Helminth fauna of Microtus cf. arvalis (Rodentia, Cricetidae) in Russia and adjacent countries

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Abstract. Kirillova NYu, Kirillov AA, Ruchin AB, Trukhachev MV. 2020. Helminth fauna of Microtus cf. arvalis (Rodentia, Cricetidae) in Russia and adjacent countries. Biodiversitas 21: 1961-1979. The helminth fauna of voles of the Microtus cf. arvalis group is reviewed focusing on the Russian fauna and that of adjacent territories. In total, 61 helminth species have been recorded in these rodents: Trematoda-14, Cestoda-21, Nematoda-25, Acanthocephala-1. The diversity of the helminth community of the common vole is due to the wide species range and abundance of this rodent. M. arvalis is the final host for most of the parasites recorded from this host species. Only 10 cestodes and trematodes species use common voles as intermediate and paratenic hosts. The core of this voles’ helminth fauna is formed by common species that parasitize many different rodent species. The helminth fauna of the common vole has been most intensively studied in Russia, where 45 species of parasitic worms have been recorded in rodents. The similarity of the helminth fauna of the common vole from different study regions is determined by both the geographical proximity of the research areas and the broad distribution of most of the M. cf. arvalis helminth species.

Keywords: Adjacent countries, helminths, Microtus cf. arvalis, Microtus levis, Russia

INTRODUCTION

Rodents are classified in the mammalian order, Rodentia (Mammalia), the most diverse and numerous in terms of known species. Over 40% of all mammalian species are rodents, and they live on all continents except Antarctica (Wilson and Reeder, 2005). They are widespread, often have a significant influence on ecosystems, and can be reservoirs of infection for humans and many different animal species, including domestic animals (Dubrovskii et al. 2005; Amundala et al. 2018; Bashinskiy and Osipov 2018; Vekhnik and Vekhnik 2018; Lawer et al. 2019; Levykh and Panin 2019).

Some species in this order are widely distributed across the continents. The common vole, Microtus arvalis Pallas, 1778 is one such species, widespread across Eurasia. This species’ range extends from the Atlantic Ocean coast in the west to Siberia and Altai in the east. The northern border of this species’ habitat passes through Finland, Karelia, the Middle Urals, and Western Siberia. The southern border of the range skirts the steppe regions of southern Russia, Ukraine, and Kazakhstan from the north and reaches the Balkan Peninsula, the Black Sea, and Asia Minor. Common voles inhabit Transcaucasia and its isolated populations are found in the Baikal region and Mongolia (Baranovskiy et al. 1994; Meyer et al. 1996; Mitchell-Jones et al. 1999; Shenbrot and Krasnov 2005; Balaž 2010; Pavlinov and Lisovsky 2012; Stojak et al. 2016; Yigit et al. 2016). The common vole has two geographic karyoforms “arvalis” s. str. and “obscurus”. There is a hybridization zone between them (Meyer et al. 1996). M. arvalis is a rodent that prefers habitats with well-developed vegetation, but has wide ecological plasticity, typically inhabiting a wide variety of habitats: fields, floodplain meadows, lowlands, ravines, heathlands, forest edges, pastures, agricultural fields, and gardens. M. arvalis occurs up to an altitude of 3000 m above sea level, inhabiting alpine meadows, rocky areas, and mountain woodlands. Common voles are a typically herbivorous rodent, their diet including about 80 plant species, mainly Poaceae, Asteraceae and Fabaceae (Krumpli et al. 1999; Cruz et al. 2002; Jokić et al. 2012; Rozhnov et al. 2019).

Shaldybin published several review articles (1972, 1979) on the helminths of Microtus voles and, in particular, the common vole of the Russian fauna, recording 54 parasite species for M. arvalis: 7 trematodes, 20 cestodes, 27 nematodes. More than 40 years have passed since these publications, and in the interim new helminth species have been described, the taxonomy of some species and taxa of parasites have changed, and some species have been reduced to synonyms. Therefore, previously published species lists of helminths need to be updated and clarified.

The East European vole, Microtus levis Miller, 1908 (= Microtus rossiaemeridionalis Ognev, 1924) is a sibling species of the common vole. In a large part of Eurasia, these two rodent species are sympatric (Baranovskiy et al. 1994; Yalkovskaya et al. 2012). Therefore, all previously conducted helminthological studies of the common vole apply equally to M. levis. To date, only a few helminths were reported in the East European vole. The metacestodes
**Echinococcus multilocularis** Leuckart, 1863, *Taenia crassiceps* (Zeder, 1800), an unidentified ascarid nematode and an unidentified acanthocephalan were found in *M. levis* from Spitsbergen, Norway (Hentonnen et al. 2001; Stien et al. 2010). The nematode *Trichuris arvicola* Felin, Spakulova, Casanova, Renaud, Morand, Hugot, Santalla et Durand, 2000 was found in one sibling vole from Finland (Callejon et al. 2012). The cestode *Paranoplocephala omphalodes* (Hermann, 1783) was noted in Vladimir and Novosibirsk regions of Russia and Finland (Vlasenko et al. 2019).

The purpose of this research is to review the helminth fauna of *Microtus arvalis* group (*M. arvalis* + *M. levis*), inhabiting the territory of Russia and adjacent countries and to systematize data about the helminths of the common vole taking into account contemporary conceptions.

**MATERIALS AND METHODS**

This comparative review of the helminth fauna of the common vole is based on an analysis of published data on the parasites of *M. cf. arvalis*, studied in different regions of Russia and adjacent countries, as well as on the results of the authors’ own research. Analysis of the helminth species composition includes the results of studies of the parasitofauna of the common vole in 13 countries: Russia, Belarus, Ukraine, Moldova, Lithuania, Poland, Bulgaria, Georgia, Armenia, Azerbaijan, Kazakhstan, Kyrgyzstan, and Mongolia. The map of the study areas is presented in Figure 1. The localities with geographic coordinates and helminth species are presented in Table 1.

A great number of sources for our review was taken from Russian parasitological literature, not indexed in electronic databases. Literature sources were collected in public libraries: the National Library of Russia (St. Petersburg), M. Gorky Scientific Library of St Petersburg University and Samara Regional Universal Scientific Library. The analysis of literary sources was conducted between 1938 and 2019.

We used on review works on the rodent helminths of the former USSR and adjacent countries (Andreyko 1973; Ryzhikov et al. 1878, 1979; Shaykenov 1981; Genov 1984; Movsesyan et al. 2004, 2006, 2018; Grikieniene 2005; Kostyunin 2010; Bychkova et al. 2017).

We searched available literature on the common vole helminths using Web of Science Core Collection (an international database), Scopus (an international database), Google Scholar (an international database) and eLIBRARY.ru (Russian scientific electronic library). To find studies on helminths we used the following search strings: Topic: ["Helminths" or "Parasites") and ("common vole" or "Microtus arvalis" or "East European vole" or "sibling vole" or "Microtus levis" or "Arvicolinea" or "Cricetidae" or "Myomorph rodents"). We used both Russian and English characters to enter our keywords in eLIBRARY.ru.

We used Yandex Maps (https://yandex.ru/maps) and the GeoCode Finder (https://www.mapdevelopers.com/geocode_tool.php) to indicate study areas according to their geographic coordinates. If the study sites included more than one locality or the exact location is not indicated, we characterized each of them by their midpoint, which was obtained using the Geographic Midpoint Calculator (http://www.geomidpoint.com).

