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The Impact of Inhabited Areas on the Quality of Streams and Rivers of a High Alpine Municipality in Southern Kosovo

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ABSTRACT

During the spring of 2011, forty-five macrozoobenthos samples were taken from streams and rivers all over the Dragash Municipality in order to assess the impact of inhabited areas in these freshwater ecosystems, considering the fact that there is no sewage treatment and waste management is dysfunctional in many parts of this Municipality. On the basis of the habitat structure evaluation, basic physical and chemical analysis and Family Biotic Index according to Hilsenhoff and EPT Index (Ephemeroptera Plecoptera Trichoptera), this study shows that the freshwater ecosystems in the Dragash Municipality are heavily polluted and impacted by human activities in their midstream and downstream segments. The main sources that deteriorate their natural ecological conditions in these segments are: load of all kinds of waste directly into the rivers and streams, industrial discharge into the freshwater ecosystems and the direct sewage discharge into the rivers and streams all over the municipality. This study also shows that the freshwater ecosystems of the area in their upper reaches are home to very interesting and rare composition of aquatic fauna. Several species and many potential ones which live only in this area and nowhere in Kosovo or abroad, or their distribution elsewhere is very limited, have been found.

Keywords: benthic macroinvertebrates, water quality, high alpine municipality, Kosovo

INTRODUCTION

Dragash is the southernmost municipality in Kosovo, covering an area of 435.8 km², sharing borders with the neighbouring countries of North Macedonia to the east and south, and Albania to the west. The Dragash municipality comprises 36 settlements with the small town of Dragash as the municipal centre. Dragash is rich in freshwater resources, with numerous water springs from the lowest altitudes to the highest areas above 2500 m, and on average 1130 mm/m² rainfall per year. The average density for the municipality is 2.1 km of water courses per km² of surface area, with 0.4 km of large permanent water courses and 1.7 km of smaller often temporary ones. Approximately 76% (700 km) of water courses in the Dragash municipality are located in the mountainous Gorë region, where river valleys and postglacial lakes contribute to the high number of waterways. About 24% of Dragash waterways are located in Opojë (215 km). Large water courses in Dragash are approximately 170 km in length. The two main lakes are Lake Shutman and Lake Brezna (Bank et al., 2014; Hajredini et al., 2013).

Basic structural information, together with the results of rapid water quality assessment, are aiming to give the initial overview regarding the quality and quantity of surface water resources in the Dragash Municipality, where sewage and domestic waters are discharged directly into freshwater ecosystems and where the waste management system is dysfunctional in many parts of this municipality.

The goal of this study was to assess the ecological conditions of running waters in the Dragash Municipality inside the area designated to be National Park and close to it. The main objective of the study was to assess the impact human settlements and existing factories have in freshwater ecosystems in the Dragash Municipality. In this regard, two categories of sampling sites were chosen: 1) those above human settlements, i.e. villages (i.e. pollution sources) and 2) those below human settlements, within or close to pollution sources.

MATERIAL AND METHODS

Data sampling and processing

During the period of 20.05.2011-30.06.2011 forty-five macrozoobenthos samples were taken in streams and rivers all over the Dragash Municipality. At the same time, the physical and chemical habitat assessment analyses were conducted at the same investigation places. All collected samples and data were analyzed in laboratory; they were statistically processed and together with the calculated parameters form the basis of the findings of this investigation. The macrozoobenthos specimens were collected by means of the Surber net with the dimensions of 30×20 cm (600 cm^2) diameter. The collected material was fixed in 4% formaldehyde. In the laboratory, the material was sorted out and the specimens were identified and preserved in 75 ethanol (Cummins, 1962).

A rapid water quality assessment is used when identifying macro-invertebrate taxa to family level and calculating Family Biotic Index according to Hilsenhoff (Hilsenhoff, 1988) and EPT (Ephemeroptera, Plecoptera, Trichoptera) percentage through standard procedures. In addition to this, basic physical and chemical habitat assessment parameters were measured and recorded in every investigated site, such as: water temperature, air temperature, stream width, stream depth, discharge, stability of the stream banks, the gradient of the stream, the amount that the stream is shaded by riparian vegetation, the composition of bottom substrata, the complexity of microhabitats, the amount of dissolved oxygen, pH, BOD. The physical habitat parameters were assessed according to Barbour and Stribling (1991).

