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Implementation of the European Water Framework Directive to assessment the water quality of Hungarian running waters with diatoms

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INTRODUCTION

As benthic algae are sessile, physical, chemical and biological interactions, disturbances in the given water have a great effect on the formation of their communities.

Therefore, they can be used in water quality assessment and biological monitoring as well. Diatoms are one of the most important groups in lotic ecosystems, major parts of benthic algae are diatoms (often 90-95 %), and accordingly they have become a substantial factor in water quality monitoring. They can be found almost in all aquatic habitats, in all periods, which is a remarkable advantage. Another important aspect is that collected diatoms can be stored until unlimited time as permanent slides or treated samples, and they can be investigated again if needed. Concept of individual can be easily defined, so species and relative abundances that belong to them can be given unambiguously. Water Framework Directive the third directive of the European Union (EU) (European Parliament, 2000, directive 2000/60/EC) require to survey and assess ecological conditions of surface water bodies. Until 2007, development of national biomonitoring systems according to WFD have begun or completed in almost every member states of the EU, and examination of benthic diatoms have become an element of these systems. Surveillance monitoring in Hungary started in 2007, previously, periphyton samples were collected from the whole country during the ECOSURV project. (Van Dam et al. 2007). In the present study, we supervised the actual qualification system (Szilágyi et al. 2008), and being in the possession of a larger data set than previously, we were able to improve it.

MATERIAL AND METHOD

The analyses were based on 1161 benthic datasets from the WFD biotic database of the Hungarian Ministry of Water and Environment. Samples were collected from 398 different Hungarian rivers during the vegetation period (from May to October) in 2005, 2006 and 2007. The diatoms were treated with H_2O_2 and HCl (according to CEN 2003), washed three times in distilled water, and mounted with Naphrax® mounting medium.

Pearson -correlations were calculated between diatom indices and chemical parameters.

RESULTS AND DISCUSSION

In Hungary 22 river types (+ three for the Danube which has 3 different types as set by the IPCDR) were separated according to the „B" typology (Table 1). The 26th type contains the heavily modified rivers. The river types are described in MoEW (2005).

In the first step we determined which diatom indices correlate significantly with the majority of investigated chemical parameters.

These indices were IPS, SID and TID, except in the case of river type 1, 23, 24 and 25. In the next step, correlation between the multimetric index made from the three mentioned indices (IPSITI= (IPS+SID+TID)/3) and chemical parameters were calculated. In this manner we received significant correlation in even more cases. In the case of river types 1, 23, 24 and 25, qualification was made with IPS. Index categories of IPSITI were constituted at the mean of the index categories of the three basic indices.

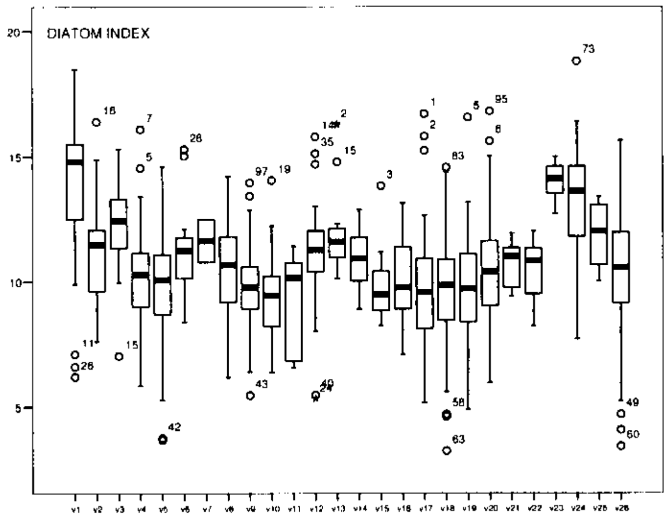

Figure 1. Values of diatom indices in the case of each river types. Five basic data of the box-plot: minimum, lower quartile (25%), median, upper quartile (75%), maximum. Outlier values are marked with circles, extremely outlier ones are marked with stars.

As it shown on Figure 1., index values of highland streams (type 1-10) are higher than the ones of lowland steams (type 11-22), but it is also conspicuous that index values of large and very large rivers with rough bed-material (type 6, 7, 13, 14) are higher than the others both in the case of highland and lowland streams. From the watercourses with fine bed-material only the very large ones (type 20) have higher index values. Consequently, the most vulnerable rivers are the slow, lowland streams with small catchments areas. Index values of heavily modified water bodies are similar to those of lowland ones, but they vary between wide ranges.

