Trematode *Apophallus müehlingi* (Jägerskiöld, 1899) Lühe, 1909 in gulls in Northwest Russia

Galina A. Yakovleva, PhD[1]; Daria I. Lebedeva, PhD[1]; Evgeny P. Ieshko, PhD[1],
[1] Institute of Biology of Karelian Research Centre of RAS

ABSTRACT

Data on the finding of *Apophallus müehlingi* (Jägerskiöld, 1899) Lühe, 1909 in gulls of Lake Ladoga and its morphological characteristics are provided for the first time. In common gull (*Larus canus),* this parasite occurred more often. In little gull (*L. minutus),* trematodes were single specimens. Mature *A. müehlingi* are registered only in these gull species during the spring period, immediately after their return from the wintering areas. Detection of the parasite indicates a potential environmental threat. To date, *A. müehlingi* is found only in the definitive host. However, the penetration of gastropods *Lithoglyphus naticoides* Pfeiffer, 1828, the parasite's first intermediate host, into Lake Ladoga will form favorable conditions for the life cycle of the parasite. This may lead to the epizooty of fish by *A. müehlingi.*

METHODS AND MATERIALS

The following seven bird species of the family Laridae were studied: little gull *Larus minutus* (14 specimens (sp.)), common gull *L. canus* (13 sp.), common tern *Sterna hirundo* (8 sp.), Arctic tern *S. paradisaea* (4 sp.), black-headed gull *L. ridibundus* (2 sp.), European herring gull *L. argentatus* (1 sp.), and lesser black-backed gull *L. fuscus* (1 sp.). All birds were captured in May 2012–2014 during the spring hunting season on the southeastern shore of Lake Ladoga (South Karelia). Some birds were collected by fishermen from fishing gear, i.e., birds that were entangled in cages or stationary nets and died. Sampling, fixation, and laboratory inspection of the parasitological material were performed by the standard methods (Dubinina, 1971). Helminths were identified using the following keys: Opredelitel' trematod… (Guide to Trematodes) (1986), Movsesyan et al. (2004). The morphological description of the species is based on measurements of 16 fixed stained helminths, which were represented by only mature specimens.
Microscopic examination and measurements of the parasites were performed using a microscope Olympus CX–41 and the software Levenhuk ToupView 3.5 (V. Levenhuk, Inc. in Scientific Center) of the collective usage platform (Institute of Biology, Karelian Research Centre of the Russian Academy of Sciences).

INTRODUCTION

Biological invasions of alien species is an important problem of fundamental and applied research, which has been closely monitored by various researchers, including parasitologists, because the number of parasitic invaders penetrating into aquatic ecosystems has increased in recent years (Ieshko et al., 2012; Evlanov et al., 2013).
Trematodes of waterfowl birds play a special role in the understanding of habitat dynamics among parasites and formation of new helminthiasis foci. In particular cases, mature trematodes are carried by birds, but their life cycle is not realized, because the intermediate hosts are not present in a new water body. As shown in a number of works (Biserova, 2005; Tyutin and Slyn'ko, 2008), there are several trematode species which penetrated into the Middle and Lower Volga through the Volga–Don Canal. Special attention should be paid for two species, Rossicotrema donicus and Apophallus müehlingi, being pathogenic to fish. These new helminthiasis foci developed owing to the migrations of the first intermediate hosts of helminths in the 1960s. They were snails *Lithoglyphus naticoides* and *L. pyramidatus* from the Black Sea region. As shown by research (Semenova and Ivanov, 1989), it took trematodes 30 years from the invasion of the mollusks to dominate in the helminth fauna and to have high infestation rates of fish. During mass infestation, A. müehlingi can cause a black spot disease of young fish—apophallesis (Biserova, 2005).
The presented data are very important for development of the classical views in parasitology on possible causes, rates, and consequences of the distribution of parasites, such as A. müehlingi (Tyutin and Slyn'ko, 2008; Tyutin and Izvekova, 2013). Anthropological transformation of the drainage system, construction of channels, and change in the historically developed water routes can have serious ecological consequences.

