; Небольшое озеро рядом с рекой Вайкис, 68°1.531’N, 32°38.834’E, 04.08.2014. Белыми стрелочками показана позиция периостракального киля. Шкала = 5 мм.

lus (e.g., *Gyraulus borealis* and *Gyraulus concinnus*) accepted in the Russian literature, are considered here as synonyms of *Gyraulus acronicus*.

According to Prozorova [2003], *Gyraulus borealis* differs from *Gyraulus acronicus* by the absolute shell size (SW at 4 whorls is lesser than 4.5 mm in *G. acronicus* and exceeds 4.5 mm in *Gyraulus borealis*) and by the presence of "traces of spiral striature" on the shell surface, which is absent in *Gyraulus acronicus*. Both species lack a periostracal keel on the shell periphery [Prozorova, 2003]. On the other hand Kijashko *et al.* [2016] stated that *Gyraulus borealis* lacks both shell sculpture and periostracal keel, but *Gyraulus acronicus* has evident spiral striature, and sometimes a low keel can be present on the shells of this species. The neotype of *Planorbis borealis* has a weak spiral striature and no apparent keel [Vinarski *et al.*, 2013a].

Almost all studied specimens of *Gyraulus acronicus* from the Kola Peninsula and northern Karelia have a weak spiral striature, often noticeable only on dried specimens under a stereomicroscope (Fig. 5F'). The intensity of the striature can be different on different parts of the same shell. Also, a weak periostracal keel was often observed on shells of this species (often keeled individuals were found in the same sample than shells without a keel – Fig. 6 D-E). These observations are in good agreement with the observations on *Gyraulus acronicus* published by Meier-Brook [1983].

Gyraulus concinnus was accepted as a valid species by Prozorova [2003], who listed as its diagnostic features the presence of the spiral sculpture and the values of the ratio between the diameter of inner whorls and the last whorl width exceeding 1.7. An examination of the type specimens of *Planorbis concinnus* demonstrated that in these shells this ratio varies from 1.35 to 1.67 [Vinarski *et al.*, 2013a] and never reaches 1.7. The spiral sculpture on the lectotype shell [Vinarski *et al.*, 2013a] is very low and corresponds to that observed in *Gyraulus acronicus*.

Stalmakova [1974] reported *Gyraulus gredleri* (Bielz in Gredler, 1859) from the Kola Peninsula. It is currently accepted that all published records of this species from Russian waterbodies belong to *Gyraulus acronicus sensu lato* [Prozorova, 2003; Vinarski, Kantor, 2016].

Gyraulus stroemi (Westerlund, 1881) (Figs 4B, 6 A-C, Table 1)

Planorbis strömi Westerlund, 1881: 380.
Anisus stroemi – Kruglov, Soldatenko, 2000: 119-115, figs 2E, 3E; Glöer, Vinarski, 2009: 718-723, figs 1, 3; Vinarski *et al.*, 2013a: 98. fig. 7D.
Gyraulus stroemi – Kijashko *et al.*, 2016: 430, pl. 8, fig. 132.
Gyraulus stromi – Welter-Schultes, 2012: 65 (misspelling).

Material studied: Barents: 13 specimens in 8 samples; **Tuloma:** 22 specimens in 4 samples; **White:** 75 specimens in 10 samples; **N Karelia:** 10 specimens in 4 samples.

Habitat. Lives on sandy substrates with silt and detritus, usually in large lakes.

Remarks. The species can be distinguished from *Gyraulus acronicus* by the presence of a wide and fringed periostracal keel, which is absent or poorly developed in *G. acronicus*. Glöer and Vinarski [2009] also reported differences in shell size between both species. Shells of *G. stroemi* often have a spiral sculpture. The pattern of variability of this trait is approximately the same as in *G. acronicus*: each large sample contains individuals with and without well-developed spiral striature. At the same time, it is impossible to distinguish discrete forms on this basis in the material seen. Fig. 6 demonstrates shells with extreme forms of variability in the spiral sculpture (Fig. 6A – strongly developed, Fig. 6B – almost absent).

Family Physidae Fitzinger, 1833
Genus *Aplexa* Fleming, 1820

Aplexa hypnorum (Linnaeus, 1758) (Figs 4A, 7L)

Bulla hypnorum Linnaeus, 1758: 727.
Aplexa hypnorum – Welter-Schultes, 2012: 57; Kijashko *et al.*, 2016: 396, pl. 6, fig. 75.
Aplexa sp. – Vinarski *et al.,* 2013b: fig. 1B.

Material studied: N Karelia: unnamed lake near Kovda (Ковда) railway station, 66°42.8664'N, 32°38.1024'E, 27.07.2009 (1 specimen).

Habitat. A single specimen of this species was found in small lake on bottom with peat and detritus.

Genus *Physella* Haldeman, 1842

Physella acuta (Draparnaud, 1805) (Figs 4A, 7K)

Physa acuta Draparnaud, 1805: 55, pl. 3, figs 10-11.
Costatella acuta – Kijashko *et al.*, 2016: 393, pl. 6, fig. 77.
Physa acuta – Welter-Schultes, 2012: 56.
Physella acuta – Nekhaev, Palatov, 2016: 352-354, figs 1, 3.

Material studied: White: Molochnaya Bay (Молочная губа), Babinskaya Imandra (Бабинская Имандра) Lake, 67°27.7217'N, 32°26.39667'E, 03.08.2015 (20 specimens).

Habitat. The species was found in the cooling spillway of the Kolskaya Nuclear Power Plant [Nekhaev, Palatov, 2016]. This habitat is strongly influenced by thermal pollution; the temperature in the spillway is throughout a year higher than 10°C. The molluscs live on stones covered with moss.

Remarks. The species is a global invader of North American origin [Vinarski, 2017]. The record of *Physella acuta* in the Molochnaya bay of the Imandra Lake remains the only reliable case of invasion of a freshwater mollusc species in the waterbodies lying north of the Arctic circle [Vinarski *et al.*, 2020].

FIG. 7. Lymnaeidae and Physidae from the Kola Peninsula and northern Karelia. **A-C.** Juveniles of *Lymnaea stagnalis*, Shchuchye (Tukhtinskoe) Lake, 68°39.349’N, 032°44.253’E, 27.05.2012. **D-E.** *Galba truncatula*; **D.** Vicinity of Kandalaksha, a small stream near Krestovaya mountain, 67°7.1167’ N, 32°29.667’E, 21.07.2009; **E.** Kildin Island, Chernaya River, 69°19.366’N, 34°16.51667’E, 15.06.2019. **F-G.** *Stagnicola palustris* from the “dwarf population”, the Tuloma River estuary, 68°49.415’N, 32°49.618’E, 17.06.2012; **F.** Specimen of the normal size; **G.** Juvenile individual. **H-I.** Juveniles of *Ampullaceana balthica*, Semyonovskoe Lake, 68°59.487’N, 33°5.731’E. **J.** *Myxas glutinosa*, Kola River, near Molochnyi settlement, 68°51.123’N, 33°1.635’E, 22.04.2012, photographed in ethanol. **K**. *Physella acuta*, Babinskaya Imandra Lake, 67°27.722’N, 32°26.397’E, 03.08.2015. **L**. *Aplexa hypnorum,* unnamed lake near Kovda railway station, 66°42.866’N, 32°38.102’E, 27.07.2009. Scale bar = 5 mm.

Family Lymnaeidae Rafinesque, 1815
Genus *Ampullaceana* Servain, 1882

Ampullaceana balthica (Linnaeus, 1758) (Figs 7 H-I, 8, 9, 10 E-I).

Helix balthica Linnaeus, 1758: 775.
Limneus ovatus Draparnaud, 1805: 50, pl. 2.
Gulnaria ovata var. *colletti* Hoyer in Esmark et Hoyer, 1886: 111, Tab. 4, fig. 28.
Limnaea ovata var. *raboti* Westerlund, 1894: 197.
Lymnaea balthica – Kruglov, Starobogatov, 1983: 1468, fig. 2 (11); Kruglov, 2005: 339-342, figs 223, 228, 229; Kijashko *et al.*, 2016: 412, pl. 7, fig. 106.
Lymnaea ovata – Kruglov, Starobogatov, 1983: 1468, fig. 2 (10); Kruglov, 2005: 342-344, figs 223, 231, 232; Kijashko *et al.*, 2016: 412, pl. 7, fig. 105.
Radix balthica – Welter-Schultes, 2012: 52.

Material studied: Tundra: 15 specimens in 6 samples; **Barents:** 149 specimens in 34 samples; **Tuloma:** 55 specimens in 19 samples; **White:** 808 specimens in 26 samples; **N Karelia:** 26 specimens in 9 samples.

Habitat. The species was found in almost all types of studied habitats except temporary waterbodies and swamps. Typically, it can be found in lakes on stones and dead wood. The only species of snails found in large lakes on the shores exposed to wave activity.

Remarks. *Ampullaceana balthica* is one of the most widespread and variable freshwater gastropod species in the studied region. Based on slight differences in shell morphology, some authors recognized a series of species closely related to *Ampullaceana balthica* s. str. [Kruglov, Starobogatov, 1983; Stadnichenko, 2004; Starobogatov *et al.*, 2004; Kruglov, 2005], but the validity of many of them lacks the molecular and/or morphological support [Schniebs *et al.*, 2011; Bolotov *et al.*, 2017; Aksenova *et al.*, 2018].

Hoyer suggested that some of the north Scandinavian specimens of this species must be separated as a variety of their own for which he introduced the name *Gulnaria ovata* var. *colletti* with the type locality situated at “Laxelv in Porsaner” (Finmarken) [Esmark, Hoyer, 1886]. Its type series consists of five shells (three of them are notably damaged) and stored in ZMO under accession number D2398 (Fig. 9 G-H). Westerlund [1894] described *Limnaea ovata* var. *raboti* from the northern part of the Kola Peninsula and East Finmarken. I found only a single syntype of this variety collected from the Tuloma river (GNHM, without an accession number; see Fig. 9C). Both *Gulnaria ovata* var. *colletti* and *Limnaea ovata* var. *raboti* are considered here as junior synonyms of *Ampullaceana balthica.*

Schileyko [1967] recorded *Peregriana peregra* (O.F. Müller, 1774) from the drainage area of the White Sea, without giving a precise locality. I suggest that his record is based on a misidentification of *Ampullaceana balthica* as the latter species can be confused with *Peregriana peregra* if conchological diagnostic characters suggested by Zhadin [1952] are used. According to the current knowledge, *Peregriana peregra* can be distinguished from *Ampullaceana* spp. only with the use of molecular characters [Aksenova *et al.*, 2018].

