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Research Article

Macrozoobenthos of Shamkirchay river under new environmental circumstances (republic of Azerbaijan)

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Abstract
Shamkirchay is one of the transboundary rivers of Azerbaijan and one of the main right tributaries of the Kura River, the main water body. For the first time, from November 2018 to March 2020, macrozoobenthos, an important component of the river's hydrofauna, was studied comprehensively, depending on the seasons. During the study, 91 species of macrobenthic organisms were identified, the development of which varied between 19-91 species, depending on the season. At the same time, we have set some hydrochemical indicators. The status of the river and its distribution on saprobic organisms and their biocenoses were also investigated during the observations.
Keywords: Biocenosis, biomass, macrozoobenthos, saprobity, Shamkirchay

Introduction
The complexity of the relief in the territory of the Republic of Azerbaijan provides an opportunity to carry out its vertical ranking into the high mountain terrane, intermediate-level mountain terrane, low-level mountain terrane, and plain-lowland terranes. The high mountainous belt covers the areas higher than 2500 m, the medium mountainous belt between 1000-2500 m, and the low mountainous belt encompasses the areas from 200-1000 m. There are many rivers, lakes, and forests in the areas covered by Greater Caucasus and Lesser Caucasus. Most of the rivers are right and left tributaries of the Kura River that flows through the Kura Basin occupying the central part of the Republic of Azerbaijan. Four large reservoirs of great economic importance have been constructed over the Kura River. Certain rivers merge with water reservoirs.
For the first time, hydrobiological research in Shamkirchay was conducted by Gasimov (Gasimov, 1972). The research was superficial and limited. In recent years (2014) a hydropower plant has been built on the river. The hydrological regime of the river, the hydro morphology of the river have changed. At the same time, a reservoir with an area of 375 hectares was created on the river. The population and settlements along the river have increased. Anthropogenic impacts on the river have

increased. The main goal is to study the species composition and distribution area of macrobenthos, which is of economic importance in the water basins that form the basis of hydro-fauna. For this purpose, certain observation points have been identified on the river, and certain results have been achieved in 2018-2020. The research was conducted to study river hydro bionts, riparian vegetation, and fauna. The study covered the period from November 2018 up to 2020. The study of those areas provides great scientific-economic significance. Monitoring was carried out comparatively. The studied rivers indicated the biocenoses replacing each other. Every biocenosis owns its characteristic habitat.

General characterization of the water basin

As a transboundary watercourse, the Shamkirchaystarts from the territory of Armenia flows through the territories of Gadabey and Shamkir regions of Azerbaijan and joins to Shamkir water reservoir. Shamkir reservoir is located on the Kura River. The Kura River is a transboundary river (1515 km long), which originates in the mountains of Turkey, flows through Georgia, enters the territory of Azerbaijan, and joins the Caspian Sea. 4 large-scale series of reservoirs have been built on the Kura River. One of them is Shamkir reservoir.

Gadabey region is located on the middle and higher mountainous belt of Lesser Caucasus; its territory covers the northern slope of Shahdagh chain, certain parts of Bashkend-Dastafur depression, and Shamkir Mountain range. Shamkirchay River flows through the south-western boundaries of the Gadabey region. The Shamkirchay River begins after the confluence of the Sarisu and Aghdashsu rivers, which flow from the north-eastern slope of the Shahdag range in the Lesser Caucasus. The beginning of the Sarisu River is considered as the source of the Shamkirchay River (Hynaldagh, 3220 m). The area of the river basin is 1170 km^2, and its length is 95 km (Mammadov, 2012). The river has 6 right and 8 left tributaries (Fig.1). The Shamkirchay River flows into the Shamkir water reservoir next to the Kura settlement. The north-eastern part of the Shamkir region is occupied by the Jeyranchol plain, the central part is encompassed with the Ganja-Gazakh plain and the southern part is covered by the northeastern foothills of Lesser Caucasus. There are high mountains, subalpine and alpine meadows in this area.

