

Modern Distribution of Gastropod Mollusks of the Family Viviparidae (Caenogastropoda) in Continental Water Bodies of Eurasia

V. V. Anistratenko^a, E. V. Degtyarenko^b, O. Yu. Anistratenko^{a, c}, and L. A. Prozorova^d

^a *Schmalhausen Institute of Zoology, National Academy of Sciences of Ukraine, Kiev, 01601 Ukraine*

^b *National University of Life and Environmental Sciences of Ukraine, Kiev, 03041 Ukraine*

^c *Institute of Geological Sciences of Ukraine, National Academy of Sciences of Ukraine, Kiev, 01601 Ukraine*

^d *Institute of Biology and Soil Science, Far East Branch, Russian Academy of Sciences, Vladivostok, 690022 Russia*
e-mail: anistrat@izan.kiev.ua, oomit@mail.ru, anistrat@rambler.ru, lprozorova@mail.ru

Received January 25, 2013

Abstract—Modern distribution of ovoviviparous mollusks of the genera *Viviparus* and *Contectiana* of the family Viviparidae has been considered for the first time in general for Eurasia. Original, museum, and literature data that have been accumulated to date on the spread of these Palearctic genera were summarized and analyzed. The modern boundaries of the distribution of Viviparidae in water bodies of the region were established, and biogeographical changes were mentioned that have occurred over the past 40 years. Information on the habitats of *Viviparus* and *Contectiana* are presented in general for Eurasia and in more detail for Ukraine. It was revealed that, with the overall stability of the habitats of these Palearctic genera, there are fluctuations in the distribution of their representatives in the basins of some rivers in Eurasia and acquisition of new and/or loss of former habitats in Eastern Europe and Western Siberia. The uneven distribution of these genera on the territory of Ukraine and their absence in the area of the Sea of Azov coast, which are not associated with the presence of geographical barriers, were shown.

Keywords: biogeography, Caenogastropoda, Viviparidae, *Viviparus*, *Contectiana*, Eurasia, Palearctic

DOI: 10.1134/S1062359014090027

INTRODUCTION

In modern conditions, the natural boundaries of the habitats of many species change their outline as a result of environmental changes sufficiently rapidly. In this regard, regular comparative analysis of geographical distribution and registration of colonization of new territories or, on the contrary, displacement from certain habitat regions is an objective criterion of the dynamics of habitats of living organisms. Along with the expansion of the habitat, the opposite pattern can be observed; regression cases also require registration and analysis of the causes and possible consequences. We studied the above-mentioned processes using a family of mollusks Viviparidae Gray 1847 as the example, among which there are also species that expand or reduce their areal independently or with the human intermediation.

The superfamily Viviparoidea is quite rich in modern and especially fossil species. At present there are about 150 species combined into approximately 30 genera (e.g., Franke et al., 2007) or, according to other estimates, more than 500 species relating to 22–26 taxa of the genus group (Prozorova and Anistratenko, 2012). Taking into account the paleontological data,

the diversity of Viviparoidea has, at least, doubled since by the present time there have been described at least 26 extinct genera and subgenera of Viviparidae (Seninski, 1905; Thiele, 1931; Wenz, 1938–1944; Popova et al., 1970; Starobogatov, 1985; Anistratenko and Gozhik, 1995; Datsenko, 2008; and others).

Discussion of this vast group requires some clarification regarding the system that was used, because there is still no common understanding among malacologists of the scope and status of the taxa that are attributable to Viviparidae.

According to the taxonomy practiced mainly by malacologists in the former Soviet Union (Sitnikova and Starobogatov, 1982; Starobogatov et al., 2004; Prozorova and Sitnikova, 2012), Viviparidae of continental water bodies of the globe are combined in the superfamily Viviparoidea Gray 1847 represented by families Viviparidae Gray 1847, Lioplacidae Gill 1863, Bellamyidae Röhrbach 1937, and Amuropaludinae Kruglov et Pavluchenkova 1995. In earlier (Starobogatov, 1970) and some modern works (Bouchet and Rocroi, 2005, and others) the family Viviparidae divided into 3 subfamilies—Viviparinae s. str., Lioplacinae (=Campelominae Thiele 1929), and

Bellamyinae. Taking into consideration the significant anatomical distinction of these groups, we believe their rank justified and accept Viviparidae as one of the families of the superfamily Viviparoidea (Prozorova and Anistratenko, 2012).

In Eurasia, three out of four of these families of Viviparidae are known, while representatives of Lioplacidae are endemic to Eastern North America. The family Viviparidae has generally a holoarctic distribution; one genus *Leopaludina* Starobogatov 1985 inhabits North America, which undoubtedly belongs to Viviparidae. In the Eurasian part of the area, representatives of Viviparidae do not go beyond the Palearctic boundaries. In the southeastern part of Asia, Viviparidae from other families live (Amuropaludinidae Kruglov et Pavluchenkova 1995 and Bellamyidae Röhrbach 1937) that, on the contrary, do not penetrate into the Palearctic through the northern boundaries of the Sino-Indian (Starobogatov, 1986; Kruglov and Starobogatov, 1993; Prozorova, 2001) or Amur transition (Berg, 1962) areas. Thus, when discussing the geography of the family Viviparidae, we speak about the distribution of this group only in the Palearctic part of Eurasia, where the family is represented by two genera—*Viviparus* Montfort 1810 and *Contectiana* Bourguignat 1880.

More than 40 years have passed since the last detailed and at the same time scale revision of Viviparidae of the globe (Starobogatov, 1970). Over this time there has been significant anthropogenic restructuring in the hydrography and hydrology of Eurasian continental water bodies resulting in changes in the fauna.

In the present study we tried to establish the current borders of distribution of Viviparidae in the waters of the region and to define their possible changes for the specified period.

To solve this problem we have summarized and analyzed original, museum, and, partially, literature data accumulated to date on the spread of both Palearctic genera of Viviparidae (Bourguignat, 1862, 1880; Kobelt, 1909; Franz, 1932; Zhadin, 1928, 1952; Zilch, 1955; Starobogatov, 1970; Chernogorenko and Starobogatov, 1987; Chernogorenko, 1988, 1989; Pavlyuchenkova, 1997; Anistratenko and Anistratenko, 2001; Falkner et al., 2001; Lazutkina, 2004; Beryozkina and Arakelova, 2010; Horsák et al., 2010; Anistratenko et al., 2012; and many others).

MATERIAL AND METHODS

During this study, extensive collections of the family Viviparidae were made on the territory of Russia, Ukraine, the Caucasus, and the adjacent countries of southern Europe and the relevant literature was reviewed. The most representative material was collected and summarized by the authors from water bodies of different types of all natural and geographic zones of Ukraine and partly of the neighboring coun-

tries during the period of 1984–2012. The geographical data of all samples containing Viviparidae were considered from the collection of the Laboratory of Zoogeography, Institute of Zoology, National Academy of Sciences of Ukraine, including sporadic collections of individual persons (see Acknowledgements). In addition, the museum catalogues of collections of the Zoological Institute, Russian Academy of Sciences, St. Petersburg, Russia and the National Museum of Natural History, National Academy of Sciences of Ukraine, Kiev, Ukraine were used.