Nekhaev [2010] reported several other species of radicine Lymnaeidae from the Kola Peninsula (e.g. *Ampullaceana fontinalis* (Studer, 1820), *Ampullaceana intermedia* (Lamarck, 1805), *Peregriana carelica* (Kruglov et Starobogatov, 1983), *Peregriana mucronata* (Held, 1836), *Peregriana tumida* (Held, 1836)). A subsequent revision of the material on which these findings were based showed that they are *Ampulaceana balthica sensu lato*.

Genus *Lymnaea* Lamarck, 1799

Lymnaea stagnalis (Linnaeus, 1758) (Figs 7 A-C, 8, 10 J-K, 11 A-D)

Helix stagnalis Linnaeus, 1758: 774.
Helix fragilis Linnaeus, 1758: 774.
Limnaea doriana Bourguignat, 1862: 60.
Limnaea stagnalis var. *bodamica* Miller, 1873: 4, pl. 1, fig. 2.
Limnaea stagnalis var. *media* Kobelt, 1877: 35, pl. 128.
Lymnaea stagnalis – Davydov *et al.*, 1981: 1326, figs 1 (3, 4), 2(2), 3 (4-6); Kruglov, 2005: 163-166, fig. 58, 61-62; Welter-Schultes, 2012: 50; Kijashko *et al.*, 2016: 403, pl. 6, fig. 87.
Lymnaea fragilis – Davydov *et al.*, 1981: 1326, figs 1(1, 2), 2(1), 3 (1-3); Kruglov, 2005: 162-163, fig. 58, 59, 60; Kijashko *et al.*, 2016: 403, pl. 6, fig. 86.
Limnaea doriana – Davydov *et al.*, 1981: 1326, figs 1(6); Kruglov, 2005: 167-168, figs 58, 64, 65; Sitnikova *et al.*, 2012: 97-98, fig. 3. J-L; Kijashko *et al.*, 2016: 404, pl. 6, fig. 88.
Lymnaea bodamica – Davydov *et al.*, 1981: 1326, figs 1(7); Kruglov, 2005: 171-172: 68, 69-70.

FIG. 7 (на предыдущей странице). Lymnaeidae и Physidae с Кольского полуострова и из Северной Карелии. **A-C.** Ювенильные особи *Lymnaea stagnalis*, озеол Щучье (Тухтинкое), 68°39.349’N, 032°44.253’E, 27.05.2012. **D-E.** *Galba truncatula*; **D.** Окрестности Кандалакши, небольщой ручей рядом с горой Крестовая, 67°7.1167’ N, 32°29.667’E, 21.07.2009; **E.** Остров Кильдин, река Чёрная, 69°19.366’N, 34°16.51667’E, 15.06.2019. **F-G.** *Stagnicola palustris* из «карликовой популяции», эстуарий Туломы, 68°49.415’N, 32°49.618’E, 17.06.2012; **F.** Экземпляр нормального, для популяции размера; **G.** Ювенильный экземпляр. **H-I.** Ювенильные особи *Ampullaceana balthica*, Семёновское озеро, 68°59.487’N, 33°5.731’E. **J.** *Myxas glutinosa*, река Кола, рядом с посёлком Молочный, 68°51.123’N, 33°1.635’E, 22.04.2012, фото сделано в этаноле. **K**. *Physella acuta*, Бабинская Имандра, 67°27.722’N, 32°26.397’E, 03.08.2015. **L**. *Aplexa hypnorum,* безымянное озеро рядом с железнодорожной станцией Ковда, 66°42.866’N, 32°38.102’E, 27.07.2009. Scale bar = 5 mm.

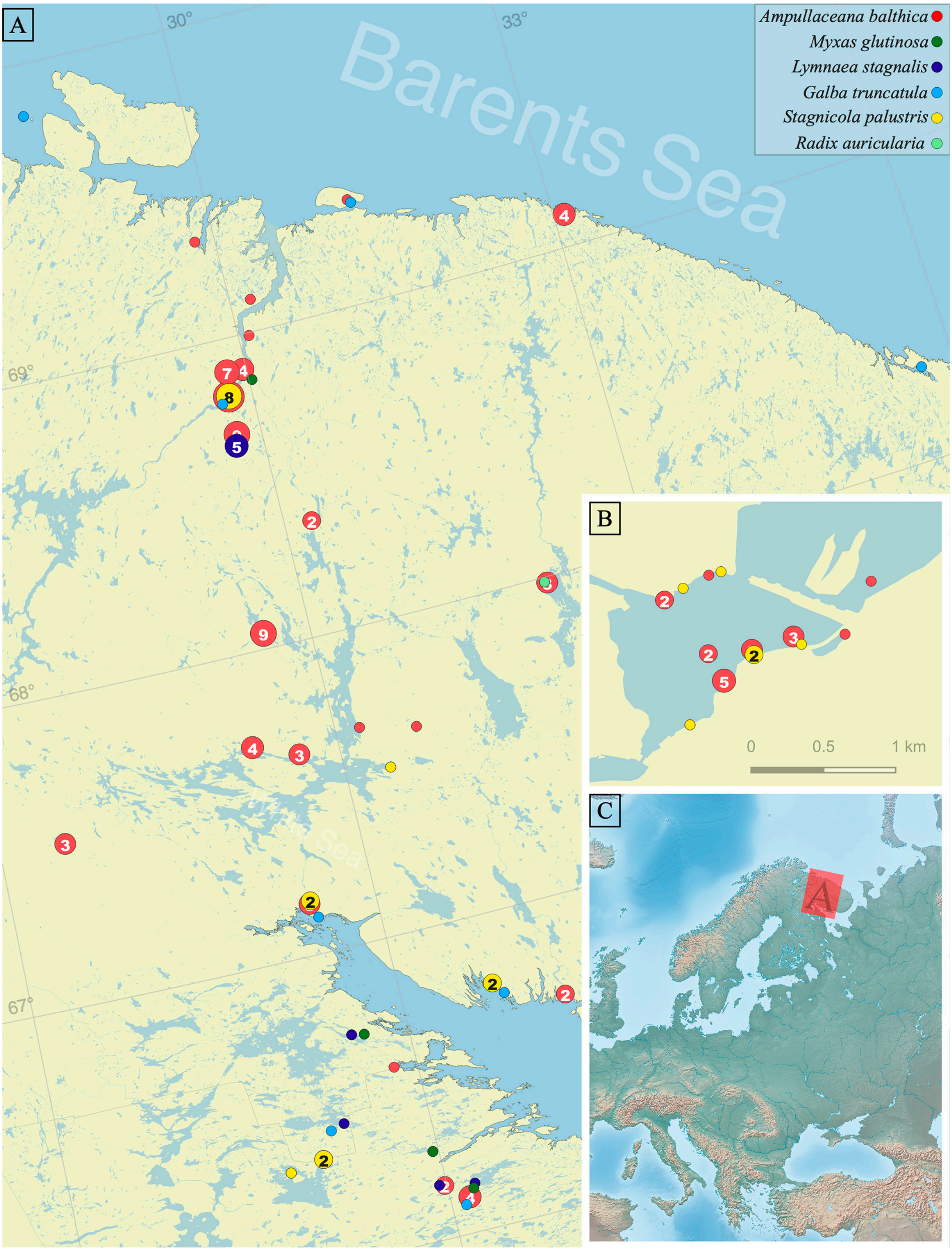

FIG. 8. Localities of the Lymnaeidae species of the Kola Peninsula and northern Karelia. **A.** general map. **B.** Tuloma River estuary. **C.** General position of the studied region. If several samples were collected from very close localities, then the number of samples is indicated in a circle.

РИС. 8. Места находок видов Lymnaeidae на Кольском полуострове и в северной Карелии. **А.** Общая карта. **B.** Эстуарий Туломы. **C.** Общее расположение изученного региона. В случае, когда несколько проб было собрано рядом, их общее число указано в кружочке.

Material studied: Barents: 84 specimens in 5 samples; **White:** 3 specimens in 1 sample; **N Karelia:** 34 specimens in 7 samples.

Habitat. Found in lakes, usually on stones.

Remarks. *Lymnaea stagnalis* is considered by the majority of the authors as a very variable species [Zhadin, 1952; Jackiewicz, 1993; Welter-Schultes, 2012]. Some authors [Davydov *et al.*, 1981; Kruglov, Starobogatov, 1985a; Kruglov, 2005] suggested that *Lymnaea stagnalis sensu lato* in Europe is a complex of several species. However, this assumption was not supported by genetic data [Mezhzherin *et al.*, 2008; Vinarski *et al.*, 2014]. On the other hand, a pair of conchologically identical species can be recognized in the northern Palearctic with the use of molecular tools; one of two inhabits the major part of Europe, while the other was found in Siberia, North America, and some localities of eastern Europe [Mezhzherin *et al.*, 2008; Vinarski *et al.*, 2014]. It should be noted that specimens from the drainage area of the Barents Sea reported here [e.g. from Stschuthcye (Щучье, 68°22.02', 33°14.29') and Domashnee (Домашнее, 68°40.77', 32°50.04') lakes] are belonging to the Siberian species, while studied specimens from the southern Karelia (not included in this study) are representatives of the European one (unpublished observations).

Davydov *et al.* [1981] reported *Lymnaea doriana* (Bourguignat, 1862) and *Lymnaea media* (Kobelt, 1877) (both are considered here as intraspecific conchological forms of *Lymnaea stagnalis*) from the Kanozero (Канозеро) Lake approximately at 67°02'N, 34°08'E. Schileyko [1967] described the variability of *Lymnaea stagnalis* in several localities belonging to the drainage area of the White Sea.

Genus *Myxas* G.W. Sowerby I, 1822

Myxas glutinosa (O.F. Müller, 1774) (Fig. 7J, 8)

Buccinum glutinosum O.F. Müller, 1774: 129.
Lymnaea glutinosa – Kruglov, Starobogatov, 1985b: 73-74, figs 1(2), 2(2); Kruglov, 2005: 376-377, figs 265(2), 267-268; Kijashko *et al.*, 2016: 401, pl. 6, fig. 84.
Myxas glutionosa – Welter-Schultes, 2012: 50.

