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ASSESSMENT OF FISH FAUNA OF NATURAL AND ARTIFICIAL WATER BODIES IN NAKHCHIVAN AND THE ENVIRONMENTAL FACTORS THAT HAVE IMPACT OVER THEM

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ОЦЕНКА ИХТИОФАУНЫ ЕСТЕСТВЕННЫХ И ИСКУССТВЕННЫХ ВОДОЕМОВ НАХИЧЕВАНИ И ВЛИЯЮЩИХ НА НИХ ФАКТОРОВ ОКРУЖАЮЩЕЙ СРЕДЫ

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Abstract. The study is dedicated to the assessment of fish fauna of the natural and artificial water bodies in Nakhchivan in 2018–2022 and the environmental factors that have impact over them. It was determined for this period that fish fauna is distributed in 10 water bodies. Out of those water bodies, Nakhchivan reservoir dominates both from the perspective of species and fish hunting. Along with the study of fish fauna in aquifers, the factors influencing their development were also assessed. Although the balance is disturbed as a natural factor, factors such as industrial waste, garbage and solid waste, sewage waste, detergents and artificial fertilizers, agrochemicals, oil and oil products, radioactivity and thermal pollution are the main factors of environmental pollution. Other factors: untimely and excessive hunting, fishing during reproductive migration, the introduction of new fish species into freshwater sources, anthropogenic factors such as hydropower also have a significant impact on fish development.

Аннотация. Исследование посвящено оценке ихтиофауны естественных и искусственных водоемов Нахичевани в 2018–2022 годах и факторам окружающей среды, оказывающим на них влияние. Установлено, что за этот период ихтиофауна распространена в 10 водоемах. Из этих водоемов Нахичеванское водохранилище доминирует как по количеству видов, так и по величине промысла рыбы. Наряду с изучением ихтиофауны также проводилась оценка факторов, влияющих на ее развитие. Основными факторами загрязнения окружающей среды являются промышленные отходы, мусор и твердые отходы, канализационные отходы, моющие средства, искусственные удобрения, агрохимикаты, нефть и нефтепродукты, радиоактивное и тепловое загрязнение. Другие факторы: несвоевременный и чрезмерный вылов, промысел в период репродуктивной миграции, интродукция новых видов рыб в пресноводные источники, антропогенные факторы, такие как гидроэнергетика, также оказывают существенное влияние на развитие рыб.

Keywords: natural factor, fisher, species, Arpachay reservoir, radioactivity, *Cyprinus carpio*, biodiversity, taxonomic status.

Ключевые слова: природный фактор, рыбак, виды, Арпачайское водохранилище, радиоактивность, *Cyprinus carpio*, биоразнообразие, таксономический статус.

Nakhchivan Autonomous Republic has dense hydrographic network. This network was formed for a long time and exposed to several changes. The hydrographic network changes because of impact

from natural processes and economic activities of humans. For using water resources, water regime of rivers, lakes and water reservoirs are oriented to the various directions. Especially, water junctions and facilities built over the rivers are of great importance. Those water basins are used for power generation, irrigation, tourism and recreation, and the development of fish farms [2, 6, 7].

The hydrographic networks own their specific rich hydro fauna. The study of hydro fauna, ichthyofauna, which is an important part of it, is of great scientific and practical importance. Taking this into account, the aim is to study the ichthyofauna of some water basins of the region (Arpachay, H.Aliyev, Uzunoba, Mazra, Nehram, Sirab, Bananiyar reservoirs, Batabat lakes). The first scientific information about the hydro fauna of the water basins of the region was reflected in the works of Z. P. Sofiyev (1969) [18].

Material and methods

Materials were collected from the water basins of the region, in the most characteristic biotopes during spring, summer and autumn seasons of years 2018-2022.

Commonly accepted research methods in ichthyology were used in the collection and analysis of ichthyological materials [3, 4, 8-10, 12].

After the existing samples were collected, they were transported to the Laboratory of the Faculty of Biology under Nakhchivan State University and scientific research was conducted over those samples.

The samples brought to the laboratory were fixed in jars and special containers in 4% formaldehyde solution. After the samples were identified at the species level, 10-15 individuals of each species and subspecies were taken, and the morphometric and meristic features were studied in the laboratory. Individuals of each species were photographed, and body color and patterns were determined on fresh samples. Relevant literature materials were used to identify fish species [1].