All the most important primary data available for us on findings of Viviparidae of both genera were mapped (Figs. 1, 2). Literature data on the geography of Viviparidae in Eurasia were only considered in general terms and are partly reproduced on the maps. Since this paper discusses the distribution of the genera *Viviparus* and *Contectiana*, and not individual species, literature data and information of museum catalogs were used without re-identification of the materials and considering the differences of taxonomic approaches. The validity of such a decision is based on the fact that belonging to a genus within Viviparidae is easily determined by the mollusk shell of any age. In addition, the determinations practiced by foreign colleagues of the type of “*Viviparus viviparus*” and “*Viviparus contectus*” correspond to our ideas on mollusks belonging to the genera *Viviparus* and *Contectiana* (Fig. 1).

RESULTS AND DISCUSSION

General Notes on the Geography of Viviparoidea

It is known that within the superfamily Viviparoidea, the family Bellamyidae is the most widespread and prosperous group of viviparids which is represented in Africa, East Asia, and Australia (e.g., Starobogatov, 1970, 1985). Some species of this family have also been introduced at present in Europe (Soes et al., 2011) and North America (Sengupta et al., 2009). Representatives of *Bellamyia* Jousseaume 1886 mainly live in Africa and the Indostan Peninsula (except the Lower Ganges), while in the Southeast Asia the generic diversity of Viviparoidea is much higher. This suggests the East Asian as the region where the genetic diversity of the superfamily was initially formed (Starobogatov, 1970).

The family Amuropaludinidae is most close to Bellamyidae, which was initially established as endemic for Amur River, but is perhaps also spread in more southern basins, for example, in the Yangtze and Mekong. Compared with Bellamyidae, representatives of Viviparidae (Europe and North America) and especially Lioplacidae (eastern North America) have much less broad geographical ranges (Prozorova and Anistratenko, 2012).

The distribution of genera between the European and the American parts of the areal of the family Viviparidae is more or less even and is as follows. In Europe, representatives of two, and in North America,

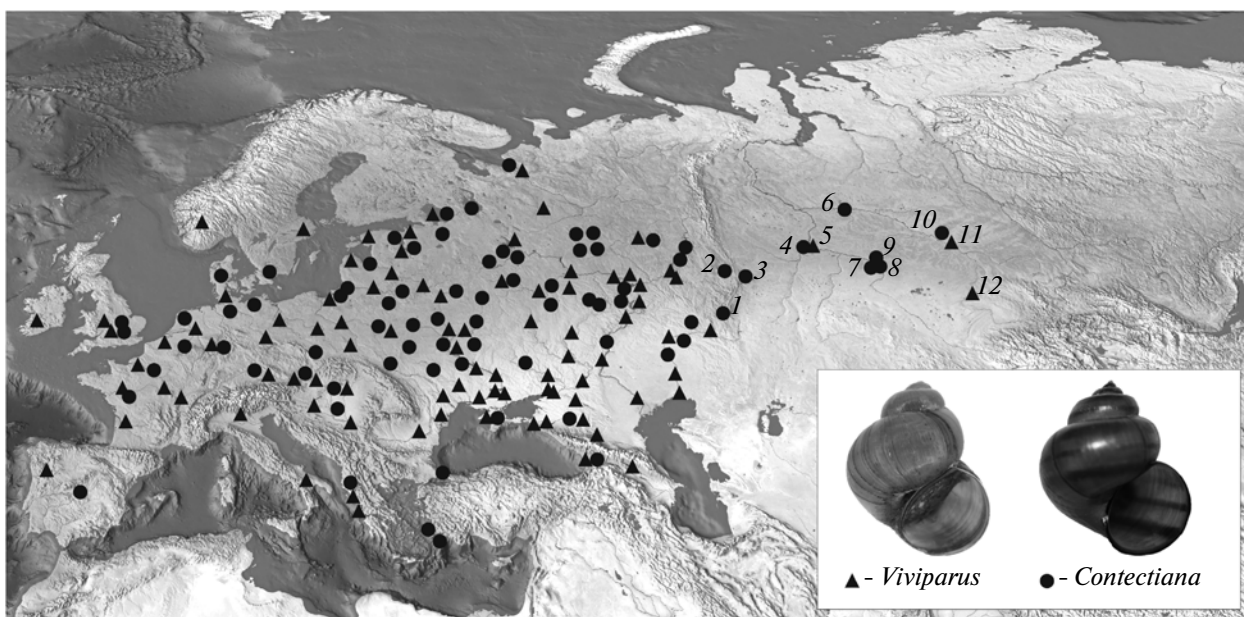


Fig. 1. Distribution of Viviparidae of the genera *Viviparus* and *Contectiana* in Eurasia. The numbers show the known findings of Viviparidae in the Urals and Western Siberia: 1—several locations in the mountains of the Southern Urals (Lazutkina, 2003); 2—locations in the Middle Urals (Lazutkina, 2003); 3—floodplain ponds of the Kalinovka River—a tributary of the Iset' River in the vicinity of Yekaterinburg (the Middle Urals, Irtysh basin) (Khokhutkin, 1971); 4—Nerda River (Irtysh basin), Tobol'sk regions, Tyumen' oblast (Khokhutkin et al., 2003); 5—kurya of the Irtysh River below the city of Tobol'sk, Tyumen oblast (collection by M.V. Vinarski, 2009); 6—waters in the vicinity of the village Salym, Nefteyugansk region, Khanty-Mansiisk Autonomous Area (personal communication by M.V. Vinarski according to data of the Zoological Museum of the Institute of Plant and Animal Ecology, Ural Branch of Russian Academy of Sciences, Yekaterinburg); 7—Lake Anan'evskoe (Irtysh basin), Tarsk region, Omsk oblast (Lazutkina, 2004); 8—Krivoe Lake (Irtysh basin), Tarsk region, Omsk oblast (Lazutkina, 2004); 9—waters in the vicinity of the settlement Ekaterinskoe (Irtysh basin), Tarsk region, Omsk oblast (Mozley, 1936); 10—waters of the surroundings of the city of Narym (the Middle Ob), Tomsk oblast (Vnukovski, 1929); 11—waters of the surroundings of Narym (the Middle Ob), Tomsk oblast (Johansen, 1934); 12—the Novosibirsk reservoir (Andreev et al., 2008).

of 3–4, nominal genera live, one of which (*Viviparus*) was previously considered as common to both the regions (Starobogatov, 1970, and others). Nevertheless, using molecular genetic methods, data recently obtained do not relate American "*Viviparus*" *georgianus* (Lea 1834) to a single cluster with the European representatives of the genus *Viviparus* (David Campbell, personal report). This agrees with the results of comparison of morphological features of the embryonic shell of "*Viviparus*" *georgianus* with European Viviparidae (V. Anistratenko, unpublished data). That is why when considering the habitat of the representatives of the family Viviparidae we assume that both the genera considered here (*Viviparus* and *Contectiana*) are limited in their distribution to the Eurasian continent. At the same time, as indicated above, species are found in North America that are similar in conchology to *Viviparus*, but belong to a separate genus (*Leopaludina*) of the same family.