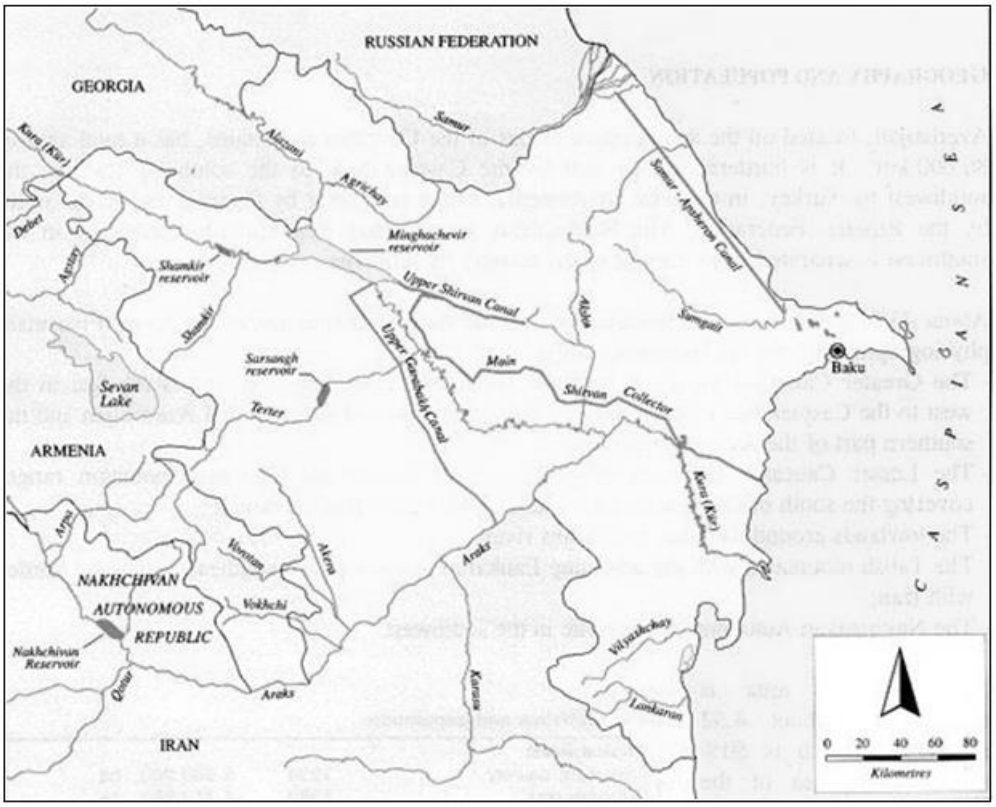

Figure 1. Shamkirchay River in the map of Azerbaijan

There were historically two hydrometric observation (monitoring) points over Shamkirchay River:1) Galakend observation point; 2) Barsum observation point

The area of the Shamkirchay River basin up to the Galakend observation point is 117 km^2. The stationary observation here started in 1966. According to the data provided from this point of the river, the flow rate is 2,34 m^3/s. The area of the Shamkirchay River basin up to the Barsum observation point is 922 km^2. Here, stationary observations started from the year 1928. The flow rate at this point is 8,47 m^3/s.

In the Project where the report is provided, hydro-biological observations were continued on pre-selected four sampling stations.

1) Gadabey region, next to the hydro-biological point in Galakend, N 40º 32′ 32.06″; E 45º 54′ 24 97″
2) The Lower part of the Shamkirchay water reservoir, N 40º 43′ 28.40″; E 46º 6′ 30.84″
3) Next to the bridge adjacent to Chinarly village of Shamkir region, N 40º 46′ 30. 58″; E 46º 6′ 30. 58″
4) Near the Kura settlement in the Shamkir region (Kura settlement), where the river flows into the reservoir, N 40º 53′ 30. 61″; E 46º 9′ 42. 56″

Material and methods

Benthic samples in water basins were taken based on common methods adopted in hydrobiology (V.I. Jadin, 1956). Organisms that lived on the soil at the bottom of the aquifers (epifauna) and inside it (infauna) and were visible to the naked eye generally formed macrobenthic organisms, or simply benthos. In benthos, motile forms or vagile creatures (river crustaceans, crabs, octopuses, starfish, etc.) lie on the ground, with noticeable immobile or sedimentary forms (ringworms, most mollusks, sea urchins, etc.) and live sedentary forms or sessile forms (sponges, bryozoans, polyps, etc.) that adhere to any solid substrate.

Materials from deeper areas were taken through special combs and bottom pickers. The materials collected with these tools were washed in a ladle, and the mass remaining in the ladle was filled into special containers, fixed, and labeled with a 4% formalin solution. Materials collected and labeled from different biotopes, different areas, and depths of the basin were removed from the soil under the laboratory conditions and the organisms were carefully removed by scraping and placed in special containers containing 4% formalin solution and tightly closed. At the same time, formalin (4%) did not affect the weight as significantly as other substances used to preserve samples - ethanol, ethylene glycol, propylene glycol, ethyl acetate (Knapp, 2012). Ethyl alcohol (70%), in addition to water, can remove lipids from tissues, which leads to large weight loss, reaching 30-35% (Mährlein et al., 2016). The differences between these fixatives in the ability to reduce the weight of organisms were considered when analyzing the results. In our work, we avoided comparing the data obtained using different fixators with each other.

After such an operation, the benthic organisms in each special container were divided into groups and their species composition was investigated. Macrozoobenthos samples were taken in Shamkirchay River sections with different hydrological characteristics: rapids (shallow rocky or rocky area in the riverbed with a sharp drop in water level and increased flow rate) and rocky river rifts, where the depths ranged from 0.10 to 0.50 m, and the current velocity from 0.10 to 0.15 m/s, and reach areas with depths from 0.1 to 4.0 m and flow rates from 0.005 to 0.5 m/s. The rapids were characterized by stony (pebble or boulder, often with a small amount of sand) soils without soft precipitation; reaches were distinguished by significant sedimentation, soft (silty or clay) soils.

The identification of the organisms we found was determined using designation books published under the editorship of S.Y.Tsalokhin (Tsalokhin, 1999; 2001). Also, another designation manual by V.R.Alekseev and S.Y.Tsalokhin (Alekseev, Tsalokhin, 2016) was used in the process of identification. Names of species (except for Mollusca) were assigned by the current European system based on the Fauna Europea database (De Jong, Y. et al., 2014). The leech (Hirudinea) fauna of the area was represented by one species (*Placobdella costata*, (Fr. Müller 1846) belonging to the Glossiphoniidae family. *P.costata* is one of the most widespread species in Azerbaijan (Farzali, Saglam, 2020). The names of the species Gastropoda and Bivalvia were given by the work (Vinarski, Kantor, 2016). In these and other articles, I also used the general methodology adopted during research in other rivers of Azerbaijan (Aliyev, 2020; Aliyev 2021a; 2021b; 2021c; 2021d; 2021e).

