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Ophthalmohelminthiasis in the Water Basins of Armenia

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ABSTRACT

Ophthalmohelminthiasis are rather widespread in the natural and artificial water basins of Armenia.

Totally 126 fish of 7 species have been researched. Fish was taken from the pond farms of the Ararat, Armavir, Kotayk and Aragatsotn regions, as well as from the rivers and ponds of the Ararat valley, the river Hrazdan and Lake Sevan.

During the investigations 4 species of pathogens have been detected: *Diplostomum spathaceum*, *D. rutili, D. mergi*, and *Tylodelphys clavata*. The metacercariae of the pathogen of *Diplostomum spathaceum* have been detected in the fish of relatively well-maintained basins, while those of *D. rutili* have been detected in the fish of waterbasins contaminated with sewage waters.

Introduction

In recent decades, an exponential growth in pisciculture has been observed in Armenia. The demand for fish and fish products in the republic surpasses the current production volumes, therefore, along with existing natural basins, new artificial ponds are being operated. Currently, an objective has been set up in our republic to breed not only popular but also new fish species. Fish farming is surely considered to be the most profitable branch of agriculture; anyhow, very often various diseases become an obstacle for the development of fish breeding sector and cause considerable damage to the overall economy. Due to the diseases, the growth and development of fish is suppressed, the reproductive function in the producing organizations is declined, while the quality of manufactured fish product doesn't meet the appropriate requirements and the percentage of fish mortality grows up (Venetikyan, 2005).

The study of parasitological situation in separate ponds of the region is not only of fundamental but also of practical significance. The knowledge in the species composition of individual fish parasites, their prevalence and quantity can be used in faunology, meteorology, and ecological parasitology.

The study on individual species of parasites living in a specific pond is rather significant for the estimation of economic damage related to fish mortality, as well as for maintaining health of population, fish-eating birds and mammals. For the mentioned categories fish are considered to be definitive, intermediate/transport, and reserve hosts of a number of parasites.

Trematodes or flatworms (Platyhelminthes: Trematoda) are singled out among the important components of fish parasitic fauna, whose larval and sexually mature forms can infect almost all the organs and tissues of all the systematic groups of fish. Trematodes can cause not only serious pathological changes in fish but also affect their marketable appearance making them unfit for human consumption: the qualitative indicators of fish carcass decline, the moisture content grows up by 3 to 5 %, while the protein and fat contents fall down by 7 to 10 % (Venetikyan, 2005). Larvae of some trematodes are also hatching in the fish eye causing blindness. The disease caused by the trematodes of the fish eye is called ophthalmohelminthiasis (Sevastyanova, 2017).

Ophthalmohelminthiasis is a widespread disease, which is caused by the metacercariae (larvae) of digenetic suckers belonging to family Diplostomidae. Metacercariae are located in the eye lens and sometimes in vitreous body causing lens opacity, while in case of severe infection it entails to blindness (Ministry of Agriculture of the Russian Federation, 1998).

The disease is found both in natural water basins, as well as in artificial ponds and reservoirs. The sexually mature forms of these trematodes parasitize in the intestines of fish-eating birds, and have not zoonotic/public health importance, whilst the infective larvae affect fish growth and development, which in its turn entails to considerable economic losses.

Diplopstomiasis is a widespread parasitic disease, the causative agents of which are found in more than 125 species of Minnows and Carps (Cyprinidae, Acipenserids/ sturgeon, and other fish species). The disease in fish is caused by the metacercariae of trematodes of genus *Diplostomum*. The parasites hatch in the fish eye, more often in eye lens and vitreous bodies (Shigin, 1986).

The body of metacercariae is oval with up to 0.55 mm length. At the anterior end of the parasite the mouth sucker is situated followed by pharynx and esophagus. The esophagus is divided into 2 blind-ending tubes extended up to the posterior end of the body. At the midventral part the ventral sucker is placed sequenced by Brandes' organ (Shigin, 1986).

The development cycle of the pathogen is rather complicated (Figure 1).

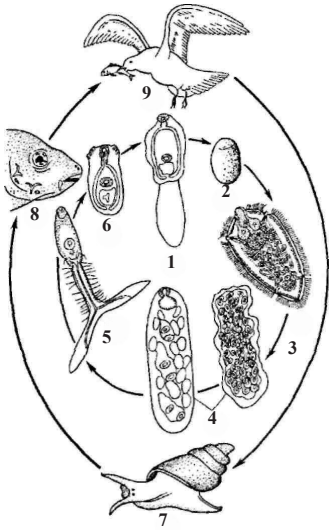

Figure 1. The developmental cycle of diplostomides: *1-Adult trematode, 2-egg, 3-miracidium, 4-sporocysts and rediae, 5-cercariae, 6-metacercariae, 7-intermediate host, 8-additional or second intermediate host, 9-definitive host* (www.researchgate.net).

