biguous. Relatively high levels of these indicators were noted during the period under review in the Amginsky and Kobyaysky uluses, relatively low in the Gorny, Megino-Kangalassky, Khangalassky and Churapchinsky uluses (although with single indicators that characterize the above-average incidence rates).

In Namsky and Tattinsky Ulus, mean values are generally noted, although there are years with different levels of general and primary incidence. The situation in the Ust-Aldansky ulus is favorable for children's morbidity, and in Yakutsk - for the incidence of the adult and the entire population.

Since we previously analyzed the medical and demographic situation in 8 uluses / districts and the city of Yakutsk, representing the Central Economic Zone (Yakutsk Medical Journal, No. 1 (61) for 2018), it is possible to assess the health status of the population in these territories by medical demographic indicators and incidence data. The most alarming situation is in Kobyajskiy district, in connection with which, in our opinion, appropriate management decisions are necessary both from the municipality and the Ministry of Health of the Republic.

The work was prepared based on the results of the project "Assessment, the main trends in the natural and socio-economic condition, human potential of the Central Economic Zone of the Sakha (Yakutia) Republic" of the Integrated Scientific Research Program in the Sakha (Yakutia) Republic aimed at developing its productive forces and social sphere in 2016-2020 years.

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HYGIENE, SANITATION, EPIDEMIOLOGY AND MEDICAL ECOLOGY

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THE ROLE OF EXPEDITIONARY RESEARCH IN STUDYING THE HEALTH OF THE POPULATION OF VILYUI REGION

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ABSTRACT

In order to preserve the original habitat, culture and traditional way of life, the health of the population of the North is of fundamental importance. The first public health studies at the state level were carried out by members of the medical and sanitary unit as part of the first complex Yakutsk expedition of the USSR Academy of Sciences (1925-1928). Subsequently, the ideas and forms of work of the Yakut expedition of the Academy of Sciences of the USSR continued to be realized by their followers. In the 60-90s of the twentieth century, a study began of the state of health of the population of the republic, including the Vilyuysk group of uluses, which turned out to be on the territory of industrial pollution by enterprises of the diamond-mining industry and the Vilyuiskaya hydroelectric station. The knowledge obtained during long-term monitoring studies makes it possible to make a long-term forecast of possible environmental changes under conditions of climate change and anthropogenic impact. The Vilyui group of uluses was characterized by transgressive water migration enriched with microelements, petroleum products and phenol. This is associated with the accumulation of toxic elements, industrial poisons in the river fauna, in fish tissues, in humans and animals. Proof of this are the established high concentrations of micro and macronutrients in the hair and in the blood of the representatives of the indigenous population. The obtained results can be used in planning programs for the socio-economic development of the Vilyui region of the Sakha Republic (Yakutia) and individual administrative regions and municipalities of the republic, in the development of projects for the integrated development of mineral deposits, the use of agricultural land, and environmental protection measures. Research materials should be used by the supervisory authorities to monitor the state of public health and the environment. In August 2018, as a result of the destruction of the dams of the dredging pits of the Irelyakhskaya placer mine of the Mirny mine, Alrosa company, pollutants were released to the Irelya, Malaya Botuobuya and Viluy rivers. Huge damage has been inflicted on water bodies, aquatic biological resources and the population living in this region. Currently, environmentalists are working, but the medical community also needs to be connected, because the pollution of water bodies, given the slow recovery typical of northern ecosystems, will inevitably affect the health of the population.

Keywords: nature, ecology, health, monitoring, technogenic influence, anthropogenic influence, ecosystems, development programs, regions.

Back in the XIX century, the works of individual naturalists found that the natives of the North (Eskimos, Nenets, Chukchi, evens, Yakuts, etc.) have their morphological and physiological characteristics that ensure their adaptation to the conditions of existence, formed under the influence of biological and social factors of the environment. Difficult

living conditions in extreme natural and climatic conditions affected human health and quality of life, especially great problems related to the health of children (low survival of newborns, high mortality). For example, the General population census of 1897 proved the hypothesis of the extinction of the Yakut people (population growth for 20 years was only 1.5 thousand people) [1, 2].

