

## PARASITES OF THE RUFFE *GYMNOCEPHALUS CERNUUS* IN THE KAMA RESERVOIR IN RUSSIA

Olga LAZAREVA<sup>1</sup>, Tatiana SIVKOVA\*<sup>1</sup>, Igor MERZLYAKOV<sup>3</sup>, Lidiya  
MERZLYAKOVA<sup>2,3</sup>, Semyon KAZARINOV<sup>3</sup>, Pavel MIKHEEV<sup>2,3</sup>

<sup>1</sup>Perm State Agro-Technological University named after Academician D.N. Pryanishnikov,  
Russia

<sup>2</sup>Perm State National Research University, Russia

<sup>3</sup>Khabarovsk branch "VNIRO", Khabarovsk, Russia

\*Corresponding author: tatiana-sivkova@yandex.ru

### ABSTRACT

Ruffe (*Gymnocephalus cernuus*) is a fish harvested by recreational fisheries and does not have commercial significance in the Kama Reservoir and Votkinsk Reservoir (Perm Krai, Russia). Nevertheless, this species of fish is involved in food chains in ecosystem and plays role as a host of many species of parasites. Material for this study (n=103) was collected from October 2024 to March 2025 from three sites: opposite the village of Khokhlovka (58°13' N., 56°20' E), near Golovanovo microdistrict (58°09' N, 56°27' E) and at the Kama Hydroelectric Power Station (58°06' N, 56°20' E). Collection and laboratory processing of biological material were carried out according to standard ichthyological and parasitological methods. In total, 16 taxa of parasitic organisms were detected. One Protozoa is represented by Microsporidea, fifteen Metazoa from four classes: Acanthocephala - 1 (*Acanthocephalus lucii*), Nematoda – 2 (*Contracaecum microcephalum*, *Anisakis sp.*), Cestoda – 2 (*Triaenophorus nodulosus*, *Proteocephalus sp.*), Trematoda – 10 (*Bunodera luciopercae*, *Podocotyle atherinae*, *Phyllodistomum folium*, *Sphaerostomum bramae*, *Apophallus muehlingi*, *Ichthyocotylurus platycephalus*, *I. variegatus*, *I. pileatus*, *Paracoenogonimus ovatus*, *Tylodelphys clavata*). Most of the *G. cernuus* parasite fauna presents flukes at the stage of metacercaria. It is important that *P. ovatus*, *A. muehlingi*, and the larvae of anisakid nematodes pose a potential danger for humans and carnivores.

**Keywords:** *ruffe, parasites, prevalence of infection, danger for humans.*

### INTRODUCTION

The Kama River with its numerous tributaries is a branched network that is rich in fish resources. There are a large number of residential areas along the river banks. Amateur and industrial fishing is developed. Despite regular ichthyological studies, not all fish have been studied as hosts of parasites.

Ruffe (*Gymnocephalus cernuus*) is a popular fish harvested by recreational fishing and does not have commercial significance in the Kama Reservoir and Votkinsk Reservoir. According to ichthyological data, the commercial stock of ruffe in the reservoir is approximately 85 tons. It represents main feeding resource for sander (*Sander lucioperca*) (Kazarinov et al., 2023), also for other species of predator fish and birds (Mineeva, 2024).

In total, 211 different parasitic species are registered for ruffe, including 17 classes. Most of them are represented by trematodes and nematodes, and more than half of them infect the ruffe in larval stages (Zhokhov, 2010). Investigation of ruffe parasitofauna has a great importance due high risk of human and animal infection and also due to possibility of alien species of parasites introduction into the river basin (Mineeva, 2024).

