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INNOVATIVE ALGOLOGICAL INVESTIGATIONS RELATED TO THE WATER FRAMEWORK DIRECTIVE

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Aim of the European Water Framework Directive

Research groups as well as decision makers are increasingly aware of the importance of algology in water quality analyses. The Water Framework Directive (WFD) of the European Union requires that all inland and coastal waters within defined river basin districts **must reach at least *good status* by 2015** and defines how this should be achieved through the establishment of environmental objectives and ecological targets for surface waters. The WFD requires that an integrated monitoring programme be established within each river basin district. Monitoring includes benthic diatoms that have been widely used in European countries to assess biological quality of water courses.

Diatoms as bioindicators

Diatoms are an important group of organisms in water ecosystems forming a large part of the benthos (often 90–95%). Benthic diatoms are well suited for the quality analysis of wetlands, because – as primary producers – they play an important role in the organic and inorganic nutrient cycles of rivers and standing waters. Since benthic diatoms are widespread, ubiquist organisms with short generation time and **high sensitivity against different impacts**, they are excellent bioindicators. The decreasing abundance of taxa indicate habitat destruction or a decrease of habitat diversity. The advantage of using benthic diatoms as indicators is that they can be found in every surface waters, at any time. Furthermore, collected diatom samples can be preserved (in form of preserved preparates or acid digested sample slides) for an unlimited period of time, thus they can be reinvestigated whenever necessary. The identification of individuals is evident, not as in the case of many other organisms. However, the investigation of diatoms requires thorough taxonomical knowledge.

New sampling method

We designed a new method for the quantitative sampling of benthic algae of large rivers, because these habitats were neglected due to sampling difficulties. A stone of movable

size with periphyton coating has to be removed from the river.The stone can be conveniently sampled on the shore by two people with the aid of a drill, dental brush, a thick, short (2-3 cm) rubber tube and a fin pipette (Figure 20).

Figure 20. Tools used for the new quantitative epilithon sampling technique and a stone sampled with this method.

Only the shoreline side of the stone should be sampled. The surface covered by the rubber tube is of known size. When pressed onto the stone by one person, it is possible for the other to rub off the periphyton with the dental brush which is fixed to the drill. Finally, water of known volume is added and the periphyton sample can thus be pipetted – the use of a fin pipette is practical – into the sample vial.

The Utermöhl-method is used for counting algal abundance. Periphyton samples are treated as phytoplankton samples, the individuum number per 10 cm^2 can be determined with the help of an inverted microscope. Chlorophyll a content of benthic samples can be determined as well.

Results of applications

As a test of this new method, epilithic algae of the River Danube were investigated alongside the river from the source streams Breg and Brigach to the end of the Hungarian stretch in a 4 years project. Species composition of epilithic algae was determined and **diatom-based water quality assessment** was performed with the aid of the widely used French software OMNIDIA, a computer program, which calculates 17 different diatom indices that help to assess water quality.

Additional samplings were carried out with monthly frequency at Göd (riv. km 1669) in order to investigate the impact of a dry period on the water quality. We found that the diatoms *Achnanthidium minutissimum* and *Amphora pediculus*, furthermore the Chlorophyta species *Protoderma viride* gained an overall strong dominance on most parts of the Danube. However, species composition was very different in the source streams Breg and Brigach and on a short upper stretch of the Danube. Two well-defined parts could be distinguished on the basis of epilithic algal composition: the source area and the lower stretch including the total length of the Austrian, Slovakian and Hungarian stretches. We concluded that the differences in the species composition and abundance between the upper stretch and the middle stretch of the Danube have practically vanished which is the result of the large-scale dam constructions on the river.

According to the diatom indices calculated with OMNIDIA, the **water quality of the Danube is good or excellent around the sources and gradually it becomes moderate, or partly bad in Slovakia and Hungary.** The method developed proved to be sensitive to detect unusual changes in the diatome assemblage. In August 2003, unusually low phytoplankton abundance values were found at Göd, which did not correspond with the low water discharge. At the same time epilithic diatoms showed unexpectedly vigorous multiplication and produced large masses of gelatinous matrix (Figure 21). The diatom-based water quality turned out to be poor (polluted). The peculiar phenomenon could only partly be explained; however, it draws attention to the need of multiple samples per year to assess water quality. (Ács et al. 2003, 2006).

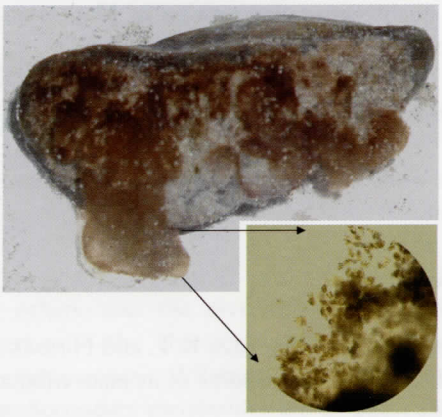

Figure 21. Cobble with a thick periphyton coating and brownish gelatinous mass produced by attached algae in the summer of 2003. A light microscopic image of the epilithic diatoms (mainly Gomphonema olivaceum*) is enlarged (right).*

Monitoring water quality

We were the first to use a benthic diatom-based water quality analysis system in Hungary, which is widely used in Europe. This method was also tested in some smaller streams in Hungary (Ács et al. 2004, Szabó et al. 2004), in the river Tisza (Kiss et al. 2002, Szabó et al. 2005). Our experiences in standard sampling methodology enabled us to work on the theoretical basis of lake monitoring (Ács et al. 2005). Based on our results in benthic diatom-based water quality analyses, we have the mandate to analyse and compare the different benthic diatom based riverine water quality analysis systems in the context of the EU WFD, and to prepare a recommendation about the system to be implemented (Szilágyi et al. 2006). For water quality analysis in Hungary from 2007 the OMNIDIA software will be used. As a commission of the Ministry of Environment and Water we have **started training biologists** of the Environmental Protectorates in diatom taxonomy, sampling and sample preparation techniques of benthic diatoms and analysis of benthic diatom samples.

Summary

Based on the bioindicator features of benthic diatoms we have developed new method for quantitative sampling and evaluation of benthic algae for water quality analysis. The

knowledge and experience of the algological team and the technical facilities of the Hungarian Danube Research Station of the Institute enable us to be an integral part of the quality assurance process of Hungarian algal monitoring in relation to the Water Framework Directives.

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