Microsoft Excel software was used for statistical data processing (plotting diagrams and species accumulation curves). The degree of similarity of the helminth fauna of the common vole was estimated using the Jaccard similarity index (Magurran 1992). The dendrogram of similarity of the helminth communities was created with “hclust” function from R statistical environment (complete linkage) (R Core Team 2016). The validation was done using the cophenetic distance analysis. The cluster is representative of the cophenetic correlation coefficient (CCC) is above 0.70. In the analysis, we did not use the species of helminths that were erroneously recorded from *M. cf. arvalis*.

Parasites taxonomy in this paper is based on the Fauna Europaea Database (https://fauna-eu.org/) and Global Cestode Database (http://tapewormdb.uconn.edu).

**RESULTS AND DISCUSSION**

The helminth fauna of *Microtus cf. arvalis* in Russia and adjacent countries includes 61 species: 14-trematodes, 21-cestodes, 25-nematodes and 1-acanthocephalan (Table 2).

The greatest diversity was observed in nematodes, namely 25 species from 9 families: Capillariidae (5), Trichinellidae (1), Trichuridae (1), Strongyloidae (1), Trichostongylidae (11), Heterostrongylidae (1), Oxuridae (3), Gongylonematidae (1) and Spirocercidae (1). All nematode species were recorded in voles as mature stages and one species (*Trichinella spiralis*) also at the larval stage.

The cestode composition of the common vole was found to be relatively less diverse-21 species from 5 families: Anoplocephalidae (5), Hymenolepididae (5), Catenotaeniidae (3), Taeniidae (7) and Mesocestoididae (1). Thirteen species of cestodes parasitize common voles as mature stages and eight as larval stages.

Common voles have 14 species of trematodes from 5 families: Brachylaimidae (3), Dicrocoeliidae (1), Plagiocordiidae (5), Notocotylidae (3) and Diplostomidae (2). Twelve trematode species have been observed in voles as mature stages and two species as larval stages.

Acanthocephalans are represented by only one widespread species-*Moniliformis moniliformis* (Moniliformidae).
Figure 1. Map of the studied areas. Red circles indicate research localities. Locality numbers refer to Table 1
Table 1. Localities and occurrence of *M arvalis* helminths

| No. | Localities                                                                 | Coordinates | Helminth species                                                                                       |
|-----|----------------------------------------------------------------------------|-------------|--------------------------------------------------------------------------------------------------------|
| 1   | Pomeranian Voivodeship (Tczew, Pruszcz Gdański), Pol 9and                  | 54°10′26.1″N 18°43′23.8″E | *T. arvicola*, *H. borealis*, *H. laevis*, *S. nigeriana*                                           |
| 2   | Kuyavian-Pomeranian Voivodeship (Bydgoszcz, Mogilno), Poland              | 52°53′22.8″N 17°58′30.1″E | *T. arvicola*, *S. nigeriana*                                                                        |
| 3   | Dziekanow Lesny, Poland                                                   | 52°20′49.1″N 20°51′15.7″E | *A. dentata*, *R. asymmetrica*, *H. taeniaeformis* (larva), *T. arvicola*, *H. laevis*, *S. nigeriana* |
| 4   | Greater Poland Voivodeship (Koscianian), Poland                          | 52°03′10.8″N 16°38′42″E  | *T. arvicola*, *H. borealis*, *H. laevis*, *S. nigeriana*                                          |
| 5   | Lower Silesian Voivodeship (Wrocław, Zlotoryja), Poland                   | 51°07′3.2″N 16°28′28.8″E | *A. dentata*, *R. asymmetrica*, *H. taeniaeformis* (larva), *T. arvicola*, *H. laevis*, *S. nigeriana* |
| 6   | Opole Voivodeship (Nysa, Brzeg), Poland                                  | 50°40′3.6″N 17°24′4.3″E  | *N. noyeri*, *A. alata* (larva), *P. omphalodes*, *R. asymmetrica*, *S. nigeriana*                |
| 7   | Subcarpathian Voivodeship (Brzozow, Lubaczow, Przemysl, Jaroslaw), Poland| 49°54′43.1″N 22°38′46.6″E | *R. exasperatum*, *P. omphalodes*, *R. asymmetrica*, *S. nigeriana*                                |
| 8   | Vicinity of Lublin, Poland                                               | 51°15′02°N 22°34′12.4″E  | *H. taeniaeformis* (larva), *T. arvicola*, *H. laevis*, *H. borealis*, *H. costellatum*, *S. nigeriana* |
| 9   | Białowieza National Park, Poland                                         | 52°45′44.5″N 23°52′2.7″E | *N. noyeri*, *A. alata* (larva), *P. omphalodes*, *R. asymmetrica*, *S. nigeriana*                |
| 10  | Lithuania (locality not specified)                                        | 55°21′0″N 23°45′0″E  | *H. taeniaeformis* (larva), *T. arvicola*, *H. laevis*, *H. borealis*, *H. costellatum*, *S. nigeriana* |
| 11  | Kamśa, Lithuania                                                         | 55°25′15.4°N 25°49′12.1°E | *R. exasperatum*, *P. omphalodes*, *R. asymmetrica*, *S. nigeriana*                                |
| 12  | Vicinity of Lake Druksiai, Lithuania                                     | 55°36′55°N 26°31′47.8°E | *A. dentata*, *R. asymmetrica*, *H. taeniaeformis* (larva), *H. costellatum*, *S. nigeriana*        |
| 13  | Berezinsky Biosphere Reserve, Belarus                                    | 54°44′21.1°N 28°19′0″E  | *N. noyeri*, *A. alata* (larva), *P. omphalodes*, *R. asymmetrica*, *S. nigeriana*                |
| 14  | Vicinity of Minsk, Belarus                                               | 53°54′8.4″N 27°33′42.8″E | *N. noyeri*, *A. alata* (larva), *P. omphalodes*, *R. asymmetrica*, *S. nigeriana*                |
| 15  | “Belovezhskaya Pushcha” National Park, Belarus                           | 52°33′27.3°N 23°48′18.9″E | *H. taeniaeformis* (larva), *T. arvicola*, *H. laevis*, *H. borealis*, *H. costellatum*, *S. nigeriana* |
| 16  | Brest region, Belarus                                                    | 52°24′43.8°N 25°15′17.2°E | *P. omphalodes*, *A. horrida*, *S. lobata*, *C. cricetorum*, *H. taeniaeformis* (larva), *T. arvicola*, *H. costellatum*, *S. nigeriana* |
| 17  | Palesky village, Brest region, Belarus                                   | 52°17′40.2°N 26°39′59″E | *P. omphalodes*, *A. horrida*, *S. lobata*, *C. cricetorum*, *H. taeniaeformis* (larva), *T. arvicola*, *H. costellatum*, *S. nigeriana* |
| 18  | Boklan’ village, Gomel region, Belarus                                   | 52°07′42.6°N 28°04′50.9°E | *R. arvicolae*, *P. elegans*, *N. noyeri*, *A. alata* (larva), *A. dentata*, *P. omphalodes*, *H. diminuta*, *T. crassiceps* (larva), *H. taeniaeformis* (larva), *T. polyacantha* (larva), *V. mustelae* (larva), *E. multilocularis* (larva), *Mesocestoides* sp. (larva), *T. arvicola*, *H. costellatum*, *H. laevis*, *S. nigeriana* |
| 19  | Markowskaye village, Gomel region, Belarus                               | 51°43′33″N 28°12′28.9″E | *P. omphalodes*, *A. horrida*, *S. lobata*, *C. cricetorum*, *H. taeniaeformis* (larva), *T. arvicola*, *H. costellatum*, *S. nigeriana* |
| 20  | Zakarpattia region, Ukraine                                             | 48°17′43.3°N 23°26′47.8°E | *P. omphalodes*, *A. horrida*, *H. taeniaeformis* (larva), *T. polyacantha* (larva), *T. arvicola*, *H. costellatum*, *S. nigeriana* |
| 21  | Liviv region, Ukraine                                                   | 49°39′4.4″N 23°49′36.1″E | *S. nigeriana*                                                                                            |
| 22  | Chernivtzi region, Ukraine                                              | 48°22′51.9″N 26°06′29.4″E | *P. omphalodes*, *A. horrida*, *H. taeniaeformis* (larva), *T. polyacantha* (larva), *T. arvicola*, *H. costellatum*, *S. nigeriana*, *M. muris* |
| 23  | Kyiv region, Ukraine                                                    | 50°10′42.9″N 30°29′33″E | *P. omphalodes*, *A. horrida*, *H. taeniaeformis* (larva), *T. polyacantha* (larva), *T. arvicola*, *H. costellatum*, *S. nigeriana*, *M. muris* |
| 24  | Lugansk region, Ukraine                                                 | 49°16′20.9″N 38°54′54.2″E | *P. omphalodes*, *A. horrida*, *H. taeniaeformis* (larva), *T. polyacantha* (larva), *T. arvicola*, *H. costellatum*, *S. nigeriana*, *M. muris* |
| 25  | Donetsk region, Ukraine                                                 | 47°55′16.6″N 37°46′51.5″E | *P. omphalodes*, *A. horrida*, *H. taeniaeformis* (larva), *T. polyacantha* (larva), *T. arvicola*, *H. costellatum*, *S. nigeriana*, *M. muris* |
26 Kherson region, Ukraine 46°32′31.8″N 33°24′28.6″E
27 Nikolaev region, Ukraine 47°23′19″N 31°56′39.2″E
28 Odessa region, Ukraine 46°06′53″N 29°57′24.2″E
29 Moldova (central part) 46°51′58.3″N 28°48′50.4″E

