2021

Blood Parasites of Fish of the Baikal Basin

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Erforsch. biol. Ress. Mongolei Halle (Saale) 2021 (**14**): 311-315

Blood parasites of Fish of the Baikal basin

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Abstract

Eight species of trypanosomes were found in nine species of fish in the Lake Baikal: *Trypanosoma percae, T. amurensis, T. schulmani, T. dogieli, T. magna*, *T. sp.1*, *T. sp.2*. Five species of trypanoplasms were detected in the blood of 13 species of Baikal fish: *Trypanoplasma lomakini*, *T. littoralis*, *T. cotti, T. zaikai, T. sp*. In the erythrocytes of the sand sculpin, *Leocottus kesslerii* were observed haemogregarins.

Key words: *Trypanosoma, Trypanoplasma,* Haemogregarinidae, Baikal, fish, blood, parasite, host

1. Introduction

Parasitic protozoa living in the bloodstream of the fish are widely distributed and are recently of great interest of researchers in connection with their diversity and pathogenicity for hosts (BECKER & KATZ 1966, LOM & DYKOVA 1992, WOO 2003 2006, KHAMNUEVA 2001). Infected fish develop anaemia, anorexia, exophthalmia, abdominal distension with ascites, general edema, and splenomegaly (WOO 1979, LI & WOO 1991). Flagellates parasitizing the blood of fish can cause serious illnesses that can result in death, such parasites are two species of trypanoplasms: *Trypanoplasma salmositica* and *T. bulloki*. The remaining numerous species of trypanosomes and trypanoplasms of fish are not pathogenic.

Trypanosomes and trypanoplasms develop with the change of hosts. Their definitive hosts are blood-sucking leeches, in the intestines of which the flagellates multiply intensely. Subsequently, the blood parasites penetrate into the vagina of the proboscis, and from there, during the act of sucking, enter the bloodstream of the fish. According to K.KH. KHAIBULAEV (1970) the blood parasites of the genera *Trypanosoma* and *Trypanoplasma* are specific to leeches; therefore, the researcher believes that the leeches are definitive hosts of these parasites.

Parasitic protozoa of the genera *Trypanosoma*, *Trypanoplasma* (Kinetoplastidea) and *Haemogregarina* (Sporozoa) were found in the blood of fish in the Lake Baikal basin.

2. Material and Methods

For this study, live fish from net and seine were taken from the different regions of Lake Baikal basin. Deep-sea cottoid fish are collected from the trawl catches of scientific research vessels. Blood was taken from the caudal artery from live or just "asleep" fish after cutting off the caudal peduncle (stem). Blood smears were dried in air, fixed with alcohol - ether (mixture of Nikiforov) or methyl alcohol and stained by the method of Romanovsky-Giemsa. In total, the results of studies of fish blood smears of 40 species were analyzed.

3. Results and discussion

In the Lake Baikal, eight species of trypanosomes were found in nine species of fish (table 1): *Trypanosoma percae, T. amurensis, T. schulmani, T. dogieli, T. magna*, *T. sp.1*, *T. sp.2*. Six species of trypanosomes were found in littoral fish species, two species - in deep-water benthic fish, trapped in a depth of 350 m.

Table 1: List of trypanosomes of the Lake Baikal and their fish hosts

No.	*Trypanosoma* species	Host species
1	*Trypanosoma percae*	*Perca fluviatilis*
2	*Trypanosoma carassii*	*Perca fluviatilis* *Thymallus baicalensis* *Leocottus kesslerii* *Cobitis melanoleuca*
3	*Trypanosoma amurensis*	*Leocottus kesslerii*
4	*Trypanosoma schulmani*	*Esox lucius*
5	*Trypanosoma dogieli*	*Leuciscus idus*
6	*Trypanosoma magna*	*Paracottus knerii* *Asprocottus pulcher* *Limnocottus pallidus*
7	*Trypanosoma* sp. 1	*Esox lucius*
8	*Trypanosoma* sp. 2	*Cobitis melanoleuca*

The greatest infection of fish with flagellates was recorded in perch *P. fluviatilis*, pike *E. lucius*, spikes *C. melanoleuca*, sand sculpin *L. kesslerii*.

Trypanosoma percae is a specific parasite of perch. It is not only the dominant species in the parasite fauna of this host, but also the dominant among the kinetoplastida fauna of the Lake Baikal basin. *T. percae* is noted in all the studied water-bodies of the Baikal basin and, obviously, its regional and global areal coincide with the area of the host.

