

WATER MONITORING OF THE SAZLIYKA RIVER, EAST AEGEAN
BASIN, BULGARIA

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The aim of the study is to carry out a comprehensive ecological assessment of the water status of the Sazliyka River based on the biological quality element macrozoobenthos and physicochemical indicators in the biotopes of water bodies located near settlements of Navasen, Radnevo-Gipsovo, Dinya, Rakinitza, and Starozagorski Bani. The studies were conducted in accordance with the standards established by the requirements of the Water Framework Directive (Directive 2000/60/EC). A total of 51 taxa with 6988 specimens and the presence of Nematoda were identified. The main biotic indices were determined. Based on our own monitoring, the physicochemical status of the waters of the Sazliyka River was assessed according to 21 indicators, with significant deviations from the reference values for most of them. According to the comprehensive assessment, the ecological status of the freshwater ecosystem in the studied biotopes varies from very poor to moderate.

Keywords: biological elements, physicochemical indicators, indices, ecological state, river ecosystem, Sazliyka River.

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МОНИТОРИНГ НА ВОДИТЕ НА РЕКА САЗЛИЙКА ОТ БЕЛОМОРСКИЯ ОТТОЧЕН БАСЕЙН НА БЪЛГАРИЯ

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Резюме: Целта на изследването е да се извърши цялостна екологична оценка на сладководната екосистема на р. Сазлика въз основа на биологичния елемент макрозообентос и физикохимичните показатели в биотопите на водните тела в близост до Навъсен, Раднево - кв. Гипсово, Диня, Ракиница и Старозагорски бани. Изследванията са проведени съгласно установените стандарти в изискванията на Рамковата директива за водите (Директива 2000/60/ЕО). Общо са идентифицирани 51 таксона с 6988 екземпляра и наличие на Nematoda. Определени са основните биотични индекси. Въз основа на собствен мониторинг е оценено физикохимичното състояние на водите на р. Сазлика по 21 показатели, като се установиха значителни отклонения от референтните стойности за повечето от тях. Според комплексната оценка екологичното състояние на сладководната екосистема в проучваните биотопи варира от много лошо до умерено.

Ключови думи: биологични елементи, физикохимични индикатори, индекси, екологично състояние, речни екосистеми, река Сазлика

INTRODUCTION

The Sazliyka River rises from the Ruya Peak, Sarnena Sredna Gora (651 m above sea level), is 145 km long and flows into the Maritsa River, east of the town of Simeonovgrad. The Sazliyka River receives several tributaries, the larger ones being the Bedechka River, the Blatnitsa River, the Ovcharitsa River, the Sokolitsa River and others. The river's catchment area is approximately 3300 km², characterized by a flat-hilly and low-mountainous relief. The Sazliyka River flows through the territories of four municipalities: Stara Zagora Municipality, Galabovo Municipality, Radnevo Municipality, and Simeonovgrad Municipality. On the territory of Galabovo and Radnevo municipalities, four thermal power plants (TPPs) of the Maritsa Iztok complex are located, namely: TPP Brickel EAD and TPP AES Maritsa Iztok I EOOD – situated near the Rozov Kladenets Dam; TPP Maritsa Iztok 2 EAD – located next to the Ovcharitsa Dam and TPP Kontur Global Maritsa Iztok 3 – located along the Sokolitsa River, a left tributary of the Sazliyka River. These thermal power plants use lignite coal for energy production (Plan for integrated development of Stara Zagora Municipality, 2021-2027; Plan for integrated development of Galabovo Municipality, 2021-2027; Plan for integrated

