

Conference Paper

Ichthyo-parasitological Characteristic of Lake Vokhtozero Roach

Olga Mamontova, Tamara Kuchko, Nikita Onishchenko, and Vadim Pavlov

Petrozavodsk State University, Petrozavodsk, Russia

Abstract

The article presents the results of ichthyo-parasitological studies of roach Lake Vokhtozero in the area of economic activity of the cage farm OOO Raduzhnaya forel (rainbow trout). It is shown that the age structure of the roach population is represented by fish aged 3+ to 10+ years. It is based on sexually mature individuals of middle age: 4+ (25%), 5+ (31%) and 6+ (21%). Of these, 61% are females and 39% are males. Roach is infected with parasites of 14 species belonging to five systematic groups: Myxosporea - 5 species, Trematoda - 5, Ciliophora - 2, Nematoda - 1 and Monogenea - 1. The most common ones are mixosporidia and trematodes. The parasitofauna of roach corresponds to a wide spectrum of nutrition of this species with a predominance of benthic herbivorous type in older individuals.

Keywords: parasitofauna, roach, Vohtozero, mixosporidia, trematodes.

Corresponding Author:

Olga Mamontova

mamontova@petsu.ru

Received: 24 December 2019

Accepted: 9 January 2020

Published: 15 January 2020

Publishing services provided by
Knowledge E

© Olga Mamontova et al. This article is distributed under the terms of the [Creative Commons Attribution License](#), which permits unrestricted use and redistribution provided that the original author and source are credited.

Selection and Peer-review under the responsibility of the BRDEM-2019 Conference Committee.

1. Introduction

Parasitological studies of hydrobionts have never lost their practical significance and have always been aimed at developing preventive measures to combat fish diseases in fishery water bodies.

The need for a complete and comprehensive study of fish parasites is determined by the fact that for some of them, representatives of the ichthyofauna are intermediate hosts [1]. A person most often becomes infected with helminths from fish, the larvae of which parasitize in the integument, muscles, body cavity and tissues of various fish organs. [2]. Due to this, monitoring water-bodies' parasitological situation is significant as well as estimation of potentially dangerous for fish and humans parasites species is required to provide their distribution effectively aiming at increasing fish capacity of water ecosystems [3].

The Republic of Karelia belongs to the regions rich in fresh water resources. In terms of the lake coefficient, it ranks first not only in Russia, but also significantly ahead of countries such as Finland, Sweden or Canada [4]. Of the more than 60 thousand lakes

OPEN ACCESS

located on the territory of the republic, the number of small lakes (about 50 thousand) with an area of 1 to 9 hectares is the highest. There are more than 7 thousand reservoirs with an area of 10 to 99 ha and 1250 lakes from 100 to 999 ha. There are about 155 lakes with an area of 1000 ha and more [5].

The abundance of the water network in Karelia predetermined the active development of the fishing industry. In large and medium-sized reservoirs, commercial fish farming and fishing for commercial species of fish (vendace, smelt, pike perch, whitefish, etc.) are carried out, and recreational fishing (roach, perch, shook, etc.) is carried out in small ones. Coastal zone of reservoirs becomes a place for developing homestead and auxiliary farms as well as population recreational activities [6].

Active economic activity of a person quite often leads to a change in the hydrochemical and hydrobiological characteristics of water bodies, which in turn has an effect on the water population, including parasites that cause diseases of hydrobionts. At the same time, wild native fish living in water bodies serve as a constant reservoir of pathogens of various diseases for fish bred in cage conditions [7]. But, despite the great species diversity, the parasitofauna of individual fish species in the lakes has their characteristic features, which are determined by the type of reservoir and the conditions for the use of its resources [8].

The aim of the work was to study the ichthyo-parasitological characteristics of the roach of Lake Vokhtozero in the context of fisheries.

The studied reservoir belongs to the Ladoga Lake basin, located on the catchment of the Vidlitsa River 80 km away from Petrozavodsk and belongs to small lakes with a water surface area of 8.78 km². This is a cold-water reservoir with a well-marked temperature stratification in the summer. The average depth reaches 11.1 m, the maximum - 35 m, the longest lake - 7.8 km, the largest width 2.0 km. The coastline is very winding, its length along the mainland is 34.2 km. The ichthyofauna of the lake is represented by 10 species of fish, among which the most numerous ones are roach, perch and pike [9].

