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FISH DEVELOPMENT IN LAKE ECOSYSTEMS, EFFECT OF HEAVY METALS

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РАЗВИТИЕ РЫБ В ОЗЕРНЫХ ЭКОСИСТЕМАХ И ВЛИЯНИЕ ТЯЖЕЛЫХ МЕТАЛЛОВ

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Abstract. Heavy metals enter the water bodies and combine with the water buffer system, then turn into poorly soluble hydroxides, carbonates, sulfides and phosphates, and also form metal-organic complexes, accumulate in the bottom sediments and in general in the bodies of the fish fauna of the reservoirs of the area, seriously affecting their development. It was determined that the amount of Ca^{2+} ions varied from 17 mg/l to 112 mg/l, and the amount of Mg^{2+} ions from 5.5 mg/l to 83.5 mg/l, in other words, towards autumn. water hardness has increased. The amount of alkali metal ($\text{Na}^+ + \text{K}^+$) ions is much lower in spring than in summer and autumn. According to the cations, the amount of chloride and sulfate ions increases in autumn. Thus, the impact of anthropogenic factors on fish is diverse and manifests itself primarily in morphological anomalies and changes in the basic biological parameters of fish populations. The main of them is the reduction of productivity and the complete loss of their natural forms, the increase of individuals and the increase of mortality.

Аннотация. Тяжелые металлы попадают в водоемы и соединяются с водной буферной системой, затем превращаются в малорастворимые гидроксиды, карбонаты, сульфиды и фосфаты, а также образуют металлоорганические комплексы, накапливаются в донных отложениях и в целом в телах представителей ихтиофауны водоемов района, серьезно влияя на их развитие. Установлено, что количество ионов Ca^{2+} изменялось от 17 мг/л до 112 мг/л, а количество ионов Mg^{2+} от 5,5 мг/л до 83,5 мг/л, то есть к осени жесткость воды увеличилась. Количество ионов щелочных металлов ($\text{Na}^+ + \text{K}^+$) весной значительно ниже, чем летом и осенью. По катионам осенью увеличивается количество хлорид- и сульфат-ионов. Таким образом, воздействие антропогенных факторов на рыб многообразно и проявляется, прежде всего, в морфологических аномалиях и изменении основных биологических параметров рыбных популяций. Главные из них — снижение продуктивности и полная потеря естественных форм, увеличение особей и рост смертности.

Keywords: lake, ecosystems, fish, mineral substances, anthropogenic factors, natural factors, water reservoir.

Ключевые слова: озеро, экосистемы, рыбы, минеральные вещества, антропогенные факторы, природный факторы, водохранилище.

The study is devoted to the assessment of the fish fauna of natural and artificial water bodies of Nakhchivan and the environmental factors affecting them in 2018-2022. For this period, it was determined that the main reason for the observed negative effects is the pollution of water bodies with heavy metals. The recommended evaluation indicators can be used in monitoring programs during the evaluation of the quality of water ecosystems in other regions of Azerbaijan during the contamination of water bodies with heavy metals. Heavy metals enter the water bodies and combine with the water buffer system, then turn into poorly soluble hydroxides, carbonates, sulfides and phosphates, and also form metal-organic complexes, accumulate in the bottom sediments and in general in the bodies of the fish fauna of the reservoirs of the area, causing serious anomalies in their development.

The general structure of the fish fauna of the region is changing due to the influence of anthropogenic factors (pollution of water bodies, fishing, etc.) on the water reservoirs of the Nakhchivan Autonomous Republic, which is reflected in the change of the dominant species in the species composition (size-age structure, reproduction mode and nutrition), the introduction of fish from abroad. release into the reservoir, the reduction of feeding and spawning areas is observed with the creation of fish-free zones; the decrease in the number of fish, bream, bream, the impoverishment of the species composition of the aquatic invertebrate fauna, as a result, led to a decrease in biological diversity in some rivers, for example Nakhchivanchay, Gilanchay, Arpachay, etc. [3, 4, 8].

