BIODIVERSITAS
Volume 21, Number 5, May 2020
Pages: 1961-1979

ISSN: 1412-033X
E-ISSN: 2085-4722
DOI: 10.13057/biodiv/d210524

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

NADEZHDA Yu. KIRILLOVA[1], ALEXANDER A. KIRILLOV[1,♥], ALEXANDER B. RUCHIN[2], MAXIM V. TRUKHACHEV[2]

[1]Institute of Ecology of the Volga River Basin of RAS-branch of the Samara Federal Research Center of RAS, Samara Region, Togliatti, Komzina Street, 10445003, Russia. Tel./fax. +7 (8482) 48-95-04 ♥email: parasitolog@yandex.ru

[2]Joint Directorate of the Mordovia State Nature Reserve and National Park "Smolny", Republic of Mordovia, Saransk, Krasnaya Street, 30430005, Russia

Manuscript received: 13 February 2020. Revision accepted: 13 April 2020.

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 Lissovsky 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 vegatation, 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 (Krumpál 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 arvicolae* Feliu, 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 "Arvicolinae" 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), Strongyloididae (1), Trichostrongylidae (11), Heteroxynematidae (1), Oxyuridae (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), Plagiorchiidae (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).

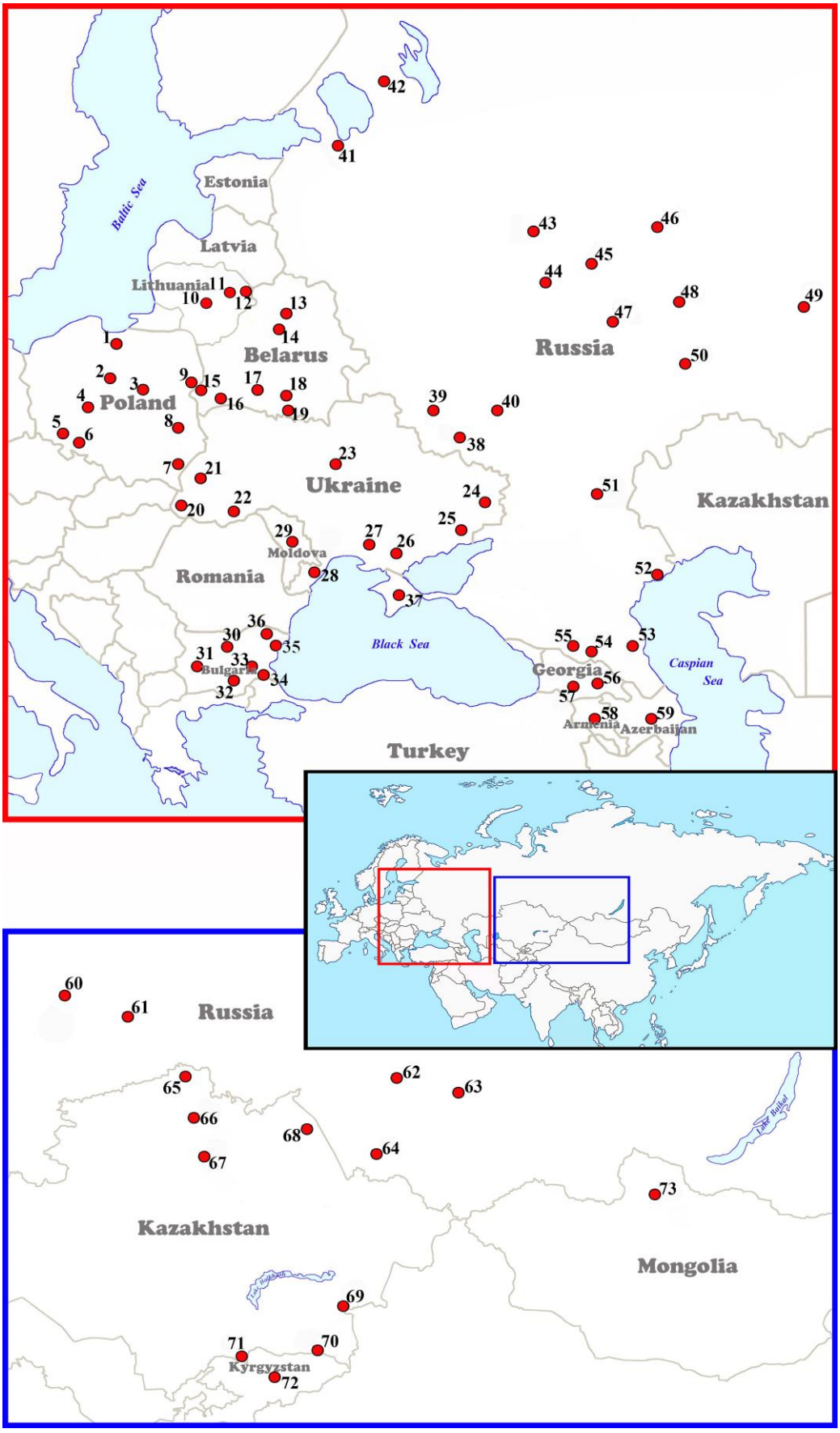

Figure 1. Map of the studied areas. Red circles indicate research localities. Locality numbers refer to Table 1

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. arvicolae*, *H. borealis*, *H. laevis*, *S. nigeriana*
2	Kuyavian-Pomeranian Voivodeship (Bydgoszcz, Mogilno), Poland	52°53′22.8″N 17°58′30.1″E	
3	Dziekanow Lesny, Poland	52°20′49.1″N 20°51′15.7″E	*T. arvicolae*, *S. nigeriana*
4	Greater Poland Voivodeship (Koscian), Poland	52°05′10.8″N 16°38′42″E	*T. arvicolae*, *H. borealis*, *H. laevis*, *S. nigeriana*
5	Lower Silesian Voivodeship (Wroclaw, Zlotoryja), Poland	51°07′3.2″N 16°28′28.8″E	
6	Opole Voivodeship (Nysa, Brzeg), Poland	50°40′3.6″N 17°24′4.3″E	
7	Subcarpathian Voivodeship (Brzozow, Lubaczow, Przemysl, Jaroslaw), Poland	49°54′43.1″N 22°38′46.6″E	
8	Vicinity of Lublin, Poland	51°15′02″N 22°34′12.4″E	*A. dentata*, *R. asymmetrica*, *H. taeniaeformis* (larva), *T. arvicolae*, *H. laevis*, *S. nigeriana*
9	Bialowieza National Park, Poland	52°45′44.5″N 23°52′2.7″E	*R. exasperatum*, *P. omphalodes*, *R. asymmetrica*, *R. fraterna*, *T. polyacantha* (larva), *H. costellatum*, *S. nigeriana*
10	Lithuania (locality not specified)	55°21′0″N 23°45′0″E	*N. noyeri*, *A. alata* (larva), *P. omphalodes*, *R. straminea*, *C. cricetorum*, *T. crassiceps* (larva), *H. taeniaeformis* (larva), *V. mustelae* (larva), *Mesocestoides* sp. (larva), *T. spiralis*, *T. retortaeformis*, *H. glareoli*, *H. laevis*, *H. costellatum*, *H. borealis*, *H. mixtum*, *S. nigeriana*
11	Kamša, Lithuania	55°25′15.4″N 25°49′12.1″E	*N. noyeri*, *A. alata* (larva), *P. omphalodes*, *R. straminea*, *C. cricetorum*, *V. mustelae* (larva), *H. taeniaeformis* (larva), *T. arvicolae*, *H. laevis*, *H. borealis*, *H. costellatum*, *H. mixtum*, *S. nigeriana*
12	Vicinity of Lake Druksiai, Lithuania	55°36′55″N 26°31′47.8″E	*H. diminuta*, *A. horrida*, *H. taeniaeformis* (larva), *H. costellatum*, *S. nigeriana*
13	Berezinsky Biosphere Reserve, Belarus	54°44′21.1″N 28°19′0.5″E	*P. omphalodes*, *A. horrida*, *S. lobata*, *C. cricetorum*, *H. taeniaeformis* (larva), *T. arvicolae*, *H. costellatum*, *H. mixtum*, *H. glareoli*, *T. spiralis*, *S. nigeriana*
14	Vicinity of Minsk, Belarus	53°54′8.4″N 27°33′42.8″E	*R. straminea*, *T. crassiceps* (larva), *T. arvicolae*, *P. sadovskoi*, *S. ratti*, *T. retortaeformis*, *H. costellatum*, *H. laevis*, *C. minutus*, *S. nigeriana*
15	"Belovezhskaya Pushcha" National Park, Belarus	52°33′27.3″N 23°48′18.9″E	*P. 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. arvicolae*, *H. costellatum*, *H. laevis*, *S. nigeriana*
16	Brest region, Belarus	52°24′43.8″N 25°15′17.2″E	*P. omphalodes*, *H. diminuta*, *R. assymmetrica*, *H. taeniaeformis* (larva), *S. nigeriana*, *C. minutus*, *M. muris*
17	Palyesky village, Brest region, Belarus	52°17′40.2″N 26°39′59″E	*P. omphalodes*, *H. taeniaeformis* (larva), *Mesocestoides* sp. (larva), *H. costellatum*, *S. nigeriana*
18	Boklan' village, Gomel region, Belarus	52°07′42.6″N 28°04′50.9″E	
19	Markowskaye village, Gomel region, Belarus	51°43′33″N 28°12′28.9″E	
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. arvicolae*, *H. costellatum*, *L. dalrymplei*, *S. nigeriana*, *M. muris*
21	Lviv region, Ukraine	49°39′4.4″N 23°49′36.1″E	*A. dentata*, *P. montana*, *P. omphalodes*, *A. horrida*, *T. crassiceps* (larva), *T. arvicolae*, *H. laevis*, *H. costellatum*, *H. mixtum*, *S. nigeriana*, *M. muris*
22	Chernivtsi region, Ukraine	48°22′51.9″N 26°06′29.4″E	
23	Kyiv region, Ukraine	50°10′42.9″N 30°29′33″E	
24	Lugansk region, Ukraine	49°16′20.9″N 38°54′54.2″E	
25	Donetsk region, Ukraine	47°55′16.6″N 37°46′51.5″E	

