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THE IMPACT OF THE PLANNED ACTIVITIES OF THE "TERNIVSKA" MINE ON THE SAKSAGAN RIVER ICHTHYOFAUNA (KRYVYI RIH, UKRAINE)

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Scientific monitoring of mine activity in the context of indicators of ichthyofauna populations, hydroecological regime and other components of the biocenosis, post-project monitoring of the place of mine activity is an important and necessary measure to ensure rational nature management.

In the course of the work, the generalized results of studies conducted in 2021 in the area of influence of the planned activity of the "Ternivska" mine were used. The study of the hydrochemical regime was carried out according to generally accepted methods Indicators were determined using the EZODO AZ-86031 hydrochemical device (Oximeter/pH-meter/conductometer/salt meter) and a set of express tests for rapid determination of water quality TESTLAB (JBL, Germany, 2021). The hydrogen index (pH), dissolved gases, biogenic elements, hardness, water temperature, electrical conductivity, general mineralization (salinity) were determined in the water. Indicators of the chemical composition of water were compared with normative criteria of water quality according to hygienic and ecological criteria (SSTU 4808:2007). Fish were caught in September in littoral zone. The fishing tools were: an ichthyological net, a siene 10 m long, fish fry traps. The entire fish catch was divided by species, their number was counted, and the length was measured with an accuracy of 1 mm and the weight of individuals was determined with an accuracy of 0.01 g. The relative abundance was taken as the number of individuals per 100 m^2 of the catch area. Species belonging was determined according to A.F. Koblytska. Statistical processing of the results was carried out using the variational statistical method with STATISTICA 6.0. The reliability of the obtained data was assessed using the Student's t-test.

The water of the Saksagan River has been characterized by quite high mineralization (2.53–2.73 g/l) for many years in a row. The ichthyocenosis of Saksagan river was dominated by short-cycle species with a high range of adaptations to transformed water bodies and characterized by the following indicators of the number and biomass of fish – 87.54 specimens/100 m^2 and 126.33 g/100 m^2. Among the studied fish species, there are no endangered species listed in the Red Book of Ukraine. Under the existing conditions, the influence of the planned activities of the "Ternivska" mine on the flora and fauna of the Saksagan River is ecologically acceptable.

The results of the research can be used in the development of the regulation of hydrobiological monitoring of the water of the Saksagan River in the zone of influence of the planned activity of the "Ternivska" mine, as well as any other water bodies used in the production process of mining enterprises.

Key words: ichthyofauna, hydrochemistry, monitoring, mine, sewage.

Problem statement and analysis of last achievements and publications. The planned activity of JSC "KRYVBASZALIZRUDKOM" consists in the continuation of the extraction of rich iron ores at the field deposit of the Ternivska mine in accordance with the Special Subsoil Use Permit No. 2556 dated 10.12.2001, Order of the State Geology and Subsoil Service of Ukraine No. 410 dated 10.31.2018 – extension of the term of validity; dated 31.10.2018 No. 412 – making changes. The design capacity of the mine is 2,000 thousand tons of rich ore. Cleaning works are carried out at the horizon of 1200 m and above. The average iron content in the mine massif at the working horizons is 55.77 %. Mine water is used for dust suppression in the underground technological process of iron ore extraction. The territories of industrial sites of mines of JSC "KRYVBASZALIZRUDKOM" are equipped with storm sewer systems and local wastewater treatment facilities.

The impact of the planned activity on the water environment of the Saksagan River is caused, first of all, by the surface runoff from the Ternivska mine site, which, after treatment at the enterprise's local treatment facilities, is discharged into the Saksagan River. In accordance with the legislation, the quality of wastewater is monitored. In accordance with the requirements of the legislation, monitoring of the quality of wastewater is provided. The collection and treatment of wastewater from the territory of the planned operation of the Ternivska mine improves the condition of the surface runoff that is formed in the given area, localizes it from infiltration into the soil layer and underground aquifers, and surface water bodies.