Material and methods

The collection of material was carried out in all seasons of 2018-2021 in the most typical biotopes of sea urchins. In total, 8,120 fish belonging to 32 species and subspecies were obtained, of which 6,960 were adults of 25 species and subspecies and 1,160 were adults of 21 species and subspecies and have been baby individuals. The morphometric characteristics of 17 types of fish belonging to the obtained species and subspecies were evaluated [5-7].

The fish obtained during morphometric measurements were used for comparison with fish samples caught daily by fisheries farms. During the research, the dependence of the development of fishes distributed in water reservoirs on environmental factors was studied. For this, weight fish is taken as standard. In the territory of the autonomous republic, the lakes are polluted mainly as a result of factory wastewater, mineral fertilizers used in the fields, household wastewater and atmospheric precipitation. The largest man-made streams are formed in the river basin. Araz reservoir is polluted by waste products of 4 republics. Heavy metals play a major role in pollution, mainly from Armenia.

Results and their discussion. Heavy metals enter the water bodies and combine with the water buffer system, then turn into poorly soluble hydroxides, carbonates, sulfides and phosphates, and also form metal-organic complexes, accumulate in the bottom sediments and in general in the bodies of the fish fauna of the reservoirs of the area, causing serious anomalies in their development. Heavy metals can enter water bodies not only through sewage, but also as a result of air pollution, where the peak increase in the load of toxic substances slowly enters during snowmelt or torrential rains [4].

Heavy metals are generally released into the atmosphere from metallurgical industry, machine building industry, battery, factories, plants, etc. it is released from fields and vehicles. In this case, the air contains copper, chromium, nickel and cadmium in excess of the norm, and serious processes are taking place. These precipitations cause complete destruction or serious damage to living organisms in the environment. The pH value of such precipitation is lower than 5.6. Toxic

heavy metals that enter the body interfere with the proper functioning of the body and can remain in the body for a long time.

During the research period, no regularity was observed in the seasonal changes in the amount of nitrogen in all forms in Nakhchivan reservoirs. The amount of ammonium (NH_4^+) ions varies from 0.13 mg/l to 0.85 mg/l, and during the intensive development of blue-green algae, up to 3.0 mg/l. The highest value of nitrate (NO_3^-) ion is 4.0 mg/l. The concentration of nitrite (NO_2^-) ion is much higher than the sanitary norm. The amount of silicon ions varies between 5.0-14.0 mg/l. Since it is consumed by diatom algae in spring and summer, its density decreases [4].

Table 1

THE AMOUNT OF SOME METALS IN WATER SAMPLES TAKEN
 FROM DIFFERENT PARTS OF THE ARAZ AQUEDUCT

<i>Control test points</i>	<i>Metals</i>			
	<i>accepted norm, mg/l</i>			
	<i>0.5</i>	<i>0.1</i>	<i>no information</i>	<i>1.0</i>
	<i>iron</i>	<i>chrome</i>	<i>aluminum</i>	<i>copper</i>
1	2.00	0.50	0.19	0.50
2	1.80	0.65	0.22	0.20
3	2.50	0.55	0.18	0.10
4	1.50	0.60	0.16	0.60
5	2.00	0.65	0.18	0.20
6	1.50	0.55	0.22	0.18
7	2.00	0.70	0.25	0.11
8	2.20	0.75	0.24	0.22
9	2.00	0.55	0.75	0.10
10	2.50	0.60	0.50	0.10
11	2.80	0.95	0.95	0.40
12	1.50	0.50	0.75	0.50
13	1.00	0.25	0.50	0.14
14	0.50	0.25	0.70	0.15
15	1.00	0.75	0.82	0.86
16	0.80	0.50	0.95	0.60
17	1.50	0.25	0.70	0.75
18	2.00	0.90	0.89	0.90
19	1.00	0.40	0.75	0.40
20	0.50	0.50	0.70	0.50
21	0.55	0.30	0.50	0.30
18	2.00	0.90	0.89	0.90
19	1.00	0.40	0.75	0.40
20	0.50	0.50	0.70	0.50
21	0.55	0.30	0.50	0.30

