Multiple lines of evidence approach to assess the quality of sediments in canals of the Rhône valley in Switzerland

Rébecca Beauvais[1], Régis Vivien[1], Sebastian Höss[2], Sergio Santiago[3], Walter Traunspurger[4], Benoît J.D. Ferrari[1], Carmen Casado-Martinez[1]

[1]Swiss Centre for Applied Ecotoxicology, EPFL Station 2, 1015 Lausanne, Switzerland
[2]Ecossa, Giselastr. 6, 82319 Starnberg, Germany
[3]Soluval Santiago, Edouard-Dubied 2, 2108 Couvet, Switzerland
[4]Department of Animal Ecology, Bielefeld University, Konsequenz 45, 33615 Bielefeld, Germany

Phone: +41-(0)-21693-0896
E-mail: rebecca.beauvais@centreecotox.ch

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Introduction: A robust assessment of the toxic risk of contaminants in sediments requires information on their chemical, ecotoxicological and ecological qualities. In this context, we collected fine sediment samples from ten sites in 3 artificial channels (I, BN and STO) impacted by urban, industrial and agricultural activities to assess their quality, using a triad approach.

Methods: The triad we applied included (i) chemical analyses (metals, PCBs, and PAHs), (ii) ecotoxicological assessment using laboratory tests on the nematode *Caenorhabditis elegans* (reproduction and growth) and the ostracod *Heterocypris incongruens* (mortality and growth), and (iii) a study of nematode and oligochaete community composition using the NemaSPEAR[%] and IOBS indices, respectively. To assess the risk based on chemical analyses, we used the method and quality criteria developed and recently published by the Ecotox Centre [1]. For the bioassays, we used previously published toxicity thresholds: 50% of reproduction inhibition and 25% of growth inhibition for the nematode [2] and 20% mortality and 35% of growth inhibition for the ostracod [3]. If none or one of the endpoints exceeded the toxicity thresholds, we classified the sediment as good (green) or moderate (orange), respectively, whereas if all the effects exceeded the toxicity thresholds, the sediment was bad (red). We used hierarchical clustering to compare the different sites in an integrative way.

Results: None of the samples resulted in a significant reduction in ostracod survival, while seven samples induced a significant inhibition of the growth of this organism. In contrast, for all sites, we observed no significant effect on *C. elegans* reproduction and growth. At the community level, the diversity of nematode taxa was rather low in all samples and the NemaSPEAR[%]genus index indicated a moderate to poor biological quality of the sediments at all sites. In addition, at each site, the diversity of oligochaete taxa was very low and the IOBS indicated poor to bad quality. Calculated risk quotients (RQ) for Ni, Zn, and Cu indicated potential toxic effects (RQ > 1) in all samples. We measured lower concentrations of PAHs and PCBs in samples that exhibited toxicity to *H. incongruens* than in samples that did not exhibit toxicity to this species. The PCB concentrations measured however showed a strong risk for benthic organisms in 6 sites.

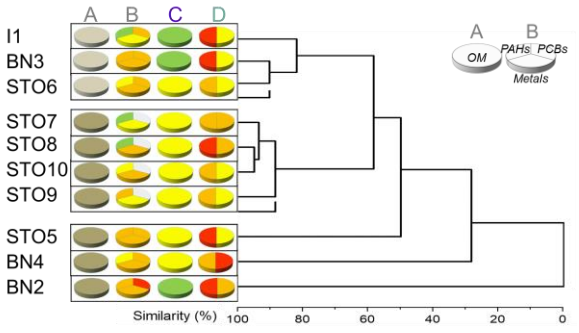

Fig. 1: *Hierarchical clustering of the studied sites (Euclidean distance). (A) OM, (B) worst RQ for metals, sum RQ PAHs and worst RQ for PCBs, (C) biotests, (D) biological indices scores.*

Discussion: Many other pollutants that were not measured in this study, such as pesticides or PFAS for example, or the effects of mixtures of contaminants, could be involved in the observed toxicity. This work represents a first study in Switzerland, mandated by a canton, on the use of a wide range of complementary tools for a thorough assessment of the quality of river sediments. This case study showed the strength of using a triad approach in contaminated sediment assessment. There has been however no decision made yet on the future of those highly contaminated canals in a recreative region.

References: [1] Casado-Martinez et al. (2022). *Ecotox Centre Report*; [2] Höss, S., et al., 2010. Environmental Pollution 158(9); [3] Casado-Martinez, M.C. et al., 2016. Chemosphere 151: p. 220-4.