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Ecological analysis of the fish trematode fauna of the Lower Kura

Y.V. Shakaralіyeva

In 2007-2022, in three sections of the lower reaches of the Kura River, 933 cyclostomes and fish belonging to 38 species were subjected to complete parasitological dissections, and 40 species of trematodes were discovered. Of these, 25 species complete their development in fish, and 15 species in fish-eating birds. 24 species parasitize in the fish intestines, 5 species in the lenses of fish eyes, and 1-2 species of trematodes are localized in other organs. Most of the discovered species of trematodes are freshwater forms; typically marine are only 4 species, which were found in marine fish that come here from the Caspian Sea. The examined fish belong to five trophic groups: ichthyophages, benthophages, planktophages, phytophages and detritiphages. In the ichthyophages were dominated by trematodes, which complete their development in fish. Apparently, these parasites enter the body of ichthyophages for the most part by eating fish infected by them. In the remaining trophic groups, the fauna of trematodes was significantly dominated by species parasitizing fish at the metacercaria stage. In the lower section of the Lower Kura, 37 species were found, of which 12 complete their development in fish-eating birds. This comparative richness of trematode fauna of lower section is due to the fact that it contains many more species of fish than other sites; the current speed is much lower and this promotes the development of mollusks - the first intermediate hosts of trematodes; there are a large number of fish-eating birds - the definitive hosts of many species of fish trematodes; the current carries here infected intermediate hosts and trematode cercariae from more upper sections; only here marine fish species were examined and marine trematodes were discovered; only here the lamprey was studied and one of its characteristic trematodes was faund. In the fish of the middle section, 26 species of trematodes were noted, of which 13 species complete development in fish-eating birds. Here the fauna of fish trematodes is somewhat poorer than in the lower section, but here there are more species of trematodes whose cercariae actively penetrate fish. This is due to the fact that not far from the point of collecting the material, Lake Sarysu is located, where a large number of fish-eating birds live. In fish living in the upper section, 22 species of trematodes were found, of which 10 species complete their development in fish-eating birds. Among all the noted trematodes, 7 species are pathogens of fish diseases and 1 species is dangerous to human.

Keywords: *the Kura River, fish, parazites, trematodes, fish-eating birds, mollusks*

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Introduction

The Kura is the largest river in the Caucasus, its length is 1515 km, and its area is 188 thousand km^2. It originates in Turkey, and flowing through this country, Georgia and Azerbaijan, flows into the Caspian Sea (Azerbaijan Republic. National atlas, 2014). This river is of very important fishery importance as a habitat for valuable commercial fish and a breeding ground for anadromous fish living in the Caspian Sea. The middle and lower reaches of this river, separated by a cascade of reservoirs, are located within the Azerbaijan. The Lower Kura is significantly larger than the Upper and Middle Kura in size and fisheries importance (Physical geography of the Republic of Azerbaijan, 2016). About 40 species of fish live here, many of which are of commercial importance. During the spawning period, migratory fish come here from the Caspian Sea. The study of parasites, including trematodes, of fish of the Lower Kura, and their distribution along the river is of great theoretical and practical importance. Meanwhile, before our research, the trematode fauna of the fish living here was completely insufficiently studied. There was only fragmentary information about them (Mikailov, 1963), which is now significantly outdated. The purpose of this article is an ecological analysis of trematode fauna of fish along the Lower Kura.

Materials and methods

During 2007-2022 in various parts of the Lower Kura for detection of trematodes using the method of a complete helminthological dissection (Bykhovskaya-Pavlovskaya, 1985; Pronina & Pronin, 2007; Ataev & Zubairova, 2015; Dorovskikh G.N. & Stepanov, 2019) we examined 933 cyclostomes and fish belonging to 13 families, 34 genera and 38 species for detection of their infection with trematodes (table 1). Of these fish, mosquitofish was introduced into the water bodies of Azerbaijan in the 1930s to combat the larvae of the malaria mosquito (Dengina, 1946), and stone moroko got there with the introduced Chinese herbivorous fish (Mustafayev & Ibrahimov, 2012; Ibrahimov & Mustafayev, 2015).