development of Radnevo Municipality, 2021-2027). Thermal power plants are among the main sources of environmental pollution with heavy metals, such as lead and mercury (Dineva, 2023). Settlements without constructed wastewater treatment plants (WWTP) are a source of pollution of surface water bodies. The Stara Zagora WWTP receives and treats the wastewater of the city of Stara Zagora and the village of Bogomilovo. There are no settlements with constructed wastewater treatment plants in Galabovo Municipality. In Radnevo Municipality, only the town of Radnevo has a wastewater treatment plant, built and operating, that treats wastewater from the city and the Gipsovo district. (Plan for integrated development of Stara Zagora Municipality, 2021-2027; Plan for integrated development of Galabovo Municipality, 2021-2027; Plan for integrated development of Radnevo Municipality, 2021-2027). Wastewater contains a number of pollutants, such as microorganisms (pathogenic bacteria and viruses), organic and inorganic materials (detergents, pesticides, fats, cyanide), nutrients (nitrogen, phosphorus), and heavy metals (Hg, Pb, Cd, Cr, Cu) (Henze, Comeau, 2008). The discharge of untreated wastewater into aquatic ecosystems disrupts the balance within hydrobiont communities. In the presence of pollution, a decrease in species numbers and the appearance of large numbers of specimens of a few species are observed. Usually, only species that are resistant to pollution and can adapt to new environmental conditions survive (Von Sperling, 2007).

According to the typology of rivers in Bulgaria, the Sazliyka River falls into Ecoregion 7 "Eastern Balkans". The Sazliyka River is part of the East Aegean region and includes two types of surface waters of the "River" category. The upper reaches of the Sazliyka River to the village of Rakitnitsa are of type R5 (Semi-mountainous rivers), the section of the Sazliyka River from the Azmaka River to the mouth and tributaries – of type R13 (Small and medium-sized plain rivers) (River Basin Management Plan in the East Aegean region, 2010-2015). The section of the Sazliyka River south of the village of Rakitnitsa to the mouth falls into protected area BG0000425 "Sazliyka River", protecting the Thick-shelled Mussel *Unio crassus* Phillipsson, 1788, as well as some species of fish, amphibians, reptiles, mammals and natural habitats (Natura 2000).

According to the Water Framework Directive (Directive 2000/60/EC), biological quality elements play a leading role in the ecological assessment of water bodies. Macrozoobenthos has been widely used in these assessments because it is sensitive and affected by changes in the aquatic environment; it is characterized by long life and low mobility (Smilyanov et al., 2018). Few scientific studies have addressed the assessment of the water quality of the Sazliyka River and its sub-basin based on the biological quality element macrozoobenthos. Such studies have been carried out by Vidinova et al. (2008), Park et al. (2022a), Park et al. (2022b), Varadinova et al. (2022) and Park et al. (2023) for the Sazliyka River; by Vidinova et al. (2008) and Dermendzhieva et al. (2018) for the Sokolitsa River; by Smilyanov et al., (2018) and Varadinova, Smilyanov (2020) for Ovcharitsa Dam. Among the main sources of water pollution in the Sazliyka River are municipal and industrial

wastewater due to the development of the coal mining and coal processing industry along the river (Zhelev et al., 2012).

The aim of the study is to carry out a comprehensive ecological assessment of the water status of the Sazliyka River based on the biological quality element macrozoobenthos and physicochemical indicators. The assessment of water quality, the protection and management of water resources, and the actions to reduce surface water pollution will help improve the water status, the quality of life of aquatic organisms, the protection of biodiversity and human health.

MATERIALS AND METHODS

For biological and physicochemical monitoring of the water status of the Sazliyka River, five biotopes were selected for collecting water samples and macrozoobenthos. The studies were carried out during the spring, summer and autumn seasons of 2024. The biotopes studied were:

1) Navasen biotope (42.094801, 25.878657; 96 m above sea level), Simeonovgrad Municipality, Haskovo District falls into a section of the river of type R13 in Ecoregion 7. The biotope is located north of the bridge over the Sazliyka River on the Kalugerovo-Navasen road. The selected section is characterized by a fast current and a bottom covered with gravel, sand and silt.