Study area

D1 – Zaplluxhe is located above the village on the right branch of the Zaplluxhe stream. D2 – Zaplluxhe is located on the second branch of the Zaplluxhe stream about 400 m above the last house. D3 – Zaplluxhe is located on the second stream of the village, just above the last house. D4 – Zaplluxhe is located below the village at the point where two afore mentioned streams join together and after the sewage of the village is discharged directly on the stream. D5 – Blaç is located inside the village in the river coming from Zaplluxhe. D6 – Bresane is located in a stream passing through the Bresane village, few meters above the last house. D7 – Bresane down, is located below the last houses of the Bresane village. D8 – Bellobradë is located inside the Bellobradë village, next to the Bresane village. D9 – Bellobradë is located beyond the Bellobrade village, close to the bridge. D10 – Kuk is located in a stream above the village of Kuk. D11 – Buzez is located below the village of Buzez in a stream coming from Kuk village. D12 – Brezne is located in a streamlet, few hundred meters before it flows into the lake. D13 – Pllajnik is located in a river above the village of Pllajnik. D14 – Kosavë is located below the village of Kosavë in a river coming from the Pllajnik village. D15 – Plavë up is located in a streamlet above the village of Plavë. D16 – Plavë meat factory is located below the Plava village after the Meka meat factory. D17 – Rrenc up is located above the Rrenc village, few hundred meters close to the source of the Rrenc stream, nearby the village school. D18 – Rrenc is located in Rrenc stream, below the Rrence village and few meters before it flows into the Plava River. D19 – Plava River (Rrenc) is located in the Plava River after all afore-mentioned streams join together. D20 – Brod up is located in the Brod River several kilometres beyond the Arxhena Hotel towards the Shutman Lake. D21 – Brod up is located above the Brod village nearby Arxhena Hotel. D22 – Brod II is located above the Brod village on the second river of the village. D23 – Brod down is located below the Brod village and after the two rivers join together after flowing through the village. D24 – Dikance is located in the Brod River past the Dikanca Hydro Power Plant. D25 – Mlika up is located above the village on Mlika stream. D26 – Mlika down is located in the Mlika stream, beyond the village. D27 – Brod River in Mlika is located in

Brod River after the Mlika stream flows into it. D28 – Rapçe up is located in Rapçe stream above the village. D29 – Rapçe down is located in the Rapçe stream below the village. D30 – Radesha up is located in Radesha River above the village. D31 – Radesha down is located below the Radesha village. D32 – Dragash is located below the town of Dragash in the river coming from the Radesha village. D33 – Restelica up is located in the Restelica River above the village. D34 – Restelica down is located in the Restelica River below the village. D35 – Krushevë up is located in the Restelica River above the Krushevë village about 5 kilometers after the previous site. D36 – Krushevë down is located in the Restelica River below the Krushevë village. D37 – Gllboçica up is located in the Restelica River above the Gllboçica village which is next to Krushevë. D38 – Zlipotok up is located in the Zlipotok River above the village. D39 – Zlipotok down is located in the Zlipotok River below the village. D40 – Zlipotok middle is located in another stream passing on through the Zlipotok village. D41 – Orçusha up is located in a stream above the Orçusha village. D42 – Orçusha middle is located inside the Orçusha village. D43 Krstec is located in a stream above the Krstec village. D44 – Wool Factory up is located above the Wool Factory. D45 – Wool factory down is located just below the wool factory, few hundred meters below the previous site.

RESULTS

During this investigation, a total of 5637 macrozoobenthos specimens were found, belonging to 47 families classified in the following macrozoobenthos classes, subclasses and orders: Turbelaria, Gastropoda, Bivalvia, Hirudinea, Oligocheta, Isopoda, Amphipoda, Coleoptera, Megaloptera, Diptera, Trichoptera, Odonata, Plecoptera and Ephemroptera. The highest number of specimens found during this investigation, belongs to three insect orders: Ephemeroptera, Plecoptera and Trichoptera. The specimens from these insect orders are found in highest percentage, especially in the stations located above settlements and inhabited areas. The lowest EPT percentage is found in the following stations: D19 (9%), D8 (12%) and D5 (14%) while the highest percentage is found in D21 (99%) and D22 (98%). The species of insect order Ephemeroptera are absent from station D19, the species of order Trichoptera are absent from stations: D4, D7 and D8, and species of order Plecoptera are absent from the following localities: D5, D6, D7, D8, D13, D16, D20, D21, D22, D24, D25, D26 and D38 (Table 1). According to the Hilsenhoff Family Biotik Index (Hilsenhoff, 1988) excellent water quality was found in 15 sites, very good water quality in 9 sites, good water quality in 5 sites, fair water quality in 1 site, fairly poor water quality in 1 site, poor water quality in 7 sites and very poor water quality in 7 sites (Table 1).

