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STUDIES OF THE DIATOM COMMUNITIES INHABITING THE SOMEŞUL MIC RIVER AND ITS TRIBUTARIES BETWEEN FLOREŞTI AND APAHIDA (CLUJ COUNTY): PRELIMINARY STUDIES ON THE WATER QUALITY OF THE ZĂPODIE AND MĂRĂLOIU STREAMS

Lidia SZIGYÁRTÓ [1], Leontin Ştefan PÉTERFI [1]
[1] Universitatea „Babeş-Bolyai", Facultatea de Biologie şi Geologie, Catedra de Taxonomie şi Ecologie,
str. Republicii, nr.42, **RO-400015 Cluj-Napoca**
e-mail: lidia_szigyarto@yahoo.com

Abstract: The article discusses the investigation of the diatom communities inhabiting two tributaries of the Someşul Mic River, the Zăpodie and the Mărăloiu streams. The Zăpodie flows near the refuse dump at Pata Rât (Cluj County), takes up much of the leechate and carries it into the Someşul Mic River. Some preliminary chemical data also indicate that the Mărăloiu stream is one of the most polluted affluents of the Someşul Mic in this region.

Water quality was evaluated based on chemical analysis of the water, respectively on the species composition of the diatom communities in October and November 2006 in three sampling sites: one on the Zăpodie downstream the refuse dump and two on the Mărăloiu near Cara and Apahida villages (Cluj County). According to the results the diatom communities seem to be affected by strong pollution in the studied sampling sites. Based on the values of the Saprobity Index (SI) the Zăpodie stream is -mesosaprobic, while the Mărăloiu is -α-mesosaprobic at both sampling sites. The values of the Biological Diatom Index (BDI) indicate inferior water quality in Zăpodie downstream the refuse dump and mediocre in Mărăloiu. The presence of many halophilic elements is also remarkable, probably due to high electrolyte concentrations in general.

These results are considered database for future investigations carried out to monitor the changes of water quality of the Zăpodie and Mărăloiu streams.

Keywords: biological diatom index (BDI), biomonitoring, diatoms, halophilic species, pollution, saprobity index (SI), species diversity, stream, water quality

Introduction

Many diatom species are water quality indicators requiring specific physical, chemical and biological conditions. Due to their sensitivity to these parameters, the composition of the diatom communities indicates the water quality and the modifications in their structure are in fact answers to the environmental changes [4, 6].

The present study is the summation of some preliminary data on the water quality of the tributaries of the Someşul Mic River between Floreşti and Apahida villages (Cluj County). The Zăpodie stream flows near the refuse dump of Cluj-Napoca at Pata Rât on a significant distance, therefore it is expected to be very polluted. It should be mentioned that the color of the water and the sediments at the sampling site downstream the refuse dump are dark brown. Physical and chemical analyses have been carried out trough time, but its diatom communities have entirely been neglected. The Mărăloiu stream, also an affluent of the Someşul Mic River not far from the Zăpodie, is a 2-3 m wide creek at Cara and it becomes much wider at Apahida village, near the confluence with the Someşul Mic River. The water is salty presumably due to the geological characteristics of the region [8].

The aims of the investigation were to establish the qualitative and quantitative composition of the benthic diatom communities in these streams and to estimate the water quality based on physical and chemical parameters and the presence of indicator species.

Materials and Methods

Benthic diatom samples were collected in October and November 2006 in three stations: from Zăpodie downstream Pata Rât and from Mărăloiu near Cara and Apahida villages. After collecting the samples from underwater surface of sediments, stones and plants [3, 7], they were preserved in 70% ethanol. The frustules were cleaned by treatment with HCl and H_2O_2, then repeatedly washed in distilled water and mounted in colophony [2]. The examination and the determination of the species was carried out using Krüss MBL2100 microscope with oil-immersion lens and based on the monographs of Krammer and Lange-Bertalot [5].

The species diversity of each diatom community was expressed based on the Shannon-Wiener formula. The saprobity level and the water quality was estimated by the Saprobity Index (SI) using the method of Zelinka and Marvan [9] and the Biological Diatom Index (BDI) [1], taking into consideration the relative abundance, the frequency and the indicative importance of each species.

Besides measuring some physical and chemical parameters of water *in situ*, water samples were also collected for chemical analysis performed mostly by using spectrophotometric and flamephotometric methods.

