ABS ACTA BIOLOGICA SIBIRICA
A journal on the biodiversity of Siberia and the adjacent lands

Acta Biologica Sibirica 10: 1359–1369 (2024)
doi: 10.5281/zenodo.14203853
http://journal.asu.ru

RESEARCH ARTICLE

First data on the trematode fauna of wetland birds in the Samara region (European Russia)

Nadezhda Yu. Kirillova[1], Alexander A. Kirillov[1]

1 *Laboratory for Zoology and Parasitology, Institute of Ecology of Volga River Basin of RAS, Samara Federal Research Center of RAS, 10 Komzina St, Togliatti, 445003, Russia*

Corresponding author: Alexander A. Kirillov (parasitolog@yandex.ru)

Academic editor: R. Yakovlev | Received 24 October 2024 | Accepted 3 November 2024 | Published 25 November 2024

http://zoobank.org/96B12DB9-43CD-4117-BFCB-3990E6CAEF0D

Citation: Kirillova NYu, Kirillov AA (2024) First data on the trematode fauna of wetland birds in the Samara region (European Russia). Acta Biologica Sibirica 10: 1359–1369. https://doi.org/10.5281/zenodo.14203853

Abstract

We have conducted the first study of trematodes in wetland birds of the Samara region (European Russia). A total of 25 trematode species from 12 families were identified in 8 species of birds. Eight digenean species (*Echinochasmus beleocephalus*, *Petasiger radiatus*, *P. exaeretus*, *Metorchis xanthosomus*, *Uroproctepisthmium bursicola*, *Leyogonimus polyoon*, *Hysteromorpha triloba*, *Cyathocotyle prussica*) were registered for the first time in birds of the Middle Volga region. The first data on helminths in *Ardea cinerea*, *Fulica atra*, *Phalacrocorax carbo*, *Larus cachinnans* and *Cygnus olor* inhabiting this territory were obtained. Fifteen species of trematodes we found have veterinary significance as causative agents of dangerous helminthiases.

Keywords

Helminths, Digenea, Anseriformes, Charadriiformes, Gruiformes, Pelecaniformes, Suliformes, Middle Volga region

Introduction

Wetland birds inhabit the coasts of various fresh and sea water bodies. In the territory of the Middle Volga region, many waterfowl nest or are encountered during spring or autumn migration. Most wetland birds are valuable game species. In this

regard, it is important to study their helminths and, in particular, trematodes, which cause mass epizootics.

Wild birds are vectors of pathogens causing helminthiasis in fish, poultry, domestic animals and humans. Thus, wetland birds play a significant role in the spread and maintenance of the number of helminthiasis pathogens, such as echinostomatosis, prostogonymosis, bilharziellosis (Smogorzhevskaya 1975).

Among avian trematodes, the trematode fauna associated with wetland birds is usually the most diverse and abundant (Sitko and Heneberg 2020). Therefore, it is necessary to conduct monitoring studies of waterfowl, the structure and dynamics of their trematode fauna. Such studies contribute to the prediction of the epidemiological and epizootological situation in a certain area.

The study of the helminth fauna of waterfowl and, in particular, their trematodes has always attracted the attention of parasitologists (Lapage 1961; Bykhovskaya-Pavlovskaya 1962; Smogorzhevskaya 1975; McDonald 1981; Iskova 1985; Ekimova 1989; Nasinkova et al. 1993; Kulisic et al. 2004; Bayssade-Dufour et al. 2006; Sitko et al. 2006; Rudolfova et al. 2007; Kavetska et al. 2008; Kanarek and Zalesny 2013; Kirillov and Kirillova 2013; Sitko and Heneberg 2020).

In recent years, a number of studies have been devoted to the fauna and distribution of wetland birds in Russia and neighboring countries (Vinogradova et Skvortsov 2002; Serbina 2005, 2018; Akramova et al. 2009, 2022; Shabunov and Radchenko 2012; Yakovleva et al. 2012, 2015; Makhmudova 2013; Syrota et al. 2018; Dugarov et al. 2020; Makhmudova and Ibrahimov 2020; Dorzhiev et al. 2021; Yakovleva 2024). Unfortunately, studies of helminth fauna in wetland birds of the Samara region (European Russia) are still missing. This paper presents the first data on trematodes from waterfowl inhabiting the Samara region.