Features of Distribution of the Genera Viviparus and Contectiana in Eurasia

The area of distribution of *Viviparus* in Europe covers almost all its territory, the eastern and southern parts of the Black Sea coast and Western Transcaucasia

(Fig. 1). Viviparids are only absent in the waters of the southwestern sector of the Iberian Peninsula, as well as in a part of the far north and south of Europe. Other notable gaps in the distribution of the genus have not been found, and therefore, the European range of *Viviparus* can be somewhat conventionally considered complete. Currently viviparids of Europe are actively being studied including from the viewpoint of their conservation in nature and have not yet caused serious fear (Cuttelod et al., 2011). At the same time, some species, such as *Viviparus ater* (Cristofori and Jan 1832), are known in Western Europe in a few localities (Soes et al., 2009). Limitation in distribution will probably serve as a basis for assigning them the protective status, although there are not enough data yet.

Unlike *Viviparus*, the genus *Contectiana* includes several nominal species that have a relatively limited range and a low population density. First of all, these are species of the subgenus *C. (Kobeltipaludina)* Chernogorenko et Starobogatov 1987: *C. fennica* (Kobelt 1909), *C. turrita* (Kobelt 1909) and *C. kormosi* (Kobelt 1909) confined to the lakes of the Baltic Basin and, probably, the North Sea Basin (Red Data Book of Nature of the Leningrad Region, 2002; Red Data Book of Nature of St. Petersburg, 2004; Starobogatov et al., 2004). The species *C. ladogensis* Chernogorenko

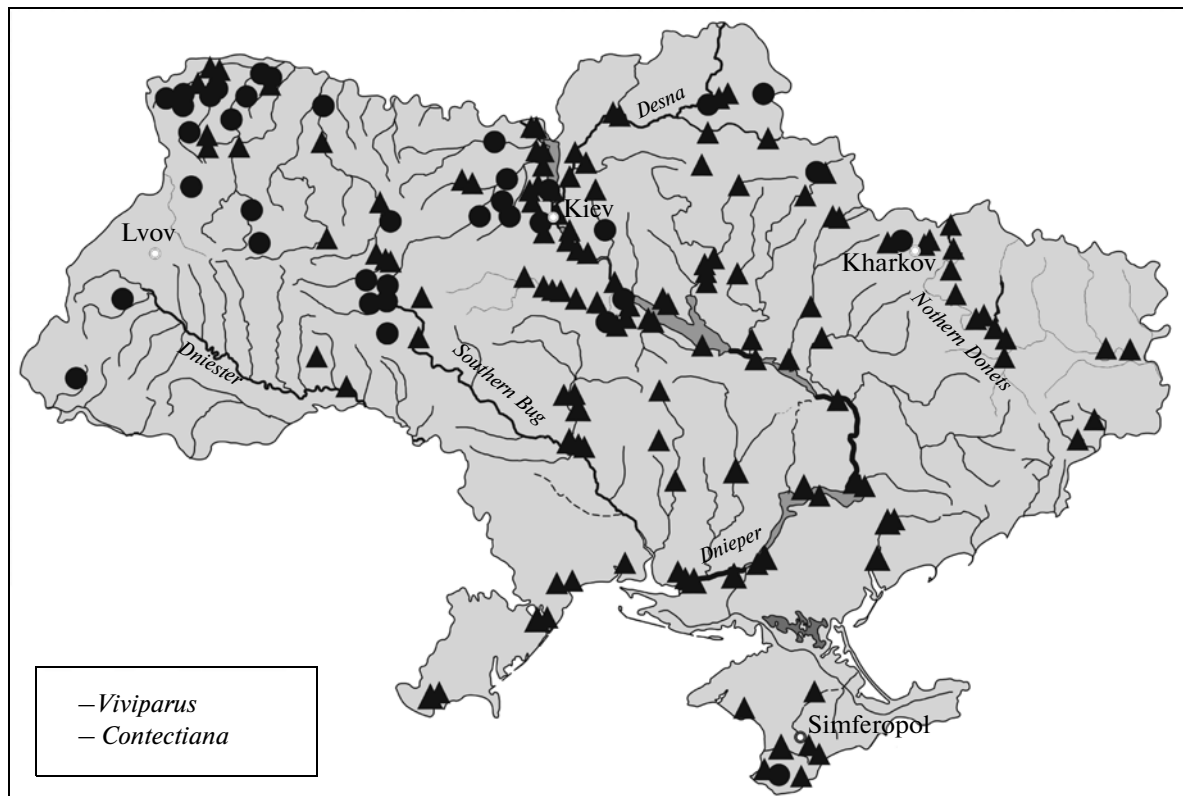


Fig. 2. Distribution of Viviparidae in Ukraine.

et Starobogatov 1987 has been so far known only from the type locality—Lake Ladoga (Chernogorenko and Starobogatov, 1987; Red Data Book of Nature of the Leningrad Region, 2002; Red Data Book of Nature of St. Petersburg, 2004). Within Ukraine, the species of the subgenus *Kobeltipaludina* are also rare and are listed only in the fauna of Shatsk Lakes (Chernogorenko, 1989). To clarify the distribution, as well as to solve the question of their independence, special research is needed. In addition to academic interest, the study of the taxonomy of this group of species is important due to the threat of their extinction and the need for protective measures that have not seemed necessary in relation to species of the genus *Viviparus*. Meanwhile, it is possible that these species of *Contectiana* represent local morphs (subspecies) of a widespread *C. listeri* (Forbes et Hanley 1849). The latter has the most extensive habitat, not only among *Contectiana*, but also probably among all Viviparidae of Eurasia. This species of viviparids is typically referred to in the literature as *Viviparus contectus* (Falkner et al., 2001; and others). However, *Contectiana contecta* (Millet 1813) in our understanding is clearly distinguished from *C. listeri* by the morphology of shells; it is found in Europe quite rarely and its area is limited to the Baltic Sea basin and the central part of the Danube and the Dnieper. The most common species of the genus *Contectiana* in Europe, which is accepted as

“*Viviparus contectus*,” should be referred to as *C. listeri* (Zilch, 1955; Chernogorenko, 1988; Anistratenko, Chernogorenko, 1989, Levina, 1992; Starobogatov et al., 2004; and others). It inhabits the waters of almost all Europe from the south of England to the Urals and penetrates to the south of Western Siberia to the right bank of the Ob River (Fig. 1).

The western border of the *Viviparus* and *Contectiana* range is formed by the Atlantic coast of Europe. Inhabitation of Viviparidae here is confirmed by publications in recent years (Falkner et al., 2001; Soes et al., 2009; Welter-Schultes, 2012; and others) and does not require clarification. The eastern boundary of the geographical range of these genera is located almost in the center of Eurasia—in Western Siberia (Starobogatov, 1970; Starobogatov et al., 2004) in the Ob basin. This is of the greatest biogeographic interest and requires special discussion, due to the wide variety of river and lake water bodies in Western Siberia, wherein species of both the genera *Viviparus* and *Contectiana* can penetrate. For example, a case of expansion of *V. viviparus* (Linnaeus 1758) was recently reported in the Novosibirsk Reservoir (Andreev et al., 2008). It is obvious that some regions within the area primarily populated with viviparids can turn out to be free of them at present.

