

03.02.04 – ЗООЛОГИЯ**03.02.04 – ZOOLOGY**

УДК 595.122:597.551.2(470.325)

DOI 10.18413/2658-3453-2019-1-1-16-22

**FAUNA OF METACERCARIAES (TREMATODES) IN CYPRINID FISH
OF THE SEVERSKY DONETS RIVER AND ITS TRIBUTARIES****МЕТАЦЕРКАРИИ ТРЕМАТОД КАРПОВЫХ РЫБ Р. СЕВЕРСКИЙ ДОНЕЦ
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Abstract

In Cyprinid Fish from the Seversky Donets river and its tributaries – Vezelka river, Razumnaya river and Nezhegol' river today there are 16 species of metacercariaes (Trematodes) from 7 families, among which there are species that are potentially epizootic (*Aphallus muehlingi* and *Posthodiplostomum cuticola* and species from the genus *Diplostomum* and *Ichthyocotylurus*) and epidemiologically (*Pseudamphistomum truncatum*, *Metagonimus yokogawai* and *Paracoenogonimus ovatus*) dangerous.

Аннотация

У карповых рыб из р. Северский Донец и его притоков – рр. Везелка, Разумная и Нежеголь на сегодняшний день отмечено 16 видов метацеркарий трематод из 7-ми семейств, среди которых имеются виды, являющиеся потенциально опасными эпизоотологически (представители рр. *Diplostomum*, *Ichthyocotylurus*, а также *Aphallus muehlingi* и *Posthodiplostomum cuticola*) и эпидемиологически (*Pseudamphistomum truncatum*, *Metagonimus yokogawai* и *Paracoenogonimus ovatus*). Промежуточными хозяевами большей части отмеченных трематод являются широко распространенные двустворчатые и брюхоногие моллюски из рр. *Anodonta* и *Unio*, *Lymnaea*, *Lithoglyphus*, *Bithynia*, *Planorbis*, *Viviparus*, *Valvata* и *Physa*. Представители всех перечисленных родов отмечены в Белгородской области, в том числе и специфичные для отдельных видов трематод промежуточные хозяева. Для таких опасных в эпидемиологическом плане видов, как *Metagonimus yokogawai* и *Pseudamphistomum truncatum* в исследуемом регионе следует провести целенаправленные исследования по установлению промежуточных хозяев. Дополнительными хозяевами, то есть хозяевами собственно метацеркарий, для всех отмеченных видов являются многие карповые рыбы, а зачастую и рыбы других семейств. Поэтому отмеченные виды метацеркарий будут, скорее всего, в том или ином количестве встречаться у других видов рыб, которые еще не были охвачены исследованиями в регионе. *Aphallus muehlingi* и *Posthodiplostomum cuticola* являются возбудителями «черно-пятнистой болезни» карповых и могут вызывать гибель молоди рыб, а представители диплостомид и ихтиокотилурид могут провоцировать развитие очагов трематодозов. Среди 16-ти отмеченных видов метацеркарий только один вид трематод поражает во взрослом состоянии рыб – это *Rhipidocotyle campanula*. Остальные же виды являются преимущественно паразитами птиц таких как цапли, чайки, поганки, кваквы, выпи и вороны, которые являются обычными для территории области.

Keywords: Cyprinid fish, Cyprinidae, parasite fauna, metacercariae, trematodes, Trematoda, Belgorod province, Seversky Donets river.

Ключевые слова: карповые рыбы, Cyprinidae, паразитофауна, метациркарии, трематоды, Trematoda, Белгородская область, Северский Донец

Introduction

Fishes belong to family Cyprinidae are hosts of many metacercariae species of trematodes. There are autogenous species that parasite in predatory fishes on marita's stage and allogenuous species that use birds and mammals as definitive hosts. Among these species of trematodes, there are a lot of economically significant for the fishing industry as well as potential causative agents of dangerous disease of human and animals used by them. In addition, parasites are integral components of biocenoses and perform regulate functions in it, that's why knowledge about their species composition and abundance allow monitor changes in the ecosystems in within the frameworks of ecological monitoring. Such data can be used to prognose epidemiological, epizootic situation or to assessment of the impact of anthropopression and prophylactic actions planning. But faunal lists of particular regions are the base for all measures we have named.