Materials and methods

Study area

The territory of the Samara region is located in the southeast of European Russia in the Middle Volga region and occupies an area approximately within 51°47,0′–54°41,0′ north latitude and 47°55,0′–52°35,0′ east longitude. The area of the Samara region is 53 565 km2 (Gorelov et al. 1990; Dmitrieva and Kabytov 1996). Within the region, the Volga riverbed is regulated and forms the Kuibyshev and Saratov water reservoirs. The territory of the Samara region is distinguished by its varied relief. On the right bank of the Volga are the Zhiguli Mountains, around which the Volga forms the well-known Samarskaya Luka. There are many natural and artificial water reservoirs in the Samara region: small rivers, lakes, ponds and streams. The region is located on the border of two natural zones – forest-steppe and steppe, which de-

termines the richness of the flora and fauna of the region. There are 379 species of vertebrates, including 235 species of birds from 9 orders, of which 195 species nest in the region (Gorelov et al. 1990; Dmitrieva and Kabytov 1996).

Trematodes collection and examination

During a comprehensive parasitological survey of vertebrates in the Samara region (Middle Volga region) in the 2023 and 2023 field seasons, the trematode fauna was studied from 15 individuals of eight species of wetland birds: *Anas platyrhynchos* Linnaeus, 1758 (4), *Cygnus olor* (Gmelin, 1789) (4), *Phalacrocorax carbo* (Linnaeus, 1758) (2), *Fulica atra* Linnaeus, 1758 (1), *Chroicocephalus ridibundus* (Linnaeus, 1766) (1), *Larus cachinnans* Pallas, 1811 (1), *Sterna hirundo* Linnaeus, 1758 (1), and *Ardea cinerea* Linnaeus, 1758 (1).

The birds were examined using the method of complete helminthological necropsy according to Dubinina (1971). No birds were killed intentionally for our study. We examined only dead wetland birds that died naturally and were kindly provided by the staff of the Togliatti Zoo Corner with a bird shelter and the Zhiguli Nature Reserve. Frozen entrails (mainly the gastrointestinal tract) of four mallards were kindly provided by local hunters.

Trematode specimens were collected from birds in six districts of the Samara region. Digeneans were recovered from the internal organs of the birds and immobilized by heating in a saline. Then the trematodes were stained with acetic carmine, dehydrated, cleared with clove oil, and mounted in Canada balsam. To characterize the trematode infection of birds, the following indices were used: prevalence of infection (P, %) and mean abundance (MA).

The taxonomic identification of wetland birds was carried out according to Spiridonov et al. (2019). Trematode species were identified according to Bykhovskaya-Pavlovskaya (1962), Sudarikov (1984), Iskova (1985), Sonin (1985), Shigin (1993), Faltynkova et al. (2008), Zazornova (2012), and Vainutis et al. (2023). The taxonomy of digeneans is given according to the GBIF database (https://www.gbif.org/, accessed on 28 September 2024) and the work of Kanarek et al. (2017). Trematode specimens are stored in the parasitological collection of the Institute of Ecology of Volga Basin of RAS (Togliatti).

This study was approved by the Bioethics Committee of the Institute of Ecology of Volga River Basin of RAS (Registration number: 6/24; 22 October 2024). Our research was conducted in accordance with the ethical standards of humane treatment of animals and recommended standards described in Directive of the European Parliament and of the Council of the European Union of 22 September 2010, "On the protection of animals used for scientific purposes" (EU Directive 2010/63/EU).

Results and discussion

As a result of the first helminthological study of wetland birds from the orders Anseriformes, Charadriiformes, Gruiformes, Pelecaniformes and Suliformes in the Samara region, we registered 25 trematode species (Table 1). All digeneans found in the avifauna were represented by adult individuals.

Trematodes found in wetland birds of the Samara region belong to 12 families (Table 1). The most represented family of trematodes in the studied birds is Echinostomatidae, which includes six species. Less represented in the birds are the families Strigeidae (4) and Diplostomidae (3). The families Echinochasmidae, Opisthorchiidae and Schistosomatidae include two species each. The remaining six families are represented in the wetland birds by only one species each.

All 15 examined individuals of birds were infected with trematodes. A total of 4905 parasite specimens were collected. The overall infection rate of birds with digeneans was 100%, MA = 319.6. The highest trematode infection was revealed in *Ph. carbo*. The overall trematode infection rates for the other wetland bird species examined were significantly lower (Fig. 1).