The "Ternivska" mine of JSC "Kryvbaszalizrudkom" has one discharge (No. 1) of return water (rainwater and meltwater from the territory of the industrial site) in the Saksagan River. Discharge of treated return water (rainwater and meltwater from the industrial site) into the Saksagan River is carried out on the basis of special water use permit No. 363/DP/49d-18 dated June 27, 2018.

To control the established standards of maximum permissible discharge of pollutants that enter the water body together with return (rain and melt) water, laboratory tests are carried out in accordance with the control procedure, in accordance with the standards of maximum permissible discharges (MDS) and the schedule of laboratory control of the quality of return (storm) water, which is agreed annually by the Department of Ecology and Natural Resources of the Dnipropetrovsk Regional State Administration (Dnipropetrovsk RSA). In addition, the enterprise carries out systematic control over the efficiency of the treatment facilities, by comparing the actual and design parameters of the water composition.

Monitoring of the influence of the planned activities of the "Ternivska" mine on the population of ichthyofauna and other components of the Saksagan River biocenosis is being carried out for the third time in 2021 year. Thus, in the second half of the 2021 (in September), monitoring studies were carried out by employees of the Scientific Research Laboratory of Hydrobiology, Ichthyology and Radiobiology of the Scientific Research Institute of Biology of DNU, taking into account the current state of the components of the environment, the direct and indirect cumulative impact of existing objects.

Highlight of the earlier unresolved parts of the general problem. Aim of the study. The activities of mining enterprises are associated with environmental impact and, in some cases, require monitoring studies of the impact of planned mining activities on environmental components. Under anthropogenic influence, the natural regime of the river changes [1, 2]. This includes: the impact of dams and dams, discharge of water, as well as water withdrawal for technical needs. The highest flow of water in Saksagani reaches 240 m^3/sec. Analyzing the data of the past years, the main pollutants coming from permanent drinking fountains in the Saksagan River are the following: chlorides – 624 mg/l, sulfates – 1015 mg/l, ammonium nitrogen – 0.56 mg/l, nitrates – 1.4 mg/l, nitrites – 0.07 mg/l, petroleum products – 0.3 mg/l, iron – 14 mg/l, phenols – 0.001 mg/l, phosphates – 0.15 mg/l, suspended matter – 14 mg/l. The total mineralization of Saksagan River water is 2660 mg/l [3–5].

In this regard, **the purpose** of the research work was to study the current indicators of the population of ichthyofauna and other components of the Saksagan river biocenosis in the conditions of the planned activities of the "Ternivska" mine, as well as the fulfillment of the environmental conditions imposed on the economic entity including the implementation of post-project monitoring, which are established by the conclusions of the environmental impact assessment.

To achieve the goal, it was necessary to perform the following **tasks:**

– prepare and carry out an expedition trip to the Saksagan River during September 2021;

– select the ichthyological material for research;

– measure the main accompanying hydrochemical (water temperature, pH, electrical conductivity, total salinity) indicators.

Materials and methods. Hydrochemical and hydrobiological studies of the Saksagan River were conducted in September 2021 during expeditionary works.

Methods of hydrochemical studies. The study of the hydrochemical regime was carried out according to generally accepted methods [6]. Hydrobiological samples were taken in September 2021 at 3 sections of the Saksagan River (stations), namely:

– 500 meters above the discharge of return (rain and melt) waters of the "Ternivska" mine (point No. 1);

– at the place of release No. 1 of return (rain and melt) waters of the "Ternivska" mine (point No. 2);

– 500 meters below the release of return (rain and melt) waters of the "Ternivska" mine (point No. 3).

The hydrogen index (pH), dissolved gases, biogenic elements, hardness, water temperature, electrical conductivity, general mineralization (salinity) were determined in the water. Indicators of the chemical composition of water were compared with normative criteria of water quality according to hygienic and ecological criteria (DSTU 4808:2007). Indicators were determined using the EZODO AZ-86031 hydrochemical device (Oximeter/pH-meter/conductometer/salt meter) and a set of express tests for rapid determination of water quality TESTLAB (JBL, Germany, 2021).