2) Radnevo-Gipsovo biotope (42.266771, 25.930492; 113 m above sea level), Radnevo Municipality, Stara Zagora District, also falls into a section of the river of type R13. The biotope is located under a bridge on the Sazliyka River southwest of the Gipsovo district, Radnevo town. The selected section is characterized by a fast current and a bottom covered with stones, sand and silt.

3) Dinya biotope (42.323239, 25.844322; 131 m above sea level), Radnevo Municipality, Stara Zagora District, also falls into a section of the river of type R13. The biotope is located under a bridge on the Sazliyka River before the village of Dinya. The section of the river is characterized by a fast current and a bottom covered mainly with silt in places with sand and gravel.

4) Rakitnitsa biotope (42.339155, 25.511386; 209 m above sea level), Stara Zagora Municipality, Stara Zagora District falls into a section of the river of type R5. The biotope is located south of the rope bridge over the Sazliyka River before the river enters the village of Rakitnitsa. The selected section is characterized by a slow current and a bottom covered with sand.

5) Starozagorski Bani biotope (42.451439, 25.520153; 451 m above sea level), Stara Zagora Municipality, Stara Zagora District falls into a section of the river of type R5. The biotope is located after the Starozagorski Mineralni Bani resort. The selected section is characterized by a slow current and a bottom covered with stones and sand (Figure 1).

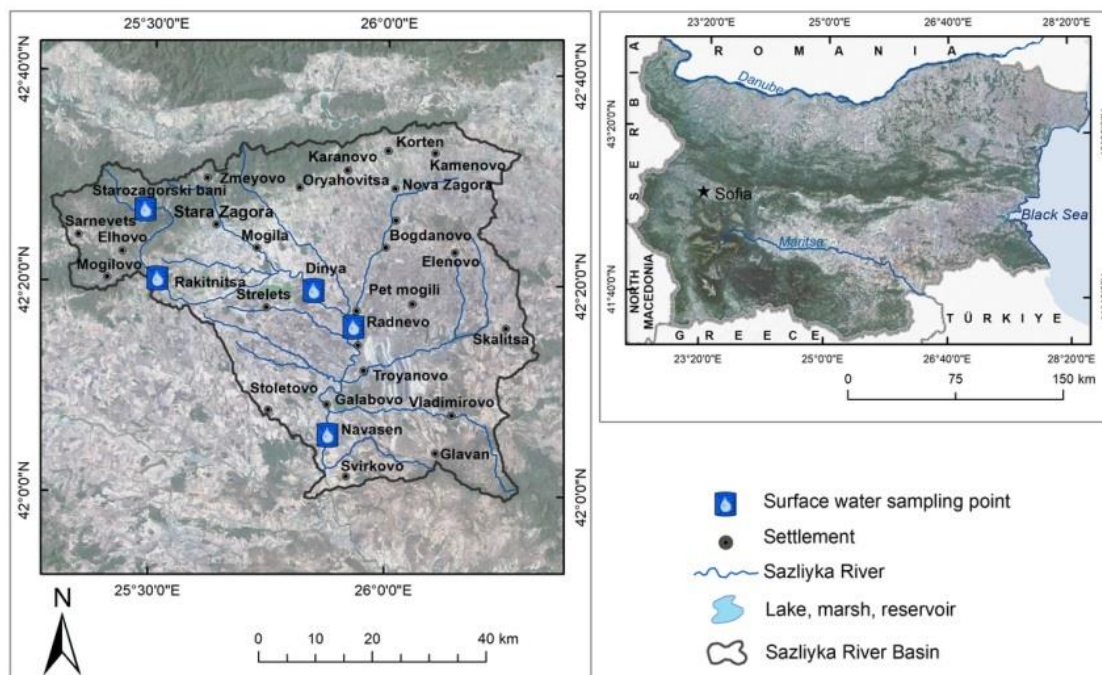


Figure. 1. Location of the studied biotopes of the Sazliyka River

The samples of the biological element macrozoobenthos were collected with a kick net sampler, mesh size 500 μm according to standard methodology (Regulation H-4/2012; Belkinova et al., 2013). The samples were processed according to BDS EN ISO 8689-1:2001 and BDS EN ISO 8689-2:2001. The taxonomic affiliation of the bioindicator organisms was determined using the Stereo Zoom Microscope, KERN OZL 464T24, microscope KERN OBN 135T241. The following metrics were determined to assess the ecological state of the waters of the selected river ecosystem (Regulation H-4/2012; Belkinova et al., 2013):

