

A risk assessment evaluation to prioritize contaminated sediment sites

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Introduction: Actual standard for evaluation of sediment and water quality in different European Countries are mainly conservative, ensuring the widest possible protection of living organisms in aquatic environments. However this approach led authorities to consider as contaminated all the sites in which sediment, water or biota quality standards are overcome for defined pollutants. Very high costs are expected to restore these contaminated sites without any indication of the real bioavailability of contaminants in the different sites. An alternative approach is provided by environmental risk assessment (ERA) evaluation conducted at specific sites, in order to rank different areas within each site: areas not at risk, areas potentially at risk and areas at risk. ERA evaluation allows the prioritization of contaminated sites, pointing out the areas with the highest specific risk for aquatic ecosystems.

Methods: ERA evaluation was developed considering different lines of evidence (chemical analyses, toxicity test and ecological analyses), applying an approach called Sediment Quality Triad (SQT) integrated with specific assessments on bioaccumulation and secondary poisoning for persistent and bioavailable pollutants; the SQT approach is supported for the evaluation of sediment quality in water bodies by the US Environmental Protection Agency (USEPA), the National Oceanic and Atmospheric Administration (NOAA), and is used also in the European Union (ECHA, 2013, European Commission 2010). The SQT approach mainly starts defining the Conceptual Site model (CSM) with relevant exposure routes and the receptors (Fig. 1). The CSM may also include some human receptors, potentially exposed to pollutants, for example through dietary consumption of fish.

The SQT procedure followed a three step Tiered approach starting from the overcoming of water, sediment and biota quality standards (Tier 1). Subsequently, a comparison was carried out between pollutant concentrations in different matrices (sediments, water, macroinvertebrates, fishes and birds) in the considered site and the toxicological chronic effects with a sensitivity specific evaluation for the considered pollutants (Tier 2); at the end (Tier 3), results allowed to define a risk management approach that consists of the definition of three different risk thresholds: a *screening threshold*, that indicates no risk, an *attention risk threshold* and a

probable risk threshold defined for different matrices (water, sediment, organisms). Based on this information, a site-specific management risk approach may be adopted.

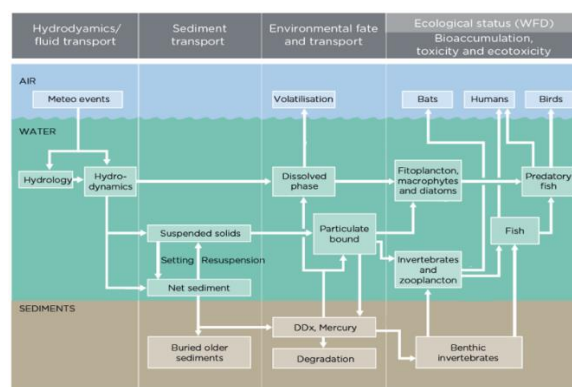


Fig. 1: Example of the conceptual site model

Results and discussion: The SQT model was applied to a large river-lake ecosystem in Northern Italy, industrially contaminated by DDTs and Hg and officially defined as a contaminated Site of National Interest (SIN). The Italian Ministry of Environment established in January 1994 a Technical Board to define the application of SQT approach to the case study, including experts of environmental authorities and public health agencies (ARPA Piemonte, ISS, Ispra), public research institutes (CNR-IRSA) and the private involved companies (Ramboll Environ and Syndial). The results of the SQT evaluation allowed to define site-specific *attention risk* and *probable risk thresholds* for all the considered pollutants (HCB, DDT and Hg) in different environmental matrices (sediment, water and biota). The present approach overcomes the simple evaluation based on chemical analyses and is protective for biota at all trophic levels. Results showed the exceedance of the *attention thresholds* for sediment (for DDx and mercury) and benthic invertebrates (only for DDx) in the lake and in the river and in some cases the exceedance of the *probable threshold* for Hg in the lake. Based on these results, it was suggested for the future to carry out a monitoring plan that takes into account these environmental matrices and possibly other lines of evidence supporting the specific environmental risk assessment. Exceedance of the *attention value* may in fact cause a low / moderate adverse effects on specific components of the ecosystem under investigation.