P. montana, P. omphalodes, A. horrida, R. straminea, C. cricetorum, H. taeniaeformis (larva), T. hydatigena (larva), V. mustelae (larva), Mesocestoides sp. (larva), C. hepaticum, T. arvicolae, T. colubriformis, H. laevis, H. costellatum, S. nigeriana

30 Plevenska Nature Reserve, Bulgaria 43°24′32.5″N 24°37′4.8″E
31 Sofia region, Bulgaria 42°41′52.3″N 23°19′19.8″E
32 Haskovo region, Bulgaria 41°56′4.5″N 23°19′19.8″E
33 Yambol region, Bulgaria 42°22′41.3″N 26°38′53.9″E
34 Strandzha region, Bulgaria 42°03′46.8″N 27°00′14″E
35 Batova river floodplain (Dobrich region), Bulgaria 43°20′50.1″N 28°04′7.7″E

B. spinulosum, P. elegans, M. blanchardi, A. dentata, T. polyacantha (larva), T. crassiceps (larva), C. hepaticum, A. murissylvatici, E. gastricus, T. arvicolae, C. cricetorum, M. blanchardi (larva), H. laevis, H. costellatum, S. nigeriana

36 Srebarna Nature Reserve, Bulgaria 44°06′41.1″N 27°04′12.9″E
37 Crimea 45°12′48.5″N 34°15′35.2″E
38 Belgorod region 50°41′50.1″N 37°33′17.6″E
39 Tsentralno-Chernozemny Biosphere Reserve, Kursk region 51°35′02.6″N 36°06′27.6″E
40 Voronezh Nature Reserve, Voronezh region 51°56′49.1″N 39°35′44.2″E
41 Leningrad region 60°01′15.1″N 32°05′7.2″E
42 Kaskesnavolok village, Karelia 61°35′38.8″N 33°19′23.0″E
43 Ivanovo region 56°55′3.3″N 41°26′6.8″E
44 Vladimir region (Afanasovo, Popolutovo) 55°39′03.6″N 41°50′04.1″E
45 Nizhny Novgorod region 55°28′18.5″N 44°05′28.2″E

A. dentata, P. omphalodes, H. diminuta, A. horrida, R. straminea, S. lobata, Mesocestoides sp. (larva), C. hepaticum, T. arvicolae

46 Vicinity of Kirov 58°36′12.7″N 49°39′50.1″E
47 Mordovia (Mordovia Nature Reserve and “Smolny” National Park) 54°44′59.5″N 44°16′44.6″E
48 Volzhsko-Kamskiy Nature Reserve, Tatarstan 55°16′2.8″N 49°19′53.1″E
49 Bashkortostan 54°43′34.6″N 55°56′51.8″E
50 “Samarskaya Luka” National Park, Samara region 53°17′22.4″N 49°42′23.1″E
51 Volgograd region 49°36′17.4″N 44°17′25.3″E

A. dentata, P. omphalodes, R. asymmetrica, A. horrida, C. cricetorum, H. taeniaeformis (larva), A. murissylvatici, H. laevis, H. borealis, H. costellatum, S. nigeriana

A. dentata, P. omphalodes, H. diminuta, T. polyacantha (larva), T. crassiceps (larva), T. arvicolae, H. costellatum, H. laevis, C. minutus

A. dentata, P. omphalodes, H. taeniaeformis (larva), T. arvicolae, H. laevis, H. costellatum, S. nigeriana, T. spiralis

A. dentata, P. omphalodes, H. diminuta, S. nigeriana, H. laevis, H. costellatum

A. dentata, P. omphalodes, H. taeniaeformis (larva), T. arvicolae, H. laevis, H. costellatum, C. minutus, A. dinniki, S. nigeriana, M. muris

P. arvicola, N. noyeri, P. omphalodes, R. asymmetrica, H. taeniaeformis (larva), T. hydatigena (larva), T. polyacantha (larva), T. arvicolae, H. laevis, H. costellatum, S. nigeriana

A. alata (larva), A. dentata, P. omphalodes, H. taeniaeformis (larva), T. hydatigena (larva), C. hepaticum, T. arvicolae, H. laevis, H. costellatum, C. minutus, A. dinniki, S. nigeriana, M. muris

N. noyeri

H. laevis

P. omphalodes

N. noyeri, A. dentata, P. omphalodes, H. diminuta, T. polyacantha (larva), H. taeniaeformis (larva), V. mustelae (larva), C. minutus, S. nigeriana

A. alata (larva), A. dentata, H. diminuta, H. taeniaeformis (larva), H. costellatum, H. laevis, S. nigeriana

A. dentata, P. omphalodes, C. cricetorum, H. taeniaeformis (larva), V. mustelae, (larva), T. arvicolae, H. laevis, C. minutus, S. nigeriana

A. dentata, P. montana, P. omphalodes, R. asymmetrica, H. taeniaeformis (larva), T. crassiceps (larva), T. hydatigena (larva), T. polyacantha (larva), T. arvicolae, H. laevis, S. nigeriana

