v vysokih shirotah [Modern ideas about the mechanisms of formation of Northern stress in humans at high latitudes] Ekologiya cheloveka, 2012, №1, P. 3-11.

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ECOLOGICAL AND TOXICOLOGICAL FACTORS CONTRIBUTING TO THE PREVALENCE OF POTENTIALLY HARMFUL TO HUMAN HEALTH BIOHELMINTHOSES OF FISH OF YAKUTIA

DOI 10.25789/YMJ.2019.65.20

ABSTRACT

During the study period on the Lena River, there is a slight increase in the prevalence of the pike with plerocercoids of *Diphyllobothrium latum*. The prevalence of the pike aged 4, 5, 6 years old is equal to 28.5, 33.3, and 36.3%, the infection intensity is from 1 to 5 specimens, the abundance index is 0.64, 0.55 and 1.09 specimens respectively. The infection of the pike aged 7, 9, 10 years old is 62.5, 60.0, 100%, with the infection intensity 1-8 specimens, the abundance index is 2.0, 3.4 and 4.25 specimens respectively. The total infection of the pike with plerocercoids of diphyllobothriasis is 45.0%, the abundance index is 1.4 specimens. For the period the infection of the burbot with the plerocercoids of *Diphyllobothrium latum*, the total prevalence was 66.6%, with the infection intensity from 2 to 11 specimens. Thus, the infection of 5-6-7-year-old burbots is 25.0, 37.5 and 71.4%, with the infection intensity 2-9 specimens, with the abundance index 3.71 specimens. The infection of the older age groups 8-9-10-11 year olds is 100%, the infection intensity is 4-12 specimens, the abundance index reaches up to 10 specimens.

The total infection of theburbot in the Viliuy river with *Triaenophorus nodulosus* plerocercoids is 36.8%. The prevalence of the burbotaged 4-5-6-7 years old is 16.6, 25.0, 44.4 and 36.3%, respectively, the infection intensity is from 1 to 3 specimens, the abundance index reaches 2.0 specimens. For the period the total infestation of the burbot aged 3-4-5-6-7 years old in the Lena river with *Triaenophorus nodulosus* plerocercoids is equal to 16.6, 25.0, 44.4, 36.3, 37.5% respectively, with the infection intensity 1-3 specimens, with the abundance index up to 0.75 specimens. In the burbot aged 9 years old the infection with *Triaenophorus nodulosus* plerocercoids is 100%, with the infection intensity 1 to 3 specimens, and the abundance index is more than 2 specimens. The total infestation of the burbot with triaenophorid larvae along the Lena River is 36.7%, and the abundance index is 0.67 specimens.

These studies broaden the understanding of the adaptive capabilities of various fish parasites when inhabiting a polluted environment and contribute to the further development of environmental toxicology and parasitology.

Keywords: parasite fauna, parasites, middle course of the Lena river, aquatic ecosystems, fish, pike, burbot, pollution, anthropogenic impact, cestodes.

Introduction. The problem of the infection with biohelminthiasis, among which the most common is diphyllobothriasis is of particular relevance for the Republic of Sakha (Yakutia). The infection with diphyllobothriasis was registered in 29 regions of the Republic and the city of Yakutsk. Despite the moderate trend of its decline, which has been observed since 2009, the infection rate in the Republic remains one of the highest in the Russian Federation. The average long-term incidence of diphyllobothriasis in the Republic was 188.9 per 100 thousand people, exceeding the average figure for the Russian Federation up to 30 times. At the same time, in a number of regions of the Republic the infection rates consistently exceed the average in the Republic: the Verkhnevilyuysky region (191.2 per 100 thousand people), Yakutsk (242.5), the Verkhnekolymsky region (277.4), the Namsky region (285.1), the Srednekolymsky region (322.8), the Bulunsky region (418.9), the Khangalassky region (531.7), the Olekminsky region (627.6), the Kobyaysky region (1167.2), the Zhigansky region (1415.8). Over the past 5 years, the infection has sharply increased in the Mirny region from 64.1 in 2010 to 369.1 in 2014 [3].