Table 1. Parasite-host checklist of trematodes of wetland bird in the Samara region

Species	D[1]	Host	Site	Locality	P, %	IR, spec.	MA
Family Plagiorchiidae							
Plagiorchis laricola Skrjabin, 1924	P	*Chroicocephalus ridibundus*	small intestine	Krasnoyarskiy district	100 (in one examined)	15	15.0
Family Echinochasmidae							
Echinochasmus beleocephalus (Linstow, 1873)	P	*Anas platyrhynchos*	small intestine	Pokhvistnevskiy district	100 (in two examined)	10–60	35.0
				Stavropolskiy district	50.0 (in one of 2 examined)	35	17.5
Uroproctepisthmium bursicola (Creplin, 1837)	P	*Ardea cinerea*	liver	Stavropolskiy district	100 (in one examined)	16	16.0
Family Echinostomatidae							
Echinostoma revolutum (Fröhlich, 1802)	C	*Anas platyrhynchos*	small intestine	Stavropolskiy district	50.0 (in one of 2 examined	2	1.0
		Cygnus olor	-	Bezenchukskiy district	50.0 (in one of 2 examined)	3	1.5
			-	Pestravskiy district	50.0 (in one of 2 examined)	4	2.0

Species	D[1]	Host	Site	Locality	P, %	IR, spec.	MA
Echinostoma miyagawai Ishii, 1932	P	*Anas platyrhynchos*	small intestine	Pokhvistnevskiy district	50.0 (in one of two examined)	6	3.0
Echinoparyphium recurvatum (Linstow, 1873)	P	*Chroicocephalus ridibundus*	small intestine	Krasnoyarskiy district	100 (in one examined)	3	3.0
		Anas platyrhynchos	small intestine	Pokhvistnevskiy district	100 (in two examined)	5–12	8.5
Petasiger radiatus (Dujardin, 1845)	P	*Phalacrocorax carbo*	small intestine	Privolzhskiy district	100 (in two examined)	98–145	121.5
Petasiger exaeretus Dietz, 1909	P	*Phalacrocorax carbo*	small intestine	Privolzhskiy district	100 (in two examined)	22–30	26.0
Hypoderaeum conoideum (Bloch, 1782)	C	*Anas platyrhynchos*	small intestine	Pokhvistnevskiy district	50.0 (in one of 2 examined)	1	0.5
Family Psilostomidae							
Psilochasmus oxyurus (Creplin, 1825)	C	*Anas platyrhynchos*	small intestine	Pokhvistnevskiy district	50.0 (in one of 2 examined)	2	1.0
Family Renicolidae							
Renicola lari Timon-David, 1933	H	*Sterna hirundo*	kidneys	Stavropolskiy district	100 (in one examined)	1	1.0
Family Notocotylidae							
Notocotylus attenuatus (Rudolphi, 1809)	C	*Anas platyrhynchos*	intestinal caeca	Pokhvistnevskiy district	100 (in 2 examined)	17–31	24.0
				Stavropolskiy district	50.0 (in one of 2 examined)	67	33.5
Family Pleurogenidae							
Leyogonimus polyoon (Linstow, 1887)	H	*Fulica atra*	small intestine	Stavropolskiy district	100 (in one examined)	1	1.0
Family Opisthorchiidae							
Metorchis xanthosomus (Creplin, 1846)	p	*Phalacrocorax carbo*	liver	Privolzhskiy district	50.0 (in one of 2 examined)	4	2.0
Apophallus muehlingi (Jägerskiöld, 1899)	P	*Phalacrocorax carbo*	small intestine	Privolzhskiy district	100 (in two examined)	1260–2100	1680.0
		Chroicocephalus ridibundus	small intestine	Krasnoyarskiy district	100 (in one examined)	7	7.0
		Larus cachinnans	small intestine	Stavropolskiy district	100 (in one examined)	230	230.0
		Sterna hirundo	small intestine	Stavropolskiy district	100 (in one examined)	6	6.0