T. polyacantha (larva)

N. noyeri, Q. volgaensis, A. dentata, P. omphalodes, H. diminuta, C. cricetorum, H. taeniaeformis (larva), E. multilocularis (larva), E. lemmi, T. arvicolae, H. laevis, H. costellatum, S. nigeriana, G. neoplasticum, M. moniliformis

A. dentata, P. omphalodes, R. asymmetrica, A. horrida, C. cricetorum, H. taeniaeformis (larva), A. murissylvatici, H. laevis, H. borealis, H. costellatum, S. nigeriana
| No. | Location                                      | Coordinates                                    | Species                                                                                     |
|-----|----------------------------------------------|-----------------------------------------------|----------------------------------------------------------------------------------------------|
| 52  | Kamyzyak, Astrakhan region                   | 46°07′13.9″N 48°04′53.6″E                     | B. recurva, B. aequans, P. multiglandularis, P. elegans, P. muris, C. spathula (larva), A. alata (larva), A. dentata, P. omphalodes, M. blanchardi, R. asymmetrica, S. lobata, H. taeniaeformis (larva), T. crassiceps (larva), T. hydatigena (larva), T. pisiformis (larva), T. polyacantha (larva), Mesocestoides sp. (larva), A. murissylvatici, P. sadovskoi, E. gastricus, T. arvicola, Heligmosomoides laevis, H. costellatum, S. nigeriana |
| 53  | Dagestan                                     | 43°03′27″N 47°07′59.6″E                       | P. omphalodes, Mesocestoides sp. (larva), T. arvicola, H. costellatum, S. nigeriana |
| 54  | North Ossetia-Alania                         | 42°59′31.5″N 44°15′49.1″E                     | H. diminuta, H. taeniaeformis (larva), S. nigeriana                                      |
| 55  | Kabardino-Balkaria                           | 43°26′34.2″N 43°25′13.7″E                     |                                                                                             |
| 56  | Vicinity of Tbilisi, Georgia                 | 41°41′36.5″N 44°48′5.2″E                      | P. montana, P. omphalodes, H. diminuta, R. asymmetrica, H. taeniaeformis (larva), V. mustelae (larva), E. multilocularis (larva), C. hepaticum, H. laevis, H. costellatum, S. nigeriana, G. neoplasticum |
| 57  | Vicinity of Ts’ikhisjvari village, Georgia   | 41°43′3.4″N 43°26′26.6″E                      | B. aequans, N. nayeri, T. tscherbakovi, A. dentata, P. montana, P. omphalodes, H. diminuta, R. straminea, R. asymmetrica, H. taeniaeformis (larva), T. pisiformis (larva), T. polyacantha (larva), E. multilocularis (larva), Mesocestoides sp. (larva), E. gastricus, A. murissylvatici, T. spiralis, H. laevis, H. costellatum, S. nigeriana, M. moniliformis |
| 58  | Armenia (most of districts)                  | 40°46′10.7″N 44°40′25.2″E                     | H. taeniaeformis (larva), E. multilocularis (larva), Mesocestoides sp. (larva), C. hepaticum, S. nigeriana, H. laevis, H. travassosi |
| 59  | Azerbaijan (locality not specified)          | 40°23′37.1″N 47°41′4.1″E                      | H. taeniaeformis (larva)                                                                  |
| 60  | Sverdlovsk region                            | 58°38′29.2″N 61°48′7.8″E                      |                                                                                             |
| 61  | Tyumen region                                | 57°22′44″N 67°00′42.2″E                       | B. recurva, A. dentata, A. horrida, E. multilocularis (larva), P. sadovskoi, C. hepaticum, T. arvicola, H. costellatum, H. mixtum, M. muris |
| 62  | Novosibirsk region                           | 54°58′19.3″N 79°28′53″E                       | P. omphalodes                                                                            |
| 63  | Azhendarovo, Kemerovo region                 | 54°45′26.6″N 87°01′31.4″E                     |                                                                                             |
| 64  | Altaisk Krai                                  | 52°41′33.6″N 82°41′35.3″E                     | B. recurva, A. dentata, A. horrida, E. multilocularis (larva), P. sadovskoi, C. hepaticum, T. arvicola, H. costellatum, H. mixtum, M. muris |
| 65  | Petropavlovsk region, Kazakhstan             | 54°47′36.0″N 69°08′50.0″E                     | P. omphalodes                                                                            |
| 66  | Former Kokshetau region, Kazakhstan          | 53°17′6.7″N 69°22′53.3″E                      | P. arvicola, N. nayeri, A. dentata, P. omphalodes, T. hydatigena (larva), T. arvicola, S. arvicola |
| 67  | Akmola region, Kazakhstan                   | 50°59′22.3″N 71°05′11.4″E                     | P. arvicola, P. elegans, N. nayeri, P. omphalodes, A. dentata, C. kirigica, T. crassiceps (larva), T. hydatigena (larva), A. murissylvatici, C. hepaticum, T. arvicola, S. nigeriana, S. arvicola, M. moniliformis |
| 68  | Pavlodar region, Kazakhstan                 | 52°09′15.2″N 77°08′55.4″E                     | P. omphalodes                                                                            |
| 69  | Dzungarian Alatau, Kazakhstan                | 45°35′53.6″N 79°04′14.5″E                     | B. recurva, A. dentata, P. omphalodes, E. multilocularis (larva), A. murissylvatici, E. lemmi, T. arvicola, M. muris |
| 70  | Ile Alatau, Kazakhstan                       | 43°00′3.3″N 78°27′21.6″E                      | B. recurva, P. omphalodes, E. multilocularis (larva), T. arvicola, A. murissylvatici, H. longispiculum, M. muris |
| 71  | Talas Alatau, Kazakhstan                     | 43°13′25.7″N 73°22′54.4″E                     | E. lemmi, T. arvicola, H. laevis, M. muris |
| 72  | Kyrgyzstan (locality not specified)          | 41°30′32.2″N 74°43′26.7″E                     | D. dendriticum, A. dentata, M. dissymetrica, H. diminuta, S. nigeriana, S. microsus |
| 73  | Lake Hovskol, Mongolia                       | 51°16′49.5″N 100°40′47″E                      | M. moniliformis                                                                         |
## Table 2. Checklist of helminths of common vole, *Microtus cf. arvalis* in Russia and adjacent countries

