Geophysical Research Abstracts
Vol. 12, EGU2010-1568-2, 2010
EGU General Assembly 2010

A water framework directive (WFD) compliant determination of eologically acceptable flows in alpine rivers - a river type specific approach

Paul Jäger (1) and Andreas Zitek (2)

(1) Regional government of Salzburg, Section water protection and pollution control, Ulrich-Schreier-Straße 18, A-5020 Salzburg, Austria (paul.jaeger@sbg.at), (2) EcoScience Research Group (ERG), Goldschlagstraße 209/6, 1140 Vienna, Austria (andreas.zitek@ecoscience.at)

Currently the EU-Water Framework Directive (WFD) represents the driving force behind the assessment for rehabilitation and conservation of aquatic resources throughout Europe. Hydropower production, often considered as “green energy”, in the past has put significant pressures on river systems like fragmentation by weirs, impoundment, hydropeaking and water abstraction. Due to the limited availability of data for determining ecologically acceptable flow for rivers at water abstraction sites, a special monitoring program was conducted in the federal state of Salzburg in Austria from 2006 to 2009.

Water abstraction sites at 19 hydropower plants, mostly within the trout region of the River Salzach catchment, were assessed in detail with regard to the effect of water abstraction on fish and macrozoobenthos. Based on a detailed assessment of the specific local hydro-morphological and biological situations, the validity of natural low flow criteria (Absolute Minimum Flow – AMF, the lowest daily average flow ever measured and Mean Annual Daily Low Flow - MADLF) as starting points for the determination of an ecologically acceptable flow was tested. It was assessed, if a good ecological status in accordance with the EU-WFD can be maintained at natural AMF. Additionally it was tested, if important habitat parameters describing connectivity, river type specific flow variability and river type specific habitats are maintained at this discharge. Habitat modelling was applied in some situations.

Hydraulic results showed that at AMF the highest flow velocity classes were lost in most situations. When AMF was significantly undercut, flow velocities between 0,0 – 0,4 m/s became dominant, describing the loss of the river type specific flow character, leading to a loss of river type specific flow variability and habitats and increased sedimentation of fines. Furthermore limits for parameters describing connectivity for fish like maximum depth at the pessimum profile and minimum flow velocity in thalweg were undercut. Additionally a significant loss of wetted width in relation to the wetted width at MADLF was documented, leading to significantly reduced ecologically available habitats.

At AMF the existence of a minimum amount of usable habitat prevented a total loss of adult fish, and a good ecological status was documented by the Fish Index Austria (FIA) in all situations, where water abstraction represented the only human pressure, and AMF was left in the river as residual flow. The fish ecological status was significantly worse in river stretches where minimum flow was significantly below the AMF. However, in about one third of these stretches a good ecological status was documented by fish. Fine grained habitat structures, expressed by mean choriotope sizes (> 20 cm) and relative roughness were found to provide enough shelter, especially for brown trout, to maintain a high variance of fish lengths influencing both, the age structure and biomass. Both variables are especially highly relevant when calculating the ecological status of rivers using the FIA, when only brown trout occurs as leading species, accompanied only by the bullhead, Cottus gobio L.. However, mean fish lengths and weights were significantly smaller in most water abstraction sites.

The method currently applied for determining the ecological status by macrozoobenthos failed, because the method is still based on some types of water pollution and the flow velocity as dominating factor in rivers is not adequately considered. However, a species specific analysis of the data showed a consistent loss of rheophilic

species at water abstraction sites. Based on this, recommendations for a more specified assessment of the ecological status by benthic invertebrates were developed.

Natural factors like slope with significant effects on hydraulic stress (bottom shear stress, maximum flow velocities, etc.) strongly overlaid the effects of water abstraction within the whole dataset. Therefore an adequate consideration of natural factors like slope, hydraulic stress and structure parameters like mean choriotope size, and a realistic identification of the significant driving pressures (water abstraction, fragmentation, and channelization) proved to be a crucial pre-requisite for a meaningful analysis and interpretation of data and determination of efficient restoration measures.

Summarizing, it can be concluded that the AMF represents a valid base for determining the ecologically acceptable flow. In most cases parameters for connectivity and river type specific habitat availability are met at this discharge. However, as this discharge represents a natural catastrophic event, it is recommended to add a dynamic component to this minimum base flow to maintain at least to some extent the river type specific flow variability, contributing to a maintenance of natural geomorphologic and ecological processes linked to natural flow patterns. Especially higher discharges, able to move substrates and flush fine sediments, should be provided in their river type specific seasonal dynamics. This seasonal clearing of sediments has been proved to be strongly related to the reproductive success of trout in the past and provides interstitial habitats for invertebrates at ecologically meaningful times of the year.

Finally, re-establishment of river connectivity at weirs and the morphological restructuring of highly channelized rivers can be seen as other important pre-requisites to achieve the good ecological status in alpine river systems.