ASSESSMENT OF THE ECOLOGICAL STATUS OF NEVĖŽIS RIVER

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Annotation

Upon Lithuania's accession to the EU, water bodies are managed and protected according to hydrologically defined natural river basin boundaries, as the quality of river water is determined by natural processes taking place in the territory of a river basin and the overall impact of economic activities. A river basin is an area from which all surface water flows into a single river. By implementing the requirements of water protection legislation, Lithuania has to achieve good status in all water bodies in the country by 2021. This article discusses the ecological status of Nevėžis river in Nevėžis sub-basin. Summarising all the parameters assessed (BOC_7, NO_3-N, Pb, Nb, O_2, NH_4-N bei pH) and assessing the water quality of Nevėžis river according to its ecological classes, it is from average to very good condition.

Key words: river basin, Nevėžis river, Nevėžis sub-basin, ecological status of a river.

Introduction

Water is one of Lithuania's most significant natural resources. Open inland water bodies cover an area of 26 000 km^2, which represents around 4% of country's territory [4].

Upon Lithuania's accession to the EU, water bodies are managed and protected not according to administrative, but according to hydrologically defined natural river basin boundaries. Implementing the requirements of water protection legislation, Lithuania has to achieve good ecological status in all water bodies in the country by 2021 [9].

Anthropogenic pollution affects surface water bodies the most. The analysis of pollution sources and the assessment of their impact on the status of surface water bodies identified the following main factors affecting the status of surface water bodies in Lithuania [8]:

- dispersed pollution, which is largely caused by pollution from agricultural activities and which is one of the main sources of nitrate nitrogen pollution, and
- concentrated pollution, the most pressing problem of which is pollution with total phosphorus and ammoniac nitrogen.
- According to the State Monitoring Programme, more than 180 river sites in Lithuania are tested for water quality. The results of the national monitoring show that as many as 51% of rivers and 40% of lake bodies do not meet the criteria for good status. Following the modernisation of wastewater treatment plants in larger cities of Lithuania, the impact of concentrated sources of pollution (urban or corporate wastewater) on the status of water bodies has significantly decreased. However, pollution from agricultural fields (dispersed pollution sources) is only increasing [18].
- The rivers in the Nevėžis basin are subject to high dispersed agricultural pollution loads. Nevėžis is the most important river in Central Lithuania – its length is 208.6 km, basin area is 6140.5 km^2. The river starts in wet forests about 6 km southeast of Troškūnai town [6]. Nevėžis flows north-west through ,,Raguva", through ,,Panevėžys", then turns south, and meanders towards ,,Kėdainiai" [16]. Nevėžis belongs to Nemunas basin and flows into Nemunas 199 km from its mouth at ,,Raudondvaris". Nevėžis flows in the middle part of the middle lowlands and therefore has a rather symmetrical pool: 43% of the basin area on the right and 57% of the basin area on the left [5]. Such a river bed makes it possible of pollution due to agricultural activities. The largest pollutant load on the Nevėžis river in ,,Panevėžys" town is caused by agricultural activities around ,,Panevėžys" town due to intensive use of manure and mineral fertilisers (72 %), background pollution (24 %), pollution of industrial plants and surface water networks (concentrated) (1%), population whose households are not connected to wastewater collection networks (dispersed) (3%) [12].

Research object: nutrients pollution of Nevėžis river.

Research aim: to assess the ecological status of Nevėžis river.

Research objectives:

1. To establish indicators characterising the water quality of Nevėžis river biochemical oxygen consumption over seven days (BOC_7), nitric nitrogen (NO_3-N,), change in total phosphorus (P_b,), change in dissolved oxygen (O_2), change of total nitrogen (N_b), ammonium nitrogen **(**NH_4-N).
2. To assess the ecological status of Nevėžis river in individual sections of this river.