After the establishment of Soviet power in Yakutia, special attention was paid to the health of the indigenous population. In his address to the Academy of Sciences of the USSR, The young leader of the Yakut people M. K. Ammosov wrote: "the October revolution created a political prerequisite for backward Yakutia, and the expedition of the Academy of Sciences should provide the scientific basis for this revival" [3].

The first studies of public health at the state level were conducted by employees of the medical and sanitary unit under The leadership of S. E. Schreiber as part of the I complex Yakut expedition of the USSR Academy of Sciences (1925-1928). The squad worked in Yakutsk, and Viliuisk, Olekminsk districts and, separately, in the Viluy leper colony [4].

The results of the surveys were disappointing: among children and women there was a continuous disease of tuberculosis, infant mortality was above 50%. Doctors have identified a number of social diseases. Thus, trachoma, which covered up to 45% of the total population, led to the fact that about 3.5% became completely blind and half-blind [5]. Epidemics of smallpox, scarlet fever and measles were rampant. Among the local population there was a high prevalence of intestinal diseases caused by poor and irrational nutrition [6].

As the main cause of morbidity, the medical and sanitary team noted the poor sanitary condition of life, poor nutrition, prevalence of smoking and alcohol consumption, the lack of real medical care [6].

Subsequently, the ideas and forms of work of the Yakut expedition of the Academy of Sciences of the USSR continued to be realized by their followers. So, by the institutes of SB RAMS, medical faculty of YSU, Academy of Sciences of RS (Ya) in 60-90-ies of XX century began the study of the health of the population of the Republic, including Vilyui group, caught in the territory of industrial pollution enterprises of the diamond industry and Vilyui HPP [7, 8].

The results and discussion. Vilyu regions enterprises of the diamond mining industry are one of the first industrial complexes of Yakutia and are located on the Vilyui river. In the formation of the Vilyui hydroelectric power station reservoir were flooded coniferous forests area of 2335 km2 and, as mentioned in "Memorandum" of the Commission of the USSR Academy of Sciences, from 19-25 August 1983, water quality in the reservoir in the first 2-3 years after filling was dramatically unsatisfactory. Thus, the concentration of phenols reached 30-40 MPC, there were large areas of hydrogen sulfide contamination. The note also stated that "there was a sharp deterioration in water quality throughout the Viluy river." In many settlements along the river, there was an increased incidence of acute intestinal infections, infectious hepatitis, pathology of pregnancy and childbirth, etc. [9, 10].

Iron oxides, aluminum, chromium, titanium and other elements, which were passed through the mouth of the river Irelyakh in the basin of the river Vilyuy in the composition of highly mineralized waters. About the anthropogenic character of changes in the composition of the Vilyui river in those years is evidenced by the analysis of the data of hydrometeorological service of the Republic of Sakha [11].

The role of shifts in the content of trace elements in the development of diseases is indirectly confirmed by the accumulation of aquatic phytophlora and river living organisms of trace elements such as Nickel (4-7 times) chromium, lead, iron (up to 7 or more times), copper and zinc (2 times), and aluminum and manganese up to 20 times. In Daldyn river vitaflora additionally accumulates silver, cobalt, compared with fitotehnie intact creeks flowing into the river basin. It is important to note that the concentration of Nickel, chromium, titanium, boron and silver in the hair is the highest in children. This can be explained by the affinity of trace elements to the tissues of a growing organism [12, 13].

At the end of the XX and the beginning of the XXI century began to study the relationship of pathological changes in the human body with the trace element composition of the environment and the role of trace elements in the development of diseases.

We studied the content of chemical elements in the hair of adults and children of Vilyui region. Our results indicate frequent contacts of men with elements-toxicants (professional contacts, contamination of the environment), which is consistent with the data by D. D. Savvinov and N. N. Sazonov studied their content in the environment [11].