- Total number of taxa;
- Number of taxa of Ephemeroptera, Plecoptera and Trichoptera (EPT);
- % (Oligochaeta & Diptera);
- % Filtering feeders;
- % EPT taxa;
- German trophic index RETI/PETI;
- Saprobity and saprobic index according to Pantle & Buck (SPUB);
- Shannon-Weaver species diversity index (H');
- Adapted Biotic Index by Flanagan & Toner, 1972; modified by Clabby & Bowman, 1979; Clabby, 1982.

Sampling was carried out in the same biotopes along the river in June and November to carry out the physicochemical monitoring of river waters in the

Sazliyka basin. Sampling was carried out at low water levels due to low water levels throughout 2024.

The water samples were analysed on-site using a field combined pH/EC/TDS-Meter MW-802 and an oximeter CO-411. The analyses were carried out in laboratory conditions with a Multiparameter Photometer HI83399 for measuring the concentrations of ammonium nitrogen, nitrate nitrogen, nitrite nitrogen, orthophosphates. For the quantitative determination of Al, As, Cd, Co, Cr, Cu, Fe, Mn, Ni, Pb and Zn, a total of 6 samples of surface water, previously fixed with nitric acid, were provided. The analysis was carried out using an Inductively Coupled Plasma Mass Spectrometer (ICP-MS DRC-e, Perkin Elmer) in the educational and scientific laboratory of the Faculty of Chemistry and Pharmacy of Sofia University "St. Kliment Ohridski".

RESULTS

Ecological state by biological quality element

For the investigated five biotopes from the Sazliyka River a total of 51 macrozoobenthos taxa with 6988 specimens belonging to 43 families (Acroloxidae, Aeshnidae, Asellidae, Baetidae, Bithyniidae, Caenidae, Chironomidae, Coenagrionidae, Corixidae, Cyrenidae, Dixidae, Dytiscidae, Elmidae, Ephemerellidae, Gammaridae, Gerridae, Glossiphoniidae, Goeridae, Gomphidae, Gyrinidae, Haemopidae, Haliplidae, Heptageniidae, Hydraenidae, Hydrometridae, Hydropsychidae, Hydroptilidae, Leptoceridae, Limnephilidae, Lumbricidae, Lumbriculidae, Lymnaeidae, Naididae, Nepidae, Notonectidae, Physidae, Planorbidae, Potamidae, Simuliidae, Sphaeriidae, Tipulidae, Unionidae, Valvatidae) were identified. The highest number of taxa were found in the Starozagorski Bani biotope in the autumn season (28 taxa represented by 427 specimens from 27 families), and the lowest – in Dinya biotope in the summer (5 taxa with 666 specimens from 5 families). The presence of Nematoda was established in the Radnevo-Gipsovo biotope in the spring and summer, in the Navasen biotope in the summer, in the Dinya biotope in the summer and in the Starozagorski Bani biotope in the autumn. The dominant taxa in the Navasen, Radnevo-Gipsovo and Rakitnitsa biotopes are *Corixa* sp. (58 specimens), *Asellus aquaticus* (Linnaeus, 1758) (959 specimens) and *U. crassus* (36 specimens), respectively, in the biotopes in the spring. Dominant taxa in the Navasen biotope in summer are *Helobdella stagnalis* (Linnaeus, 1758) and *Hydropsyche ornatula* McLachlan 1878, larvae with 15 specimens each; in the Radnevo-Gipsovo and Dinya biotopes – *As. aquaticus* (454 and 587 specimens, respectively); in the Starozagorski Bani biotope – *Gammarus pulex* (Linnaeus, 1758) (283 specimens). In autumn, the Navasen biotope is dominated by *H. ornatula* (269 specimens), Radnevo-Gipsovo – *G. pulex* (220 specimens), Dinya biotope – *As. aquaticus* (741 specimens), in the Starozagorski Bani biotope – *G. pulex* (148 specimens).