Previously conducted studies concerning the description of ruffe parasites in our region were carried out in the period from 1974 to 1986. At that studies 12 species of parasites were described (Kostarev, 2003). More recently, in 2013-2014 other authors detected 5 parasitic species for ruffe including *Ichthyocotylurus platycephalus* Creplin, 1852, *Proteocephalus cernua* Gmelin, 1790, *Bunodera acerinae* Roitman and Sokolov, 1999, *Diplostomum spathaceum* (Rudolphi, 1819) Braun, 1893 and *Triaenophorus nodulosus* Pallas, 1781 (Mikheeva and Mikheev, 2014). It is obvious that diversity of parasitic species for ruffe at such large waterbody is not sufficiently studied and requires careful analysis. Our study aimed to describe the parasites of the ruffe at the three areas of Kama Reservoir and Votkinsk Reservoir located near city of the Perm in Russian Federation.

## MATERIAL AND METHODS

Material for analysis (n=103) was collected from October 2024 to March 2025 from three sites (Fig.1):

- 1) opposite the village of Khokhlovka (58°13' N., 56°20' E);
- 2) near Golovanovo microdistrict (58°09' N, 56°27' E);
- 3) at the Kama Hydroelectric Power Station (58°06' N, 56°20' E).

The fish was taken from the catches of amateur fishermen. Collection and investigation of biological material were carried out according to standard ichthyological and parasitological methods (Pravdin, 1966; Chugunova, 1959). Parasitological investigation was carried out at the laboratory of parasitology at the Perm State Agro-Technological University named after Academician D.N. Pryanishnikov according to standard procedure (Byhovskaya-Pavlovskaya, 1985) using manual (Bauer, 1987). Each fish was examined externally, weighed and measured. The body cavity and internal organs, including the intestines, swim bladder, liver, kidneys and gonads, were opened and examined. Muscle sections were examined under a microscope to detect parasite cysts. The slides were examined using a Meiji microscope (Japan), photographed with a Vision camera (Canada). Prevalence and intensity of parasite infection were analyzed: Prevalence of infection (P), average infection intensity (II) and abundance index (AI). Mathematical processing was performed in Microsoft Excel.

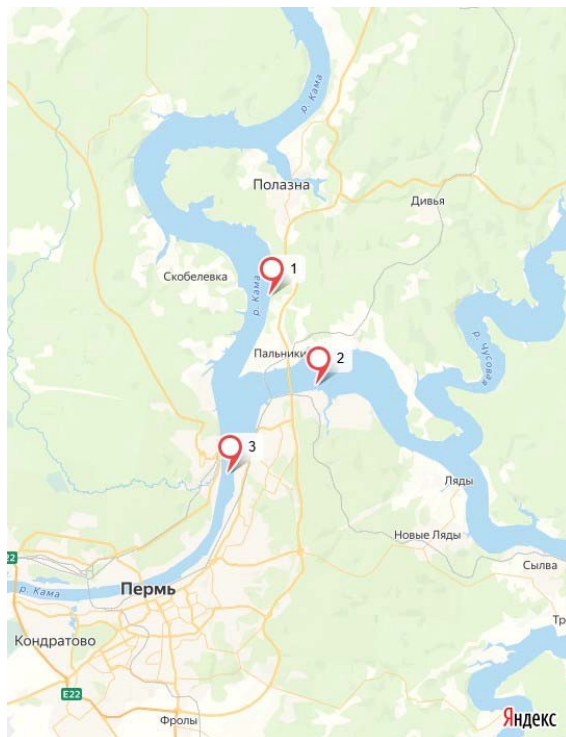


Fig.1. Map of sites of research

## RESULTS AND DISCUSSION

The results of measuring of ruff mass and length are represented in Table 1. Fish from first site had smallest size while ones from Golovanovo microdistrict had biggest size. Results of the measuring did not depend on the season.

Table 1. Results of ruff's measuring in the different sites of Kama Reservoir and Votkinsk Reservoir

Site	n	Mass, g	Body length, mm
1) opposite the village of Khokhlovka	33	7,78±4,83	73.85±15,33
2) near Golovanovo microdistrict	51	13,25±5,66	91,49±13,12
3) at the Kama Hydroelectric Power Station	19	9,70±3,41	76,84±5,08

In total, 16 taxa of parasitic organisms were detected: one of Protozoa represented by Microsporidea, eight - Metazoa related to two classes: Cestoda – 2 species and Trematoda – 10 ones. Obtained data about parasite fauna of analyzed fish from different sites are represented in the Table 2.