It is known that European freshwater mollusks have been introduced in Western Siberia easily and

repeatedly. These processes were activated in the Miocene, when the sea within the West Siberia epicontinental basin regressed completely resulting in a situation in which the local malacofauna became a variant of the Palearctic at the end of the Eopleistocene (Starobogatov, 1970). Plain regions of the basin of the Irtysh and Ob are considered to have been the corridor of distribution of European freshwater mollusk species in the eastern direction during the Pleistocene and Holocene (Krivosheina and Starobogatov, 1973). Perhaps, this is the lake–river network of left tributaries of Irtysh which contributed to penetration of many elements of the European malacofauna into the south of Western Siberia from Europe, in particular, representatives of Viviparidae. It should be noted that the Ural Mountains not only did not interfere, as was noted for other groups of mollusks (Pirogov et al., 1994), but also may have contributed to the penetration of the Volga viviparids into the Ob basin. The basis for this conclusion is the detection of viviparids not only on the western slopes, but in the mountainous part of the Middle and Southern Urals (Lazutkina, 2003), including the waters of the Ob system (Khokhutkin, 1971).

It was previously shown that the natural border of the species *Viviparus* to the east runs from north to south along the Urals, including Western Transcaucasia (Zhadin, 1952; Starobogatov, 1970, 1977). According to our data, the Caucasian section of the border has remained in the same place since we found *Viviparus* in Georgia in Paleostomi Lake and the Pichora River (Fig. 1). However, the eastern limit of the genus range markedly moved in the Siberian direction.

In the waters of Western Siberia, viviparids have been known since the beginning of the last century, since the discovery of *C. contecta* around the settlement Narym in the basin of Ket' River, the right tributary of the Middle Ob (Vnukovski, 1929). After some time, B.G. Johansen confirmed this fact but also noted that in addition to this species there was *V. duboisianus* Mousson 1863 (= *V. viviparus* L. 1758) in Siberia (Johansen, 1934). The presence of *V. viviparus* in the Ob basin was disputed by A. Mozley who considered that there had been a mess of labels (Mozley, 1936). In addition, Mozley himself reported a finding of the species of the group *Contectiana* resulting in the situation in which the point of view by Mozley was adopted in subsequent papers (including authorship by Joganzen) and only one species of viviparids was on the list (Joganzen and Novikov, 1971, and many others). At the beginning of the 1990s, *V. viviparus* was again registered in the Middle Ob, this time in the Novosibirsk water reservoir (Selezneva, 2005; Andreev et al., 2008).

Compared with *Viviparus* representatives of *Contectiana* are not rare in the southern part of Western Siberia. After the first finding in the vicinity of Narym (Vnukovski, 1929), they were regularly recorded in the middle part of the Ob (Johansen, 1934; Joganzen and

Novikov, 1971; Lazutkina, 2004; and others) and in Irtysh basins (Mozley, 1936; Khokhutkin, 1971; Lazutkina, 2004; and others). According to materials of the malacologic collection of the Institute of Plant and Animal Ecology, Ural Branch, Russian Academy of Sciences, *Contectiana* are found not only in the plains and lowlands, but in the waters of the Ural mountain country (Lazutkina, 2003), and not only in the Volga basin, but also in the Ob basin (Khokhutkin, 1971).

West Siberian *Contectiana* were identified to differently at different times: *Viviparus contectus* (Starobogatov, 1970, 1977; Khokhutkin, 1971; and others), *Viviparus fasciatus* (Müller 1774) (wrongly, as this name is a synonym of *Viviparus viviparus*) (Mozley, 1936), and finally as *Contectiana listeri* after revision of modern Viviparidae of Europe (Chernogorenko and Starobogatov, 1987, and others) in all subsequent regional studies.

Summarizing the above data, we can state that in general the outlines of habitat of *Viviparus* and *Contectiana* remain stable; the picture presented by Starobogatov (1970) has changed insignificantly. Over the past decade, Viviparidae moved westward of the Pyrenees; they were registered in Spain and northern Portugal (Welter-Schultes, 2012). However, in the trans-Urals of Eurasia, these mollusks are still known from only a few localities (Fig. 1). According to Sharapova (2008), the ecological barrier for the penetration of both European and East Siberian species in the waters of Western Siberia is the natural properties of the latter—long freeze-up, the annual winter kill, and low mineralization of water in the taiga and tundra zones. For these reasons, the appearance of species here from neighboring regions is determined by making here of artificial reservoirs: reservoirs and especially cooling ponds that have comparatively mild hydrological conditions. For example, in the cooling pond of the Tyumen heat and power plant, four alien species of gastropods have recently been found for the first time (Sharapova, 2008), and although none of them are viviparids, there is an ecologically similar European species *Borysthenia naticina* (Menke 1846). Earlier in a cooling pond of Belovo hydropower plant, an exotic species from the family Ampullariidae was found (Yanygina et al., 2005), which is related to Viviparidae.

To date, the finding of *Contectiana* in the area of Nefteyugansk can be considered the most northerly found of viviparids within West Siberia (Fig. 1). The most eastern reliable discover of Viviparidae in this region is associated with artificial reservoirs and possibly, unintentional introduction. As mentioned above, in the Novosibirsk water reservoirs *V. viviparus* appeared as early as in the 1990s, after a decade and a half they have completely settled down here (Selezneva, 2005) and, after a complete cycle of naturalization, will undoubtedly play a significant role in the zoobenthos in this water body (Andreev et al., 2008).

*Notes on the Geography of Viviparidae
on the Territory of Ukraine*

In addition to the overall picture of distribution of viviparids in Eurasia, we considered the Ukrainian part of the ranges of *Viviparus* and *Contectiana* in more detail as a model of their regional fauna. In particular, the changes were characterized that have occurred in the past century. For this, extensive original as well as museum material, and partly published literature data on the occurrence of Viviparidae in Ukraine and in the adjacent areas of some neighboring countries were analyzed (Puzanov, 1927; Zhadin, 1952; Starobogatov, 1970, 1977; Chernogorenko, 1989; Levina, 1992; and others).

According to the results, mollusks of the family live in rivers and lakes of all natural regions of Ukraine, including the Crimea (Fig. 2). They are found without significant geographical lacunas, forming a nearly complete network of populations (Anistratenko et al., 2012). Gaps in the network are mainly determined by insufficient knowledge of the territory (most of the Dniester River basin) or the lack of suitable biotopes (the Carpathians and the Crimean Mountains).

A special case is the Ukrainian part of the Sea of Azov coastal region, a well-studied region, where there are well-suited ecological conditions for viviparids. We have collected material here for a number of years on a dense grid of routes, but *Viviparus* were only discovered in the region of the Molochnaya River (Fig. 3). *Viviparus* are quite common from the mouth to the headwaters of the river at the confluence of the Chingul River (Degtyarenko, 2009). However, in waters eastward of Molochnaya—from the Domuzla River to the Berda River inclusive, Viviparidae have never been found for all years of observations (2000–2010) despite the fact that the main hydrological characteristics of these waterflows are quite similar to those of the Molochnaya River and its tributaries.