Regarding the total number of taxa, the ecological state is bad in the Dinya biotope in summer, which varies to very good in the Starozagorski Bani biotope. In the Rakitnitsa biotope, the ecological state is very good in spring, but in summer and autumn, the studied section of the river is completely dry. Two biotopes (Dinya and Starozagorski bani) are included in the monitoring study in summer and autumn (Table 1).

Table 1.

Basic metrics for the ecological state of the Sazliyka River by biotope

BIOTOPE		METRICS				
		seasons	Total number of taxa	Number of EPT taxa	RETI/PETI	SPUB
NAVASEN	spring	13 good	3 moderate	0.75 good	2.43 moderate	2.5 (0.5) moderate
	summer	7 moderate	3 moderate	0.57 good	2.28 moderate	2 (0.4) bad
	autumn	13 good	5 moderate	0.87 very good	2.41 moderate	2.5 (0.5) moderate
RADNEVO- GIPSOVO	spring	12 good	1 bad	0.03 very bad	2.22 good	2 (0.4) bad
	summer	14 good	2 moderate	0.06 very bad	2.16 good	2.5 (0.5) moderate
	autumn	14 good	3 moderate	0.06 very bad	1.58 very good	2.5 (0.5) moderate
DINYA	spring	–*	–	–	–	–
	summer	5 bad	0 very bad	0.08 very bad	2.87 bad	1.5 (0.25) very bad
	autumn	10 moderate	0 very bad	0.11 very bad	2.73 bad	1.5 (0.25) very bad
RAKIT- NITSA	spring	16 very good	4 moderate	0.57 good	1.93 very good	2.5 (0.5) moderate
	summer	–	–	–	–	–
	autumn	–	–	–	–	–
STAROZA- GORSKI BANI	spring	–	–	–	–	–
	summer	21 very good	3 moderate	0.90 very good	1.88 very good	3.5 (0.7) good
	autumn	28 very good	5 moderate	0.65 good	1.60 very good	3 (0.6) moderate

* unestablished

** n(EQR) – Normalised Ecological Quality Ratio

According to the EPT metric, the Dinya biotope has a very bad ecological state (summer and autumn), and in the remaining biotopes and seasons, the ecological state is moderate, except the Radnevo-Gipsovo biotope in spring – bad ecological state (Table 1).

In the Navasen biotope, two Oligochaeta taxa (*Lumbricus rubellus* Hoffmeister, 1843 – 2 specimens; *Limnodrilus hoffmeisteri* Claparède, 1862 – 20 specimens) and one Diptera taxon (*Chironomus plumosus* (Linnaeus, 1758), larvae – 5 specimens) were found, with the share of % (Oligochaeta & Diptera), representing 19.85% of the total abundance, being highest in spring. In the Rakitnitsa biotope, two taxa from the Filtering feeders group were found (*Dixella* sp., larvae – 1 specimen; *U. crassus* – 36 specimens), representing 22.56% respectively in the spring. The high values of % (Oligochaeta & Diptera) in the Navasen biotope and of % Filtering feeders in the Rakitnitsa biotope indicate deteriorated environmental conditions. In the Navasen biotope, the proportion of EPT taxa, 67.16%, is highest in the autumn and indicates lower pollution.