Material studied: Barents: the Kola (Кола) River, near Molochniy (Молочный) village, 68°51.1236'N, 33°1.635'E, 22.04.2012 (1 specimen); **N Karelia:** an unnamed lake near Kovda (Ковда) railway station, 66°42.8664'N, 32°38.1024'E, 27.07.2009 (5 specimens); Loukhskoe (Лоухское) Lake, 66°08.586N, 33°12.194E, 14.06.2007 (1 specimen); Nizhnee Kotozero (Нижнее Котозеро) Lake, 66°17.4348'N, 32°57.18'E, 14.07.2009 (1 specimen).

Habitat. Individuals of this species were found at dead wood and water plants.

Genus *Stagnicola* Leach in Jeffreys, 1830

Stagnicola palustris (O.F. Müller, 1774) (Fig. 7 F-G, 8, 11 E-G)

Buccinum palustre O.F. Müller, 1774: 131.
Lymnaea palustris – Kruglov, 2005: 202-204, figs 92 (2), 94, 95; Kijashko *et al.*, 2016: 408-409, pl. 6, fig. 94.
Stagnicola palustris – Welter-Schultes, 2012: 55.

Material studied: Barents: 3 specimens in 2 samples; **Tuloma:** 46 specimens in 6 samples; **White:** 53 specimens in 5 samples; **N Karelia:** 19 specimens in 3 samples.

Habitat. Found in large and medium-sized lakes and rivers. Usually lives on stones and dead wood. In the Tuloma river estuary, *Stagnicola palustris* was found on the upper littoral under the stones and mosses.

Remarks. Specimens of *Stagnicola palustris* from the Tuloma estuary differ from other representatives of the species by smaller size (about 10 mm in height) and shell proportions (Fig. 7 F-G). These molluscs correspond to "*Lymnaea (Stagnicola) fusca maritima* (Clessin, 1878)" as described by Kruglov [2005]. However, I consider them a dwarf form of *Stagnicola palustris sensu lato* because the taxonomic position of *Stagnicola fusca maritima* is remains unclear.

Stagnicola corvus (Gmelin, 1791) (Figs 4B, 11 H-I)

Helix corvus Gmelin, 1791: 3665.
Lymnaea corvus – Kruglov, Starobogatov, 1984: 60, figs 1(1), 2 (I, II); Kruglov, 2005: 149-151, figs 50(1), 51, 52; Kijashko *et al.*, 2016: 406, pl. 6, fig. 91.
Lymnaea curtacorvus Kruglov et Starobogatov, 1984: 65-66, figs 1(3), 2 (V, VI); Kruglov, 2005: 153-155, figs 50(3), 55.
Stagnicola corvus – Welter-Schultes, 2012: 54.

Material studied: N Karelia: Pudos (Пудос) River, 66°26.3166'N, 32°14.8254'E, 20.07.2009 (14 specimens); Romanovskiy (Романовский) rivulet, 66°43.3188'N, 32°31.9962'E, 26.07.2009 (2 specimens).

Habitat. Found in small rivers with slow current, on horsetails.

Remarks. Conchologically, the studied specimens resemble shells of the species with *Stagnicola curtacorvus* Kruglov et Starobogatov, 1984 which was considered a synonym of *Stagnicola corvus* by Vinarski and Kantor [2016]. The authors also hypothesized that *"curtacorvus"* is a conchological form of *Stagnicola corvus* characteristic for large lakes. However, the specimens I studied were collected in a small swampy stream.

Genus *Galba* Schrank, 1803

Galba truncatula (O.F. Müller, 1774) (Figs 7 D-E, 8)

Buccinum truncatulum O.F. Müller, 1774: 130-131.
Lymnaea truncatula – Kruglov, 2005: 188-189, figs 79(3), 83-84; Welter-Schultes, 2012: 45; Kijashko *et al.*, 2016: 405, pl. 6, fig. 89.
Galba truncatula – Welter-Schultes, 2012: 49.

Table 2. Morphometrical characters of *Radix auricularia* from the Kola Peninsula (Popovskoe Lake, 67°59.1167′N, 35°3.05′E, n = 36), and results of comparison with those for *Radix auricularia* and *Radix parapsilia* provided by Vinarski and Glöer [2009].

Табл. 2. Морфометрические характеристики *Radix auricularia* с Кольского полуострова (озеро Поповское, 67°59.1167′N, 35°3.05′E, n = 36) и результаты сравнения с таковыми для *Radix auricularia* и *Radix parapsilia,* представленными в работе Винарского и Глоера [Vinarski, Glöer, 2009].

	SH, mm	**AH, mm**	**LWH, mm**	**SpH, mm**	**SW, mm**	**AW, mm**	**BWH_2, mm**	**PWW, mm**	**PWH, mm**	**SW/ SH**	**SpH/ SH**	**BWH/ SH**	**AH/ SH**	**AW/ AH**
Av.	19.69	14.19	17.43	5.5	13.81	1.99	3.52	3.22	1.58	.7	.28	.88	.72	.77
σ	1.98	1.64	1.91	.67	1.78	1.51	.47	.26	.19	.04	.03	.02	.03	.04
Min.	16.69	11.64	14.5	4.39	11.01	8.6	2.78	2.67	1.28	.62	.22	.84	.67	.69
Max.	23.91	17.81	21.6	6.73	17.25	14.77	4.46	3.67	2.11	.78	.33	.91	.78	.84
T_1	**13.8**	**16.9**	**13.6**	.8	**13.5**	**12.4**	**2.5**	**2.4**	1.2	**4.5**	**12.3**	**5.7**	**9.8**	**4.7**
p_1	**<.01**	**<.01**	**<.01**	.434	**<.01**	**<.01**	**.014**	**.021**	.234	**<.01**	**<.01**	**<.01**	**<.01**	**<.01**
T_2	**4.6**	**4.5**	**5.2**	.8	**4.3**	**6.7**	**3.1**	**3.2**	**343.5**	1.1	**4.2**	**8**	1.2	**7.3**
p_2	**<.01**	**<.01**	**<.01**	.447	**<.01**	**<.01**	**<.01**	**<.01**	**<.01**	.285	**<.01**	**<.01**	.237	**<.01**

Av. – average value, σ – standard deviation, Min. and Max. – minimal and maximal values respectively, T_1 and p_1 –values of Student t-test when morphometrical characters of *Radix auricularia* from the Kola Peninsula were compared with those provided by Vinarski and Glöer [2009] for *Radix auricularia*; T_2 and p_2 –values of Student t-test when morphometrical characters of *Radix auricularia* from the Kola Peninsula were compared with those provided by Vinarski and Glöer [2009] for *Radix parapsilia.* Zeros before decimal points are omitted. Statistically significant values are bolded.

Av. – среднее значение, σ – стандартное отклонение, Min. и Max. – минимальные и максимальные лимиты соответственно, T_1 и p_1 –значения t-критерия Стьюдента при сравнении морфометрических признаков *Radix auricularia* с Кольского полуострова с данными Винарского и Глера [2009] для *Radix auricularia*, T_2 и p_2 – значения t-критерия Стьюдента при сравнении морфометрических признаков *Radix auricularia* с Кольского полуострова с данными Винарского и Глоера [Vinarski, Glöer, 2009] для *Radix parapsilia*. Нули перед десятичным разделителем опущены. Статистически достоверные различия выделены полужирным шрифтом.

Material studied: Tundra: Kildin Island, Chernaya (Чёрная) River, 69°19.366‘N, 34°16.51667‘E, 15.06.2019 (1 specimen); Bolshoy Aynov (Большой Айнов) Island, small bog, 69°50.149‘N, 31°33.810‘E, 17.06.2008 (1 specimen); unnamed rivulet, coast of Ivanovskaya (Ивановская) Inlet, 68°17.82‘N, 38°42.426‘E, 30.07.2020 (3 specimens); **Barents:** small rivulet, 68°47.8773‘N, 32°43.428‘E, 21.08.2010 (3 specimens); **White:** Trestozero (Трестозеро) Lake, 66°44.1336‘N, 33°50.097‘E, 21.06.2013 (7 specimens); small stream near Krestovaya (Крестовая) Mountain, 67°7.1167′N, 32°29.667′E, 24.08.2020 (10 specimens); **N Karelia:** unnamed inflow of Pudos (Пудос) Lake, 66°25.9782‘N, 32°11.4234‘E, 21.07.2009 (4 specimens); small lake near Loukhi (Лоухи) village, 66°5.7564‘N, 33°6.909‘E, 16.06.2007 (4 specimens).

Habitat. Usually found in small rivulets and bogs, sometimes in small puddles.

Genus *Radix* Montfort, 1810

Radix auricularia (Linnaeus, 1758) (Figs 8, 10 A-D, Table 2)

Helix auricularia Linnaeus, 1758: 774.
Lymnaea auricularia – Kruglov, 2005: 250-252, figs 137(1), 138-139; Kijashko *et al.*, 2016: 402, pl. 6, fig. 85.
Radix auricularia – Welter-Schultes, 2012: 52.

Material studied: Barents: Popovskoe Lake (Lovozero) (Поповское озеро (Ловозеро)), 67°59.1167′ N, 35°3.05′E, 28-30.08.2020 (151 specimens).

Habitat. Found in the isolated part of a large lake (Lovozero), on stones and sand.

Remarks. Russian authors [Starobogatov *et al.*, 2004; Kruglov, 2005] had recognized another species of *Radix* conchologically similar to *Radix auricularia – Radix psilia* (Bourguignat, 1862) in Northern Europe, Vinarski & Glöer [2009] demonstrated that the name *Limnaea psilia* is in fact a junior synonym of *Lymnaea auricularia*, and, consequently, they redescribed *Lymnaea psilia sensu* Kruglov [2005] as a new species, *Radix parapsilia* Vinarski et Glöer, 2009. The latter differs from *Radix auricularia* by minor differences in the absolute shell size, proportions and rates of growth. No hiatus between the characters of the two species, which would help to clearly separate them, was found. The authors also suggest that species can be separated only when the large samples are taken into account. However, the statistically significant differences were demonstrated only for two syntopic samples of the two species from Western Siberia, while ranges of both species are quite large and include most of the northern Eurasia [Vinarski & Glöer, 2009].