CONTACT

Galina A. Yakovleva
Institute of Biology of Karelian Research Centre of RAS
Email: galina_il87@mail.ru
Phone: 8-814-2-76-27-06
Website:
http://ib.krc.karelia.ru/member.php?id=741&plang=r

RESULTS

Among all bird specimens under study, *A. müehlingi* was found in *L. canus* and *L. minutus* (Figs. 1 and 2). In the case of *L. canus*, 3 of 13 specimens (2–85 worms) were invaded. As for L. minutus, 1 of 14 specimens (13 worms) was infected. This pattern of invasion is associated with the feeding habits of birds. The diet of *L. canus* is based on fish, whereas L. minutus prefers aquatic invertebrates and small fish. The second intermediate hosts of *A. müehlingi* are cyprinid and perch fish (Biserova, 2005). On the basis of these factors, it can be suggested that L. canus is the main disseminator of *A. müehlingi* in Karelia.
The morphological characteristics of helminths from different hosts were similar, but their sizes were different. Larger worms were registered in *L. canus.* This may be associated with the size of the host, i.e., the larger the bird, the larger the helminths found in it.

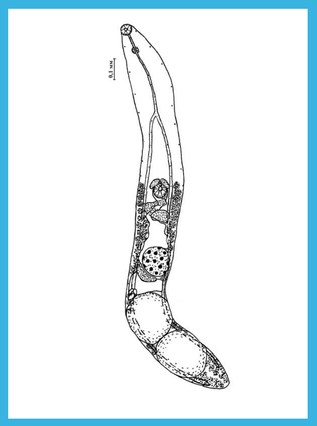

Figure 1. *Apophallus müehlingi* (orig.), common gull *(Larus canus*), Lake Ladoga, Karelia.

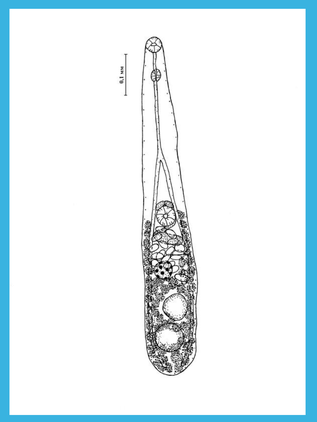

Figure 2. *Apophallus müehlingi* (orig.), little gull *(Larus minutus),* Lake Ladoga, Karelia.

DISCUSSION

We cannot say with certainty that this parasite develops in Lake Ladoga, because there are no data in the literature on any findings of its first intermediate host (mollusks of the genus *Lithoglyphus)* in the fauna of the water body (Aleksandrov, 1965; Ladozhskoe ozero…, 2000). Metacercariae of the parasite have not been found as yet in fish from Lake Ladoga (Lebedeva and Ieshko, 2009). At the same time, the parasite occurs in many cyprinid species from water bodies of the Volga Region and smaller rivers of the Baltic coast (Biserova, 2005; Sitko et al., 2006). Thus, this helminth species is currently considered as an alien one for the water area of Lake Ladoga. According to Tyutin and Slyn'ko (2008), *Apophallus müehlingi* trematodes are the most representative biological "mark" of mollusks in a new water body, because "the direct result of host specifics of parthenitae in many trematode species is almost complete overlapping of their habitats with the habitats of hosting mollusks."
From this point of view, an additional factor indicating possible development of *Apophallus müehlingi* in the system of Lake Ladoga is the finding of *Parasymphylodora markewitschi* Kulakowskaja, 1947 in the following three fish species inhabiting this water body: roach (*Rutilus rutilus* L., 1758*),* ide *(Leuciscus idus* L., 1758), and chub (*Squalius cephalus* L., 1758) (Lebedeva, 2006). Both parasitic species use the same hosts and were found in *Lithoglyphus* naticoides from the system of the Volga River when the foci of apophallesis were investigated (Tyutin and Slyn'ko, 2008). Considering the fact that mollusks of the genus *Lithoglyphus* have rapidly colonized the system of the Volga River in the 20th century, one can expect that they will move further northwards, into the basin of Lakes Ladoga and Onega. Thus, favorable conditions will develop for realization of the life cycle of *Apophallus müehlingi,* an invasive species of trematodes.

CONCLUSIONS

Successful habitat expansion of *A. müehlingi is also* promoted by birds and mammals carrying mature maritae, which was registered by us. Possibly, as birds in the water area of Lake Ladoga are studied further, new species of the definitive hosts for *A. müehlingi will be found, because the range of hosts* for this parasite is larger in other regions. In Vologda oblast, *A. müehlingi* was registered in *L. argentatus, in* addition to *L. canus*. In the Czech Republic and Slovakia, the parasite was carried by *L. argentatus, L. canus, L. ridibundus,* and *Phalacrocorax* (Sitko et al., 2006).
Data obtained on the occurrence of the new alien invader, one of the most invasive species among trematodes, in Karelia show that there is an urgent need for further detailed research on the distribution of new hydrobionts in Lake Ladoga.
The research is supported by Grant of the President of the RF (MK-5350.2015.4), state order 0221-2014-0004 and the Russian Foundation for Basic Research (project no. 14-34-50729).