Species	D[1]	Host	Site	Locality	P, %	IR, spec.	MA
Family Diplostomidae							
Diplostomum chromatoforum (Brown, 1931)	H	*Larus cachinnans*	small intestine	Stavropolskiy district	100 (in one examined)	2	2.0
Diplostomum helveticum (Dubois, 1929)	P	*Larus cachinnans*	small intestine	Stavropolskiy district	100 (in one examined)	4	4.0
Hysteromorpha triloba Rudolphi, 1819	H	*Phalacrocorax carbo*	small intestine	Privolzhskiy district	50.0 (in one of 2 examined)	292	146.0
Family Schistosomatidae							
Bilharziella polonica (Kowalewski, 1895)	C	*Anas platyrhynchos*	blood vessels	Pokhvistnevskiy district	100 (in two examined)	9–25	17.0
				Stavropolskiy district	50.0 (in one of 2 examined)	7	3.5
Dendritobilharzia pulverulenta (Braun, 1901)	C	*Fulica atra*	blood vessels	Stavropolskiy district	100 (in one examined)	10	10.0
Family Strigeidae							
Cotylurus cornutus (Rudolphi, 1809)	P	*Cygnus olor*	small intestine	Bezenchukskiy district	100 (in two examined)	15–23	19.0
				Pestravskiy district	100 (in two examined)	8–14	11.0
Cotylurus flabelliformis (Faust, 1917)	H	*Anas platyrhynchos*	-	Pokhvistnevskiy district	100 (in two examined)	7–100	53.5
Cotylurus brevis Dubois & Rausch, 1950	H	*Anas platyrhynchos*	small intestine	Pokhvistnevskiy district	100 (in two examined)	12–20	16.0
Ichthyocotylurus pileatus (Rudolphi, 1802)	H	*Sterna hirundo*	small intestine	Stavropolskiy district	100 (in one examined)	12	12.0
Family Cyathocotylidae							
Cyathocotyle prussica Mühling, 1896	P	*Phalacrocorax carbo*	small intestine	Privolzhskiy district	100 (in two examined)	69–83	76.0

Note: 1 – D – distribution, P – Palearctic, H – Holarctic, C – Cosmopolitan.

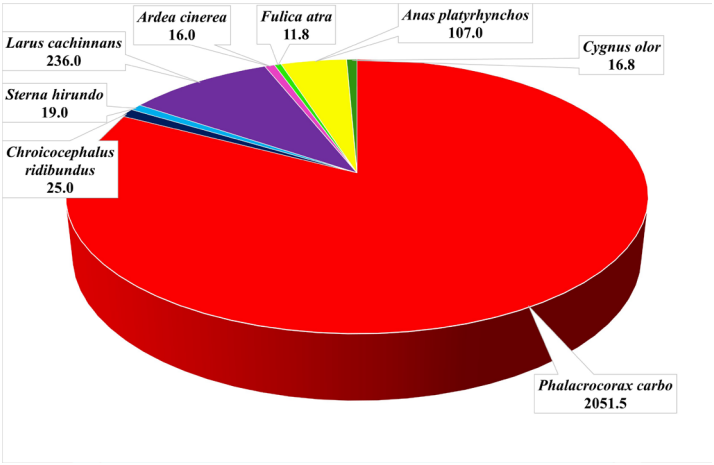

Figure 1. Overall mean abundance index of trematodes in wetland birds from the Samara region.

The richest trematode fauna was found in the mallard (*A. platyrhynchos*), as it included 10 parasite species. Six trematode species were found in the great cormorant (*Ph. carbo*). Few trematodes were identified in *Ch. ridibundus*, *L. cachinnans* and *S. hirundo* – 3 species each. Two trematode species were recorded in *C. olor* and *F. atra*. Only one trematode species was found in *Ardea cinerea* (Table 1, Fig. 2).

For the studied bird species, the most common parasite was *A. muehlingi*, recorded in four host species. *Echinostoma revolutum* and *E. recurvatum* occurred in two hosts each. Twenty-two trematode species were recorded in only one host species.

Most of the identified trematode species (16 species) are obligate parasites of wetland birds. Four species (*R. lari*, *D. chromatoforum*, *D. helveticum*, *I. pileatus*) are host-specific parasites of gulls. Metorchis xanthosomus is an obligate parasite of birds of prey. Trematodes of the genus *Petasiger* are host-specific parasites of *Phalacrocorax carbo*, and *Leyogonimus polyoon* is a common parasite of rallid birds. The trematode *Plagiorchis laricola* can parasitize birds of different orders.

Twelve species of trematodes that we found in wetland birds of the Samara region are common in the Palearctic, seven trematode species are widespread in the Holarctic, and the remaining six species are cosmopolitan (Table 1).