Since 2007, a trout cage farm of the OOO Raduzhnaya forel with a capacity of 300 tons of marketable fish per year has been operating in the reservoir [10].

2. Methods

Ichthyo-parasitological studies of the roach of Lake Vokhtozero were carried out in the spring-summer period of 2015-2017.

For ichthyological analysis, roach was caught by gill nets with a mesh of 20 to 50 mm in the area of the trout farm located directly at the cages and at a distance of 200

meters from them. Age, sex, and size and weight characteristics were determined in fish by standard methods [11].

Studies of fish infection were carried out by the method of complete parasitological autopsy with the study of all the main systematic groups of parasites, except parasites of the circulatory system. The indicators of the extensity and intensity of roach infection and the indices of parasite abundance per one studied fish were evaluated [12]. For the species identification of the detected parasites, the Identifier was used [13].

3. Results

The age structure of the roach population of Lake Vokhtozero in the region where the trout farm was located was represented by fish aged 3+ to 10+ years (Fig. 1). The population was based on middle-aged mature individuals: 4+ (25%), 5+ (31%) and 6+ (21%). Of the total number of fish caught, 61% (70 pieces) were females and 39% (44 pieces) were males.

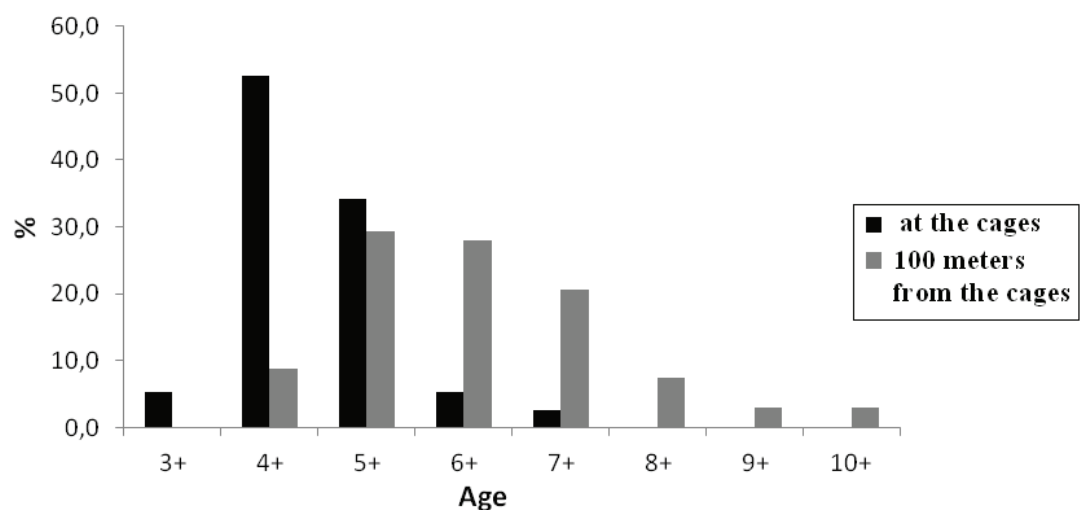


Figure 1: Lake Vokhtozero roach composition by age.

Fishes of five age groups (from 3+ to 7+) were present in catches near the cages; while individuals aged 4+ and 5+ (52% and 35%, respectively) represented the majority. Less often we found roach at the age of 7+ (3%). As for the sex ratio, females made up 43% (20 pcs.), and males - 57% (26 pcs.).

At a distance of 200 m from cages in catches from seven age groups (from 4+ to 10+), roach 5+ and 6+ (30% and 28%, respectively) were found most often. In this case, females prevailed - 70% (48 individuals), and males accounted for only 30% (20 individuals).

The analysis of roach growth indices in the cage location zone and at a distance of 200 m from them did not reveal significant differences in linear and weight indices in coeval roach groups. The mass of fish ranged from $72,45 \pm 11,5$ g (3+) to $259,98 \pm 13,44$ g (10+), body length according to Smith: from $19,1 \pm 0,4$ mm to $25,7 \pm 0,7$ mm, respectively (Table 1).

TABLE 1: Size and weight indicators of roach Lake Vokhtozero.