REFERENCES

1. Aleksandrov, B.M. Bivalve mollusks in Karelian lakes, in Fauna ozer Karelii (Fauna of Karelian Lakes), Tr. Karel. Fil., Inst. Biol. Akad. Nauk SSSR, Moscow: Nauka, 1965, pp. 96–110.
2. Biserova, L.I. Trematodes *Apophallus müehlingi* and *Rossicotrema* donicum—fish parasites of the Volga River delta: ecological features and ichthyoparasitosises, Extended Abstract of Cand. Sci. (Biol.) Dissertation, Moscow: Inst. Parasitol., Russ. Acad. Sci., 2005.
3. Dubinina, M.N. Parazitologicheskoe issledovanie ptits (Parasitological Analysis of Birds), Leningrad: Nauka, 1971.
4. Evlanov, I.A., Kirilenko, E.V., Mineev, A.K., Mineeva, O.V., Mukhortova, O.V., Popov, A.I., Rubanova, M.V., and Shemonaev, E.V. Influence of alien species of hydrobionts on structural-functional organization of ecosystems of Saratov reservoir, Izv. Samar. Nauch. Tsentra, Ross. Akad. Nauk, 2013, vol. 15, no. 3 (7), pp. 2277– 2286.
5. Ieshko, E.P., Shul'man, B.S., Lebedeva, D.I., Barskaya, Yu.Yu., and Niemela, E. Bullhead (*Cottus gobio L.)* invasion in the Utsjoki River (Northern Finland): parasitological aspects, Russ. J. Biol. Invasions, 2012, vol. 4, no. 1, pp. 17–23.
6. Ladozhskoe ozero. Monitoring, issledovanie sovremennogo sostoyaniya i problemy upravleniya Ladozhskim ozerom I drugimi bol'shimi ozerami (The Ladoga Lake: Monitoring, Modern Status, and Management Problems of the Ladoga Lake and Other Large Lakes), Petrozavodsk: Karel. Nauch. Tsentr, Ross. Akad. Nauk, 2000.
7. Lebedeva, D.I. Occurrence of trematodes of genus *Parasymphylodora* Szidat, 1943 in Cyprinidae fishes in the Ladoga Lake, Biol. Vnutr. Vod, 2006, no. 3, pp. 78–80.
8. Lebedeva, D.I. and Ieshko, Y.P., Trematode fauna patterns of the freshwater fish on the border of the geographical range, Biol. Bull., 2009, vol. 36, no. 5, pp. 464–468.
9. Movsesyan, S.O., Chubaryan, F.A., and Nikogosyan, M.A. Trematody fauny yuga Malogo Kavkaza (Trematodes of the Fauna of Southern Minor Caucasus), Moscow: Nauka, 2004.
10. Opredelitel' trematod ryboyadnykh ptits Palearktiki (opistorkhidy, renikolidy, strigeidy) (Guide for Identification of Trematodes of Birds-Ichthyophages: Opistorchids, Renicolids, and Strigeids), Moscow: Nauka, 1986.
11. Semenova, N.N. and Ivanov, V.M. Laridae birds as the distributers of fish apophallesis in the Volga River delta and Northern Caspian region, in Mater. nauch. konf. "Gel'mintologiya segodnya: problemy i perspektivy," Moskva, 4–6 aprelya 1989 g., Tezisy dokladov (Proc. Sci. Conf "Modern Helminthology: Problems and Prospects," Moscow, April 4–6, 1989, Abstracts of Papers), Moscow, 1989, vol. 2, pp. 95–96.
12. Sitko, J., Faltýnková, A., and Scholz, T. Checklist of the Trematodes (Digenea) of Birds of the Czech and Slovak Republics, Prague: Academia, 2006, vol. 1.
13. Tyutin, A.V. and Izvekova, G.I. Infection of mollusks and fish by the trematode *Apophallus müehlingi* (Jagerskiold, 1898) and its interrelations with intermediate hosts, Inland Water Biol., 2013, vol. 6, no. 1, pp. 52–56.
14. Tyutin, A.V. and Slynko, Yu.V. First find of the Black Sea mollusk *Lithoglyphus naticoides* (Gastropoda) and associated species specific trematodes in the Upper Volga basin, Ross. Zh. Biol. Invazii, 2008, no. 1, pp. 23–30.