

WATER QUALITY EVALUATION IN TRANSYLVANIAN RIVERS BASED ON THE DIATOM BIOLOGICAL INDEX (DBI)

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Key words: *Transylvanian rivers, diatom, Diatom Biological Index (DBI)*

INTRODUCTION

The diatoms (Bacillariophyta) are well known water quality bioindicators use in the biomonitoring of lotic ecosystems.

Diatom Biological Index (DBI) (Prygiel & Coste, 2000) permits to estimate river water quality in monitoring programs. Based on their sensitivity to pollution and computing the DBI makes possible to obtain an evaluation of the degree of both organic pollution and eutrophication, the value of which is relatively independent from the degree of the physical alteration. The system is based on 209 taxa and seven water quality classes (F) defined from fourteen common physical and chemical parameters. River waters may be included in five quality categories: excellent water, good water, mediocre water, acceptable, inferior water respectively.

Especially in the European Union, DBI is successfully applied for qualitative assessment of running waters (Gomà et al., 2004; Rollin et al., 2002; Tudesque & Ector, 2002). In Romania it has also been employed for the assessment of water quality in the Someșu Cald and Someșu Mare rivers (Battes et al., 2004; Voicinco et al., 2004).

In this paper there are included the DBI values computed for the Arieșu Mare river (2004), Someșu Mare river and his tributaries (Țibleș, Rebra and Meleș) in years 2004-2005.

MATERIAL AND METHOD

Samples of the periphytic diatom communities were collected periodically from the littoral zone of the investigated rivers. The diatom samples were preserved in 4% formaldehyde or 20% ethylic alcohol and subsequently mounted in colophony. In every slide there have been counted at least 400 individuals.

The DBI calculation required various steps:

- from the total diatom taxa identified should be retained paired taxa (different species with similar ecological affinities);
- there were eliminated associated taxa (subspecies, varieties); their percentage abundance being added to taxa with they are associated;

- calculation of percentage abundance (A%) only of those taxa that reach a percentage abundance higher than the threshold values (Annex 3, Guide Méthodologique pour la mise en oeuvre de l'Indice Biologique Diatomées);
- appreciation of presence probability of the retained taxa for each water quality class:

$$F(i) = \frac{\sum_{x=1}^n A_x P_x(i) V_x}{\sum_{x=1}^n A_x V_x}$$

A_x = percentage abundance of the xth taxa (%);

P_x(i) = presence probability of the xth taxa for the ith water quality class (Annex 3);

V_x = ecological value of the xth taxa (Annex 4).

There were obtained 7 values of F(i) which were used to calculate the B factor:

$$B = F(1) + 2F(2) + 3F(3) + 4F(4) + 5F(5) + 6F(6) + 7F(7)$$

DBI values - calculated based on B factor (Table 1) - permit water quality assessment (Table 2).

Table 1. DBI calculated based on B factor

B	[0-2]	(2-6)	[6-7]
DBI	1	4.75xB-8.5	20

RESULTS AND DISCUSSIONS

According to the existing informations (plates in DBI manual of Prygiel & Coste, 2000), our microscope slides revealed many of the specific diatom taxa for the five water quality classes.

For excellent water quality there were recognized: *Diatoma hiemale*, *D. mesodon*, *Meridion circulare* var. *constrictum*, *Eunotia exigua*, *Stauroneis phoenicenteron*, *Fragilaria arcus*, *Encyonema mesianum*, *Achnanthes minutissima*, *Cymbella affinis*, *Encyonema minutum*, *Nitzschia dissipata*, *Cymbella lanceolata*, *Reimeria sinuata*, *Fragilaria capucina* var. *vaucheriae*, *Navicula radiosa*, *Diatoma vulgare*, *Gomphonema olivaceum*, *G. minutum*, *G. acuminatum*, *Frustulia vulgare* and *Cymatopleura elliptica* indicated good water quality.

Table 2. Water quality assessment based on DBI values.

