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Professional paper

WATER QUALITY ASSESSMENT OF THE SHUSHIC RIVER USING BENTHIC MACROINVERTEBRATES

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Abstract

The study of river waters and the water flows of their tributaries is very important and necessary for the protection, use, and improvement of their condition. According to the Water Framework Directive (WFD, 2000) the use of benthic macroinvertebrates in river water quality monitoring is considered an efficient method.
This study was conducted in 2019 in the Shushicë River, where its purpose was to assess the quality of river waters using the biotic index ASPT (BMWP) and the biotic index - SWRC.
The sampling method used was based on the Kick net technique with a mesh size of 500 microns. From the sampling taken in four stations, 481 individuals belonging to two types (Arthropoda and Annelida), one class (Insecta), and one subclass (N/K Oligochaeta) were collected.
The unidentified species belong to 8 orders (Ephemeroptera, Plecoptera, Trichoptera, Diptera, Coleoptera, Haplotaxid, Odonata, Hoplonemertea) and 28 families.
Based on the results obtained from the calculation of the ASPT (BMWP) biotic index, stations I and III result in a "Clean" bio classification, and stations II and IV result in a "Partially clean" bio-classification. From the SWRC Biotic index calculations, the first station and the fourth station result in a bio classification of "Good", the second station results in a bio classification of "Clean", and the third station results in a bio classification of "Excellent"
Based on the Biotic index ASPT (BMWP) and SWRC we can say that the Shushic River has good water quality, and partially with a slight organic pollution.

Keywords: Biotic Index, Bio classification, Macroinvertebrate, SWRC.

1. Introduction

The study of the river waters and the water flows of their tributaries is very important and necessary for the protection, use, and improvement of their condition. (Hey, 1993; Harper et al., 1995). Based on this, the river's water environment is constantly modified, for this purpose ecologists insist and direct their focus on the identification of these factors and finding ways to establish natural balances in them. (King, 2004; Vaughan et al., 2009). This leads to the need for a better understanding of these ecosystems and the preservation of their biodiversity. (Arthington et al., 2010; Ormerod et al. 2010).
A high diversity of organisms lives in riverine habitats, some of which have specific preferences for the environment and can be used as bioindicator species (WFD 2000). The use of bioindicators and the calculation of biotic indices allow us to understand the state of a river's flow and to evaluate the ecological composition (Peja, 2004; Pepa, 2014). The frequency of distribution of taxon and their sensitivity to pollution are used for the assessment of water quality through the calculation of bio indices (Tachet 2002).
In this study, benthic macroinvertebrates sampled in the Shushica River were used for the assessment of the water quality. This evaluation was made based on the results of the biotic index ASPT (BMWP) and the biotic index – SWRC. Macroinvertebrate populations clearly reflect changes in time of water quality in aquatic ecosystems (Cobaj et al 2022; Paparisto 2009).

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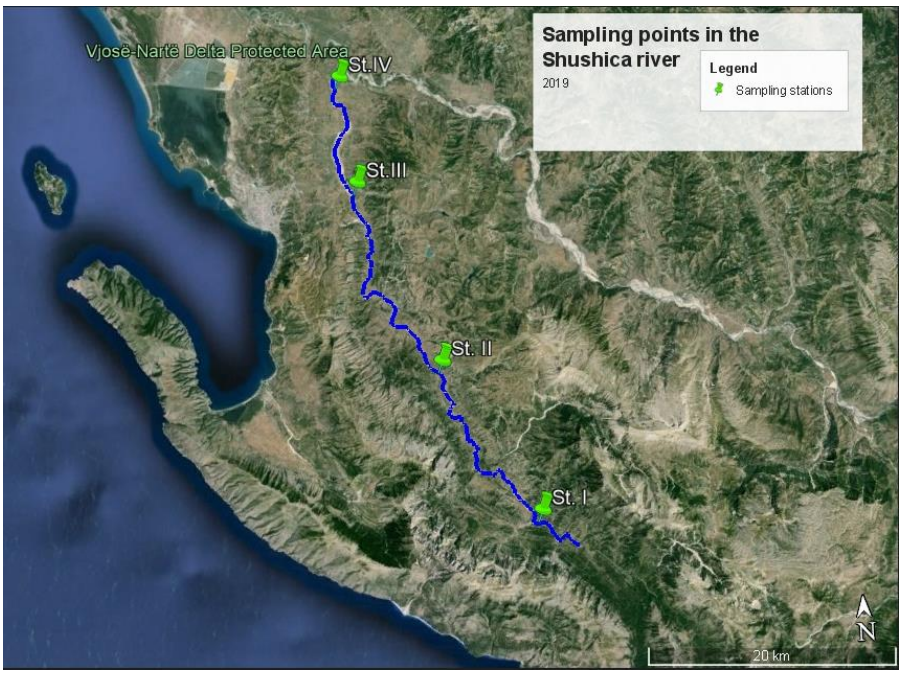
2. Materials and Methods

