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Parasites of Common (*Sterna hirundo*) and Arctic (*Sterna paradisaea*) Terns (Charadriiformes, Laridae) in Karelia

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Abstract—The fauna of parasites of Common (*Sterna hirundo*) and Arctic (*Sterna paradisaea*) terns obtained during the spring hunting period of 2013–2015 on the coast of Lake Ladoga has been studied. We found 15 species of parasites of various systematic groups: Cestoda (six species), Trematoda (four species), Nematoda (two species), Acanthocephala (two species), and Crustacea (one species). In the Common tern, 11 species of parasites have been registered, and in the Arctic tern, seven species. All parasites identified are typical and widespread helminths of fish-eating birds that are ubiquitous in the Palearctic. For the first time in the territory of Karelia, the species *Reighardia sternae* Diesing 1864 has been recorded.

Keywords: terns, *Sterna hirundo*, *Sterna paradisaea*, parasites, Lake Ladoga

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INTRODUCTION

Karelia is characterized by a rich species diversity of birds, due to its geographical position, landscape peculiarities, considerable length from south to north and the variety of different types of habitats. One of the main places of the concentration and nesting of birds is Lake Ladoga, the largest freshwater reservoir in Europe, located on the White Sea–Baltic bird flyway (Mikhaleva et al., 2000). This path is followed by more than 70 species of waterfowl birds, including birds of the family Laridae Vigors, 1825 which is represented by 13 species in Karelia (Zimin et al., 1993; Noskov, 1997). One of the representatives of this family is terns of the genus *Sterna* Linnaeus, 1758.

The Common tern (*Sterna hirundo*) is one of the mass species of fish-eating birds of northwestern Russia. It nests throughout Karelia, but the largest colonies are located on lakes Ladoga and Onega and on some smaller reservoirs in the southern part of the republic. To the north, the number of birds decreases, and on the border with Murmansk region, the Common tern becomes rare (Zimin et al., 1993). A representative of the Arctic fauna, the Arctic tern (*Sterna paradisaea*), nests mainly on the islands and coasts of the White Sea within the republic, where it dominates the rest of the gulls species (Bianki, 1967; Cherenkov et al., 2014). Individual pairs were recorded nesting on large freshwater reservoirs of the region, on lakes Ladoga and Onega, where the Arctic tern is numerous during migrations (Khokhlova and Artemyev, 2015).

Due to the fact that terns, like most fish-eating birds, are migratory, they can bring new species of helminths with them, for which, in turn, it is likely to find suitable intermediate hosts for the implementation of the life cycle in the territory of Karelia. Thus, during host migration, parasites are resettled. Recent studies have shown that the most of alien species occupy the European part of Russia. Here, 78% of the country's population lives, the main transport routes pass, and the highest level of disturbance of natural ecosystems is observed (Dgebuadze, 2014).

There have been no special studies of parasites of fish-eating birds in Karelia. To date, there are only fragmentary data on the fauna of parasites of gulls of the Republic, including common terns, which are given in the works of Martyanov (2001), Pelgunov (2012), and Yakovleva et al. (2013). The aim of this publication is to expand knowledge about the species composition of parasites of the Common and Arctic terns for the territory of Karelia.

MATERIALS AND METHODS

We investigated 16 specimens of the Common tern and six specimens of the Arctic tern, obtained on the eastern coast of Lake Ladoga (Olonetsky district) near the mouth of the Olonka River (61°06′ N, 32°58′ E). The material was collected in May 2013–2015 (during the spring hunt).

The collection, fixation, and laboratory processing of parasitological material were carried out according to the generally accepted technique (Dubinina, 1971). The identification of helminths was carried out on the basis of keys and numerous original descriptions

