Changing Perspectives: a new macroinvertebrate community metric to evaluate habitat loss in residual flow stretches

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ABSTRACT: In Austria, hydropower is one of the most important sources of renewable energy, providing more than half of the country's energy supply. Despite creating baseload energy, one of its main strengths is balancing fluctuations in energy production and demand. Therefore, large reservoirs are created in high alpine regions by abstracting water from multiple streams, which is then pumped or drained into storage lakes to gain the necessary capacity and flexibility for energy production. Abstracting water can nevertheless have severe impacts on the ecosystem, by altering environmental conditions like habitat availability and quality. To fulfill the requirements of the EU's Water Framework Directive hydrologically and morphologically altered water bodies need to be assessed according to the resident communities of aquatic organisms to analyze their ecological status and subsequently either maintain or improve the ecological status.

A wide range of metrics and metric combinations is available for assessing macroinvertebrate communities to evaluate the ecological status based on this organism group. Nevertheless, all of these metrics depict the investigated stretch as a kind of "decoupled system", without considering the size of the whole water body in relation to the unimpacted stretch. While this approach is perfectly suitable, if the studied impact is supposed to be viewed as independent of the size of river cross-section (e.g. in case of altered flow velocity, or pollution), it neglects one of the main effects of water abstraction on riverine ecosystems: the loss of wetted area and the concomitant quantity of available habitats.

In the present study, six high alpine streams were investigated, all of which are affected by water abstraction. At each stream one sampling site was situated above the water abstracting weir as a reference site and three downstream, in the residual flow stretch. At each sampling site macroinvertebrate communities were analyzed. The stream width was measured and a representative median value was calculated per site. Based on the gathered data, metrics considering the abundance/biomass per area can be complemented by one dimension (multiplication with stream width), offering a possibility to depict the total abundance and biomass of a river section. The use of this new metric offers an opportunity to evaluate residual flow stretches from another perspective. In combination with other, well-established macroinvertebrate metrics it can create a basis for a holistic evaluation system as well as for implementing adequate mitigation measures to reduce the impact of water abstraction on the ecosystem.