Radix auricularia from the Kola Peninsula occupy, in realtion to size, the intermediate position between *Radix auricularia* and *Radix parapsilia*, and differ slightly, but significantly, from the two

FIG. 9. *Ampullaceana balthica* from the Kola Peninsula and adjacent areas. **A.** Pagel Lake, 68°2.634'N, 32°40.001'E, 07.08.2014. **B, E.** Krasnaya Lambina Lake, 68°3.268'N, 32°36.448'E, 06.08.2014. **C.** Syntype of *Lymnaea ovata* var. *tulomica* (GNHM); **D, F.** Vaykis Lake, 68°2.307'N, 32°27.903'E, 05.08.2014. **G-H.** Syntypes of *Gulnaria* ovata var. *colletti* (ZMO D2398). Scale bar = 10 mm.

РИС. 9. *Ampullaceana balthica* с Кольского полуострова и прилегающих районов. **A.** Озеро Пагель, 68°2.634'N, 32°40.001'E, 07.08.2014; **B, E.** Озеро Красная Ламбина, 68°3.268'N, 32°36.448'E, 06.08.2014; **C.** Синтип *Lymnaea ovata* var. *tulomica* (GNHM); **D, F.** Озеро Вайкис, 68°2.307'N, 32°27.903'E, 05.08.2014; **G-H.** Синтипы *Gulnaria* ovata var. *colletti* (ZMO D2398). Шкала = 10 мм.

FIG. 10. Lymnaeidae from the Kola Peninsula and northern Karelia. **A-D.** *Radix auricularia*, Popovskoe Lake (Lovozero), 67°59.1167′N, 35°3.05′E, 28-30.08.2020. **E-I.** *Ampullaceana balthica*; **E.** Krasnaya Lambina Lake, 68°3.268’N, 32°36.448’E, 06.08.2014; **F-G.** Vaykis Lake, 68°2.307’N, 32°27.903’E, 05.08.2014; **H.** Dolgoe Lake, 68°54.305’N, 32°51.103’E, 11.07.2007; **I.** Kildin Island, no certain locality (GNHM). **J-K.** *Lymnaea stagnalis*, Shchuchye (Tukhtinskoe) Lake, 68°39.349’N, 032°44.253’E, 27.05.2012. Scale bar = 10 mm.

РИС. 10. Lymnaeidae с Кольского полуострова и Северной Карелии. **A-D.** *Radix auricularia*, Поповское озеро (Ловозеро), 67°59.1167′N, 35°3.05′E, 28-30.08.2020. **E-I.** *Ampullaceana balthica*; **E.** Озеро Красная Ламбина, 68°3.268’N, 32°36.448’E, 06.08.2014; **F-G.** Озеро Вайкис, 68°2.307’N, 32°27.903’E, 05.08.2014; **H.** Озеро Долгое, 68°54.305’N, 32°51.103’E, 11.07.2007; **I.** Остров Кильдин, без точного местонахождения (GNHM); *Lymnaea stagnalis***,** озеро Щучье (Тухтинское), 68°39.349’N, 032°44.253’E, 27.05.2012. Шкала = 10 мм.

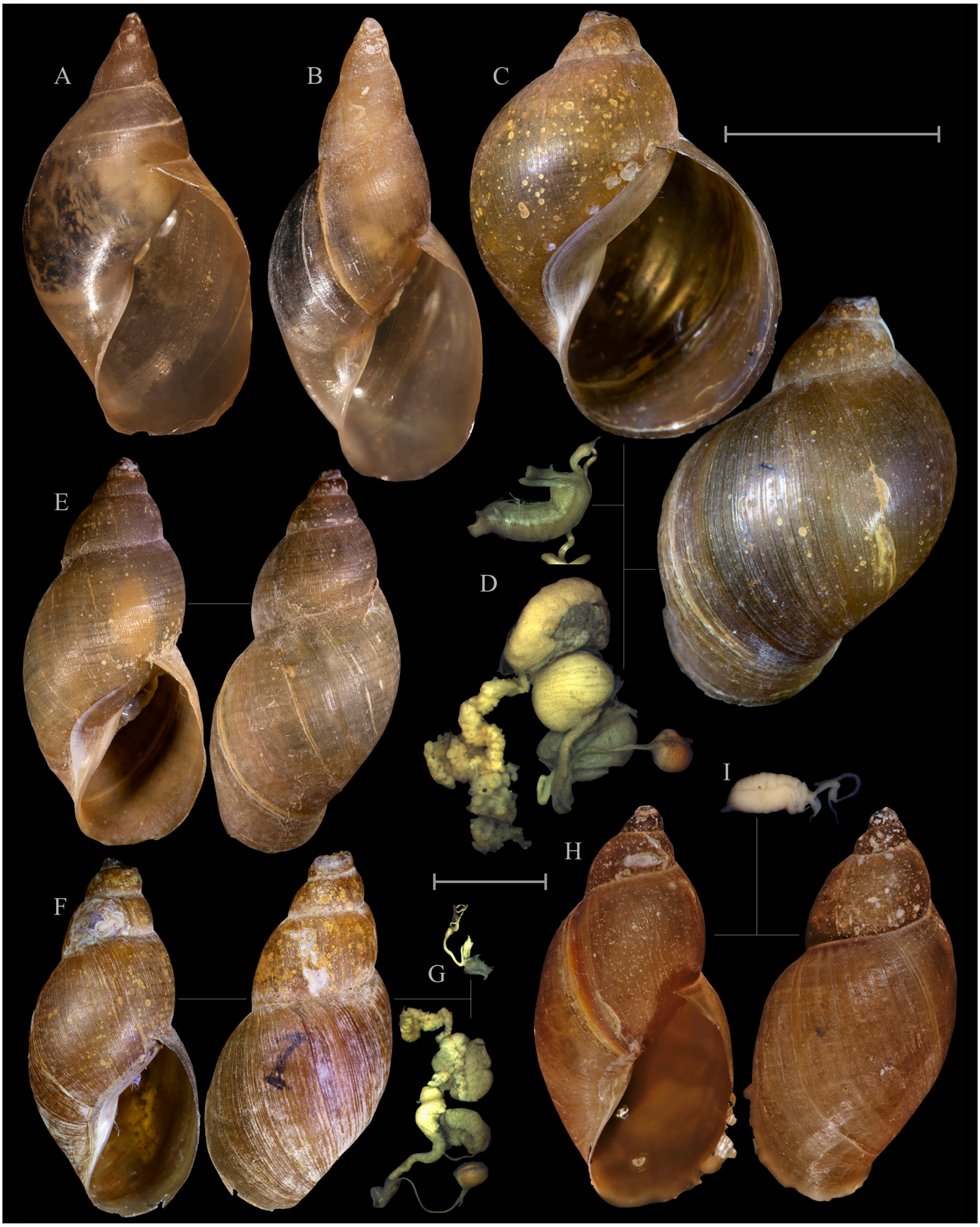

РИС. 11. Lymnaeidae from the Kola Peninsula and northern Karelia. **A-D.** *Lymnaea stagnalis*; **A.** Romanovskiy Rivulet, 66°43.319'N, 32°31.996'E, 26.07.2009; **B.** Notozero Lake, 66°27.041'N, 32°13.198'E, 20.07.2009; **C-D.** Tiksheozero Lake, 66°20.8782'N, 32°4.6146'E, 05.08.2011. **E-G.** *Stagnicola palustris*. **E.** Nizhnetulomskoe Reservoir, 68°47.076'N, 32°40.269'E, 16.07.2006; **F-G.** Tiksheozero Lake, 66°20.878'N, 32°4.615'E, 05.08.2011; **H-I.** *Stagnicola corvus*, Pudos River, 66°26.317'N, 32°14.825'E, 20.07.2009. White lines connected shell and genitals of the same specimen. Scale bars: for shells (**A-C, E-F, H**) = 10 mm, for genitals (**D, G, I**) = 5 mm.

РИС. 11. Lymnaeidae с Кольского полуострова и северной Карелии. **A-D.** *Lymnaea stagnalis*; **A.** Ручей Романовский, 66°43.319'N, 32°31.996'E, 26.07.2009; **B.** Нотозеро, 66°27.041'N, 32°13.198'E, 20.07.2009; **C-D.** Тикшеозеро, 66°20.8782'N, 32°4.6146'E, 05.08.2011. **E-G.** *Stagnicola palustris*. **E.** Нижнетуломское водохранилище, 68°47.076'N, 32°40.269'E, 16.07.2006; **F-G.** Тикшеозеро, 66°20.878'N, 32°4.615'E, 05.08.2011. **H-I.** *Stagnicola corvus*, река Пудос, 66°26.317'N, 32°14.825'E, 20.07.2009. Белые линии соединяют раковины и гениталии одного экземпляра. Шкалы: для раковин (**A-C, E-F, H**) = 10 мм, для гениталий (**D, G, I**) = 5 мм.

Table 3. Distribution and frequency of occurrence of freshwater gastropods in the Kola Peninsula and northern Karelia.

Табл. 3. Распространение и частота встречаемости пресноводных брюхоногих моллюсков на Кольском полуострове и в северной Карелии.

	Tundra	**Tuloma**	**Barents**	**White**	**N. Karelia**	**All areas**
Valvata sibirica	-	-	28	9**	3	17.4
Valvata depressa	-	25	5	9**	-	8.1
Acroloxus lacustris	-	-	-	-	4	0.4
Arniger crista	-	-	-	2	-	0.4
Bathyomphalus contortus	8	-	7	11**	15	8.1
Gyraulus acronicus	31	61	48	39**	23	44.1
Gyraulus stroemi	-	11	7	19**	15	11
Gyraulus albus	-	-	1	-	-	0.4
Aplexa hypnorum	-	-	-	-	4	0.4
Physella acuta	-	-	-	2	-	0.4
Ampullaceana balthica	46*	53	32	48**	35	39.8
Lymnaea stagnalis	-	-	5	2	27	5.5
Myxas glutinosa	-	-	1	0	12	1.7
Radix auricularia	-	-	1	-	-	0.4
Stagnicola palustris	-	17	3	9	12	7.2
Stagnicola corvus	-	-	-	-	8	0.8
Galba truncatula	23*	-	1	4	8	3.4
Samples total	**13**	**36**	**107**	**54**	**26**	**236**
Species observed	4	5	12	11	12	17
Expected number of species (Chao 2)	4	5	15	12.5	12.3	21
Standard deviation for Chao 2	0.22	0.005	4	2.5	0.89	6

Only samples contained snails are included. * – also found in the coastal islands; ** – also found in the Lapland Nature Reserve. Frequency of occurrence was calculated as a ratio between number of samples containing certain species and total number of samples. The record of alien *Physella acuta* was not into the Chao 2 calculation.