Table 1. Species composition of tern parasites and indicators of infection

Parasite species	The Common tern ($N = 16$)		The Arctic tern ($N = 6$)	
	P, %	M, specimens	P, % (specimens)	M, specimens
Platyhelminthes				
Cestoda				
Dibothriocephalus dendriticus Nitzsch 1824 (Plerocercoid)	18.75 ± 9.76	0.25	–	–
Dibothriocephalus sp.	6.25 ± 6.05	0.13	–	–
Schistocephalus pungitii Dubinina, 1959	6.25 ± 6.05	0.13		
Schistocephalus sp.	–	–	16.67 (1)	0.17
Tetrabothrius erostris (Lönnberg 1889) Baylis 1926	12.50 ± 8.27	*	–	–
Cestoda	6.25 ± 6.05	*	–	–
Trematoda				
Diplostomum pseudospathaceum Niewiadomska 1984	–	–	16.67 (1)	0.33
Diplostomum sp.	–	–	16.67 (1)	0.50
Giganthobilharzia mazuriana Khalifa 1974	12.50 ± 8.27	*	66.67 (4)	*
Echinochasmus sp.	–	–	16.67 (1)	0.17
Nematoda				
Eucoleus contortus Creplin 1839	12.50 ± 8.27	0.13	16.67 (1)	0.17
Contracaecum microcephalum Rudolphi 1809	6.25 ± 6.05	0.06	16.67 (1)	0.33
Acanthocephala				
Corynosoma semerme Forssell 1904	6.25 ± 6.05	0.06	–	–
C. strumosum (Rudolphi 1802) Lühe 1904	6.25 ± 6.05	0.06	–	–
Arthropoda				
Maxillopoda				
Reighardia sternae Diesing 1864	6.25 ± 6.05	0.13	–	–
Species in total	11		7	

N is the number of birds examined.
P for the Arctic tern is the actual number of infected birds additionally shown in brackets. The dash means no parasite detected.
* M cannot be counted, since the material is represented by fragments of bodies.

(Smogorzhevskaya, 1976; *Opredelitel' trematod...,* 1985, 1986; Khokhlova, 1986; Shigin, 1993; Sonin and Barus, 1996; Barus et al., 1978; Ryzhikov et al., 1985; Pérez-del-Olmo et al., 2014). Based on the results of identification and calculation of the detected helminths, the values of the quantitative parameters of bird infection, namely, the prevalence (P, %) and the abundance index (M, specimen per bird), have been calculated.

In addition, we studied the nutrition of terns by analyzing the contents of the stomachs and intestines. It was found that the content contains three main fractions: fish, plants, and invertebrates. Fish, smelt, and vendace, which were identified by otoliths, predominate in the diet.

RESULTS AND DISCUSSION

As a result of the study, 15 species of parasites of various groups were identified (Table 1): Cestoda (six species), Trematoda (four species), Nematoda (two species), Acantocephala (two species), and Maxillopoda (one species). In the Common tern, 11 species of parasites were recorded, and, in the Arctic tern, seven species.

Of the parasite species found, nine were first observed in both Arctic and Common terns on the territory of Karelia. Among them, three parasite species, *Giganthobilharzia mazuriana*, *Eucoleus contortus*, and *Contracaecum microcephalum,* were usual for both species of terns (Table 1). These helminths indicate the same ecological particulars and diet of the hosts.

The trematode *Gigantobilharzia mazuriana* showed the highest rates of infection. However, calculation of the exact number of worms, unfortunately, is impossible because of their fragility and the large number of body fragments. These trematodes were found not only on the southeastern coast of Lake Ladoga, but also in the Common and Black-headed gulls on Kostomuksha Lake (Lebedeva et al., 2016). Earlier,

G. mazuriana marites were described only from the black-headed gull and the common tern in Poland (Khalifa, 1974), and cercariae were found in snail *Anisus vortex* in Belarus (Akimova et al., 2012). Therefore, it can be assumed that the migratory route of terns passes through the territory of these countries, and from there the birds carry helminths. This is also supported by the fact that the studied *G. mazuriana* marites were sexually mature. According to ornithologists, terns nesting or spending the summer months in northwestern Russia fly here both along the coast of the Baltic Sea and across the eastern Mediterranean (*Migratsii...,* 2016).

Two species of nematodes were observed in the terns studied (Table 1): *Eucoleus contortus* in the esophagus and *Contracaecum microcephalum* in the stomach. Both species of nematodes are typical parasites of fish-eating birds. Earlier, representatives of these genera were found in the European herring gull from the coasts of Lake Ladoga and Lake Onega (Martyanov, 2001). The find of *C. microcephalum* indicates that invertebrates are included in the diet of terns, in addition to fish. The second intermediate hosts for these nematodes are freshwater insects (chironomids, dragonfly larvae) and fish (Smogorzhevskaya, 1990; Sonin and Barush, 1996). *E. contortus* is a biohelminth with a direct development cycle. Birds get infected with their larvae by eating grass. However, paratenic hosts may participate in the development of this species: earthworms of different species and, possibly, other invertebrates (Sonin and Barush, 1996).