Table 2. Prevalence of infection (P), average infection intensity (II) and abundance index (AI) of ruffe in the different sites of Kama Reservoir and Votkinsk Reservoir

Class, species of parasites	Localization	P, %	II, examples	AI, examples
<b>1) opposite the village of Khokhlovka (58°13' N., 56°20' E), n = 33</b>				
<b>TREMATODA</b>				
<i>Ichthyocotylurus platycephalus metacercaria</i>	body cavity	45	22 (1-240)	9,9
<i>I. variegatus metacercaria</i>	swim bladder	12	26 (1-100)	3,2
<i>I. pileatus metacercaria</i>	gills	3	(2)	0,06
<i>Paracoenogonimus ovatus metacercaria</i>	mussels	33	4,5 (1-26)	1,5
<i>Tyloodelphys clavata metacercaria</i>	vitreous body of the eye	21	1-9 (1-4)	0,4
<b>CESTODA</b>				
<i>Triaenophorus nodulosus</i>	intestine	9	1	0,09
<i>Proteocephalus sp.</i>	intestine	12	1,25 (1-2)	0,15
<b>2) Golovanovo microdistrict (58°09' N, 56°27' E), n = 51</b>				
<b>MICROSPORIDEA</b>				
<i>Microsporidium sp.</i>	intestine	4	1	0,04
<b>TREMATODA</b>				
<i>Apophallus muehlingi metacercaria</i>	eyes	2	1	0,02
<i>Ichthyocotylurus platycephalus metacercaria</i>	body cavity, serous membranes, eyes	78	15 (1-31)	11,5
<i>I. variegatus metacercaria</i>	swim bladder	6	18 (10-29)	0,05
<i>I. pileatus metacercaria</i>	gills	2	(33)	0,65
<i>Paracoenogonimus ovatus metacercaria</i>	mussels	39	1,8 (1-8)	0,70
<i>Tyloodelphys clavata metacercaria</i>	vitreous body of the eye	4	1	0,04
<b>CESTODA</b>				
<i>Triaenophorus nodulosus</i>	intestine	4	1,5	0,06

<b>3) Kama Hydroelectric Power Station (58°06' N, 56°20' E), n = 19</b>				
<b>TREMATODA</b>				
<i>Bunodera luciopercae</i>	intestine	21	2,75 (1-8)	0,58
<i>Podocotyle atherinae</i>	intestine	11	4 (1-7)	0,42
<i>Phyllodistomum folium</i>	urine bladder	5	1	0,05
<i>Sphaerostomum bramae</i>	intestine	5	1	0,05
<i>Tylodelphys clavata metacercaria</i>	eyes	5	1	0,05
<i>Paracoenogonimus ovatus metacercaria</i>	mussels	37	3,4 (1-10)	0,93
<i>Ichthyocotylurus platycephalus metacercaria</i>	body cavity	16	14,6 (6-26)	2,3
<i>I. variegatus metacercaria</i>	body cavity	68	18 (1-134)	12,3
<b>CESTODA</b>				
<i>Proteocephalus sp.</i>	intestine	32	1,2 (1-2)	0,4
<b>NEMATODA</b>				
<i>Contraeaecum microcephalum larva</i>	body cavity	11	1 (1)	0,1
<i>Anisakis sp. larva</i>	body cavity	5	4 (4)	0,2
<b>ACANTHOCEPHALA</b>				
<i>Acanthocephalus lucii</i>	intestine	5	1	0,05

Thus, among the identified parasitic organisms, the majority are broadly specific and are recorded not only in the the ruffe.