From the zoogeographical point of view, the indicated regional asymmetry in the distribution of viviparids during the absence of an obvious geographical or ecological barrier is extremely interesting. Representatives of the family Viviparidae have a very high vagility (i.e., the ability to distribute) and, due to ovoviviparity, are able to form a population in a place suitable for their habitat with a small number of the founder specimens. Then how can we explain such selectivity of viviparids?

One should pay attention to the fact that in the Molochnaya River *Viviparus* live exclusively in the mainstream and are absent even in major tributaries. For other rivers in Ukraine, this is absolutely atypical—in the middle basin of the Dnieper, Viviparidae are found in small rivers and even in tributaries of the second and third order. Certain light is shed on this mystery by the fact that all the rivers of the Azov region have a slightly elevated alkalinity (pH of about 8) as compared with waters of rivers of the Black Sea coastal

region with a neutral or weakly acidic reaction (Mel'nikov and Chaplina, 1961; and others). Since this is the only general characteristic of the rivers of the Azov region known to us, we associate the increased alkalinity of water with the absence of *Viviparus* here, as well as some other trivial species. For example, *Lithoglyphus naticoides* (C. Pfeiffer 1828), *Bithynia tentaculata* (Linnaeus 1758), *Valvata cristata* (O.F. Müller 1774), *Planorbarius corneus* (Linnaeus 1758), *Dreissena polymorpha* (Pallas 1771), and some other mollusks which commonly live in the rivers of the Black Sea basin (Anistratenko et al., 2010; Degtyarenko, 2011) have not been found in any of the rivers of the Ukrainian Azov region in recent years. However, these species were common in the waters of the Sea of Azov coastal region until the 1970s and “fell” from the mollusk fauna of region over the past 30–40 years (Degtyarenko and Anistratenko, 2013). These facts point to a degradation of water quality, which is undoubtedly also a factor in limiting the distribution of viviparids in the Sea of Azov region. It is possible that the high alkalinity of the water prevents inhabitation also by species of the genus *Contectiana* in the river basins of northern part of the Sea of Azov region. In fact, despite the lack of large lakes or ponds in this area, where they usually live, almost every river has a series of reservoirs, dams, etc. (Degtyarenko, 2009).

Comparison of the geography of the discussed genera within Ukraine shows that the distribution of *Contectiana* in water bodies of Ukraine (Fig. 2) is not as uniform as that of *Viviparus*. We have revealed a significant depression in population density of *Contectiana* in the direction from west to east. Thus, in the waters of the western regions, primarily in the Volyn region, they are almost ubiquitous and are represented by fairly dense populations (15 individuals/m² or higher). In Khmel'nitskyi oblast, *Contectiana* are often found even in small dams and small rivers in the coastal zone, often with *Viviparus*, while *Contectiana* usually dominate. In the central forest–steppe regions (Vinnitsa and Cherkassy oblast), mollusks of the genus *Contectiana*, on the contrary, are found relatively rarely than *Viviparus* (less than 1 individual/m²), and they are absent in many water bodies suitable for their habitat. Eastern regions of Ukraine are mainly inhabited by species of the genus *Viviparus*, whereas *Contectiana* are almost absent here (Anistratenko et al., 2012). In the waters of the Crimean Peninsula, Viviparidae are recorded relatively rarely, although species of both genera discussed are known in the Chernaya River (Puzanov, 1927; Prokopov, 2003).

Thus, currently *Contectiana* mainly inhabit the northwestern and partly the central sector of Ukraine. Old indications on findings of “*Viviparus contectus*” in Kharkov (catalog of the Institute of Zoology, RAS) and some other areas are likely to belong to extinct populations.

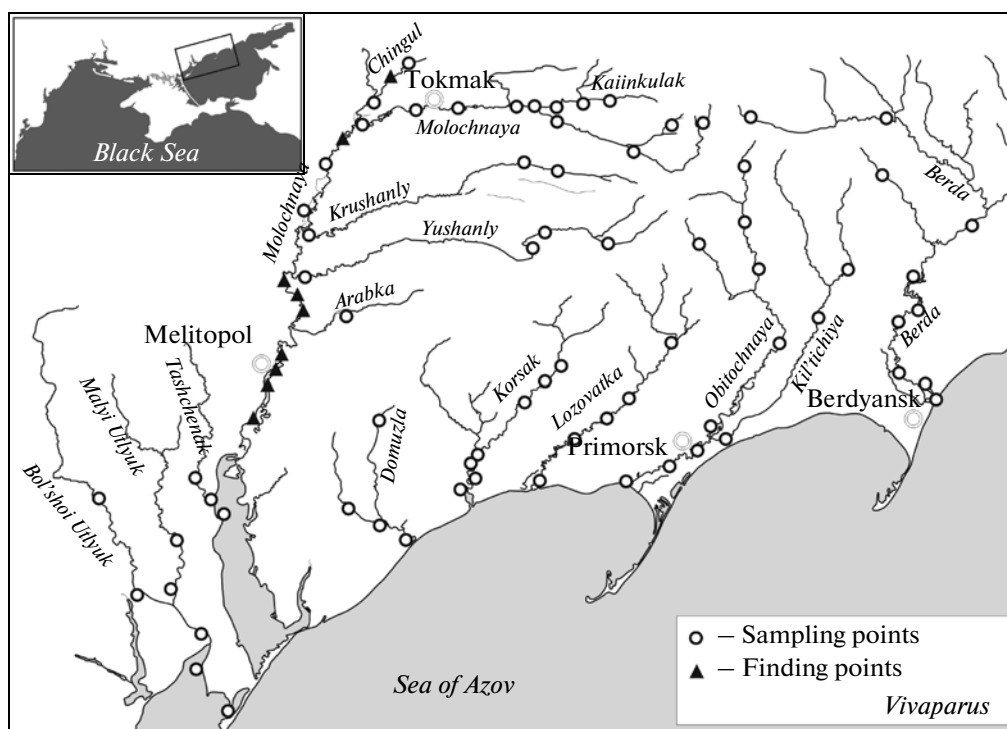


Fig. 3. Distribution of *Viviparus* in reservoirs of Ukrainian part of the Sea of Azov coastal region.

CONCLUSIONS

The geographical range of Viviparidae in Eurasia has retained its stability. The overall picture of the distribution of viviparids on the scale of the Palearctic constructed using our data differs insignificantly from that given by Starobogatov (1970). However, this similarity is only revealed at the level of the areal of the entire family, as in the monograph by Starobogatov, all Palearctic viviparids were considered within the single genus (*Viviparus*). In this paper, data on the geography of Viviparidae are given separately for the genera *Viviparus* and *Contectiana*.

Changes in the distribution of *Viviparus* and *Contectiana* over the past 40 years were mainly in the outlines of the marginal parts of their ranges. They occupy new and/or lose their former habitats, what is observed, for example, in Eastern Europe and Western Siberia. These fluctuations in the edge regions of the habitat of Viviparidae can only be marked in very general terms, since the scale of the region is not comparable to the number of mollusk samples stored even in the largest collections.

In the western part of the Palearctic, Viviparidae were significantly indicated westward of the Pyrenees, and in the east they remain within the basin of the Middle Ob. At a stable high abundance of mollusks in waters in Eastern Europe and even spread due to new water bodies (as happens, for example, in Russia and Ukraine), viviparids, apparently, become more rare in Western Europe.