Another six species of parasites were recorded on the territory of Karelia, either only in the Common tern or only in the Arctic tern. In both species of terns, cestodes of the genus *Schistocephalus* have been recorded, which indicates that birds feed on small fish. In the development cycles of *Schistocephalus* spp. cestodes, different species of fish can take part: stickleback, loach, bullhead (Dubinina, 1966). *Schistocephalus pungitii* was found in common terns. In the development cycle of this species in Lake Ladoga, a ninespined stickleback is involved (Rumyantsev and Ieshko, 1997). In the Arctic tern, cestodes were recorded as mature fragments (12–58 proglottids), in which the ends of the strobilus were cut off. The parasite identification keys are based on the number of segments in the strobilus and specificity at the stage of the second intermediate host (Ryzhikov et al., 1985); therefore, we can identify the worms only as *Schistocephalus* sp. On the territory of Fennoscandia, four species of the *Schistocephalus* genus are known: *S. cotti*, *S. nemachili*, *S. pungitii*, and *S. solidus* (Rumyantsev and Ieshko, 1997; Evseeva, 2001; Chubb et al., 2006). The molecular taxonomy is being developed for parasites of this genus (Waeschenbach et al., 2017; Pruter et al., 2018), using which it will be possible to further refine the list of *Schistocephalus* species in birds and fish of Karelia.

Trematodes of the genus *Diplostomum*, found only in the Arctic tern, are characterized by low rates of infection (Table 1). The occurrence of a small number of diplostomids is explained by the low abundance index of metacercariae parasitizing the eyes of fish, in particular smelt and vendace on Lake Ladoga (Rumyantsev and Ieshko, 1997; Lebedeva, 2006). In the intestines of birds, we found otoliths of these fish species, which are one of the food objects of terns.

A single occurrence is also typical for trematodes of *Echinochasmus* sp. in the Arctic tern. The development cycle of parasites of this genus is associated with mollusks, as the first intermediate hosts, and fish, as the second intermediate hosts (*Fauna Ukrainy...,* 1985). Most likely, with these trematodes, birds were invaded along the migration route from wintering sites, since the parasite *Echinochasmus* sp. has not been recorded in fish in the water bodies of Karelia and in the Kola Peninsula (Rumyantsev and Ieshko, 1997; Mitenev, 2000, 2003; Barskaya et al., 2008; Rumyantsev and Mamontova, 2008).

Single specimens of cestodes of the genus *Dibothriocephalus* (syn. *Diphyllobothrium*) were found in three out of 16 investigated Common terns. These species are usual parasites of gulls in Europe, Asia, Africa, and North America (Baer, 1962; Smogorzhevskaya, 1976; Bakke, 1985; Waeschenbach et al., 2017). In Karelia, genus *Dibothriocephalus* was recorded in the Common tern, Common and Lesser black-backed gulls on the shores of Lake Ladoga and Lake Onega (Martyanov, 2001; Pelgunov, 2012). In terns of Vologda and Murmansk regions adjacent to Karelia, these parasites were not recorded (Shabunov, 2002; Kulachkova and Kochetova, 1964; Kuklin and Kuklina, 2005).

The cestodes *Tetrabothrius errostris* were found by us only in the intestines of the Common tern. Species of this genus in the territories closed to Karelia were noted earlier in the Arctic tern of Kandalaksha Bay, White Sea (Kulachkova and Kochetova, 1964) and on the Seven Islands Archipelago (Belopolskaya, 1952; cited from Kuklin and Kuklina, 2005). Cestodes of genus *Tetrabothrius* were first discovered in Common terns in Karelia, although *S. hirundo* was already registered as a host for *T. erostris* in Scandinavia (Ryzhikov et al., 1985). Most likely, the bird was invaded during its departure from wintering places, as the parasites were very poorly preserved at the time of catching the birds.

One fragment of the strobilus of the Cestoda sp. was found in the intestine of the Common tern and was probably obtained by it at wintering sites. Due to the poor preservation of the material, it is not possible to determine the parasite.

Two species of acantocephalans, *Corynosoma semerme,* and *C. strumosum* were found in Common terns (Table 1). The helminths were immature. Most likely, the acanthocephalans got into the gastrointestinal tract of terns when the latter were eating fish. On

Lake Ladoga both species of the genus *Corynosoma* are parasites of the body cavity and internal organs of various fish species, which are additional hosts of acantocephalans (Rumyantsev and Ieshko, 1997).