Results and Discussions

The values of the physical and chemical parameters are shown in Table 1. It should be noticed that the values of the conductivity showing the quantity of total dissolved inorganic substances is very high in all three sampling sites, indicating eutrofic conditions. The values of the salinity and the concentration of Na^+, NO_2^- and NO_3^- is also remarkably high, placing these waters into the 4th and 5th water quality class based on the standard values established by the Department of Waters and Environment Protection. In addition it should also be observed that the values of all parameters measured are significantly higher in the Zăpodie stream downstream Pata Rât, which indicates the polluting effect of the refuse dump.

Table 1: Physical and chemical parameters of water samples collected in October and November 2006

Parameters	Sampling sites		
	Mărăloiu (Cara)	Mărăloiu (Apahida)	Zăpodie (Pata Rât)
t °C	5.8	6.3	3.0
pH	8.19	8.21	8.54
conductivity ($\mu S \cdot cm^{-1}$)	4110	4060	4620
salinity ($g \cdot l^{-1}$)	2	2	2.2
Na^+ ($mg \cdot l^{-1}$)	2824.23	3041.48	3186.32
K^+ ($mg \cdot l^{-1}$)	6.95	9.57	65.34
NO_2^- ($mg \cdot l^{-1}$)	< 0.01	< 0.01	1.13
NO_3^- ($mg \cdot l^{-1}$)	8.85	19.13	96.97
PO_4^{3-} ($mg \cdot l^{-1}$)	< 0.05	< 0.05	0.1

There were identified 76 species (in all three sampling locations) belonging to 20 genera (Table 2.).

Table 2: Floristic composition of diatom communities of the Mărăloiu and Zăpodie streams in October and November 2006

No.	Taxa	Mărăloiu (Cara)	Mărăloiu (Apahida)	Zăpodie (Pata Rât)
1.	Achnanthes lanceolata var. frequentissima	+	+	+
2.	A. lanceolata var. lanceolata	+		
3.	A. minutissima	+		+
4.	Amphora pediculus		+	+
5.	A. veneta			+

6.	Bacillaria paradoxa	+	+	
7.	Caloneis amphisbaena	+		
8.	Cocconeis pediculus		+	
9.	C. placentula	+	+	
10.	Cyclotella meneghiniana		+	
11.	Cymbella silesiaca			+
12.	Diatoma tenuis		+	
13.	Fragilaria capucina var. vauchaeria	+		
14.	F. fasciculata	+		
15.	F. ulna	+	+	
16.	Frustulia vulgaris	+		
17.	Gomphonema angustatum	+	+	
18.	G. angustum		+	
19.	G. minutum	+		+
20.	G. parvulum	+	+	+
21.	G. truncatum		+	
22.	Gyrosigma acuminatum	+		
23.	Hantzschia amphioxys	+		
24.	Navicula accomoda	+		+
25.	N. cryptocephala			+
26.	N. cryptotenella	+		+
27.	N. cuspidata	+		+
28.	N. erifuga	+		+
29.	N. gregaria	+	+	+
30.	N. lacunolaciniata		+	+
31.	N. lanceolata	+	+	+
32.	N. mutica var. mutica	+		
33.	N. nivalis			+
34.	N. phylleptosoma	+	+	+
35.	N. pygmaea			+
36.	N. salinarum	+	+	
37.	N. saprophila		+	
38.	N. simplex	+	+	
39.	N. slesvicensis	+		
40.	N. spicula	+	+	
41.	N. subminuscula		+	+
42.	N. suecorum var. dismutica	+		
43.	N. tripunctata	+		
44.	N. veneta	+	+	+
45.	Nitzschia acicularis		+	
46.	N. bergii		+	
47.	N. capitellata	+	+	+
48.	N. clausii	+		
49.	N. commutata			+
50.	N. constricta	+	+	+
51.	N. dubia	+		+
52.	N. fonticola		+	+
53.	N. frustulum		+	+
54.	N. inconspicua	+	+	+
55.	N. levidensis var. salinarum	+	+	+
56.	N. linearis	+		+
57.	N. lorenziana	+	+	
58.	N. nana			+
59.	N. palea	+		
60.	N. pusilla			+
61.	N. reversa		+	
62.	N. sigma	+		
63.	N. sigmoidea	+		

64.	N. supralitorea		+	
65.	N. thermaloides		+	
66.	N. tubicola			+
67.	N. vermicularis	+		
68.	N. vitrea var. salinarum	+		
69.	Pinnularia lundii	+		
70.	Pleurosigma elongatum	+		
71.	Rhoicosphaenia abbreviata		+	+
72.	Surirella angusta	+	+	
73.	S. brebissonii var. brebissonii	+	+	+
74.	S. brebissonii var. kuetzingii	+	+	+
75.	S. subsalsa	+		
76.	Thalassiosira weissflogii	+	+	