| Species                                                                 | Distribution      | Region (author)                                                                 |
|------------------------------------------------------------------------|-------------------|---------------------------------------------------------------------------------|
| **TREMATODA**                                                          |                   |                                                                                 |
| **Family Brachylaimidae Joyeux et Foley, 1930**                        |                   |                                                                                 |
| *Brachylaima recurva* (Dujardin, 1845) (Syn.: *Brachylaimus recurvus* (Dujardin, 1845)) | Palearctic        | Altai Krai (Ryzhikov et al. 1978); Astrakhan region (Ivanov et al. 2012); Kazakhstan (Shaykenov 1981) |
| *Brachylaima spinulosum* (Hofman, 1899) (Syn.: *Brachylaimus spinulosus* (Hofman, 1899)) | Palearctic        | Bulgaria (Genov, 1984)                                                         |
| *Brachylaima aequans* (Looss, 1899) (Syn.: *Brachylaimus aequans* (Looss, 1899)) | Palearctic        | Astrakhan region (Kalmykov et al. 2010; Ivanov et al. 2012); Armenia (Movsesyan et al. 2004) |
| **Family Dicrocoeliidae (Looss, 1899)**                                |                   |                                                                                 |
| *Dicrocoelium dendriticum* (Rudolphi, 1819) (Syn.: *Dicrocoelium lanceatum* Stiles et Hassall, 1896) | Cosmopolitan      | Kyrgyzstan (Tokobaev 1976)                                                     |
| **Family Plagiorchiidae Lühe, 1901**                                   |                   |                                                                                 |
| *Plagiorchis arvicolaev* Schulz et Skvortzov, 1931                     | Palearctic        | Leningrad region (Ryzhikov et al. 1978); Belarus (Shimalov 2002); Bulgaria (Genov 1984); Kazakhstan (Shaykenov 1981) |
| *Plagiorchis elegans* (Rudolphi, 1802)                                  | Holarctic         | Astrakhan region (Ivanov et al. 2012); Belarus (Shimalov 2002); Bulgaria (Genov 1984); Kazakhstan (Shaykenov 1981) |
| *Plagiorchis multiglandulalis* Semenov, 1927 (Syn.: *Plagiorchis eutamiais* Schulz, 1932) | Palearctic        | Astrakhan region (Kalmykov et al. 2010; Ivanov et al. 2012)                    |
| *Plagiorchis muris* Tanabe, 1922                                       | Holarctic         | Astrakhan region (Ivanov et al. 2012)                                          |
| *Rubenstrema exasperatum* (Rudolph, 1819) (Syn.: *Distoma exasperatum* Rudolph, 1819; *Plagiorchis microi* Soltys, 1949) | Holarctic         | Poland (Soltys 1949)                                                           |
| **Family Notocotylidae Lühe, 1909**                                    |                   |                                                                                 |
| *Notocotylus novyi* Joyeux, 1922                                       | Holarctic, Neogea, Notogea | Karelia (Leontyev et al. 2016); Leningrad region (Ryzhikov et al. 1978); Nizhny Novgorod region (Kostyunin 2010); Samara region (Kirillova and Kirillov 2005; Kirillova 2011); Belarus (Shimalov 2002, 2012; Bychkova et al. 2017); Lithuania (Mažeika 2004; Griekieniene 2005); Armenia (Movsesyan et al. 2004); Kazakhstan (Shaykenov 1981) |
| *Quinqueserialis wolgaensis* Skvorzov, 1934                            | Europe            | Samara region (Kirillova and Kirillov 2005; Kirillova 2011)                    |
| *Tetraserialis tscherbakovi* Petrov et Tsichtkova, 1960                | Palearctic        | Armenia (Movsesyan et al. 2004)                                                 |
| **Family Diplostomidae Poirier, 1886**                                 |                   |                                                                                 |
| *Conodiplostomum spathula* (Crepelin, 1829), larva                      | Palearctic        | Astrakhan region (Ivanov et al. 2012)                                          |
| *Alaria alata* (Goeze, 1782), larva                                   | Cosmopolitan      | Astrakhan region (Ivanov et al. 2012); Kirov region (Erofeeva 2016); Voronezh region (Romashov 1997; Romashova 2012); Belarus (Shimalov 2002; Bychkova et al. 2017); Lithuania (Mažeika 2004; Griekieniene 2005) |
Family Anoplocephalidae Cholodkowsky, 1902

Anoplocephaloides dentata (Galli-Valerio, 1905) (Syn.: Paranoplocephala dentata Galli-Valerio, 1905; Aprostomatrya caucasia Kirshenblatt, 1938)

Paranoplocephala montana (Kirshenblatt, 1941) (Syn.: Andrya montana Kirshenblatt, 1941)

Paranoplocephala omphaloidees (Hermann, 1783) (Syn.: Aprostomatrya omphaloidees Hermann, 1783; Paranoplocephala caucasia (Kirschenblatt, 1938))

? Paranoplocephala macrocephala (Douthitt, 1915) (Syn.: Aprostomatrya macrocephala (Douthitt, 1915); Andrya biadowzensis Soltys, 1949)

? Paranoplocephala microti (Hansen, 1947) (Syn.: Aprostomatrya microti (Hansen, 1947); Microlicola Blanchardi (Moniez, 1891); Paranoplocephala Blanchardi (Moniez, 1891); Mathevaenia dissymetrica Tokobajev et Erculov, 1966)

Family Hymenolepididae Ariol, 1899

Hymenolepis diminuta Rudolph, 1819

Arostrilepis horruda (Linstow, 1901) (Syn.: Hymenolepis horruda (Linstow, 1901))

Rodentolepis fraterna (Stiles, 1906)

Rodentolepis striamea (Goze, 1782)
Rodentolpis asymmetrica (Janicki, 1904)  
European Range: Tatarstan, Leningrad, Volgograd and Astrakhan regions (Ryzhikov et al. 1978); Belarus (Shimalov 2012; Bychkova et al. 2017); Bulgaria (Genov 1984); Georgia (Ryzhikov et al. 1978); Armenia (Movsesyan et al. 2006); Poland (Soltys 1949)

Family Catenotaeniidae Spassky, 1950

Catenotaenia cricetorum Kirshenblat, 1949  
Palearctic Range: Mordovia (this paper); Samara region (Kirillova and Kirillov 2005, 2008; Kirillova 2011; Kirillov and Kirillova 2017); Volgograd region (Ryzhikov et al. 1978); Lithuania (Mažeika 2004; Grikieniene 2005); Belarus (Shendrik 2018); Moldova (Andreyko 1973)

Catenotaenia pusilla (Goeze, 1782)  
Holarctic Range: Astrakhan region (Ryzhikov et al. 1978); Kirov region (Erofeeva 2016); Nizhny Novgorod region (Kostyunin 2010); Poland (Soltys 1949; Kisielewska et al. 1973); Kazakhstan (Shaykenov 1981)

Catenotaenioides kirgizica (Tokobaev, 1959) (Syn.: Catenotaenia kirgizica, Tokobaev, 1959)  
Central Asian Range: Crimea (Zavaleeva and Kuzmina 1980); Astrakhan region (Kalmykov et al. 2010); Belarus (Shendrik 2018)

Family Taeniidae Ludwig, 1886

Hydatigera taeniaefornis (Batsch, 1786), larva (Syn.: Taenia taeniaefornis (Batsch, 1786); Strobilocercus fasciolaris Rudolfi, 1808)  
Cosmopolitan Range: Kabardino-Balkaria and North Ossetia-Alania (Khurans 2000); Mordovia (this paper); Tatarstan, Leningrad, Volgograd, Astrakhan and Sverdlovsk regions (Ryzhikov et al. 1978); Kirov region (Erofeeva 2016); Kursk region (Vlasov et al. 2015, 2016); Voronezh region (Romashova 1997; Romashova 2012); Nizhny Novgorod region (Kostyunin 2010); Samara region (Kirillova and Kirillov, 2005, 2008; Kirillova 2007, 2011; Kirillov and Kirillova 2017); Belarus (Shimalov 2002, 2012; Bychkova et al. 2017); Lithuania (Mažeika 2004; Grikieniene 2005); Moldova (Andreyko 1973); Ukraine (Vysotskaya 1997); Poland (Furmagara 1957); Georgia and Azerbaijan (Ryzhikov et al. 1978); Armenia (Movsesyan et al. 2006)