Many of the investigated stations, especially those inside, around or below human settlements are characterized by a considerable load of garbage of all kinds: animal remains, animal dung, fruits, vegetables, all kinds of food, plastic bags, plastic pots, metallic pots, empty bottles, metallic remains of household equipment, bricks, remains from construction demolition and all other things which are usually deposited from a typical household in the area. Usually, all this waste is thrown directly into the stream or river, sometimes in stream and river banks creating a huge pile of waste. In several cases, the waste is deposited in streams and rivers above the villages as well (for example in D3, D13, and D30). Although in some villages the waste disposal containers were visible inside the village (for example in Bresane village), the waste was still seen inside and around the rivers and streams only few meters away while these containers were empty. These are the stations where the waste loads were seen during the field visits inside the rivers or on river banks: D3, D4, D5, D7, D8, D9, D11, D13, D14, D16, D23, D26, D27, D29, D30, D36, D37, D41, D44 and D45.

DISCUSSION

In general, basic assessed physical habitat parameters in the stations upstream from villages are within natural conditions. The river/stream bad and banks are not altered, neither upstream nor downstream, with the only exception of few cases (Blaç, Buzez and Bresane down) where the river banks are altered in terms of wall barriers of houses which are located in the vicinity. All sites with excellent score of water quality are located above human settlements and are out of anthropogenic impact. However, three of the investigated sites, although located above villages (D17, D30 and D28), are scored with very good water quality

Table 1. FBI and EPT values

Code	Sampling site	F B I	Water quality	% EPT
D1	Zaplluxhë	2.97	Excellent	87
D2	Zaplluxhë	2.83	Excellent	85
D3	Zapluxhë	1.88	Excellent	98
D4	Zaplluxhë	7.29	Very poor	29
D5	Blaç	8.59	Very poor	14
D6	Bresanë up	3.48	Excellent	80
D7	Bresanë down	7.56	Very poor	24
D8	Bellobrad	7.86	Very poor	12
D9	Bellobradë	8	Very poor	20
D10	Kuk	3.66	Excellent	71
D11	Buzez	6.77	Poor	49
D12	Brezne	6.69	Poor	16
D13	Pllajnik	3.6	Excellent	45
D14	Kosavë	7.11	Poor	44
D15	Plavë up	1.65	Excellent	91
D16	Plavë (Meka factory)	6.98	Poor	27
D17	Rrenc Up	3.85	Very good	86
D18	Rrence	4.09	Very good	41
D19	Rrencë (River Plava)	7.79	Very poor	9
D20	Brod Camp	3.39	Excellent	94
D21	Brod Up	2.87	Excellent	99
D22	Brod II	3.35	Excellent	98
D23	Brod Down	3.77	Very good	88
D24	Dikanca	4.59	Good	81
D25	Mlika up	3.52	Excellent	87
D26	Mlika Down	3.91	Very good	25
D27	Mlika (River Brod)	3.96	Very good	96
D28	Rapçë up	3.83	Very good	87
D29	Rapçë down	4.95	Good	26
D30	Radesha Up	3.8	Very good	91
D31	Radesha	6.93	Poor	34
D32	Dragash	5.86	Fairly poor	56
D33	Restelica Up	2.47	Excellent	86
D34	Restelica Down	6.63	Poor	48
D35	Krushevë Up	4.77	Good	82
D36	Krushevë Down	4.76	Good	85
D37	Glloboçica Up	4.06	Very good	83
D38	Zli Potok Up	3.53	Excellent	89
D39	Zli Potok Down	3.54	Excellent	88
D40	Zli Potokë Middle	4.27	Good	68
D41	Orçusha Up	3.99	Very good	54
D42	Orçushë Middle	5.31	Fair	38
D43	Krstec	3.04	Excellent	95
D44	Wool factory Up	7.45	Very poor	37
D45	Wool factory	6.58	Poor	54

category even though these stations would be expected to have excellent water quality. The reason for this could be the temporary circumstances in these stations as a result of emergence period for some pollutant intolerant taxa. A large number of adults (mostly Plecoptera), who are noted for being intolerant to organic pollution, was noticed around these stations. In cases of emergence period (when larvae from water are transformed in flying adults) the FBI may give slightly inadequate overview of