As expected the lower number of species and genera was found in Zăpodie probably due to a higher pollution, the higher species and genera number was recorded in Mărăloiu, station Cara. There are no significant differences between the values of the Shannon-Wiener diversity (Table 3.), in the Mărăloiu however (in both sampling sites) these values are lower, probably because the environmental conditions favor two or three species, like *Navicula lanceolata, Navicula gregaria* and *Surirella brebissonii* var. *brebissonii.* These cosmopolitan species are β-βα-mesosaprobic and βα-α-mesosaprobic indicators, which prefer low temperatures and occur in much higher number in the studied diatom communities than the other elements of the community.

The genera represented by the largest number of species are shown in Fig. 1. Genera *Nitzschia* and *Navicula* are the richest in all three sampling sites, followed by *Surirella, Gomphonema, Achnanthes, Fragilaria, Amphora* and *Cocconeis*.

Tabel 3: Number of species and species diversity of the diatom communities in Mărăloiu and Zăpodie in October and November 2006

Sampling sites		Mărăloiu (Cara)	Mărăloiu (Apahida)	Zăpodie (Pata Rât)
Number of identified genera		15	13	8
Species diversity	Nr. of species	50	39	35
	Shannon-Wiener diversity (H)	2.45	2.52	2.66
	Equitability (J)	0.62	0.68	0.74

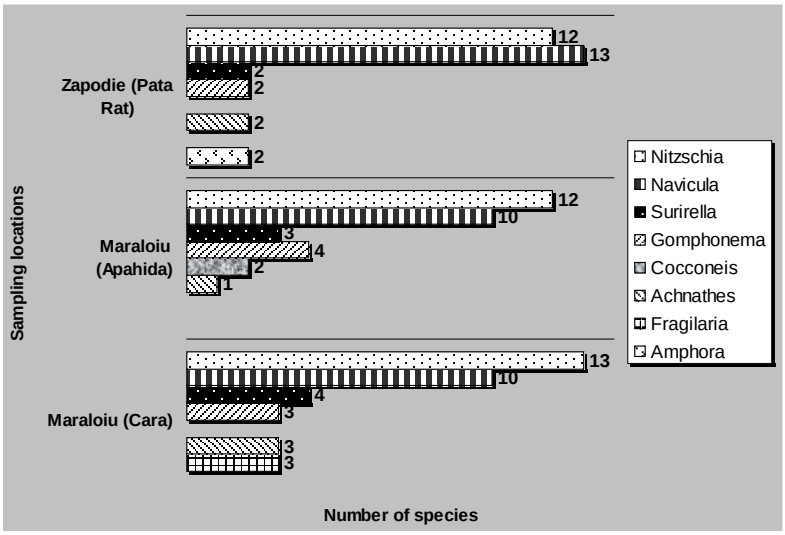

Fig. 1: Genera represented by relatively large number of species in Mărăloiu and Zăpodie in October and November 2006

Some of the identified diatoms are cosmopolitan, indifferent elements like: *Achnanthes minutissima, Cocconeis placentula, Fragilaria ulna, Gomphonema parvulum, Surirella brebissonii.* Many halophilic elements such as *Navicula gregaria, Navicula lanceolata, Navicula phylleptosoma, Navicula salinarum, Navicula slesvicensis* and *Navicula veneta* are present in large individual numbers. Their presence is explained by the high values of salinity and conductivity presumably due to the geological characteristics of the region (salty springs) [8] and partly to the inflow of domestic wastes.

In Mărăloiu station Cara the dominant species are *Navicula lanceolata, Navicula slesvicensis, Cocconeis placentula, Nitzschia sigmoidea* indicators of β-mesosaprobity, there also appear βα-α-mesosaprobic species like *Navicula gregaria, Bacillaria paradoxa* and in relatively large number the oβ-β-mesosaprobic *Gyrosigma acuminatum,* indicating that the water here is less polluted with organic substances.

In Mărăloiu station Apahida dominant taxa are -βα-mesosaprobic and βα-α-mesosaprobic indicators like *Surirella brebissonii, Navicula lanceolata, Navicula gregaria, Amphora pediculus* and *Nitzschia inconspicua,* but also occur αp-polisabrobity indicators like *Navicula subminuscula*.