Results

In total, 19 species of benthic organisms were recorded in four pre-determined biological monitoring points or stations in November 2018 (Fig. 2). Two species out of them belong to worms (Oligochaeta), three species from mollusks (Mollusca), three species from crustaceans Crustacea), five species from Odonata (Odonata), two species from Mayfly larvae (Ephemeroptera), one species from bugs (Hemiptera), and finally three species from Caddisfly (Trichoptera). A total of 36,8% of identified species account for aquatic insects.

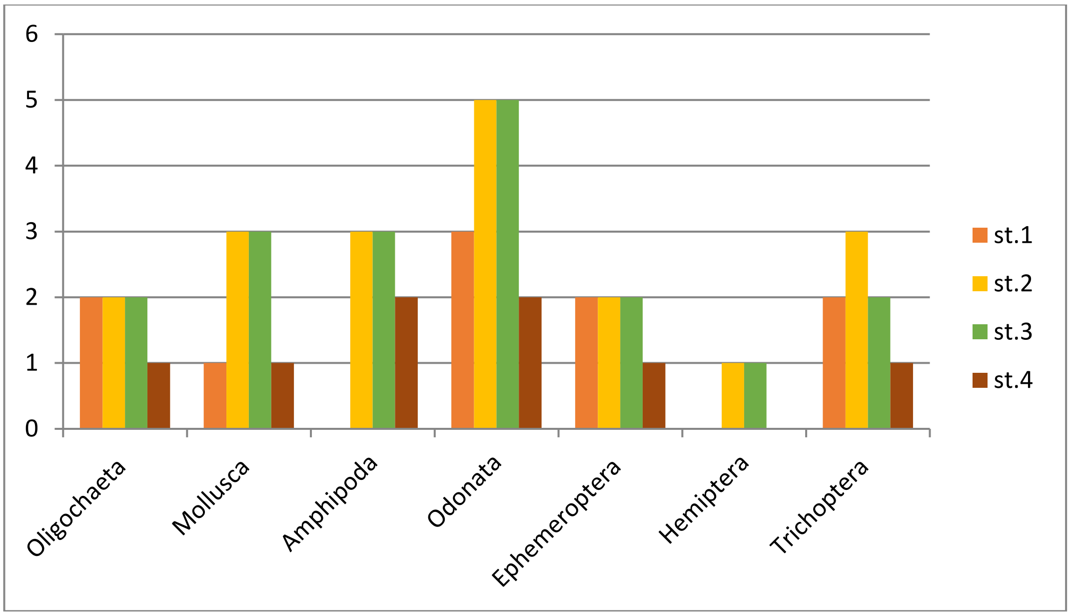

Figure 2. The number of macrobenthos species for groups in November 2018

During the observations for March 2019, a total of 22 species of benthic organisms was recorded in 4 pre-determined biological monitoring points of Shamkirchay River. Out of those species, 2 belong to worms (Oligochaeta), 2 species - to mollusks (Mollusca), 1 species - crustaceans (Crustacea), 4 species - to Mayfly larvae (Ephemeroptera), 6 species - to Caddisfly (Trichoptera), and 5 species - to Chironomidae larvae.72,7% of identified species account for aquatic insects.

During the observations for May 2019, a total of 68 species of benthic organisms was recorded in 4 pre-determined biological monitoring points of Shamkirchay River. Out of those species, 4 belong to worms (Oligochaeta), 8 species - to mollusks (Mollusca), 7 species - crustaceans (Crustacea), 6 species - to Mayfly larvae (Ephemeroptera), 10 species - to Caddisfly (Trichoptera), and 7 species - to Chironomidae larvae. 76,5% of identified species account for aquatic insects.

The observations conducted during July 2019 enabled us to find 91 species of macrobenthicorganismsforShamkirchay River, which were included in 13 systematic groups. Out of the identified organisms, 54 species were collected from Galakend station, 68 species - from the area downstream of the reservoir, 72 species - from the area next to Chinarly village, and 42 species of organisms collected from the area,whereShamkirchay River joins water reservoir. During the survey, mainly Mayfly and Caddisfly larvae were distinguished due to their encountering intensity, i.e., they dominated. The percentage ratio of the species identified is presented in Fig.3.

