Biotic impact of different sediment flushing practices in Italian alpine rivers

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Introduction: Alpine rivers and streams in the northern Italian region of Lombardy are vastly affected by both large scale and small scale hydropower facilities. Large reservoirs tend to occur in the upper reaches of such rivers and, due to the natural sediment inflow, they need periodical maintenance for both safety and production reasons. It is a common and widespread practice since several decades to remove sediment by implementing different flushing operations. The aquatic communities can be affected by these operations by both mechanical and physiochemical impacts. Understanding and managing the impact of such operation on the biota is thus of paramount importance for the protection of the biotic community and the ecosystem.

Methods: The data were collected by reservoir managers from ≈ 30 flushing operations in Lombardy (Northern Italy) during the last 10 years (2006 to 2015). For a series of flushing events, before, during and after sampling approach was implemented: both macroinvertebrates and fish samples were collected while during the events suspended solids concentration was measured. Whenever possible, physical-chemical parameters and land use information were retrieved as well. Analyses were performed considering the entire dataset, plus two case studies were developed on the reservoirs of Cancano and Valgrosina (both along the Adda River). These two reservoirs were selected for the relevance both in terms of intensity and duration of the flushing operations. SEV index (SEV - Severity Effect Value; Newcombe and Jensen 1996) was calculated to evaluate the estimated effects of suspended solids on fish communities. Selected benthic invertebrate metrics were calculated: i) the 6 metrics that compose the Italian index used for the ecological status classification i.e. the STAR_ICM index (Buffagni, Erba & Furse, 2007); ii) the metrics recently proposed in Italy for surveillance and investigative monitoring; iii) *ad hoc* developed metrics. Moreover a Multivariate Regression Trees analyses (De'ath, 2002) was performed in order to group the samples by days elapsed from the beginning of the flushing events.

Results and discussion: As far as the fish community is concerned, similarity indexes showed in most of the cases differences before-after events. SEV index was compared to the real mortality ratio found in the before-after samples: the mortality ratio predicted by SEV was in some case concordant with the effective mortality, but generally under estimated the real effects.

The MRT analyses, based on the benthic community, showed an impact/recovery pattern linked to the time distance from the flushing event. With the goal of developing benthic metrics that mainly reflect alteration due to flushing operations, several metrics were developed and tested (e.g. selected Ephemeroptera-Plecoptera-Trichoptera Taxa, Selected Diptera-Oligochaeta). As expected, to discriminate between before and after groups, the STAR_ICM metrics and index can be effectively integrated with information provided by the *ad hoc* developed metrics, that showed a clear response to the flushing impact (Fig. 1).
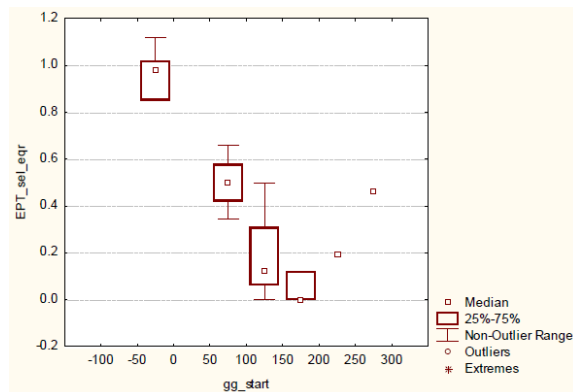

Fig. 1: Example of distribution of observed values of the Selected EPT metric vs days elapsed from the flushing (gg_start).

These results, yet preliminary, were helpful to suggest recommendations for the development of best management practice for the Lombardy reservoirs in order to minimize the impact of flushing events on the aquatic communities.

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