

# A protocol for assessing sediment toxicity in reservoirs before flushing

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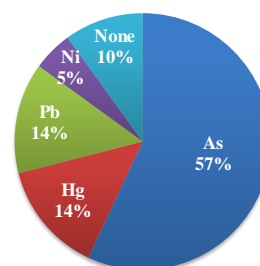
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**Introduction:** Reservoir desiltation is often necessary to maintain or recover storage capacity. Sediments are frequently removed by flushing, causing potential adverse effects on the riverine ecosystem receiving the removed sediments. The physical-mechanical impact may primarily impair aquatic communities, but in some cases chemical compounds accumulated in the sediments may induce toxic effects at long-term. Some researches emphasized that flushing operations may determine release of contaminants from sediments altering their bioavailability. Based on real case studies from Northern Italy, an analytical protocol for ecotoxicological and physical-chemical characterization of sediments in reservoirs (PrATo) was developed for a proper management of flushing operations. Preliminary results of trials are presented.

**Methods:** The protocol was developed by considering 30 reservoirs of Lombardy Region (Northern Italy), characterized by different degrees of silting and anthropogenic pressures. PrATo includes standard protocols for sampling, chemical analysis and ecotoxicological characterization of sediments of the reservoirs and of the downstream river stretches. It also includes criteria for risk assessment using an approach similar to TRIAD, which takes into account: 1) the comparison between micropollutant concentrations (trace elements and organic compounds) in the sediments and quality thresholds selected from existing national legislation or from literature (e.g. cb-TEC and cb-PEC); 2) the assessment of toxicity of reservoir sediments using ecotoxicological test batteries (for example, the chronic test with *Heterocypris incongruens* is considered as screening test); 3) the chemical and ecotoxicological assessment of sediments of the downstream river stretch *before* flushing as basis for planning proper operations, and *after* flushing as criteria to evaluate the results of these operations by comparison with the previous conditions. The final aim of the characterization is to provide practical information for a sustainable management of flushing operations. For example, a proper sediment:water dilution factor to be applied during flushing to prevent overcoming toxicity thresholds can be calculated.

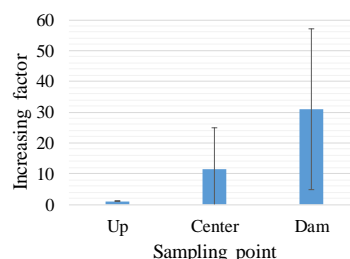
**Results and discussion:** Most reservoirs (90% of 21 cases) showed high values of trace elements in

sediments (Fig. 1), in particular As, Hg, Pb and Ni, exceeding selected quality thresholds. Most contaminants derived from natural watershed leaching, but were accumulated into fine sediments in the reservoirs, with potential higher values in comparison with sediments of the downstream rivers.



**Fig. 1:** Percent of analysed reservoirs (N = 21) showing values of contaminants in sediments exceeding selected quality thresholds. None = no exceedance.

An increasing trend of contaminant concentrations was generally observed within the reservoirs (Fig. 2), in particular for organic compounds, following the longitudinal distribution of fine sediment fractions and organic carbon. Toxicity evaluated with chronic test batteries (*H. incongruens*, *Chironomus riparius*, plants such as *Sorghum saccharatum*) generally followed the same trend, with some unexpected exceptions.



**Fig. 2:** Increasing factor (mean ± st.dev.) of pollutant concentrations in the reservoir sediments from the upper point (value set at 1 in Up) to the dam (N = 21).

Results show that the definition of proper quality thresholds is rather difficult, since they are generally not representative of site-specific bioavailability. Therefore, the ecotoxicological characterization is necessary to assess sediment toxicity. PrATo provides a practical and efficient tool for a sustainable management of the flushing activities and will be adopted in Lombardy as technical guidance for the reservoir management plans.