The current ecological state of the Lena river basin, associated with increasing anthropogenic impact, requires evaluation and forecasting of the changes occurring there. The need for such research is associated with the enormous importance of the Lena basin, primarily as a fishery and transport reservoir. In this respect, the left tributary of the Lena river – the Viliuy river, where the intensive mining is being conducted, is a convenient model for considering the anthropogenic impact on the ecosystem under present conditions. For this purpose, we have studied and compared the composition and structure of the parasite fauna of the pike and the dace of the middle course of the Lena river and the middle course of the Viliuy river.

The greatest anthropogenic load is experienced by the Lena river, especially by its large tributaries: the Aldan and Viliuy rivers. Such distribution of water use is due to a large number of industrial mining enterprises, fuel and power complex facilities and large settlements in the basins of these rivers.

Fish parasites are reliable indicators of the ecological state of the reservoir. Under intense man-made load the ecological stability of the system weakens, the fish immunity decreases, they become more susceptible to infectious and invasive diseases, and the indices of infestation of hosts by parasites are increased [11]. Parasites that develop with the participation of planktonic crustaceans are indicators of the increased level of biogenic elements dissolved in water. Domestic sewage pollution promotes the spread of a dangerous zooanthroponosis - *Diphyllobothrium latum* in lakes. Accordingly, this species will be an indicator in determining the level of contamination of the reservoir. *Ligula*

intestinalis infestation is a very reliable indicator in assessing the trophic status of the reservoir [4]. This is most clearly reflected in the fish of the Vilyui reservoir, where in recent years, as a result of the eutrophication of the reservoir and the replacement of the rheophilic forms of zooplankton with limnophilic on es, the contamination of the dacer by the harpians has increased [1].

The advantage of parasites over other test objects is that parasites, especially those with a complex development cycle, accumulate changes that occur in all parts of the trophic chains of the aquatic ecosystem, as well as fish parasites have a relatively short lifespan and therefore show the ecological state of the reservoir at present [9]. Consequently, parasites of fish serve as a reliable ecological indicator of the processes of eutrophication and dystrophy [4].

The aim of the study is to study the fauna of main species of fish cestodes, to ascertain characteristics of infection under changing ecological and toxicological conditions of the middle course of the Lena river and its tributaries.

Materials and methods of research. Fish helminthological dissection was carried out according to the method developed by K.I. Skryabin (1928) and modified with respect to fish by VA. Doghel and E.M. Leyman, and also in accordance with the Methodological instructive regulations 3.2.988-00 *Methods of sanitary-parasitological examination of fish, shellfish, crustaceans, amphibians, reptiles and products of their processing* [2]. We have examined 160 fish specimens of 2 species, including 51 pikes, 109 burbots.

The species of parasites found in fish has been determined according to *Manual of freshwater fish parasites of the USSR fauna* [6, 7, 8].

For the study, the regions with different anthropogenic load were selected: the middle course of the Lena river and its left tributary - the Viliuy river.

Results and discussion. To identify the environmental consequences of human impact on natural water bodies, the studies of the population biology of fish parasites are of particular value. The research of the specificity of occurrence and distribution of the number of cestodes that have a complex development cycle allows us to consider main ways of parasites adaptation to changing environmental conditions and hosts resistance to infection. *Diphyllobotrium* and *Triaenophorus* cestodes can be one of the objects for studying the population biology of parasites.