Table 2: List of trypanoplasms of the Lake Baikal and their fish hosts

No.	*Trypanosplasma* species	Host species
1	*Trypanoplasma lomakini*	*Cottocomephorus grewingkii*
2	*Trypanoplasma litoralis*	*Cottocomephorus grewingkii* *Perca fluviatilis*
3	*Trypanoplasma cotti*	*Cottocomephorus grewingkii* *Cottocomephorus inermis* *Cyphocottus eurystomus* *Cyphocottus megalops* *Limnocottus bergianus* *Limnocottus godlewskii* *Asprocottus intermedius*
4	*Trypanoplasma zaiki*	*Batrachocottus multiradiatus* *Cyphocottus megalops* *Limnocottus bergianus* *Limnocottus griseus* *Procottus major*
5	*Trypanoplasma* sp.	*Cobitis melanoleuca* *Paracottus knerii*

The greatest infection of fish with trypanosomes was established in the Chivyrkuy Bay of the Lake Baikal. Obviously, the Bay has the most favorable conditions for definitive hosts of flagellates - fish leeches: shallow depths, aquatic plants and algae.

Five species of trypanoplasms were found in 13 species of Baikal fish (table 2): *T. lomakini*, *T. litoralis*, *T. cotti, T. zaikai* and *T.* sp.

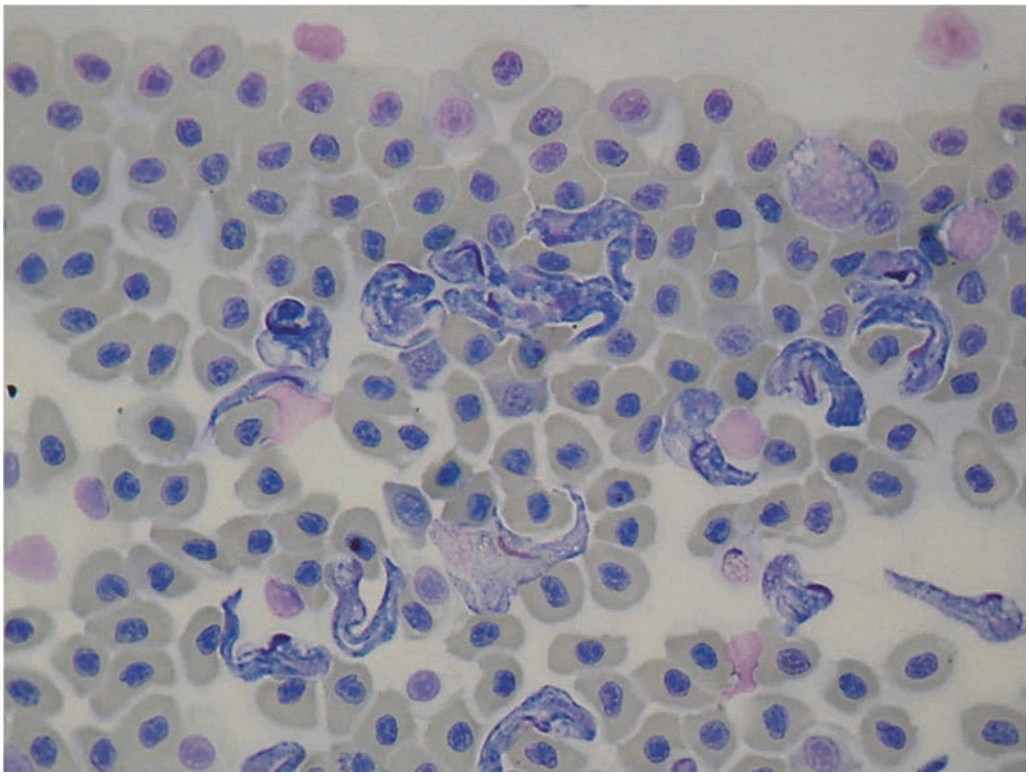

Fig. 1: Trypanoplasms in blood smear *of Cottocomephorus grewingkii* (amplification 1000 x).

The greatest extent of invasion by trypanoplasms was observed in *Batrachocottus multiradiatus* (39.3 %), *Cottocomephorus grewingkii* (28.6 %) and *Cottocomephorus inermis* (13 %).