Age	3+	4+	5+	6+	7+	8+	9+	10+
Body mass, gr	$72,5 \pm 11,5$	$102,2 \pm 16,4$	$126,3 \pm 14,9$	$153,8 \pm 19,5$	$181,5 \pm 17,1$	$210,4 \pm 17,9$	$221,6 \pm 13,1$	$259,98 \pm 13,4$
Body length (AC), mm	$19,1 \pm 0,4$	$19,7 \pm 1,1$	$21,1 \pm 1,2$	$22,2 \pm 0,8$	$23,2 \pm 0,7$	$24,5 \pm 1,0$	$24,7 \pm 0,8$	$25,7 \pm 0,7$
Quantity of fish, pcs.	3	28	35	24	15	5	2	2

For parasitological studies, roach aged 4+ to 7+ was used; it was found both in the cage zone and at a distance from them. A total of 90 fish specimens were examined.

An analysis of roach infestation with parasites revealed representatives of 14 species belonging to five systematic groups: Myxosporea - 5 species, Trematoda - 5, Ciliophora - 2, Nematoda - 1 and Monogenea - 1. More than half of them (8 species) were found in fish caught, both at the cages and at a distance of 200 meters from them (Fig. 2).

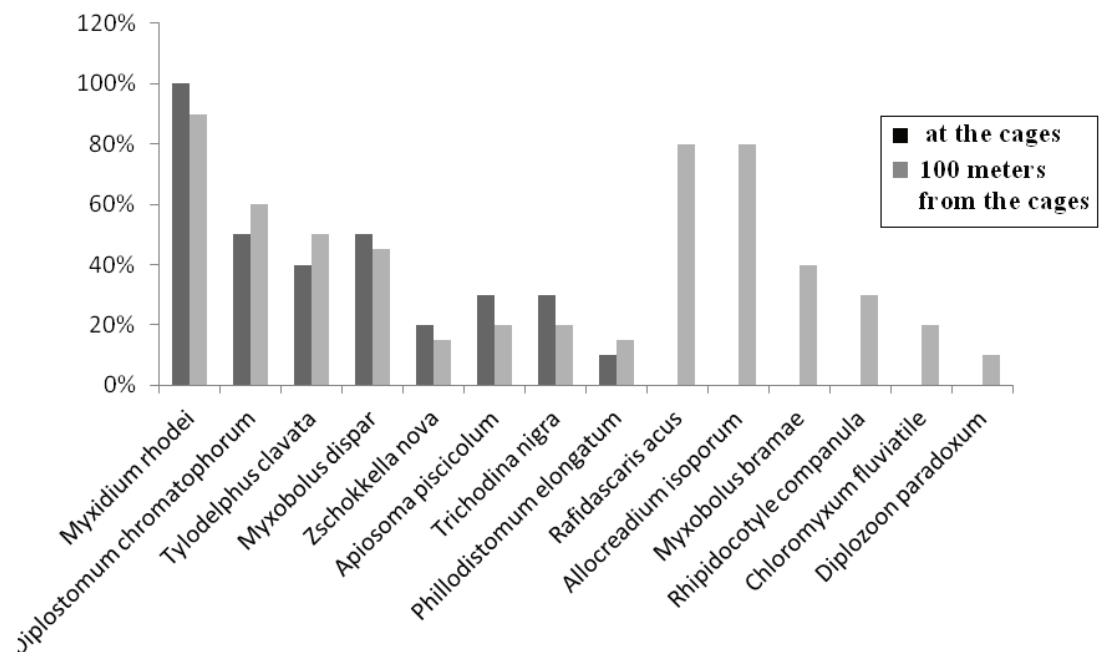


Figure 2: Roach infection rate (*Rutilus rutilus*), %.

The basis of the parasitofauna of the roach of Lake Vokhtozero in the area where the cage is located is mixosporidia and trematodes. In almost 100% of the fish studied, myxidium (*Myxidium rhodei*) was found in the kidneys, and myxobolus (*Myxobolus dispar*

or *Myxobolus bramaie*) in more than 50% of the gills. *Chloromyxum (Chloromyxum flyviatile)* was detected in the gall bladder, and a shockella (*Zschokkella nova*) in the bladder. Infection with the last one amounted to 20%.

As for trematodes, in more than half of the fish studied, diplostomum (*Diplostomum chromatophorum*) and tylodelphus (*Tylodelphys clavata*) were found in the eyes. Trematodes of the species *Phyllodistomum elongatum* (infection rate - 10%) were also present in the kidneys and liver of roach, and *Rhipidocotyle campanula* (infection rate 30%) in the muscles.