Diphyllobotrium and *Triaenophorus* cestodes are widely distributed parasites of the Holarctic fish. Three *Diphyllobotrium* species - *D. latum, D. dendriticum, D. ditremum* and two species *Triaenophorus* - *T. nodulosus* and *T. crassus* inhabit the freshwater bodies of the north-east of Asia. The cycle of *Diphyllobotrium* development has two intermediate hosts. The first intermediate host is the planktonic copepods of *Copepoda* - 7 species. The composition of the second intermediate host *D. latum* in the conditions of Yakutia includes 5 fish species, *D. dendriticum* - 2 species, *D. ditremum* - 4 species [10]. The main final hosts are carnivores and humans.

The cycle of *Triaenophorus* development has two intermediate hosts. The first intermediate host for both *Triaenophorus nodulosus* and *Triaenophorus crassus* is the planktonic copepods of Copepoda. The composition of the second intermediate host of both species includes 6 species (taimen, grayling, pike, ruff, burbot, perch, dace, roach) for *Triaenophorus nodulosus*, whitefish species for *Triaenophorus crassus*. The main final host for both species is the pike *Esoxlucius L.*, in the intestine of which parasites reach sexual maturity [11].

Like helminthes with a complex development cycle, these species of cestodes of *Diphyllobotrium* and *Triaenophorus* give great information about the composition and abundance of the fish population and zooplankton in the reservoir. The infection of potential hosts with *Diphyllobotrium* and *Triaenophorus* cestodes also allows to determine the anthropogenic impact of the pollutants on the hydrobionts of freshwater reservoirs.

For the period of 2011-2015 there is a slight increase in the prevalence of the pike with plerocercoids of Diphyllobothrium latum. The prevalence of the pike aged 4, 5, 6 years old is equal to 28.5, 33.3, and 36.3%, the infection intensity is from 1 to 5 specimens, the abundance index is 0.64, 0.55 and 1.09 specimens respectively. The infection of the pike aged 7, 9, 10 years old is 62.5, 60.0, 100%, with the infection intensity 1-8 specimens, the abundance index is 2.0, 3.4 and 4.25 specimens respectively. The total infection of the pike with plerocercoids of diphyllobothriasis is 45.0%, the abundance index is 1.4 specimens (Table 1).

For the period of 2011-2015 the infection of the burbot with the plerocercoids of *Diphyllobothrium latum*, the total prevalence was 66.6%, with the infection intensity from 2 to 11 specimens. Thus, the infection of 5-6-7-year-old burbots is 25.0, 37.5 and 71.4%, with the infection intensity 2-9 specimens, with the abundance index 3.71 specimens. The infection of the older age groups 8-9-10-11 year olds is 100%, the infection intensity is 4-12 specimens, the abundance index reaches up to 10 specimens. (Table 2).

The influence of the size-age composition of the burbot on its infection with *Triaenophorus nodulosus* plerocercoids.

The total infection of the burbot in the Viliuy river with *Triaenophorus nodulosus* plerocercoids is 36.8%. The prevalence of the burbot aged 4-5-6-7 years old is 16.6, 25.0, 44.4 and 36.3%, respectively, the infection intensity is from 1 to 3 specimens, the abundance index reaches 2.0 specimens. (Table 3).

For the period of 2011-2015 the total infestation of the burbot aged 3-4-5-6-7 years old in the Lena river with *Triaenophorus nodulosus* plerocercoids is equal to 16.6, 25.0, 44.4, 36.3, 37.5% respectively, with the infection intensity 1-3 specimens, with the abundance

Table 1

Distribution of *Diphyllobothrium latum* plerocercoids in the pike along the middle course of the Lena river (2011-2015)

Age	Number of studied fish, specimens	Prevalence, %	Infection intensity, specimens	Abundance index, specimens
3+	-	-	-	-
4+	14	28,5	1-4	0,64
5+	9	33,3	1-2	0,55
6+	11	36,3	2-5	1,09
7+	8	62,5	1-5	2
9+	5	60,0	4-8	3,4
10+	4	100	2-7	4,25
	51	45,0	1-8	1,4

Table 2

Distribution of *Diphyllobothrium* latum plerocercoids in the burbot along the middle course of the Lena river (2011-2015)

