



## Benthic invertebrates as ecological indicators of impounded rivers

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Hydropower contributes significantly to the electric energy production in Austria. As a result most of the hydropower generation potential is already used and only few river sections remained untouched. The main types of hydropower plants in Austria are pumped storage plants, river run-off plants and water diversion plants (most of the latter are small hydropower industry). Any of them store the water in impoundments with the effect that 31% of rivers sections in rivers with a catchment area larger than 1000 km<sup>2</sup> are significantly affected by impoundments. The paper points out the use of benthic invertebrates as indicators of the ecological status of (impounded) rivers under the aspects of modern water management including methodological facts of environmental impact assessment, discussing mitigation measures and conclusions how to use the hydropower in harmony with nature. The database reflects the experiences of the last five years biomonitoring within the scope of implementing the EU Water Framework Directive. The impoundments under study comprise a wide range of water bodies, from small rivers (affected by small hydropower plants), medium rivers and large rivers (e.g. River Traun, Upper Austria and Danube, Upper Austria and Lower Austria) affected by medium to large run-off river plants. Samples have been taken following the multi-habitat-sampling principles. Shallow water bodies have been sampled with a standard EU-handnet with a mesh size of 500 micrometer (at least 4 investigation sites along an impoundment's gradient from the headrace to the weir; 20 sampling units per investigation site). Medium and large impoundments have been sampled with an airlift-sampler (various numbers of cross sections along the impounded stretch with 6 to 15 replicates per cross section). The article describes the effect of river impounding on the benthic invertebrate communities in quantitative and qualitative terms, and points out significant biological measures (metrics) that describe the reaction of the benthic biota under increasing stress. A special focus is given on the following metrics types: species richness measures (number of taxa, number of EPT (Ephemeroptera-Plecoptera-Trichoptera) taxa, number of Oligochaeta Taxa), species composition measures (% EPT-Taxa, % Oligochaeta-Taxa), tolerance measures (number of sensitive taxa, degradation score), biodiversity measures (Margalef-Index), saprobity measures (saprobic index, saprobic score; share of xenosaprobic and oligosaprobic valencies), stream zonation patterns, functional feeding guild aspects (e.g. ratio of active and passive filtering collectors; share of grazers and shredders, share of detritivorous collectors, rhithron feeding type index), among others. As a contribution to an EU Water Framework Directive adequate aquatic bio-monitoring, the application of a rapid field screening methodology (four metrics based on biological data that are available in the field) and the development of a stressor specific multimetric index to effectively depict the effects of impounding are described and discussed.