In the European part of the areal of *Viviparus* and *Contectiana*, reduction and depression of their populations can be mentioned. Perhaps, Viviparidae over time will need protection at least in some regions.

In Ukraine Viviparidae inhabit the waters of all natural and geographic zones, but each of the genera is represented unevenly across regions. For such a relatively small region, we obtained a more detailed picture of the distribution of viviparids and, accordingly, clearer regularities were recorded. In the western, central, and northeastern regions, *Viviparus* and *Contectiana* live together (in this case *Contectiana* dominate locally in the West). In the south and southeast of the country, ponds are inhabited with almost only species of the genus *Viviparus*. In addition, in the Ukrainian Sea of Azov coastal region, a geographical lacuna was revealed in the habitat of Viviparidae, probably related to the hydrochemical characteristics of surface waters in the region.

ACKNOWLEDGMENTS

We are deeply grateful to T.L. Aleksenko (Hydrobiological Station of the National Academy of Sciences of Ukraine, Kherson), R.V. Babko, E.S. Kudlay, M.V. Tarashchuk (Institute of Zoology of the National Academy of Sciences of Ukraine, Kiev), V.A. Chumak, V.V. Krasovskaya (Uzhgorod National University, Uzhgorod), I.S. Mityai (National University of Life and Environmental Sciences of Ukraine, Kiev),

E.S. Zhitova (Zhitomir National Agrarian University, Zhitomir), S.N. Pisarev (Kramatorsk City Center of Extracurricular Activities, Kramatorsk), Z.V. Tsegel'nik (Cherkassy National University, Cherkassy), V.V. Bogatov (Biology and Soil Science Institute, Far East Branch, Russian Academy of Sciences, Vladivostok) for the material of Viviparidae provided from different regions of Ukraine, Russia, and Poland. We specially thank Bruno Dell'Angelo, Genova, Italy, for assistance in obtaining samples of Viviparidae from Italy and Sweden. Mollusks for the work with the museum collections and catalogues were kindly provided by L.L. Yarokhnovich (Institute of Zoology, Russian Academy of Sciences, St. Petersburg) and S.G. Pogrebnyak (National Museum of Natural History, National Academy of Sciences of Ukraine, Kiev). We thank M.V. Vinarski (Omsk State Pedagogical University, Omsk) and an anonymous reviewer for critical comments, important additions, and useful discussion during the preparation of the manuscript.

This work was supported by the program of joint projects, National Academy of Sciences of Ukraine and the Russian Foundation for Basic Research (project nos. 08-04-12 (U), 12-04-90408-Ukr_a) and a project of the Division of Biological Sciences, Russian Academy of Sciences (12-1, P30-01).

REFERENCES

- Andreev, N.I., Andreeva, S.I., Vinarski, M.V., Lazutkina, E.A., and Selezneva, M.V., *Viviparus viviparus* L., 1758 (Mollusca: Gastropoda): A new species in the fauna of Novosibirsk Reservoir, *Materialy Mezhdunar. konf. "Sovremennoe sostoyanie vodnykh bioresursov," 26–28 marta 2008 g* (Proc. Int. Conf. "Current State of Water Resources," March 26–28, 2008), Novosibirsk, 2008, pp. 118–120.
- Anistratenko, V.V. and Anistratenko, O.Yu., *Fauna Ukrainy* (The Fauna of Ukraine), vol. 29: *Mollyuski* (Mollusks), fasc. 1, b. 1, Kiev: Veles, 2001.
- Anistratenko, V.V. and Chernogorenko, E.V., The fauna and ecology of gastropods in the Middle Dnieper basin, *Vestn. Zool.*, 1989, no. 2, pp. 3–6.
- Anistratenko, V.V. and Gozhik, P.F., Molluscs of the families Neritidae, Viviparidae, Lithoglyphidae, and Pyrgulidae (Gastropoda, Pectinibranchia) from Kimmerian deposits of Abkhazia, *Vestn. Zool.*, 1995, vol. 29, no. 1, pp. 3–13.
- Anistratenko, O., Degtyarenko, E., and Anistratenko, V., Shell and radula comparative morphology of the Gastropod Molluscs family Valvatidae from the North Black Sea coast, *Ruthenica*, 2010, vol. 20, no. 2, pp. 91–101.
- Anistratenko, O.Yu., Degtyarenko, E.V., and Anistratenko, V.V., On geographic distribution of viviparids (Mollusca: Gastropoda: Viviparidae) in Ukraine, *Materialy III Mezhdunar. nauch. konf. "Sovremennye problemy gidrobiologii. Perspektivy, puti i metody reshenii," Kherson, 17–19 maya 2012 g.* (Proc. III Int. Conf. "Modern Problems in Hydrobiology: Prospects, Paths and Methods of Solution," Kherson, May 17–19, 2012), Kherson: PP Vyshemir'skii, 2012, pp. 27–31.
- Beryozkina, G.V. and Arakelova, E.S., The life-cycles and growth of some comb-branchial molluscs (Gastropoda: Pectinibranchia) in the ponds of European part of Russia, *Tr. Zool. Inst. Ross. Akad. Nauk*, 2010, vol. 314, no. 1, pp. 80–92.
- Berg, L.S., Territorial division of the Palearctic and Amur region into zoogeographic regions based on the distribution of freshwater fish species, in *Izbrannye trudy* (Selected Works), Moscow: Akad. Nauk SSSR, 1962, vol. 5, pp. 320–360.
- Bouchet, P. and Rocroi, J., Classification and Nomenclator of Gastropod Families, *Malacologia*, 2005, vol. 47, nos. 1–2, pp. 1–397.
- Bourguignat, M.J.R., Notice sur les *Vivipara* d'Europe. Les spiciles malacologiques. Extrait de la revue et Magasin de Zoologie, Chez Baillièrre et Fils Librairies, Paris, 1862, pp. 123–133.
- Bourguignat, M.J.R., *Recensement des Vivipara du système européen*, Paris: Imp. Bouchard-Huzard, 1880.
- Chernogorenko, E.V., On the species composition of viviparids (Gastropoda, Viviparidae) in Europe and West Asia, *Zool. Zh.*, 1988, vol. 67, no. 5, pp. 645–655.
- Chernogorenko, E.V., Mollusks of the families Valvatidae and Viviparidae in the Fauna of Ukraine, *Cand. Sci. (Biol.) Dissertation*, Kiev: Institute of Zoology, UkrSSR Acad. Sci., 1989.
- Chernogorenko, E.V. and Starobogatov, Ya.I., Review of the recent European Viviparidae, in *Mollyuski. Rezul'taty i perspektivy ikh issledovaniy. Vos'moe Vsesoyuznoe soveshchanie po izucheniyu mollyuskov* (Abstr. Eighth All-Union Conf. "Mollusks: Results and Prospects of Studies"), Leningrad: Nauka, 1987, pp. 145–147.
- Cuttelod, A., Seddon, M., and Neubert, E., *European Red List of Non-Marine Molluscs*, Luxembourg: Publications Office of the European Union, 2011.
- Datsenko, L.N., Late-Cenozoic Viviparoidea of the southwest part of East-European Platform, *Doctoral (Geol.) Dissertation*, Kiev: Institute of Geology, Natl. Acad. Sci. of Ukraine, 2008.
- Degtyarenko, E.V., Current status of *Viviparus viviparus* (L. 1758) (Mollusca; Gastropoda) populations in rivers of the Sea of Azov region, *Biologiya ta valeologiya. Zb. nauk. prats'* (Biology and Valeology: Collected Scientific Papers), vol. 11, Kharkiv: Kharkiv Nats. Ped. Univ., 2009, pp. 11–15.
- Degtyarenko, E.V., Mollusca species no longer inhabiting the River Molochnaya, *Vestn. Zool.*, 2011, vol. 45, no. 1, p. 34.
- Degtyarenko, E.V. and Anistratenko, V.V., Molluscs in continental waters of the North-West Azov Sea Coast: A faunistic review with notes on distribution and ecology, *Zb'ornik Prats' Zoologichnogo muzeyu NNPM NAN Ukraïni*, 2013 (2011), no. 42, pp. 13–57.
- Falkner, G., Bank, R.A., and von Proschwitz, T., Check-list of the non-marine molluscan species-group taxa of the 1 states of Northern, Atlantic and Central Europe (CLECOM I), *Heldia (Munchner Malakologische Mitteilungen)*, 2001, no. 4 (1/2), pp. 1–76.
- Franke, H., Riedel, F., Glaubrecht, M., Kohler, F., and von Rintelen, T., Evolution and biogeography of Southeast Asian viviparids (Gastropoda: Caenogastropoda), *Abstr. World Congress of Malacology, Antwerp, Belgium, 15–20 July 2007*, Antwerp: Univ. Antwerpen Press, 2007, pp. 15–20.
- Franz, V., *Viviparus*. Morphometrie, Phylogenie und Geographie der europäischen, fossilen und rezenten Paludinen, *Denkschriften der Medizinisch-Naturwissen-*