Age	Number of studied fish, specimens	Prevalence, %	Infection intensity, specimens	Abundance index, specimens
5+	4	25,0	1-2	0,5
6+	8	35,5	2-5	1,3
7+	7	71,4	2-9	3,7
8+	4	100	5-11	7,7
9+	3	100	4-11	8,0
10+	3	100	8-12	10
11+	1	100	8	8
	30	66,6	2-12	4,3

Table 3

Distribution of *Tariaenophorus nodulosus* plerocercoids in the burbot along the Viliuy river (2011-2015)

Age	Fish length, mm	Number of studied fish, specimens	Prevalence, %	Infection intensity, specimens	Abundance index, specimens
3+	359	6	16,6	1	0,3
4+	375	8	25,0	1-2	0,3
5+	468	9	44,4	1-3	0,6
6+	481	11	36,3	1-3	0,6
7+	559	8	37,5	1-3	0,7
8+	579	5	40,0	2-3	1
9+	748	2	100	1-4	2
		49	36,7	1-3	0,6

index up to 0.75 specimens. In the burbot aged 9 years old the infection with *Triaenophorus nodulosus* plerocercoids is 100%, with the infection intensity 1 to 3 specimens, and the abundance index is more than 2 specimens. The total infestation of the burbot with triaenophorid larvae along the Lena river is 36.7%, and the abundance index is 0.67 specimens. (Table 4).

In general, the proposed work is a report of the parasites fauna of the Lena and Viliuy rivers, representing sanitary and hygienic interest, which for a long period of time are subjected to a multi-factor man-caused load. Reactions of groups of parasites to the negative influence of toxicants in Yakutia have been revealed.

In the conditions of the Lena river basin, the study of the influence of industrial pollutants on parasitic systems of freshwater fish was not possible, although a lot of work are devoted to the problems of parasites fauna, epizootology, epidemiology of fish invasive diseases in the water bodies of Yakutia [5, 10, 12, 13, 14].

Considering the great influence of the anthropogenic factor such as communal pollution, in 2011-2015, in the middle course of the Lena river in the area of Yakutsk, the Khangalassky, Namsky districts, we investigated 81 fish specimens of two species, including 51 pikes, 30 burbots by the method of complete helminthological dissection. The analysis of the research results on infestation with the larvae of diphyllobothriids and triaenophores, carried out for each species separately, reveals the widespread distribution of *Diphyllobothrium latum* and

Table 4

Distribution of *Triaenophorus nodulosus* plerocercoids in the burbot along the middle course of the Lena river (2011-2015)

Age	Fish length, mm	Number of studied fish, specimens	Prevalence, %	Infection intensity, specimens	Abundance index, specimens
5+	475	4	100	3-5	3,5
6+	497	8	75,0	2-6	3
7+	563	7	85,7	3-4	2,7
8+	590	4	100	2-5	3,2
9+	732	3	100	2-4	3,0
10+	792	3	100	4-6	5,0
11+	807	1	100	5	5,0
		30	90,0	2-6	3,3

Triaenophorus nodulosus plerocercoids along the Lena river:

The pike. When examining 51 specimens of the pike caught in the middle course of the Lena river, the infection with *Diphyllobothrium latum* plerocercoids has been found. The prevalence is 39.1%, the infection intensity is 8.29 ± 0.88 specimens.

The burbot. From the dissected 30 specimens of the burbot the prevalence 67.0% was infected with *Diphyllobothrium latum* plerocercoids, the infection intensity was 16.2 ± 2.51 larvae; with *Triaenophorus nodulosus* plerocercoids prevalence 83.5%, with the infection intensity 2.1 ± 1.24 specimens.