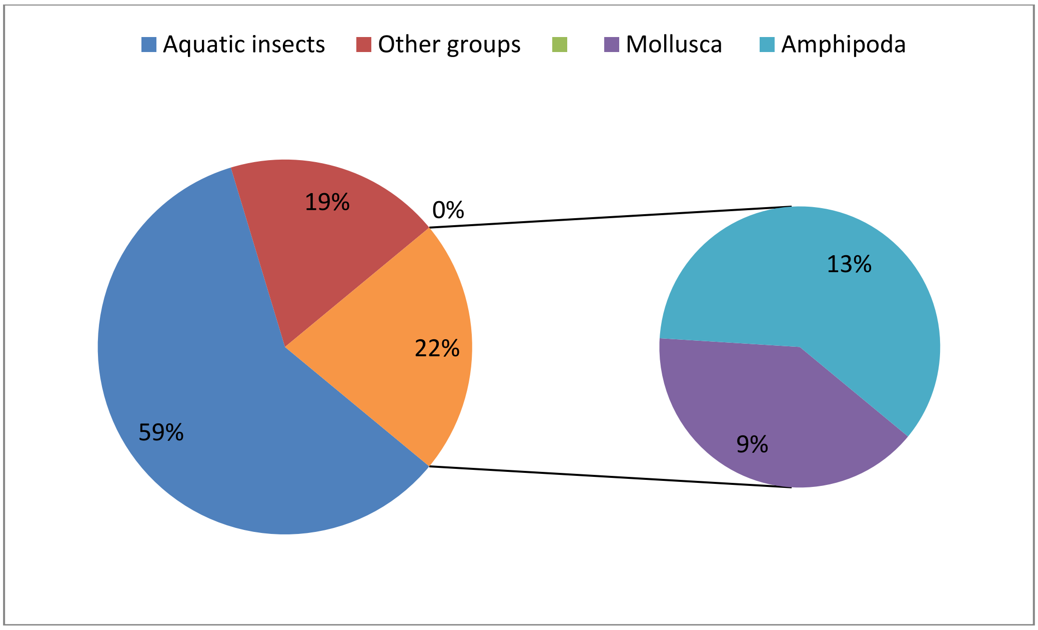

Figure 3. The percentage ratio of species composition of macrozoobenthos in Shamkirchay River

During the observations conducted in August 2019, 85 species of macrobenthic organisms were recorded for the Shamkirchay River, which was included in 13 systematic groups. 7 species belong to worms (Oligochaeta), 1 species - to leeches (Hirudinea), 8 species - to mollusks (Mollusca), 12 species - crustaceans (Crustacea), 5 species - to Odonata (Odonata), 6 species - to Mayfly larvae (Ephemeroptera), 9 species - to water mites (Hydrocarina), 5 species - to bugs (Hemiptera), 15 species - to Caddisfly (Trichoptera), 6 species - to Chironomidae larvae (Chironomidae), 3 species - to heleides (Ceratopogonidae), 5 species – to Culicidaes, and 3 species belong to Simuliidae (Figure 11). 56,3% of identified species account for aquatic insects.

25 species of macrobenthic organisms were recorded for Shamkirchay River during the observations conducted in November 2019, which were included into 6 systematic groups. 4 species out of those organisms belong to worms (Oligochaeta), 4 species - to mollusks (Mollusca), 3 species - crabs (Crustacea), 6 species - to Mayfly larvae (Ephemeroptera), 3 species - to Odonata (Odonata), 5 species - to Caddisfly (Trichoptera). Aquatic insects dominated in the studied points (56,3%).

During the observations conducted in January 2020, 13 species of macrobenthic organisms were recorded for the Shamkirchay River, which was included in 6 systematic groups. During the survey, mainly Mayfly and Caddisfly larvae were distinguished due to their encountering intensity, i.e. dominated. Aquatic insects dominated in the studied points (Fig.4).

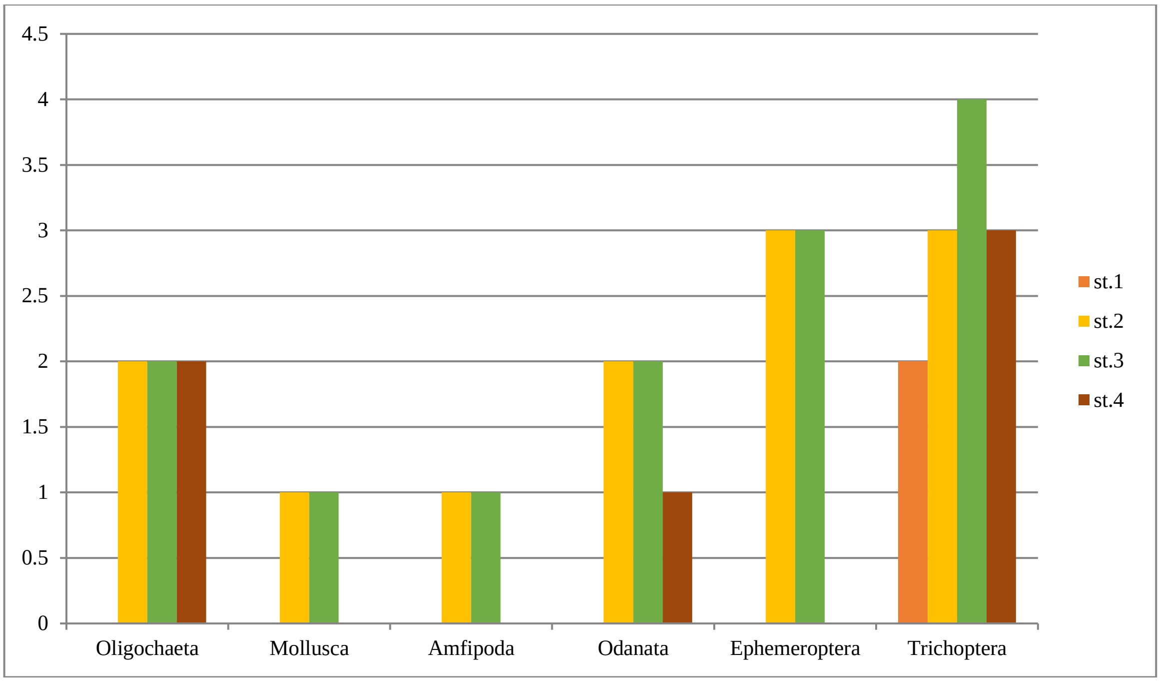

Figure 4. The number of macrozoobenthos species for groups in January 2020

13 species of macrobenthic organisms were recorded for Shamkirchay River during the observations, which were included into 6 systematic groups. 2 species out of those organisms belong to worms (Oligochaeta), 1 species - to mollusks (Mollusca), 1 species - crustaceans (Crustacea), 3 species - to Mayfly larvae (Ephemeroptera), 2 species - to odonata larvae (Odonata), 4 species - to Caddisfly (Trichoptera). 69% of identified organisms account for aquatic insects. The water temperature in the river near Galakend station was 2°C. The development of macrobenthic organisms does not progress well under such temperatures. The lifecycle of some aquatic insects starts in May.