Methods of ichthyofauna studies. Fish were caught in September in littoral zone. The fishing tools were: an ichthyological net, a siene 10 m long, fish fry traps. The entire fish catch was divided by species, their number was counted, and the length was measured with an accuracy of 1 mm and the weight of individuals was determined with an accuracy of 0.01 g [7]. The relative abundance was taken as the number of individuals per 100 m^2 of the catch area [7]. Species belonging was determined using FishBase Database (https://www.fishbase.se/search.php).

Statistical processing of the results was carried out using the variational statistical method. The reliability of the obtained data was assessed using the Student's t-test. The null hypothesis was rejected at $p \leq 0.05$. All calculations were performed using the Statistica 6.0 software package.

Study results and their discussion. Hydrochemical analysis. In order to quickly assess the quality of water as a habitat for hydrobionts, a field assessment of hydrochemical parameters was conducted using a certified TESTLAB hydrochemical set (JBL, Germany, 2021).

This approach allows you to instantly determine the quality of water during sampling and quickly determine the ecotoxicological state of the aquatic environment. When testing the water, the following indicators were determined: the content of ammonium (NH^{4+}), nitrites (NO^{2-}), nitrates (NO^{3-}), iron (Fe^{2+}), phosphates (PO_4^{3-}). The results of the express assessment are shown in Table 1.

According to the results of the study, water at all investigated sampling points met the physical and chemical parameters of State Standarts of Ukraine DSTU 4808: 2007.

Table 1. **Results of the rapid assessment of the quality of the water environment of the Saksagan River, in the area of influence of "Ternivska" mine**

Indicator / Points	Date of measurements 14.09.2021		
	№ 1	**№ 2**	**№ 3**
NH_4^+, mg/dm³	<0.05	<0.05	<0.05
NO_2^-, mg /dm³	<0.01	<0.025	<0.01
NO_3^-, mg /dm³	<0.5	1	<0.5
Fe^{2+}, mg /dm³	<0.02	<0.02	<0.02
PO_4^{3-}, mg /dm³	<0.02	<0.02	<0.02

Note: point № 1 – 500 m above the discharge of return (rain and melt) water; point № 2 – place of release of (rain and melt) water; point №3 – 500 m below the release of return (rain and melt) water.

The results of the hydrochemical analysis allowed us to note that the content of ammonium nitrogen (NH^{4+}) at all test points is <0.05 mg N/dm³, which does not exceed the requirements for water quality and characterizes it within the 1st quality class. Different forms of nitrogen can change into each other during the nitrogen cycle.

The content of nitrites at all experimental points does not exceed the maximum allowable concentrations and corresponds to the 2nd class of water quality. The content of nitrates (NO^{3-}) at all test points also does not exceed the maximum permissible concentrations – from <0.5 mg/dm³ to 1 mg/dm³, which corresponds to the 3rd class of water quality.

Comparing the obtained results with summer indicators, the concentration of nitrites and nitrates did not change.

The content of iron (Fe^{2+}) in the water at all test points was satisfactory and characterizes it within the 1st quality class. The content of these compounds may vary depending on the regional, climatic, landscape and hydrological features of the zone of existence.

As for the content of phosphates, their content was kept at the level of <0.02 mg/dm³, which corresponds to the standards of DSTU 4808:2007. In autumn, this indicator slightly decreased compared to summer indicators, this is due to seasonal climatic changes. Phosphorus compounds enter the water as a result of intrareservoir processes, weathering and dissolution of rocks, exchange with bottom sediments, and from anthropogenic sources.

Analyzing the data obtained from last year's research [1], the content of ammonium nitrogen (NH^{4+}) and the content of nitrites (NO^{2-}) at the experimental points did not change. The content of nitrates (NO^{3-}) also did not change significantly, except for the point of release of (rain and melt) water, where a slight increase of this indicator was observed. The iron content decreased three times at the point above the discharge of return (rain and melt) water. As for the content of phosphates (PO_4^{3-}), its content is at the level of last year's values and did not exceed the normative indicators.