Taenia crassiceps (Zeder, 1800), larva  
Holarctic Range: Tatarstan and Astrakhan region (Ryzhikov et al. 1978); Lithuania (Ryzhikov et al. 1978; Mažeika 2004); Belarus (Shimalov 2002, 2012; Bychkova et al., 2017); Bulgaria (Genov 1984); Ukraine (Ryzhikov et al. 1978); Kazakhstan (Shaykenov 1981)

Taenia hydatigena (Pallas, 1766), larva (Syn.: Taenia tenuicollis, Rudolfi, 1819)  
Cosmopolitan Range: Tarapets, Leningrad and Astrakhan regions (Ryzhikov et al. 1978); Voronezh region (Romashova 1997; Romashova 2012); Moldova (Andreyko 1973); Kazakhstan (Shaykenov 1981)

Taenia pisiformis (Bloch, 1780), larva  
Cosmopolitan Range: Astrakhan region (Ryzhikov et al. 1978); Armenia (Movsesyan et al. 2006)

Taenia polyacantha Leuckart, 1856, larva (Syn.: Tetratiotaenia polyacantha (Leuckart, 1856))  
Holarctic Range: Bashkortostan, Tatarstan, Leningrad and Astrakhan regions (Ryzhikov et al. 1978); Nizhny Novgorod region (Kostyunin 2010); Belarus (Shimalov 2002, 2012; Bychkova et al. 2017); Bulgaria (Genov 1984); Ukraine (Vysotskaya 1997); Armenia (Movsesyan et al. 2006); Poland (Soltys 1949)

Versteria mustaelae (Gmelin, 1790), larva (Syn.: Taenia mustaelae Gmelin, 1790)  
Holarctic Range: Mordovia (Ruchin et al. 2016; this paper); Nizhny Novgorod region (Kostyunin 2010); Belarus (Shimalov 2002, 2012; Bychkova et al. 2017); Moldova (Andreyko 1973); Georgia (Ryzhikov et al. 1978); Lithuania (Mažeika 2004; Grikieniene 2005)

Echinococcus multilocularis Leuckart, 1863, larva (Syn.: Alveococcus multilocularis (Leuckart, 1863))  
Holarctic, Neogean Range: Samara region (Kirillova and Kirillov 2005, 2008; Kirillova 2007, 2011; Kirillov and Kirillova 2017); Altai Krai (Ryzhikov et al. 1978); Belarus (Shimalov 2002); Georgia and Azerbaijan (Ryzhikov et al. 1978); Armenia (Movsesyan et al. 2006); Kazakhstan (Shaykenov 1981)

Family Mesocestoididae Perrier, 1897

Mesocestoides sp., larva (Syn.: Mesocestoides lineatus (Goeze, 1782) sensu Zavaleeva and Kuzmina (1980); Ryzhikov et al. (1978); Shimodal (2002); Mažeika (2004); Grikieniene (2005); Movsesyan et al. (2006); Bychkova et al. (2017)  
Cosmopolitan Range: Crimea (Zavaleeva and Kuzmina 1980); Dagestan and Astrakhan region (Ryzhikov et al. 1978); Lithuania (Mažeika 2004; Grikieniene 2005); Belarus (Shimalov 2002; Bychkova et al. 2017); Moldova and Azerbaijan (Ryzhikov et al. 1978); Armenia (Movsesyan et al. 2006)
NEMATODA

Family Capillariidae Neveu-Lemaire, 1936

Aonchotheca murisylvaetici (Diesing, 1851) (Syn.: Capillaria murisylvaetici) (Diesing, 1851)
Pterohominx sadovskoi (Morozov, 1956) (Syn.: Armocapillaria sadovskajae (Morosov, 1959))
Calodium hepaticum (Bancroft, 1893) (Syn.: Hepaticola hepatica (Bancroft, 1893))

Family Trichuridae Ransom, 1911

Eucoleus gastricus (Baylis, 1926) (Syn.: Thominx gastricus (Baylis, 1926))
Eucoleus lemmi (Retzius, 1841)

Family Trichinellidae Leiper, 1908

Trichinella spiralis Owen, 1835

Family Trichostrongylidae Ransom, 1911

Trichuris avicularis Feliu, Spakulova, Casanova, Renaud, Morand, Hugot, Santalla et Durand, 2000 (Syn.: Trichurus murrissylvaetici (Schrank, 1788) sensu Vysotskaya (1997), Furmaga (1957), Andreyko (1973), Kisielewska et al. (1973), Zavaleeva and Taran (1977), Zavaleeva and Kuzmina (1980), Genov (1984), Romashov (1997), Shimalov (2002, 2013), Romashova (2012), Mazheyka (2004), ; Grikieniene (2005), Kirillova (2005), Aliev et al. (2007)

Family Strongylidae Chitwood and MacIntosh, 1934

Strongyloides ratti Sandground, 1925

Family Strongylostrongylidae Leiper, 1908

Trichostrongylus colubridiformis (Giles, 1892)
Trichostrongylus retortaeformis (Zeder, 1800)
Heligmosomoides glareolii (Baylis, 1928)
Heligmosomoides laevis (Dujardin, 1845) (Syn.: Heligmosomoides polygyrus (Dujardin, 1845) ex parte in Kirillova (2005, 2010, 2011), Kirillova, Kirillov (2005, 2011); Heligmosomum polygyrum (Dujardin, 1845) sensu Andreyko (1973), Kisielewska, Zubczevska (1973), Petrov and Kvitskio (1976), Shaykenov (1981); Heligmosomoides polygyrus (Dujardin, 1845) sensu Erofeeva (2016); Heligmosomum skrijabinii (Schulz, 1926) sensu Andreyko (1973), Petrov and Kvitskio (1976), Mazheyka (2004), Grikieniene (2005)
Heligmosomoides longispiculum (Tokobajev et Erculov, 1966) (Syn.: Heligmosomum longispiculum Tokobajev et Erculov, 1966)

Family Strongylostrongylidae Leiper, 1908

Astrakhan region (Kalmykov et al. 2017); Volgograd region (Ryzhikov et al. 1979); Bulgaria (Genov 1984); Armenia (Movsesyan et al. 2018); Kazakhstan (Shaykenov 1981)

Astrakhan region (Kalmykov et al. 2017); Armenia (Movsesyan et al. 2018); Bulgaria (Genov 1984)

Astrakhan region (Kalmykov et al. 2017); Armenia (Movsesyan et al. 2018); Bulgaria (Genov 1984)

Holartic

Palearctic

Cosmopolitan

Palearctic

Cosmopolitan

Palearctic

Holartic

Palearctic

Cosmopolitan

Central Asia

Kazakhstan (Shaykenov 1981)
Family Heteroxynematidae Skrjabin et Schikhobalova, 1948

Mastophorus muris (Schulz, 1926) (Syn.: Heligmosomoides glemophilus Tschertkowa et Tarjymanova, 1973)

Heligmosomum costellatum (Dujardin, 1845) (Syn.: Heligmosomum halli (Schulz, 1926))

Heligmosomum mixtum Schulz, 1954

Heligmosomum borealis (Schulz, 1930)

Longistriata dalrymplei Dikmans 1935

Carolinensis minutus (Dujardin, 1845) (Syn.: Longistriata volgaensis Schulz, 1926; Boreostrongylus borealis Travassosi, 1926; Cobbold (1927); Dujardin, 1845)