Of the intestinal parasitofauna, the most common were the trematodes of the species *Allocreidium isoporum* and the larval stages of the nematodes of the species *Raphidascaris acus*, found in more than 80% of fish caught at a distance of 200 m from the cages.

More than 30% of captured fish were found to have parasitic infusoria trichodina (*Trichodina nigra*) and apiosome (*Apiosoma piscicolum*) on the surface of the body. Of the monogenes in individual roach individuals, a diplozoon (*Diplozoon paradoxum*) was discovered - a gill parasite, which belongs to the largest representatives of this group.

4. Discussion

According to the results of studies, it should be noted that the parasitofauna of roach Lake Vokhtozero in the area of garden trout farming corresponds to a wide range of food for this fish species with a predominance of benthic herbivorous type in older individuals. This can explain the widespread occurrence of mixosporidia in roach, especially myxobolus, whose spores quickly (because they do not have devices for soaring in water) sink to the bottom or to aquatic vegetation.

Roach belongs to the native species of Lake Vokhtozero and in natural conditions, as a rule, it can be affected by a large number of individuals of various parasites, becoming infected immediately after hatching and throughout their life. In the natural environment, this is considered the norm, since parasites are members of the biocenosis and maintain homeostasis of its state, participating in the regulation of the number of various hosts [14].

It is also characteristic for roach that juveniles and adult fish are in direct contact with each other. Therefore, it does not have a sharp change in parasites, depending on the age of the fish. Our research fully confirms this. As the roach grows, along with "baby" parasites (*Trichodina nigra*, *Apiosoma picicolum*), parasites characteristics of adult fish (*Chloromyxom fluviatile*) appear.

Analysis of species diversity of Vokhtozero roach parasites allowed us to draw a conclusion about its relative deficiency compared to other Karelian reservoirs. For example, the parasitofauna of roach in Lake Tolvoyarvi is represented by 37 species among which the most widespread are *Myxidium rhodei* (100%), *Raphidascaris acus* (93%), *Allocreadium isoporum* (80%), *Chloromyxum fluviatile* (20%). In the Syamozero lake alone, roach mixosporidia are 9 species, and specific are *Allocreadium isoporum*, *Phyllodistomum elongatum*, *Diplostomum gavium*, *Diplostomum rutili* [15].

The above types of parasites were discovered by us in Lake Vokhtozero, but the degree of infection of roaches by them was less. From trematodes, we discovered ripidocotyle (*Rhipidocotyle campanula*). They are found in those lakes where there are mollusks, in particular toothless. Metacercariae of this parasite are localized on the gills (larval stage).

The most common intestinal parasite related to trematodes is the allocreadium trematode (*Allocreadium isoporum*), which appears in the roach after it passes to a more intensive feeding of bottom organisms - caddis flies, mayflies, oligochaetes.

It can be assumed that a certain role in this was played by trout farming and a partial transition of roach to feeding on artificial fish feeds. This is confirmed by research of Lesonen M.A., Shustov Yu. A. et al., who studied the nutritional characteristics of the Vokhtozero roach in 2011–2013. [16] and our data. An analysis of the intestinal contents of fish that we caught near cages showed the presence of trout feed in it, the volume of which reached 25% of the food lump.

In general, the species composition of the roach parasites of Lake Vokhtozero is relatively poor. We believe that this is due to living conditions. And they, both for roach and for its parasites and their owners, are less optimal. As for the picture of infection, it corresponds to a wide range of roach nutrition, but mainly to benthic herbivorous. The most diverse ones are parasites whose intermediate hosts are benthic organisms.

5. Conclusion

In the course of our research, the results were obtained, based on which we can draw the following conclusions:

1. The general parasitological situation of the reservoir during the study period did not cause concern.
2. It was revealed that the species composition of roach parasites corresponds to the spectrum of its nutrition.

3. It has been shown that the basis of parasitofauna is mixosporidia and trematodes. The most common types of parasites are *Myxobolus dispar*, *Myxobolus bramaie*, *Myxidium rhodei*, *Allocreidium isoporum*.

4. It has been established that roach is characterized by direct contact between young and adult fish; therefore, with age, it does not exhibit a sharp change in parasites, which is typical of most other freshwater fish species. This feature underlies the formation of parasitofauna of roach.