In accordance with the technical task, the following indicators were determined using the hydrochemical device EZODO AZ-86031 (Oximeter/pH-meter/conductometer/salt meter): temperature (t °C), hydrogen indicator (pH), oxygen content, mineralization and electrical conductivity of water.

In water bodies, the temperature is the result of the simultaneous action of solar radiation, heat exchange with the atmosphere, heat transfer by currents, mixing of water masses and the arrival of heated water from an external source. Temperature is one of the limiting factors affecting the composition and properties of water. The average water temperature at the sampling points was at the level of +18.6 °C to +18.9 °C.

Hydrogen indicator pH ranged within acceptable limits from 7.85 units to 7.91 units. The development and vital activity of aquatic organisms, the stability of various forms of elements and its migration, and the form of existence of a number of chemical compounds in water depend on the value of pH.

The amount of mineralization in different areas of the experimental reservoir varied from 2530.0 mg/dm³ at the point of release of return (rain and melt) water to 2730.0 mg/dm³ at the point above the release of return (rain and melt) water.

The lowest indicator of electrical conductivity of water was at the points of discharge of return (rain and melt) water and amounted to 529 µS, and the highest at the place above the release of return (rain and melt) water – 550 µS (Table 2).

Table 2. **Hydrochemical parameters of Saksagan River water near "Ternivska" mine, September 14, 2021**

Selection point	pH	t °C	Oxygen content, mg/dm³	Oxygen content, %	Mineralization, mg/dm³	Conductivity, µS
500 m above the catchment of return (rain and melt) waters	7.85	18.7	6.5	46.4	2730.0	550.0
Place of release of (rain and melt) water	7.91	18.9	7.0	50.0	2530.0	529.0
500 m below the flow of return (rain and melt) waters	7.85	18.6	6.6	47.1	2720.0	541.0

Comparing the data with last research [1], it was found that the mineralization of water increased by an average of 20.6 %, and the electrical conductivity of water decreased by 14.05 %. Indicators of water mineralization and the content of main ions in water have a tendency to transform both under the influence of anthropogenic load and as a result of the action of natural factors. The electrical conductivity of water depends mainly on the concentration of dissolved mineral salts and temperature.

The highest oxygen content in water was recorded at the point of discharge of return (rain and melt) water and was 50 %, and the lowest indicator was at the point above the discharge (rain and melt), which was 46.4 %. The content of dissolved oxygen in water is subject to seasonal and daily fluctuations.

Comparing the obtained data with last year's research, we observe an increase in oxygen content in all experimental areas. The main sources of oxygen entering water bodies are gas exchange with the atmosphere (atmospheric aeration), photosynthesis, as well as rainwater and meltwater, which, as a rule, are oversaturated with oxygen. Oxidative reactions are the main sources of energy for most hydrobionts. The main consumption of dissolved oxygen occurs in the process of respiration of hydrobionts and oxidation of organic substances by microorganisms. The low content of dissolved oxygen affects the entire complex of biochemical and ecological processes in the water body.

Ichthyofauna. Out of 75 common species of fish in the Dnipropetrovsk region, the ichthyofauna of Kryvorizhzhy includes 37 species. Among them, 5 species of fish are included in the «Red Book of Ukraine»: burbot (*Lota lota* L.), common dace (*Leuciscus leuciscus* L.), ide (*Leuciscus idus* L.), crucian carp (*Carassius carassius* L.), percarina (*Percarina demidoffii* Nordmann).

Regulation of the flow of the Ingulets and Saksagan rivers affected the formation of ichthyofauna, which led to changes in the faunal complexes and trophic groups of fish: the changes were reflected in the species composition and number of fish groups. Due to stocking, the ichthyofauna of the reservoir has been enriched with introduced species: grass carp (*Ctenopharyngodon idella* Valenciennes) and silver carp (*Hypophthalmichthys molitrix* Valenciennes), which are mainly introduced for the purpose of biomelioration.