Literature review

For the solution of surface water quality problems and convenience of management in Lithuania, 4 river basin districts (RBD) are distinguished, which are composed of one or more river basins [9, 13] :

- **Nemunas RBD** is a part of the Nemunas river basin located in the territory of Lithuania, a part of the Sea rivers basins (except the Šventoji and Bartuva river basins), a part of the Prieglius river basin, a part of the Curonian Spit and coastal waters of the Baltic Sea;
- **Lielupė RBD** - includes a part of Lielupė river basin located in the territory of Lithuania;
- **Venta RBD** - includes: parts of Venta, Bartuva and Šventoji river basins located in the territory of Lithuania;
- **Daugava RBD**, - includes a part of Daugava river basin located in the territory of Lithuania.

Nemunas RBD. Nemunas RBD occupies the biggest part of the territory of Lithuania. The total area of the Nemunas basin covers 97 928 km^2, of which 46 700 km^2 is in the territory of Lithuania, 45 450 km^2 in the territory of Belarus, 2 520 km^2 in the territory of Poland, 3 170 km^2 in the territory of Russia and 88 km^2 in the territory of Latvia. The length of Nemunas river is 937 km, it flows 475 km through Lithuania and flows into the Curonian Spit which connects via strait to the Baltic Sea. Nemunas basin covers about 75% of the Lithuania's territory. Nemunas RBD consists of: Neris little tributaries (with Neris) sub-basin; Merkys sub-basin; Nemunas little tributaries (with Nemunas) sub-basin; Žeimena sub-basin; Šventoji sub-basin; Nevėžis sub-basin; Dubysa sub-basin; Šešupė sub-basin; Jūra sub-basin; Minija sub-basin; Prieglius sub-basin; Lithuanian seaside rivers basin; interim and coastal waters [1,9].

Nemunas rivers basin district is characterised by high socio-economic indicators, as it is home to the largest and economically strongest downs in the country. The following industries are mainly developed in the territory of Nemunas river basin in Lithuania: food, wood processing, textiles, chemistry, metal processing, machine manufacturing, appliances manufacturing. There are 32 hydroelectric power plants in Nemunas basin area in Lithuania, the largest of which is Kaunas HE [10].

Nemunas RBD has a large concentration of licensed Integrated Pollution Prevention and Control companies in poultry and pig farming, aquacultural companies and other industrial facilities [11]. Following the update of the RBD management plan in 2015, it was found that more water bodies in Nemunas RBD river are identified as significantly affected by dispersed agricultural pollution. Agricultural pollution has a very clear geographical spread in Nemunas basin – the largest agricultural pollution is found in the northern and central Lithuanian river sub-basins, where farming and livestock farming are the most intensive due to favourable farming conditions [7].

Nevėžis sub-basin. Nevėžis basin spreads in the lowlands of Central Lithuania, and the basin of its largest tributary – Šušvė – drains the lowlands of the ,,Žemaičiai" highlands. The surface is dominated by heavier mechanical carbonated rocks, with 10 % of the pool surface covered with sand [2].

The longest and largest Nemunas tributaries in Lithuania are rivers Merkys, Neris, Nevėžis, Dubysa, Šešupė, Jūra and Minija. Lengths and basin areas of the main RBD rivers running on Lithuanian territory are listed in Table 1. They differ in size, economic development and their impact. The total length of the rivers is 8162 km. The density of the rivers network is 1.33 km/km2 . Nevėžis receives part of the water from Lėven and Šventoji [9].

Table 1

Rivers lengths and basin areas [9]

Rivers	Length overall, km	Length in Lithuania, km	Total basin area, km^2	Basin area in Lithuania, km^2
Merkys	203	185.2	4415.7	3798.73
Neris	509.5	228	24942.3	4266.79
Dubysa	139	139	1965.9	1965.9
Šešupė	276.6	157.5	6104.8	4769.75

Rivers	Length overall, km	Length in Lithuania, km	Total basin area, km^2	Basin area in Lithuania, km^2
Jūra	171.8	171.8	4005.06	4005.06
Nevėžis	208.6	208.6	6140.5	6140.5
Minija	201.8	201.8	2939.97	2939.97
Šventoji	246	246	6789.18	6789.18
Žeimena	79.6	79.6	2775.25	2775.25