Conclusion

Thus, we have obtained the first data on the trematode fauna in wetland birds in the Samara region. A total of 25 trematode species were identified in 8 species of birds. For the first time, data on these parasites of *Ardea cinerea*, *Fulica atra*, *Phalacrocorax carbo*, *Larus cachinnans* and *Cygnus olor* were obtained for the Middle Volga region.

Previously, 72 digenean species were recorded for wetland birds in this area (Kostyunin 2010; Kirillov et al. 2012). As a result of our research, the list of trematodes in the wetland avifauna was expanded by eight species of parasites (*E. beleocephalus*, *P. radiatus*, *P. exaeretus*, *M. xanthosomus*, *U. bursicola*, *L. polyoon*, *H. triloba*, *C. prussica*) and currently includes 80 digenean species.

Fifteen species of trematodes found in wetland birds of the Samara region have veterinary significance as pathogens of dangerous helminthiases, namely: *E. revolutum*, *E. miyagawai*, *E. recurvatum*, *H. conoideum*, *E. beleocephalus*, *N. attenuatus*, *B. polonica*, *D. pulverulenta*, *A. muehlingi*, *D. chromatoforum*, *D. helveticum*, *C. cornutus*, *C. flabelliformis*, *C. brevis*, and *I. pileatus*.

Our first study of trematodes in wetland birds in the Samara region showed interesting results. Therefore, the prospect of further parasitological study of wetland birds requires both an expansion of the number of host bird species and an increase in the number of individuals of the already studied birds for examination.

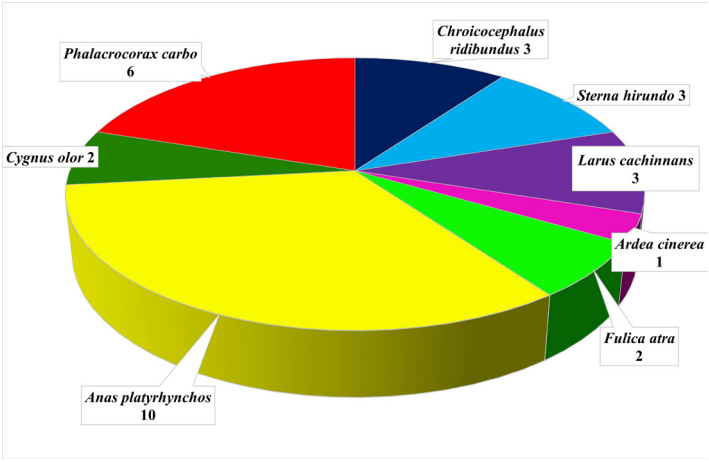

Figure 2. Species richness (number of species) of trematodes in wetland bird from the Samara region.

Acknowledgements

This research was supported by the Russian Science Foundation, grant number 23-24-10021, https://rscf.ru/en/project/23-24-10021/.

The authors express their deep gratitude to the head of the Togliatti Zoo Corner with a bird shelter Natalya I. Goncharova and the senior researcher of the Zhiguli Nature Reserve Galina P. Lebedeva for providing materials on wetland birds.

References

Akramova FD, Azimov DA, Golovanov VI, Shakarboev EB (2009) Ecologo-faunistic analysis of trematodes of the genus *Trichobilharzia* – parasites of hydrophilous birds. Russian Journal of Parasitology 2: 5–15. [In Russian]

Akramova F, Shakarbaev U, Yorkulov Z, Arepbaev I, Mirzaeva A, Azimov D (2022) Life cycle of *Bilharziella polonica* (Trematoda, Schistosomatidae) parasite of semi-aquatic birds in Uzbekistan. Biosystem Diversity 30(2): 137–142. https://doi.org/10.15421/012213

Bayssade-Dufour C, Jouet D, Rudolfova J, Horak P, Ferte H (2006) Seasonal morphological variations in bird schistosomes. Parasite 13: 205–214.