For the first time on the territory of Karelia, a larid pentastome *Reighardia sternae* was recorded, which parasitizes as the adult state in the respiratory system of gulls and terns. The 2 parasites were found in one Common tern. Geographically, the parasite is extremely widespread (Dubinina and Smogorzhevskaya, 1956; Kanarek et al., 2005; Naupay et al., 2016; Literak et al., 2017): in the far north (Greenland, Norway, East Murman) and in the south (deltas of the Danube and Volga rivers, eastern China, Brazil, Italy, and Poland). Birds become infected with *R. sternae* by eating eggs of the parasite with larvae that hatch in the intestines of the host and migrate into the body cavity to the posterior air sacs. Females move through the lungs into the trachea and beak cavity to lay eggs, which are subsequently swallowed by the host and naturally removed from the body of birds (Banaja et al., 1975; Böckeler, 1984; Kanarek et al., 2005). Furthermore, some authors believe that fish can act as an intermediate host in the life cycle of *R. sternae* (Bakke, 1972; Riley, 1972). Perhaps this parasite is characterized by self-infection, which is one of the adaptations to living conditions (Banaja et al., 1976). *R. sternae* is one of the few parasites in which development proceeds along a double path of development. Moreover, one or two individuals of the one species (final and intermediate host) participate in the development of the parasite, and both come from the same population (Kanarek et al., 2005).

The data obtained on parasites of terns *Sterna hirundo* and *S. paradisaea* in Karelia are consistent with materials on their biology and diet (Zimin et al., 1993). Common terns dive searching the food, which is mainly a small fish. They also feed on mollusks and insects. The diet of Arctic terns includes fish, crustaceans, mollusks, insects, and earthworms.

Helminth fauna of terns in the water area of Lake Ladoga in the spring is notable for its small variety with respect to the species composition of parasitic worms. Perhaps this is due to natural deworming during migration—the disappearance from the parasite fauna of species with a short cycle and the absence or limitation of the possibility of a new infection. Further study of birds is expected to expand the list of tern parasites.

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COMPLIANCE WITH ETHICAL STANDARDS

Conflict of interest. The authors declare that they have no conflicts of interest.

Statement on the welfare of animals. All applicable international, national, and/or institutional guidelines for the care and use of animals were followed.

REFERENCES

Akimova, L.N., Khrisanfova, G.G., Tolstenkov, O.O., Bychkova, E.I., Zhukova, T.V., et al., Morphological and molecular-genetic identification of new species of bird schistosomes (Trematoda: Schistosomatidae) found in mollusks *Anisus vortex* (Planorbidae) in Belarus, *Doklady NAN Belarusi*, 2012, vol. 56, no. 2, pp. 86–91.

Baer, J.G., Cestoda, in *The Zoology of Iceland*, 1962, vol. 2.

Bakke, T.A., *Reighardia sternae* (Diesing, 1864) Ward 1899 [Pentastomida; Cephalobaenida] from the common gull (*Larus canus* L.) in a Norwegian locality, *Norw. J. Zool.*, 1972, no. 20, pp. 273–277.

Bakke, T.A., Studies of the helminth fauna of Norway XL: the common gull, *Larus canus* L., as a final host for Cestoda (Platyhelminthes), *Fauna Norv. Ser. A*, 1985, vol. 6, no. 5, pp. 42–54.

Banaja, A.A., James, J.L., and Riley, J., An experimental investigation of a direct life-cycle in *Reighardia sternae* (Diesing, 1864), a pentastomid parasite of the herring gull (*Larus argentatus*), *Parasitology*, 1975, vol. 71, pp. 493–503.

Banaja, A.A., James, J.L., and Riley, J., Some observations on egg production and autoreinfection of *Reighardia sternae* (Diesing, 1864), a pentastomid parasite of the herring gull, *Parasitology*, 1976, vol. 72, pp. 81–91.

Barskaya, Yu.Yu., Ieshko, E.P., and Lebedeva, D.I., *Parazity lososevidnykh ryb Fennoskandii* (Parasites of Salmonid Fishes of Fennoscandia), Petrozavodsk: Kar. Nauchn. Tsentr Ross. Akad. Nauk, 2008.

Barus, V., Sergeeva, T.P., Sonin, M.D., and Ryzhikov, K.M., *Helminths of Fish-Eating Birds of the Palaearctic Region I. Nematoda*, Prague: Academia, 1978.