Family Heteroxynematidae Skrjabin et Schikhobalova, 1948

? Aspiculuris tetraptera (Nitsch, 1821)

Aspiculuris dinniki Schulz, 1927

Family Oxyuridae Cobbold, 1864

Syphacia arvicolae Sharpilo, 1973

Syphacia nigeriana Baylis, 1928

(Syn.: Syphacia obvelata (Rudolphi, 1802) sensu Furmaga (1957), Andreyko (1973), Kisielewska et al. (1973), Petrov and Kvitko (1976), Tokoavae (1976), Ryzhikov et al. (1979), Shayanov (1981), Vysotskaya (1997), Khuranov (2000), Mažeika (2004), Grikieniene (2005) Kostyunin (2010), Bychkova et al. (2017), Kalmykov et al. (2017) Movsesyan et al. (2018), Shendrik (2018); Syphacia stroma Linstow, 1884 sensu Kalmykov et al. (2010, 2017))

Syphacia microstus Erculov et Moldonijazova, 1975

Family Gongylonematidae Sobolev, 1949

Gongylonema neoplasticum (Fibiger et Ditlevsen, 1914) (Syn.: Gongylonema problematicum Schulz, 1924)

Family Spiroceridae Chitwood and Wehr, 1932

Mastophorus muris (Gmelin, 1790)
| ACANTHOCEPHALA |  |
|---------------|---|
| Family Moniliformidae Van Cleave, 1925 |  |
| *Moniliformis moniliformis* (Bremser, 1811) | Cosmopolitan | Samara region (Kirillova and Kirillow 2005, 2011, 2017; Kirillova 2010, 2011); Armenia (Movsesyan et al. 2018); Kazakhstan (Shaykenov 1981); Mongolia (Tinin et al. 2011) |
Discussion

Molecular genetic studies have shown that the cestode *Anoplocephaloides dentata* is a species complex and includes at least five species common in the Holarctic region: four species in Western Eurasia and one in the rest of Eurasia and Alaska (Haukisalmi et al. 2009). *Anoplocephaloides dentatoïdes* Sato, Kamiya, Tenora et Kamiya, 1993 from Japan also belongs to this species complex (Sato et al. 1993). The cestode *Paranoplocephala omphalodes*, which is widely distributed among the voles of Eurasia, also includes several species (Haukisalmi et al. 2004; Vlasenko et al. 2019).

Reports of *Catenotaenia pusilla* in common vole are erroneous since the cestode is a specific parasite of mice (*Mus musculus* Linnaeus, 1758 and *Apodemus* spp.) and does not occur in *Microtus* voles. All reports of findings of this parasite in other host species have not been confirmed (Haukisalmi et al. 2009, 2010).

It is now known that the distribution of *Paranoplocephala macrocephala* and *P. microti* is limited to the Nearctic (Haukisalmi and Henttonen 2003; Haukisalmi et al. 2004). Records of their recovery from European voles are erroneous.

The larval stages of *Mesocestoides* spp. found in micromammals should be called *Mesocestoides* sp., since the diagnosis of larval stages of the cestodes in this genus by conventional microscopy is possible only to the generic level. Identification of *Mesocestoides* tapeworms to the species level is possible using molecular-based methods (Zalesny and Hildebrand 2012; Skirnisson et al. 2016; Makarikov et al. 2017; et al.).

Studies of *Trichuris* nematodes from European voles revealed that arvicoline rodents have a new species of parasite *T. arvicolae* (Felui et al. 2000; Cutilias 2002) and not *T. muris* (Schrank, 1788).

*Sphyacia petruseviczii* is a specific parasite of the bank vole, *Myodes glareolus* (Schreber, 1780). *Sphyacia montana* was attributed to synonyms of *Sphyacia obvelata*-specific parasite of mice (Ogdén 1971). Registration of these *Sphyacia* species in the common vole is erroneous. It is more likely that the parasite recovered from common voles was *Sphyacia nigeriana*-a common parasite of mice and voles from the families Muridae and Cricetidae.

*Heligmosomum skrjabini* and *H. polygyrum* are synonyms of *Heligmosomoides polygyrus* (Ryzhikov et al. 1979; Genov 1984). *Heligmosomoides polygyrus* is a specific parasite of mice. Its findings in the common vole are erroneous.

*Aspiculuris tetraperta* is a parasite only of *Mus* spp. Records of this species from voles are incorrect. Probably, researchers were dealing with *Aspiculuris tainjinensis* Liu, Bu et Zhang, 2012-a parasite that has been described from the voles of China (Liu et al. 2012). This parasite has been reported in Europe in bank vole from UK (Behnke et al. 2015).

Fifteen species of helminths (from the 61 recorded in the common voles) are common parasites of rodents: trematodes *Brachylaima recurva*, *B. spinulosum*, *B. aequans*, *Plagiorchis muris*, cestodes *Aerostrilepis horrida*, *Rodentolepis fraterna*, *R. straminea*, *Catenotaenia cricetorum*, *Hymenolepis diminuta*, nematodes *Aonchotheca mursiyalyavici, Pterothomixx sadovskoi, Trichostrongylus colubriformis*, *Heligmosomum mixtum*, *Gongylonema neoplasticum* and *Mastophorus muris*.

Eight helminth species parasitize only representatives of the families Muridae and Cricetidae: cestodes *Paranoplocephala montana*, *Catenotaeniodes kirigiza*, nematodes *Eucoloeus gastricus, E. lemi*, *Strongyloides ratti*, *Trichostrongylus retortaeformis*, *Syphacia nigeriana*, *Carolinesis minutus* and *Aspiculuris dinniki*.

Three species of helminths (cestodes *Anoplocephaloides dentata*, *Paranoplocephala omphalodes* and nematode *Heligmosomoides bravissimi*) have been observed in rodents from the family Cricetidae.

Nine species of helminths are found only in arvicoline rodents: trematodes *Plagiorchis arvicolae*, *Tetraserialis tcherbakovii*, *Notocotylus noyeri*, *Quinqueserialis wolgaensis*, cestodes *Microtioleuta blandura*, *Rodentolepis asymmetrica*, nematodes *Trichurus arvicolae*, *Heligmosomum costellatum* and *H. borealis*.

The nematodes *Heligmosomoides laevis* and *H. longipisculum* are specific parasites of *Microtus* voles.

Five species of helminths found in common voles are common parasites of mammals from different orders: the trematodes *Plagiorchis elegans*, *Dicrocoelium dendriticum*, nematodes *Calodium hepaticum*, *Trichinella spiralis* and the acanthocephalan *Moniliformis moniliformis*. *P. elegans* also parasitizes birds and reptiles.

Occasional parasites of voles are the trematodes *Plagiorchis multiglandularis* (a parasite of birds), *Rubenstremia exasperata* (a specific parasite of shrews), the cestode *Skrjabinotaenia lobata* (a specific parasite of mice (*Muridae*)) and the nematodes *Syphacia arvicolae* (a specific parasite of European water vole *Arvicolal amphibia* (Linnaeus, 1758)), *Longistriata dalrymplei* (a specific parasite of muskrat *Ondatra zibethicus* (Linnaeus, 1766)) and *Heligmosomoides glareoli* (a specific parasite of Myodes voles).