Учтены только пробы, в которых были обнаружены брюхоногие моллюски. * – также обнаружен на прибрежных островах; ** – также обнаружен в Лапландском природном заповеднике. Частота встречаемости была посчитана как отношение числа проб, содержащих определённый вид к общему числу проб. Обнаружение инвазийного *Physella acuta* не было принято во внимание при расчёте Chao 2.

species in most of the conchological indices when the data obtained by Vinarski and Glöer [2009] is used for comparison. (Table 3). In my opinion, a more extensive study of conchological variability is required to clarify the taxonomic status of *Radix parapsilia* and its differences from *Radix auricularia*. Therefore, I prefer to use the name *Radix auricularia sensu lato* for the designation of *Radix* snails found in the Lovozero Lake.

According to Schileyko [1967], *Radix auricularia* occurs also in the White Sea drainage.

Discussion

General comments

Table 3 summarizes the primary data on the distribution and frequency of occurrence of freshwater gastropods in each studied area. In general, *Ampullaceana balthica* and *Gyraulus acronicus* are the most frequently recorded freshwater snails in the region. The freshwater gastropod fauna of the Kola Peninsula and northern Karelia consists of species common in northern Europe. There are no rare and endemic species known from the region. However, Schikov and Nekhaev [2016] described a subspecies of the amphibiotic snail *Oxyloma sarsi tulomica* (Succineidae), whose known distribution is restricted to the Tuloma river estuary. But it cannot be treated as a true freshwater taxon and therefore not discussed in the present study. The only alien species known from the Kola Peninsula and northern Karelia is *Physella acuta* found only in the spillway from the Kolskaya Nuclear Power Plant.

The northernmost records of aquatic snails in the

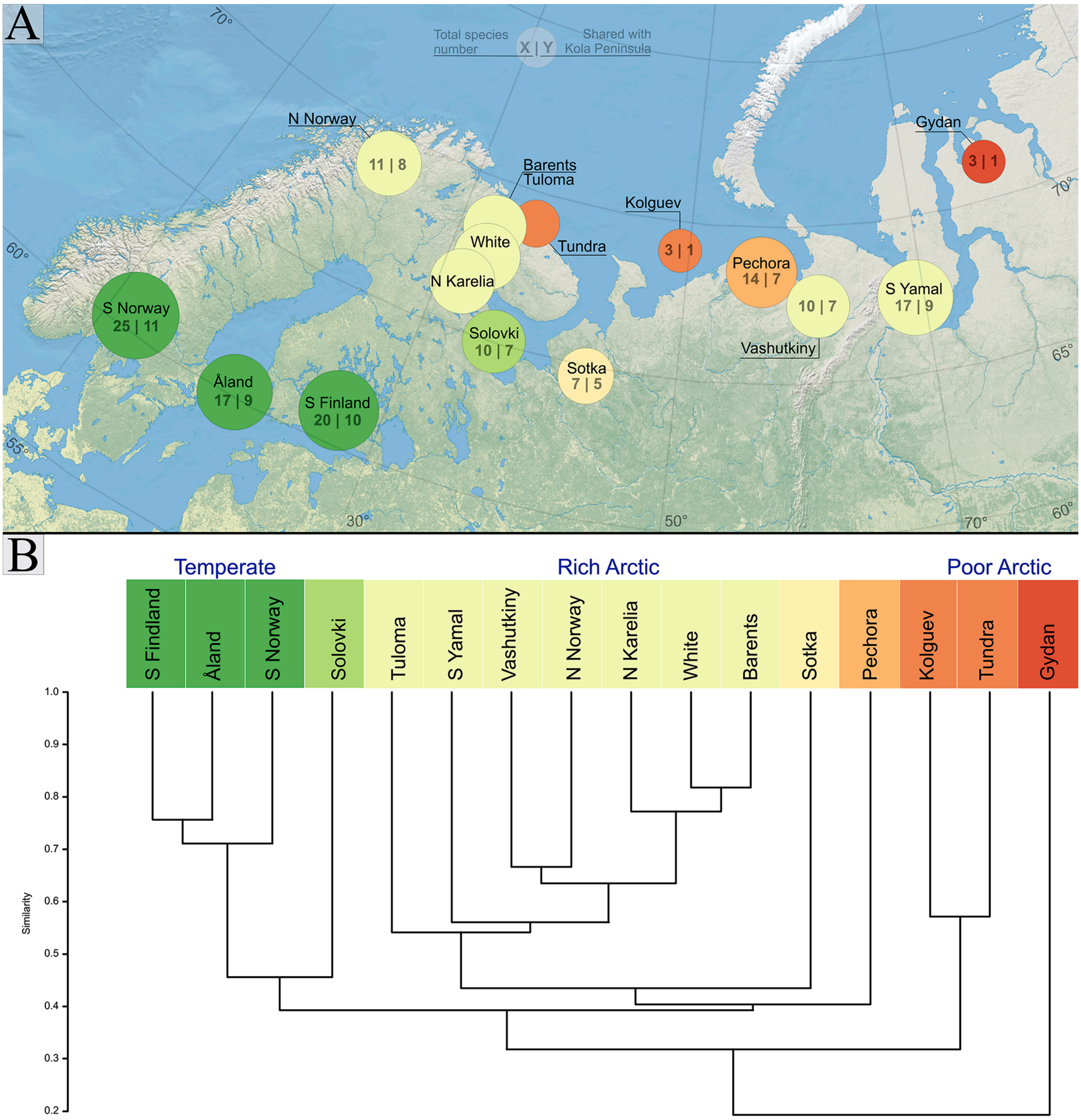

FIG. 12. Comparison of the local gastropod faunas of the northern part of Europe and Western Siberia. **A**. Map demonstrating the geographical position of the compared local faunas (circles), total number of species in each local fauna (numeral before line inside circle) and number of species shared with the Kola Peninsula and northern Karelia (numeral after line inside the circle). Circles' color reflects the grouping on the dendrogram (**B**), the circle size is proportional to the total species richness of the given locality. **B**. A cluster dendrogram based on Dice similarity distance. *Åland* – Åland Isles; *Barents* – Kola Peninsula, the Barents Sea drainage area of the Barents Sea; *Gydan* – Gydan Peninsula near Gyda river; *Kolguev* – Kolguev Island; *N Karelia* – northern Karelia; *N Norway* – northern Norway; *Pechora* – the Pechora Sea coast; *Tuloma* – Kola Peninsula, Tuloma River estuary; *Tundra* – tundra zone of the Kola Peninsula; *S Finland* – southern Finland; *S Norway* – southern Norway; *S Yamal* – southern Yamal, basin of Schutchya river; *Solovki* – Solovetskie Isles; *Sotka* – Sotka river, NE Europe; *Vashutkiny* – Vashutkiny Lakes, NE Europe; *White* – Kola Peninsula, drainage area of the White Sea.

РИС. 12. Сравнение локальных фаун брюхоногих моллюсков северных частей Европы и западной Сибири. **А**. карта, показывающая географическое положение сравниваемых локальных фаун (круги), общее число видов в конкретной локальной фауне (цифры до линии внутри круга) и число видов, общих с Кольским полуостровом и северной Карелией (цифры после линии внутри круга). Цвет кругов отражает положение региона на дендрограмме (**B**), размер пропорционален общему числу видов в конкретной локальной фауне. **B**. Дендрограмма, основанная на мере сходства Дайса. *Åland* – Аланские острова; *Barents* – Кольский полуостров, водосборный бассейн Баренцева моря; *Gydan* – Гыданский полуостров, окрестности реки Гыда; *Kolguev* – остров Колгуев; *N Karelia* – северная Карелия; *N Norway* – северная Норвегия; *Pechora* – побережье Печорского моря; *Tuloma* – Кольский полуостров, эстуарий реки Тулома; *Tundra* – тундровая зона Кольского полуострова; *S Finland* – южная Финляндия; *S Norway* – южная Норвегия; *S Yamal* – южный Ямал, басссейн реки Щучья; *Solovki* – Соловецкие острова; *Sotka* – река Сотка; *Vashutkiny* – Вашуткины озёра; *White* – Кольский полуостров, бассейн Белого моря.

region are the record of *Galba truncatula* on Bolshoy Aynov Island (69°50.149'N, 31°33.810'E) as well as the findings of *Galba truncatula* (69°19.37'N, 33°16.517'E, Fig. 7E) and *Ampullaceana balthica* (certain coordinates are unknown, Fig. 10I) on Kildin Island.

Based on an estimation of the expected number of species (Table 3), it can be assumed that the fauna of freshwater gastropods has almost completely been revealed in all areas. Nonetheless, the discovery of species, new for the whole studied region, is possible especially if other sampling methods will be used and other habitats will be studied (in particular, the deep-water zones of large lakes). Also, the examined material included no samples from the eastern part of the Kola Peninsula. It should be noted that a conservative approach to the taxonomical identification of molluscs was applied in the present study. The use of handbooks and other taxonomical contributions that consider minor differences in the shape and size of the shell may also affect the assessment of the species composition of molluscs.

Apart from the taxa listed in the present study, several more species names were used in the previous studies of the freshwater Gastropoda of the Kola Peninsula and northern Karelia (Table 4). While some of them are evidently a result of the taxonomic misidentification, the presence of other species of freshwater snail in the studied region needs a confirmation. Unfortunately, most of such published records lack either images or descriptions of the snails, the taxonomic identity of which thus cannot be verified. At the same time, some of previously published records used different approaches to the taxonomic identification of molluscs. Nevertheless, the current list of snail species of the studied region may be expanded in the future, provided that some doubtful occurrences are confirmed.