DBI	DBI $\geq$ 17.0	17.0>DBI $\geq$ 13.0	13.0>DBI $\geq$ 9.0	9.0>DBI $\geq$ 5.0	DBI<5.0
Water quality	excellent	good	acceptable	mediocre	inferior

Acceptable water quality is indicated by: *Fragilaria pulchella*, *Navicula capitatoradiata*, *Amphora pediculus*, *Navicula viridula*, *Gyrosigma attenuatum*, *Cocconeis pediculus*, *Gomphonema truncatum*, *Gomphonema parvulum*, *Rhoichosphenia abbreviata*, *Amphora montana*, *Cyclotella meneghiniana*, *Sellaphora pupula*, *Actinocyclus normanii*, *Luticola goeppertiana*, *L. mutica*, *Hantzschia amphioxys*, *Bacillaria paradoxa*, *Nitzschia palea*, *N. filiformis* and *Surirella ovalis* indicated mediocre water quality. Finally, species identified for inferior water quality were: *Craticula cuspidata*, *Amphora veneta*, *Navicula arvensis*, *Craticula halophila*, *C. accomoda*, *Navicula veneta*, *Nitzschia capitellata*, *N. umbonata* and *N. frustulum*.

Conventional signs used for different water quality classes in the histograms:

-  excellent
-  good
-  acceptable
-  mediocre
-  inferior

At the station upstream Albac, on the Arieșu Mare river water quality was good (DBI: 16.3 in May and 15.7 in October 2004) and satisfactory in July (DBI 9.6), probably induced by low quantity of dissolved oxygen (40.2%) (Fig. 1).

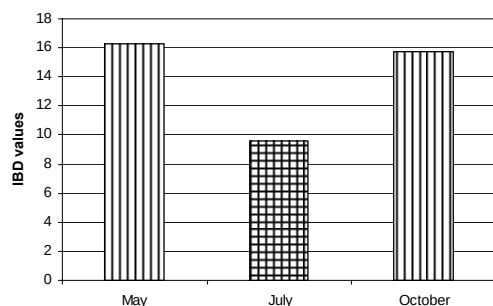


Fig. 1. DBI values for the Arieșu Mare river, upstream Albac.

For the headwater of Țibleș river (Fig. 2), tributary of Someșu Mare, DBI values indicated a good water quality in 2004 and excellent in 2005.

At Mocod on the Țibleș river, at the confluence with Someșu Mare, good water quality was found in all the seasons, except in April 2004, when the DBI reflected mediocre quality (11.7) (Fig. 3).

Rebra river, an affluent of the Someșu Mare from the Rodnei Mountains, exhibited water of good quality for both stations, except the cold season – spring of 2004 and 2005 – when DBI values indicated excellent water quality (Fig. 4, 5).

Țibleș, upstream Poienile Zagrei

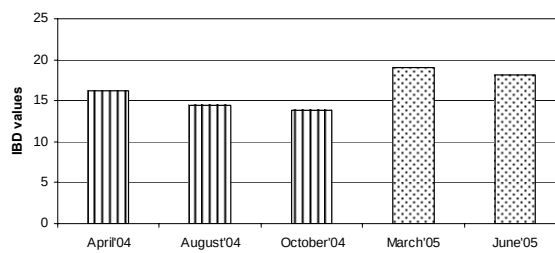


Fig. 2. DBI values for the Țibleș river, upstream Poienile Zagrei.

Țibleș, at Mocod

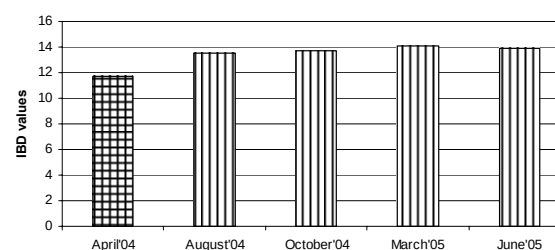


Fig. 3. DBI values for the Țibleș river, at Mocod.

Rebra, upstream Parva

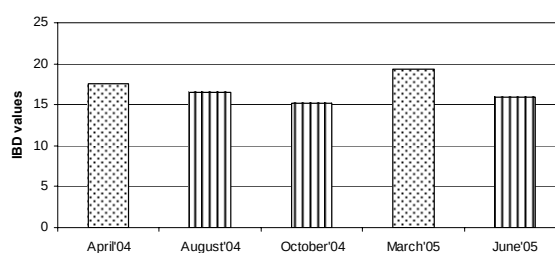


Fig. 4. DBI values for the Rebra river, upstream Parva.