Along the Viliuy river 79 specimens of the burbot were examined by the method of complete helminthological dissection. According to the research, *Diphyllobothrium latum* plerocercoids have not been found in fish. Out of 79 specimens of the burbot in 36.8% of them the larval stage of *Triaenophorus nodulosus* has been found with the infection intensity 3.82 ± 1.25 specimens.

The conclusion. Thus, according to the results of investigations along the Lena river, there is the intense infection with plerocercoids of Diphyllobothrium latum in fish, potential additional hosts of diphyllobothriids, which indicates to intense contamination of this part of the river with municipal waste. The infection of fish with the larvae of *Triaenophorus nodulosus* remains at a high level. This proves favorable conditions for the full development of the communities of hydrobionts, which does not hinder the biological cycle of these cestodes.

Along the Viliuy River the prevalence with the larval stage of *Triaenophorus nodulosus* is lower, compared with the Lena river. In this river the plerocercoids of *Diphyllobothrium latum* have not been found in fish, which, in our opinion, is due to less pollution of the Viliuy river with municipal waste, the absence of intense navigation as in the Lena river. But, in comparison with the Lena River, the low infection of fish with triaenophorosis indicates significant changes in the structure of hydrobionts as a result of the man-made pollution, which leads to a decrease or complete loss of individual components of the life cycle of helminthes, as a result of which the population of the parasite infection of hosts decreases.

These studies broaden the understanding of the adaptive capabilities of various fish parasites when inhabiting a polluted environment and contribute to the further development of environmental toxicology and parasitology.

References

1. Apsolikhova. O.D. Odnokurtsev V.A. Parazity ryb Yakutii i ikh vliyaniye na zabolevayemost naseleniya gelmintami [Parasites of fishes of Yakutia and their influence on the incidence of helminths] Yakutskiy meditsinskiy zhurnal [Yakut medical journal]. Yakutsk. 2009, No 4(28), p.103-105.

2. MUK 3.2.988-00 Metody sanitarno-parazitologicheskoy ekspertizy ryby. mollyuskov. rakoobraznykh. zemnovodnykh. presmykayushchikhsya i produktov ikh pererabotki [MUK 3.2.988-00 methods of sanitary-parasitological examination of fish, shellfish, crustaceans, amphibians, reptiles and products of their processing] Protivoepidemicheskiye meropriyatiya. Tom 1. [Anti-epidemic measures. Vol. 1] Sanitarnyye pravila i metodicheskiye dokumenty. [Sanitary rules and methodological documents]. Moscow, «INTERSEN». 2006.

3. Nikolayeva G.G. Samoylova I.Y. Epidemiologicheskaya situatsiya po difillobotriozu v Respublike Sakha (Yakutiya) [The epidemiological situation in the Republic of Sakha (Yakutia)] Dalnevostochnyy zhurnal infektsionnoy patologii. [Far Eastern journal of infectious pathology]. Khabarovsk, 2015, No. 29, p.99-100.

4. Novak A.I.. Novak M.D. Parazitotsenozy vodnykh ekosistem Volzhskogo basseyna [Parasitocenosis water ecosystems of the Volga basin] Parazitotsenozy vodnykh ekosistem: monografiya [Parasitocenosis aquatic ecosystems: monograph]. Ryazan, Izd-vo RGATU, 2011, p.241.

5. Odnokurtsev V.A. Parazitofauna ryb presnovodnykh vodoyemov Yakutii [Parasite fauna of fish of freshwater bodies of Yakutia]. Novosibirsk, 2010.

6. Opredelitel parazitov presnovodnykh

ryb SSSR: [The determinant of freshwater fish parasites of the USSR]. Leningrad, Nauka, 1984. V.1.

7. Opredelitel parazitov presnovodnykh ryb fauny SSSR [The determinant of parasites of freshwater fish fauna of the USSR] Paraziticheskiye mnogokletochnyye T.2. [Parasitic multicellular]. Leningrad, Nauka, 1985, V.2.