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	Pleven region, Bulgaria	43°24′32.5″N 24°37′4.8″E	*P. arvicolae*, *P. elegans*, *M. blanchardi*, *T. crassiceps* (larva), *T. arvicolae*, *H. laevis*, *S. nigeriana*
31	Sofia region, Bulgaria	42°41′52.3″N 23°19′19.8″E	*P. arvicolae*, *M. blanchardi*, *T. crassiceps* (larva), *T. arvicolae*, *H. costellatum*, *H. laevis*, *C. minutus*
32	Haskovo region, Bulgaria	41°56′4.5″N 25°33′20.4″E	*T. arvicolae*, *H. laevis*, *S. nigeriana*
33	Yambol region, Bulgaria	42°22′41.3″N 26°38′9.9″E	*E. gastricus*, *T. arvicolae*, *C. minutus*, *S. nigeriana*
34	Strandzha region, Bulgaria	42°03′46.8″N 27°00′14″E	*T. polyacantha* (larva), *T. crassiceps* (larva), *T. arvicolae*
35	Batova river floodplain (Dobrich region), Bulgaria	43°20′50.1″N 28°04′7.7″E	*R. asymmetrica*, *T. crassiceps* (larva), *T. arvicolae*, *C. minutus*
36	Srebarna Nature Reserve, Bulgaria	44°06′41.1″N 27°04′12.9″E	*B. spinulosum*, *P. elegans*, *M. blanchardi*, *A. horrida*, *A. dentata*, *T. polyacantha* (larva), *T. crassiceps* (larva), *C. hepaticum*, *A. murissylvatici*, *E. gastricus*, *T. arvicolae*, *C. minutus*
37	Crimea	45°12′48.5″N 34°15′35.2″E	*P. omphalodes*, *H. diminuta*, *A. horrida*, *R. straminea*, *S. lobata*, *Mesocestoides* sp. (larva), *C. hepaticum*, *T. arvicolae*
38	Belgorod region	50°41′50.1″N 37°33′17.6″E	*A. dentata*, *P. omphalodes*, *H. diminuta*, *S. nigeriana*, *H. laevis*, *H. costellatum*
39	Tsentralno-Chernozemny Biosphere Reserve, Kursk region	51°35′02.6″N 36°06′27.6″E	*A. dentata*, *P. omphalodes*, *H. taeniaeformis* (larva), *T. arvicolae*, *H. costellatum*, *S. nigeriana*, *T. spiralis*
40	Voronezh Nature Reserve, Voronezh region	51°56′49.1″N 39°35′44.2″E	*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*
41	Leningrad region	60°01′15.1″N 32°05′7.2″E	*P. arvicolae*, *N. noyeri*, *P. omphalodes*, *R. asymmetrica*, *H. taeniaeformis* (larva), *T. hydatigena* (larva), *T. polyacantha* (larva), *T. arvicolae*, *H. laevis*, *H. costellatum*, *S. nigeriana*
42	Kaskesnavolok village, Karelia	61°35′38.8″N 33°19′23.0″E	*N. noyeri*
43	Ivanovo region	56°55′0.3″N 41°26′6.8″E	*H. laevis*
44	Vladimir region (Afanasovo, Popolutovo)	55°39′03.6″N 41°50′04.1″E	*P. omphalodes*
45	Nizhny Novgorod region	55°28′18.5″N 44°05′28.2″E	*N. noyeri*, *A. dentata*, *P. omphalodes*, *H. diminuta*, *T. polyacantha* (larva), *H. taeniaeformis* (larva), *V. mustelae* (larva), *C. minutus*, *S. nigeriana*
46	Vicinity of Kirov	58°36′12.7″N 49°39′50.1″E	*A. alata* (larva), *A. dentata*, *H. diminuta*, *H. taeniaeformis* (larva), *H. costellatum*, *H. laevis*, *S. nigeriana*
47	Mordovia (Mordovia Nature Reserve and “Smolny” National Park)	54°44′59.5″N 44°16′44.6″E	*A. dentata*, *P. omphalodes*, *C. cricetorum*, *H. taeniaeformis* (larva), *V. mustelae*, (larva), *T. arvicolae*, *H. laevis*, *C. minutus*, *S. nigeriana*
48	Volzhsko-Kamskiy Nature Reserve, Tatarstan	55°16′2.8″N 49°19′53.1″E	*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*
49	Bashkortostan	54°43′34.6″N 55°56′51.8″E	*T. polyacantha* (larva)
50	“Samarskaya Luka” National Park, Samara region	53°17′22.4″N 49°42′23.1″E	*N. noyeri*, *Q. wolgaensis*, *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*
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*

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. arvicolae*, *Heligmosomoides laevis*, *H. costellatum*, *S. nigeriana*
53	Dagestan	43°03′27″N 47°07′59.6″E	*P. omphalodes*, *Mesocestoides* sp. (larva), *T. arvicolae*, *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),
57	Vicinity of Ts'ikhisjvari village, Georgia	41°43′3.4″N 43°26′26.6″E	*E. multilocularis* (larva), *C. hepaticum*, *H. laevis*, *H. costellatum*, *S. nigeriana*, *G. neoplasticum*
58	Armenia (most of districts)	40°46′10.7″N 44°40′25.2″E	*B. aequans*, *N. noyeri*, *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*
59	Azerbaijan (locality not specified)	40°23′37.1″N 47°41′4.1″E	*H. taeniaeformis* (larva), *E. multilocularis* (larva), *Mesocestoides* sp. (larva), *C. hepaticum*, *S. nigeriana*, *H. laevis*, *H. travassosi*
60	Sverdlovsk region	58°38′29.2″N 61°48′7.8″E	*H. taeniaeformis* (larva)
61	Tyumen region	57°22′44″N 67°00′42.2″E	*P. omphalodes*
62	Novosibirsk region	54°58′19.3″N 79°28′53″E	
63	Azhendarovo, Kemerovo region	54°45′26.6″N 87°01′31.4″E	
64	Altai Krai	52°41′35.6″N 82°41′35.3″E	*B. recurva*, *A. dentata*, *A. horrida*, *E. multilocularis* (larva), *P. sadovskoi*, *C. hepaticum*, *T. arvicolae*, *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. arvicolae*, *N. noyeri*, *A. dentata*, *P. omphalodes*, *T. hydatigena* (larva), *T. arvicolae*, *S. arvicolae*
67	Akmola region, Kazakhstan	50°59′22.3″N 71°05′11.4″E	*P. arvicolae*, *P. elegans*, *N. noyeri*, *P. omphalodes*, *A. dentata*, *C. kirgizica*, *T. crassiceps* (larva), *T. hydatigena* (larva), *A. murissylvatici*, *C. hepaticum*, *T. arvicolae*, *S. nigeriana*, *S. arvicolae*, *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. arvicolae*, *M. muris*
70	Ile Alatau, Kazakhstan	43°00′3.3″N 78°27′21.6″E	*B. recurva*, *P. omphalodes*, *E. multilocularis* (larva), *T. arvicolae*, *A.murissylvatici*, *H. longispiculum*, *M. muris*
71	Talas Alatau, Kazakhstan	43°13′25.7″N 73°22′54.4″E	*E. lemmi*, *T. arvicolae*, *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. microtus*
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 arvicolae 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 multiglandularis Semenov, 1927 (Syn.: *Plagiorchis eutamiatis* 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 (Rudolphi, 1819) (Syn.: *Distoma exasperatum* Rudolphi, 1819; *Plagiorchis microti* Soltys, 1949)	Holarctic	Poland (Soltys 1949)
Family Notocotylidae Lühe, 1909		
Notocotylus noyeri 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; Grikieniene 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 Tschertkova, 1960	Palearctic	Armenia (Movsesyan et al. 2004)
Family Diplostomidae Poirier, 1886		
Conodiplostomum spathula (Creplin, 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; Grikieniene 2005)