Trematodes compose a most large group of helminthes in all sites of investigation as a prevalence of infection reached 67%. Our results confirm high level of its distribution among total areal of ruffe including Saratov water reservoir (Zhokhov, 2010; Mineeva, 2016). Majority of trematodes species are find in the metacercaria stage because *G. cernuus* plays role of intermediate host in great list of parasites in fish, birds and mammals which serve as a definitive host. For example, fish-eating birds are definitive hosts for *Ichthyocotylurus spp.* and *Tylodelphys clavata*. For *P. ovatus* and *A. muehlingi* both birds and mammals are described in the same role (Mineeva, 2016). It is important that mentioned helminthes are dangerous also for human after consumption of undercooking fish (Mineeva, 2016).

The most significant prevalence was registered for *I. platycephalus* (Fig 2): 45% in the first site and 78% in the second site, while this indicator was only 16% at the Kama Hydroelectric Power Station where other *I. variegatus* reached value of 68%, although it had been less at other sites. It is possible that not equal distribution among

the genus *Ichthyocotylurus* depends on presence of definitive hosts – different fish-eating birds and on a hydrological specificity.

One of the most interesting findings is definition of alien species - *A. muehlingi* with low prevalence at the level of only 2%. Earlier we described *A. muehlingi* in *Clupeonella cultriventris* from Kama Reservoir (Lazareva, 2024). Mentioned trematode has been expanding its areal recently.

Only specimens of ruffe from Kama Hydroelectric Power Station were infected by adult stages of flukes (*B. luciopercae*, *P. atherinae*, *Sphaerostomum bramae* and *Phyllodistomum folium*) which compose common parasite fauna of family *Percidae*. Concerning Cestoda, we detected widespread among prey fish *T. nodulosus* and no identified *Proteocephalus* sp. (Fig.3) with highest prevalence at 12% (Pravdin, 1966; Bauer, 1987; Zhokhov, 2010).

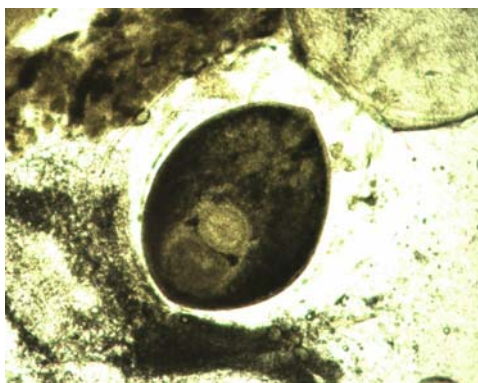


Fig.2. *I. platycephalus* metacercaria. X400



Fig.3. Immature *Proteocephalus* sp. X40

Finding of *A. lucii* only in the site 3 confirms a specificity of environment conditions in water area around Kama Hydroelectric Power Station and shows importance of the hydropower dams as a barrier for distribution of fish parasites.

At the first time *Microsporidium* infection in ruffe from described sites was established. Xenomas were found in the wall of small intestine of 4% of fish from site 2. Unfortunately, the quantity of biological material did not allow DNA to be isolated for differentiation. At the same time, there are two species *Loma acerinae* and *Pleistophora acerina* in the specific parasite fauna of ruffe (Zhokhov, 2010). According to morphological traits (Lom J., 2002) we suppose presence of *L. acerinae* in this case.

In comparison, only five parasitic species at the period from 2013 to 2014 were found including two of Cestoda (*T. nodulosus* and *P. cernua*) and three of Trematoda (*I. platycephalus*, *Bunoderia acerinae*, *Diplostomum spathaceum*) (Mikhieva and Mikhiev, 2014). Infection of *D. spathaceum* was very rare that's probably why we didn't find it in the ruffe or other fish species.

## CONCLUSIONS

In the study of the ruffe from the Kama Reservoir and Votkinsk Reservoir, 16 taxa of parasites were found, one Protozoa and fifteen Metazoa belonging to 3 classes. Most of the parasite fauna of *G. cernuus* were trematodes, all at the larval stage. The parasites found are mainly specific to many fish. In general, an increase in the species composition of the parasitic fauna of the ruffe is noted. Among all parasites, at the minimum *P.ovatus*, *A. muehlingi*, *C.microcephalum* and *Anisakis sp. larva* are potentially dangerous for human.

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