Although the intake of some heavy metals is necessary for living organisms, some of these heavy metals naturally enter water resources with anthropogenic environmental wastes and cause problems for living organisms. Among them, the elements belonging to the “xenobiotic” group have a negative impact on human life. When these elements enter living organisms, they cause poisoning and even death. These include cadmium, arsenic, mercury, lead, zinc and chromium. Among them, lead and cadmium are mainly toxic, and arsenic is a very toxic substance. The formation of mercury

in the aquatic environment by R-Hg-X and R-Hg-R type organometallic compounds was studied. In general, methylmercury is most concentrated in fish. In the dam of the Araz reservoir, the amount of mercury in the clean or slightly polluted water area (dam part) varies between 0.1-0.2 µg/l (microkilogram/liter). This is 3 times less than the oceans. Aquatic plants absorb mercury. At the same time, fish and crab also absorb mercury. It forms a compound in the form of methylmercury. This causes “Minamata” disease in animals. Nervousness causes nervous disorders, damage to internal organs, weakening of vision and hearing, which even results in death [2]. Mineral substances. The water of Nakhchivan reservoirs is hydrocarbonate-calcium [1]. The amount of salts dissolved in water varies throughout the year and over the years, depending on soil-geological, climatic conditions and the degree of mineralization of river waters (Table 2).

The research conducted in the Nakhchivan reservoir shows the change of river water depending on the degree of mineralization throughout the year and over the years in the table below.

Table 2

DEGREE OF MINERALIZATION OF WATER
 IN NAKHCHIVAN RESERVOIR IN DIFFERENT YEARS

Years	Amount	Cations			Anions			The sum of the ions
		Ca ²⁺	Mg ²⁺	Na ⁺ +K ⁺	HCO ₃ ⁻	SO ₄ ²⁻	Cl ⁻	
2018	mg/l	50.4	22.3	60.3	215.0	106.0	54.0	508
	mgEq	2.52	1.85	2.62	3.52	2.20	1.52	14.23
2019	mg/l	46.6	22.0	56.4	184.0	98.0	42.0	449
	mgEq	2.33	1.83	2.45	3.02	2.0	1.18	12.81
2020	mg/l	56.3	28.3	65.4	235.0	115.0	56.0	556
	mgEq	2.82	2.36	2.84	3.85	2.4	1.58	15.85
2021	mg/l	47.0	21.0	54.0	210.0	100.0	48.0	480
	mgEq	2.37	1.75	2.34	3.50	2.08	1.35	13.39

During the research years, the average annual minerality of water varied between 600-700 mg/l. It was determined that the amount of Ca²⁺ ions varied from 17 mg/l to 112 mg/l, and the amount of Mg²⁺ ions from 5.5 mg/l to 83.5 mg/l, in other words, towards autumn. water hardness has increased. The amount of alkali metal (Na⁺ + K⁺) ions is much lower in spring than in summer and autumn. According to cations, the amount of chloride and sulfate ions increases in autumn [2].

Summarizing the above, we note that heavy metals enter water bodies and combine with the buffer system of water, then turn into poorly soluble hydroxides, carbonates, sulfides and phosphates, and also form metal-organic complexes, accumulating in the bottom sediments and in general in the bodies of the fish fauna of the water reservoirs of the area they have a serious impact on their development.

Thus, the impact of anthropogenic factors on fish is diverse and manifests itself primarily in morphological anomalies and changes in the basic biological parameters of fish populations. The main of them is the reduction of productivity and the complete loss of their natural forms, the increase of individuals and the increase of mortality.

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