The fertile soils of Central Lithuania are favourable for the development of agriculture. The significant impact of dispersed pollution here is determined both by intensive agricultural activity and by the hydrological and physical – geographical conditions of the sub-basin. For this reason, the Nevėžis sub-basin rivers are the most affected by agricultural pollution. Studies have shown that nitrate and/or total nitrogen concentrations do not meet the requirements for good ecological status/potential in 58 of the 70 river sub-basins of identified Nevėžis water bodies (83%). Nevėžis river is affected by nitrogen compounds. Nitrogen concentrations increased on average by 46,6 % between 1991 and 2010 [16,17]. Due to drainage systems, nitrate transport time to water bodies is shortened and the potential for containment/degradation is greatly increased. Soluble nitrates entering drainage systems do not decompose and are rapidly transferred to water bodies. Carried out assessments show that in 2015, due to the impact of agricultural activities, about 1655 km of water bodies belonging to the Nemunas RBD river category (19% of the total length of the identified water bodies) were not in compliance with the requirements for good ecological status [7]. The upward trend in nitrate concentrations is observed in Nevėžis river basins. Agricultural activity therefore remains one of the most significant factors affecting the quality of water bodies [9]. Mineral phosphorus compounds are formed by biological treatment of domestic and some industrial wastewater [3].

Assessment of the ecological status of rivers. Water quality can be analysed according to various characteristics: physical properties of water, quantity of present substances, content of organic, mineral, toxic substances, etc. The general physicochemical water quality elements that have the greatest impact on the status of biological elements in rivers are BOC_7, total phosphorus, P-PO_4, total nitrogen, N-NH_4, N-NO_3 and O_2 [9, 15].

The ecological status of rivers is assessed on the basis of physicochemical quality elements – common data (nutrients, organic substances, oxygen saturation): nitric nitrogen (NO_3-N), ammonium nitrogen (NH_4-N), total nitrogen (N_b), total phosphorus (P_b), biochemical oxygen usage over 7 days (BOC_7) and dissolved oxygen quantity in water (O_2), the values of which are specified in the methodology for determining the status of surface water bodies. For each indicator, the water body is classified in one of five ecological status classes on an annual average basis [14]. The chemical status of the surface water of rivers, canals, lakes and ponds are assessed in accordance with the maximum permissible concentrations in the water body in the receiver according to the Order No. D1-236 of the Minister for the Environment of the Republic of Lithuania on 17 May 2006 “Regarding the Approval of the Wastewater Management Regulation”. See Table 2 for maximum permissible concentrations (MPC) and limit values for priority hazardous substances and hazardous and other controlled substances in natural surface water bodies.

Table 2

Maximum levels (MPC) for other controlled substances in Lithuania [14]

Name of the substance	MPC to waste water collection system, mg/l	MPC to natural environment mg/l	MPC in water body - the receiver, mg/l	Limit concentration in the waste water collection system, mg/l	Limit concentration in the natural environment, mg/l
Total nitrogen	100	30	*	50	12
Nitrites (NO_2-N)/NO_2	-	0.45/1.5	*	-	0.09/0.3
Nitrites (NO_3-N)/NO_3	-	23/100	*	-	9/39
Ammonium ions (NH_4-N)/NH_4	-	5/6.43	*	-	2/2.57
Total phosphorus	20	4	*	10	1.6
Phosphates (PO_4-P)/PO_4	-	-	*	-	-

* The average annual values of these substances in the surface water body (broken down by ecological status classes) are specified in the Methodology for the Determination of the Status of Surface Water Bodies approved by the Minister of the Environment of the Republic of Lithuania on 4 March 2010 by Order No. D1-178 (Official Gazette 2010, No. 29-1363). “Limit concentration” is the maximum concentration of a substance calculated, measured or planned to be exceeded up to which it is not yet required for it to be normalised/controlled. Maximum permissible concentration (MPC) is the maximum concentration allowed by legislation for a given pollutant or group of pollutants in waste water, water body, sediment or biota. MPC are general minimum requirements for the contamination of waste water or the aquatic environment and may only be applied on a case-by-case basis (MPC equal to the permitted concentration) if legislation on environmental sensitivity, the nature of the activity or other specific circumstances does not impose more stringent or additional requirements.