Table 1. Number of cyclostomes and fish examined in the Lower Kura

Names of fish	upper part	middle part	lower part
Family Petromyzontidae			
Caspian lamprey – *Caspiomyzon wagneri* (Kessler, 1870)	-	-	15
Family Acipenseridae			
Beluga – *Huso huso* (Linnaeus, 1759)	-	-	1
Family Salmonidae			
Caspian salmon – *Salmo caspius* Kessler, 1870	-	-	2
Family Esocidae			
Northern pike – *Esox lucius* Linnaeus, 1758	14	13	18
Family Cyprinidae			
Caspian roach – *Rutilus caspicus* (Jakovlev, 1870)	16	15	19
Kutum – *R. kutum* (Kamensky, 1901)	-	-	17
Caucasian chub – *Squalius agdamicus* (Kamensky, 1901)	16	15	-
Rudd – *Scardinius erythrophthalmus* (Linnaeus, 1758)			21
Caspian asp – *Aspius aspius taeniatus* (Eichwald, 1831)	7	6	13
Stone moroko – *Pseudorasbora parva* (Temminck et Schlegel, 1846)	-	-	15
Tench – *Tinca tinca* (Linnaeus, 1758)	5	7	12
South Caucasian gudgeon – *Romanogobio macropterus* (Kamensky, 1901)	-	9	10
Kura khramulya – *Capoeta capoeta* (Güldenstaedt, 1773)	10	-	-
Bulatmai barbel – *Barbus capito* (Güldenstaedt, 1773)	14	12	-
Kura barbel – *B. cyri* (Filippi, 1865)	12	-	-
Caspian barbel – *Luciobarbus caspius* (Berg, 1914)	-	-	7
Kura shemaya – *Alburnus chalcoides* (Güldenstaedt, 1772)	14	11	18
Kura bleak – *A. filippi* Kessler, 1877	8	12	16
Schneider – *Alburnoides eichwaldi* (Filippi, 1863)	12	16	15
White bream – *Blicca bjoerkna transcaucasica* Berg, 1916		17	12
Oriental bream – *Abramis brama orientalis* Berg, 1949	19	14	16
Caspian zahrte – *Vimba vimba persa* (Pallas, 1774)	-	-	11
European bitterling – *Rhodeus amarus* (Bloch, 1782)	10	12	11
Prussian carp – *Carassius gibelio* Bloch, 1782	18	14	16
European carp – *Cyprinus carpio* Linnaeus, 1758	15	19	23
Family Balitoridae			
Kura loach – *Oxynoemacheilus brandti* (Kessler, 1877)	8	7	15
Family Cobitidae			
Khvalin loach – *Cobitis amphilekta* Vasil'eva et Vasil'ev, 2012	4	6	14
Golden spined loach – Sabanejewa *aurata* (Filippi, 1865)	5	11	18
Family Siluridae			
Catfish – *Silurus glanis* Linnaeus, 1758	3	2	10
Family Poeciliidae			
Mosquitofish – *Gambusia affinis* (Baird et Girard, 1853)	-	-	18
Family Mugilidae			

ISSN 2075-5457 (print), ISSN 2220-9697 (online)

Names of fish	upper part	middle part	lower part
Golden grey mullet – *Chelon auratus* (Risso, 1810)	-	-	10
Family Atherinidae			
Caspian sandsmelt – *Atherina caspia* Eichwald, 1831	-	-	11
Family Percidae			
Zander – *Sander lucioperca* (Linnaeus, 1758)	16	10	12
Perch – *Perca fluviatilis* Linnaeus, 1758	-	8	13
Family GOBİİDAE			
Round goby – *Neogobius melanostomus* (Pallas, 1814)	-	4	7
Monkey goby – *N. pallasi* (Berg, 1949)	4	3	10
Bighead goby – *Ponticola gorlap* (Iljin, 1949)	6	5	9
Tubenose goby – *Proterorhinus marmoratus* (Pallas, 1814)	3	3	8

Among the studied fish, the most numerous are representatives of the carp family, which represented by 22 species. Of all the discovered species, Caspian pipe fish, golden gray mullet, and Caspian sandsmelt are marine and for this reason were found only in the lower part of the water area we studied. Caspian lamprey, beluga, Caspian salmon, and kutum are obligately anadromous forms and enter the Kura River only during the spawning period. Caspian roach, Caspian asp, Caspian barbel, Kura shemaya, oriental bream, Caspian zahrte, European carp and zander have both anadromous and local river populations. Round goby, monkey goby, bighead goby and tubenose goby being highly euryhaline, have both marine and riverine populations. Of all the species, Caspian lamprey, beluga, pike, Caspian roach, kutum, Caucasian mullet, rudd, Caspian asp, tench, Kura khramulya, bulatmai barbel, Kura shemaya, oriental bream, Caspian zahrte, Prussian carp, European carp, catfish, golden gray mullet, zander and perch are commercial fish and are caught by the fisheries available here. When determining the species of fish, appropriate keys were used (Abdurakhmanov, 1962; Boqutskaya & Naseka, 2004; Boqutskaya et al., 2013; Mustafayev, 2023).

All detected trematodes were fixed in a standard manner in 70° ethyl alcohol and delivered to the laboratory for further office processing. Here, the collected worms were stained with aluminous or acetic acid carmine, passed through aqueous solutions of ethanol with increasing concentrations from 70% to 100%, make transparent in clove oil, mounted in Canada balsam on a slide and covered with a coverslip. The permanent preparations obtained in this way are stored at the Department of Medical Biology and Genetics of the Azerbaijan Medical University. Identification of trematode species was carried out using the corresponding monographs (Bykhovskaya-Pavlovskaya & Kulakova, 1987; Qayevskaya et al., 1975). A schematic map of the study area and the location of material collection points given in the fig. 1.

Results and discussion

In fish living in various parts of the Lower Kura, we noted 40 species of trematodes belonging to 17 families and 24 genera. Of these, 25 species complete their development in the body of fish, and 15 species in the body of piscivorous birds. Below is a taxonomic overview of all trematode species we discovered, indicating hosts and localization, as well as the extent (%) and intensity (specimens) of trematode infestation.