Considering the original index boundaries, in each type we selected sampling points which had good values on the basis of chemistry and indices, too. If several samples from the same site were at our database, we worked with the best index value, except in the case of large rivers, when we used all of them. Omission of bad index values in the case of small streams was reasonable, since these waters may show worse values because of autosaprobity, lack of water, or shading effect of macrophytes.

25^{th} percentile of index values of the selected water bodies was considered the boundary between excellent /good (H/M) quality. Additional index boundaries were made with dividing the remainder into four parts.

EQR boundaries were determined with normalization, that it should have values between 0 and 1, with equal categories. Values constructed in this manner, were plotted against index boundaries. (EQR

H/G= 0,8; G/M= 0,6; M/P= 0,4; P/B= 0,2) EQR can be calculated from the observed index value and the equation of the line that best fit for the given points. (Table 1., Y is the value of EQR, X is the observed index value).

Table 1. *Equations for calculating EQR values within each type.*

type	equation	R^2
1.	Y=0.0528x-0.028	0.9978
2.	y=0.0531x-0.0219	0.9966
3-20. and 26.	y = -0.0014x2 + 0.0807x - 0.0653	0.9977
23-24.	y = 0.0528x - 0.0808	0.9978
25.	y = 0.0529x - 0.0471	0.9991

Among the 398 investigated water bodies, there were 15 with high, 204 with good, 165 with moderate, 11 with poor and 3 with bad condition (Figure 2). Categories determined by diatom indices reflected well to improving values of chemical variables (for instance, correspondence between chemical oxygen demand and water quality classes is presented on figure 3.) It is well known that diatoms can be used effectively to monitor organic pollution and eutrophication, but our result suggest that in the case of lower categories (especially in the case of heavily polluted water bodies), qualification with benthic diatoms may loose its relevance.

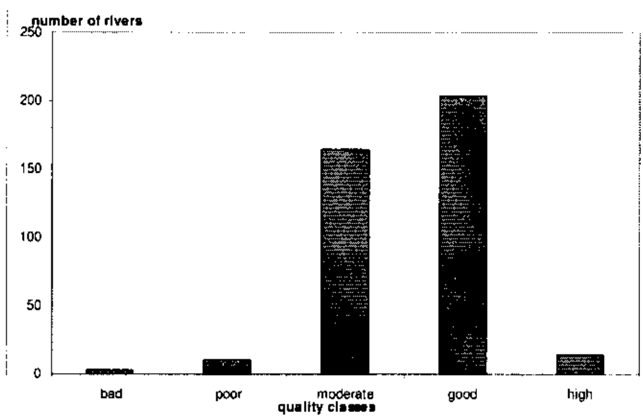

Figure 2. *Water quality of the investigated Hungarian streams based on benthic diatom investigations.*

SUMMARY

By the analysis of the benthic diatom data of the Hungarian national database, an EQR based qualification system has been developed, of which results are presented in this paper. The values of the new multimetric diatom index showed that lowland streams are in worse ecological status than highland streams in Hungary. Our most vulnerable rivers are slow, lowland ones with small catchments areas.

More than the half of the 398 investigated streams achieved the level of good ecological status. Our results also suggest that in the case of lower categories, qualification with benthic diatoms may loose its relevance.

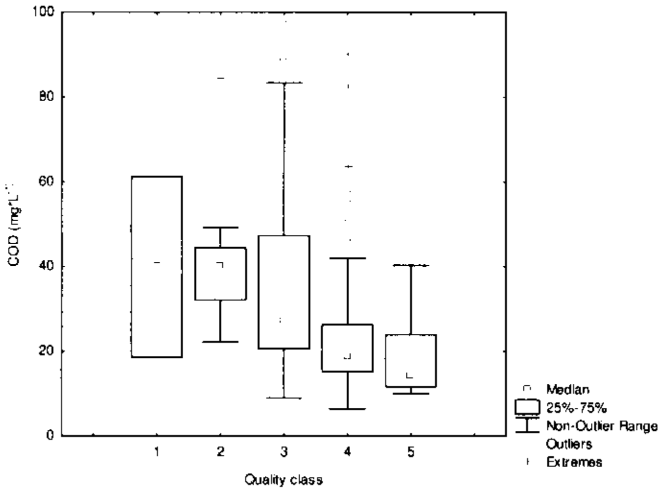

Figure 3. *Values of chemical oxygen demand in each quality classes (1: bad, 5: high).*

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