As a result of the calculated German trophic index RETI/PETI, the ecological state of the Sazliyka River varies from very bad in the Radnevo-Gipsovo biotope during the three seasons (0.03 and 0.06) and in the Dinya biotope during the summer and autumn (0.08 and 0.11, respectively) to very good in the Navasen biotope during the autumn (0.87) and in the Starozagorski Bani biotope during the summer (0.90). According to the applied methodology, the results obtained for the Radnevo-Gipsovo and Dinya biotopes indicate organic pollution (Table 1).

The total of 51 macrozoobenthos taxa identified from the Sazliyka River during the spring, summer and autumn seasons belong to 5 sensitivity groups. Only in the Navasen biotope during the autumn season was identified one taxon (2 specimens) from sensitivity group A (sensitive forms). Group B (less sensitive forms) is represented by one taxon in spring in the Navasen biotope, three taxa in the Rakitnitsa biotope in spring and with 1 and 2 taxa in summer and autumn in the Starozagorski Bani biotope. Group C (relatively tolerant forms) is best represented as dominating in spring and autumn in the Navasen biotope, in the three seasons in the Radnevo-Gipsovo biotope, in spring in the Rakitnitsa biotope and in summer and autumn in the Starozagorski Bani biotope. Group D (tolerant forms) dominates in summer in the Navasen biotope and in autumn in the Dinya biotope. Group E (most tolerant forms) is represented by one taxon in all seasons in the biotopes (except in summer in the Navasen biotope). In all five studied biotopes from the Sazliyka River, with the highest number of taxa, is represented by group C (3-15 taxa), followed by group D (3-8 taxa), groups B (1-3 taxa) for the Rakitnitsa biotope (3 taxa) and groups A and E (with one taxa each).

Regarding the saprobity groups, in all biotopes during the studied period, the bioindicator macrozoobenthos for 0-β-mesosaprobic conditions (3-6 taxa) dominated, except for the summer in the Navasen biotope with the dominance of macrozoobenthos for α-mesosaprobic conditions and β-α-mesosaprobic conditions (2 taxa each), and for the summer in the Dinya biotope for α-mesosaprobic

conditions (3 taxa); in autumn in the Radnevo-Gipsovo and Starozagorski Bani biotopes taxa for β -mesosaprobic conditions also dominate (3 and 6 taxa, respectively).

The Saprobic Index by Pantle & Buck (SPUB) represents water quality through the saprobic significance of the bioindicator macrozoobenthos. According to the results obtained in this study, the SPUB indicates from bad (poor) ecological state in the Dinya biotope during the summer and autumn seasons to very good in the Radnevo-Gipsovo (autumn), Rakitnitsa (spring) and Starozagorski Bani biotopes (summer and autumn) (Table 1).

The Shannon-Weaver species diversity index (H') indicates β -mesosaprobic conditions in the Navasen and Starozagorski Bani biotopes during the autumn season and p -saprobic conditions in the Radnevo-Gipsovo biotope during the autumn season. In all other variants, the index indicates α -mesosaprobic conditions.

The Biotic Index indicates good ecological state in the Starozagorski Bani biotope during the summer and bad ecological state in the Navisen and Gipsovo biotopes during the summer and spring, respectively. Very bad ecological state is recorded in the Dinya biotope during summer and autumn. All other biotic index results indicate moderate ecological state (Table 1).

Ecological state by physicochemical indicators

The physicochemical state of the river at the specified monitoring points has been assessed according to the requirements of Regulation H-4/2012 (amended and supplemented 2023) and the Environmental Quality Standards (EQS) Regulation of 2010 (amended and supplemented 2015).