Trematodes that completing their development in the body of fish

Family Bucephalidae Poche, 1907

Bucephalus polymorphus Baer, 1827 – adult worms in intestines of pike (44.4%), zander (75.0%), perch (30.7%); metacercariae in the tissues of intestines, fins, gills of rudd (19.1%), tench (16.7%), shemaya (16.3%), bleak (5.6%), bitterling (33.3%), Prussian carp (6.3%), European carp (14.1%), Kura loach (13 .3%); intensity of infestation 8-39 specimens in pike, zander and perch, 1-14 in other fish.

Rhipidocotyle companula (Dujardin, 1845) – adult worms in the intestines of pike (66.7%) and zander (34.2%); metacercariae in the tissues of fins and gills of rudd (19.1%), tench (8.3%), gudgeon (10. 5%), white bream (6.9%), Prussian carp (12.5%), European carp (17.5%), Kura loach (16.7%), khvalin loach (8.3%), round goby (9.1%); intensity of infestation 4-46 specimens in pike and zander, 1-14 in other fish.

Rh.kovalae Ivanov, 1967 – in intestines of beluga (in the only one researched specimen); intensity of infestation 2 specimens.

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Figure 1. Map of study area and locations of material collection points (▲)

Family Sanguinicolidae Graff, 1907

Sanguinicola volgensis (Razin, 1929) – in blood of zahrte (9.1%); intensity of infestation 3 specimens.

Family Halipegidae Poche, 1925

Bunocotyle cingulata Odhner, 1928 – in stomach, intestines of salmon (in one of the 2 studied specimens), pike (11.1%), zander (15.7%), bighead goby (5.0%); intensity of infestation 2-14 specimens.

Family Haploporidae Nicoll, 1914

Saccocoelium obesum Looss, 1902 – in intestines of mullet (20.0%); intensity of infestation 2-14 specimens.

S. tensum Looss, 1902 – in intestines of mullet (30.0%); intensity of infestation 2-12 specimens.

Dicrogaster contracta Looss, 1902 – in intestines of mullet (10.0%); intensity of infestation 5-16 specimens.

Family Monorchidae Odhner, 1911

Asymphylodora demeli Markowsky, 1935 – in intestines of pike (17.7%), asp (23.1%), Caucasian chub (6,5%), rudd (9,5%), bleak (25.0%), white bream (20.7%), zahrte (18.2%), bitterling (30.5%), Prussian carp (18.8%), European carp (12.3%), perch (19.1%), round goby (9.1%), bighead goby (25.0%); intensity of infestation 2-21 specimens.

A. imitans (Müling, 1898) – in intestines of oriental bream (10.2%); intensity of infestation 3-17 specimens.

A. kubanica (Issaitschikoff, 1923) – in intestines of roach (48.0%), kutum (58.8%), asp (46.2%), Caspian barbel (28.6%), shemaya (9.3%), zahrte (45.5%), catfish (26.7), bighead goby (10.0%); intensity of infestation 4-46 specimens.

A. tincae (Modeer, 1790) – in intestines of pike (35.5%), asp (42.6%), tench (91.7%), catfish (13.3%), zander (18.4%), perch (19.1%), bighead goby (15.0%); intensity of infestation 23-218 specimens in tench, which is the specific host of this parasite, and 6-17 in other fish.

Parasymphylodora parasquamosa Kulakova, 1972 in intestines of oriental bream (6.2%); intensity of infestation 2 specimens.

Family Bunoderidae Nicoll, 1914

Bunodera luciopercae (Mueller, 1776) – in intestines of catfish (13.3%), zander (26.3%), perch (19.1%); intensity of infestation 1-14 specimens.

Family Gorgoderidae Looss, 1899

Phyllodistomum elongatum Nybelin, 1926 – in intestines of gudgeon (21.5%); intensity of infestation 1-2 specimens.

ISSN 2075-5457 (print), ISSN 2220-9697 (online)

Family Acanthocolpidae Lühe, 1909

Skrjabinopsolus semiarmatus (Molin, 1858) in intestines of beluga (in the only one researched specimen); intensity of infestation 5 specimens.

Family Azygiidae Odhner, 1911

Azygia lucii (Mueller, 1776) – in intestines of pike (37.7%), catfish (6.7%), zander (15.7%); intensity of infestation 3-17 specimens.

Family Orientocreadiidae Skrjabin et Kowal, 1960

Orientocreadium siluri (Bychowsky et Dubinina, 1954) – in intestines of catfish (33.3%); intensity of infestation 2-12 specimens.

Family Allocreadiidae Looss, 1902

Allocreadium baueri Spassky et Roitman, 1960 – in intestines of bulatmai barbel (11.5%), khvalin loach (8.3%), golden spined loach (14.7%), perch (13.3%); intensity of infestation 1-14 specimens.

A. dogieli Kowal, 1950 – in intestines of asp (7.7%), khramulya (20.0%), oriental bream (12.4%), bighead goby (10.0%); intensity of infestation 1-4 specimens.