Table 2. Coordinates and habitat characteristics

Code	Sampling site	Latitude N	Longitude E	Altitude m	Channel alteration	Stream width m	Stream depth m	Stream flow m/s	Discharge m^3/s
D1	Zaplluxhë	40° 07’35.99”	20° 46´06.14”	1313	No	1.4	0.12	0.45	0.0756
D2	Zaplluxhë	40° 07’58.90”	20° 45´51.59”	1217	No	0.95	0.09	0.41	0.035
D3	Zapluxhë	40° 07’56.47”	20° 45´46.46”	1115	No	0.96	0.09	0.42	0.0362
D4	Zaplluxhë	42° 07’47.47”	20° 44´44.96”	1142	No	2.6	0.2	0.64	0.332
D5	Blaç	42° 07’29.62”	20° 43´50.42”	1096	Medium	2.2	0.28	0.42	0.258
D6	Bresanë up	42° 06’37.78”	20° 43´51.51”	1220	No	3.3	0.2	0.9	0.594
D7	Bresanë down	42° 06’34.94”	20° 43´21.84”	1123	Yes	5.2	0.26	1.25	1.69
D8	Bellobrad	42° 07’09.97”	20° 41´26.05”	1010	No	5.9	0.31	0.8	1.463
D9	Bellobradë	42° 07’02.63”	20° 41´06.16”	1003	No	5.8	0.3	0.78	1.357
D10	Kuk	42° 05’47.58”	20° 43´04.91”	1235	No	2.4	0.1	0.62	0.148
D11	Buzez	42° 06’29.14”	20° 42´40.35”	1131	No	2.3	0.14	0.6	0.193
D12	Brezne	42° 07’45.80”	20° 38´23.90”	944	No	1	0.24	0.4	0.096
D13	Pllajnik	42° 04’28.42”	20° 42´20.13”	1358	No	2.75	0.1	0.69	0.189
D14	Kosavë	42° 05’54.42”	20° 41´48.50”	1124	No	1.8	0.33	0.9	0.5346
D15	Plavë up	42° 06’00.41”	20° 38´48.22”	1010	No	1	0.05	0.3	0.015
D16	Plavë (Meka factory)	42° 05’53.92”	20° 39´05.49”	973	No	0.5	0.08	0.4	0.016
D17	Rrenc Up	42° 05’05.45”	20° 39´36.46”	1010	No	0.65	0.08	0.83	0.043
D18	Rrence	42° 05’05.45”	20° 38´52.35”	922	No	2.1	0.13	0.5	0.136
D19	Rrencë (River Plava)	42° 04’52.60”	20° 38´50.62”	916	No	6.3	0.24	0.71	1.073
D20	Brod Camp	41° 55’41.08”	20° 44´00.06”	1972	No	–	–	–	–
D21	Brod Up	41° 58’57.88”	20° 42´30.57”	1401	No	6.2	0.35	1.13	2.45
D22	Brod Midle	41° 59’31.41”	20° 42´44.88”	1415	No	3.2	0.15	0.81	0.388
D23	Brod Down	41° 59’41.01”	20° 42´12.53”	1386	No	9	0.32	1	2.88
D24	Dikanca	42° 00’36.89”	20° 40´27.47”	1137	No	8	0.4	1.25	4
D25	Mlika	42° 01’38.40”	20° 38´36.04”	977	No	1.2	0.09	0.47	0.05
D26	Mlika Down	42° 02’16.16”	20° 38´24.16”	941	No	1.4	0.08	0.48	0.053
D27	Mlika (River Brod)	42° 02’17.91”	20° 38´26.44”	940	No	7	0.27	0.83	1.568
D28	Rapçë up	42° 05’33.23”	20° 36´53.02”	1040	No	2.5	0.2	0.8	0.4
D29	Rapçë	42° 04’42.59”	20° 37´32.54”	910	No	1.7	0.1	0.58	0.0986
D30	Radesha Up	42° 03’04.23”	20° 41´48.50”	1207	No	4.1	0.27	0.79	0.874
D31	Radesha	42° 03’13.78”	20° 41´25.47”	1265	No	4.2	0.275	0.8	0.924
D32	Dragash	42° 03’50.06”	20° 39´07.37”	1012	No	3	0.3	0.89	0.801
D33	Restelica Up	41° 56’28.24”	20° 40´53.80”	1417	No	6.9	0.23	0.8	1.269
D34	Restelica Down	41° 57’14.59”	20° 39´02.12”	1212	No	8.2	0.36	1.12	3.306
D35	Krushevë Up	41° 58’26.01”	20° 38´33.12”	1216	No	8	0.5	1	4
D36	Krushevë Down	41° 58’49.79”	20° 38´08.41”	1150	No	7.3	0.5	0.94	3.431
D37	Gllboçica Up	41° 59’48.59”	20° 38´34.89”	1237	No	3	0.1	0.8	0.24
D38	Zli Potok Up	41° 58’35.84”	20° 39´39.11”	1348	No	1.5	0.13	0.66	0.128
D39	Zli Potok Down	41° 58’25.72”	20° 38´35.62”	1296	No	2	0.15	0.64	0.192
D40	Zli Potokë Middle	41° 58’26.98”	20° 38´39.58”	1367	No	1	0.25	0.5	0.125
D41	Orçusha Up	42° 02’06.43”	20° 36´49.48”	1107	No	0.65	0.08	0.4	0.0208
D42	Orçushë Middle	42° 02’26.42”	20° 36´09.21”	968	No	1	0.07	0.8	0.056
D43	Krstec	42° 04’28.41”	20° 36´49.48”	955	No	0.7	0.09	0.7	0.0041
D44	Wool factory	42° 03’06.40”	20° 38´34.91”	997	No	2.75	0.15	0.71	0.292
D45	Wool factory Up	42° 03’05.87”	20° 38´39.26”	999	No	2.75	0.15	0.71	0.292