A comparison with other local faunas

In general, the distribution of the gastropod species richness in the Kola Peninsula and northern Karelia follows the same pattern as in other northern regions. Species lists of each area in the studied region (see Fig. 1) were compared with those of some other local gastropod faunas of the northern part of Europe and Western Siberia: Åland Isles (Fig. 12, *Åland*) [Carlsson, 2001]; Gydan Peninsula near Gyda river (Fig. 12, *Gydan*) [Bespalaya *et al.*, 2021]; Kolguev Island, Barents Sea (Fig. 12, *Kolguev*) [Smith, 1896; Nekhaev, unpublished data]; northern Norway (Fig. 12, *N Norway*) [Økland, 1990]; the Pechora Sea coast (Fig. 12, *Pechora*) [Bespalaya *et al.*, 2017]; southern Finland (Fig. 12, *S Finland*) [Aho *et al.*, 1981]; southern Norway (Fig. 12, *S Norway*) [Økland, 1990]; southern Yamal, the Stchutchya River basin (Fig. 12, *S Yamal*) [Palatov, Vinarski, 2012]; Solovetskie Isles (Fig. 12, *Solovki*) [Bespalaya *et al.*, 2009]; Sotka river, NE part of European Russia (Fig. 12, *Sotka*) [Nekhaev, unpublished]; and the Vashutkiny Lakes, NE Europe (Fig. 12, *Vashutkiny*) [Bolotov *et al.*, 2014]. The non-indigenous species, e.g. *Physella integra* and *Potamopyrgus antipodarum* (Gray,1843), were excluded from the analysis.

The number of species identified in each area of the Kola Peninsula and northern Karelia is close to that in other regional faunas (Fig. 12A). The compared areas were grouped into several main clusters (Fig. 12B). Species diversity is lowest in the northernmost regions (*Gyda, Tundra, Kolguev*) ("poor Arctic"). The largest group ("rich Arctic") includes all the studied areas from the Kola Peninsula and northern Karelia (except the tundra zone) as well as northern Norway and southern Yamal. The regions of southern Scandinavia formed a cluster sister to the "rich Arctic" cluster ("temperate").

The decrease in the species richness of freshwater molluscs towards the north has repeatedly been noted in the literature [Økland, 1990; Nekhaev, 2011; Vinarski *et al.*, 2012, 2020]. This pattern is usually attributed to unfavorable for molluscs climatic condition smollusc, the low productivity of waterbodies, as well as to the young age of many Arctic landscapes. The entire region studied was freed from the ice sheet almost simultaneously between 12 and 10 ka ago [Corner *et al.*, 2001; Patton *et al.*, 2017], therefore the age of the landscape cannot be relevant. Climatic conditions (temperature in particular) are changing gradually over most of the study area, except the coastal territories of the Barents Sea [Yakovlev, 1961]. Therefore, one cannot speak of the direct influence of climatic factors per se on the species richness of molluscs.

The main food objects for freshwater gastropods are aquatic vegetation and plant detritus [Tsikhon-Lukanina, 1987; Dillon, 2000]. In the waterbodies of the Kola Peninsula, where the abundance of aquatic vegetation is low, leaf litter and dead wood are the main sources of plant detritus. Likely, the sharp decrease in the number and abundance of gastropod species in the tundra is associated with the decrease in the flow of organics from terrestrial ecosystems. The assumption of a connection between terrestrial landscapes and the diversity of aquatic molluscs is at least partially confirmed by a comparison of the regions of the Kola Peninsula with other regions of northern parts of Europe and western Siberia (Fig. 11). This pattern, however, cannot account for the high species richness of freshwater molluscs on the Pechora Sea coast [Bespalaya *et al.*, 2017].

Table 4. Species names used for the gastropods from the Kola Peninsula and northern Karelia mentioned previously, but not included in the present checklist.

Таблица 4. Видовые названия, использованные для брюхоногих моллюсков с Кольского полуострова и северной Карелии ранее, но не включённые в текущий список видов.

Name	Reference	Remark
Anisus spirorbis (Linnaeus, 1758)	Stalmakova, 1974	Needs confirmation
Anisus agardhi (Prozorova in Starobogatov, Prozorova, Bogatov et Saenko, 2004)	Nekhaev, 2006	Synonym of *Bathyomphalus contortus*
Gyraulus gredleri (Bielz in Gredler, 1859)	Stalmakova, 1974	Synonym of *Gyraulus acronicus*
Anisuus borealis (Lovén in Westerlund, 1875)	Nekhaev, 2006	Synonym of *Gyraulus acronicus*
Gyraulus laevis (Alder, 1838)	Stalmakova, 1974; Yakovlev, 2005	Needs confirmation, can be confused with *Gyraulus acronicus*
Gyraulus rossmaesleri (Auerswald in A. Schmidt, 1852)	Yakovlev, 2005	Needs confirmation, can be confused with juvineles of *Gyraulus* spp. and *Armiger crista*
Lymnaea fontinalis (Studer, 1820),	Nekhaev, 2010	Misidentification of *Ampullaceana balthica* sensu lato
Lymnaea intermedia (Lamarck, 1805)	Nekhaev, 2010	Misidentification of *Ampullaceana balthica* sensu lato
Lymnaea carelica (Kruglov et Starobogatov, 1983)	Nekhaev, 2010	Misidentification of *Ampullaceana balthica* sensu lato
Lymnaea peregra (O.F. Müller, 1774)	Stalmakova, 1974; Shileyko, 1964; Yakovlev, 2005	Needs confirmation, can be recognized from *Ampullaceana balthica* only with use of molecular characters
Lymnaea doriana (Bourguignat, 1862)	Davydov *et al.*, 1981	Synonym of *Lymnaea stagnalis*
Lymnaea media (Kobelt, 1877)	Davydov *et al.*, 1981	Synonym of *Lymnaea stagnalis*
Lymnaea mucronata (Held, 1836)	Nekhaev, 2010	Misidentification of *Ampullaceana balthica* sensu lato
Lymnaea tumida (Held, 1836)	Nekhaev, 2010	Misidentification of *Ampullaceana balthica* sensu lato
Valvata cristata O.F. Müller, 1774	Valkova, Kashulin, 2013; Stalmakova, 1974; Yakovlev, 2005	Needs confirmation, can be confused with *Valvata sibirica*
Valvata macrostoma Mörch, 1864	Stalmakova, 1974	Needs confirmation, can be confused with *Valvata sibirica*
Valvata piscinalis (O.F. Müller, 1774)	Stalmakova, 1974; Yakovlev, 2005	Needs confirmation, probably conspecific with *Valvata depressa* reported here
Valvata pulchella (S. Studer, 1789)	Stalmakova, 1974	Needs confirmation, probably conspecific with *Valvata depressa* reported here

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References

Aho J., Ranta E., Vuorinen J. 1981. Species composition of freshwater snail communities in lakes of southern and western Finland. *Annales Zoologici Fennici*, 18: 233–241.

Aksenova O.V., Bolotov I.N., Gofarov M.Y., Kondakov A. V., Vinarski M. V., Bespalaya Y.V., Kolosova Y.S., Palatov D.M., Sokolova S.E., Spitsyn V.M., Tomilova A.A., Travina O. V., Vikhrev I. V. 2018. Species richness, molecular taxonomy and biogeography of the radicine pond snails (Gastropoda: Lymnaeidae) in the Old World. *Scientific Reports*, 8(1): 1–17. https://doi.org/10.1038/s41598-018-29451-1

Beryozkina G.V, Starobogatov Y.I. 1988. Reproduction ecology and egg capsules of freshwater pulmonate gastropods. *Proceedings of the Zoological Institute of the Academy of Sciences of the USSR*, 174: 1–306 [In Russian].

Bespalaya Y.V. 2014. Molluscan fauna of an Arctic lake is dominated by a cosmopolitan *Pisidium* species. *Journal of Molluscan Studies*, 81(2): 294–298. https://doi.org/10.1093/mollus/eyu081

Bespalaya Y.V., Aksenova O.V., Bolotov I.N., Kondakov A., Kogut Y.E. 2017. Freshwater mollusc fauna of coastal lowlands of the Pechora Sea (the Bolshezemelskaya Tundra, the Nenets autonomous district). *Fauna Urala i Sibiri*, 2017(1): 25–32 [In Russian].

Bespalaya Y.V., Aksenova O.V., Sokolova S.E., Shevchenko A.R., Tomilova A.A., Zubrii N.A. 2021. Biodiversity and distributions of freshwater mollusks in relation to chemical and physical factors in the thermokarst lakes of the Gydan Peninsula, Russia. *Hydrobiologia*,. https://doi.org/10.1007/s10750-020-04227-9

Bespalaya Y.V., Aksenova O.V., Zubriy N.A. 2018. Molluscan fauna of the lower reaches of the Syoyakha River (Yamal Peninsula). *Arctic Environmental Research*, 18(2): 76–81. https://doi.org/https://doi.org/10.3897/issn2541-8416.2018.18.2.76

Bespalaya Y.V., Bolotov I.N., Aksenova O.V., Kondakov A., Gofarov M., Paltser I. 2015a. Occurrence of a *Sphaerium* species (Bivalvia: Sphaeriidae) of Nearctic origin in European Arctic Russia (Vaigach Island) indicates an ancient exchange between freshwater faunas across the Arctic. *Polar Biology*, 38(9): 1545–1551. https://doi.org/10.1007/s00300-015-1656-5

Bespalaya Y.V., Bolotov I.N., Aksenova O.V., Kondakov A., Paltser I., Gofarov M. 2015b. Reproduction of *Pisidium casertanum* (Poli, 1791) in Arctic lake. *Royal Society Open Science*, 2(1): 140212. https://doi.org/10.1098/rsos.140212

Bespalaya Y.V., Bolotov I.N., Usacheva O.V. 2011. Structure and species diversity of topical groups of mollusks in lakes of the Solovetsky Islands and Onega Peninsula, northwestern Russia. *Russian Journal of Ecology*, 42(2): 143–150. https://doi.org/10.1134/S1067413611010048

Bespalaya Y.V., Bolotov I.N., Zubriy N.A. 2009. Topical groups of mollusks in the lakes of Bol'shoy Solovetskiy Island (Solovetskiy Archipelago, White Sea, Northwestern Russia). *Inland Water Biology*, 2(2): 177–186. https://doi.org/10.1134/S1995082909020114

Bolotov I.N., Aksenova O. V., Bespalaya Y.V., Gofarov M.Y., Kondakov A. V., Paltser I.S., Stefansson A., Travina O. V., Vinarski M. V. 2017. Origin of a divergent mtDNA lineage of a freshwater snail species, *Radix balthica*, in Iceland: cryptic glacial refugia or a postglacial founder event? *Hydrobiologia*, 787(1): 73–98. https://doi.org/10.1007/s10750-016-2946-9

Bolotov I.N., Bespalaya Y.V., Aksenova O. V., Gofarov M.Y., Sokolova S.E. 2014. Mollusks in the zoobenthos of relict lakes with abnormally high biological production in the eastern European subarctic. *Inland Water Biology*, 7(1): 61–71. https://doi.org/10.1134/S1995082914010040

Bourguignat J.R. 1862. Notice monographique sur les Limnées d'Europe du groupe de la *Limnaea stagnalis*. *Revue et Magasin de Zoologie, série 2*, 14: 54–63.