The intensity of invasion of some cottids with trypanoplasm was high, in *Cottocomephorus inermis* abundance reaches 33 specimens, in *Asprocottus intermedius* - 678 specimens*, in Limnocottus megalops* - up to 2600 specimens, *L. eurystomus* - 1553 specimens (fig. 1). In the blood smears of the last species, from 3 to 8 flagellates were found in each area of vision. The intensity of invasion of other species of cottids varies from 1 to 15 specimens. The high concentration in the blood of the cottoid fishes is due, presumably, to the frequent attack of leeches on these fish.

In the the blood smears of sand sculpin *Leocottus kesslerii* very large trypanoplasms were detected, possibly it is a new species. The body length of these parasites reaches 119 µm. Flagellates found in water-bodies of another regions have a body length of 20-60 µm (BAUER et al. 1984).

Fish infected with trypanoplasms occur from the littoral to the abyssal zone (1100 m).

High prevalence of invasion of littoral fish species with trypanosomes is the result of parasitizing them by fish leech *Piscicola geometra*, deep-water fish species are infected with blood-parasites through the endemic deep-sea leeches *Codonobdella truncata* and *Baicalobdella torquata*.

Haemogregarines are poorly studied parasitic sporozoans, related to the family Haemogregarinidae of the Adeleida group. The development of haemogregarines is complex, occurs with the change of two types of hosts. That are blood-sucking invertebrates and otherwise vertebrates, including fish. Most part of its life cycle, haemogregarines are carried out in fish erythrocytes. Complete life cycles have been studied for only a small part of the species (DAVIES & JOHNSTON 2000, SIDDAL & DESSER 2001, DAVIES et al. 2004, HAYES et al. 2006). In the Lake Baikal haemogregarines are found in the erythrocytes of the sand sculpin *L. kesslerii* (fig. 2). The prevalence of invasion was 14.9 %.

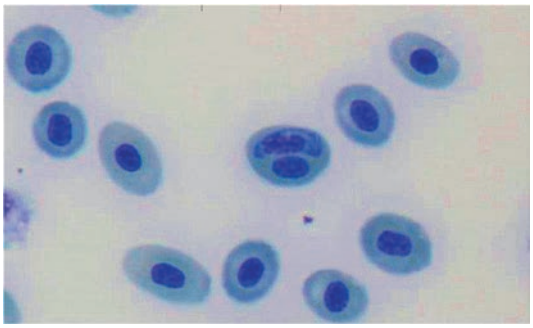

Fig. 2: Haemogregarins in the erythrocytes of the sand sculpin *Leocottus kesslerii.*

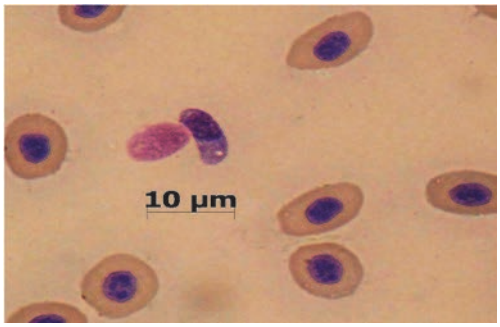

Fig. 3: Free haemogregarines in the *Leocottus kesslerii* blood plasma.

Several free haemogregarines being outside the erythrocytes were found in the blood plasma (fig. 3). In the smears were observed atypical forms of haemogregarines. A thickened or rounded shape distinguishes them. The width of the parasite is up to 4.99 µm. The occurrence of these atypical forms is low (7 %).

Invased erythrocytes are slightly enlarged in size to 10.9 µm in length and 7.98 µm in width (the sizes of uninvased red blood cells are on average 10.1 and 7.05 respectively), the nucleus is displaced aside. Intra-leukocyte haemogregarines were not detected.

In the Selenga River, trypanosomes were found in blood smears of perch *Perca fluviatilis* on the territory of Russia, and in *Brachymystax lenok* in Mongolia (KHAMNUEVA & PRONIN 2001, MAZUR et al. 2014). Our laboratory investigated the blood-parasites of 14 fish species of the Mongolian part of the Selenga river basin. Blood-parasites were found in four fish species: tripanosomes in perch *Perca fluviatilis* (near the Lake Ugii), trypanoplasms in grayling *Thymallus nigrescens* (Lake Hubsugul), and both genera of flagellates in *Leuciscus idus* from the Orkhon River (MAZUR et al. 2014).