CESTODA

Family Anoplocephalidae Cholodkowsky, 1902

Anoplocephaloides dentata (Galli-Valerio, 1905) (Syn.: *Paranoplocephala dentata* Galli-Valerio, 1905; *Paranoplocephala brevis* Kirschenblatt, 1938)	Holarctic	Mordovia (Ruchin et al. 2016; this paper); Tatarstan and Volgograd region (Ryzhikov et al. 1978); Voronezh region (Romashova 2012); Belgorod region (Kononova 2018); Kirov region (Erofeeva 2016); Kursk region (Vlasov et al. 2015); Nizhny Novgorod region (Kostyunin 2010); Samara region (Kirillova and Kirillov 2005, 2008, 2017; Kirillova 2011; Kirillov and Kirillova 2017); Astrakhan region (Kalmykov et al. 2010); Altai Krai and Eastern Siberia (Ryzhikov et al. 1978); Belarus (Shimalov 2002, 2012; Bychkova et al. 2017); Ukraine (Ryzhikov et al. 1978); Poland (Furmaga 1957); Bulgaria (Genov 1984); Armenia (Movsesyan et al. 2006); Kazakhstan (Shaykenov 1981); Kyrgyzstan (Tokobaev 1976)
Paranoplocephala montana (Kirshenblat, 1941) (Syn.: *Andrya montana* Kirshenblat, 1941)	Europe	Tatarstan (Ryzhikov et al. 1978); Moldova (Andreyko 1973); Ukraine and Georgia (Ryzhikov et al. 1978); Armenia (Movsesyan et al. 2006)
Paranoplocephala omphalodes (Hermann, 1783) (Syn.: *Aprostatandrya caucasica* Kirshenblatt, 1938; *Paranoplocephala caucasica* (Kirschenblatt, 1938))	Holarctic	Dagestan and Tatarstan (Ryzhikov et al., 1978); Mordovia (this paper); Crimea (Zavaleeva and Kuzmina 1980); Leningrad and Volgograd regions (Ryzhikov et al. 1978); Belgorod region (Petrov and Kvitko 1976); Kursk region (Vlasov et al. 2015); Voronezh region (Romashov 1997; Romashova 2012); Nizhny Novgorod region (Kostyunin 2010); Samara region (Kirillova and Kirillov 2005, 2008, 2017; Kirillova 2011; Kirillov and Kirillova 2017); Astrakhan region (Kalmykov et al. 2010); Tyumen region (Timoshenko and Zhigileva 2007; Zhigileva 2011); Novosibirsk region (Ryzhikov et al. 1978); Vladimir and Kemerovo regions (Vlasenko et al. 2019); Belarus (Shimalov 2002, 2012); Ukraine (Ryzhikov et al. 1978; Vysotskaya 1997); Lithuania (Mažeika 2004; Grikieniene 2005); Bulgaria (Genov 1984); Poland (Soltys 1949); Moldova (Andreyko 1973); Armenia (Movsesyan et al. 2006); Georgia (Ryzhikov et al. 1978); Kazakhstan (Shaykenov 1981; Vlasenko et al. 2019)
? *Paranoplocephala macrocephala* (Douthitt, 1915) (Syn.: *Aprostatandrya macrocephala* (Douthitt, 1915); *Andrya bialowizensis* Soltys, 1949)	Nearctic	Altai Krai and Eastern Siberia (Ryzhikov et al. 1978); Samara region (Kirillova and Kirillov 2005, 2008, 2017; Kirillova 2011; Kirillov and Kirillova 2017); Belarus (Bychkova et al. 2017; Shendrik 2018); Kazakhstan (Shaykenov 1981); Lithuania (Mažeika 2004; Grikieniene 2005); Poland (Soltys 1949; Furmaga 1957; Kisielewska et al. 1973); Armenia (Movsesyan et al. 2006)
? *Paranoplocephala microti* (Hansen, 1947) (Syn.: *Aprostatandrya microti* (Hansen, 1947))	Nearctic	Armenia (Movsesyan et al. 2006)
Microticola blanchardi (Moniez, 1891) (Syn.: *Paranoplocephala blanchardi* (Moniez, 1891))	Palearctic	Astrakhan region (Ryzhikov et al. 1978); Bulgaria (Genov 1984)
Mathevotaenia dissymetrica Tokobajev et Erculov, 1966	Central Asia	Kyrgyzstan (Tokobaev 1976)

Family Hymenolepididae Ariola, 1899

Hymenolepis diminuta Rudolphi, 1819	Cosmopolitan	Kabardino-Balkaria and North Ossetia-Alania (Khuranov 2000); Crimea (Zavaleeva and Kuzmina 1980); Belgorod region (Kononova 2018); Kirov region (Erofeeva 2016); Nizhny Novgorod region (Kostyunin 2010); Samara region (Kirillova and Kirillov 2005, 2008; Kirillova 2011; Kirillov and Kirillova 2017); Belarus (Shimalov 2002; Bychkova et al. 2017); Armenia (Movsesyan et al. 2006); Georgia (Ryzhikov et al. 1978); Kyrgyzstan (Tokobaev 1976)
Arostrilepis horrida (Linstow, 1901) (Syn.: *Hymenolepis horrida* (Linstow, 1901))	Holarctic	Crimea (Zavaleeva and Kuzmina 1980), Altai Republic, Eastern Siberia, Volgograd region (Ryzhikov et al. 1978), Belarus (Bychkova et al. 2017; Shendrik 2018); Bulgaria (Genov 1984); Moldova (Andreyko 1973); Ukraine (Ryzhikov et al. 1978)
Rodentolepis fraterna (Stiles, 1906)	Cosmopolitan	Poland (Soltys, 1949)
Rodentolepis straminea (Goeze, 1782)	Palearctic	Crimea (Zavaleeva and Kuzmina 1980); Lithuania (Mažeika 2004; Grikieniene 2005); Belarus (Bychkova et al. 2017); Moldova (Andreyko 1973); Armenia (Movsesyan et al. 2006)