A special situation was revealed in Meleș river, crossing the Transylvanian Plain, tributary of the Someșu Mare, when DBI indicated admissible water quality upstream Bidiu in August-October 2004, but mediocre in April 2004 and June 2005 (Fig. 6).

Rebra, downstream Rebra

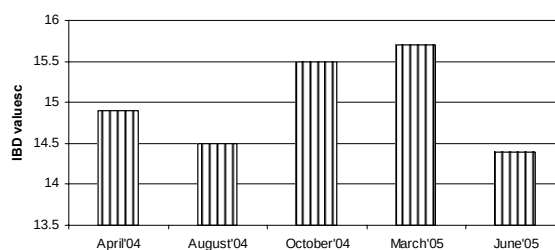


Fig. 5. DBI values for the Rebra river, downstream Rebra.

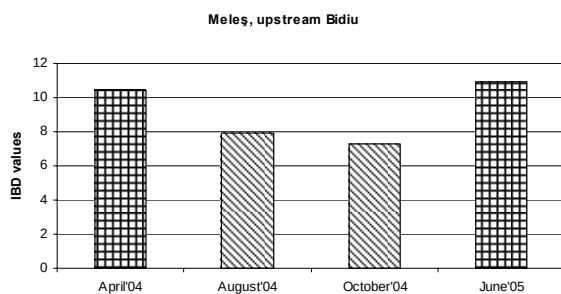


Fig. 6. DBI values for the Meleş river, upstream Bidiu.

At the confluence of the Meleş river with the Someşu Mare in Beclean, DBI reflected an inferior water quality in October 2004, but a higher ones in the other seasons (Fig.7).

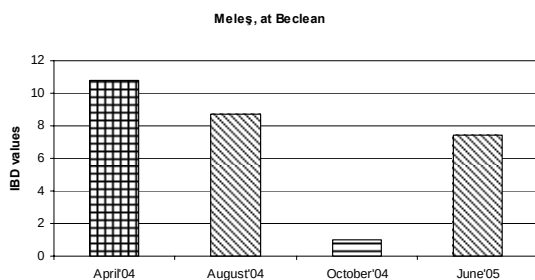


Fig. 7. DBI values for the Meleş river, at Beclean.

For the Someşu Mare river, section Ilva Mică, the water quality was good to excellent (DBI: 13.4-21.6 upstream Ilva Mică, DBI: 13.3-20.0 downstream) (Fig. 8; Fig. 9).

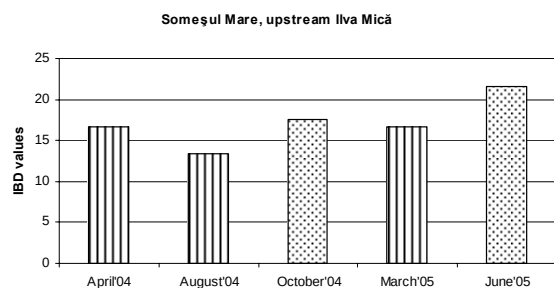


Fig. 8. DBI values for the Someşu Mare river, upstream Ilva Mică.

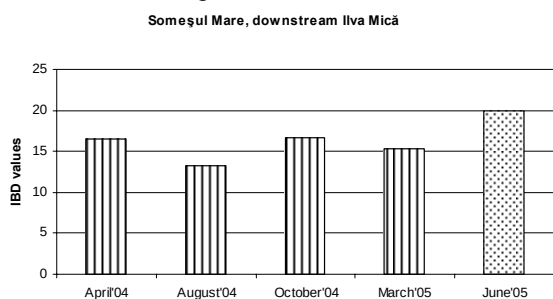


Fig. 9. DBI values for the Someşu Mare river, downstream Ilva Mică.

At the station upstream Rebrîşoara, DBI values indicated excellent water quality in October

2004 and June 2005 and good one in the other seasons (Fig. 10).

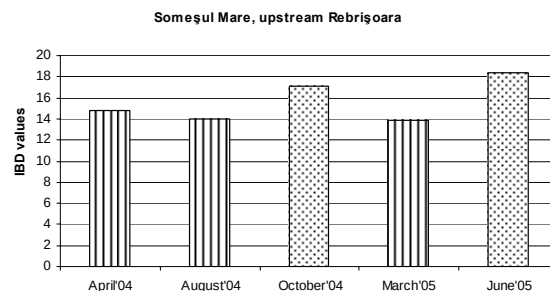


Fig. 10. DBI values for the Someşu Mare river, upstream Rebrîşoara.