A. isoporum (Looss, 1894) – in intestines of pike (22,2%), Caucasian chub (12.9%), khramulya (10.0%), bulatmai barbel (3.9%), Kura barbel (16.7%), shemaya (18.6%); intensity of infestation 3-15 specimens.

A. transversale (Rudolphi, 1802) – in intestines of tench (16.7%), Prussian carp (12.5%), European carp (14.1%); intensity of infestation 3-21 specimens.

Family Opecoelidae Ozaki, 1925;

Sphaerostomum bramae Mueller, 1776 – in intestines of Caucasian chub (16.1%), Kura barbel (8.3%), bleak (12.5%); intensity of infestation 3-19 specimens.

S. globioporum (Rudolphi, 1802) – in intestines of asp (7.7%); интенсивность инвазии 2-11 specimens.

Family Fellodistomatidae Nicoll, 1913

Pronoprymna ventricosa (Rudolphi, 1819) – in intestines of mullet (10.0%), sandsmelt (36.4%); intensity of infestation 1-3 specimens.

Trematodes that complete their development in the body of fish-eating birds

Family Diplostomatidae Poirier, 1886

Diplostomum chromatophorum (Brown, 1931) (fig. 2a) – in eye lenses of pike (24.4%), roach (20,0%), kutum (5.9%), rudd (42.9%), khramulya (30.0%), Kura barbel (20.0%), shemaya (13.9%), bleak (16.7%), schneider (18.6%), zahrte (27.3%), bitterling (22.2%), European carp (22.8%), Kura loach (3.3%), Khvalin loach (20.1%), golden spined loach (20.6%), catfish (20.0%), mosquitofish (5.6%), mullet (20.0%), sandsmelt (27.3%), zander (5.7%), perch (47.6%), round goby (18.2%), bighead goby (25.0%), monkey goby (27.3%); intensity of infestation 1-98 specimens.

D. gobiorum Shigin, 1965 (fig. 2b) – in eye lenses of round goby (18.2%), bighead goby (25.0%), monkey goby (18.2%), tubenose goby (12.5%); intensity of infestation 1-12 specimens.

D. mergi Dubois, 1932 (fig. 2c) – in eye lenses of khramulya (10.0%), schneider (9.3%), Prussian carp (25.0%), European carp (5.3%), golden spined loach (11.8%), mosquitofish (11.1%), bighead goby (15.0%); intensity of infestation 3-14 specimens.

D. paracaudum Iles, 1959 (fig. 2d) – in eye lenses of roach (26.0%), Caucasian chub (16.1%), rudd (33.3%), Kura barbel (16.7%), zahrte (9.1%), bitterling (25.0%), Khvalin loach (16.7%), mullet (10.0%), perch (23.8%); intensity of infestation 2-63 specimens.

*D. petromyz*onifluviatilis Diesing 1860 (fig. 2e) – in brain of lamprey (13.3%); intensity of infestation 1-4 specimens.

D. spathaceum (Rudolphi, 1819) (fig. 2f) – in eye lenses of pike (15.5%), rudd (19.1%), stone moroko (13.3%), Caucasian chub (13.3%), tench (25.0%), gudgeon (26.3%), bulatmai barbel (23.1%), white bream (24.1%), oriental bream (25.0%), Prussian carp (18.8%), European Carp (21.1%); intensity of infestation 3-74 specimens.

Tylodelphys clavata (Nordmann, 1832) – in eye vitreous body of pike (26.6%), kutum (5.9%), rudd (9.5%), bleak (25.0%), oriental bream (12.4%), zahrte (18.2%), Prussian carp (12.5%), zander (15.7%), bighead goby (20.0%); intensity of infestation 1-26 specimens.

T. podicipina Kozicka et Niewiadomska, 1960 – in eye vitreous body of gudgeon (31.6), perch (28.6%), bighead goby (10.0%); intensity of infestation 1-7 specimens.

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Hysteromorpha triloba (Rudolphi, 1819) – in muscles, skin of roach (24.0%), rudd (38.1%), khramulya (10.0%), Prussian carp (31.3%), European carp (14.1%); intensity of infestation 3-23 specimens.

Posthodiplostomum cuticola (Nordmann, 1832) – in skin, muscles of roach (36.0%), rudd (33.3%), asp (15.4%), shemaya (6.9%), white bream (13.8%), oriental bream (24.5%), bitterling (19.4%), Prussian carp (18.8%), European carp (10.5%), Kura loach (20.0%), perch (38.1%); intensity of infestation 2-36 specimens.

P. brevicaudatum (Nordmann, 1832) – in eyes, brain of Caucasian chub (3.3%), khramulya (20.0%), schneider (6.9%), white bream (6.9%), oriental bream (2.1%), bitterling (9.1%), Khvalin loach (4.2%); intensity of infestation 2-9 specimens.

Family Strigeidae Railliet, 1919

Ichthyocotylurus pileatus (Rudolphi, 1802) – in swim bladder of Caucasian chub (6.5%), bulatmai barbel (7.7%); intensity of infestation 1-4 specimens.