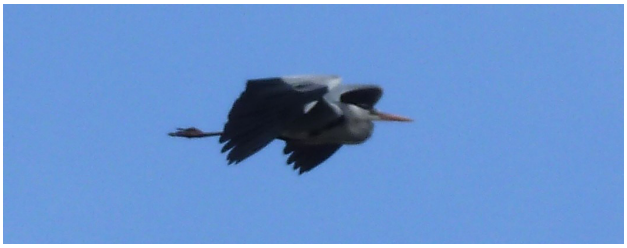

Figure 2. Grey heron (*Ardea cinerea*), a common definitive host of *Diplostomum sp.* in Armenia (www.researchgate.net).

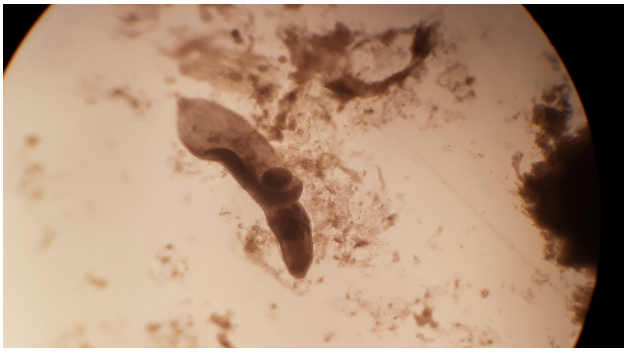

Figure 3. Adult *Diplostomum spathaceum* in grey heron`s small intestine *(*www.researchgate.net*)*.

In Armenia, the sexually mature pathogens are mainly detected in the intestines of gulls, herons, ducks and other fish-eating birds (Figure 2).

The intermediate hosts are various gastropod snails (Voropaeva, et al., 2008), and additional intermediate hosts are hundreds of fish species belonging to different systematic groups.

The studies on fish parasites date back to early times, but mainly individual ponds were investigated (Petukhov, 2003, Novak, 2010, Ivanov, 2012).

A number of research activities on the fish parasitic fauna have been also carried out in the natural and artificial ponds located in the territory of the Republic of Armenia (Vardanyan, et al., 1972, Voropaeva, et al., 2008, Hovhannisyan, 2008, 2009, 2010).

Materials and methods

The investigations were carried out in 2021-2022 at the Research Center for Veterinary Medicine and Veterinary Sanitary Examination of the Armenian National Agrarian University, as well as at the Laboratory of General Parasitology and Helminthology of the Scientific Center of Zoology and Hydroecology, National Academy of Sciences of the Republic of Armenia.

Totally 126 fish samples of 7 species have been researched. Fish was taken from the pond farms of the Ararat, Armavir, Kotayk and Aragatsotn regions, from the rivers and ponds of Ararat valley, as well as from the Hrazdan river and Lake Sevan.

To detect the helminths or larvae of the eyes the eyeball was taken out from the eyesocket, the vitreous body and eyelens were removed, then squeezed with the compressor or glass slides, and examined with small magnification of the microscope. The species identification of the trematodes was conducted via a special ID key (Shigin, 1986, Sudarikov, 2002).

Results and discussions

Research results are presented in the Table.

The table data show that 49 samples (39.68 %) out of the 126 investigated fish were infected with metacercariae. The pathogens were detected both in the artificial and natural pond farms and water basins.

The research results indicate that there are 4 species of pathogens in the fish eyes: *Diplotomum spathaceum* Rudolphi, 1819, *D. rutili* Razmashkin, 1969, *D. mergi* Dubois, 1932, and *Tylodelphys clavata* von Nordmann, 1832. As a rule, the metacercariae of *D. spathaceum* (Figure 5) trematode were detected in the fish of the so called well-maintained basins, and in the undermaintained basins, like Yerevan Lake, Hrazdan River, particularly in its lower streams, the metacercariae of *D. rutili* (Figure 4) trematode were found. This is possibly related to the pollution rate of water basins. *D. rutili* find more favorable surviving conditions in the organisms of fish inhabiting in the basins contaminated with sewage waters in contrast to *D. spathaceum* metacercariae.