8. Opredelitel parazitov presnovodnykh ryb fauny SSSR [The determinant of parasites of freshwater fish fauna of the USSR] Paraziticheskiye mnogokletochnyye T.3. [Parasitic multicellular]. Leningrad, Nauka, 1987, V.3.

9. Petrova V.V. Izmeneniye parazitofauny nekotorykh promyslovykh ryb Finskogo zaliva za dlitelnyy promezhutok vremeni v usloviyakh antropogennogo vozdeystviya [Change of parasitofauna of some commercial fish of the Gulf of Finland for a long period of time in the conditions of anthropogenic impact]. avtoref. dis. … PhD. (Biol.) – Saint Peterburg: 2000.

10. Platonov T.A. Difillobotriidy (Diphyllobothriidae) srednego techeniya reki Leny (fauna. ekologiya i mery borby) [Diphyllobotriids (Diphyllobothriidae) of the middle course of the Lena river (fauna, ecology and control measures)]. avtoref. diss. … PhD. (Biol.).Tyumen, 2002.

11. Proskurina V.V. Volodina V.V. Izmeneniya parazitotsenozov ryb Volgo-Kaspiyskogo regiona kak sledstviye nestabilnosti ekosistemy [Changes of parasitocenosis fish of the Volga-Caspian region as a consequence of the instability of ecosystems] Trudy 11-oy mezhdunarodnoy konferentsii «Aktualnyye problemy sovremennoy nauki». Estestvennyye nauki. Ch. 14. Ekologiya. [Proceedings of 11-th international conference "Actual problems of modern science". Natural science. - Part 14. Ecology]. Samara: 2010, p.70-75.

12. Pugachev O. N. Katalog parazitov presnovodnykh ryb Severnoy Azii [A catalogue of the parasites of freshwater fishes of North Asia] Knidarii. monogenei i tsestody [Cnidarians, monogenea and cestodes]. Saint Peterburg, 2003.

13. Pugachev O.N. Katalog parazitov presnovodnykh ryb Severnoy Azii [A catalogue of the parasites of freshwater fishes of North Asia] Knidarii, monogenei i tsestody [Cnidarians, monogenea and cestodes]. Saint Peterburg, 2002.

14. Pugachev O.N. Katalog parazitov presnovodnykh ryb Severnoy Azii [A catalogue of the parasites of freshwater fishes of North Asia] Prosteyshiye [Protozoa]. Saint Peterburg, 2001.

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ASSESSING AIR QUALITY DETERIORATION BY SNOWCOVER REDOX POTENTIAL

DOI 10.25789/YMJ.2019.65.21

ABSTRACT

This study is an attempt to obtain a qualitative understanding of oxygen concentrations in the winter atmospheric air of a northern city from snowcover redox potential. Snowcover is a natural accumulator of chemicals deposited from the atmosphere and is thus a good indicator of atmospheric pollution. Because the oxygen ratio in the air and snowcover is constant, changes in air oxygen levels during the winter can be qualitatively assessed from redox potentials of snowmelt water.

The redox potential in the urban snowcover was found to be about 200-250 mV lower than background. Lower snowcover Eh values within the city may suggest reduced oxygen levels in the air. The negative redox potential anomalies in the snowcover are associated with the air pollution sources and complex anthropogenic geochemical haloes.

The high level of pollution with added effects of reduced air oxygen levels deteriorates the quality of the urban environment for human health and well-being. Estimation of pollution based on negative redox potential anomalies in snowcover provides an additional means of assessing the winter air quality in urban areas.

Keywords: North, cities, snowcover, redox potential, oxygen deficiency, public health.

Introduction. The urban atmosphere is characterized by a number of factors, such as warmer air temperature compared to the surroundings and higher concentrations of gaseous pollutants (carbon and nitrogen dioxides) and particulate matter, which can cause breathing problems. Atmospheric oxygen level is one of the most important factors affecting the health and well-being of urban residents. The normal atmosphere contains approximately