There is Belgorodskoye reservoir on the Seversky Donets River within the boundaries of Belgorod, parasitofauna of fishes of it was studied by the staff of the Dmitrov Fishery Technological Institute and the All-Russian Research Institute of Freshwater Fisheries (settlement Rybnoye, Moscow region) for several years (2010–2017). Results of their studies were published by N.A. Golovina with her co-authors [Golovina et al, 2017; Golovina et al, 2018]. There are 12 species of trematodes on metacercariae stage in those articles. It's worth noting that the fish for these studies was caught by fishing nets and it's age exceeded 3 (and even 4) years. Therefore data about invasion among fish juveniles was not published in these articles, authors pay attention. Furthermore, parasitological situation may vary for the Belgorodskoye reservoir and for minor rivers even though those situate near the reservoir. This may be due to peculiar existence conditions, for example, the presence of different intermediate hosts species of molluscs or different definitive hosts species, they are birds and mammals. Also, the state of coasts and coastal vegetation are important. Therefore, the aim of the present study was to investigate and analyze the parasitofauna of fishes from river net in the Belgorod region. In this article we present first results.

Materials and methods

The sampling of fishes took place at all four sites:

1. Seversky Donets River, the north edge of Belgorod (50°37'56.80"N, 36°38'29.00"E) – fishing float rod, 2018, June: bleak – *Abramis alburnus* (Linnaeus, 1758) (15 individuals, age 1+–3+);

2. Vezelka River, the center of Belgorod (50°35'28.00"N, 36°34'51.20"E) – fishing float rod, 2017, May, June, September: redfin – *Scardinius erythrophthalmus* (Linnaeus, 1758) (14 individuals, age 1+–3+), roach – *Rutilus rutilus* (Linnaeus, 1758) (1 individual, age 2+), bleak (17 individuals, age 1+–2+);

3. Razumnaya River, Razumnoe village, Belgorod district (50°32'2.45"N, 36°39'50.00"E) – fishing nets and fishing float rod, 2017, May: redfin (8 individuals), roach (29), bleak (3), bream – *Abramis brama* Linnaeus, 1758 (6), silver bream – *Blicca bjoerkna* (Linnaeus, 1758) (15), tench – *Tinca tinca* Linnaeus, 1758 (8), crucian carp – *Carassius carassius* (Linnaeus, 1758) (4) – the age of all fishes – 3+ and more;

4. Nezhgol River, Shebekino district, between the villages Arkhangelskoe and Titovka, near the confluence of the Seversky Donets River (50°38'52.90"N, 36°38'41.80"E) – fishing float rod, 2018, June: sunbleak – *Leucaspius delineatus* Heckel, 1843 (3 individuals, age 2+), bleak (4 individuals, age 1+–2+).

All caught fish besides fishes from Razumnaya River were investigated according to method of complete parasitological autopsy of fish was applied [Bykhovskaya-Pavlovskaya, 1969]. From cysts that have been found metacercariae were extract for doing temporary

preparations and studying them under the microscope Motic BA300 (40–400×). This microscope fitted with a digital camera and has software for taking measurements for identification of species.

Identification of fishes was carried out according to "The keys of vertebrate animals of the fauna of the USSR" [Kuznetsov, 1974], age of them was set "on scales" [Pravdin, 1966], identification of trematodes metacercariae was carried out according to special keys with species descriptions [Oprelitel' parazitov ..., 1987; Sudarikov et al., 2002].

Resulting from study metacercariae belonging to at least 15 species were found, of which 14 were identified.