RESEARCH METHODOLOGY

Water quality monitoring was carried out on 3 March 2021 and 10 March 2021. Nevėžis river water samples for analysis were taken from 3 river sites (above and below) at Panevėžys, see Table 3.

Table 3

Coordinates of surface water monitoring sites, water sample, test site and test collection site address

Water sample No.	Test collection site	Test collection site address	Coordinates in the LKS 94 coordinate system	
			X	Y
1 and 4	V_1	Nevėžis river (by Nemuno str.)	55.7410443	24.3402908
2 and 5	V_2	Nevėžis river (by Parko str.)	55.7378705	24.3268821
3 and 6	V_3	Nevėžis river (by Vakarinė str.)	55.7383568	24.3131093

For methods, procedures and parameters used to determine the chemical parameters nitric nitrogen (NO_2-N), nitrite nitrogen (NO_2-N) total nitrogen (Nb), total phosphorus (P_b), biochemical oxygen usage over 7 days (BOC_7) and dissolved oxygen quantity in water (O_2) see Table 4.

Table 4

Measurements of parameters, measurement methods and procedures of surface water bodies

Measured parameters	Measurement method	Reference to documents
Organic content BOC_7 (mg/l O_2)	Electrochemical	LAND 47-1:2007 Biochemical oxygen usage over 7 days (BOC7) determined by electrometric method
Dissolved oxygen (O_2 mg/l)	Electrochemical	LST EN Standard 25814:2012 Water quality. Determining dissolved oxygen. Electrochemical probe method
Phosphates (mg/l)	Spectrometric, using ammonium molybdenum	LAND Standard 58-2003 Water quality. Determinig phosphorus. Spectrometric method using ammonium molybdate /Chapter 3/Determination of orthophosphorus
Nitrites (mg/l N)	Spectrometric	LAND Standard 39-2000 Water quality. Determination of nitrite quantity Molecular absorption spectrometric method
Nitrites (mg/l N)	Spectrometric	LAND Standard 65-2005 Water quality. Determination of nitrite quantity. Spectrometric method using sulphosalicylic acid
Ammonium nitrogen (mg/l N)	Spectrometric	LAND Standard 38-2000 Water quality. Determination of ammonium quantity. Manual spectrometry method.
Total phosphorus (mg/l)	Spectrometric, using ammonium molybdenum	LAND Standard 58-2003 Water quality. Determining phosphorus. Spectrometric method using ammonium molybdate/Chapter 6/Determination of total phosphorus by peroxodisulphate oxidation
Total nitrogen (mg/l)	Spectrometric, mineralization using peroxodisulphate	LAND Standard 59-2003 Water quality. Determination of nitrogen. Part 1. Oxidative mineralisation with peroxodisulphate method.

For chemical analysis, a sample of water was collected in clean containers of 1 litre capacity with sealed stoppers. The container must be filled fully to avoid exposure to atmospheric air. The sample is delivered to the laboratory stored at +4°C within 24 hours.

The water quality of Nevėžis river was assessed in accordance with the methodology for determining the status of surface water bodies. According to the average annual values of the indicators, a body of water is classified in one of five ecological status classes: very good, good, average, bad, very bad, see Table 5.