24 species of macrobenthic organisms were recorded for Shamkirchay River during the observations conducted in March 2020, which were included into 6 systematic groups. Number dynamics and biomass of organisms found in the Shamkirchay River were separately recorded. The biomass of organisms in studied areas was 0,16-0,50 g/m^2, and the number was 32-154 sp./m^2.

During the studies, certain water samples were taken from the 4 stations and sent to the Central Laboratory of the Ministry of Ecology and Natural Resources. Based on the results, the average indicators for physical-chemical elements in water are as follows (Table 1):

Table 1. Physical-chemical parameters of water in Shamkirchay River during November 2018 - March 2020 period

	Average	min	max
Dissolved Oxygen, mg/L	10,2	8,39	12,4
TDS, mg/L	150	108	197
Turbidity, NTU	8,35	3,5	19,4
pH	8,02	7,29	8,64
Conductivity, µs/cm	301	201,5	394
Temperature, C	14,3	2	27,2
Ammonia (NH4+), mg/L	<0,02	<0,02	<0,02

Fluoride (F^-), mg/L	0,15	0,11	0,18
Chloride (Cl^-), mg/L	4,03	<3	7
Nitrite (NO_2^-), mg/L	0,04	<0,03	0,12
Bromide (Br^-), mg/L	<0,05	<0,05	<0,05
Nitrate (NO_3^-), mg/L	6,5	4,2	9,2
Sulfate ($SO4^{2-}$), mg/L	32,9	5,3	56
Phosphate (PO_4^{3-}), mg/L	0,57	<0,04	1,78
COD, mg/L	28	<5	212
BOD5, mg/L	3	1	3
TSS, mg/L	7,48	<2	21

With the help of the experts involved in the UNDP-GEF Kura 2 Project, the initial assessment was conducted to determine the water status in the river. The obtained result from chemical analysis enables us to summarize that there are normal conditions in the river for the development of organisms (Table 1-2, Fig.5).

Table 2. The status of the benthic community in Shamkirchay River

Water Status Assessment - Shamkirchay River	
November 2018	Moderate
March 2019	Good
May 2019	Moderate
July 2019	Good
August 2019	Good
November 2020	Moderate
January 2020	Poor
March 2020	Good

While summarizing the conducted monitoring results, the number of species varied between 13-91 in Shamkirchay (Table 3).

Table 3. Number of species in Shamkirchaymacrozoobenthos

Biologicalstations	*2018 November*	*2019 March*	*2019 May*	*2019 July*	*2019 August*	*2019 November*	*2020 January*	*2020 March*
st.1	10	11	47	54	50	16	2	8
st.2	19	22	58	68	64	16	12	20
st.3	18	19	54	72	70	14	13	22
st.4	8	12	36	42	40	8	6	7
Total	**19**	**22**	**68**	**91**	**85**	**25**	**13**	**24**

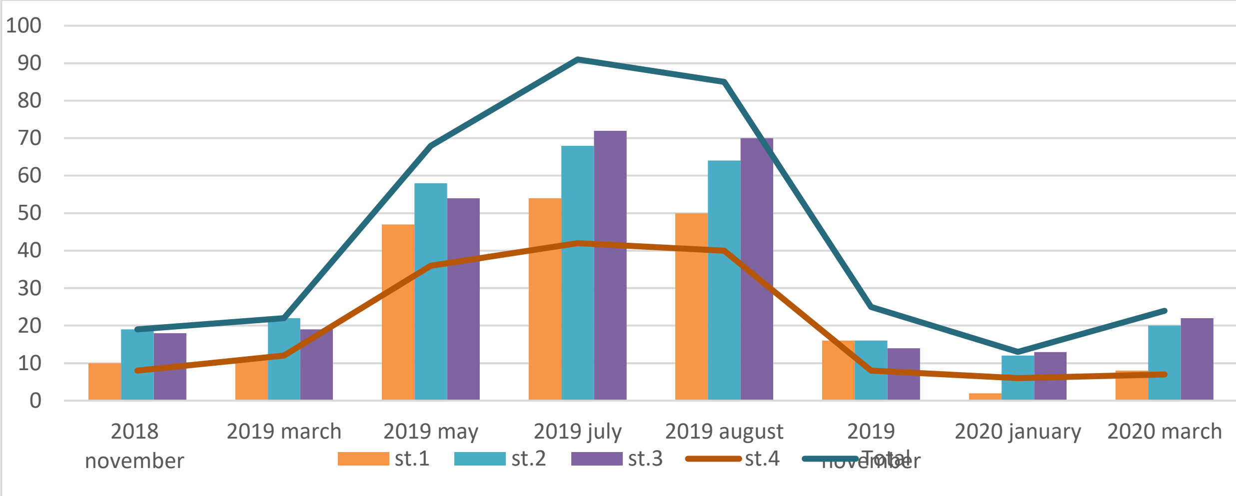

Figure 5. Several species for biological stations in Shamkirchaymacrozoobenthos

Biological indicators are satisfying in studied stations. The amount of dissolved oxygen in the water for Shamkirchay River was 8,33-12,71 mg O_2/l, pH was 7,29-8,64, and the temperature varied between 2-27,2 °C. Hydrobionts develop well under such values; it is particularly favorable for oxyphilic organisms.