Results and discussion

As a result of combining the data published by N.A. Golovina et al. [2017, 2018] and data from our own research, a list of species of trematodes metacercariae that are a parasite in carp fish (Cyprinidae) from Seversky Donets River (with Belgorodskoye reservoir) and its inflows – Vezelka, Razumnaya and Nezhegol Rivers today includes at least 16 species from 7 families. Hereinafter annotated listing with helminths species, hosts in which they were found and their localizations in the host's body and data about intermediate, supplementary, definitive hosts from literature sources [Oprelitel' parazitov ..., 1987; Sudarikov et al., 2002] are placement. Acronyms and Abbreviations: SD – Seversky Donets River, V – Vezelka River, R – Razumnaya River, N – Nezhegol River, "*" – species was noted in Belgorodskoye reservoir by Golovina et al. [2017, 2018].

Bucephalidae Poche, 1907

Rhipidocotyle campanula (Dujardin, 1845)

Metacercariae in cysts and without them were found on the body surface, in fins, gills, muscles of bleak, roach, redfin and sunbleak from SD, V and N. This species are invasion more often for fish juveniles, and the number of cysts can reach several dozen in one individual. Intermediate hosts are species of *Anodonta* and *Unio* genus, 7 of them were noted in the Belgorod region, among them *Unio pictorum* (Linnaeus, 1758), *Anodonta stagnalis* (Gmelin, 1791) and *A. cygnea* (Linnaeus, 1758) mollusks [here and further by: Mandrygina, Snegin, 2005] are widespread species. Supplementary hosts are many species of Cyprinidae and Percidae, the latter are also the definitive hosts of this species of trematodes, like some other predatory fish.

Diplostomidae Poirier, 1886

**Diplostomum* sp.

Unidentified for various reasons species of the genus *Diplostomum* Nordmann, 1832 were found in the lens of the eyes of bleak, redfin, roach, tench and silver bream from V, R and N. Number of metacercariae in the eyes of explored fishes goes up with age of host. Intermediate hosts are mollusks of *Lymnaea* genus, they are usual water bodies inhabitants in the Belgorod region. Supplementary hosts are species of Cyprinidae and Percidae; definitive hosts are piscivorous birds (Laridae).

**Diplostomum chromatophorum* (Brown, 1931) Shigin, 1986

It was found in bleak from V and R. Intermediate hosts are *Lymnaea stagnalis* (Linnaeus, 1758), *L. ovata* (Draparnaud, 1805), *L. palustris* (Mueller, 1774) mollusks, they were registered in the Belgorod region. *L. stagnalis* is one of the usual widespread species from water bodies in the region. Supplementary hosts are species of Cyprinidae, Percidae and other fishes; definitive hosts are piscivorous birds (Laridae).

Diplostomum commutatum (Diesing, 1850) Dubois, 1937

Its metacercariae were found in bleak from SD. N.A. Golovina and her co-authors registered **D. rutili* Razmashkin, 1969 in the Belgorodskoye reservoir, it similar to *D. commutatum*. Probably, its intermediate hosts are *L. ovata* and *L. fontinalis* (Studer, 1820) as at *D. rutili*, that mollusks were registered in the Belgorod region. Supplementary hosts are species of Cyprinidae and Percidae; definitive hosts are piscivorous birds (Laridae).

Diplostomum helveticum (Dubois, 1929) Shigin, 1977

It was found in bleak from SD. Among its intermediate hosts only *L. ovata* was found on the territory of the Belgorod region. Supplementary hosts are species of Cyprinidae and Percidae; definitive hosts are piscivorous birds (Laridae).

**Tylodelphys clavata* (Nordmann, 1832) Diesing, 1850

It was found in the vitreous of the eye in a large individual of roach, redfin and tench from V and R. Metacercariae weren't found in fish juveniles (younger than 4 years old). The intermediate host – *L. ovata*. Supplementary hosts are species of Cyprinidae, Percidae and other fishes; definitive hosts are piscivorous birds (Podicipedidae).