Funding

This work was supported and published as part of the implementation of the activities package of the Strategic Development Program of Petrozavodsk State University for 2019.

Acknowledgement

The authors are sincerely grateful to their colleagues - parasitologists and ichthyologists, with whom they had to work for several years. For assistance in organizing field work and providing material, we express our gratitude to the management of the cage fishery 000 «Raduzhnaya forel».

Conflict of Interest

The authors have no conflict of interest to declare.

References

- [1] Valeeva, D.I., Vozgorkova, E.O. (2019). Helminthiasis of fish: veterinary and medical significance of the problem. *Scientific Review. Pedagogical sciences*, No. 2-4, P. 7-10.
- [2] Mamontova, O.V. (2016). Features of the trout parasitofauna (*Salmo trutta morpha lacustris* L.) in the lakes of Karelia. *Scientific notes of Petrozavodsk State University*, No. 4 (157), P.72-75.
- [3] Golovina, N.A., Komarov, N.K., Kashkovskaya, V.P., Burdakova, N.V. (2014). Parasitofauna of roach (*Rutilus rutilus* L.) in reservoirs of the Moscow Region. *Agrarskii vestnik Urala*, No. 3 (121), pp. 67-69.

- [4] Litvinenko, A.V., Bogdanova, M.S., Karpechko, V.A., Litvinova, I.A., Filatov, N.N. (2011). Water resources of Karelia: the main problems of rational use and protection in *Proceedings of the Karelian Scientific Center of the Russian Academy of Sciences*, No. 4, P. 12-20.
- [5] Ilmast, N.V., Kuchko, T.Yu., Savosin, D.A., Zakharova, N.I., Alekseeva, E.V., Ustinova, D.V. (2015). Ways to increase the efficiency of trout cultivation at fish breeding enterprises of Karelia in *Collection of articles of the Russian scientific conference "Ecological basis of advanced technologies"*. Penza. P.52-56.
- [6] Kuchko, T.Yu., Ilmast, N.V. (2016). Cage trout farming in the Republic of Karelia (current situation and development prospects). *Fisheries and fishing industry: annual scientific and practical journal*, No. 9 (129), P. 8-13.
- [7] Kuznetsova, E.V. (2016). The influence of parasites of native fish on the epizootic state of cage farms in the European part of Russia. *Actual problems of veterinary biology*, No. 3 (31), P. 46-52.
- [8] Rumyantsev, E.A. (2008). On the issue of anthropogenic impact on the fauna of fish parasites in lakes. *Parasitology*, No. 42.4, P. 300 - 307.
- [9] *Catalog of Lakes of Karelia* (2001). Petrozavodsk: Karelian Scientific Center of the Russian Academy of Sciences.
- [10] Onishchenko, I.N., Ryzhkov, L.P., Onishchenko, N.A. (2013). Vohtozero - a reservoir of cage fish farming. *Scientific notes of Petrozavodsk State University*, No. 2 (131). P. 23-26.
- [11] Ryzhkov, L.P., Dkhubuk, I.M., Kuchko, T.Yu. (2013). *Ichthyologic studies in water bodies*. Petrozavodsk: PetrSU.
- [12] Ieshko, E.P., Korosov, A.V. (2012). Assessment of species abundance of fish parasitofauna: ecological approach. *Principles of Ecology*, No. 4, P. 28-40.
- [13] *Key to the fauna of freshwater parasites of fish in the reservoirs of the USSR. A series of identifiers for the fauna of the USSR*. (1962). M.L.: Ed. ZIN AN USSR, V. 80, 776 p.
- [14] Khovansky, I.E., Mlynar, E.V., Kavtaradze, T.M., Koshkin, M.A. (2014). Parasitological indicators of the ecological conditions of fish habitat. *Fundamental research*. No. 9-2, P. 345-348
- [15] Novokhatskaya, O.V., Ieshko, E.P. (2008). The fauna of mixosporidia of Syamozero fish in *Proceedings of Karelian Scientific Center of the Russian Academy of Sciences*. Issue 13, P. 75-79.

- [16] Lesonen, M.A., Shustov, Yu.A., Onishchenko, N.A., Mamontova, O.V. (2018). Peculiarities of feeding lake fish in trout cages (Republic of Karelia). *Scientific notes of Petrozavodsk State University*, No. 8 (177), P. 38 -42.