As it is known, physical-chemical parameters of water change depending on the seasons; the temperature gets higher as the winter is replaced by summer, oxygen is getting increased, and the organisms start to develop and reproduce. However, in the spring and summer, the amount of oxygen decreases due to the process of photosynthesis in aquatic plants. This process has also a certain impact on the development of oxyphilic organisms.

The detailed information regarding the species composition, number of individuals, and saprobity of the Shamkirchay river is provided in the tables below.

Table 4. Species composition of macrobenthos, number of individuals, and saprobity of Shamkirchay River

	Name of species	**Saprobity**	**Station 1. Gadabey district, Gala village**	**Station 2. The downstream part of Shamkirchay reservoir**	**Station 3. Shamkir district, Chinarly village**	**Station 4. Shamkir district, Kura settlement**
	Class: Oligochaeta					
1	*Eisenella tetraedra* (Savigny, 1826)	β	5	10	8	0
2	*Branchiura sowerbyi* Beddard, 1892	«0»	8	10	12	14
3	*D.obtusa* Udekem, 1855	«0»	0	0	7	10
4	*Auloforus furcatus* Müller, 1773	«0»	0	0	6	12
5	*Aulodrilus piqueti* Bretscher, 1899	«0»	15	0	9	0
6	*A.limnobius* Kowalevski, 1914	β	10	0	7	0
7	*Limnodrilus hoffmeisteri* Clapararede, 1862	«0»	8	0	9	0

	Class: Hirudinea					
8	*Placobdella costata* (Fr.Müller, 1846)	β	10	15	0	0
	Phylum: Mollusca					
9	*Lymnaea auriculiaria* Linnaeus, 1758	«0»	8	20	24	10
10	*Costatella acuta* Draparnaud, 1805	«0»	0	6	12	0
11	*Lymnaea stagnalis*Linnaeus, 1758	«0»	0	13	17	0
12	*L.ovata* Drap.	«0»	10	0	15	22
13	*Aplexa hypnorum* Linnaeus, 1758	«0»	8	6	0	0
14	*Melanopsis praerosa*Linnaeus, 1758	«0»	0	0	5	0
15	*Anisus spirorbis* Linnaeus, 1758	«0»	3	9	15	2
16	*A.contortus* Linnaeus, 1758	«0»	2	6	3	3
	Order: Amphipoda					
17	*Pontogammarus robustoides* Grimm, 1894	«0»	0	10	5	7
18	*Dikerogammarus haemobaphes* Eichwald, 1841	«0»	6	0	4	2
19	*Gammarus lacustris* Sars, 1895	«0»	8	0	4	0
20	*G.k aralensis* Derzhavin, 1945	«0»	5	0	7	0
21	*G.aralensis setosus*, Shaeferna, 1914	«0»	9	0	3	0
22	*G.b.talyschensis* Derzhavin, 1945	«0»	0	0	0	6
23	*G.matienus* Derzhavin, 1945	«0»	0	0	10	12
24	*G.balcanicus alarodines* Derzhavin, 1938	«0»	11	15	24	8
25	*P.sarsi* Sovinski, 1905	«0»	0	12	18	7
26	*P.maeoticus* Sovinski, 1905	«0»	5	11	3	3
27	*Nifarqus kurdus* Derzhavin, 1945	«0»	6	8	10	3
28	*N.abricossovi* Birstein, 1934	«0»	0	6	5	2
	Order: Hydrocarina					
29	*Eylais hamata* Koen, 1897	«0»	20	32	18	0
30	*E.degererata* Koen, 1897	β	15	30	22	14
31	*Hydrachna prosessifera* Koen, 1897	«0»	0	10	20	13
32	*H.geographica* O.F. Müller, 1776	«0»	18	28	16	10

33	*Diplodontus despiciens* O.F. Müller, 1776	β	0	14	10	3
34	*Neumania spinipes* O.F. Müller, 1776	«0»	0	6	3	2
35	*Limnochares aquatica* O.F. Müller, 1776	β	0	7	3	1
36	*Sperchonopsis verrucosa* (Protz, 1886)	«0»	10	4	5	1
37	*Atractides arcuatus* (Ther, 1914)	«0»	8	12	6	4
	Order: Odonata					
38	*Epallage fatime* Charpentier, 1840	β	10	12	5	0
39	*Agrion virgo* Linnaeus, 1758	«0»	0	0	0	8
40	*A.splendens* Harris, 1782	«0»	0	0	0	6
41	*L. virens* Charpentier, 1885	β	9	3	7	0
42	*L.sponsa* Hausemann, 1825	«0»	0	7	3	2
	Order: Ephemeroptera					
43	*Centroptilum luteoum* O.F. Müller, 1776	«0»	11	19	24	6
44	*Ordella macrura*Stephens, 1835	«0»	17	13	7	3
45	*Baetis rhodani* Pictet, 1843	«0»	12	18	5	2
46	*Ephemera vulgata* Linnaeus, 1758	«0»	0	0	6	2
47	*A.lapponica* Bengtsson, 1912	«0»	8	4	3	1
48	*Ecdyonurus auranticecus* Burmeister, 1839	«0»	3	5	7	2
	Order: Hemiptera					
49	*Hydrometra stagnorum* Linnaeus, 1758	«0»	3	5	9	2
50	*Aphelocheirus aestivalis* (Fabricus, 1794)	«0»	11	15	21	4
51	*Cymatia coleoptrata*Fabricus, 1776	β	8	6	2	1
52	*Corixa punctata* Illiger, 1807	«0»	7	10	14	6
53	*C.affinis* Leach, 1817	β	6	3	2	2
	Order: Trichoptera					
54	*Lype reducta* Hag.,1844	«0»	24	32	16	8
55	*Hydropsyche ornatula* McLachlan, 1878	«0»	10	5	14	10
56	*H.instabilis* Curtis, 1834	«0»	8	16	21	6
57	*Rhyancophila nubela* Zetterstedt, 1840	«0»	10	32	17	9