Heterophyidae (Leiper, 1909) Odhner, 1914

Apophallus muehlingi (Jagerskiold, 1899) Luhe, 1909 (fig. A)

This parasite was found in skin, fins, gills and muscles of bleak and sunbleak from SD and N. Among its possible intermediate hosts *Lithoglyphus naticoides* (C. Pfeiffer, 1828) was found on the territory of Belgorod region. Supplementary hosts are species of Cyprinidae; definitive hosts are piscivorous birds (Laridae), carnivorous mammals (cats, dogs). *Apophallus muehlingi* metacercariae are dangerous pathogen for fish juveniles of Cyprinidae, this species intense invasion can cause their death.

Metagonimus yokogawai (Katsurada, 1912) Katsurada, 1913 (see fig., C)

Were found bean-shaped and rounded cysts on the body surface and in scales of bleak from SD. It is difficult to say, what mollusks species can be intermediate hosts on the territory of Belgorod region, because among species that were listed in literary sources no one was registered in the Belgorod region. However, mollusk *Parafossarulus manchouricus* (Bourguignat, 1860) from Bithyniidae in some articles [Solov'yeva et al., 2015] are noted as its intermediate host. We can assume that representatives of *Bithynia* genus can participate in life-cycles of *Metagonimus yokogawai* in the Belgorod region. Of course, this hypothesis requires verification. Supplementary hosts are species of Cyprinidae; definitive hosts are herring gull, cormorants, night heron, carnivorous mammals and human. *Metagonimus yokogawai* is potentially dangerous species for human that's why more careful study of its biology must be continued in the region.

Opisthorchiidae Braun, 1901

Methorchis xanthosomus (Creplin, 1846) Braun, 1902 (see fig., D)

Thick-walled cysts of this metacercariae were found in gills and muscles of redfin, bleak and sunbleak from SD, V and N. The intermediate host is *Bithynia tentaculata* (Linnaeus, 1758). Supplementary hosts are Cyprinidae; definitive hosts are piscivorous birds (Laridae, Corvidae).

**Pseudamphistomum truncatum* (Rudolphi, 1819) Luhe, 1908 (see fig., B)

Its metacercariae have thin-walled large cysts that were found in gills and muscles of redfin, bleak, roach and tench from Seversky Donets, Veselka and Nezhegol. Intermediate hosts are mollusks of *Bithynia* genus (?); supplementary hosts are species of Cyprinidae; definitive hosts are predatory mammals and human. This species is the causative agent of pseudamphistomiasis and morphologically similar to *Opisthorchis felineus* (Rivolta, 1884) Blanchard, 1895, that is pathogenic for humans too. At this moment *Opisthorchis felineus* is not registered in SD and its inflows but there is some information about found of *Opisthorchis* in Oskol River [Buryak, Malysheva, 2009].

Posthodiplostomidae Sudarikov, 1997

**Posthodiplostomum brevicaudatum* (Nordmann, 1832) Wisniewski, 1958

It was found in the vitreous of the eye of a large individual of roach from R. The intermediate host is *Planorbis planorbis* (Linnaeus, 1758) that is frequently encountered species in the water bodies in the Belgorod region. Supplementary hosts are species of Cyprinidae, Percidae and other fishes; definitive hosts are bitterns.

**Posthodiplostomum cuticola* (Nordmann, 1832) Dubois, 1936

Metacercariae of this species have cysts that are located under specific black spots on the skin of fish. It was found in muscles of redfin, roach, bleak and tench from SD, V and R. In the region the intermediate host is *P. planorbis*; supplement hosts are species of Cyprinidae and

Percidae; definitive hosts are herons (Ardeidae). This species of metacercariae causes "black-spot disease", mainly of carp fish.