Bykhovskaya-Pavlovskaya IE (1962) Trematodes of birds of the fauna of the USSR. Academy of Sciences of the USSR Publish, Moscow-Leningrad, 407 pp. [In Russian]

Dmitrieva EYa, Kabytov PS (eds) (1996) Samara region (geography and history, economics and culture). Textbook. SamVen, Samara, 669 pp. [In Russian]

Dorzhiev TsZ, Badmaeva EN, Dugarov ZhN (2021) Helminths in wetland birds of Baikal Siberia: Taxonomic diversity and distribution by hosts. Nature of Inner Asia 1(17): 23–65. [In Russian]

Dubinina MN (1971) Parasitological study of birds. Nauka, Leningrad, 139 pp. [In Russian]

Dugarov ZN, Zhepkholova OB, Tolochko LV, Sondueva LD, Pyzhjanov SV, Shesterikov DS, Pyzhjanova MS, Shabaganova IV (2020) Finding of *Petasiger radiatus* (Trematoda: Echinostomatidae) in a great cormorant in lake Baikal. Parazitologiya 54(1): 42–48. https://dx.doi.org/10.31857/S1234567806010058

Ekimova EN (1989) Trematodes of waterfowl and semi-aquatic birds of the Eastern European tundra. Proceedings of Komi Scientific Center of the Academy of Scienses of the USSR 100: 111–115. [In Russian]

Faltynkova A, Gibson DI, Kostadinova A (2008) A revision of *Petasiger* Dietz, 1909 (Digenea: Echinostomatidae) and a key to its species. Systematic Parasitology 71: 1–40. https://doi.org/10.1007/s11230-008-9146-6

Gorelov MS, Matveev VM, Ustinova AA (1990) Nature of the Kuibyshev Region. Book Publishing House, Kuibyshev, 461 pp. [In Russian]

Iskova NI (1985) Trematoda. Echinostomatata. Fauna of Ukraine. Vol. 34. Naukova Dumka, Kiev, 200 pp. [In Russian]

Kanarek G, Zalesny G (2013) Extrinsic- and intrinsic-dependent variation in component communities and patterns of aggregations in helminth parasites of great cormorant (*Phalacrocorax carbo*) from N.E. Poland. Parasitology Research 113: 837–850.

Kanarek G, Zalesny G, Sitko J, Tkach VV (2017) The systematic position and structure of the genus *Leyogonimus* Ginetsinskaya, 1948 (Platyhelminthes: Digenea) with comments on the taxonomy of the superfamily Microphalloidea Ward, 1901. Acta Parasitologica 62(3): 617–624. https://doi.org/10.1515/ap-2017-0075

Kavetska K, Rząd I, Sitko J (2008) Taxonomic structure of Digenea in wild ducks (Anatinae) from West Pomerania. Wiadomosci Parazytologiczne 54(2): 131–136.

Kirillov AA, Kirillova NY (2013) Trematodes of birds (Aves) from the Middle Volga region. 2. Orders Plagiorchiida, Renicolida, Strigeida and Schistosomatida. Parazitologiya 47: 136–177. [In Russian]

Kirillov AA, Kirillova NY, Chikhlyaev IV (2012) Trematodes of terrestrial vertebrates of the Middle Volga region. Cassandra, Togliatti, 329 pp. [In Russian]

Kostyunin VM (2010) Helminth fauna of land vertebrates in the Middle Volga region. Nizhny Novgorod State Pedagogical University, Nizhny Novgorod, 225 pp.

Kulisic Z, Lepojev O, Aleksis-Bakrac N, Jakic D, Pavlovic I, Milutinovic M, Misic Z (2004) Trematodes of the Eurasian coot (*Fulica atra* L.) in the Belgrade area. Acta Veterinaria (Beograd) 54(5–6): 447–456. http://dx.doi.org/10.2298/AVB0406447K

Lapage G (1961) A list of the parasitic Protozoa, Helminths and Arthropoda recorded from species of the Family Anatidae (Ducks, Geese and Swans). Parasitology 51(1-2): 1–109. https://doi.org/10.1017/s0031182000068517

Makhmudova EA (2013) Ecological and faunistical analysis of trematodes in wetland birds of the transboundary lake Jandar in the Transcaucasus. The South of Russia: ecology, development 1: 67–71. [In Russian]

Makhmudova EA, Ibrahimov ShR (2020) Dependence of Trematode Fauna of Waterbirds of Azerbaijan on Their Seasonal Migration. Inland Water Biology 4: 404–411. https://dx.doi.org/10.31857/S0320965220040129 [In Russian]

McDonald ME (1981) Key to trematodes reported in waterfowl. US Department of the Interior. Fish and Wildlife Service, Resource Publication, 142, Washington, 156 pp.

Nasinkova V, Moravec F, Scholz T (1993) Trematodes of the common cormorant (*Phalacrocorax carbo*) in Czech Republic. Acta Societatis Zoologicae Bohemicae 57(1): 31–46.

