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CORRELATION BETWEEN PHYSICOCHEMICAL PARAMETERS AND AQUATIC MACROONEVERTEBRATES FROM THE MIDDLE AND LOWER COURSE OF SIRET RIVER, ROMANIA

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INTRODUCTION

Macroinvertebrates, along with other aquatic organisms, are used in the biomonitoring of surface water quality (EC 2000 , S.W.B.A. 2010). They are preferred in biomonitoring because they have low mobility and thus reflect well the physicochemical conditions of the water (PRICOPE 2009).

In this study we analyzed the correlation between general physicochemical parameters and a series of biological indices calculated on the basis of aquatic macroinvertebrates.

Samples were taken seasonally from six sections on the middle and lower course of the Siret River for a period of four years. Fifty-two samples were analyzed, both biologically and physico-chemically.

MATERIALS AND METHODS

Samples of aquatic macroinvertebrates were analyzed. After the list of species was drawn up, a series of biological indices were calculated, like diversity indices (Shannon-Wiener Index) and quality index (Saprobic Index, Ephemeroptera-Plecoptera-Trichoptera-EPT Index and a Multimetric Index).

Shannon-Wiener Index (SW). In calculating the index, is taken account the number of species and the number of individuals in each species. In 1948, Shannon proposed the following formula (SHANNON 1948):

$$\mathbf{H` = - \Sigma p_i \ln (p_i)} \quad (1)$$

Where:
H`=the Shannon-Wiener index
p_i=the proportion by which the "i" taxon is represented in biocenosis.

Saprobic Index (SI). Pantle and Buck (PANTLE and BUCK 1955), in 1955, proposed a biological index based on the degree of saprobity of the organisms. The authors proposed the following formula:

$$\mathbf{S=\sum(s \times h)/\sum h} \quad (2)$$

Where:
s=saprobe value of the species
h=absolute frequency.

Ephemeroptera-Plecoptera-Trichoptera Index (EPT). Represents the number of individuals in Ephemeroptera-Plecoptera-Trichoptera insect groups relative to the total number of individuals in the sample (CHIRIAC, VARDUCA et al. 2008).

Multimetric Index (MI). In 2008, Chiriac et al. proposed a multimetric index calculated on the basis of seven biological indices (CHIRIAC, VARDUCA et al. 2008). It is used for natural water courses. The authors proposed the following formula:

MI=0.3*SI+0.1*EPT+0.2*SW+0.1*FAM+0.1*IOCH+0.1*FG+0.1*REO/LIM (3)

Where:
SI=Saprob Index
EPT=Ephemeroptera-Plecoptera-Trichoptera Index (individuals)
SW=Shannon-Wiener Index
FAM=Number of families
OCH=Oligochaeta-Chironomidae Index
FG= Function Groups Index
REO / LIM= Preferable water flow rate Index.

From the physicochemical point of view, the general parameters were analyzed: suspended matters, oxygen regime and nutrient regime. The following indicators were analyzed: dissolved oxygen (O_2D), biochemical oxygen demand (BOD_5), chemical oxygen demand (COD), ammoniacal nitrogen ($N\text{-}NH_4$), nitrite nitrogen ($N\text{-}NO_2$), nitrate nitrogen ($N\text{-}NO_3$) and total phosphorus (P).

To establish the correlation between physicochemical parameters and biological indices we analyzed the linear relationship between the two sets of variables.

RESULTS AND DISCUSSIONS

Taking into account each section, we determined the correlation between physicochemical parameters and biological indices. Medium and strong correlations occur between suspended matters, O_2D, BOD_5, COD, P and NO_3, and biological indices. Below are the results obtained for each section. *Downstream Pascani Section*. Strong correlations occur between BOD_5 and the MI and EPT index (Table 1.).

Medium, positive and negative correlations are recorded between the biological indices and the parameters that are part of the nutrient regime.

Dragesti Section. The strongest correlation is between suspendes matters and EPT (Table 2.). Strong correlations also arise between the oxygen regime, the nutrient regime, and the biological indices. *Adjudu Vechi Section*. Between the suspended matters, O_2D, BOD_5, N-NH_4, N-NO_3 and P and the biological indices, both positive and negative medium correlations occur (Table 3.).

Cosmesti Section. There were strong correlations between BOD_5 and biological quality indexes (MI and SI) (Table 4.). Medium correlations occur between suspended matters and SI, between O_2D and MI and SI, between BOD_5 and EPT and between N-NO_2 and SW.

Biliesti Section. In this section there are medium correlations between suspended matters, O_2D, BOD_5, N-NO_3 and P, and biological indices (Table 5.).

Lungoci Section. Table 6 shows that they appear strong correlations between suspended matters, O_2D, N-NH_4 and P and quality indices . Medium correlations are recorded between suspended matters and SI, between O_2D and MI and SW, between BOD_5 and EPT, between N-NO_3 and quality indices and between P and SI.