Rodentolepis asymmetrica (Janicki, 1904)	Europe	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	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	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 Asia	Kazakhstan (Shaykenov 1981)
Skrjabinotaenia lobata (Baer, 1925)	Palearctic	Crimea (Zavaleeva and Kuzmina 1980); Astrakhan region (Kalmykov et al. 2010); Belarus (Shendrik 2018)
Family Taeniidae Ludvig, 1886		
Hydatigera taeniaeformis (Batsch, 1786), larva (Syn.: *Taenia taeniaeformis* (Batsch, 1786); *Strobilocercus fasciolaris* Rudolphi, 1808)	Cosmopolitan	Kabardino-Balkaria and North Ossetia-Alania (Khuranov 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 (Romashov 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 (Furmaga 1957); Georgia and Azerbaijan (Ryzhikov et al. 1978); Armenia (Movsesyan et al. 2006)
Taenia crassiceps (Zeder, 1800), larva	Holarctic	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*, Rudolphi, 1819)	Cosmopolitan	Татарстан, Leningrad and Astrakhan regions (Ryzhikov et al. 1978); Voronezh region (Romashov 1997; Romashova 2012); Moldova (Andreyko 1973); Kazakhstan (Shaykenov 1981)
Taenia pisiformis (Bloch, 1780), larva	Cosmopolitan	Astrakhan region (Ryzhikov et al. 1978); Armenia (Movsesyan et al. 2006)
Taenia polyacantha Leuckart, 1856, larva (Syn.: *Tetratirotaenia polyacantha* (Leuckart, 1856))	Holarctic	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 mustelae (Gmelin, 1790), larva (Syn.: *Taenia mustelae* Gmelin, 1790)	Holarctic	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, Neogea	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); Shimalov (2002); Mažeika (2004); Grikieniene (2005); Movsesyan et al. (2006); Bychkova et al. (2017)	Cosmopolitan	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 murissylvatici (Diesing, 1851) (Syn.: *Capillaria murissylvatici* (Diesing, 1851))	Holarctic	Astrakhan region (Kalmykov et al. 2017); Volgograd region (Ryzhikov et al. 1979); Bulgaria (Genov 1984); Armenia (Movsesyan et al. 2018); Kazakhstan (Shaykenov 1981)
Pterothominx sadovskoi (Morozov, 1956) (Syn.: *Armocapillaria sadovskajae* (Morosov, 1959))	Palearctic	Altai Krai (Ryzhikov et al. 1979); Astrakhan region (Kalmykov et al. 2010, 2017); Belarus (Bychkova et al. 2017)
Calodium hepaticum (Bancroft, 1893) (Syn.: *Hepaticola hepatica* (Bancroft, 1893))	Cosmopolitan	Crimea and Altai Krai (Ryzhikov et al. 1979); Voronezh region (Romashov 1997; Romashova 2012); Moldova (Andreyko 1973); Bulgaria (Genov 1984); Kazakhstan (Shaykenov 1981); Georgia and Azerbaijan (Ryzhikov et al. 1979)
Eucoleus gastricus (Baylis, 1926) (Syn.: *Thominx gastricus* (Baylis, 1926))	Palearctic	Astrakhan region (Kalmykov et al. 2017); Armenia (Movsesyan et al. 2018); Bulgaria (Genov 1984)
Eucoleus lemmi (Retzius, 1841)	Palearctic	Samara region (Kirillova and Kirillov 2005, 2011; Kirillova 2010, 2011); Kazakhstan (Shaykenov 1981)
Family Trichinellidae Ward 1907		
Trichinella spiralis Owen, 1835	Cosmopolitan	Kursk region (Vlasov et al. 2016); Belarus (Bychkova et al. 2017); Lithuania (Mažeika 2004); Armenia (Movsesyan et al. 2018)
Family Trichuridae Ransom, 1911		
Trichuris arvicolae Feliu, Spakulova, Casanova, Renaud, Morand, Hugot, Santalla et Durand, 2000 (Syn.: *Trichuris muris* (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 (2003, 2012), Mazheyka (2004), ; Grikieniene (2005), Kirillova (2005), Aliyev et al. (2007)	Palearctic	Dagestan (Aliev et al. 2007); Crimea (Zavaleeva and Kuzmina 1980); Mordovia (this paper); Tatarstan, Altai Krai and Leningrad region (Ryzhikov et al. 1979); Kursk region (Vlasov et al. 2015); Voronezh region (Romashov 1997; Romashova 2012); Samara region (Kirillova and Kirillov 2005, 2011; Kirillova 2010, 2011); Astrakhan region (Kalmykov et al. 2017); Lithuania (Ryzhikov et al. 1979; Mažeika 2004; Grikieniene 2005); Belarus (Shimalov 2002; Shendrik 2018); Moldova (Andreyko 1973); Ukraine (Ryzhikov et al. 1979; Vysotskaya 1997); Bulgaria (Genov 1984); Poland (Furmaga 1957; Kisielewska et al. 1973); Kazakhstan (Shaykenov 1981)
Family Strongyloididae Chitwood et MacIntosh, 1934		
Strongyloides ratti Sandground, 1925	Holarctic	Belarus (Bychkova et al. 2017)
Family Trichostrongylidae Leiper, 1908		
Trichostrongylus colubriformis (Giles, 1892)	Palearctic	Moldova (Andreyko 1973)
Trichostrongylus retortaeformis (Zeder, 1800)	Cosmopolitan	Belarus (Bychkova et al. 2017); Lithuania (Mažeika 2004)
Heligmosomoides glareoli (Baylis, 1928)	Palearctic	Belarus (Bychkova et al. 2017; Shendrik 2018); Lithuania (Ryzhikov et al. 1979; Mažeika 2004)
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, Zubczewska (1973), Petrov and Kvitko (1976), Shaykenov (1981); *Heligmosomoides polygyrus* (Dujardin, 1845) sensu Erofeeva (2016)); *Heligmosomum skrjabini* (Schulz, 1926) sensu Andreyko (1973), Petrov and Kvitko (1976), Mazheyka (2004), Grikieniene (2005)	Palearctic	Mordovia (this paper); Tatarstan and Leningrad region (Ryzhikov et al. 1979); Kirov region (Erofeeva 2016); Belgorod region (Petrov and Kvitko 1976; Kononova 2018); Ivanovo region (Kostyunin 2010); Voronezh region (Romashov 1997; Romashova 2012); Volgograd region (Ryzhikov et al. 1979); Samara region (Kirillova and Kirillov 2005, 2011, 2017; Kirillova 2010, 2011); Astrakhan region (Kalmykov et al. 2017); Lithuania (Mažeika 2004; Grikieniene 2005); Poland (Furmaga 1957; Kisielewska et al. 1973); Belarus (Shimalov 2002, 2012; Bychkova et al. 2017; Shendrik, 2018); Moldova (Andreyko, 1973); Bulgaria (Genov, 1984); Ukraine, Georgia and Azerbaijan (Ryzhikov et al. 1979); Armenia (Movsesyan et al. 2018); Kazakhstan (Shaykenov 1981)
Heligmosomoides longispiculum (Tokobajev et Erkulov, 1966) (Syn.: *Heligmosomum longispiculum* Tokobajev et Erculov, 1966)	Central Asia	Kazakhstan (Shaykenov 1981)

Heligmosomoides travassosi Schulz, 1926 (Syn.: *Heligmosomoides glomerophilus* Tschertkowa et Tarjymanova, 1973)	Europe	Azerbaijan (Ryzhikov et al. 1979)
Heligmosomum costellatum (Dujardin, 1845) (Syn.: *Heligmosomum halli* (Schulz, 1926))	Palearctic	Dagestan, Altai Krai, Leningrad and Volgograd regions (Ryzhikov et al. 1979); Kirov region (Erofeeva 2016); Belgorod region (Petrov and Kvitko 1976); Kursk region (Vlasov et al. 2015); Voronezh region (Romashov 1997; Romashova 2012); Astrakhan region (Kalmykov et al. 2017); Samara region (Kirillova and Kirillov 2005, 2011, 2017; Kirillova 2010, 2011); Lithuania (Ryzhikov et al. 1979; Mažeika 2004; Grikieniene 2005); Ukraine (Ryzhikov et al. 1979; Vysotskaya 1997); Belarus (Shimalov 2002, 2012; Shendrik 2018); Moldova (Andreyko 1973); Bulgaria (Genov 1984); Poland (Soltys 1949; Kisielewska et al. 1973); Georgia (Ryzhikov et al. 1979); Armenia (Movsesyan et al. 2018)
Heligmosomum mixtum Schulz, 1954	Palearctic	Dagestan (Aliev et al. 2007); Crimea (Zavaleeva and Kuzmina 1980); Altai Krai (Ryzhikov et al. 1979); Tyumen region (Timoshenko and Zhigileva 2007; Zhigileva 2011); Belarus (Shendrik 2018); Ukraine (Ryzhikov et al. 1979); Lithuania (Mazheyka 2004; Grikieniene 2005)
Heligmosomum borealis (Schulz, 1930)	Palearctic	Volgograd region (Ryzhikov et al. 1979); Lithuania (Mažeika 2004; Grikieniene 2005); Poland (Kisielewska et al. 1973)
Longistriata dalrymplei Dikmans 1935	Holarctic	Ukraine (Vysotskaya 1997)
Carolinensis minutus (Dujardin, 1845) (Syn.: *Longistriata wolgaensis* Schulz, 1926; *Boreostrongylus minutus* (Dujardin, 1845)	Palearctic	Mordovia (Ruchin et al. 2016); Nizhny Novgorod region (Kostyunin 2010); Voronezh region (Romashov 1997; Romashova 2012); Belarus (Bychkova et al. 2017); Bulgaria (Genov 1984)
Family Heteroxynematidae Skrjabin et Schikhobalova, 1948		
? *Aspiculuris tetraptera* (Nitsch, 1821)	Cosmopolitan	Crimea (Zavaleeva and Kuzmina 1980); Kabardino-Balkaria and North Ossetia-Alania (Khuranov 2000); Dagestan and Volgograd region (Ryzhikov et al. 1979); Voronezh region (Romashova 2012); Lithuania (Mažeika 2004); Belarus (Bychkova et al. 2017); Moldova (Andreyko 1973); Georgia (Ryzhikov et al. 1979); Armenia (Movsesyan et al. 2018); Kyrgyzstan (Tokobaev 1976)
Aspiculuris dinniki Schulz, 1927	Palearctic	Voronezh region (Romashov 1997; Romashova 2012)
Family Oxyuridae Cobbold, 1864		
Syphacia arvicolae Sharpilo, 1973	Palearctic	Kazakhstan (Shaikenov 1981)
Syphacia nigeriana Baylis, 1928 (Syn.: *Syphacia obvelata* (Rudolphi, 1802) sensu Furmaga (1957), Andreyko (1973), Kisielewska et al. (1973), Petrov and Kvitko (1976), Tokobaev (1976), Ryzhikov et al. (1979), Shaykenov (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)	Holarctic	Kabardino-Balkaria and North Ossetia-Alania (Khuranov 2000); Mordovia (this paper); Dagestan, Tatarstan, Leningrad and Volgograd regions, Eastern Siberia (Ryzhikov et al. 1979); Kirov region (Maslennikova et al. 2014); Belgorod region (Petrov and Kvitko 1976; Kononova 2018); Kursk region (Vlasov et al. 2015); Voronezh region (Romashov 1997; Romashova 2012); Nizhny Novgorod region (Kostyunin 2010); Samara region (Kirillova and Kirillov 2005, 2011, 2017; Kirillova 2010, 2011); Astrakhan region (Kalmykov et al. 2010, 2017); Lithuania (Mažeika 2004; Grikieniene 2005); Ukraine (Ryzhikov et al. 1979; Vysotskaya 1997); Belarus (Shimalov 2002, 2012; Bychkova et al. 2017; Shendrik 2018); Moldova (Andreyko 1973); Poland (Furmaga 1957; Kisielewska et al. 1973); Bulgaria (Genov 1984); Georgia and Azerbaijan (Ryzhikov et al. 1979); Armenia (Movsesyan et al. 2018); Kazakhstan (Shaykenov 1981); Kyrgyzstan (Tokobaev 1976)
Syphacia microtus Erculov et Moldonijazova, 1975	Central Asia	Kyrgyzstan (Ryzhikov et al. 1979)
Family Gongylonematidae Sobolev, 1949		
Gongylonema neoplasticum (Fibiger et Ditlevsen, 1914) (Syn.: *Gongylonema problematicum* Schulz, 1924)	Palearctic	Samara region (Kirillova and Kirillov 2005, 2011; Kirillova 2010, 2011); Georgia (Ryzhikov et al. 1979)
Family Spirocercidae Chitwood et Wehr, 1932		
Mastophorus muris (Gmelin, 1790)	Cosmopolitan	Altai Krai (Ryzhikov et al. 1979); Voronezh region (Romashov 1997; Romashova 2012); Belarus (Bychkova et al. 2017); Ukraine (Ryzhikov et al. 1979; Vysotskaya 1997); Kazakhstan (Shaykenov 1981)