Carlsson R. 2001. Freshwater snail communities and lake classification. An example from the Åland islands, southwestern Finland. *Limnologica*, 31: 129–138.

Clewing C., Von Oheimb P.V., Vinarski M.V., Wilke T., Albrecht C. 2014. Freshwater mollusc diversity at the roof of the world: Phylogenetic and biogeographical affinities of Tibetan Plateau *Valvata*. *Journal of Molluscan Studies*, 80(4): 452–455.

Colwell R.K., Coddington J.A. 1994. Estimating terrestrial biodiversity through extrapolation. *Philosophical Transactions of the Royal Society B: Biological Sciences*, 345: 101–118. https://doi.org/10.1098/rstb.1994.0091

Corner G.D., Kolka V. V., Yevzerov V.Y., Møller J.J. 2001. Postglacial relative sea-level change and stratigraphy of raised coastal basins on Kola Peninsula, northwest Russia. *Global and Planetary Change*, 31(1–4): 155–177. https://doi.org/10.1016/S0921-8181(01)00118-7

Davydov A.F., Kruglov N.D., Starobogatov Y.I. 1981. Experimental crosses of two forms of *Lymnaea stagnalis* (Gastropoda, Pulmonata) and problems of taxonomy of the subgenus *Lymnaea* s.str. *Zoologishesky Zhurnal*, 60(9): 1325–1338 [In Russian].

Dillon R.T. 2000. *The ecology of freshwater molluscs*. Cambridge University Press, Cambridge, 509 pp.

Draparnaud J.P.R. 1805. *Histoire naturelle des mollusques terrestres et fluviatiles de la France*. Renaud et Plassan, Montpellier-Paris, 164 pp.

Esmark B., Hoyer Z. 1886. Die Land- und Süsswassermolluskmolluscen des arctischen Norwegens. *Malakozoologische Blatter*, 8: 84–123.

Férussac J.B.L. 1807. *Essai d'une méthode conchyliologique appliquée aux Mollusques terrestres et fluviatiles*. de l'Imprimerie de Delange, Paris, 142 pp.

Field J.G., Clarke K.R., Warwick R.M. 1982. A practical strategy for analysing multispecies distribution patterns. *Marine Ecology Progress Series*, 8: 37–52.

Frolov A.A. 2009. Species composition and specific features of distribution of bivalves from the superfamily Pisidioidea (Mollusca, Bivalvia) in the coastal zone of the Lower Tuloma reservoir and in the Tuloma River estuary (Kola Peninsula, Russia). *Inland Water Biology*, 2(4): 73–80. https://doi.org/10.1134/S1995082909040117

Frolov A.A. 2010. New species of Bivalves of the genus *Euglesa* (Mollusca, Bivalvia) in water bodies of the northern part of Kola Peninsula. *Vestnik Zoologii*, 44(5): 393–402 [In Russian].

Glöer P., Vinarski M.V. 2009. Taxonomical notes on Euro-Siberian freshwater molluscs: 2. redescription of *Planorbis* (*Gyraulus*) *stroemi* Westerlund, 1881 (Mollusca: Gastropoda: Planorbidae). *Journal of Conchology*, 39(6): 717–725.

Gmelin J.F. 1791. *Caroli a Linné Systema Naturae per regna tria naturae, secundum classes, ordines,* *genera, species, cum characteribus, differentiis, synonymis, locis. Editio decima tertia, aucta, reformata*. G.E. Beer, Leipzig, 3021–3910 pp.

Hammer Ø., Harper D.A., Ryan D.D. 2001. PAST: paleontological statistics software package for education and data analysis. *Palaeontologia Electronica*, 4(1): 1–9. https://doi.org/10.1016/j.bcp.2008.05.025

Jackiewicz M. 1993. Phylogeny and relationships within European species of the family Lymnaeidae (Gastropoda: Pulmonata: Basommatophora). *Folia Malacologica*, 5: 61–95.

Kijashko P.V, Soldatenko E.V, Vinarski M.V. 2016. Gastropoda. In: Tsalolikhin S. Y. (Ed). *A handbook of zooplankton and zoobenthos of the freshwaters of European Russia*. KMK Scientific Press Ltd., Moscow-Saint-Petersburg: 335–438 [In Russian].

Kobelt W. 1877. *Iconographie der Land- und Süsswasser-Mollusken.* 5. C.W. Kreidel's Verlag, Wiesbaden, 129 pp.

Kruglov N.D. 2005. *Molluscs of the family Lymnaeidae (Gastropoda Pulmonata) in Europe and northern Asia*. SGPU Publ, Smolensk, 507 pp [In Russian].

Kruglov N.D., Soldatenko E.V 2000. New data on species composition of the subgenus *Gyraulus* of the genus *Anisus* from the European part of Russia and adjacent territorries. *Ruthenica: Russian Malacological Journal*, 10(2): 113–120 [In Russian].

Kruglov N.D., Starobogatov Y.I. 1983. A contribution to the morphology and taxonomy of European representatives of the subgenus *Peregriana* (Lymnaea, Gastropoda, Pulmonata). *Zoologishesky Zhurnal*, 62(10): 1462–1473 [In Russian].

Kruglov N.D., Starobogatov Y.I. 1984. Morphological peculiarities and taxonomy of molluscs of the subgenus *Courvusiana* of the genus *Lymnaea* (Gastropoda Pulmonata Lymnaeidae). *Bulleten Moskovskogo Obshchestva Ispytateley Prirody*, 89(2): 58–70 [In Russian].

Kruglov N.D., Starobogatov Y.I. 1985a. Method of experimental hybridization and some results of its application in the taxonomy of Lymnaeidae (Gastropoda: Pulmonata). *Malacological Review*, 18: 21–35.

Kruglov N.D., Starobogatov Y.I. 1985b. *Myxas*-similar Lymnaeidae (Gastropoda, Pulmonata), their origin and specific composition. *Bulleten Moskovskogo Obshchestva Ispytateley Prirody*, 90(2): 69–78 [In Russian].

Kruglov N.D., Starobogatov Y.I. 1991. Generic composition of the family Acroloxidae (Gastropoda, Pulmonata) and species of *Acroloxus* living in the USSR. *Zoologishesky Zhurnal*, 70(2): 67–79 [In Russian].

Leshko Y.V. 1998. *Fauna of the European North-East of Russia. Vol V, pt.1. MolluscMolluscs*. Nauka, Saint Petersburg, 168 pp [In Russian].

Linnaeus C. 1758. *Caroli Linnaei ... systema naturae per regne tria naturae, secundum classes, ordines, genera, species, cum characteribus, differentiis, synonymis, locis... Editio decima reformata*. L. Salvius, Holmiae, 823 pp.

Mandahl-Barth G. 1938. Land and freshwater Mollusca. *Zoology of Iceland*, 4(65): 1–31.

Meier-Brook C. 1983. Taxonomic studies on *Gyraulus* (Gastropoda: Planorbidae). *Malacologia*, 24(1–2): 1–113.

Mezhzherin S.V, Garbar A.V, Korshunova E.D., Zhalay E.I. 2008. The analysis of the morphological and genetic variation of the snail *Lymnaea stagnalis* s.l. (Gastropoda, Lymnaeidae) in Ukraine. *Vestnik Zoologii*, 42(4): 339–345. [In Russian].

Miller K. 1873. Die Schaltiere des Bodensees. *Schrifte der Vereiniss für Geschichte des Bodensees und seiner Umgebung*, 4: 123–134.

Middendorff A.T. 1851. Mollusken. In: Middendorff A.T. *Reise in den äussersten Norden und Osten Sibiriens. Band II. Zoologie*. Theil 1. Wirbellose Thiere. Kaiserlische Akademie der Wissenschaften, Saint-Pétersburg: 163–464.

Moiseenko T.I., Gashkina N.A., Sharov A.N., Vandysh O.I., Kudryavtseva L.P. 2009. Anthropogenic transformations of the Arctic ecosystem of Lake Imandra: Tendencies for recovery after long period of pollution. *Water Resources*, 36(3): 296–309. https://doi.org/10.1134/S0097807809030051

Müller O.F. 1774. *Vermium terrestrium et fluviatilium seu animalium infusorium, helminthicorum et testaceorum non marinorm succincta historia. Volumen alterum.* Heineck et Faber, Hafnia et Lipsia, 214 pp.

Nekhaev I.O. 2006. The peculiarities of distribution of limnetic molluscs of the family Planorbidae (Gastropoda, Pulmonata) in the northwestern part of the Murmansk region. *Vestnik Murmanskogo Gosudarstvennogo Tekhnicheskogo Universiteta*, 9(5): 793–796 [In Russian].

Nekhaev I.O. 2010. Life forms of freshwater Gastropoda in the north part of the Kola Peninsula. *Vestnik Murmanskogo Gosudarstvennogo Tekhnicheskogo Universiteta*, 13(4): 661–664 [In Russian].

Nekhaev I.O. 2011. Geographic distribution features of the subgenera and life forms of Lymnaeidae (Gastropoda, Pulmonata) in Eastern Europe. *Biology Bulletin*, 38(4): 406–411. https://doi.org/10.1134/S1062359011040121

Nekhaev I.O. 2015. Surviving at the edge of land: finding of the limnetic snail *Sibirenauta sibirica* (Gastropoda: Physidae) on the coast of the Laptev Sea (Eastern Siberia). *Byulleten' Dal'nevostochnogo Malakologicheskogo Obshchestva*, 19: 25–30.

Nekhaev I.O., Palatov D.M. 2016. From the Black Sea to the White Sea: The first record of the invasive mollusc *Physella acuta* in the extreme north of Europe. *Russian Journal of Biological Invasions*, 7(4): 61–65. https://doi.org/10.1134/S2075111716040056

Nekhaev I.O., Schiøtte T., Vinarski M.V. 2015. Type materials of European freshwater molluscs described by Otto Friedrich Müller. *Archiv fur Molluskenkunde*, 144(1): 51–64. https://doi.org/10.1127/arch.moll/1869-0963/144/051-064

Økland J. 1990. *Lakes and snails. Environment and Gastropoda in 1500 Norwegian lakes, ponds and rivers*. Universal Book Services / Dr. W. Backhuys, Oegstgeest, 516 pp.