Table 5

Ecological status classes of rivers in terms of physico-chemical quality elements [14]

No.	Quality element		Parameter	River type	Criteria for river ecological status classes according to the values of physico-chemical quality elements				
					Very good	Good	Average	Bad	Very bad
1.	General characteristics	Nutrient substances	NO_3-N, mg/l N	1-5	<1.30	1.30-2.30	2.31-4.50	4.51-10.00	>10.00
2.			NH_4-N, mg/l N	1-5	<0,10	0.10-0.20	0.21-0.60	0.61-1.50	>1.50
3.			N_b, mg/l	1-5	<2,00	2.00-3.00	3.01-6.00	6.01-12.00	>12.00
4.			PO_4-P, mg/l P	1-5	<0,050	0.050-0.090	0.091-0.180	0.181-0.400	>0.400

No.	Quality element	Parameter	River type	Criteria for river ecological status classes according to the values of physico-chemical quality elements				
				Very good	Good	Average	Bad	Very bad
5.		P_b, mg/l	1-5	<0.100	0.100-0.140	0.141-0.230	0.231-0.470	>0.470
6.	Organic substances	BOC_7, mg/l O_2	1-5	<2,30	2.30-3.30	3.31-5.00	5.01-7.00	>7.00
7.	Saturated with oxygen	O_2, mg/l	1, 3, 4, 5	>8.50	8.50-7.50	7.49-6.00	5.99-3.00	<3,00
8.		O_2, mg/l	2	>7.50	7.50-6.50	6.49-5.00	4.99-2.00	<2,00

Test sites are marked in Figure 1.

Fig. 1. Sampling sites

RESULTS AND ITS ANALYSIS

Change of Biochemical Oxygen Consumption (BOC_7) concentration

BOC_7 (biochemical oxygen consumption over seven days) is the main indicator of organic substances quantity in water bodies. It indicates the amount of dissolved oxygen required for biochemical oxidation of organic substances in water. One of the reasons for the apperance of organic substances into the water body is industrial and domestic wastewater. The results of BOC_7 are presented in Table 6.

Table 6

Results of the Biochemical Oxygen Consumption (BOC_7) Test

Date of testing	Sample No.	Sampling site	Indicator	Test results	Ecological status of rivers in terms of physico-chemical quality elements indicators
30/03/2021	1.	V_1	BOC_7	2,24 mg/l O_2	Very good
	2.	V_2		2,31 mg/l O_2	Good
	3.	V_3		2,33 mg/l O_2	Good
10/03/2021	4.	V_1		2,32 mg/l O_2	Good
	5.	V_2		2,33 mg/l O_2	Good
	6.	V_3		2,44 mg/l O_2	Good

During the test period (3 March 2021 and 10 March 2021), the concentration of BOC_7 varied from 2,24 mgO_2/l to 2,44 mgO_2/l. The maximum concentration was recorded at 2.44 mgO_2/l on 10 March 2021 and the minimum concentration at 2.24 mgO_2/lon 3 March 2021. The maximum variation in BOC_7 concentration is observed V_3 at test site at 0,11 mgO_2/l and the minimum at 0,02 mgO_2/l - V_2. According to the BOC_7, the ecological status of the river water V_1 at test site is very good and V_2 and V_3 - good.

Change in dissolved oxygen (O_2) concentration

Oxygen is essential for many aquatic plants and animals. The main sources of oxygen are atmosphere and aquatic plants and photosynthesis in green organisms. The oxygen quantity of water is an indicator of its contamination (the less oxygen it contains, the more organic substances in water for which oxidise oxygen is consumed). The results of the dissolved O_2 concentration variation tests in the Nevėžis river are presented in Table 7.

Table 7

Results of dissolved oxygen quantity (O_2) test analysis

Test date	Sample No.	Sampling site	Indicator	Test results	Ecological status of rivers in terms of physico-chemical quality elements indicators
30/03/2021	1.	V_1	O_2	9.34 mg/l.	Very good
	2.	V_2		8.92 mg/l.	Very good
	3.	V_3		8.50 mg/l.	Good
10/03/2021	4.	V_1		9.58 mg/l.	Very good
	5.	V_2		9.70 mg/l.	Very good
	6.	V_3		8.60 mg/l.	Good

During the test period (3 March 2021 and 10 March 2021), the O_2 concentration varied from 8,50 mg/l to 9,70 mg/l. The maximum concentration was recorded at 9.70 mg/l on 10 March 2021 and the minimum concentration at 8.50 mg/l on 30 March 2021. The maximum variation in O_2 concentration is seen V_2 at test site at 078 mg/L, and the minimum variation - 0,1 mg/l - V_3 According to O_2, the ecological status of the river water V_1 and V_2 at test site is very good, and V_3 - good.

