A sensitive integrated approach to assess sediment quality: application to a low contamination case study (Minho River)

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Introduction: The sediment quality assessment is crucial for the management of dredged material and for a better understanding of aquatic ecosystems functioning. Adverse effects have been evaluated mainly in contaminated sediments, using chemical data, responses of sensitive organisms, or both approaches [1]. However, sensitivity of indicators to low contaminated sites has been poorly explored.
This work reports the responses of freshwater species to the quality of sediments and sediment elutriates of samples collected along the Minho River and its tributaries.

Methods: Eighteen surface sediment samples were collected in May 2012 along the Minho River and its tributaries.
The elements Al, As, Cd, Co, Cr, Cu, Hg, Ni, Pb, and Zn were determined in dried sediments according to [2]. Twenty-two PCB congeners were determined following [3].

The following bioassays were carried out for each sediment sample and for the respective elutriate:

Sediment samples: 15-min bioluminescence inhibition with the bacteria *Vibrio fisheri* (decomposer) and 72-h reproduction with the epibenthonic crustacean *Heterosypris incongruens* (primary consumer);

Elutriates: 72-h growth inhibition with the green microalgae *Pseudokirchneriella subcapitata* (primary producer) and 96-h embryonic development with the fish *Danio rerio* (secondary consumer).

Results: Concentrations (µg g^{-1}) of As (3.4-24), Cd (0.020-0.37), Co (1.3-22), Cr (18-51), Cu (1.3-50), Hg (<0.05), Ni (2.8-41), Pb (12-32), Zn (11-150) and PCBs (<0.007) in sediments were low, without evidence of contamination hotspots. Furthermore, good linear relations were obtained with Al (4.2-12%), indicating that contaminant concentrations are related with sediment nature.
Sediment samples exerted no significant effects in the production of bioluminescence of *V. fisheri* but induced significant inhibition in the growth rate of *H. incongruens* exposed to the sediments from the Minho River with the exception of two sites, TM01 and TM03 (Fig. 1). Though elutriates also induced significant effects on the growth of *P. subcapitata* and in body length and heart beat of *D. rerio*, the intensity of the observed effects were lower than those observed in the assays with sediments.

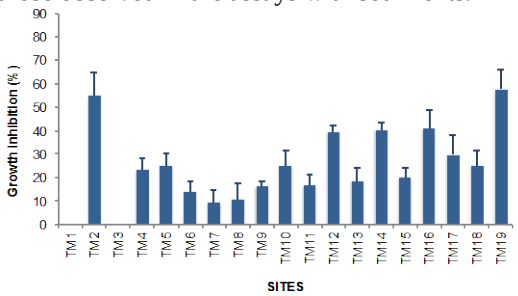

Fig. 1: Growth inhibition (%), relatively to the control, of *Heterocypris incongruens* after being exposed, for 72-h, to sediments collected at the Minho River and tributaries.

Discussion: The sub-lethal adverse effects observed in the model species exposed to the Minho sediments suggest that despite their low chemical contamination, organisms may still respond to the presence of potential pollutants. It is unlikely that such broad interval of concentrations among sites can be attributed to natural variability. The ecotoxicological assays may have been sensitive to low levels of trace elements and PCBs existing in the sediments or to other potential contaminants. Synergetic relations between pollutants should also be considered. This work emphasises the relevance of using integrated ecotoxicological indicators as a complement to chemical and biological indicators in order to classify the ecological status of water bodies within the WFD.

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