During these years the mill tailings was found to have a high content of iron oxides, aluminum, chromium, titanium and other elements, which were passed through the mouth of the river Irelyakh in the basin of the river Vilyuy in children living in the Viliuisk region, also observed the imbalance in the content of some chemical elements, particularly in relation to the contents of Be, Sn, Ca and Se boys got into a more "scarce" group than in the other regions.

Girls have a relatively high content of Cr and Si in their hair and a low content of Ca and Mg. In connection with the established facts, it is now extremely important to study the resistance of the body to monitor the health of the local population.

Therefore, one of the stages of the work was the study took the state of the environment (water, soil, bottom sediments) and its impact on the health of the inhabitants of the Vilyui region.

The relationship of the prevalence of certain diseases with the elemental composition of the hair is established. So, the residents of the Vilyui zone due to excessive accumulation in the hair Cr, Fe, K, Mn, Va, Pb and Si and the relatively low content of Ca, Co, I, Mg, Se and Zn have higher morbidity according to classes X, IX, III, IV, VI and XIX, and the children – I, IV, II, VI, XIII and XII.

Thus, we can conclude that the Vilyui group was characterized by water transgressive migration, fortified foods, oil products and phenol. This is due to the accumulation of toxic elements, industrial poisons in the river fauna, in the tissues of fish, in humans and animals. The established high concentrations of micro - and macronutrients in the hair and blood of indigenous people, as well as highly toxic poison-boron, in the hair of children with apilation serve as proof of this [13, 14].

In the first years of the XXI century the budget financing of many scientific researches has sharply decreased and expedition works have practically stopped. During these years, work continued only

Table 1

The incidence of infectious hepatitis per 100,000 population in the uluses of the Vilyui region of the Republic of Sakha (Yakutia)

uluses	1988	1989	1990	1991	1992	1993	1994
Vilyuisk	314,1	455,5	169,9	162,1	454,9	717,9	1007,0
Verkhnevilyuysky	775,4	343,9	218,0	211,3	641,5	1050,7	1811,1
Nyurbinsk	311,8	388,4	193,8	406,8	2681,2	2063,5	441,1
Suntarsky	681,4	397,4	372,2	500,0	1245,4	1619,9	1198,5
Republic RS (Y)	279,5	241,2	341,3	370,1	380,0	350,3	303,9

Table 2

The dynamics of the main epidemiological indicators of tuberculosis in the uluses of the Vilyui region of the Republic of Sakha (Yakutia) per 1000 population

uluses	Morbidity			Incidence			Bacillary			Mortality		
	1980	1992	1994	1980	1992	1994	1980	1992	1994	1980	1992	1994
Vilyuisk	780,6	381,0	442,8	75,9	71,4	84,8	305,3	119,0	136,4	9,3	6,8	3,7
Verkhnevilyuysky	890,1	300,0	442,1	148,3	88,8	86,0	322,0	214,9	196,5	11,4	9,8	11,1
Nyurbinsk	602,7	395,3	568,6	99,2	94,6	277,1	277,1	141,9	273,2	10,0	6,8	9,2
Suntarsky	814,1	353,4	242,0	146,0	318,8	301,7	301,7	102,7	66,4	9,6	7,1	7,0
Republic RS (Y)	448,2	252,5	240,3	71,9	48,6	55,9	180,2	86,5	79,9	8,6	7,4	6,9

Table 3

Complications, course and outcomes of pregnancies in the uluses of the Vilyui region of the Republic of Sakha (Yakutia) for 1982-1992 (per 1000 pregnant women)

uluses	1983	1985	1990	1991	1992
Vilyuisk	427,1	439,9	817,6	801,3	1036,2
Verkhnevilyuysky	397,3	318,7	253,8	495,8	675,8
Nyurbinsk	396,3	472,2	336,2	483,1	678,5
Suntarsky	198,0	359,8	595,4	677,0	607,6
	397,4	205,6	207,0	315,6	355,9
Republic RS (Y)	309,7	359,7	450,6	611,1	515,2