Table 1. Physicochemical parameters and biological indices in the downstream Pascani section

Downstream Pascani	**susp. matters (mg/l)**	**O_2D (mgO/l)**	**BOD_5 (mgO/l)**	**COD (mgO/l)**	**N-NH_4 (mgN/l)**	**N-NO_2 (mgN/l)**	**N-NO_3 (mgN/l)**	**Total P (mgP/l)**
MI	-0.058	-0.028	-0.726	-0.215	-0.518	0.364	0.411	-0.556
SI	0.263	-0.373	0.348	0.052	0.249	-0.344	-0.165	0.457
EPT	0.120	-0.371	-0.793	-0.377	-0.430	0.517	0.666	-0.257
SW	-0.134	0.169	-0.460	-0.317	-0.005	0.548	0.110	-0.500

Table 2. . Correlations between physicochemical parameters and biological indices in the Dragesti section

Dragesti	**susp. matters (mg/l)**	**O_2D (mgO/l)**	**BOD_5 (mgO/l)**	**COD (mgO/l)**	**N-NH_4 (mgN/l)**	**N-NO_2 (mgN/l)**	**N-NO_3 (mgN/l)**	**Total P (mgP/l)**
MI	0.567	0.355	0.384	0.095	0.135	-0.009	0.638	0.010
SI	-0.334	-0.618	-0.231	0.182	0.097	0.226	-0.071	-0.351
EPT	0.893	0.022	0.646	0.280	-0.043	0.154	0.583	-0.080
SW	0.466	-0.150	-0.152	0.455	0.569	0.663	0.425	0.052

Table 3. Physicochemical parameters and biological indices in the Adjudu Vechi section

Adjudu Vechi	**susp. matters (mg/l)**	**O_2D (mgO/l)**	**BOD_5 (mgO/l)**	**COD (mgO/l)**	**N-NH_4 (mgN/l)**	**N-NO_2 (mgN/l)**	**N-NO_3 (mgN/l)**	**Total P (mgP/l)**
MI	-0.553	-0.542	-0.256	0.146	-0.460	-0.001	-0.460	0.074
SI	-0.090	-0.402	0.132	0.162	0.042	0.324	0.276	0.554
EPT	-0.330	-0.206	-0.490	-0.167	-0.408	-0.010	-0.515	-0.132
SW	-0.471	-0.343	-0.173	-0.344	-0.448	0.187	0.027	-0.002

Table. 4. Correlations between physicochemical parameters and biological indices in the Cosmesti section

Cosmesti	**susp. matters (mg/l)**	**O_2D (mgO/l)**	**BOD_5 (mgO/l)**	**COD (mgO/l)**	**N-NH_4 (mgN/l)**	**N-NO_2 (mgN/l)**	**N-NO_3 (mgN/l)**	**Total P (mgP/l)**
MI	0.260	-0.495	-0.723	-0.109	-0.388	0.066	-0.308	-0.115
SI	-0.530	0.402	0.629	0.037	0.141	-0.123	0.216	0.053
EPT	-0.015	-0.310	-0.508	-0.147	-0.398	-0.146	-0.369	-0.151
SW	-0.385	0.070	0.031	-0.059	-0.337	-0.413	-0.371	0.027

Table 5. Corelations between physicochemical parameters and biological indices in the Biliesti section

Biliesti	**susp. matters (mg/l)**	**O_2D (mgO/l)**	**BOD_5 (mgO/l)**	**COD (mgO/l)**	**N-NH_4 (mgN/l)**	**N-NO_2 (mgN/l)**	**N-NO_3 (mgN/l)**	**Total P (mgP/l)**
MI	0.592	-0.384	-0.311	-0.174	0.342	0.103	-0.437	0.444
SI	-0.459	0.466	0.405	-0.047	-0.184	-0.371	0.151	-0.129
EPT	0.423	-0.390	-0.230	-0.193	0.270	-0.061	-0.569	0.209
SW	0.082	-0.056	0.128	0.351	0.187	0.203	-0.133	-0.432

Table 6. Correlations between physicochemical parameters and biological indices in the Lungoci section

Lungoci	susp. matters (mg/l)	O_2D (mgO/l)	BOD_5 (mgO/l)	COD (mgO/l)	$N\text{-}NH_4$ (mgN/l)	$N\text{-}NO_2$ (mgN/l)	$N\text{-}NO_3$ (mgN/l)	Total P (mgP/l)
MI	0.612	0.456	0.351	-0.186	0.714	0.506	0.503	0.757
SI	-0.432	-0.744	-0.076	0.319	-0.226	-0.241	-0.516	-0.415
EPT	0.698	0.658	0.427	-0.167	0.686	0.368	0.445	0.750
SW	0.197	0.432	-0.104	0.194	0.256	0.243	0.351	0.226

Unlike the results obtained by Nechifor et al. in 2014 (NECHIFOR, FACIU et al. 2014), in the sections analyzed on the Uz River, where the strongest correlations occur between the total P and the O_2D and the indices of diversity and between the BOD_5 and SI in the downstream Poiana Uzului accumulation, in the sections on the Siret River almost all the physicochemical parameters are in medium or strong correlation with biological indices.

CONCLUSIONS

Water and aquatic macroinvertebrates were sampled and analyzed from the middle and lower course of the Siret River over a four-year period between 2011 and 2014. Based on the macroinvertebrates, four biological indices were calculated. The influence of physicochemical parameters on these indices was followed.

Medium and strong correlations were recorded between almost all physicochemical parameters and biological indices. If in the downstream Pascani section, located on the middle course of the river, significant correlations occur between the biological indices and the parameters that are part of the nutrient regime, in the Lungoci section, near the spill, the biological indices are in significant correlation with almost all physicalchemical parameters. This can be explained by the numerous sources of pollution present along the analyzed river sector.

ABSTRACT

The structure of aquatic macroinvertebrates communities reflects the quality of water over time. To determine the influence of water quality on macroinvertebrates, we analyzed the correlations between the general physical and chemical parameters and four biological indices calculated on the basis of macro-invertebrates. Samples of water and macroinvertebrates were taken from six sections located on the middle and lower course of the Siret River for a period of four years.

We analyzed the linear relationship between physicochemical parameters and biological indices and we have obtained significant correlations between them. Knowing these correlations, we can predict the evolution of the macro-invertebrates structure according to changes in the chemical structure of the water.

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