- schafilichen Gesellschaft zu Jena*, Jena: Gustav Fischer, 1932, vol. 18, part 1, pp. 1–160.
- Horsák, M., Juříčková, L., Beran, L., Čejka, T., and Dvořák, L., Annotated list of mollusc species recorded outdoors in the Czech and Slovak Republics, *Malacol. Bohemoslovaca*, 2010, Suppl. 1, pp. 1–37.
- Ioganzen, B.G. and Novikov, E.A., Results of studies on freshwater mollusks in the Middle Ob basin, *Mollyuski. Puti, metody i itogi ikh izucheniya. Chetvertoe soveshchanie po izucheniyu mollyuskov* (Abstr. Fourth All-Union Conf. “Mollusks: Results and Prospects of Studies”), Leningrad: Nauka, 1971, pp. 88–89.
- Johansen, B., The freshwater molluscs of Western Siberia, *Proc. Malacol. Soc. London*, 1934, vol. 21, pp. 28–36.
- Khokhutkin, I.M., Observations on the abundance of Lister’s river snails in water bodies of the Middle Urals, *Mollyuski. Puti, metody i itogi ikh izucheniya. Chetvertoe soveshchanie po izucheniyu mollyuskov* (Abstr. Fourth All-Union Conf. “Mollusks: Results and Prospects of Studies”), Leningrad: Nauka, 1971, p. 76.
- Khokhutkin, I.M., Erokhin, N.G., and Grebennikov, M.E., *Mollyuski: Bioraznoobrazie, ekologiya (Katalogi kolekcitsii Zoologicheskogo muzeya Instituta ekologii rastenii i zhivotnykh UrO RAN)* (Mollusks: Biodiversity and Ecology. Catalogs of Collections of Zoological Museum, Institute of Plant and Animal Ecology, Ural Branch, Russian Academy of Sciences), Yekaterinburg: Ural. Otd. Ross. Akad. Sci., 2003.
- Kobelt, W.A., Die Gattung *Paludina* Lam. (*Vivipara* Montfort). Neue Folge, in *Systematisches Conchylien-Cabinet von Martini F. und Chemnitz J.*, 1909, pp. 313–430.
- Krasnaya kniga prirody Leningradskoi oblasti* (Red Data Book of Nature of the Leningrad Region), vol. 3: *Zhivotnye* (Animals), Noskov, G.A., Ed., St. Petersburg: Mir i Sem’ya, 2002.
- Krasnaya kniga prirody Sankt-Peterburga* (Red Data Book of Nature of St. Petersburg), Noskov, G.A., Ed., St. Petersburg: Professional, 2004.
- Krivosheina, L.V. and Starobogatov, Ya.I., Composition and zoogeographic characteristics of freshwater malacofauna in the mountain part of the Upper Irtysh basin, *Zool. Zh.*, 1973, vol. 52, no. 3, pp. 348–355.
- 2 Kruglov, N.D. and Starobogatov, Ya.I., Guide to Recent mollusks of northern Eurasia: 3. Annotated and illustrated catalogue of species of the family Lymnaeidae (Gastropoda, Pulmonata, Lymnaeiformes) of Palearctic and adjacent river drainage areas. Part 1, *Ruthenica*, 1993, vol. 3, no. 1, pp. 65–92.
- Lazutkina, E.A., Freshwater pectinibranch mollusks (Mollusca: Gastropoda: Pectinibranchia) of the Urals and neighboring regions (based on materials from collections of the Zoological Museum of Institute of Plant and Animal Ecology, Ural Branch, Russian Academy of Sciences), *Problemy global’noi i regional’noi ekologii: Materialy konf. molodykh uchenykh (31 marta - 4 aprelya 2003 goda)* (Problems in Global and Regional Ecology: Proc. Young Scientists Conf., March 31–April 4, 2003), Yekaterinburg: Akademkniga, 2003, pp. 109–111.
- Levina, O.V., Mollusks of the family Viviparidae in reservoirs of the Dnieper cascade, *Gidrobiol. Zh.*, 1992, vol. 28, no. 1, pp. 60–64.
- Mel’nikov, G.B. and Chaplina, A.M., Hydrobiological and fishery characteristics of small rivers in the northern Sea of Azov region as related to their current state, in *Malye vodoemy ravninnykh oblastei SSSR i ikh ispol’zovanie* (Small Water Bodies and Their Exploitation in Plain Regions of the Soviet Union), Moscow: Izd-vo Akad. Nauk SSSR, 1961, pp. 336–345.
- Mozley, A., The freshwater and terrestrial Mollusca of northern Asia, *Trans. Royal Soc. Edinburg*, 1936, vol. 58, no. 24, pp. 605–695.
- Pavlyuchenkova, O.V., Morphofunctional and karyological analysis of mollusks of the superfamily Viviparoidea (Gastropoda, Pectinibranchia) from the faunas of Russia and neighboring areas, *Extended Abstract of Cand. Sci. (Biol.) Dissertation*, St. Petersburg: Zool. Inst. Russ. Acad. Sci., 1997.
- Pirogov, V.V., Tarasov, A.G., and Kazantseva, S.Z., Malacofauna of typical waterbodies of the middle and lower Ural River, *Ruthenica*, 1994, vol. 4, no. 1, pp. 61–65.
- Popova, S.M., Devyatkin, E.V., and Starobogatov, Ya.I., *Mollyuski kyzylgirskei svity Gornogo Altaya* (Mollusks from the Kyzylgir Formation, the Altai Mountains), Moscow: Nauka, 1970.
- Prokopov, G.A., The freshwater fauna of the Chernaya River basin, in *Voprosy razvitiya Kryma. Nauchno-prakticheskii diskussionno-analiticheskii sbornik* (Problems in the Development of the Crimea: Discussion and Analysis, Collected Scientific Practical Papers), vol. 15: *Problemy inventarizatsii krymskoi bioty* (Problems in the Inventory of the Crimean Biota), Simferopol: Tavriya-Plus, 2003, pp. 151–174.
- Prozorova, L.A., Specific features in the distribution of freshwater malacofauna in the Russian Far East and biogeographic zoning of this region, in *Chteniya pamyati Vladimira Yakovlevicha Levanidova. Vladivostok, 20–22 marta 2001 g* (Vladimir Yakovlevich Levanidov Memorial Lectures, Vladivostok, March 20–22, 2001), Vladivostok: Dal’nauka, 2001, vol. 1, pp. 112–125.
- Prozorova, L.A. and Anistratenko, V.V., Morphogenesis of Ancient freshwater snails of superfamily Viviparoidea (Gastropoda: Architaenioglossa), *I Vseross. nauch. konf. “Sovremennye issledovaniya v biologii, 25–27 sentyabrya 2012 g.* (Proc. I All-Russia Sci. Conf. “Modern Research in Biology,” September 25–27, 2012), Vladivostok: BPI DVO RAN, 2012, pp. 209–211. <http://www.biosoil.ru/files/00011219.pdf>
- Prozorova, L.A. and Sitnikova, T.Ya., The first finding of spirochetes in the gut of freshwater mollusks from the Amur basin, *I Vseross. nauch. konf. “Sovremennye issledovaniya v biologii, 25–27 sentyabrya 2012 g.* (Proc. I All-Russia Sci. Conf. “Modern Research in Biology,” September 25–27, 2012), Vladivostok: BPI DVO RAN, 2012, pp. 205–208. <http://www.biosoil.ru/files/00011218.pdf>
- Puzanov, I.I., Materials on the study of Crimean terrestrial mollusks: 3. Composition, distribution, and genesis of the Crimean malacofauna, *Byull. Mosk. O–va Ispyt. Prir., Otd. Biol.*, 1927, vol. 36, nos. 3–4, pp. 221–282.
- Selezneva, M.V., Evaluation of the current ecological state of Novosibirsk Reservoir based on structural and functional parameters of macrozoobenthos, *Extended Abstract of Cand. Sci. (Biol.) Dissertation*, Novosibirsk, 2005.
- Sengupta, M.E., Kristensen, Th.K., Madsen, H., and Jørgensen, A., molecular phylogenetic investigations of the