ACANTHOCEPHALA		
Family Moniliformidae Van Cleave, 1925		
Moniliformis moniliformis (Bremser, 1811)	Cosmopolitan	Samara region (Kirillova and Kirillov 2005, 2011, 2017; Kirillova 2010, 2011); Armenia (Movsesyan et al. 2018); Kazakhstan (Shaykenov 1981); Mongolia (Tinnin 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 dentatoides* 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* (Feliu et al. 2000; Cutillas 2002) and not *T. muris* (Schrank, 1788).

Syphacia petrusewiczii is a specific parasite of the bank vole, *Myodes glareolus* (Schreber, 1780). *Syphacia montana* was attributed to synonyms of *Syphacia obvelata*-specific parasite of mice (Ogden 1971). Registration of these *Syphacia* species in the common vole is erroneous. It is more likely that the parasite recovered from common voles was *Syphacia 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 tetraptera 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 *Arostrilepis horrida*, *Rodentolepis fraterna*, *R. straminea*, *Catenotaenia cricetorum*, *Hymenolepis diminuta*, nematodes *Aonchotheca murissylvatici*, *Pterothominx sadovskoi*, *Trichostrongylus colubriformis*, *Heligmosomum mixtum*, *Gongylonema neoplasticum* and *Mastophorus muris*.

Eight helminth species parasitize only representatives of the families Muridae and Critetidae: cestodes *Paranoplocephala montana*, *Catenotaenioides kirgizica*, nematodes *Eucoleus gastricus*, *E. lemmi*, *Strongyloides ratti*, *Trichostrongylus retortaeformis*, *Syphacia nigeriana*, *Carolinensis minutus* and *Aspiculuris dinniki*.

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

Nine species of helminths are found only in arvicoline rodents: trematodes *Plagiorchis arvicolae*, *Tetraserialis tscherbakovi*, *Notocotylus noyeri*, *Quinqueserialis wolgaensis*, cestodes *Microticola blanchardi*, *Rodentolepis asymmetrica*, nematodes *Trichuris arvicolae*, *Heligmosomum costellatum* and *H. borealis*.

The nematodes *Heligmosomoides laevis* and *H. longispiculum* 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), *Rubenstrema exasperatum* (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 *Arvicola amphibius* (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. arvalis* 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 spathula*. For the nematode *Trichinella spiralis* myomorph rodents can serve as both intermediate and final hosts.

The greatist 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. arvalis* 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 Jacquard 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).

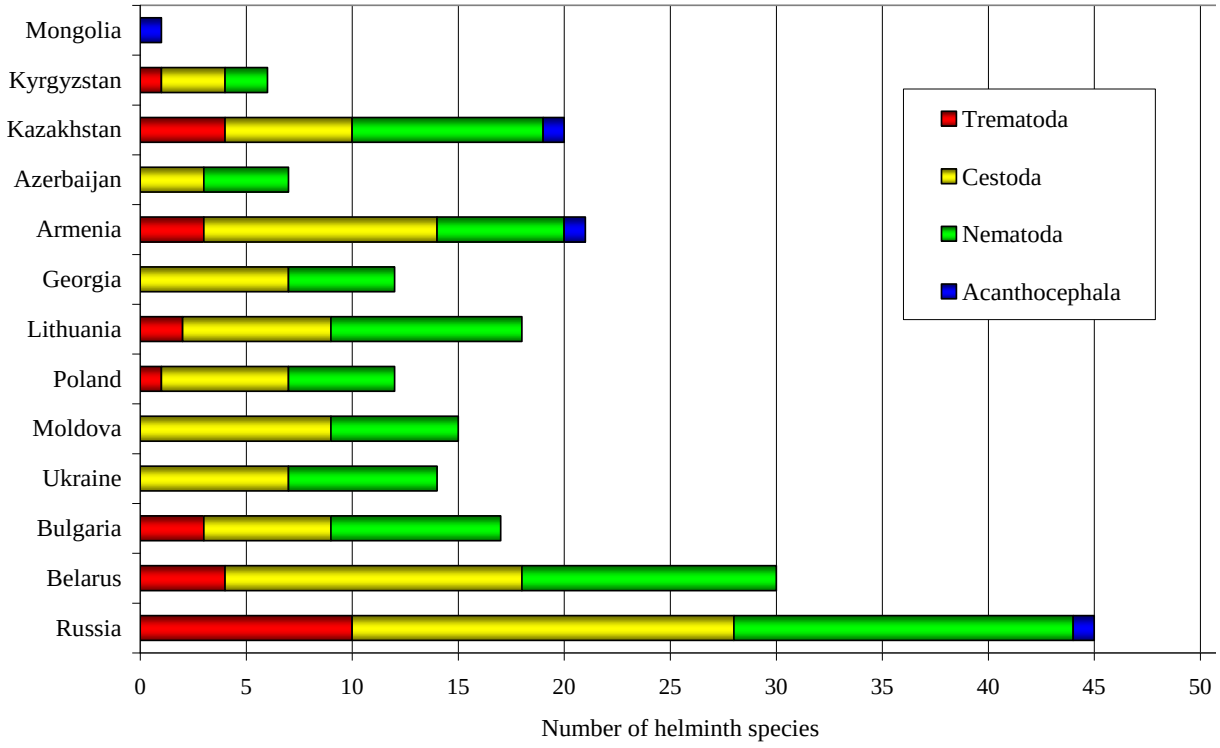

Figure 2. Species richness of helminths of *Microtus cf. arvalis* in Russia and adjacent countries