In the middle sector of the river, downstream Salva, water quality varied between mediocre (October 2004), good and excellent - in March 2005 (Fig. 11).

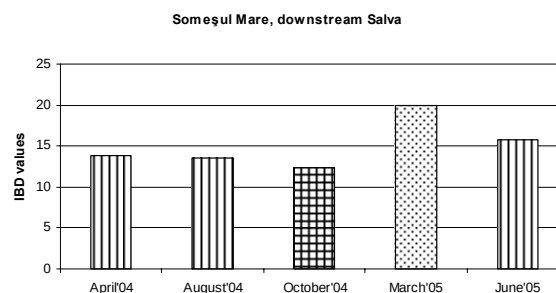


Fig. 11. DBI values for the Someşu Mare river, downstream Rebrîşoara.

At the Beclean section of the Someşu Mare, water quality was mediocre in all seasons, except spring 2005 when it became good one (Fig. 12; Fig. 13).

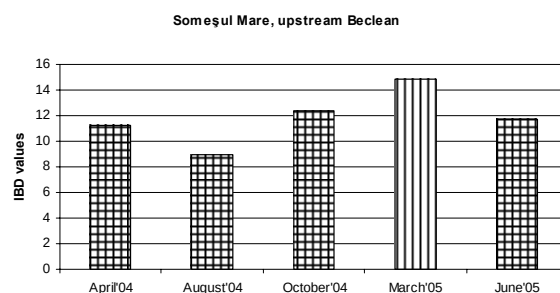


Fig. 12. DBI values for the Someşu Mare river, upstream Beclean.

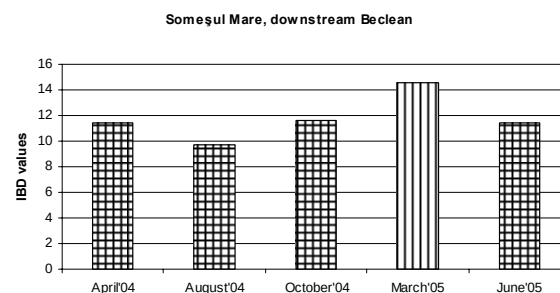


Fig. 13. DBI values for the Someşu Mare river, downstream Beclean.

CONCLUSIONS

The superior course of mountain rivers (Arieșul Mare, Someșul Mare and his tributaries – Țibleș and Rebra) exhibited excellent and good water quality.

In the middle course of Meleș river water quality was satisfactory and mediocre, becoming lower in its inferior course (autumn 2004).

The river sectors downstream Salva – downstream Beclean on the Someșu Mare river and the lower courses of Țibleș and Rebra rivers, DBI reflected good and acceptable quality.

REZUMAT

Indicele Biologic de Diatomee (IBD) permite aprecierea calității apei râurilor pe baza structurii comunităților de diatomee bentonice, aceasta fiind de 5 categorii: excelentă, bună, acceptabilă, mediocră și inferioară. Modul de calcul al IBD-ului se găsește în ghidul metodologic al lui Prygiel și Coste, 2000.

Pentru râul Arieșul Mare, amonte Albac, valorile IBD indică ape de calitate bună în mai și octombrie 2004, iar în vară, calitatea apei devine acceptabilă (probabil, datorită cantității reduse a O₂ dizolvat).

În bazinul Someșului Mare, punctele de prelevare au fost pe afluenții acestuia (Țibleș, Rebra și Meleș) și pe Someșul Mare între Ilva Mică și Beclean. Valorile IBD-ului, începând din aprilie 2004 până în iunie 2005, indică ape din toate cele cinci categorii de calitate. De regulă, apa de calitate excelentă și bună a fost întâlnită pe râurile de munte (Țibleș și Rebra) și în prima porțiune a Someșului Mare, până la punctul aval Salva, apoi calitatea apei devine mediocră în secțiunea Beclean. Pe râul Meleș, calitatea apei variază între nivelul acceptabil și inferior, datorită substratului instabil și a deversărilor frecvente.

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