In recent years, the ichthyofauna of the region has been enriched due to the spread of resident species. For example, through the Dnipro-Kryvyi Rih canal and the Ingulets River to the Saksagan River, Black and Caspian Sea sprat (*Clupeonella delicatula* Nordmann), black-striped pipefish (*Syngnathus abaster* Risso), three-spined stickleback (*Gasterosteus aculeatus* L), round goby (*Neogobius melanostomus* Pallas) and pumpkinseed (*Lepomis gibbosus* L.).

The 8 species of fish are of industrial and fishery importance: roach (*Rutilus rutilus* L.), white bream (*Blicca bjoerkna* L.), freshwater bream (*Abramis brama* L.), common carp (*Cyprinus carpio* L.), prussian carp (*Carassius gibelio* Bloch), european perch (*Perca fluviatilis* L.), pike-perch (*Zander lucioperca* L.), northern pike (*Esox lucius* L.), wels catfish (*Silurus glanis* L.), which are found in different parts of the river.

Within the studied stations, the modern species composition of fish included 15 species of fish belonging to 6 families (Clupeidae – 1; Cyprinidae – 7; Percidae – 1, Cobitidae – 1; Centrarchidae – 1; Gobiidae – 4), which is 40.5 % from the total species composition of fish of the Saksagan River for the entire period of ichthyological research (starting from the 30s of the last century). In the previous period of research (2020), 15 species were also recorded on the river section, but according to the species composition in 2021, no catfish was caught by fishing gear, instead, european perch was caught.

As in the previous year, the ichthyocenosis was dominated by short-cycle species with a high range of adaptations to transformed water bodies – the stone moroko, european bitterling, and bleak. In the previous research period (2019–2020), the dominance of these species was also observed.

The number of the bleak reached 34.08 specimens/100 m^2 at a point 500 m below the discharge of return (rain and melt) waters of the "Ternivska" mine with the average number and biomass in the zone of influence of the mine – 22.55 specimens /100 m^2 and 45.48 g/100 m^2 respectively (Table 3).

In the multi-year aspect, the number of the bleak remained at a stable level. The number of the stone moroko, fluctuates significantly, which is caused by the cyclical phenomena of its reproduction: in 2006, it was 12.0 specimens/100 m^2, in 2018 – 392 specimens/100 m^2, in 2019 – 49.39 specimens/100 m^2 , in 2020 – 32.65 specimens/100 m^2, in 2021 – 24.88 specimens/100 m^2.

Wide variation in fish abundance is also associated with sampling season, level regime and water temperature. The tendency of the distribution and numerical dominance of short-cycle species can be explained by the lack of places for effective natural spawning and feeding for fry of other fish species, which are more demanding to the conditions of natural reproduction, as well as by the inflow of municipal and industrial wastewater, and other negative factors.

In September 2021, the section of the Saksagan River, which is under the influence of the Ternivska mine, was characterized by the following indicators of the number and biomass of fish – 87.54 specimens/100 m^2 and 126.33 g/100 m^2, which is almost at the level of the indicators of 2020.

During the research period, fish that have a protective status and are listed in the Red Book of the Dnipropetrovsk Region or the Red Book of Ukraine were not found within the scope of the planned activities of the "Ternivska" mine.

Conclusion and perspectives of further development. Based on the results of hydro-ecological monitoring studies conducted in the water area of the Saksagan River in autumn of 2021 within the scope of the planned activities of the "Ternivska" mine, the following generalizations can be made:

1. According to the hydrochemical composition, the water of the Saksagan River has been characterized by quite high mineralization (2.53–2.73 g/l) for many years in a row, which is caused by the complex influence of several

Table 3. **Species composition, number and biomass of fish in the Saksagan River, September 2021**