- Viviparidae (Gastropoda: Caenogastropoda) in the lakes of the Rift Valley area of Africa, *Mol. Phylog. Evol.*, 2009, vol. 52, pp. 797–805.
- Seninski, K.I., New data on Neogene strata in southwestern Transcaucasia, *Tr. O—va Estestvoisp. Imp. Yur'ev. Univ.*, 1905, vol. 16, pp. 64–80.
- Sharapova, T.A., Distributional and Ecological Peculiarities of Invading Mollusks in the Cooler Reservoir at the Tyumen Heat and Power Plant in Western Siberia, *Vestn. Zool.*, 2008, vol. 42, no. 2, pp. 185–187.
- Sitnikova, T.Ya. and Starobogatov, Ya.I., The volume and taxonomic status of the group Architaenioglossa (Gastropoda, Pectinibranchia, Vivipariformes), *Zool. Zh.*, 1982, vol. 61, no. 6, pp. 831–842.
- Soes, D.M., Glöer, P., and de Winter, A.J., *Viviparus acerosus* (Gastropoda: Viviparidae), a new exotic snail species for the Dutch fauna, *Aquat. Invasions*, 2009, vol. 4, no. 2, pp. 373–375.
- Soes, D.M., Majoor, G.D., and Keulen, S.M.A., *Bellamyia chinensis* (Gray, 1834) (Gastropoda: Viviparidae), a new alien snail species for the European fauna, *Aquat. Invasions*, 2011, vol. 6, no. 1, pp. 97–102.
- Starobogatov, Ya.I., *Fauna mollyuskov i zoogeograficheskoe raionirovanie kontinental'nykh vodoemov zemnogo shara* (Molluscan fauna and zoogeographical divisions of the continental waterbodies of the globe), Leningrad: Nauka, 1970.
- Starobogatov, Ya.I., Prozorova, L.A., Bogatov, V.V., and Saenko, E.M., *Opredelitel' presnovodnykh bespozvonochnykh Rossii i sopredel'nykh territorii* (Key to Freshwater Invertebrates of Russia and adjacent lands), vol. 6: *Mollyuski, Polikhety, Nemertiny* (Mollusks, Polychaetes, Nemerteans), St. Petersburg: Nauka, 2004.
- Thiele, J., *Handbuch der systematischen Weichtierkunde*, Jena: Gustav Fischer, 1931, vol. 1, part 2, pp. 377–778.
- Vnukovski, V.V., On the molluscan fauna of Siberia, *Izv. Zap.-Sib. Otd. Russ. Geogr. O—va*, 1929, vol. 6, pp. 51–55.
- Welter-Schultes, F.W., *European Non-Marine Mollusca: A Guide for Species Identification*, Göttingen: Planet Poster Editions, 2012.
- Wenz, W., Allgemeiner Teil und Prosobranchia, in *Handbuch der Paläozoologie*, vol. 6: *Gastropoda*, parts 1–7, Berlin, 1938–1944.
- Yanygina, L.V., Kirillov, V.V., and Zarubina, E.Yu., Role of invader species in the formation of biocenoses in the cooling reservoir of the Belovskaya Regional Power Plant, *Chuzherodnye vidy v Golarktike (Borok-2): Tezisy dokl. Vtorogo mezhdunar. simpoziuma po izucheniyu invaziiynykh vidov* (Alien Species in the Holarctic (Borok-2): Abstr. Second Int. Symp. on Alien Species), Borok, 2005, pp. 110–111.
- Zhadin, V.I., Studies on the ecology and variability of *Vivipara fasciata* Müll., *Monogr. Volzhsk. Biol. Stantsii*, no. 3, Saratov, 1928.
- Zhadin, V.I., *Mollyuski presnykh i solonovatykh vod SSSR. Opredelitel' po faune SSSR* (Mollusks of Fresh and Brackish Waters of the USSR: A Key to the Fauna of the USSR), Leningrad: Zool. Inst. Akad. Nauk SSSR, 1952, vol. 46.
- Zilch, A., Die Typen und Typoide des Natur-Museums Senckenberg: 14. Mollusca, Viviparidae, *Arch. Molluskenkd.*, 1955, vol. 84, no. 1/3, pp. 45–87.

Translated by M. Novikova

SPELL: 1. taxa, 2. Kruglov