The highest prevalence of infection with trypanosomes was observed in perch *Perca fluviatilis* (73.3 %). Data on the invasion of fish with trypanoplasms showed low prevalence of these parasites in *Brachymystax lenok* (10 %), *Leuciscus idus* (8.3 %) and *Thymallus nigrescens* (4 %).

In view of the very high variability of the meristic features of these parasites, molecular genetic studies are necessary to determine the species belonging to the haemoflavellates.

Acknowledgement

The research was carried out in the framework of the project № AAAA-A17-117011810039-4 supported by the Russian Federal Budget.

References

BAUER, O.N.; SHULMAN, S.S. (Eds.) (1984): Keys to the identification of parasites of freshwater fishes of the fauna of the USSR. Vol.**1.** Parasitic Protozoa. – Leningrad, Nauka, 428 pp. (in Russian).

BECKER, C.D. (1966): Host relationships of *Cryptobia salmositica* (Protozoa: Mastigophora) in a Washington hatchery stream. - Transactions of the American Fisheries Society **95**: 196-202.

DAVIES, A.J.; JOHNSTON, M.R.L. (2000): The biology of some intraerythrocytic parasites of fishes, amphibia and reptiles. - Advances in Parasitology **45**: 1-107.

DAVIES, A.J.; SMITH, N.J.; HAYES, P.M.; SEDDON A.M.; WERTHEIM, D.F. (2004): *Haemogregarina bigemina* (Protozoa: Apicomplexa: Adeleorina) – past, present and future. - Folia parasitologica **51**: 99-108.

HAYES, P.M.; SMITH, N.J.; SEDDON, A.M.; WERTHEIM, D.F.; DAVIES, A.J. (2006): A new fish haemogregarina from South Africa and its suspected dual transmission with trypanosomes by a marine leech. - Folia Parasitologica **53**: 241-248.

KHAIBULAEV, K.Kh. (1970): On the role of leeches in the life cycle of blood parasites of fishes. - Parazitologiya **4** (1): 13-17. (in Russian).

KHAMNUEVA, T.R.; BALDANOVA, D.R. (2016): The first record of haemogregarine infection in fish of Lake Baikal. - Parazitologiya **50** (1): 92-95. (in Russian).

KHAMNUEVA, T.R.; PRONIN, N.M. (2001): Kinetoplastida: Kinetoplastidea. – In: Index of Animal Species inhabiting Lake Baikal and its catchment area. Vol. **1**: Lake Baikal, Book 1, p. 122-128. - Novosibirsk: Nauka (in Russian).

LOM, J.; DYKOVA, I. (1992): Protozoan parasites of Fishes: Developments in Aquaculture and Fisheries Sciences. – Amsterdam, London, New York, Tokio; Elsevier. 315 pp.

LI, S.; WOO, P.T.K. (1991): Anorexia reduces the severity of cryptobiosis in *Oncorhynchus mykiss*. - J. Parasitol. **77**: 467-471.

MAZUR, O.E.; BURDUKOVSKAYA, T.G.; BATUEVA, M.D.; PRONIN, N.M. (2015): The occurrence of blood parasites in fish of the Mongolian part of the Selenga river. – In: Ecosystems of Central Asia under Current Conditions of Socio-Economic Development. - Proc. Int. Conf. Vol. **2**. Ulaanbaatar (Mongolia), September 8-11. 2015. - Ulaanbaatar, p. 62-64. (In Russian).

SIDDAL, M.E.; DESSER, S.S. (2001): Developmental stages of *Haemogregarina delagei* in the leech *Oxytonostoma typical*. – Can. J. Zool. **79**: 1897-1900.

WOO, P.T.K. (1979): *Trypanoplasma salmositica*: experimental infections in rainbow trout, *Salmo gairdneri*. - Expl. Parasitol. **47**: 36-48.

WOO, P.T.K. (2003): *Cryptobia (Trypanoplasma) salmositica* and salmonid cryptobiosis. - J. Fish Dis. **26**: 627–626.

WOO, P.T.K. (2006): Diplomonadida (Phylum: Parabasalia), Kinetoplastea (Phylum Euglenozoa). - In: WOO P.T.K. (ed.): Fish diseases and disorders, vol. **1**: Protozoan and metazoan infections. - 2nd ed. CABI, Wallingford, pp. 46-114.

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