№	Species of the fish	age	Mine "Ternivska"							
			Point 1		Point 2		Point 3		Average value	
			N, specimens /100 m²	B, gr/100 m²	N, specimens /100 m²	B, gr/100 m²	N, specimens /100 m²	B, gr/100 m²	N, specimens /100 m²	B, gr/100 m²
Clupeidae family Cuvier, 1816										
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
1	Black and Caspian Sea sprat *Clupeonella cultriventris* (Nordmann, 1840)	no a/d	0.36	0.65	0.22	0.18	0.16	0.12	0.25	0.32
Cyprinidae family Fleming, 1822										
2	Bleak *Alburnus alburnus* (Linnaeus, 1758)	no a/d	9.42	32.17	24.16	42.14	34.08	62.14	22.55	45.48
3	Prussian carp *Carassius gibelio* (Bloch, 1782)	0+	1.44	0.98	3.46	2.95	2.34	2.78	2.41	2.24
		1+	0.34	2.04	2.46	4.68	4.22	3.45	2.34	3.39
		2+	1.34	46.26	2.45	32.17	0.14	6.43	1.31	28.29
4	Belica *Leucaspius delineatus* (Heckel, 1843)	no a/d	0.42	0.08	0	0	0	0	0.14	0.03
5	Stone moroko *Pseudorasbora parva* (Temminck et Schlegel, 1846)	no a/d	12.46	5.28	8.46	4.29	9.48	4.02	10.13	4.53
6	European bitterling *Rhodeus amarus* (Bloch, 1782)	no a/d	22.18	9.46	24.12	5.86	28.35	5.28	24.88	6.87
7	Roach *Rutilus rutilus* (Linnaeus, 1758)	0+	3.24	1.88	2.44	1.24	3.22	2.19	2.97	1.77
		1+	0.46	0.92	0.44	2.98	0.94	3.48	0.61	2.46
		2+	0.12	8.42	0.42	8.42	0	0	0.18	5.61

Continuation of Table 3

1	2	3	4	5	6	7	8	9	10	11
8	Rudd *Scardinius erythrophthalmus* (Linnaeus, 1758)	0+	1.89	1.23	2.43	1.04	5.44	1.28	3.25	1.18
		1+	8.42	3.12	7.44	2.35	10.18	3.21	8.68	2.89
		2+	0.32	6.18	0.64	9.22	0.21	8.24	0.39	7.88
Cobitidae family Swainson, 1839										
9	Spined loach *Cobitis taenia* Linnaeus, 1758	no a/d	0.32	0.24	0.56	0.34	0	0	0.29	0.19
Centrarchidae family Bleeker, 1759										
10	Pumpkinseed *Lepomis gibbosus* (Linnaeus, 1758)	no a/d	1.34	4.68	3.18	15.28	0.52	3.56	1.68	7.84
Gobiidae family Fleming, 1822										
11	Racer goby *Babka gymnotrachelus* (Kessler, 1857)	no a/d	0	0	1.45	0.67	0	0	0.48	0.22
12	Monkey goby *Neogobius fluviatilis* (Pallas, 1814)	no a/d	0.15	0.22	0.46	0.18	0.42	0.14	0.34	0.18
13	Round goby *Neogobius melanostomus* (Pallas, 1814)	no a/d	2.48	0.98	0.44	0.32	2.47	0.89	1.80	0.73
14	Tubenose goby *Proterorhinus marmoratus* (Pallas, 1814)	no a/d	0.32	0.24	2.28	1.02	2.36	1.12	1.65	0.79
Percidae family Cuvier, 1816										
15	European perch *Perca fluviatilis* Linnaeus, 1758	no a/d	0	0	1.34	4.64	2.22	5.67	1.19	3,44
	Total:		67,02	125.03	88.85	139.97	106.75	114.00	87.54	**126.33**

Note: point 1 – 500 m above the discharge of return (rain and melt) water; point 2 – place of release of (rain and melt) water; point 3 – 500 m below the release of return (rain and melt) water. N – number of specimens/100 m^2 B – biomass, g/100 m^2; Age – no a/d – no age determination; 0+ – this year old; 1+ – two years old; 2+ – three years old; 3+ – four years old.

factors: physical and geographical conditions of the location of the reservoir, flow regulation (Makortivske, Kresivske, Saksagan reservoirs), periodic low water.