Family Clinostomatidae Lühe, 1901

Clinostomum complanatum (Rudolphi, 1819 – in muscles, skin of pike (28.9%), rudd (28,6%), tench (33.3%), khramulya (30.0%), shemaya (20.6%), bleak (16.7%), oriental bream (16.3%), zahrte (9.1%), European carp (21.5%), Kura loach (26.7%), Khvalin loach (12.5%), golden spined loach (22.2%), zander (23.7%), monkey goby (27.3%); intensity of infestation 1-29 specimens.

Family Heterophyidae Odhner, 1914

Ascocotyle coleostoma Looss, 1896 – in gills, internal organs of mullet (10.0%), sandsmelt (18.2%), round goby (18.2%), monkey goby (7.4%); intensity of infestation 2-14 specimens.

Pygidiopsis genata Looss, 1907 – in gills, muscles of sandsmelt (18.2%); intensity of infestation 1-4 specimens.

For the 23 species we discovered, fish are only definitive hosts; however 2 species (*Bucephalus polymorphus* and *Rhipidocotyle companula*) although at the metacercaria stage parasitize in the tissues of various fish, but reach sexual maturity in the intestines of predatory fish; 15 species of trematodes (representatives of the families Diplostomatidae, Strigeidae, Clinostomatidae and Heterophyidae) parasitize fish only at the metacercariae stage; their final hosts are piscivorous birds.

24 species parasitize in the digestive tract of fish, of which 2 species live in the intestines of predatory fish, but at the metacercaria stage they are localized in the tissues of fins and gills of any other fish, 5 species are parasites of the lens of the eyes, 2 species are parasites of the vitreous body of the eyes, 2 species are parasites of tissues of fins and gills, 1 species – blood, 1 species – brain, 1 species – eyes and brain, 1 species – swim bladder, 1 species – skin and muscles, 1 species – tissues of gills and internal organs, 1 species – tissues of gills and muscles.

The following number of trematode species was found in different fish species: northern pike – 11 species, rudd, European carp and bighead goby– 10 species each, Prussian Prussian carp, Perch and zander – 9 species each, oriental bream – 8 species, tench, Caspian chub, Kura khramulya and Caspian zahrte – 7 species each, Caspian asp, Kura shemaya, Kura bleak, European bitterling, Khvalin loach and catfish – 6 species each, Caspian roach, white bream, Kura loach and round goby – 5 species each, South Caucasian gudgeon, bulatmai barbel, Kura barbel, golden spined loach and monkey goby – 4 species each, schneider – 3 species, mosquitofish – 2 species, stone moroko, Caspian barbel and tubenose goby – 1 species each.

Most fish trematodes of the Lower Kura are freshwater forms; only *Saccocoelium obesum, S. tensum, Dicrogaster contracta* and *Pronoprymna ventricosa* are typically marine, which are found in marine fish, such as golden gray mullet and Caspian sandsmelt, which enter the delta and lower sections of the river. At the same time, freshwater trematodes *Diplostomum chromatophorum, D. paracaudum, Ascocotyle coleostoma* and *Pygidiopsis genata* were also found in these fish, which they could have become infected with after entering the Kura.

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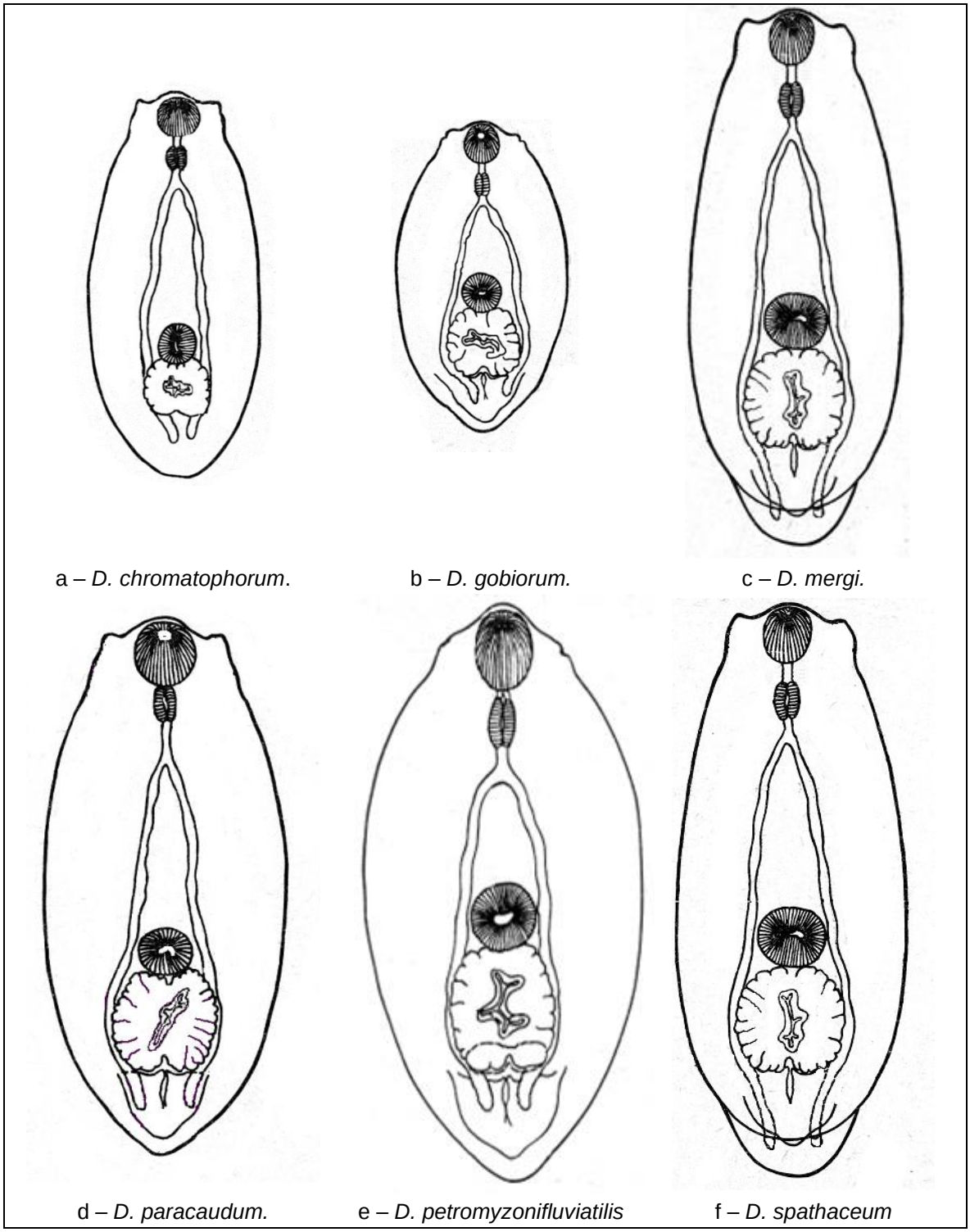