Belopol'skaya, M.M., Parasitofauna of marine waterfowl, *Uch. Zap. Len. Gos. Univ., Ser. Biol.*, 1952, no. 28, pp. 127–180.

Bianki, V.V., *Kuliki, chaiki, chistikovye Kandalakshskogo zaliva* (Waders, Gulls, and Auks of Kandalaksha Bay), Tr. Kandalaksh. Gos. Zapov., Murmansk, 1967, no. 6.

Böckeler, W., Der Entwicklungszyklus von *Reighardia sternae* (Pentastomida) nach Untersuchungen an natürlich und experimentell infestieren Möwen, *Zoologischer Anzeiger*, 1984, no. 213, pp. 374–394.

Cherenkov, A.E., Semashko, V.Yu., and Tertitskii, G.M., *Ptitsy Solovetskikh ostrovov i Onezhskogo zaliva Belogo morya: materialy i issledovaniya (1983–2013 gg.)* (Birds of Solovki Islands and Onega Bay of the White Sea: Materials and Research (1983–2013)), Arkhangel'sk, 2014.

Chubb, J.C., Seppala, T., Luscher, A., Milinski, M., and Valtonen, E.T., *Schistocephalus cotti* n. sp. (Cestoda: Pseudophyllidea) plerocercoids from bullheads *Cottus gobio* L. in an Arctic river in Finland, with a key to the plerocercoids of the Palaearctic species of the genus, *Syst. Parasitol.*, 2006, vol. 65, pp. 161–170.

Dgebuadze, Yu.Yu., Invasions of alien species in Holarctic: some results and perspective of investigations, *Russ. J. Biol. Invasions*, 2014, vol. 5, no. 2, pp. 61–64.

Dubinina, M.N., *Remnetsy fauny SSSR* (Ligulidae of the Fauna of the USSR), Leningrad: Nauka. Leningr. Otd., 1966.

Dubinina, M.N., *Parazitologicheskoe issledovanie ptits* (Parasitological Study of Birds), Leningrad: Nauka, 1971.

Dubinina, M.N. and Smogorzhevskaya, L.A., About *Reighardia sternae* dies (Pentastomiga) described as *Squamofilaria macroovata* Sercova (Nematoda), *Parazitol. Sb. Zool. Inst. Akad. Nauk SSSR*, 1956, vol. 16, pp. 213–216.

Evseeva, N.V., Diversity of parasites of grandling (*Nemachilus barbatulus* L.) and bullheads (*Cottus gobio* L.) in urban ecosystem of the Lososinka River, in *Ekologo-parazitologicheskie issledovaniya zhivotnykh i rastenii Evropeiskogo Severa* (Ecological and Parasitological Studies of Animals and Plants of the European North), Petrozavodsk: Kar. Nauchn. Tsentr Ross. Akad. Nauk, 2001, pp. 30–35.

Fauna Ukrainy: Trematody. Ekhinostomataty (Fauna of Ukraine: Flukes. Echinostomates), Kiev: Naukova Dumka, 1985, vol. 34, no. 4.

Kanarek, G., Rolbiecki, L., and Misztal, M., *Reighardia sternae* (Diesing, 1864)—a pentastomid (Pentastomida) species new for the fauna of Poland, *Fragmenta Faunistica*, 2005, vol. 48, no. 1, pp. 101–106.

Khalifa, R., Studies on Schistosomatidae Looss, 1899 (Trematoda) of aquatic birds of Poland. II. *Gigantobilharzia mazuriana* sp. n. with a discussion of the subfamily Gigantobilharziinae Mehra 1940, *Acta Parasitol. Pol.*, vol. 22, no. 23, pp. 265–284.

Khokhlova, I.G., *Akantotsefaly nazemnykh pozvonochnykh fauny SSSR* (Acanthocephalans of Terrestrial Vertebrates of the Fauna of the USSR), Moscow: Nauka, 1986.

Khokhlova, T.Yu. and Artem'ev, A.V., Nesting of the Arctic tern Sterna paradisaea in large reservoirs of Karelia, *Russ. Ornitol. Zh.*, 2015, vol. 24, no. 1109, pp. 599–601.

Kuklin, V.V. and Kuklina, M.M., *Gel'minty ptits Barentseva morya: fauna, ekologiya, vliyanie na khozyaev* (Helminths of Birds of the Barents Sea: Fauna, Ecology, and Impact on Hosts), Apatity: Kol'sk. Nauchn. Tsentr Ross. Akad. Nauk, 2005.