Table 4

Complications of childbirth in women in labor of uluses of the Vilyui region of the Republic of Sakha (Yakutia) for 1983-1992 (per 1000 births)

uluses	1983	1985	1990	1991	1992
Vilyuisk	412,4	362,7	449,5	459,6	411,6
Verkhnevilyuysky	388,2	485,7	360,7	559,6	776,4
Nyurbinsk	329,5	246,8	579,0	723,7	543,9
Suntarsky	414,3	447,2	765,8	934,8	843,1
	330,7	380,5	321,5	618,2	513,3
Republic RS (Y)	273,9	329,4	444,7	641,5	695,3

in the Nyurba ulus on the initiative of the head of V. A. Petrova, concerned about the impact of the launch of the Nakyn diamond Deposit on the health of the population. Medical Institute together with the staff of the Institute of ecology of the North, Academy of Sciences of Sakha (Yakutia) held 5 scientific expeditions with the survey 5381 adults and 5415 children and adolescents in 18 towns and the city of Nyurba. The results of these comprehensive studies formed the basis of the collective monograph “habitat and human health in the North: ecological and medical aspects”.

The main results of scientific works in 1999-2002 in Nyurbinsky ulus stated the following: the general level of morbidity of children and adults above the average national indicators; the dependence of the level of morbidity of the population in certain forms of pathology on the state of the source of water supply and the degree of their pollution (r. Markha, r. Vilyui); trace element analysis in the hair of children showed increased concentrations of manganese, lead, associated with increased content of these elements in the soil, drinking water, bottom sediments.

The conducted immuno-epidemiological studies confirmed the high prevalence of chronic diseases as clinical “masks” of immunodeficiency States associated with the immune phenotype of the inhabitants of the North.

These results caused a certain public response and became one of the prerequisites for the implementation of programs for the prevention of the consequences of environmental pollution, protection of public health and the supply of clean drinking water.

Subsequently, on the initiative of the new head of the Nyurba V. M. Prokopiev in 2008, to continue monitoring the health of the population, medical Institute staff also went to work in 5 settlements. However, with the termination of further funding, monitoring of the health of other settlements did not work.

Table 5

The average content of chemical elements in the hair of adults in the Vilyui zone of Yakutia (μg / g)

Element	Women n=120	Men n=90
Al	14,2±2,05	17,27±2,8
As	0,1±0,056	0,11±0,013
B	0,98±0,17	1,23±0,36
Be	0,01±0,001	0,01±0,001
Ca	853±108	399±30
Cd	0,06±0,01	0,11±0,02
Co	0,04±0,01	0,03±0,01
Cr	0,53±0,04	0,72±0,04
Cu	10,94±0,25	10,5±0,26
Fe	21±2,37	23,45±1,93
Hg	0,74±0,08	0,74±0,08
I	1,3±0,18	1,22±0,6
K	543±102	825±108
Li	0,05±0,01	0,08±0,02
Mg	155±23	56±6
Mn	1,8±0,27	1,46±0,17
Na	847±150	875±128
Ni	0,38±0,05	0,31±0,05
P	168±6	186±13
Pb	1,45±0,22	3±0,43
Se	0,49±0,09	0,45±0,03
Si	48±7,31	32,15±2,7
Sn	0,25±0,05	0,2±0,05
V	0,07±0,01	0,08±0,01
Zn	167±5	161±4

Note: the content of microelements exceeding or below the reference values is highlighted (according to P. Bertram, 1992; with additions A.V. Skalniy, 2000).

Table 6

The average content of chemical elements in the hair of children from the Vilyui zone of Yakutia (μg / g)

Element	Girls n=175	Boys n=152
Al	14,35±0,7	15,09±1,08
As	0,08±0,004	0,14±0,013
B	1,69±1,26	1,34±0,5
Be	0,003±0,001	0,001±0,0002
Ca	313±13	246±9
Cd	0,11±0,01	0,15±0,01
Co	0,02±0	0,02±0
Cr	0,63±0,002	0,9±0,05
Cu	10,45±0,31	11,03±10,35
Fe	28,96±1,24	30,33
Hg	0,74±0,08	0,74±0,08
I	1,3±0,18	1,22±0,6
K	543±102	825±108
Li	0,05±0,01	0,08±0,02
Mg	155±23	56±6
Mn	1,8±0,27	1,46±0,17
Na	847±150	875±128
Ni	0,38±0,05	0,31±0,05
P	168±6	186±13
Pb	1,45±0,22	3±0,43
Se	0,49±0,09	0,45±0,03
Si	48±7,31	32,15±2,7
Sn	0,25±0,05	0,2±0,05
V	0,07±0,01	0,08±0,01
Zn	167±5	161±4

Note: the content of microelements exceeding or below the reference values is highlighted (according to P. Bertram, 1992; with additions A.V. Skalniy, 2000).