The results of the chemical analysis of the water samples show a deteriorated quality of the river waters by most indicators. Along the entire length of the river, the waters do not meet the requirements for "good chemical status", according to the adopted methodology for determining the status of water bodies (Management Plan of ..., 2024) by the indicators of electrical conductivity, orthophosphates, and dissolved oxygen (in addition, the values of the indicator of oxygen saturation in % have deteriorated significantly). Almost by all indicators, the waters in the points downstream Radnevo (near Gipsovo) and upstream Navasen (after Galabovo) are in "moderate" chemical status. The most significant excess of the reference values for "moderate condition" is the content of ammonium nitrogen and nitrite nitrogen. The possible reasons for this condition are most likely the discharges of untreated domestic wastewater due to the lack of built sewage systems in the villages and the absence of Wastewater Treatment Plants in Galabovo and Radnevo. A second major problem is the several large livestock farms in the riverside in the area of the villages of Bozduganovo and Pastren (Table 2a). A significant content of potentially toxic substances is also registered in the river waters. Compared to the reference standards (under the EGS Regulation), the highest values are those of chromium, copper, cadmium and iron. The reasons for

this are both natural (Zhelev, 2020; Penin, Zhelev, 2011) and technogenic, caused by the discharges of industrial wastewater from enterprises in Stara Zagora, and the energy complex "Maritsa - East" and others (Table 2b).

Table 2a.

Content of some physicochemical indicators in the waters of the Sazliyka River from the studies in 2024 (in yellow – corresponding to “moderate” state under Regulation H-4/2012, in green – to “good” state according to physicochemical indicators)

Month	T°C	pH	DO	O ₂	Cond	NH ₄ -N	PO ₄ -P	NO ₃ -N	NO ₂ -N	Note
Unit			mg/dm ³	%	µs/cm	mg/dm ³	mg/dm ³	mg/dm ³	mg/dm ³	
Reference values (R5) "good"		6.5-8.5	6.0	70*	750	0.2	0.04	1.4	0.03	
Sazliyka HMS-Rakitnitsa village										
June	26.0	8.0	7.0	90	890	0.17	0.26	0.0	0.023	slow-flowing, clear
November	7.4	7	7.1	62.5	610	0.16	0.37	0.0	0.011	
Reference values (R13) "good"		6.5-8.5	6.0	70*	750	0.3	0.15	2.0	0.06	
Sazliyka near Radnevo-Gipsovo										
June	24	8.0	3.4	61	690	1.14	1.59	1.0	0.498	overgrown banks, fast current, slightly muddy
November	8.3	7.0	6.7	56.8	830	2.48	2.5	1.1	0.034	
Sazliyka upstream Navasen										
June	25	8.0	2.9	42	1000	0.37	1.68	1.2	0.600	very muddy, black, slow-flowing
November	9.3	7.0	6.6	57.6	1310	2.04	1.44	1.7	0.036	

* Regulation No. 4/2000

Table 2b.

Content of some priority and specific indicators (potentially toxic substances) in the waters of the Sazliyka River from the studies in 2024 (in orange – exceeding the average annual value under the EQS Regulation)

	Physicochemical indicators										
Month	Al	Cr	Mn	Fe	Co	Ni	Cu	Zn	As	Cd	Pb
Reference values (µg/dm ³)	15.0	3.4	50.0	100.0	20,0*	4.0	1.0	10.9	10.0	0.08	1.2
	Sazliyka HMS-Rakitnitsa village										
June	1.13	26.2	0.56	55.0	0.49	5.81	1.53	0.62	2.12	0.02	0.008
November	2.53	8.66	2.81	108.1	0.36	0.49	3.38	4.58	0.54	0.41	0.011
	Sazliyka near Radnevo-Gipsovo										
June	2.29	7.38	1.17	67.6	0.57	2.81	3.05	5.62	2.98	0.04	0.131
November	132.8	12.29	5.86	81.2	0.43	1.19	1.55	8.31	2.34	1.15	0.056
	Sazliyka before Navasen										
June	1.88	6.32	1.39	82.7	0.89	6.51	2.74	12.5	9.03	0.09	0.098
November	57.63	7.64	15.24	148.8	1.17	2.86	9.73	8.24	18.41	0.86	0.017

* Regulation No. 4/2000

Assessment of the physicochemical state

As a result of the analysis of the measurement results and the fixation of the sources of impact, the physicochemical state of the river waters can be determined as bad at the points near Radnevo and near Navasen in both spring and autumn and at the point near Rakitnitsa as transitional between good and bad according to separate indicators for the two seasons.