Table. Fish infection with diplopstomiasis*

Fish species	Researched fish number	Infected fish number	Infection rate, %	Species detected
Wild Prussian carp (*Cyprinus carpio* Linnaeus, 1758)	6	3	50	*D. spathaceum*
Common carps (*Cyprinus carpio* Linnaeus, 1758)	25	8	32	*D. spathaceum*
Rainbow trout (*Parasalmo mykiss* Walbaum, 1972)	21	1	4.76	*D. spathaceum*
Capoeta capoeta sevangi De Filippi, 1865	12	2	16.67	*D. spathaceum*
Rutilus schelkovnikovi Derjavin, 1926	5	5	100	*D. rutili, D. spathaceum*
Sevan whitefish (*Coregonus lavaretus* Linnaeus, 1758)	22	17	63.6	*D. spathaceum, T. clavata*
Alburnoides eichwaldii De Filippi, 186	10	3	30	*D. rutili*
Crucian carp from Lake Sevan and Ararat Valley water basins (*Carassius auratus* Linnaeus, 1758)	22	9	40.9	*D. spathaceum, D. mergi*
Crucian carp from Yerevan Lake (*Carassius auratus* Linnaeus, 1758)	3	2	66.6	*D. rutili*
Total	126	50	39.68	

*Composed by the authors.

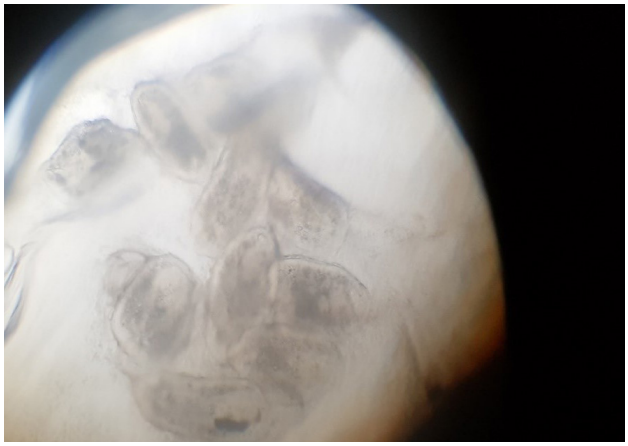

Figure 4. Metacercariae of Diplostomum rutili (www.researchgate.net).

Figure 6. Metacercaria of Tylodelphys clavata (www.researchgate.net).

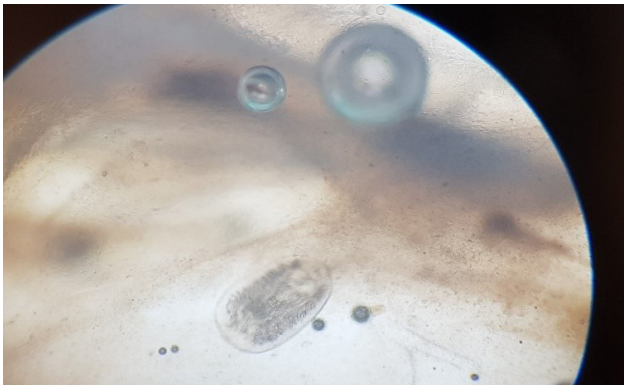

Figure 5. Metacercaria of *Diplostomum spathaceum* (www.researchgate.net).

Figure 7. Fish eye infected with *D. spathaceum metacercariae* (www.researchgate.net).

The highest infection rate with the pathogen of *D. spathaceum* is observed in Lake Sevan and it amounts to 63.6 % in the whitefish, while the pathogens of *D. rutili* (maximum 66.6 to 100 %) have been detected in the crucian carp and *Rutilus schelkovnikovi* living in the lower streams of the river Hrazdan. *D. mergi* metacercaria was detected in one crucian carp from the low stream of river Hrazdan only.

Tylodelphys clavata metacercariae (Figure 6) were registered in whitefish from Lake Sevan only.

The number of metacercariae in the eye fluctuates within 1 to 20. In 18 samples (36 % of the infected fish) both eyes were infected, while in 32 samples (64 % of the infected fish) only one eye was affected. There wasn't any regularity regarding the infection rate of left and right eyes.

The metacercariae in the eye lens cause lens opacity, and the light doesn't penetrate into the posterior eye chamber. Due to the accumulation of calcareous particles, the lens becomes milk-colored (Figure 7). Due to the exudate afflux in the anterior chamber of the eye exophthalmia is developed. The eye lens is deformed and in the result of cornea rupture it can be displaced. Ultimately, the fish becomes blind, loses appetite, emaciation is observed. Hence, it either dies or becomes foodstuff for fish-eating birds.

Conclusion

1. Ophthalmohelminthiasis is a rather common disease occurred in the natural and artificial ponds of the Republic of Armenia; about 39.68 % of the investigated fish are infected with the mentioned disease.

2. Four pathogen species have been detected: *Diplostomum spathaceum*, *D. rutili, D. mergi*, and *Tylodelphys clavata*.

3. The metacercariae of *D. spathaceum* have been detected in the fish of relatively well-maintained water basins, while the metacercariae of *D. rutili* pathogen – in the fish of water basins contaminated with sewage water.

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