Nitric nitrogen (NO_3-N) concentration variation

Human activity significantly increases the nitrogen input of nitrates into rivers. Inorganic nitrogen compounds are released into natural waters by leaching inorganic fertilisers and mineralisation products from soils, with dry and wet fallout, and with sewage (domestic, industrial, agricultural). The results of Nevėžis river nitrate (NO_3-N) concentration variation tests are presented in Table 8.

Table 8

Test results for nitric nitrogen (NO_3-N)

Test date	Sample No.	Sampling site	Indicator	Test results	Ecological status of rivers in terms of physico-chemical quality elements indicators
30/03/2021	1.	V_1	NO_3-N, mg/l N	1,21 mg/l N	Very good
	2.	V_2		1,25 mg/l N	Very good
	3.	V_3		1,52 mg/l N	Good
10/03/2021	4.	V_1		1,60 mg/l N	Good
	5.	V_2		1,47 mg/l N	Good
	6.	V_3		1,78mg/l N	Good

During the test period (30 March 2021 and 10 March 2021) NO_3-N concentration varied from 1,21 mg/l N to 1,78 mg/l N. The maximum concentration was recorded at 1.78 mg/L N on 10 March 2021 and the minimum concentration on 30 March 2021 - 1.21 mg/lN. The maximum variation in NO_3-N concentration is observed at the V_1 test site at 0,39 mg/l N, and the minimum - 0,22 mg/l N at the V_2 test site. According to NO_3-N ecological status of river water is good at all test sites.

Ammonium nitrogen (NH_4-N) concentration variation

Ammonium is present in water in ionized (NH_4^+) and non-ionized (NH_3) forms. Ammonium is not very toxic to aquatic animals in the ionised form (NH_4^+). The concentration of ammonium nitrogen depends on the intensity of biochemical processes occurring in soil and water. The results of Nevėžis river phosphates (NH_4-N) concentration variation tests are presented in Table 9.

Table 9

Ammonium nitrogen (NH_4-N) test results

Test date	Sample No.	Sampling site	Indicator	Test results	Ecological status of rivers in terms of physico-chemical quality elements indicators
30/03/2021	1.	V_1	NH_4-N	0,30 mg/l N	Average
	2.	V_2		0,08 mg/l N	Very good
	3.	V_3		0,13 mg/l N	Good
10/03/2021	4.	V_1		0,28 mg/l N	Average
	5.	V_2		0,05 mg/l N	Very good
	6.	V_3		0,20 mg/l N	Good

During the test period (3 March 2021 and 10 March 2021), the NH_4-N concentration varies from 0,05 mg/l N to 0,30 mg/l N. The maximum concentration was recorded at 0.30 mg/l N on 30 March 2021 and the minimum concentration at 0,05 mg/lN on 10 March 2021. The change in NH_4-N concentration at all test sites is insignificant. According to NH_4-N, the ecological status of the river water V_1 at test site is average, V_2 - very good and V_3 – good.

Change in total phosphorus (P_b) concentration

Phosphorus compounds naturally enter naturally formed circulation circles, but due to anthropogenic activity the increased load of these substances has long before become a contamination. Intensive agricultural production and the use of mineral fertilisers contribute to exceeding the limit values for certain quantities of biogenic substances in rivers water. The results of the total phosphorus (P_b) concentration variation tests of the Nevėžis river are presented in Table 10.

Table 10

Results of total phosphorus (P_b) test

Test date	Sample No.	Sampling site	Indicator	Test results	Ecological status of rivers in terms of physico-chemical quality elements indicators
30/03/2021	1.	V_1	P_b	0.120 mg/l	Good
	2.	V_2		0.142 mg/l	Average
	3.	V_3		0.143 mg/l	Average
10/03/2021	4.	V_1		0.122 mg/l	Good
	5.	V_2		0.141 mg/l	Average
	6.	V_3		0.144 mg/l	Average

During the test period (3 March 2021 and 10 March 2021) the concentration of P_b varies from 0,120 mg/l to 0,144 mg/l. The maximum concentration was recorded at 0.144 mg/l on 10 March 2021 and the minimum concentration at 0.121 mg/l on 30 March 2021. P_b concentration change is insignificant. V_1 at test site - 0.002 mg/l, V_1 and V_2 at test sites - 0.001 mg/L. Based on P_b , the ecological status of the river water V_1 at test site is good, V_2 and V_3 – average. ..