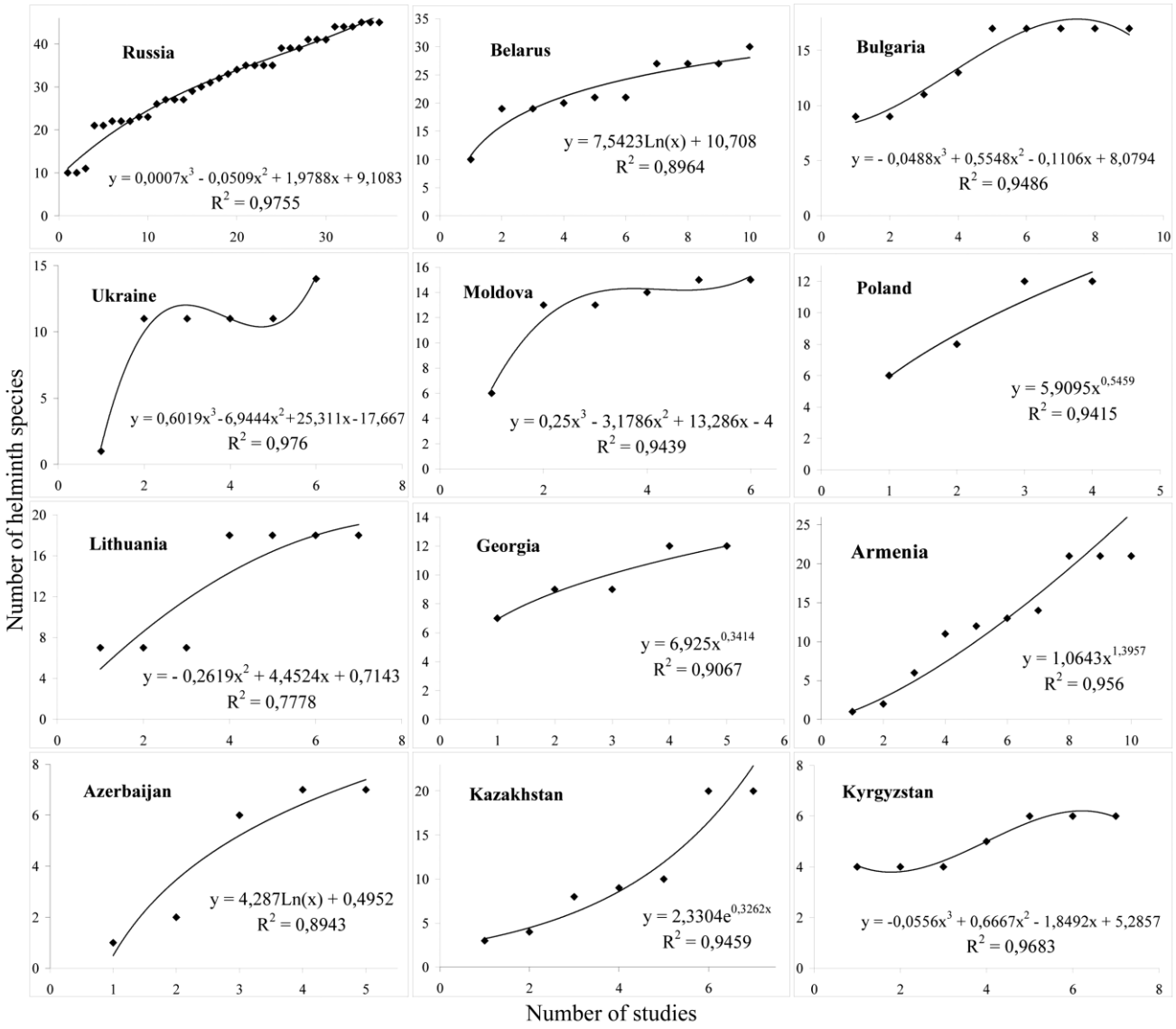

Figure 3. Helminth species accumulation curves

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 in 12 of 13 study regions and *Heligmosomoides laevis*-in 11 regions. Three parasite species (cestodes *Paranoplocephala omphalodes*, *Hydatigera taeniaeformis* (larva) and nematode *Heligmosomum costellatum*) were found in nine countries. The cestode *Anoplocephaloides dentata* and nematode *Trichuris arvicolae* 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).

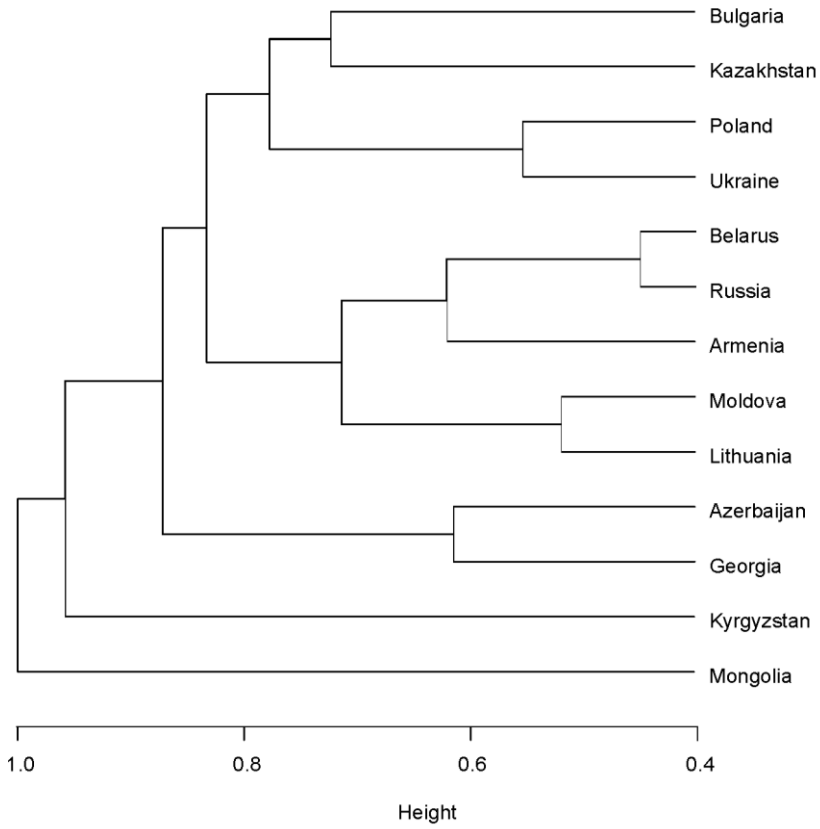

Figure 4. Similarity of helminth fauna of *Microtus cf. arvalis* of Russia and adjacent countries

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*.

ACKNOWLEDGEMENTS

The authors would like to thank Vladimir Krapivin from the Department of Invertebrate Zoology, Saint Petersburg State University, Russia and Anatoliy Khapugin from the Joint Directorate of the Mordovia State Nature Reserve and National Park "Smolny", Russia for the valuable help in statistical data processing. The research was carried out on the subject of research of the Institute of Ecology of the Volga River Basin of the Russian Academy of Sciences-Branch of the Samara Federal Research Center of the Russian Academy of Sciences "Ecological patterns of sustainable functioning of ecosystems and the potential resources of the Volga basin" AAAA-A17-117112040039-7.

REFERENCES

Aliev SK, Rashkueva ZI, Gadzhieva RU. 2007. The parasite fauna of rodents from North-Eastern Caucasus. Russian Parasitological Journal 1: 5-10. [Russian]

Andreyko OF. 1973. Parasites of Mammals of Moldavia. Stiintsa, Kishinev. [Russian]

Amundala ND, Kasereka P, Gambalemoke SM, Kennis J, Beneker C, Maindo AM-N, Ngbolua KN, Dudu AM, Katuala PG-B. 2018. Farmers survey of wild mammals species implicated in crop damage in the Okapi Wildlife Reserve (OWR-Epulu, Democratic Republic of the Congo): severity and control strategies. Nat Conserv Res 3 (1): 58-64. DOI: 10.24189/ncr.2018.007

Baláž I. 2010. The influence of the altitude on somatic characteristics size of common vole (*Microtus arvalis*) in Slovakia. Ekológia (Bratislava) 29 (2): 174-181.

Baranovskiy PM, Bogomolov PL, Karaseva EV, Demidova TN. 1994. Distribution of East European and common voles. In: Synanthropy of rodents. Russian Academy of Sciences, Ivanovo-Moscow. [Russian]

Bashinskiy IV, Osipov VV. 2018. Distribution and dynamic of *Castor fiber* (Castoridae, Mammalia) population in forest-steppe rivers: a case of the State Nature Reserve Privolzhskaya Lesostep', Penza region, European Russia. Nature Conservation Research 3 (2): 110-115. DOI: 10.24189/ncr.2018.068

Behnke JM, Stewart A, Bajer A, Grzybek M, Harris PD, Lowe A, Ribas A, Smales L, Vandegrift KJ. 2015. Bank voles (*Myodes glareolus*) and house mice (*Mus musculus*/*domesticus*) in Europe are each parasitized by their own distinct species of *Aspiculuris*. Parasitology 142 (12): 1493-1505. DOI: 10.1017/S0031182015000864

Bychkova EI, Akimova LN, Degtyarik SM, Yakovich MM. 2017. Helminths of vertebrates and humans in Belarus. Belaruskaya Navuka, Minsk. [Russian]

Callejon R, De Rojas M, Feliu C, Balao F, Marrugal A, Henttonen H, Guevara D, Cutillas C. 2012. Phylogeography of *Trichuris* populations isolated from different Cricetidae rodents. Parasitology 139 (13): 1795-1812. DOI: 10.1017/S0031182012001114

Cruz R, Santos S, Mira A, Monteiro A, Queiros F, Mathias ML. 2002. First record of the common vole *Microtus arvalis* (Pallas 1778) for Portugal. Mammalia 64: 606-609.

Cutillas C, Oliveros R, Rojas M, Guevarra DC. 2002. Determination of *Trichuris muris* from murid hosts and *T. arvicolae* (Nematoda) from arvicolid rodents by amplification and sequestration of the ITS1-5.8S-ITS2 segment of the ribosomal DNA. Parasitology Research 88 (6): 574-582.

Dubrovskii VYu, Roshchin MV, Cherepushkin SA. 2005. Species composition and population structure of small mammals of the Vishera Reserve at low abundance. Russ J Ecol 36 (2): 135-137. [Russian]

Erofeeva VV. 2016. Helminth fauna of rodents in urbanized ecosystems in the Kirov region [Dissertation]. RUDN University, Moscow. [Russian]

Feliu C, Spakulova M, Casanova JC, Renaud F, Morand S, Hugot JP, Santalla F, Durand P. 2000. Genetic and morphological heterogeneity in small rodent whipworms in southwestern Europe: characterization of *Trichuris muris* and description of *Trichuris arvicolae* n.sp. (Nematoda: Trichuridae). J Parasitology 3 (86): 442-449.