Figure 2. Metacercariae of trematodes of the genus *Diplostomum*.

The examined fish belong to five trophic groups: 1) ichthyophages – beluga, Caspian salmon, northern pike, Caspian asp, wels catfish, zander, perch, and bighead goby; 2) benthophages – Caspian roach, kutum, Caspian chub, stone moroko, South Caucasian gudgeon, bulatmai barbel, Kura barbel,

ISSN 2075-5457 (print), ISSN 2220-9697 (online)

Caspian barbel, white bream, oriental bream, Caspian zahrte, European bitterling, Prussian carp, European carp, Kura loach, Khvalin loach, golden spinned loach, round goby, monkey goby, and tubenose goby; 3) planktophages – Kura shemaya, Kura bleak, mosquitofish, and Caspian sandsmelt; 4) phytophages – rudd; 5) detritophages – golden gray mullet and Kura khramulya. Of course, the boundaries between these groups are not clearly defined, since the same fish can feed, for example, on both benthocatfish and detritus, but each fish has prevailing food items, and this allows it to be included in one of these groups. The diet of Caspian lamprey has not been studied, so it is impossible to include it in any trophic group. The infestation of fish with trematodes depends to one degree or another on their diet. If a fish feeds on benthic invertebrates, among which there are second intermediate hosts of trematodes, then adult specimens (marites) of trematodes are observed in it, and it is also infected with metacercariae of trematodes, since the first intermediate hosts of these parasites, mollusks, mostly live at the bottom or in thickets of vegetation. If a fish feeds on plants, it is attacked by trematode cercariae, which emerge from mollusks that live on plants. Ichthyophagous fish are characterized by the accumulation in their dige stive tract of trematodes of the fish on which they feed. Table 3 provides data on the number of trematodes at different stages of development observed in fish of different trophic groups. The table does not include marine fish (golden

Table 2. Number of trematode species in the marita and metacercaria stages found in fish of different trophic groups (without marine fish - golden grey mullet and Caspian sandsmelt and obligate anadromous fish - beluga, Caspian salmon, kutum and Caspian barbel)

Trophic groups	Names of fish	Stages of development of trematodes		
		Marita	Metacercariae	Together
Ichthyophages	Northern pike	7	4	11
	Caspian asp	5	1	6
	Catfish	5	1	6
	Zander	6	3	9
	Perch	5	4	9
	Bighead goby	5	5	10
Caspian Benthophages	Caspian roach	1	4	5
	Caspian chub	3	4	7
	Stone moroko			1
	Tench	3	4	7
	South Caucasian gudgeon	2	2	4
	Bulatmai barbel	2	2	4
	Kura barbel	2	2	4
	Schneider		3	3
	White bream	2	3	5
	Oriental bream	3	5	8
	Caspian zahrte	3	4	7
	European bitterling	2	4	6
	Prussian carp	4	5	9
	European carp	4	6	10
	Kura loach		3	5
	Khvalin loach	2	4	6
	Golden spined loach	1	3	4
	Round goby	2	3	5
	Monkey goby		4	4
	Tubenose goby		1	1
Planktophages	Kura shemaya	3	3	6
	Kura bleak	3	3	6
	Mosquitofish		2	2
Phytophages	Rudd	3	7	10
Detritophages	Kura khramulya	2	5	7