Study area

The Shushica Valley is located in the Southern Mountain Province in the Vlora district, between Cika Mountain from the West and Kurvelesi from the East, with a length of 51 km and, a width from 400-600 m to 4-5 km. It starts in the lower Kurvelesh (Buronjat) and has a general NW-SE orientation, it is built of limestone in the flanks, of flysch and molasses, and has a tectonic-erosive origin. The valley is elaborated by Shushica and its tributaries such as the Smokthina River, Black Stream of Gjormi, Great Stream of Trubulli, and Vajza (from left). The upper part extends from Kuci (Buronje) to Brataj, it has irregular and not well-processed ends, steep slopes, and in many cases in the form of a cliff. The lower part extends from Drashovica to the estuary and the riverbed reaches its greatest width of 800 m. Shushica is the main branch of Vjosa, which flows in the Southwest of Vlora district (Pano, 2008).

Sampling stations

Sampling was carried out in four stations. The determination of the sampling points was carried out by taking into account several factors such as: the morphology of the soil, proximity to the inhabited centers, human activities and clean water supplies from streams and springs (AQEM, 2002). The sampling stations are: Station 1 "Horë-Vranishte", station 2 "Gjormi Bridge", station 3, "Peshpi Bridge" and station 4 "Estuary of the Shushicë River" (Map 1).



Map. 1. Watershed of Shushica River. Sampling stations in the Shushica River: a) St. 1 Horë−Vranishtë, St. 2 Gjormi Bridge, St. 3 Peshkëpi Bridge, St. 4 The estuary of the river Shushice

Sampling method

For benthos sampling we operate with the methods of CAMPAIOLI et al, (Campaioli et al., 1994). The technique we used was the kick-net sampling technique (digging with kicking) where a grid with a rectangular structure with dimensions of 480 x 250 mm and a hole spacing of 500 µm was used. During the sampling time, river environments were chosen that have a

not-too-rapid flow and a depth of no more than 1 m. We took the collected materials from the net and put them in a 250 ml plastic bottle. Each bottle is branded with the name of the respective station. The samples were preserved with alcohol and transported to the laboratory where they were cleaned and taxon identification was performed (Bouchard et al., 2004; Tachet et al., 1980).

Calculation of the biotic index

ASPT Biotic Index (BMWP)

This parameter gives the bio classification of the water quality of a water body, based on the calculations of the average tolerance values of different families within the benthic macroinvertebrate community. Tolerance values for each taxon refer to BMWP (Biological Monitoring Working Party) X= SUM OF VALUES / NUMBER OF TAXONA (Friedrich et al., 1996).

Biotic Index – SWRC (Stroud Water Research Center)

This biotic index takes into consideration two elements, taxa abundance and their pollution tolerance value. It refers to the fact that different types of benthic organisms have different tolerance limits to organic pollution. $\boldsymbol{SWRC - Index} = \frac{\sum N * TV}{N}$

Where "n" is the total number of individuals of each taxon, "TV" gives the tolerance value of the corresponding taxon and "N" gives the total number of individuals at a sampling point (SWRC 2003).