Furmaga S. 1957. Helmintofauna gryzoni polnych (Rodentia) ocolic Lublina. Acta Parasitologica Polonica 5 (2): 9-50. [Polish]

Genov T. 1984. Helminths of insectivores and rodents in Bulgaria. Bulgarian Academy of Sciences, Sofia. [Bulgarian]

Grikieniene J. 2005. Investigations into endoparasites of small mammals in the environs of Lake Druksiai. Acta Zoologica Lithuanica 15: 109-114.

Haukisalmi V, Henttonen H. 2003. What is *Paranoplocephala macrocephala* (Douthitt, 1915) (Cestoda: Anoplocephalidae)? Systematic Parasitology 54: 53-69.

Haukisalmi V, Wickstrom LM, Henttonen H, Hantula J, Gubanyi A. 2004. Molecular and morphological evidence for multiple species within *Paranoplocephala omphalodes* (Cestoda, Anoplocephalidae) in Microtus voles (Arvicolinae). Zoologica Scripta 33 (3): 277-290.

Haukisalmi V, Hardman LM, Henttonen H, Laakkonen J, Niemimaa J, Hardman M, Gubбnyi A. 2009. Molecular systematics and morphometrics of *Anoplocephaloides dentata* (Galli-Valerio) (Cestoda: Anoplocephalidae) and related species in voles and lemmings. Zoologica Scripta 38 (2): 199-220.

Haukisalmi V, Hardman LM, Henttonen H. 2010. Taxonomic review of cestodes of the genus *Catenotaenia* Janicki, 1904 in Eurasia and molecular phylogeny of the Catenotaeniidae (Cyclophyllidea). Zootaxa 2489 (1): 1-33.

Henttonen H, Fuglei E, Gower CN, Haukisalmi V, Ims RA, Niemimaa J, Yoccoz NG. 2001. *Echinococcus multilocularis* on Svalbard: introduction of an intermediate host has enabled the local life-cycle. Parasitology 123: 547-552. DOI: 10.1017/S0031182001008800

Ivanov VM, Semenova NN, Kalmykov AP. 2012. Helminths in the Volga Delta ecosystem. Vol. 1. Trematodes. IPK Volga, Astrakhan. [Russian]

Jokić G, Vukša M, Elezović I, Djedovic S, Kataranovski D. 2012. Application of grain baits to control common vole *Microtus arvalis* (Pallas, 1778) in alfalfa crops, Serbia. Arch. Biol. Sci. 64 (2): 629-637. DOI: 10.2298/abs1202629j

Kalmykov AP, Fedorovich VV, Parshina OYu, Kirsanov MA, Ivanov VM, Semenova NN. 2010. Dynamics of species composition of helminths of rodents and insectivores in the Astrakhan region. Almanac of modern science and education 5 (36): 72-74. [Russian]

Kalmykov AP, Semenova NN, Ivanov VM. 2017. Helminths in the Volga Delta ecosystem. Vol. 2. Nematodes of Vertebrates. Print, Izhevsk. [Russian]

Khuranov AB. 2000. Helminths of rodents of the Central Caucasus: fauna, ecological and geographical analysis [Dissertation]. Skryabin's All-Union Institute of Helminthology, Moscow. [Russian]

Kirillov AA, Kirillova NYu. 2017. Overview of cestodes of terrestrial vertebrates of the Samarskaya Luka. Bulletin of the Samara Scientific Center of the Russian Academy of Sciences 19 (2): 29-36. [Russian]

Kirillova NYu. 2007. Fauna of the larval stages of cestodes of mouse-like rodents of the Middle Volga. Bulletin of the Samara Scientific Center of the Russian Academy of Sciences 9 (4): 965-972. [Russian]

Kirillova NYu. 2010. Ecological analysis of nematodes (Nematoda) of mouse-like rodents of the Samarskaya Luka. Bulletin of Samara State University. Natural Science Series 6 (80): 206-216. [Russian]

Kirillova NYu. 2011. Helminths of small mammals from the Samarskaya Luka. Fauna and ecology. Lambert Academic Publish., Saarbrucken. [Russian]

Kirillova NYu, Kirillov AA. 2005. Ecological analysis of helminth fauna of mouse-like rodents in the Samarskaya Luka. Bulletin of the Samara Scientific Center of the Russian Academy of Sciences. Special issue: Actual Problems of Ecology 4: 261-275. [Russian]

Kirillova NYu, Kirillov AA. 2008. Ecological analysis of cestodes (Cestoda) of mouse-like rodents in the Samarskaya Luka. Povolzhskiy J Ecol 1: 20-28. [Russian]

Kirillova NYu, Kirillov AA. 2011. Nematodes (Nematoda) of small mammals in the Samarskaya Luka. Bulletin of the Samara Scientific Center of the Russ Acad Sci 13 (1): 114-122. [Russian]

Kirillova NYu, Kirillov AA. 2017. Overview of helminths in small mammals in the Zhiguli State Reserve. Nature Conservation Research 2 (2): 24-37. DOI: 10.24189/ncr.2017.007 [Russian]

Kisielewska K, Fraczak K, Krasowska I, Zubczewska Z. 1973. Intestinal helminthes as indexes of reproduction dynamics in the host population-common vole. Acta Parasitologica Polonica 21 (5): 71-83.

Kononova MI. 2018. The first data on helminth fauna of mouse-like rodents of the state nature reserve «Belogorye» (Belgorod region). In: Galaktionov KV, Frolov AO, Medvedev SG, Ryss AYu (eds.) Modern parasitology-main trends and challenges; Proceeding of the VI Congress of the Society of Parasitologists, Zoological Institute RAS, Saint Petersburg, 15-19 October 2018. [Russian]

Kostyunin VM. 2010. Helminth fauna of terrestrial vertebrates in the Middle Volga region. Nizhny Novgorod State Pedagogical University Publish., Nizhny Novgorod. [Russian]

Krumpal M, Cyprich D, Zejda J, Ambros M. 1999. The occurrence of field vole (*Microtus arvalis* Pallas, 1778) and its acarofauna on Spitsbergen (Svalbard). Biologia 46 (10): 881-885.

Lawer EA, Mupepele AC, Klein AM. 2019. Responses of small mammals to land restoration after mining. Landscape Ecology 34 (3): 473-485. DOI: 10.1007/s10980-019-00785-z

Leontyev IA, Yakimova AE, Bugmyrin SV. 2016. To helminth fauna of *Microtus* voles of the Republic of Karelia. In: Theriofauna of Russia and adjacent territories: proceedings of the International Meeting (X Congress of the Russian Theriological Society RAS), A.N. Severtsov Institute of Ecology and Evolution RAS, Moscow, 1-5 Febrary 2016. [Russian]

Levykh AYu, Panin VV. 2019. Species composition and community structure of small mammals in Parapolsky Dol (Koryak State Nature

Reserve, Kamchatka). Nat Conserv Res 4 (3): 1-12. DOI: 10.24189/ncr.2019.026

Liu B, Bu Y, Zhang L. 2012. A new species of Aspiculuris Schulz, 1924 (Nematoda, Heteroxynematidae) from the gray-sided vole, *Clethrionomys rufocanus* (Rodentia, Cricetidae), from Tianjin, China. Acta Parasitologica 57 (3): 311-315. DOI: 10.2478/s11686-012-0031-8

Magurran AE. 1992. Ecological diversity and its measurement. Mir, Moscow. [Russian]

Makarikov AA, Stakheev VV, Orlov VN. 2017. On helminth fauna of rodents from the Northwest Caucasus. Parasitologiya 51 (4): 317-328. [Russian]

Maslennikova OV, Erofeeva VV, Pukhlyanko VP. 2014. Rodent syphaciosis and its ecological and epidemiological significance. Fundamental research 9: 1542-1544. [Russian]

Mažeika VV. 2004. Helminths of rodents in Lithuania. In: Modern problems of parasitology, zoology and ecology. Kaliningrad State Tecknical University Publish., Kaliningrad. [Russian]

Meyer MN, Golenitshev FN, Radzhabli SI, Sablina OL. 1996. *Microtus* voles of the fauna of Russia and adjacent territories. Proceedings of Zoological Institute RAS 232: 1-320. [Russian]

Mitchell-Jones AJ, Amori G, Bogdanowicz W, Kryštufek B, Reijnders PJH, Spitzenberger F, Stubbe M, Thissen JBM, Vohralík V, Zima J. 1999. The Atlas of European Mammals. Academic Press, London.

Movsesyan SO, Chubarian FA, Nikoghosian MA. 2004. Trematodes of fauna of the South of the Lesser Caucasus. Nauka, Moscow. [Russian]

Movsesyan SO, Chubarian FA, Nikoghosian MA. 2006. Cestodes of fauna of the South of the Lesser Caucasus. Nauka, Moscow. [Russian]

Movsesyan SO, Nikoghosian MA, Petrosian RA, Vlasov EA, Kuznetsov DN. 2018. Nematodes of rodents of Armenia. Ann Parasitol 64 (3): 173-180. DOI: 10.17420/ap6403.148

Ogden CG. 1971. Observation on the systematics of nematodes belonging to the genus *Syphacia* Seurat, 1916. Bull Br Mus (Nat Hist) Zool. 20: 253-280.