Results and their discussion. During the studies, 32 fish species belonging to 6 orders were recorded based on the materials collected from the water basins during the studies and the analysis of literature materials [5, 13-15, 17, 18]. When the found species are investigated, *Cyprinidae* family has most species (22) — 68,75%; it is followed by *Balitoridae* family (2 species) — 6,2% and *Cobiidae* family (2 species) — 6,2%; other families come at the last place with 1 species for each one (*Acipenseridae* 3,125%, *Salmonidae* 3,125%, *Cobitidae* 3,125%, *Siluridae* 3,125%, *Poecilidae* 3,125%, *Percidae* 3,125%) (see the Chart).

Nakhchivan water reservoir. The Nakhchivan Reservoir is a large-scale artificial reservoir established on the Aras River in 1972 on the border of the Nakhchivan Autonomous Republic and the Islamic Republic of Iran. The reservoir was built on the basis of a joint Azerbaijani-Iranian hydro project. The 900 m long and 35 m high dam was built 422 km above the river mouth and 750 m above sea level.

The area of the water reservoir is 14, 500 ha, the water capacity — 1,35 billion m³, average depth is 9,31 m. The greatest depth is up to 35 m closed to the dam. The length of the reservoir is 40,5 km; the widest point is 7,0 km, and the average width is 3,6 km. The catchment area of the basin is 54,300 km², and the average annual modulus of water flow for the area is 2.9 l / sec.km².

Nakhchivan reservoir is a lake-type reservoir due to its geographical location. Its average annual water exchange coefficient is 3.66. The average water collection rate is 4.98 km³, ranging from 4.01 to 6.51 km³. The average value of perennial water consumption is 156 m³/sec. The reservoir is located at 778 m above sea level under normal grading.

Nakhchivan reservoir is a river reservoir according to its origin, a valley basin according to its shape, and a plain water body due to its height above sea level.

27 fish species belonging to 6 families were recorded from the water reservoir during the study. 20 species out of the total found samples belong to *Cyprinidae* family, 2 — *Cobidae*, 1 — *Cobitidae*, 1 — *Poecilidae* and 1 — *Percidae* families. According to the intensity of encountered species, *Pseudorasbora parva*, *Alburnus filippi*, *Alburnoides bipunctatus eichwaldi*, *Abramis brama orientalis*, *Cyprinus carpio*, *Carassius auratus gibelio*, *Gambusia affinis*, *Neogobius platyrostris* constructor and other species are differed. Among the species in the water reservoir, *Cyprinus carpio* and *Cyprinus carpio* dominated.

Arpachay reservoir — located at 915 m above sea level, it was established in Arpachay valley. Its area is 600 ha, the length of reservoir is 6 km, full water volume is 140 million m³ [3]. A hydro power plant (HPP) with the generation volume of 25 mW has been constructed over the reservoir in recent years. The water temperature ranged 21,2-23,4°C; pH ranged between 7,1 and 7,4 and oxygen regime 8,2-8,4 mg/l during the monitoring. 16 fish species belonging to 4 families were recorded for the water reservoir during the study. Out of the found species, 12 belong to *Cyprinidae* family, 2 to *Balitoridae* family, 1 to *Cobidae* and 1 to *Poecilidae* family. According to the intensity of encountered species, *Alburnus filippi*, *Alburnoides bipunctatus eichwaldi*, *Carassius auratus gibelio* species dominated.

H. Aliyev reservoir — The area of the reservoir is 0,45 km², useful volume is 90 million m³. During the observations, water temperature was 21,2-22,7°C, pH — 7,1-7,2, and oxygen regime was 8,1-8,4 mg/l. 14 fish species belonging to 4 families were recorded for the reservoir during the study. 10 out of the found species belong to *Cyprinidae* family, 2 to *Balitoridae* family, 1 to *Cobidae* and 1 to *Poecilidae* families. According to the intensity of encountered species, *Alburnus filippi*, *Alburnoides bipunctatus eichwaldi*, *Carassius auratus gibelio* species dominated.

Uzunoba water reservoir — it was constructed out of the course. The reservoir is located at the left bank of Nakhchivan river, 2 km west of the Uzunoba village, at 1000 m altitude. The water is transferred to the catchment of reservoir through the artificial canal, while being taken from Nakhchivan river. Its area is 1,15 km². The total volume is 9,0 million m³, the useful volume is 8,53 million m³. The reservoir is operated since 1961. During the observations, the water temperature ranges between 19,4-19,8 °C, pH 7,2-7,3 and oxygen regime is 8,2-8,4 mg/l. 11 fish species belonging to 4 families were recorded from the reservoir. 8 out of found species belong to *Cyprinidae* family, 1 to *Balitoridae*, 1 to *Cobidae* and 1 to *Poecilidae* families. According to the intensity of encountered species, *Alburnus filippi*, *Alburnoides bipunctatus eichwaldi*, *Carassius auratus gibelio* species dominated.