58	*Rh.cupressorum* Martynov, 1909	«0»	0	9	11	4
59	*Ecnomus tenellus* Rambur, 1842	«0»	15	29	18	**7**
60	*H.instabilis* Curtis, 1834	«0»	6	10	13	3
61	*H pellucidula* Curtis, 1834	«0»	5	9	11	7
62	*H.acuta* Martynov, 1909	«0»	6	10	0	2
63	*Cheumotopsyche lepida* Pictet, 1834,	«0»	10	0	5	3
64	*Plectrocnemia conspersa* (Curtis, 1830)	«0»	11	12	9	4
65	*Psychomyia pusilla* Fabricius, 1781	«0»	10	3	5	3
66	*Philopotamus montanus* (Donovan), 1813	«0»	7	8	6	4
67	*Granunotaulus atomatius* Fabricus, 1776	«0»	4	6	7	2
68	*Limnephilus flavicornis* Fabricus, 1776	β	0	14	18	6
69	*Micrasema bifolatum*Pictet, 1834	«0»	12	9	16	4
70	*Leptocerus tinecformis* Curtis, 1834	«0»	5	9	11	7
71	*Oecetis furva* Rambur, 1842	«0»	8	10	12	3
	Family: Chironomidae					
72	*Chironomus plumosus*	β	3	10	3	5
73	*Cryptochironomus defectus* Kieffer, 1921	β	9	12	10	3
74	*Einfeldia pagana* Kieffer, 1920	β	3	5	6	4
75	*Polypedilum nubeculosum* Kieffer, 1921	β	1	4	7	10
76	*P.convictum* Walker, 1856	β	0	9	13	4
77	*Cricotopus silvestris*Fabricus, 1794	β	9	12	0	0
78	*Pentapedilum exectum* Kieffer, 1920	«0»	6	8	6	2
	Family: Heleidae					
79	*Culicoides nubeculosum* Meigen, 1818	«0»	3	2	1	1
80	*C.puncticollis* Becker, 1902	β	4	2	0	0
81	*C.salinarius* Kieffer, 1920	«0»	0	5	3	3
	Family: Culicidae					
82	*Anopheles hyrcanicus* Pallas, 1774	«0»	30	46	28	16
83	*A.maculipennis* Meigen, 1818	«0»	0	0	23	0
84	*A.bifurcatus*Linnaeus, 1758	«0»	24	38	18	12

85	*Aides caspicus caspius* (Pallas, 1774)	«0»	0	0	15	0
86	*A.cinereus* Meigen, 1818	«0»	10	0	16	3
	Family: Simuliidae					
87	*Prosimulium petrosum* Rubtsov, 1955	«0»	38	54	6	20
88	*P.gigas* Rubtsov, 1955	«0»	0	26	18	10
89	*P.rachiliense* Dzahafarov, 1956	«0»	13	31	40	9
90	*Cnephia nigra* (Rubtsov, 1955)	«0»	60	58	46	12
91	*Cn.terterjani* Rubtsov, 1955	«0»	0	14	12	9

Discussion

The results of research conducted for about a year and a half show that aquatic insects (54 species, 59%) predominate in the macrozoobenthos of Shamkirchay. Other groups are represented by 1-12 species, the last of which is occupied by Amphipoda crabs (Fig. 6). The saprobity zone of the river has been investigated. It was determined that 74 of the registered species belong to the oligosaprobic zone, and 17 species belong to the beta-mesosaprobic zone. At the same time, some hydrochemical parameters were determined in the river. The results obtained correspond to the allowable concentration (PDK). At the same time, the status of the river was determined, and the results showed that the condition of the river water is good. This water can be widely used in the water supply of the population.