Pavlinov IYa, Lissovsky AA. (Eds.). 2012. The Mammals of Russia: a Taxonomic and Geographic Reference. Proceedings of Zoological Museum of Moscow University. Vol. 52. KMK Scientific Press Ltd., Moscow. [Russian]

Petrov OV, Kvitko NV. 1976. To the knowledge of endoparasites of mouse rodents of forest-steppe oak forests. Bulletin of the Leningrad University 3: 65-69. [Russian]

Romashov BV. 1997. Helminths of the mouse-like rodents of the Usmanskiy forest. Proceedings of the Voronezh State Reserve 27: 186-206. [Russian]

Romashova NB. 2012. Modern fauna and ecology features of helminths of mouse-like rodents of the Usmanskiy forest. Proceedings of the Voronezh State Reserve 42: 184-194. [Russian]

Rozhnov VV, Lavrinenko IA, Razzhivin VYu, Makarova OL, Lavrinenko OV, Anufriev VV, Babenko AB, Bizin MS, Glazov PM, Goryachkin SV, Kolesnikova AA, Matveyeva NV, Pestov SV, Petrovskii VV, Pokrovskaya OB, Tanasevich AV, Tatarinov AG. 2019. Biodiversity revision of a large arctic region as a basis for its monitoring and protection under conditions of active economic development (Nenetsky Autonomous Okrug, Russia). Nature Conservation Research 4 (2): 1-28. DOI: 10.24189/ncr.2019.015

Ruchin AB, Kirillov AA, Chikhlyaev IV, Kirillova NYu. 2016. Parasitic worms of land vertebrates of Mordovia State Nature Reserve (annotated list of species). Flora and fauna of reserves. Iss. 124. RAS Committee for the Reserve of Biological Diversity, Moscow. [Russian]

Ryzhikov KM, Gvozdev EV, Tokobaev MM, Shaldybin LS, Matsaberidze GM, Merkusheva IV, Nadtochiy EV, Khokhlova IG, Sharpilo LD. 1978. The identifier of rodent helminth fauna of the USSR. Cestodes and trematodes. Nauka, Moscow. [Russian]

Ryzhikov KM, Gvozdev EV, Tokobaev MM, Shaldybin LS, Matsaberidze GM, Merkusheva IV, Nadtochiy EV, Khokhlova IG, Sharpilo LD. 1979. The identifier of rodent helminth fauna of the USSR. Nematodes and acanthocephalans. Nauka, Moscow. [Russian]

Sato H, Kamiya H, Tenora F, Kamiya M. 1993. *Anoplocephaloides dentatoides* sp. n. from the gray-backed vole, *Clethrionomys rufocanus bedfordiae*, in Hokkaido, Japan. Journal of the Helminthological Society of Washington. 60: 105-110.

Shaldybin LS. 1972. Helminths of *Microtus* voles of the fauna of the Soviet Union. Scientific notes of the Gorky State Pedagogical Institute 3: 3-22. [Russian]

Shaldybin LS. 1979. Helminths of common vole of the fauna of the Soviet Union. In: Shaldybin LS. (ed.) Fauna, systematic, biology and ecology of helminths and its intermediate hosts. Gorky State Pedagogical Institute, Gorky. [Russian]

Shaykenov B. 1981. Helminths of rodents of Kazakhstan. Nauka of the Kazakhstan. SSR, Alma-Ata. [Russian]

Shenbrot GI, Krasnov BR. 2005. An Atlas of the Geographic Distribution of the Arvicoline Rodents of the world (Rodentia, Muridae: Arvicolinae). Pensoft Publ., Sofia.

Shendrik TV. 2018. Assessment of the component communities structure of helminths of rodents and the patterns of its formation under the influence of the urbanization process. News of Gomel State University 6 (111): 48-54. [Russian]

Shimalov VV. 2002. Helminth fauna of small rodents in the banks of canals in reclaimed territories. Parazitologiya. 36 (3): 247-252. [Russian]

Shimalov VV. 2012. Helminth fauna of small insectivorous mammals and rodents inhabiting along roads. News of the National Academy of Sciences of Belarus. Biological Science Series 4: 106-111. [Russian]

Skirnisson K, Jouet D, Ferte H, Nielsen OK. 2016. Occurrence of *Mesocestoides canislagopodis* (Rudolphi, 1810) (Krabbe, 1865) in mammals and birds in Iceland and its molecular discrimination within the *Mesocestoides* species complex Parasitology Research 115 (7): 2597-2607. DOI: 10.1007/s00436-016-5006-5

Soltys A. 1949. Pasożyty wewnwetrzne drobnych gryzoni leśnych (Muridae) Parku Narodowego w Białowieży. Annales Universitatis Marie Curie Sklodowska. Sectio C, Biologia 4: 232-257. [Polish]

Stojak J, McDevitt AD, Herman JS, Krystufek B, Uhlikova J, Purger JJ, Lavrenchenko LA, Searle JB, Wojcik JM. 2016. Between the Balkans and the Baltic: Phylogeography of a Common Vole Mitochondrial DNA Lineage Limited to Central Europe. PLoS ONE 11 (12): e0168621. DOI: 10.1371/journal.pone.0168621

Stien A, Voutilainen L, Haukisalmi V, Fuglei E, Mork T, Yoccoz NG, Ims RA, Henttonen H. 2010. Intestinal parasites of the Arctic fox in relation to the abundance and distribution of intermediate hosts. Parasitology 137: 149-157. DOI: 10.1017/S0031182009990953

Timoshenko PV, Zhigileva ON. 2007. The biological diversity of rodents and their helminths in the reserve «Rafaylovskiy» and Tyumen city. Vestnik ecologii, lesovedeniya i landshaftovedeniya 7: 78-84. [Russian]

Tinnin DS, Ganzorig S, Gardner SL. 2011. Helminths of small mammals (Erinaceomorpha, Soricomorpha, Chiroptera, Rodentia and Lagomorpha) of Mongolia. Special publication of Museum of Texas Tech University. № 59. Texas Tech University, Lubbock.

Tokobaev MM. 1976. Helminths of wild mammals of Central Asia. Ilim, Frunze. [Russian]

Vekhnik VA, Vekhnik VP. 2018. A case study of the edible dormouse (*Glis glis*: Gliridae, Rodentia) biology using nestboxes. Nature Conservation Research 3 (3): 86-91. DOI: 10.24189/ncr.2018.021. [Russian]

Vlasenko P, Abramov S, Bugmyrin S, Dupal T, Fomenko N, Gromov A, Zakharov E, Ilyashenko V, Kabdolov Z, Tikunov A, Vlasov E, Krivopalov A. 2019. Geographical distribution and hosts of the cestode *Paranoplocephala omphalodes* (Hermann, 1783) Lühe, 1910 in Russia and adjacent territories. Parasitology Research 118 (12): 3543-3548. DOI: 10.1007/s00436-019-06462-z

Vlasov EF, Malysheva NS, Krivopalov AV. 2015. Helminth fauna of myomorh rodents (Rodentia, Myomorha) in the Central Chernozem State Nature Reserve. Russian Parasitological Journal 4: 24-33.

Vlasov EA, Vagin NA, Malysheva NS, Elizarov AS, Samofalova NA. 2016. Helminthozoonoses in the Kursk region. Medical parasitology and parasitic diseases 3: 44-48. [Russian]

Vysotskaya SO. 1997. Helminths of small mammals from Transcarpathian region (the East Carpathians, Ucraine). Parasitologiya 31 (4): 346-355. [Russian]

Zavaleeva DD, Kuzmina LN. 1980. To parasite fauna of voles in Crimea. IX conference of the Ukrainian parasitological society, Lviv, Ukraine, 17-19 September 1980. [Russian]

Zalesny G, Hildebrand J. 2012. Molecular identification of Mesocestoides spp. from intermediate hosts (rodents) in central Europe (Poland). Parasitology Research 110: 1055-1061. DOI 10.1007/s00436-011-2598-7

Zhigileva ON. 2011. Correlation of biodiversity of small mammals and their helminths in ecosystems of Western Siberia. Sibirskiy ekologicheskiy zhurnal 4: 555-562. [Russian]

Wilson DE, Reeder DM. (eds.) 2005. Mammal Species of the World: A Taxonomic and Geographic Reference (3rd ed.). Johns Hopkins University Press, New York.

Yalkovskaya L, Markova E, Zykov S, Sibiryakov P. 2012. New cytogenetic data on the distribution of the common vole (*Microtus arvalis*) of the obscurus karyotypic form (Arvicolinae, Rodentia) in the Vyatka-Kama CIS-Ural region. Zoologicheskiĭ Zhurnal 91 (9): 1109-1113. [Russian]

Yigit N, Hutterer R, Krystufek B, Amori G. 2016. *Microtus arvalis*. The IUCN Red List of Threatened Species 2016: e.T13488A22351133. DOI: 10.2305/IUCN.UK.20162.RLTS.T13488A22351133.en