Assessment of the ecological state

The comprehensive ecological assessment shows a moderate ecological state for the Navasen (spring, autumn) and Starozagorski Bani biotopes (summer, autumn); bad ecological state for the Navasen biotope (summer) and Rakitnitsa biotope (spring); very bad ecological state for the Radnevo-Gipsovo (spring, summer, autumn) and Dinya biotopes (summer, autumn).

DISCUSSIONS

In a previous study (Park et al., 2022a) on the macroinvertebrate fauna in the lower section of the Sazliyka River (before the mouth of the Musatjevska River, the bridge for Svirkovo village, and Troyan village), 31 taxa were reported. In the current monitoring study in the lower section of the Sazliyka River (Navasen biotope), 20 taxa of bioindicator macrozoobenthos and the presence of Nematoda were found. The results indicate lower taxonomic diversity, which is believed to result from organic pollution of the river caused by the cow farm located near the study area (Navasen biotope).

The RETI/PETI indices show the most significant imbalance for the Radnevo-Gipsovo biotope (spring, summer and autumn) and the Dinya biotope (summer and autumn). At the same time, the best indicators were established for the Starozagorski Bani biotope (summer) for the Sazliyka River from this study, as well as after the confluence of the Bedechka River (RETI/PETI=0.9) from previous studies (Vidinova et al., 2008; Park et al., 2023). In addition, the same authors found higher Shannon-Weaver indices for the mouth of the Sazliyka River (3.1 and 2.71, respectively) in contrast to the results of the present study (Navasen – between $H'=1.09$ and $H'=2.24$; Radnevo-Gipsovo – between $H'=0.468$ and $H'=1.48$; Dinya – $H'=1.44$ and $H'=1.72$; Rakitnitsa – $H'=1.56$ and Starozagroski Bani – $H'=1.13$ and $H'=2.31$). The lower index values found in the present study indicate that the river ecosystem was not in good ecological condition during the study period.

Park et al. (2022b) indicate that the waters of the Sazliyka River, in the section before the mouth of the Musatjevska River, the bridge for Svirkovo village and Troyan village, and before its confluence with the Maritsa River, were in bad ecological state in 2021 according to Bulgarian legislation. Varadinova et al. (2022) report bad ecological state for the section of the Sazliyka River before the mouth; bridge for Svirkovo Village and Troyan Village in 2020 and 2021. The present study shows that the bad ecological state of the Sazliyka River downstream (Navasen biotope) persisted in 2024. In the Radnevo-Gipsovo and Dinya biotopes, the ecological state remained very bad throughout the study period.

CONCLUSIONS

During the study of the freshwater ecosystem of the Sazliyka River in spring, summer, and autumn of 2024, a total of 51 taxa comprising 6988 specimens were identified. The most significant number of taxa was found in the Starozagorski Bani biotope in the autumn season (28 taxa). According to the conducted ecological monitoring study of the Sazliyka River for 2024, based on biological quality elements and physicochemical indicators, and the results obtained from the calculated indices and metrics, it was established that the ecological state in the Navasen biotope is bad; in the Radnevo-Gipsovo and Dinya biotopes – very bad, and in the Rakitnitsa and Starozagorski Bani biotopes – moderate.

It is recommended to continue the ecological monitoring studies of the Sazliyka River, especially in the middle and lower sections of the river, where the worst ecological condition was established; researching to develop the ecological state of the waters in the tributaries of the Sazliyka River; wide dissemination of the results of the ecological monitoring studies; imposing stricter control by the competent authorities over the activities of livestock farms and industrial enterprises in the region to reduce anthropogenic pressure.

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