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grey mullet and Caspian sandsmelt) and obligate anadromous fish (beluga, Caspian salmon, kutum and Caspian barbel), since they do not stay long in the Lower Kura.From the data given in the table it can be seen that in different species of fish belonging to the group of ichthyophages, from 6 to 11 species of trematodes were noted. Despite the fact that ichthyophages feed on invertebrate intermediate hosts of trematodes much less frequently than representatives of other trophic groups of fish, they have from 5 to 7 species of trematodes that complete their development in fish. Typically, these parasites enter the fish's body when they eat intermediate hosts. However, they apparently get into ichthyophages also when they eat fish infected with these trematodes. In the remaining trophic groups, the trematode fauna was significantly dominated by species that parasitize fish at the metacercaria stage. The number of species in the fauna of benthophagous trematodes varied greatly from 1 to 10 species, which is associated with the large number of benthophages and the diversity of their ecology. It is noteworthy that among benthophages, carp and crucian carp are infected with a relatively large number of trematode species. These are relatively large fish that eat a lot of invertebrates, including the second intermediate hosts of trematodes. In addition, living near the bottom and in thickets of aquatic plants, they are spatially close to mollusks – the first intermediate hosts of trematodes and are more susceptible to attack by cercariae. Planktophages shemaya and bleak had 13 species that completed their development in fish and 13 species that completed their development in fish-eating birds. The only phytophage, rudd, was infected with 10 species of trematodes. Moreover, of the trematodes found in it, only one species reaches sexual maturity in the body of a fish; the remaining species parasitize in the body of fish at the metacercaria stage. This certainly is the result of the fact that, being a phytophage, this fish lives in thickets of aquatic vegetation and is attacked by trematode cercariae. The only fish species classified as fresh water detritophages, khramulya, lives at the bottom of the river and it is also in spatial proximity to mollusks, the first intermediate hosts of trematodes. For this reason, of the 7 species of trematodes found in it, 5 species parasitize fish at the metacercaria stage.

Table 3 shows data on the distribution of the parasites we discovered in three sections of the Lower Kura. As one would expect, fish living in different sections were infected different numbers of trematodes.

As can be seen from the data given in the table, in the lower section of the river the fish was infected with most of trematode species, which indicated for the Lower Kura. 37 species were found here, of which 12 complete their development in fish-eating birds. There are several reasons for this relative abundance of species: first, there are many more fish species in the lower section than in the middle and upper sections; secondly, the lower section is more wider and as result the rate of current here is much lower, and this contributes to the development of limnophilic hydrofauna, including mollusks, which are first intermediate hosts of trematode; thirdly, in this section of the river live a large number of fish-eating birds, which are the final hosts of many trematode species that parazite fish; fourthly, the river current to carry here from upper and middle sections infected intermediate hosts and trematode cercariae, and they infect fish; fifthly, only in this section were studies carried out on such marine fish species as mullet and sandsmelt, in which marine trematodes *Saccocoelium obesum, S. tensum, Dicrogaster contracta* and *Pronoprymna ventricosa* were found, which were not recorded in other fish species; sixthly, only in this section the lamprey was studied, and only in it, the specific trematode *Diplostomum petromyzonifluviatilis* was discovered. In fish studied in the middle section of the Lower Kura, 26 species of trematodes were noted, of which 13 species complete their development in fish. Here the fauna of fish trematodes is somewhat poorer than in the lower section, but the species of trematodes which cercariae actively penetrate the fish are not less. This is due to the fact that not far from the site where the material was collected, Lake Sarysu is located, where a large number of fish-eating birds live, which are the definitive hosts of many fish trematodes. In fish studied in the upper section, 22 species of trematodes were found, of which only 12 complete their development in fish. For only 10 species of trematodes were found in this section birds are the definitive hosts. Such a character of distribution, expressed in a gradual reduction in the number of species from the mouth of the river to its sources, was noted in the Caucasus in relation to fish (Abdurakhmanov, 1962; Kuljanishvili, Epitashvili, Freyhof et al. 2020; Kuljanishvili, Mumladze, Japoshvili et al., 2021) and their parasites (Mikailov and Ibragimov, 1980; Kurashvili, Mikailov, Gogebashvili, 1980; Shakaraliyeva, 2022).

It should be noted that of the trematodes we found, 7 species (*Diplostomum chromatophorum, D. gobiorum, D. mergi, D. paracaudum, D. petromyzonifluviatilis, D. spathaceum, and Posthodiplostomum cuticola*) are known from the practice of ichthyopathology as pathogens of fish diseases (Golovina et al.,