existing water quality (Table 2). This is the reason why FBI must be calculated accordingly during all four seasons in order to have an average result and a real view of the existing situation. The stations inside, around or below human settlements are scored in most of the cases with very poor water quality according to FBI and only in some cases with poor category of water quality.

The oxygen concentration values are in line with the Family Biotic Index according to the Hilhsenhoff values. The highest values of oxygen are found in the stations located upstream from villages while low values are registered inside or below the villages where the organic load is high. The pH values are within the allowed limits in the investigated stations with the exception of the station D45 close to a wool factory, where the lowest pH value of 5.2 was registered, which makes the habitat there unsuitable for normal life of living organisms. High values of pH close to 8 or more are registered in several stations belonging to Restelica River and Brod River but this seems to be natural condition in these rivers, since high values of pH are registered from the very upstream stations, where there is no significant human activity.

There are three factories operating in the Dragash Municipality: Meka Meat Factory, Milk Factory and Wool Factory. The processed water from these industries is directly discharged into the streams and rivers either through the sewage system of the area where they are located (Meka Factory and Milk Factory) or directly into the river (Wool Factory). In first two cases, it was impossible to assess the direct impact from these factories in the water quality of streams and rivers around, since their industrial water is mixed with the sewage waters from the area, while in the case of the wool factory, the impact is direct and catastrophic for river biota where their processed is discharged, and thus for water quality. During the end of May field visit, there was no sign of industrial water discharge from the wool factory into the river although two pipes, about 30 meters apart from each other, coming directly from the Factory were seen and registered. During the mid-July field visit at the same place, the authors sampled and analyzed the site in the moment when the process of industrial water discharge into the river was taking place. It was obvious that the industrial water is released into the river without any prior treatment. The water was violet in colour with pH 5.2 and there was no sign of living organisms in vicinity of the place where the water is discharged. The pH of water from the river was measured during that time in several places downstream from the factory and it was significantly lower than upstream from the factory. It is a well-known fact that this low value of pH makes it impossible for all macro-organisms in the rivers to thrive (pH) (Table 3).

The importance of freshwater (river and streams) ecosystem conservation and protection is highlighted in a number of Global and European Union conventions and resolutions and is a precondition to be met for Kosovo either in a process of EU preassociation or from the legal perspective for the areas aiming to have protected zones. Rivers and streams are the basic structure of natural water circulation and their conservation and good maintenance provides not only sustainable resources for drinkable water, but also gives an excellent perspective for tourism and good economic perspective. The research into relevant international agreements, such as the UN Convention, the SADC Protocol, Agenda 21, the Convention of Biological Diversity and the Ramsar Convention, shows that the need for integrated water resource management strategies that ensure protection of ecosystems has gained wide recognition in international Water Law and Policy.