In 2013 on the initiative of the next head B. N. Popov implemented a project that also established a high prevalence of chronic diseases among the population and identified the main modifying risk factors for coronary heart disease such as hypertension, age factor, male gender,

Table 7

The relationship between individual classes of disease and the content of microelements in the hair of the population of the Vilyui zone of the Republic of Sakha (Yakutia)

Element	Class of diseases	
Gaps / imbalances Cr, Fe, K, Mn, Pb, Si	X. Respiratory system IX. Circulatory system III. Blood systems IV. Endocrine system VI. Nervous system XIX. Injuries and poisoning	I. Infectious diseases IV.Endocrine system II. Neoplasm XI. Digestive organs VI. Nervous system XIII. Bone Muscular System XVII. Congenital anomalies
deficienciesCa, I, Co, Mg, Se, Zn		

burdened heredity, obesity, hyperlipidemia and smoking.

At present, the new head A. M. Innokentyev is set to continue monitoring the health of settlements located in the Markha river basin. We believe that the continuation of expeditionary research will reveal and confirm the role of chronic environmental pollution (soil, water) by toxicants of the diamond industry on human health and the profile of widely encountered nosologies.

Regarding the monitoring of the health of the population of other areas of the diamond region, we can say that in accordance with the priorities of the Strategy of socio – economic development of the Republic of Sakha (Yakutia) until 2030 and determining the main directions until 2050, approved by the government of the RS(Ya), the Government of the Republic is implementing a program of integrated research in the RS (Ya). Under this program, the medical Institute of NEFU at the stage of 2016-2017 worked on the territory of the Verkhnevilyuysky ulus under the state contract: "Multifactorial study of the health status of the indigenous and alien population of the RS(Ya) in order to optimize regional programs to improve the quality of life of the inhabitants of the Republic, taking into account territorial and ethnic characteristics in the conditions of modern socio – economic development."

It should be noted that although the human genetic program provides the broadest opportunities for its implementation in a particular environment, however, limited energy and structural reserves of the body impose a fairly rigid framework on the possibility of its adaptation. The trend of changes in physiological functions also makes it possible to predict pre - and pathological changes in the body, observed in living in this ecological region, as well as to judge the patterns of formation of adaptive defense mechanisms in the process of life.

Conclusion. The results obtained in the course of many years of expeditionary research in the Vilyui region indicate that the price of adaptation in the studied conditions can become so high that it will cause not only a decrease in professional opportunities, but also the ability to produce healthy offspring.

In 2018-2019, it is anticipated that this project will be a comprehensive research with the transfer to the government of the Republic of Sakha (Yakutia) developed recommendations and technologies aimed at optimizing regional programmes to improve the quality of medical care and increase the longevity of human life in the North.

In August 2018, as a result of the destruction of the dams of the dredge pits of the Irelyakhskaya Deposit, the Mirninsky GOK of ALROSA, there was a release of pollutants in the rivers Irelyakh, Malaya Botuobuya and Vilyui. Huge damage has been caused to water bodies, water biological resources and the population living in the region. Currently, the work of environmentalists is underway, but it is necessary to connect the medical community, because the pollution of water bodies, given the slow recovery characteristic of the Northern ecosystems, will inevitably affect the health of the population.

In modern conditions, humanity can no longer develop further without environmental orientation in all spheres of life – from the economy to public consciousness and culture. That is why only on the basis of multifactorial becomes possible to develop scientifically-based approaches to the assessment and prediction of health.

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

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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*