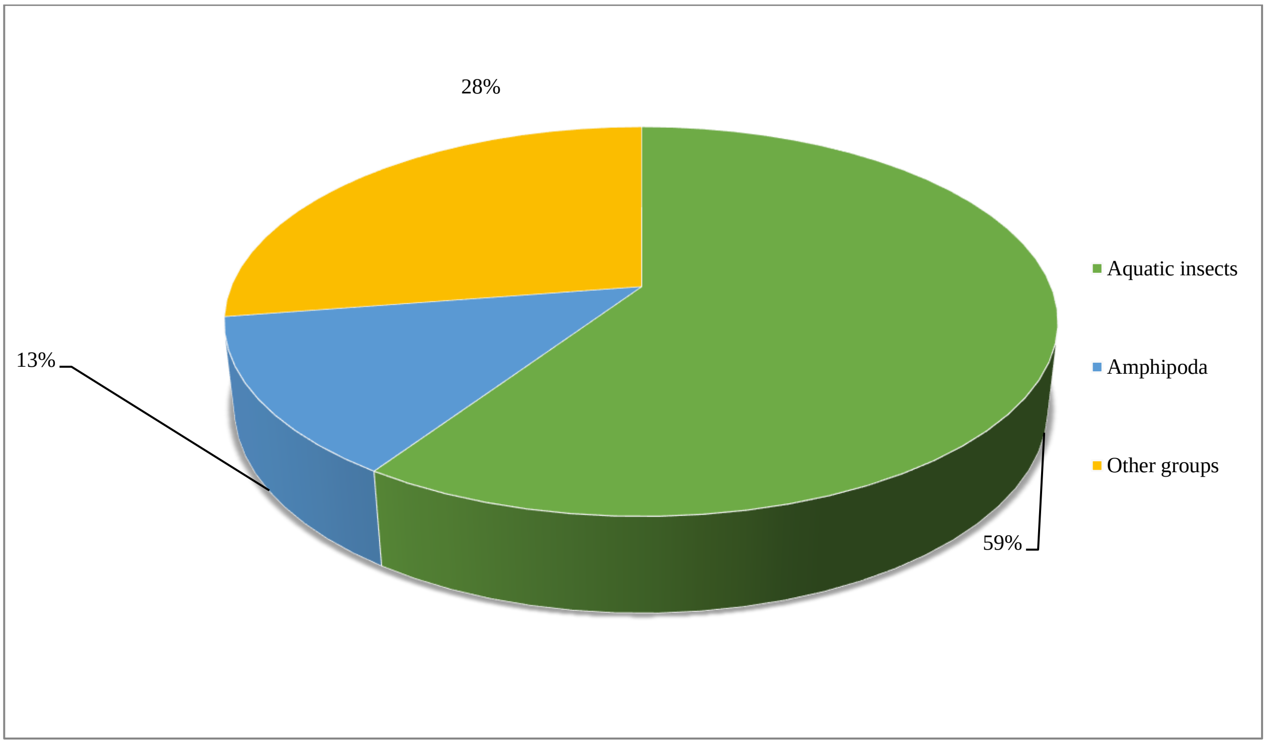

Figure 6. The percentage ratio of the number of species in Shamkirchay

During the observation period, the number of species in November 2018 was 10-19, in March 2019 11-22, on May 36-58, in July 42-72, in August 40-64, on November 8-16, in January 2020 2- 13, and in March it was 7-22. The total number of species by season varied from 13 (January 2020) to 91 (July 2019). The maximum number of species during the monitoring period was in July-August 2019 (85-91 species). Biological indicators are satisfying. The Oxygen regime of water for Shamkirchay River was 8,33-12,71 mg O_2/l, pH was 7,29-8,64, and the temperature varied between 2-27,2 °C. Hydrobionts develop well under such values; it is particularly favorable for oxyphilic organisms.

Hydropower plant (HPP) built on the Shamkirchay River is of great importance for the energy provision of the country. The construction of a hydropower dam prevents the migration of a few hydrobionts. Hydrobionts lose their breeding grounds. During their reproduction, fish species move from the Caspian Sea to the source of the rivers, placing their eggs in suitable places at the source of the rivers. Temporary fish spawn at the bottom of the dams. On the other hand, when the turbines of HPPs operate, the thermal regime of the water changes, the temperature rises, and to some extent, pollution occurs, because of which some hydrobionts are destroyed. To improve water supply, it is necessary not only to reduce water use and use it sparingly but also to conduct research to increase water resources. However, in this way, it is possible to provide all sectors of the population and the economy with the required amount and quality of water by international standards, and at the same time to achieve a stable environmental situation in rivers, lakes, and reservoirs. The quality of water in reservoirs depends on the degree of pollution of the rivers flowing into it, the sanitary and hygienic condition of their beds. Studies have shown that water quality deteriorates sharply as a consequence of anthropogenic eutrophication (food fractions) of reservoirs created against the background of intensive river pollution.

Conclusion

Along with the collection of materials, we paid attention to the water flow velocity, vegetation, soil, hydrological changes in the river, hydrochemistry. As it is known, physical-chemical parameters of water change depending on the seasons; the temperature gets higher as the winter is replaced by summer, oxygen is getting increased, and the organisms start to develop and reproduce. However, in the spring and summer, the amount of oxygen decreases due to the process of photosynthesis in aquatic plants. This process has also a certain impact on the development of oxyphilic organisms.

One of the distinguishing features of my reservoirs from natural reservoirs is that their water level is unstable. Fluctuations in the level of reservoirs depend on several factors. This includes the operating mode of the turbines, the volume of incoming water, the volume of water allocated for crops, etc. Decreases in reservoirs occur most often in the first months of spring and summer. Because more water is needed to supply the fields with water during these months. It is known that the spring months are the most intensive breeding period for animals. Most of the freshwater fish spawn currently, in the coastal shallows. It is very easy to understand the consequences of a drop in the water level in the reservoir at the end of spring and the beginning of summer.

The biological cover is a complex biocenosis, and the micro-and macro-organisms that live there are of different types and have high biomass. From microscopic organisms living in the biological cover, mainly to whips, infusions, bacteria, plankton algae, etc. happens to come across. In the biological cover, as well as in the aquifer, these organisms play an important role as a biofilter in the purification of water from harmful substances. Organisms specific to the biological cover (crustaceans, snails, etc.) form very large biomass in almost all water bodies: underwater objects in the seas and oceans, in submarines, in the underwater parts of ships. Organisms with such large biomass play a "sanitary" role in filtering water, cleaning it of harmful wastes and substances, feeding on pathogenic microorganisms, and preventing water pollution. It should be noted that all single and multicellular organisms living in the biological cover alternate in the biological cover cenosis (bacteria-algae-primitive-multicellular organisms), repeatedly filtering the water around them, and the water is repeatedly purified. In this biocenosis, the process that many organisms cannot perform is completed by other groups. Therefore, living things in the biological cover play a very important role in water purification.

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