2. The ichthyocenosis of Saksagan river was dominated by short-cycle species with a high range of adaptations to transformed water bodies and characterized by the following indicators of the number and biomass of fish – 87.54 specimens/100 m^2 and 126.33 g/100 m^2 respectively, which is almost at the level of the indicators of 2020.

3. As in previous years, there are no protected territories (reserves, nurseries and natural monuments), objects of the nature reserve fund, territories of the Emerland network (Emerald network) in the area of influence of the "Ternivska" mine. Among the studied fish species, there are no endangered species listed in the Red Book of Ukraine.

4. Under the existing conditions, the influence of the planned activities of the "Ternivska" mine on the flora and fauna of the Saksagan River is ecologically acceptable.

The results of the research can be used in the development of the regulation of hydrobiological monitoring of the water of the Saksagan River in the zone of influence of the planned activity of the "Ternivska" mine, as well as any other water bodies used in the production process of mining enterprises.

ВПЛИВ ПЛАНОВОЇ ДІЯЛЬНОСТІ ШАХТИ «ТЕРНІВСЬКА» НА ІХТІОФАУНУ РІЧКИ САКСАГАНЬ (КРИВИЙ РІГ, УКРАЇНА)

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Здійснення наукового супровіду діяльності шахт в контексті показників популяцій іхтіофауни, гідроекологічного режиму та інших складових біоценозу, постпроектного моніторингу місця діяльності шахт є важливим та необхідним заходом для забезпечення раціонального природокористування.

У ході роботи використовувалися узагальнені результати досліджень, що проводилися у 2021 р. в районі впливу планової діяльності шахти «Тернівська». Дослідження гідрохімічного режиму проводили згідно із загальноприйнятими методиками. Визначення показників здійснювали з використанням гідрохімічного приладу EZODO AZ-86031 (Оксиметр/pH-метр/кондуктометр/солемір) та набору експрес тестів для швидкого визначення якості води TESTLAB (JBL, Німеччина, 2021). У воді визначали водневий показник (pH), розчинені гази, біогенні елементи, жорсткість, температуру води, електропровідність, загальну мінералізацію (солоність). Показники хімічного складу води порівнювали з нормативними критеріями якості води за гігієнічними та екологічними критеріями (ДСТУ 4808:2007). Доісліджeння іхтіофауни проводили загальноприйнятими іхтіологічними методами. Особин відловлювали у вересні на мілководдях. Знаряддями лову були: іхтіологічний сачок, невід завдовжки 10 м, пастки для мальків риб. Увесь улов риб розподіляли за видами, підраховували їхню кількість і проводили вимірювання довжини з точністю до 1 мм і вимірювання маси особин з точністю до 0,01 г. За відносну чисельність приймали кількість особин на 100 м^2 площі облову. Видову належність визначали за А. Ф. Коблицькою. Статистичну обробку результатів проводили варіаційно-статистичним методом із використанням STATISTICA 6.0. Достовірність одержаних даних оцінювали за допомогою t-критерію Стьюдента.

За гідрохімічним складом вода р. Саксагань вже багато років поспіль характеризується досить високою мінералізацією (2,53–2,73 г/л). Іхтіофауна річки Саксагань представлена домінуванням короткоциклових видів з широким спектром пристосувань до трансформованих водойм, і характеризувалась чисельністю та біомасою – 87,54 екземплярів/100 м^2 та 126,33 г/100 м^2 відповідно. Серед досліджених видів риб відсутні зникаючі та занесені до Червоної книги України види. За наявних умов вплив планової діяльністі шахти «Тернівська» на флору та фауну річки Саксагань є екологічно допустимим.

Результати досліджень можуть бути використані у розробці регламенту гідробіологічного моніторингу води річки Саксагань у зоні впливу планової діяльності шахти «Тернівська», а також будь яких інших водойм, що використовуються у виробничому процесі гірничо-добувних підприємств.

Ключові слова: іхтіофауна, гідрохімія, моніторинг, шахта, стічні води.