CONCLUSIONS

This study showed that the freshwater ecosystems in the Dragash Municipality are heavily polluted and impacted by human activities in their midstream and downstream segments. The main sources that deteriorate their natural ecological conditions in these segments are: discharge of all kinds of waste directly into the rivers and streams, industrial discharge into the freshwater ecosystems and the direct sewage discharge into the rivers and streams all over the municipality. This study also shows that freshwater ecosystems of the area in their upper reaches are home to very interesting and rare composition of aquatic fauna. Several species and many other potential ones which live either only in this area and nowhere in Kosovo or abroad, or their distribution elsewhere is very limited, were found. In this regard, conservation of biodiversity is an effective tool for prosperous economic and touristic development of an area especially in the case of Dragash Municipality where the sustainable future economic profile of the municipality will be heavily based on its nature and ecosystem values. This study is in line with other recent similar investigations reflecting the increased anthropogenic impact on freshwater ecosystems in Kosovo during the last decades (Dauti et al., 2007; Gashi 1993, 2006; Ibrahimi, 2007; Ibrahimi et al., 2007; Musliu et al., 2018; Shukriu 1979; Zhushi-Etemi 2005).

Table 3. Physico-chemical parameters

Code	Sampling site	Air temperature °C	Water temperature °C	pH	O_2 mg/l	BOD mg/l
D1	Zaplluxhë	21	14	7.3	11.4	4.1
D2	Zaplluxhë	21.5	13.5	7.72	10.2	4.4
D3	Zapluxhë	21	13	7.62	11	4
D4	Zaplluxhë	21	15	7.3	6.4	8.1
D5	Blaç	22	14	7.36	5.1	8.9
D6	Bresanë up	22	9	7.42	12.3	4.9
D7	Bresanë down	21	11	7.5	6.3	3.7
D8	Bellobrad	22	12	7.4	7.8	11.9
D9	Bellobradë	22	10.5	7.4	5.1	9.1
D10	Kuk	21.5	10.5	6.8	10.6	4.7
D11	Buzez	20	11	6.8	9.4	10.6
D12	Brezne	23	14	6.48	11	7.5
D13	Pllajnik	19.5	8.5	7.05	12.5	3.3
D14	Kosavë	19	9	7.35	6.5	6.2
D15	Plavë up	22	15	7.1	13.1	3.4
D16	Plavë (Meka factory)	22	15	7.3	7.5	11.1
D17	Rrenc Up	22	11	7.67	12.1	4.9
D18	Rrence	21.5	10.5	7.3	10.3	5.1
D19	Rrencë (River Plava)	21	12	7.5	6.3	10
D20	Brod Camp	–	–	–	–	–
D21	Brod Up	18	8.5	7.86	14.5	3.4
D22	Brod Midle	18	9	7.95	13.3	4.1
D23	Brod Down	21	10	8.05	10.9	8.3
D24	Dikanca	21	10.5	7.75	10.3	8.9
D25	Mlika	19	12	7.5	12.4	5
D26	Mlika Down	19	11	7.58	10.8	5.3
D27	Mlika (River Brod)	19.5	10.5	7.6	10.2	7.1
D28	Rapçë up	19	10	7.5	10.9	4.1
D29	Rapçë	19	11	7.6	8.5	4.6
D30	Radesha Up	21	8.5	7.1	14.2	3.8
D31	Radesha	21	9	7.06	10.3	10.3
D32	Dragash	22.5	12	6.9	10.1	5.2
D33	Restelica Up	17	8	7.89	13.7	3.1
D34	Restelica Down	18	9	8	6.8	9.9
D35	Krushevë Up	19	11	8.26	11.2	8.1
D36	Krushevë Down	19	11.5	7.84	9.4	7.3
D37	Gllboçica Up	20.5	12	7.68	9.1	7.4
D38	Zli Potok Up	20.5	14	7.85	11.8	5.9
D39	Zli Potok Down	19	12	8.26	10.1	4.2
D40	Zli Potokë Middle	20	15	6.96	11.3	6
D41	Orçusha Up	21	13	7.55	13.1	9
D42	Orçushë Middle	21	14	7.46	10.2	9.3
D43	Krstec	19	14	7.5	13.6	8.6
D44	Wool factory	22	15	5.2	5.1	14.9
D45	Wool factory Up	22	15	7	6.2	12.1