Kulachkova, V.G. and Kochetova, I.V., Characteristic features of the helminthofauna of gulls of Kandalaksha Bay, in *K prirodnoi ochagovosti parazitarnykh i transmissivnykh zabolevanii v Karelii* (On the Natural Foci of Parasitic and Vector-Borne Diseases in Karelia), Moscow, 1964, pp. 48–57.

Lebedeva, D.I., Trematodes of fishes of Lake Ladoga: fauna, ecology, and zoogeography, *Extended Abstract of Cand. Sci. (Biol.) Dissertation*, St. Petersburg, 2006.

Lebedeva, D.I., Yakovleva, G.A., and Ieshko, E.P., Parasites of gulls (*Larus canus* L., 1758 and *L. ridibundus* L., 1766) in Northern Karelia, *Tr. Karel. Nauchn. Tsentra Ross. Akad. Nauk*, 2016, no. 1, pp. 84–88.

Literák, I., Casero, M., Koubková, B., Těšínský, M., and Heneberg, P., Morphological and molecular assessment of pentastomes from gulls in Portugal, *J. Parasitol.*, 2017, vol. 103, no. 5, pp. 588–592.

Mart'yanov, R.S., Helminthological research of *Larus canus*, *L. argentatus*, and *Sterna hirundo* of Onega and Ladoga lakes, in *Ekologo-parazitologicheskie issledovaniya zhivotnykh i rastenii Evropeiskogo Severa* (Ecological and Parasitological Studies of Animals and Plants of the European North), Petrozavodsk: Karel. Nauchn. Tsentr Ross. Akad. Nauk, 2001, pp. 96–99.

Migratsii ptits Severo-Zapada Rossii. Nevorob'inye (Migrations of Birds of North-West Russia: Non-Passerine Birds), Noskov, G.A., Rymkevich, T.A., and Gaginska, A.R., Eds., St. Petersburg: Professional, 2016.

Mikhaleva, E.V., Sazonov, S.V., Medvedev, N.V., Lapshin, N.V., and Zimin, V.B., *Inventarizatsiya i izuchenie biologicheskogo raznoobraziya na territorii Zaonezhskogo poluostrova i severnogo Priladozh'ya. Ptitsy* (The Inventory and Study of Biological Diversity in the Territory of Zaonezhie Peninsula and the Northern Ladoga Region: Birds), Petrozavodsk, 2000, pp. 279–301.

Mitenev, V.K., *Parazity sigovykh ryb Kol'skogo Severa (fauna, ekologiya, zoogeografiya)* (Parasites of Whitefishes of the Kola North (Fauna, Ecology, and Zoogeography), Murmansk, 2003.

Mitenev, V.K., *Parazity karpovykh ryb Cyrinidae Kol'skogo Severa (fauna, ekologiya, zoogeografiya)* (Parasites of Carp Fishes (Cyprinidae) of the Kola North (Fauna, Ecology, and Zoogeography)), Murmansk, 2000.

Naupay, A.I., Cribillero, N.G., Lopez-Urbina, M.T., Gonzalez, A.E., and Gomez-Puerta, L.A., Finding of pentastomes of genus *Reighardia* (Pentastomida) in the Belcher's gull (*Larus belcheri*), *Parasitol. Int.*, 2016, vol. 65, no. 3, pp. 288–290.

Noskov, G.A., Migrations of waterfowl in the Northwest region of Russia and the tasks of their study, in *Proceedings of the First Seminar on the Topic "Study of the State & Trends of Migratory Birds Populations in Russia,"* Moscow, 1997, pp. 12–19.

Opredelitel' trematod ryboyadnykh ptits Palearktiki (brakhilaimidy, klinostomidy, tsiklotselidy, fastsiolidy, notokotilidy, plagiorkhidy, shistosomatidy) (Key to the Trematodes of Fish-Eating Birds in Palaearctic Region (Brachylaimids, Clinostomids, Cyclocoelids, Fasciolids, Notocotylids, Plagiorchids, and Shistosomatids)), Moscow: Nauka, 1985.

Opredelitel' trematod ryboyadnykh ptits Palearktiki (opistorkhidy, renikolidy, strigeidy) (Key to Trematodes of Fish-Eating Birds in Palaearctic Region (Opisthorchidae, Renicolidae, and Strigeidae)), Moscow: Nauka, 1986.