Batabat lake — located in the territory of Shahbuz region, in the upper part of Nakhchivanchay basin, on the southern side of Bichanak pass (2113 m a.s.l.). The altitude of the slopes surrounding the lake is 50-150 m. In the southern part of the Bichenak Pass, there were 5 wetlands, the surface of which was once covered with peat, and the main water came from springs and snow. Due to their favorable location, since 1946, three wetlands have been dammed and turned into reservoirs. At present, these lakes are widely used for intensive irrigation, regulation of Nakhchivanchay flow and irrigation of arable lands. The lake gets its main water from Zorbulag, which flows into it from the north-east. The area of the lake is ~ 116 ha. Due to the low mineral content of the lake water, it is used in all areas of the economy. The water is calcium bicarbonate [3].

6 fish species belonging to 3 families were recorded from the water reservoir. 4 out of found species belong to *Cyprinidae* family, 1 to *Balitoridae* and 1 to *Cobitidae* family. According to the intensity of encountered species *Cyprinus carpio* and *Carassius auratus gibelio* dominated.

Bananiyar reservoir. The Bananiyar reservoir located out of the course was commissioned in 1990. The water reservoir enabled the irrigation of about 4230 ha plantations in the territory of Julfa

and Babek districts. A water intake facility and a 7.7 km long supply canal were built on the Alinjachay River about 7 km above the reservoir to supply water to the reservoir. The reservoir is 1.1 km long, 0.96 m wide, 1.6 km² in area and has a volume of 17.4 million m³. During the observations, the water temperature was 19.8-20.29, the pH was 7.1-7.3, and the oxygen regime was 8.4-8.5 mg/l.

14 fish species belonging to 4 families were recorded for the reservoir. 10 out of the found species belong to Cyprinidae family, 2 to *Balitoridae*, 1 to *Cobitidae* and 1 to *Pociliidae* family. According to the intensity of encountered species, *Alburnus filippi*, *Alburnoides bipunctatus eichwaldi*, *Carassius auratus gibelio* were dominated.

Nehram reservoir. Nehram water reservoir was commissioned in 1965. It is located at an absolute altitude of 900 m above sea level. The water capacity of the reservoir is 6 million m³. More than 1540 ha plantation area is irrigated with the water of the reservoir.

15 fish species belonging to 4 families were recorded for the reservoir. 11 out of the found species belong to Cyprinidae family, 2 to *Balitoridae*, 1 to *Cobitidae* and 1 to *Pociliidae* families. According to the intensity of encountered species, *Alburnus filippi*, *Alburnoides bipunctatus eichwaldi*, *Carassius auratus gibelio* species dominated.

Mazra lake. This lake was constructed and put into operation in 1980. The volume of the lake is 1 million m³. The area of more than 200 ha is provided with irrigation water with the water of Mazra lake.

15 fish species belonging to 4 families were recorded for the water reservoir. Out of found species, 11 belong to Cyprinidae families, 2 to *Balitoridae*, 1 to *Cobitidae*, 1 to *Pociliidae* families. According to the intensity of encountered species, *Alburnus filippi*, *Alburnoides bipunctatus eichwaldi*, *Carassius auratus gibelio* species dominated.

Sirab water reservoir. Sirab water reservoir located in Sirab village of Babek district was commissioned in 1980. The source of its feeding is from Nakhchivanchay through the canal. After the commissioning of the Heydar Aliyev Reservoir, it is fed mainly through the left bank canal. The height of the dam is 23 m, the length of the dam is 2650 m, the total volume is 12.7 million m³, the useful volume is 12 million m³. The area irrigated by the reservoir is 2700 ha, water consumption is 5 m³/sec.

12 fish species belonging to 4 families were recorded for the water reservoir. 8 out of found species belong to Cyprinidae family, 2 to *Balitoridae*, 1 to *Cobitidae* and 1 to *Pociliidae* families. According to the intensity of encountered species, *Alburnus filippi*, *Alburnoides bipunctatus eichwaldi*, *Carassius auratus gibelio* dominated.

Dastagol lake. It is fed by the ditches built from the Duylunchay river that starts from the altitude of 3000 m. Dasta 1 lake was built and put into operation in 1962, and Dasta 2 lake was built and commissioned in 1981. Their area is 60 ha, and water capacity is 0,45 million m³. Those lakes supply water to 350 ha planted area in the territory of Dasta village.

8 fish species included in 3 families were recorded from the reservoir. 6 out of the found species belong to Cyprinidae family, 1 to *Balitoridae*, and 1 to *Cobitidae* family. According to the intensity of species encountered, *Alburnus filippi*, *Alburnoides bipunctatus eichwaldi*, *Carassius auratus gibelio* species dominated.