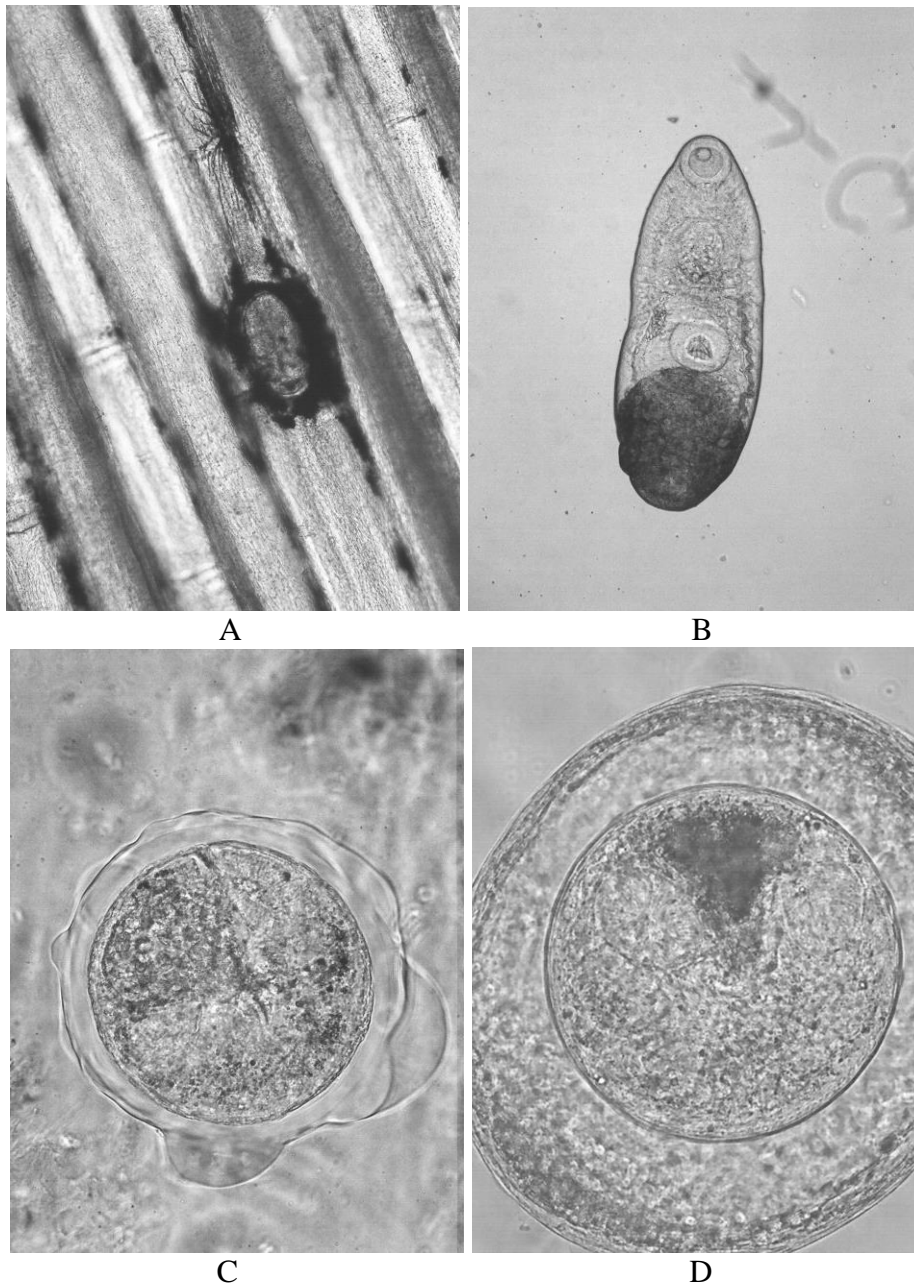


Fig. Metacercariae from *Abramis alburnus* from Seversky Donets river:

A – *Apophallus muehlingi* in the fin (increase 10×); B – *Pseudamphistomum truncatum* (extracted from the cyst) from the muscles (increase 10×); C – *Metagonimus yokogawai* from the scales (increase 40×); D – *Methorchis xanthosomus* from the muscles (increase 40×)