Table 4. Physical habitat assessment parameters

Code	Sampling site	Bottom substrate	Bottom stability	Habitat complexity	Pool quality	Bank stability	Bank protection	Canopy
D1	Zaplluxhë	Optimal	Optimal	Optimal	Poor	Suboptimal	Optimal	Optimal
D2	Zaplluxhë	Suboptimal	Suboptimal	Suboptimal	Poor	Suboptimal	Suboptimal	Optimal
D3	Zapluxhë	Optimal	Optimal	Optimal	Poor	Suboptimal	Suboptimal	Optimal
D4	Zaplluxhë	Suboptimal	Optimal	Suboptimal	Marginal	Suboptimal	Suboptimal	Optimal
D5	Blaç	Marginal	Suboptimal	Poor	Marginal	Suboptimal	Suboptimal	Suboptimal
D6	Bresanë up	Optimal	Optimal	Optimal	Suboptimal	Optimal	Optimal	Optimal
D7	Bresanë down	Suboptimal	Suboptimal	Marginal	Marginal	Optimal	Optimal	Suboptimal
D8	Bellobrad	Suboptimal	Suboptimal	Suboptimal	Marginal	Suboptimal	Marginal	Suboptimal
D9	Bellobradë	Suboptimal	Suboptimal	Suboptimal	Marginal	Suboptimal	Marginal	Suboptimal
D10	Kuk	Optimal	Optimal	Optimal	Marginal	Optimal	Optimal	Optimal
D11	Buzez	Suboptimal	Suboptimal	Suboptimal	Poor	Suboptimal	Optimal	Optimal
D12	Brezne	Marginal	Suboptimal	Suboptimal	Suboptimal	Optimal	Optimal	Optimal
D13	Pllajnik	Optimal	Optimal	Optimal	Suboptimal	Optimal	Optimal	Optimal
D14	Kosavë	Suboptimal	Suboptimal	Suboptimal	Suboptimal	Optimal	Suboptimal	Suboptimal
D15	Plavë up	Suboptimal	Suboptimal	Suboptimal	Poor	Suboptimal	Suboptimal	Optimal
D16	Plavë (Meka factory)	Poor	Marginal	Suboptimal	Poor	Suboptimal	Suboptimal	Suboptimal
D17	Rrenc Up	Suboptimal	Suboptimal	Suboptimal	Suboptimal	Suboptimal	Suboptimal	Suboptimal
D18	Rrence	Suboptimal	Optimal	Suboptimal	Optimal	Optimal	Optimal	Optimal
D19	Rrencë (River Plava)	Suboptimal	Suboptimal	Suboptimal	Marginal	Suboptimal	Suboptimal	Poor
D20	Brod Camp	Optimal	Optimal	Suboptimal	Suboptimal	Optimal	Optimal	Suboptimal
D21	Brod Up	Optimal	Optimal	Suboptimal	Suboptimal	Optimal	Suboptimal	Poor
D22	Brod Midle	Suboptimal	Suboptimal	Suboptimal	Suboptimal	Optimal	Optimal	Suboptimal
D23	Brod Down	Optimal	Optimal	Suboptimal	Optimal	Optimal	Suboptimal	Poor
D24	Dikanca	Optimal	Optimal	Optimal	Optimal	Optimal	Optimal	Suboptimal
D25	Mlika	Optimal	Optimal	Suboptimal	Suboptimal	Optimal	Optimal	Suboptimal
D26	Mlika Down	Suboptimal	Suboptimal	Suboptimal	Marginal	Optimal	Optimal	Suboptimal
D27	Mlika (River Brod)	Suboptimal	Suboptimal	Suboptimal	Suboptimal	Optimal	Optimal	Optimal
D28	Rapçë up	Optimal	Optimal	Suboptimal	Marginal	Optimal	Optimal	Suboptimal
D29	Rapçë	Suboptimal	Suboptimal	Suboptimal	Suboptimal	Suboptimal	Optimal	Marginal
D30	Radesha Up	Optimal	Optimal	Suboptimal	Marginal	Optimal	Suboptimal	Suboptimal
D31	Radesha	Optimal	Optimal	Suboptimal	Marginal	Optimal	Suboptimal	Suboptimal
D32	Dragash	Suboptimal	Suboptimal	Suboptimal	Suboptimal	Optimal	Optimal	Optimal
D33	Restelica Up	Optimal	Optimal	Suboptimal	Suboptimal	Optimal	Optimal	Optimal
D34	Restelica Down	Optimal	Optimal	Suboptimal	Suboptimal	Optimal	Optimal	Suboptimal
D35	Krushevë Up	Suboptimal	Suboptimal	Suboptimal	Suboptimal	Optimal	Optimal	Suboptimal
D36	Krushevë Down	Suboptimal	Suboptimal	Suboptimal	Suboptimal	Optimal	Optimal	Suboptimal
D37	Gllboçica Up	Marginal	Suboptimal	Suboptimal	Suboptimal	Optimal	Optimal	Suboptimal
D38	Zli Potok Up	Suboptimal	Suboptimal	Marginal	Suboptimal	Optimal	Optimal	Marginal
D39	Zli Potok Down	Optimal	Optimal	Suboptimal	Suboptimal	Optimal	Optimal	Suboptimal
D40	Zli Potokë Middle	Suboptimal	Optimal	Optimal	Suboptimal	Suboptimal	Suboptimal	Poor
D41	Orçusha Up	Optimal	Optimal	Optimal	Marginal	Optimal	Optimal	Marginal
D42	Orçushë Middle	Suboptimal	Suboptimal	Suboptimal	Marginal	Optimal	Optimal	Suboptimal
D43	Krstec	Optimal	Optimal	Suboptimal	Suboptimal	Optimal	Optimal	Suboptimal
D44	Wool factory	Suboptimal	Suboptimal	Marginal	Suboptimal	Suboptimal	Suboptimal	Suboptimal
D45	Wool factory Up	Suboptimal	Suboptimal	Marginal	Suboptimal	Suboptimal	Suboptimal	Suboptimal