Apparently, the cestode *Mathevotaenia dissymetrica* and the nematode *Syphacia microtus* described from *M. arvialis* in Kyrgyzstan should be considered as specific parasites of the common voles (Tables 1 and 2).

The cestode larvae of *Hydatigera taeniaeformis*, *Taenia hydatigena*, *T. crassiceps*, *T. pisiformis*, *T. polyacantha*, *Versteria mustelae*, *Echinococcus multilocularis* and *Mesocestoides* sp. are common parasites of myomorph rodents, which act as intermediate hosts.

Voles are paratenic hosts for larvae of the trematodes *Alata alata* and *Conodiplostomum spatula*. For the nematode *Trichinella spiralis* myomorph rodents can serve as both intermediate and final hosts.

The greatest richness of the helminth fauna of the common vole is in Russia (45 species). Thirty species of parasites have been recorded in Belarus; in Armenia-21, Kazakhstan-20, Lithuania-18, Bulgaria-17 (Figure 2).

The helminth community of *M. arvialis* is relatively less diverse in Moldova (15), Ukraine (14), Poland (12), Georgia (12), Azerbaijan (6) and Kyrgyzstan (6). Only one parasite species is known for Mongolia (Figure 2). Nematodes and cestodes are found in common voles in all
countries except Mongolia. Trematodes have been observed in *M. arvalis* in five studied regions. Acanthocephalans have been found in voles in only four regions (Figure 2).

The number of helminth species found depends on the number of research efforts undertaken in a particular region. The species richness of rodent helminths in Russia is due to a large number of studies compared to other regions. Figure 3 shows the dependence of the helminth species number on the number of studies in each region. The species accumulation curve was not constructed for Mongolia, because only one helminthological study of *M. arvalis* is known in this region.

The greatest accumulation of the number of species with an increase in the number of studies is noted at the beginning of the curves, when the number of recorded species not noted in previous works is still large. With further research, the number of detected species is gradually reduced, and the curve becomes more gentle. This can be seen in the graphs for Bulgaria, Moldova, Lithuania, and Kyrgyzstan.

The achievement of the horizontal asymptote on the curves with the accumulation of the number of species was not detected. This allows the assumption that with further studies of the common vole helminths fauna in Russia and adjacent countries, undetected (rare and occasional) parasite species will be recorded.

The dendrogram of similarity of the helminth communities of *M. arvalis* from different regions is presented in Figure 4. The cophenetic correlation coefficient is 0.87, which means the cluster is valid. A comparative analysis of the helminth fauna of the common vole from different areas shows that the greatest similarity of the species composition of the rodent is in the pairs Russia-Belarus (Jaccard index = 0.56) and Ukraine-Poland (0.53). The similarity of helminth fauna of rodents from Moldova and Lithuania is less (0.44) (Figure 4).

Armenia is included in the Russia-Belarus cluster, and indicates a relatively high degree of similarity of helminth fauna of the common vole in these countries (Armenia-Russia-0.44; Armenia-Belarus-0.38).

The Moldova-Lithuania cluster joins the Russia-Belarus-Armenia group since the similarity of helminth fauna of voles from Lithuania and Belarus is relatively high-0.50. Also, the helminths community of voles is close in similarity between Lithuania and Russia (0.34), Moldova and Belarus (0.32). The similarity of parasite community is slightly lower between Lithuania and Armenia (0.30), Moldova and Russia (0.30), Moldova and Armenia (0.29).

The similarity of the helminth community of voles from Bulgaria and Kazakhstan, forms a separate group, and according to the Jaccard index, was only 0.32. This group is adjacent to the Ukraine-Poland cluster (Figure 4). The similarity of helminth fauna of voles from Ukraine and Bulgaria is 0.35; from Poland and Bulgaria-0.32. The similarity of parasite community is lower in pairs Ukraine-Kazakhstan (0.26) and Poland-Kazakhstan (0.19).
Figure 3. Helminth species accumulation curves

The similarity of the helminth community of voles from Azerbaijan and Georgia, forms a separate cluster, was 0.36. Mongolia and Kyrgyzstan do not form a group with anyone due to the low similarity of helminth community of common voles with other countries (Figure 4). The Jaccard similarity index of the helminth community of Mongolian voles with other regions varied from 0 to 0.02, for Kyrgyzstan—from 0 to 0.13.

The similarity of the helminth fauna of the common vole of different research areas is determined not only by the geographical proximity, but, mainly, by the wide distribution of most helminth species of Microtus cf. arvalis. Most of the common voles’ helminths, found in Russia and adjacent countries, belong to the Palearctic faunistic complex (25 species). Fifteen species of parasites are cosmopolitans. Thirteen species of helminths of M. arvalis have a Holarctic distribution. Four species of parasites are found in rodent in Europe and in Central Asia—4 species too (Tables 1 and 2).

No helminth species from common voles was found in all areas of the study. The most widespread were the nematodes Syphacia nigeriana in rodents, and Heligmosomoides laevis in 11 regions. Three parasite species (cestodes Paranoplocephala omphalodes, Hydatigera taeniaformis (larva) and nematode Heligmosomum costellatum) were found in nine countries. The cestode Anoplocephaloides dentata and nematode Trichuris arvicolae (larva) were reported in eight study areas. Six helminth species (cestodes Rodentolepis asymmetrica, Taenia crassiceps (larva), T. polyacantha (larva), Echinococcus multilocularis (larva), Mesocestoides sp. (larva) and nematode Calodium hepaticum) were recorded in six studied regions (Tables 1 and 2).
Six parasite species (the trematode Notocotylus noyeri, cestodes Paranoplocephala montana, Hymenolepis diminuta, Arostrilepis horrida, Rodentolepis straminea and Versteria mustelae (larva)) were recorded in M. arvalis from five study areas. In four regions, eight species were recorded: trematodes Plagiorchis arvicolae and P. elegans, cestode Catenotaenia cricetorum, nematodes Trichinella spiralis (larva), Aonchotheca murissylvatici, Heligmosomum mixtum, Mastophorus muris and acanthocephalan Moniliformis moniliformis. Four parasite species (trematode Alaria alata (larva), nematodes Eucoleus gastricus, Carolinensis minutus, and Heligmosomum borealis) were found in three regions. The remaining 30 helminth species were recorded in the common voles in only one or two studied areas (Table 2).

Thus, the helminth fauna of Microtus cf. arvalis in Russia and adjacent countries currently includes 61 species: 14-trematodes, 21-cestodes, 25-nematodes and 1-acanthocephalan. The diversity of the helminth community of the common vole is due to the wide geographical range and abundance of this rodent. Microtus cf. arvalis is the final host for most recorded parasites. Only 10 species of cestodes and trematodes use common voles as intermediate and paratenic hosts. The core of the helminth fauna of voles is formed by common species that parasitize many species of rodents.

A comparative analysis of the helminth communities of voles from different regions showed that the most studied parasitofauna of Microtus cf. arvalis in Russia, where 45 species of parasitic worms were recorded. Russia has a much greater size compared to adjacent countries, and is located in different nature zones. The helminths of common voles have been studied in different Russian regions, which are geographically and climatically distant from each other. In other countries, common voles have fewer parasites. The similarity of the common vole helminth fauna of different countries is determined both by the geographical proximity of the research areas and by the broad distribution of most helminth species of Microtus cf. arvalis.

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