Change of total nitrogen (N_b) concentration

Nitrogen compounds, like phosphorus, naturally enter into naturally formed circulation circles, but the anthropogenic activity has resulted in increased loads of these substances becoming a contamination. Intensive agricultural production contributes to exceeding the limit values for certain quantities of biogenic substances in river water. The results of the total nitrogen (P_b) concentration variation tests in Nevėžis river are presented in Table 11.

Table 11

Results of Total Nitrogen (N_b) Test

Test date	Sample No.	Sampling site	Indicator	Test results	Ecological status of rivers in terms of physico-chemical quality elements indicators
30/03/2021	1.	V_1	N_b	1.98 mg/l	Very good
	2.	V_2		2.22 mg/l	Good
	3.	V_3		2.14 mg/l	Good
10/03/2021	4.	V_1		1.96 mg/l	Very good
	5.	V_2		2.25 mg/l	Good
	6.	V_3		2.18 mg/l	Good

During the test period (3 March 2021 and 10 March 2021), the concentration of N_b varies from 1,96 mg/l to 2,25 mg/l. The maximum concentration was recorded at 2.25 mg/l on 10 March 2021 and the minimum concentration at 1.98 mg/l on 30 March 2021. The change in concentration of N_b is insignificant. V_1 at test site - 0.02 mg/l , V_2 - 0.03 mg/l. and V_3 at 0,04 mg/l. Based on N_b, the ecological status of the river water V_1 at test site is very good and V_2 ir V_3 - good.

Change of pH concentration

During the test period (3 March 2021 and 10 March 2021), the hydrogen ion concentration in the Nevėžis river water varied from 6,6 to 8,3. The average hydrogen ion concentration in river water is 7.45. According to the limit values for the water quality indicators specified in the description of the protection requirements for surface water bodies in which freshwater fish can live and breed, the water pH of the Nevėžis river complies with the requirements. The pH concentrations of most water sampling sites were similar to each other during the test period. This suggests that the acidity – alkalinity - of Nevėžis river water is relatively constant and varies slightly.

Conclusions

1. In order to determine the water quality of the Nevėžis river, a physico-chemical water test was carried out and the following indicators were assessed: BOC_7, NO_3-N, P_b, N_b, O_2, NH_4-N ir Ph. Summary of the results of the study showed that none of the indicators exceeded the allowed maximum concentrations.

2. In order to assess the ecological status of Nevėžis river, the water for the tests was taken from 3 river sites near Panevėžys. Having assessed the water quality of Nevėžis river, it was found that according to:

- biochemical oxygen consumption during seven days the ecological status of the river water at Nemunas street is very good, at Parkas street and at Vakarinė street - good.
- the dissolved oxygen quantity river's water ecological status is very good at Nemunas street and Parkas street, and good at Vakarinė street .
- nitric nitrogen, ecological status of the river water is good at all test sites.
- ammonium nitrogen, the ecological status of the river water is average at Nemunas street, very good at Parko street and good at Vakarinė street.
- the total phosphorus in the river water is in good ecological condition at Nemunas street, at Parkas and Vakarinė street – average. It is believed that more intensive fertilisation of soils with phosphorus fertilisers may have contributed to this.
- total nitrogen ecological status of the river water at Nemunas street is very good, at Parko and Vakarinė street – good.

Summarising all the parameters assessed (BOC_7, NO_3-N, Pb, Nb, O_2, NH_4-N bei pH) and assessing the water quality of Nevėžis river according to its ecological classes, it is from average to very good condition.

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