The Zăpodie at Pata Rât seems to be more affected by organic pollution: the dominant taxa are αp-polisabrobity indicators like *Nitzschia capitellata, Navicula accomoda, Navicula saprophila, Navicula veneta.* A few βα-α-mesosaprobic species were also found (*Navicula gregaria, Navicula pygmaea*).

As concerning the Saprobity Index (SI) the organic pollution in Mărăloiu in both sampling sites is considered moderate to strong (βα-mesosaprobic), respectively strong (α-mesosaprobic) in Zăpodie downstream the refuse dump at Pata Rât. These results are in concordance with the values of the Biological Diatom Index (BDI), which indicate mediocre water quality for Mărăloiu, respectively inferior water quality for Zăpodie stream (Table 4.).

Tabel 4: Water quality and saprobity level based on the values of BDI and SI

		Saprobity index (SI)	Biological Diatom Index (BDI)
Mărăloiu (Cara)	value	2.32	6.6
	water quality	moderate to strong saprobity	mediocre
Mărăloiu (Apahida)	value	2.37	8.1
	water quality	moderate to strong saprobity	mediocre
Zăpodie (Pata Rât)	value	2.60	4.7
	water quality	strong saprobity	inferior

Conclusions

According to measured physical and chemical parameters the water of Mărăloiu and Zăpodie streams belong to the 4^{th} and 5^{th} quality class established based on standard values. The high value of conductivity, salinity and concentration of several ions appears to be in correlation with the significant presence of eutrofic and halophilic diatom species.

Most of the identified species in all three sampling sites indicate moderate or strong organic pollution.

The values of the saprobity index indicate βα-mesosaprobity in Mărăloiu, respectively α-mesosaprobic conditions in Zăpodie, conditions confirmed by the Biological Diatom Index, according to which the Mărăloiu has mediocre, the Zăpodie has inferior water quality.

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STUDIUL COMUNITĂŢILOR DE DIATOMEE DIN SOMEŞUL MIC ŞI AFLUENŢII ACESTUIA ÎNTRE FLOREŞTI ŞI APAHIDA (JUD. CLUJ): DATE PRELIMINARE PRIVIND CALITATEA APEI PÂRÂURILOR ZĂPODIE ŞI MĂRĂLOIU

(Rezumat)

Rampa de gunoi de la Pata Rât este în continuare o sursă importantă de poluare a mediului. Pârâul Zăpodie, afluent al Someşului Mic, curge foarte aproape de rampă, preia majoritatea scurgerilor şi le transportă în Someş. De asemenea, analizele chimice preliminare indică faptul că pârâul Mărăloiu cu vărsarea în Someşul Mic în apropierea comunei Apahida, este unul dintre cei mai poluaţi afluenţi ai acestuia.

În realizarea lucrării s-a urmărit determinarea compoziţiei comunităţilor de diatomee din cele două pârâuri. Folosind datele obţinute împreună cu cele ale analizelor chimice am evaluat calitatea apelor menţionate. Probele algologice şi cele de apă au fost prelevate din Zăpodie, aval de rampa de gunoi, respectiv din Mărăloiu, în apropiere de Cara şi amonte de deversarea în Someş la Apahida, în toamna anului 2006. Compoziţia comunităţilor de diatomee, ca şi valorile indicelui de saprobitate reflectă bine starea degradată a apei în zonele studiate, apa pârâului Mărăloiu având caracter βα-mezosaprob, iar a pârâului Zăpodie α-mezosaprob. Valorile Indicelui Biologic de Diatomee confirmă aceste rezultate, pe baza lor apa pârâului Mărăloiu se consideră de calitate mediocră, iar apa Zăpodiei de calitate inferioară. Numărul speciilor în Zăpodie este relativ mic, în comparaţie cu celelalte comunităţi studiate, probabil datorită prezenţei unor substanţe chimice în concentraţii mult peste limitele admise, devenind astfel toxice pentru diferite specii de diatomee. În toate cazurile se remarcă abundenţa mare a speciilor halofile, în concordanţă cu valorile mari de salinitate şi conductivitate măsurate, probabil datorită pe de o parte caracterelor geologice ale zonei studiate, pe de altă parte datorită influxului de ape menajere.

Rezultatele prezentate în această lucrare constituie o bază de comparaţie pentru investigaţiile viitoare, efectuate cu scopul de a monitoriza evoluţia stării de poluare a apelor din această zonă.

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