Рис. Метациркаррии из уклейки из р. Северский Донец:

A – *Apophallus muehlingi* в лучах плавника (увеличение 10×); B – *Pseudamphistomum truncatum* (извлеченный из цисты) из мышц (увеличение 10×); C – *Metagonimus yokogawai* из чешуи (увеличение 40×); D – *Methorchis xanthosomus* из мышц (увеличение 40×)

Prohemistomidae (Lutz, 1935) Sudarikov, 1961

**Paracoenogonimus ovatus* Katsurada, 1914

It was found in the muscles and hepar of roach, tench and sunbleak from R and N. Intermediate hosts of this species are *Viviparus viviparus* (Linnaeus, 1758) mollusks;

supplementary hosts are species of Cyprinidae and Percidae; definitive hosts are piscivorous birds, sometimes mammals. This species is likely to be pathogenic for humans.

Strigeidae Railliet, 1919

**Ichthyocotylurus platycephalus* (Creplin, 1825) Odening, 1969

It was found in the heart of bleak, roach and crucian carp from SD and R. The intermediate host is *Valvata piscinalis* (O.F. Müller, 1774); supplementary hosts are species of Cyprinidae and Percidae; definitive hosts are piscivorous birds (Laridae, Podicipidae and others).

The next three species were register only in the Belgorodskoye reservoir.

**Ichthyocotylurus variegatus* (Creplin, 1825) Odening, 1969

The intermediate host is *V. piscinalis*; supplementary hosts are species of Cyprinidae and Percidae; definitive hosts are piscivorous birds (Laridae).

**Ichthyocotylurus erraticus* (Rudolphi, 1809) Odening, 1969

The intermediate host is unknown in the Belgorod region, but perhaps it is mollusks of *Physa* genus. Supplementary hosts are species of Coregonidae and rarely – Cyprinidae; definitive hosts are piscivorous birds (Laridae, Gaviidae).

**Ichthyocotylurus pileatus* (Rudolphi, 1802) Odening, 1969

The intermediate host is unknown; supplementary hosts are species of Cyprinidae and Percidae; definitive hosts are piscivorous birds (Laridae).

Conclusion

As can be seen, intermediate hosts of most of the marked trematodes are widespread bivalves and gastropods, representatives of the genera *Anodonta* and *Unio*, and *Lymnaea*, *Lithoglyphus*, *Bithynia*, *Planorbis*, *Viviparus*, *Valvata* and *Physa*. Representatives of all named genera, including specific intermediate hosts of specific species of trematodes were found in the Belgorod region. For *Metagonimus yokogawai* and *Pseudamphistomum truncatum*, which are dangerous species for the epidemiological situation, in the researched region need to be further purposeful studies to establish intermediate hosts.

Supplementary hosts, in which metacercariae develop, for all the found species of trematodes are many species of carp fish, and often fishes from other families. Therefore, the registered species of metacercariae will most likely be found in one quantity or another in other fish species that have not yet been covered by research in the Belgorod region.

Apophallus muehlingi and *Posthodiplostomum cuticola* are the causative agents of "black-spot disease" of Cyprinid fishes and can be the cause of fish juveniles death. Representatives of Diplostomidae and Ichthyocotyluriidae can provoke the development of focal of trematodosis.

Among registered the 16 metacercariacea species only one species of trematodes is autogenous parasite in water bodies – *Rhipidocotyle campanula*. Its marita parasites in gut of predatory fishes. 15 others are allogenuous species, its mainly parasites of birds, for example, herons, night herons, terns, grebes, bitterns and crows that are usual species on the territory of the Belgorod region [Zhivotnyy mir ..., 2012]. Among trematodes that were identified there are some potentially dangerous for mammals including human – first of all, *Pseudamphistomum truncatum*, and also *Metagonimus yokogawai* and *Paracoenogonimus ovatus*.

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Поступила в редакцию 01.02.2019 г.