Table 3. Fauna of trematodes of fish in various sections of the Lower Kura

Names of trematodes	Upper section	Middle section	Lower section
Bucephalus polymorphus	+	+	+
Rhipidocotyle companula	+	+	+
Rh.kovalae Ivanov	-	-	+
Sanguinicola volgensis	-	-	+
Bunocotyle cingulata	-	-	+
Saccocoelium obesum	-	-	+
S. tensum	-	-	+
Dicrogaster contracta	-	-	+
Asymphylodora demeli	-	+	+
A. imitans	+	+	+
A. kubanica	-	-	+
A. tincae	+	+	+
Parasymphylodora parasquamosa	-	+	+
Bunodera luciopercae	+	+	+
Phyllodistomum elongatum	-	-	+
Skrjabinopsolus semiarmatus	-	-	+
Azygia lucii	+	+	+
Orientocreadium siluri	+	+	+
Allocreadium baueri	+	-	+
A. dogieli	-	+	+
A. isoporum	+	+	+
A. transversale	+	+	+
Sphaerostomum bramae	+	+	+
S. globioporum	+	-	+
Pronoprymna ventricosa	-	-	+
Diplostomum chromatophorum	+	+	+
D. gobiorum	-	+	+
D. mergi	+	+	+
D. paracaudum	+	+	-
D. petromyzonifluviatilis	-	-	+
D. spathaceum	+	+	+
Tylodelphys clavata	+	+	+
T. podicipina	+	+	-
Hysteromorpha triloba	+	+	+
Posthodiplostomum cuticola)	+	+	+
P. brevicaudatum	+	+	-
Ichthyocotylurus pileatus	-	+	+
Clinostomum complanatum	+	+	+
Ascocotyle coleostoma	-	-	+
Pygidiopsis genata	-	+	+
40 species	22 species	26 species	37 species

2003; Skudnaya, 2021; Mikulich, 2022). In addition, cases of parasitism of the trematode Clinostomum complanatum in the human body have been reported in the literature (Yamashita, 1938; Park et al., 2009; Hara et al., 2014; Song et al., 2018; Kim et al., 2023). This fact should be taken into account by medical and veterinary organizations when carrying out any activities related to the Lower Kura.

Conclusion

As a result of a parasitological study of 933 cyclostomes and fish belonging to 38 speciesin the lower reaches of the Kura River, 40 species of trematodes were found. Of these, 25 species complete their

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development in fish, and 15 species in fish-eating birds. 24 species parasitize in the intestines of fish, 5 species in the lenses of eyes, and 1-2 species of trematodes are localized in other organs. Most of the discovered species of trematodes are freshwater forms; typically marine are only 4 species that were found in marine fish that migrated here from the Caspian Sea. The ichthyophages dominated by trematodes that complete their development in fish, while the remaining trophic groups of fish dominated by species that parasitize fish at the metacercaria stage. In the lower section of the Lower Kura, 37 species, in the middle section – 26 species, in the upper section - 22 species of fish trematodes. A decrease in the number of fish species and their parasites as one moves up the river is typical not only for the Kura, but also for the water bodies of the Caucasus in general. Among all the noted trematodes, 7 species are causative agents of fish diseases and 1 species is dangerous to humans.

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Екологічний аналіз фауни трематод риб Нижньої Кури

Є.В. Шакаралієва

У 2007-2022 роках у трьох ділянках нижньої течії річки Кура повним паразитологічним розтинам піддано 933 круглоротих та риб, що належать до 38 видів, виявлено 40 видів трематод. З них 25 видів завершують свій розвиток у рибах, а 15 видів – у рибоїдних птахах. 24 види паразитує в кишечнику, 5 видів у кришталиках очей риб, в інших органах локалізуються 1-2 види трематод. Більшість виявлених видів трематод – прісноводні форми, типово морські – лише 4 види, виявлені у морських риб, що заходять сюди з Каспійського моря. Обстежені риби належать до п'яти трофічних груп: іхтіофаги, бентофаги, планктофаги, фітофаги та детритофаги. У іхтіофагів переважали трематоди, що закінчують свій розвиток у рибі. Очевидно, в організм іхтіофагів ці паразити потрапляють під час поїдання заражених ними риб. В інших трофічних груп у фауні трематод значно переважали види, що паразитують у риб на стадії метацеркарію. У нижній ділянці Нижньої Кури знайдено 37 видів, з яких 12 завершують свій розвиток у рибоїдних птахах. Це порівняльне багатство фауни трематод пов'язане з тим, що тут мешкає набагато більше видів риб, ніж інших ділянках; швидкість течії тут набагато нижча і це сприяє розвитку молюсків – перших проміжних господарів трематод; тут велика кількість рибоядних птахів - остаточних господарів багатьох видів трематод риб; течія зносить сюди заражених проміжних господарів і церкарій трематод з інших ділянок; тільки тут обстежено морські види риб та виявлено морські трематоди; тільки тут досліджено мінога та виявлено один її специфічний вид трематод. У риб середньої ділянки відмічено 27 видів трематод, з яких 13 видів завершують розвиток у рибоїдних птахах. Тут фауна трематод риб дещо бідніша, ніж у нижній ділянці, проте видів трематод, церкарії яких активно проникають у риб, тут більше. Це пов'язано з тим, що недалеко від пункту збору матеріалу, розташоване озеро Сарису, де мешкає велика кількість рибоїдних птахів. У риб, що мешкають у верхній ділянці, було виявлено 22 види трематод, з яких 10 видів завершують свій розвиток у рибоїдних птахах. Серед всіх виявлених трематод 7 видів є збудниками захворювань риб, а один вид небезпечний для людини.

Ключові слова: *р. Кура, риби, паразити, трематоди, рибоїдні птахи, молюски*

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