3. Results and discussions

Biodiversity of species

After determining all taxa, a total of 439 individuals belonging to 28 families were collected (table 1). The approximate number of individuals indicates population stability at all stations as well as stable diversity. Based on this study, benthic macroinvertebrates belong to two classes: Insecta and Oligochaeta. The dominant class is Insects. In this class, the dominant families present at each station are the families Chironomidae (Diptera) (St. 1 = 23.5%; St. 2 = 18.3%; St. 3 = 22.3%; St. 4 = 21 .7%) and Hydropsychidae (Trichoptera) (St. 1 = 2.9%; St. 4 = 24.6%). The EPT group (Ephemeroptera- Plecoptera - Trichoptera) represents the largest number of families (15 families). The EPT group is very sensitive to organic pollution and an indicator of clean waters.

Table 1. Distribution of organisms for each station

Order	Family	St .1	St .2	St .3	St.4
Ephemeroptera	Ephemeridae	4.9%	0%	1.6%	7.2%
	Beatidae	3.9%	0%	0%	0%
	Ephemerellidae	0%	6.1%	0%	0%
	Polymitarcyidae	0%	0%	4.9%	0%
	Heptagenidae	0%	0%	6.6%	0%
	Caenidae	0%	0%	3.3%	0%
	Potamanthidae	0%	0%	0%	1.4%
Plecoptera	Capniidae	1.9%	0%	5.7%	7.2%
	Chloroperlidae	0%	0.6%	0%	0%
	Leuctridae	0%	0%	3.3%	0%
Trichoptera	Glossosomatidae	0.9%	0%	0%	0%
	Rhyacophylidae	8.8%	0%	0%	0%
	Hydropsychidae	2.9%	18.3%	4.9%	24.6%
	Phylopotamidae	0%	2%	0%	0%
	Hidroptilidae	0%	0.6%	0%	0%
Diptera	Chironomidae	23.5%	18.3%	22.3%	21.7%
	Thaumaliidae	4.9%	14.2%	7.4%	14.4%
	Ceratopogonidae	15.6%	5.4%	0%	7.2%
	Empididae	0%	2%	0%	0%
	Tabanidae	0%	1.3%	0%	0%
	Hemicefales	0%	0%	0.1%	0%
Coleoptera	Hidroptilidae	3.9%	0%	0%	0%
	Emilidae	0%	0%	0%	4.3%
Haplotaxid	Lumbricidae	0%	25.1%	31.4%	11.5%
Odonata	Libelluidae	1.9%	0%	0%	0%
	Cordulegastridae	26.4%	0%	0%	0%
	Gomphidae	0%	2.7%	0%	0%
Hoplonemertea	Tetrastematidae	0%	2.7%	7.4%	0%

ASPT Biotic Index (BMWP)

Based on the calculation of the ASPT (BMWP) index (table 2) and the Professional paper of values according to the standard of this index for water quality, it results that:

- At the first station, the ASPT biotic index (BMWP) was 6.4 and according to the bio classification of this index (> 6), the water quality is "Clean".
- The second station resulted in the bio classification "Partially clean" (5−6), the value of the biotic index ASPT (BMWP) was 5.3.
- The third station results in "Clean" bio classification (> 6), ASPT biotic index values (BM WP) 6.4.
- The fourth station results with bio classification "Partially clean" (> 6), ASPT biotic index values (BMWP) 5.5.

Table 2. Calculation of ASPT Biotic Index (BMWP)