Ovchankova N.B., Pankov N.N., Shadrin N.Y. 2015. Fauna and zoogeographical characteristic of molluskmolluscs of the superfamily Pisidioidea of the North and East of European Russia. *Vestnik Udmurtskogo Universiteta*, 25(2): 126–134 [In Russian].

Palatov D.M., Vinarski M.V. 2012. Materials on fauna of water gastropods (Gastropoda) of the basin of

Stchutchya river (southern Yamal). *Estestvennye nauki i ekologiya: Ezhegodnik OmGPU*, 16: 154–162 [In Russian].

Patton H., Hubbard A., Andreassen K., Auriac A., Whitehouse P.L., Stroeven A.P., Shackleton C., Winsborrow M., Heyman J., Hall A.M. 2017. Deglaciation of the Eurasian ice sheet complex. *Quaternary Science Reviews*, 169: 148–172. https://doi.org/10.1016/j.quascirev.2017.05.019

Pfeiffer C. 1821. *Systematische Anordnung und Beschreibung Deutscher Land- und Wasser-Schnekken, mit besonderer Rücksicht auf die bisher in Hessen gefundenen Arten*. Verlag des Verfassers, Cassel, 134 pp.

Prozorova L.A. 2003. Taxonomy and species composition of the genus *Anisus* Studer (Gatropoda: Planorbidae) in the fauna of Russia. *Byulleten' Dal'nevostochnogo Malakologicheskogo Obshchestva*, 7: 99–115 [In Russian].

Prozorova L.A., Starobogatov Y.I. 1998. Subgenus *Sibirovalvata* of the genus *Cincinna* (Pectinibranchia, Valvatidae) in Russia and adjacent countries. *Byulleten' Dal'nevostochnogo Malakologicheskogo Obshchestva*, 2: 54–74 [In Russian].

Rautio M., Dufresne F., Laurion I., Bonilla S., Vincent W.F., Christoffersen K.S. 2011. Shallow freshwater ecosystems of the circumpolar Arctic. *Écoscience*, 18(3): 204–222. https://doi.org/10.2980/18-3-3463

Saito T., Prozorova L., Sitnikova T., Surenkhorloo P., Hirano T., Morii Y., Chiba S. 2018. Molecular phylogeny of glacial relict species: a case of freshwater Valvatidae molluscs (Mollusca: Gastropoda) in North and East Asia. *Hydrobiologia*, 818(1): 105–118. https://doi.org/10.1007/s10750-018-3595-y

Schikov E.V., Nekhaev I.O. 2016. *Oxyloma sarsii tulomica* subsp. nov. (Gastropoda: Pulmonata: Succineidae) from the Kola Peninsula. *Ruthenica: Russian Malacological Journal*, 26(1): 25–34 [In Russian].

Schileyko A.A. 1967. On the variability of lymnaeids (Mollusca, Gastropoda) of the Kola Peninsula. *Gidrobiologicheskiy Zhurnal*, 3: 77–80 [In Russian].

Schniebs K., Glöer P., Vinarski M.V., Hundsdoerfer A. 2011. Intraspecific morphological and genetic variability in *Radix balthica* (Linnaeus, 1758) (Gastropoda: Basommatophora: Lymnaeidae) with morphological comparison to other European *Radix* species. *Journal of Conchology*, 40(6): 657–678.

Sheppard R. 1823. Description of seven new British land and fresh-water shells, with observations upon many other species, including a list of such as have been found in the county of Suffolk. *Transactions of the Linnean Society of London*, 14(1): 148–170.

Sitnikova T., Kijashko P. V, Sysoev A.V. 2012. Species names of J.-R. Bourguignat and their application in current taxonomy of fresh-water gastropods of the Russian fauna. *Byulleten' Dal'nevostochnogo Malakologicheskogo Obshchestva*, 15/16: 87–116.

Smith E.A. 1896. On some fresh-water shells from the Island of Kolguev. *Proceedings of the Malacological Society of London*, 2: 104.

Stadnichenko A.P. 2004. *Lymnaeidae and Acroloxidae of Ukraine*. Centr Uchebnoy Literatury, Kiev, 327 pp [In Russian].

Stalmakova G.A. 1974. Benthos of lakes of different landscapes of the Kola Peninsula. In: *Lakes of different landscapes of the Kola Peninsula. Part 2. Hydrochemistry and Hydrobiology*. Nauka, Leningrad: 180–212 [In Russian].

Starobogatov Y.I., Prozorova L.A., Bogatov V. V, Saenko E.M. 2004. Molluscs. In: Tsalolikhin S. Y. (Ed). *Handbook of freshwater invertebrates of Russia and adjacent countries. Vol. 6 Molluscs, polychaets, nemerteans*. Nauka, Saint Petersburg: 9–491 [In Russian].

Starobogatov Y.I., Prozorova L.A., Zatravkin M.N. 1989. The composition of the family Physidae (Gastropoda, Pulmonata) in Siberia and the Far East of the USSR (with notes on European species). *Bulleten Moskovskogo Obshchestva Ispytateley Prirody*, 94(1): 62–76 [In Russian].

Tsikhon-Lukanina E.A. 1987. *Trophology of aquatic molluscs*. Nauka, Moscow, 176 pp [In Russian].

Valkova S.A., Kashulin N.A. 2013. Peculiarity of the structure and functional organization of zoobenthos communities under thermophication. *Trudy Kolskogo Nauchnogo Centra RAN*, 2013(3): 97-105 [In Russian].

Vinarski M.V. 2017. The history of an invasion: phases of the explosive spread of the physid snail *Physella acuta* through Europe, Transcaucasia and Central Asia. *Biological Invasions*, 19(4): 1299–1314. https://doi.org/10.1007/s10530-016-1339-3

Vinarski, M.V., Glöer P. 2009. Taxonomic notes on Euro-Siberian snails, 4. Re-examination of *Limnaea psilia* Bourguignat 1862, with the description of *Radix parapsilia* n. sp. (Gastropoda: Pulmonata: Lymnaeidae). *Archiv für Molluskenkunde*, 138: 123-136.

Vinarski M.V., Andreyev N.I., Andreyeva S.I., Karimov A. V., Lazutkina E.A. 2012. Latitudinal changes in the diversity of freshwater gastropods (Mollusca: Gastropoda) in waterbodies of western Siberia. *Inland Water Biology*, 5(1): 83–90. https://doi.org/10.1134/S1995082911040213

Vinarski M.V., Bolotov I.N., Aksenova O.V., Babushkin E.S., Bespalaya Y.V., Makhrov A.A., Nekhaev I.O., Vikhrev I.V. 2020. Freshwater Mollusca of the Circumpolar Arctic: a review on their taxonomy, diversity and biogeography. *Hydrobiologia*. https://doi.org/10.1007/s10750-020-04270-6

Vinarski M.V., Kantor Y.I. 2016. *Analytical catalogue of fresh and brackish water Molluscs of Russia and Adjacent Countries*. KMK Scientific Press Ltd., Moscow, 544 pp.

Vinarski M.V., Nekhaev I.O., Glöer P., Proschwitz T. 2013a. Type materials of freshwater gastropod species described by C.A. Westerlund and accepted in current malacological taxonomy: a taxonomic and nomenclatorial study. *Ruthenica: Russian Malacological Journal*, 23(2): 79–108.

Vinarski M.V., Nekhaev I.O., Palatov D.M. 2013b. Finding of molluscs of the genus *Aplexa* (Gastropoda: Pulmonata: Physidae) in the waterbodies of the northern part of Western Siberia. *Byulleten' Dal'nevostochnogo Malakologicheskogo Obshchestva*, 17: 142–150 [In Russian].

Vinarski M.V., Schniebs K., Glöer P., Nekhaev I.O., Hundsdoerfer A. 2014. The structure of species in the great pond snail, *Lymnaea stagnalis*: a multidimensional approach. In: *The 6th International Symposium of Integrative Zoology. 23-30 November 2014, Bejing, China*. Bejing: 10.

Volkova L.A. 1974. The higher aquatic vegetation of lakes of the Kola Peninsula. In: *Lakes of different landscapes of the Kola Peninsula. Part 2. Hydrochemistry and Hydrobiology*. Nauka, Leningrad: 63–77 [In Russian].

Welter-Schultes F. 2012. *European non-marine molluscs: a guide for species identification*. Planet Poster Editions, Göttingen, 674 pp.

Westerlund C.A. 1871. Exposé critique des mollusques de terre et d'eau douce de la Suède et de la Norvège. *Nova Acta Societatis Regiae Scientiarum Upsaliensis, ser. 3*, 8(1): 1–200.

Westerlund C.A. 1873. *Fauna molluscorum terrestrium et fluviatilium Sueciae, Norvegiae et Daniae. 2. Sotvatten Mollusker*. O.W. Backmann, Stockholm, 297–651 pp.

Westerlund C.A. 1875. Malakologische Studien, Kritiken und Notizen. *Malakozoologische Blätter*, 22: 98–117.

Westerlund C.A. 1881. Malakologiska bidrag. II. För Vetenskapen nya Land- och Sötvatten Mollusker. *Öfversigt af Kongliga Vetenskaps-Akademiens Förhandlingar*, 4: 50–70.

Westerlund C.A. 1894. Specilegium Malacologicum. Neue Binnen-Conchylien aus der Paläarktischen Region. *Nachrichtsblatt der Deutschen Malakozoologischen Gesellschaft*, 26: 190–205.

Westerlund C.A. 1897. Synopsis molluscorum extramarinorum Scandinaviæ (Sueciæ, Norvegiæ, Daniæ & Fenniæ). *Acta Societatis pro Fauna et Flora Fennica*, 13(7): 1–238.

Yakovlev B.A. 1961. *Climate of the Murmansk Region*. Murmansk Book Publ., Murmansk, 180 pp [In Russian].

Yakovlev V.A. 2005. *Freshwater zoobenthos of northern Fennoscandia (diversity, structure and anthropogenic dynamic). Part 2*. Kola Scientific Centre of the Russian Academy of Sciences, Apatity, 145 pp [In Russian].

Zhadin V.I. 1933. *Freshwater molluscs of the USSR*. Lensnabtekhizdat, Leningrad, 232 pp [In Russian].

Zhadin V.I. 1952. *Molluscs of fresh and brackish waters of the USSR*. The Academy of Sciences of the USSR Press, Moscow–Leningrad, 376 pp [In Russian].

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