Sanitary and environmental status of water basins was also assessed. The indicator role of mentioned 135 species in water basins was determined. 64 out of the found species are encountered in the rivers, while 104 species are found in the lakes. Certain species are found both in rivers and lakes. 86,5% of the species found in the rivers, and 78,1% of the species encountered in the lakes belong to the share of oligosaprobe species. The distribution of the organisms for biocenosis is

variable. The maximum development of macrozoobentos is observed in phytophilous biocenosis in Batabat lake, while in rivers, it is observed in lithophilous biocenosis.

Fish species living in natural and artificial lakes of the Nakhchivan Autonomous Republic are an important source of food for the local population. In recent years, according to fishermen, the number and diversity of fish in reservoirs has decreased. Most of the factors that lead to the decline of fish populations are caused by human activities (anthropogenic). The protection of this wealth is as important as the identification of species. For this reason, the factors affecting the fish fauna of the region's aquifers and the measures needed to protect them need to be added to the recommendations.

It has been observed that some taxa, which increase species diversity and form a link in the food chain in the ecosystem, face the same danger.

Natural factors. The decline of ichthyofauna resources in the aquifers have several reasons. However, the disturbance of natural balance is the main factor.

Environmental pollution factors. The gradual decline in the quality of aquifers, a significant change in the biomass, species diversity, density, and distribution of fish, leads to a weakening of the food chain by reducing the contact of algae with oxygen.

- Industrial waste
- Garbage and solid waste
- Sewage waste
- Detergents and artificial fertilizers
- Agrochemical substances
- Oil and oil product
- Radioactivity
- Thermal contamination

The technology, which is developing in parallel with the growth of the population, leads to environmental pollution, which has a serious impact on the rich fish fauna of the region if no measures are being taken. The problem of environmental pollution caused by the production and consumption activities of individuals and companies, in particular, has a serious impact on the spawning and fertilization of fish.

Other factors. In some watersheds with low control, both professional and amateur fishermen catch fish to meet their fish needs, regardless of the season, regardless of the abundance of fish in that reservoir. Due to these factors, fish productivity in reservoirs is declining, and the quality of shelter, spawning and development environment suitable for fish is rapidly declining.

Hunting in prohibited periods and in excessive amount. These periods are not strictly observed during the period when fishing is prohibited. Although some authorities have tried to prevent the hunt, these measures have not yet been very successful. In order to prevent illegal and uninformed hunting, it is necessary to educate the local population, strengthen controls and increase the penalties. Undoubtedly, untimely, and excessive fishing in inland waters creates problems depending on the connection of the food chain. The decline of one species leads to the decline of the other species that feed on it.

During the breeding season, fishing reduces the number of fish and, accordingly, has a significant impact on the survival of the offspring. Spawning times of fish species that are resistant to changes in environmental conditions should be determined and their breeding should be facilitated to ensure sustainable fishing. Sometimes the reproduction periods of individuals of the same species may be different because the development of the gonads varies depending on environmental conditions, especially temperature-to-region changes. For this reason, it is important to determine the breeding season of fish.

The introduction of new fish species to freshwater sources. One of the important factors that influence on fish population is the introduction of new species. New species in freshwater resources, which enter to the natural environment occasionally and without information may lead to the disappearing of local (endemic) species. In addition, hybridization, predators, competition, habitat

changes, diseases, and parasites due to dangerous effects. Some fish become localized, and others become extinct, especially as carnivorous fish are brought into stagnant water bodies as ecosystems improve. Fish species released into lakes endanger the population of naturally occurring fish species and subsequently lead to their extinction. To take certain precautionary measures and prevent undesirable results, the necessary research, comments, effective planning and follow-up should be carried out before conducting research. Introduction activities that disrupt the structure of natural fish fauna should be prevented. The natural ichthyofauna of fish species distributed in the area is sensitive and vulnerable to such intrusions.

Hydropower plants. New environmental conditions form due to the hydro power plants (HPPs) that are built on rivers to generate energy, fight floods, and irrigate. Changes in the natural structure and deposits of the river can affect the lifestyle of fish, leading to the extinction of some species over time or their isolation in certain areas. In addition, as we explain in more detail under the heading of proposal, when the reservoir is filled, the lack of oxygen and the accumulation of sludge have a negative effect on the fish.

Modification of streams because of anthropomorphic activities such as dam and pond construction, climate change, and the entry of some species into the environment may increase the interval of formation of hybridization, which is very rare in nature.

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