Nr	Taxon	Family	BMWP	ST. I	ST.II	ST. III	ST. IV
1	Ephemeroptera	Ephemeridae	10	10	–	10	10
2		Beatidae	4	4	–	–	–
3		Ephemerellidae	10	–	10	–	–
4		Polymitarcyidae	–	–	–	–	–
5		Heptagenidae	10	–	–	10	–
6		Caenidae	7	–	–	7	–
7		Potamanthidae	10	–	–	–	10
8	Plecoptera	Capnidae	–	–	–	–	–
9		Chloroperlidae	10	10	–	–	–
10		Leuctridae	10	–	–	10	–
11	Trichoptera	Glossosomatidae	7	7	–	–	–
12		Rhyacophylidae	7	7	–	–	–
13		Hydropsychidae	5	5	5	5	5
14		Phylopotamidae	8	–	8	–	–
15		Hidroptilidae	6	–	6	–	–
16	Diptera	Chironomidae	2	2	2	2	2
17		Thaumaliidae	–	–	–	–	–
18		Ceratopogonidae	–	–	–	–	–
19		Empididae	–	–	–	–	–
20		Tabanidae	–	–	–	–	–
21		Larves– Hemicefales	–	–	–	–	–
22	Coleoptera	Hidroptilidae	5	5	–	–	–
23		Emilidae	5	–	–	–	5
24	Nënvkl	Lumbricidae	1		1	1	1
25	Oligochaeta						
26	Odonata	Libelluidae	–	–	–	–	–
27		Cordulegastridae	8	8	–	–	–
28		Gomphidae	–	–	–	–	–
29	Hoplonemertea	Tetrastematidae	–	–	–	–	–
VALUE OF ASPT				6.4	5.3	6.4	5.5

Biotic Index – SWRC

Based on the calculation of the Biotic SWRC index (Table 3**)** and the Professional paper of values according to the standard of this index for water quality, it results that:

- The first station results in "Good" bio classification (3.76 - 5.0), this shows that we have slight organic pollution.
- The second station results in a "Clean" bio classification (5.1-6.5), this shows that we are dealing with significant organic pollution. Pollution is caused by the sediments brought by the streams that join the river at this station, and the presence of vehicles that take inert materials.
- The third station results in "Excellent" bio classification (≤ 3.75). This station has no organic pollution. This is because at this point the depth of the water column increases.
- The fourth station, like the first station, results in a "Good" bio classification (3.76 - 5.0), which indicates slight organic pollution according to this index.

So, based on the SWRC Biotic Index calculation, we can say that the Shushicë River results in good water quality, and partly with a slight organic pollution.

Table 3. Calculation of SWRC Biotic Index

Nr	Order	TV	D				TV*D			
			St. I	St.II	St.III	St.IV	St.I	St.II	St.II	St.IV
1	Ephemeroptera	3.6	9	9	20	6	32.4	32.4	72	21.6
2	Plecoptera	1	2	1	11	5	2	1	11	5
3	Trich/ Hydropsychidae	5	3	27	6	17	15	135	30	85
4	Trichoptera/të tjerë	2.8	10	4	0	0	28	11. 2	0	0
5	Odonata/Anisoptera	4	29	4	0	0	116	16	0	0
6	Diptera/Chironomidae	6	24	47	27	15	144	282	162	90
7	Diptera te tjerë	6	11	3	10	15	66	18	60	90
8	Coleoptera	4.6	4	0	0	3	18.4	0	0	13.8
9	Nënkl/Oligochaeta	8	0	47	0	0	0	376	0	0
SUM			102	193	74	61	481.8	1177.6	270	289.8
SWRC Biotic Index							4.7	6.1	3.6	4.7

4. Conclusions

The identification of the taxa sampled in the Shushicë River shows that this taxa belongs to two types (Arthropoda and Annelida), one class (Insect) and one subclass (N/K Oligocheta). The unidentified species belong to 8 orders (Ephemeroptera, Plecoptera, Trichoptera, Diptera, Coleoptera, Haplotaxid, Odonata, Hoplonemertea) and 28 families.

According to the results obtained from the calculation of the Biotic ASPT index (BMWP), the Shushicë River is of clean quality in the first and third stations, while in the second and fourth stations, it is partially clean. At stations two and four pollution is due to the sediments brought by the streams that join the river, and the presence of vehicles that take inert materials. Station four, even though it is located near agricultural lands, is not very polluted, since the water flow is powerful and the water column is higher.

From the SWRC Biotic index calculations, the first station and the fourth station result in a bio classification of "Good", the second station results in a bio classification of "Clean", and the third station results in a bio classification of "Excellent"

Based on the Biotic index ASPT (BMWP) and SWRC we can say that the Shushicariver results in a good quality of water and partly with a slight organic pollution.

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