Rudolfova J, Littlewood DTJ, Sitko J, Horak P (2007) Bird schistosomes of wildfowl in the Czech Republic and Poland. Folia Parasitologica 54: 88–93.

Serbina EA (2005) Distribution of trematodes of the family Prosthogonimidae in river and lake ecological systems in the south of the Western Siberia. Parazitologiya 39(1): 50–65. [In Russian]

Serbina EA (2018) Trematodes in wetland birds from the lake Chany (South of western Siberia). Proceedings of the Center of Parasitology of the Institute of Ecology and Evolution Problems of RAS: Parasite Biodiversity 50: 234–236. [In Russian]

Shabunov AA, Radchenko NM (2012) Parasites of fishes, amphibians and gulls in ecosystems of large water bodies in the Vologda region. Vologda State University, Vologda, 243 pp. [In Russian]

Shigin AA (1993) Trematodes of the Russian fauna and adjacent regions. Genus *Diplostomum*. Adults. Nauka, Moscow, 208 pp. [In Russian]

Sitko J, Heneberg P (2020) Systemic collapse of a host-parasite trematode network associated with wetland birds in Europe. Parasitology Research 119: 935–945. https://doi.org/10.1007/s00436-020-06624-4

Sitko J, Faltynkova A, Scholz T (2006) Checklist of the Trematodes (Digenea) of birds of the Czech and Slovak Republics. Vol. 1. Academia, Praha, 111 pp.

Smogorzhevskaya AA (1976) Helminths of waterfowl and wetland birds of the fauna of Ukraine. Naukova Dumka, Kiev, 416 pp.

Sonin MD (Ed.) (1985) Keys to the trematodes of fish-eating birds of the Palearctic (brachylaimids, clinostomids, cyclocoelids, fasciolids, notocotylids, plagiorchids, schistosomatids). USSR Academy of Sciences, All-Union Society of Helminthologists, Nauka, Moscow, 255 pp. [In Russian]

Spiridonov SN, Grishutkin GF, Lapshin AS, Kuznetsov VA, Mosalov AA (2019) Birds and animals of the Republic of Mordovia. Field guide. Red October, Saransk, 224 pp. [In Russian]

Sudarikov VE (1984) Trematodes of the Fauna of the USSR. Strigeids. Nauka, Moscow, 168 pp. [In Russian]

Syrota YaYu, Greben OB, Poluda AM, Maleha OM, Lisitsyna OI, Kornyushin VV (2018) Helminths of the mallard, *Anas platyrhynchos* (Aves, Anatidae), in Ukraine: analysis of the diversity in mixed forest zone and the Black Sea region. Vestnik Zoologii 52(4): 267–278. https://doi.org/10.2478/vzoo-2018-0028

Vainutis KS, Voronova AN, Andreev ME, Shchelkanov MYu (2023) Morphological and molecular identification of *Neomoliniella longicorpa* gen. et sp. nov. (Digenea: Echinostomatidae) from the Eurasian coot *Fulica atra* (Aves: Rallidae): a taxonomic evaluation. Russian Journal of Parasitology 17(2): 181–197. https://doi.org/10.31016/1998-8435-2023-17-2-181-1972023

Vinogradova AA, Skvortsov V (2002) Duck helmints of the Northwestern Russia and Estonia. Parasitologiia 56(2): 108–125. https://doi.org/10.31857/S0031184722020028 [In Russian]

Yakovleva GA (2024) The Species Composition of the Definitive Hosts of the Trematode *Bilharziella polonica* (Schistosomatidae) of Southern Karelia (Northwestern Russia). Biology Bulletin 51: 667–674. https://doi.org/10.1134/S1062359023603415

Yakovleva GA, Lebedeva DI, Ieshko EP (2012) Trematode's fauna of waterfowl birds in Karelia. Parazitologiya 46(2): 98–110. [In Russian]

Yakovleva GA, Lebedeva DI, Ieshko EP (2015) Trematodes in wetland birds of Karelia (based on materials from the 319th USSR helminthological expedition, 1958–1962). Proceedings of the Karelian Scientific Center of RAS 2: 95–110. https://dx.doi.org/10.17076/eco119i [In Russian]

Zazornova OP (2012) Systematic status of species of the genus *Cotylurus*. In: Be'er SA (Ed.) Biodiversity and ecology of parasites. Nauka, Moscow, 81–98. [In Russian]