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REFERENCES

1. Bank P., Bemmerlein-Lux F., Gagica I., Hajredini E. 2014. Sustainable development atlas framework for a comprehensive and balanced rural development for the Municipality of Dragash/Dragaš Kosovo. Vol. I: Introduction and methodology. United Nations Development Programme. Conservation of Biodiversity and Sustainable Land Use Management in Dragash/Dragaš. pp. 249.
2. Barbour M.T., Stribling B.J. 1991. Use of habitat assessment in evaluating the biological integrity of stream communities. Biol. Criteria: Research and Regulation, 25-38
3. Cummins K. 1962. An evaluation of some techniques for the collection and analysis of benthic samples with special emphasis on lotic waters. The American Midland Naturalist, 477-504.
4. Dauti E., Ibrahimi H., Gashi A., Grapci-Kotori L. 2007. Spatial and temporal distribution of Plecoptera larvae in the Prishtina River (Kosova). Entomol. Rom., 12, 223-225.
5. Gashi A. 1993. Prostorna i sezonska distribucija makrozoobentosa u rijeci Miruši, magistarski rad, Prirodoslovno Matematički Fakultet Sveučilišta u Zagrebu, pp. 110.
6. Gashi A. 2006. Analiza biocenologjike dhe ekologjike e makrozoobentosit dhe nektonit të lumit Llap, FSHMN, Prishtinë, disertacioni i doktoratës pp. 150.
7. Hajredini E., Bank P., Bemmerlein-Lux F., Gagica I., Ibrahimi H. 2013. Sustainable development atlas framework for a comprehensive and balanced management plan of "Sharr" National Park Kosovo. Volume I: Introduction and methodology. United Nations Development Programme, pp. 266.
8. Hilsenhoff W.L. 1988. Rapid field assessment of organic pollution with a family-level biotic index. J. N. Am. Benthol. Soc. 7(1).
9. Ibrahimi H. 2007. Biološka procjena ekološkog stanja rijeke Priština na osnovu sastava makrozoobentosa, PMF Sarajevo, magistarski rad, pp. 130.
10. Ibrahimi H., Dauti E., Gashi A., Trožić-Borovac S., Škrijelj R., Grapci-Kotori L. 2007. The impact of sewage effluents in water quality and benthic macroinvertebrate diversity of the Prishtina river (Kosova). Entomol. Rom., 12, 227-231.
11. Musliu M., Bilalli A., Durmishi B., Ismaili M., Ibrahimi H. 2018. Water quality assessment of the morava e binçës river based on the physicochemical parameters and water quality index. J. Ecol. Engin., 19(6), 104-112.
12. Shukriu A. 1979. Ekološka uvjetanost i zonalni raspored makrozoobentosa u rijeci Prizrenska Bistrica, Doktorska disertacija, PMF, Zagreb, pp. 135.
13. Zhushi-Etemi F. 2005. Valorizimi biologjik i ujërave të lumit Sitnicë në bazë të përbërjes së faunës bentale, disertacion i doktoratës, FSHMN, Prishtinë, pp. 120.