ЛІТЕРАТУРА

1. Стась М. М., Колесник В. І. (2016). Гідроекологічна оцінка якості води Дніпровського водосховища. *Питання біоіндикації та екології*, 21(1–2), 87–98.
2. Khristov O. O., Kochet V. M, Zagubizhenko N. I. (2006). Problems of mine waters discharge in the Samara River and its influence on biota of the ecosystem. *Biosystems Diversity*, 14(2), 86–93.
3. Marenkov, O. M., & Nesterenko, O. S. (2020). Hydroecological monitoring over the impact of the “Ternivska” mine on the biocenoses of the Saksagan river (Krivyi Rih, Ukraine). Publishing House “Baltija Publishing”, 2, 472–492.
4. Шерстюк Н. П., Хільчевський В. К. Особливості гідрохімічних процесів у техногенних і природних водних обє’ктах Кривбасу. Дніпропетровськ: Акцент. 2012. 263 с.
5. Alexeyeva, A. A., Marenkov, O. M., Kurchenko, V. O., Holub, I. V., & Petrovsky, O. O. (2019). Biotesting and phytoindication of aquatic environment

quality of urbanized territories. *Ecology and Noospherology*, 30(2), 101–105.
6. Методи гідроекологічних досліджень поверхневих вод. Під ред. В.Д. Романенко. 2006. Київ. 628 с.
7. Озінковська С. П., Єрко В. М., Коханова Г. Д., Тарасова О. М., Полторацька В. І. Методика збору і обробки іхтіологічних і гідробіологічних матеріалів з метою визначення лімітів промислового вилучення риб з великих водосховищ і лиманів України. Київ: ІРГ УААН. 1998. 47 с.

REFERENCES

1. Stas M. M., Kolesnyk, V. I. (2016). *Hidroekolohichna otsinka yakosti vody Dniprovskoho vodoskhovyshcha* [Hydroecological assessment of the water quality of the Dnipro Reservoir]. *Pytannia bioindykatsii ta ekolohii*, 21(1–2), 87–98. [in Ukrainian].
2. Khristov O. O., Kochet V. M, Zagubizhenko N. I. (2006). Problems of mine waters discharge in the Samara River and its influence on biota of the ecosystem. *Biosystems Diversity*, 14(2), 86–93.
3. Marenkov, O. M., & Nesterenko, O. S. (2020). Hydroecological monitoring over the impact of the "Ternivska" mine on the biocenoses of the Saksagan river (Krivyi Rih, Ukraine). Publishing House "Baltija Publishing", 2, 472-492. ISBN 978-9934-588-73-0
4. Sherstiuk N. P., Khilchevskyi V. K. (2012). *Osoblyvosti hidrokhimichnykh protsesiv u tekhnohennykh i pryrodnykh vodnykh obiektakh Kryvbasu* [Peculiarities of hydrochemical processes in man-made and natural water bodies of Kryvbas]. Dnipropetrovsk: Aktsent. [in Ukrainian].
5. Alexeyeva, A. A., Marenkov, O. M., Kurchenko, V. O., Holub, I. V., & Petrovsky, O. O. (2019). Biotesting and phytoindication of aquatic environment quality of urbanized territories. *Ecology and Noospherology*, 30(2), 101-105.
6. *Metody hidroekolohichnykh doslidzhen poverkhnevykh vod* [Methods of hydroecological research of surface waters]. Pid red. V. D. Romanenko. 2006. Kyiv. [in Ukrainian].
7. Ozinkovska S. P., Yerko V. M., Kokhanova H. D., Tarasova O. M., Poltoratska V. I. (1998). *Metodyka zboru i obrobky ikhtiolohichnykh i hidrobiolohichnykh materialiv z metoiu vyznachennia limitiv promyslovoho vyluchennia ryb z velykykh vodoskhovyshch i lymaniv Ukrainy* [Methods of collecting and processing ichthyological and hydrobiological materials for the purpose of determining the limits of industrial extraction of fish from large reservoirs and estuaries of Ukraine]. Kyiv: IRH UAAN. [in Ukrainian].