Pel'gunov, A.N., Infestation of gulls with two species of diphyllobothriids in Karelia, *Tr. Tsentra Parazitol.,* Moscow: Nauka, 2012, vol. XLVII, pp. 177–186.

Pérez-del-Olmo, A., Georgieva, S., Pula, H.J., and Kostadinova, A., Molecular and morphological evidence for three species of *Diplostomum* (Digenea: Diplostomidae), parasites of fishes and fish-eating birds in Spain, *Parasites Vectors*, 2014, vol. 7, pp. 502–517.

Prüter, H., Franz, M., Auls, S., Czirják, G.Á., Greben, O., et al., Chronic lead intoxication decreases intestinal helminth species richness and infection intensity in mallards (*Anas platyrhynchos*), *Sci. Total Environ.*, 2018, vol. 644, pp. 151–160.

Riley, J., Some observations on the life-cycle of *Reighardia sternae* Diesing, 1864 (Pentastomida), *Zeitschrift Parasitenkunde*, 1972, vol. 40, pp. 49–59.

Rumyantsev, E.A. and Mamontova, O.V., *Parazity presnovodnykh ryb: uchebnoe posobie* (Parasites of Freshwater Fishes: Textbook), Petrozavodsk: Petr. Gos. Univ., 2008.

Rumyantsev, E.A. and Ieshko, E.P., *Parazity ryb vodoemov Karelii: sistematicheskii katalog* (Parasites of Fishes of Water Bodies of Karelia: A Systematic Catalogue), Petrozavodsk: Karel. Nauchn. Tsentr Ross. Akad. Nauk, 1997.

Ryzhikov, K.M., Ryšavý, B., Khokhlova, I.G., Tolkacheva, L.M., and Kornyuchin, V.V., *Helmihths of Fish-Eating Birds of the Palaearctic Region. II. Cestoda and Acanthocephales*, Prague: Academia, 1985.

Shabunov, A.A., The role of gulls in the spread of helminths of fishes in large water bodies of Vologda oblast, *Extended Abstract of Cand. Sci. (Biol.) Dissertation*, St. Petersburg, 2002.

Shigin, A.A., *Trematody fauny Rossii i sopredel'nykh regionov. Rod Diplostomum. Marity* (Trematodes of the Fauna of Russia and Adjacent Regions. Genus Diplostomum. Maritas), Moscow: Nauka, 1993.

Smogorzhevskaya, L.A., *Gel'minty vodoplavayushchikh i bolotnykh ptits fauny Ukrainy* (Helminths of Waterfowl and Wading Birds of the Fauna of Ukraine), Kiev: Naukova Dumka, 1976.

Smogorzhevskaya, L.A., *Akuaroidei (Acuaroidea). Nematody* (Acuaroidea. Nematodes), Kiev: Naukova Dumka, 1990.

Sonin, M.D. and Barush, V., *Nematody dikikh kurinykh ptits Palearktiki* (Nematodes of Wild Birds (Galliformes) of the Palearctic), Moscow: INPA RAN, 1996.

Waeschenbach, A., Brabec, J., Scholz, T., Timothy, D., Littlewood, J., and Kuchta, R., Ehe catholic taste of broad tapeworms—multiple routes to human infection, *Int. J. Parasitol.*, 2017, vol. 47, pp. 831–843.

Yakovleva, G.A., Lebedeva, D.I., and Ieshko, E.P., Trematodes of some gulls (Laridae) of Karelia, in *Materialy V S"ezda Parazitologicheskogo obshchestva pri RAN: Vserossiiskaya konferentsiya s mezhdunarodnym uchastiem (24–27 sentyabrya 2013 g., Institut sistematiki i ekologii zhivotnykh SO RAN, Novosibirsk)* (Proceedings of the V Congress of the Parasitological Society of RAS: Russian Conference with International Participation (September 24–27, 2013, Institute of Systematics and Ecology of Animals, Novosibirsk)), Novosibirsk: Garamond, 2013, p. 228.

Zimin, V.B., Sazonov, S.V., Lapshin, N.V., Khokhlova, T.Yu., Artem'ev, A.V., et al., *Ornitofauna Karelii* (The Avifauna of Karelia), Petrozavodsk: Karel. Nauchn. Tsentr Ross. Akad. Nauk, 1993.

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