

Molecular biomarkers and integrated Environmental Risk Assessment in estuarine ecosystems

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Estuarine sediments can be a reservoir of contaminants from several sources that, under certain circumstances, may be returned available to the biota. The assessment of the toxicological potential of sediment-bound xenobiotics has many constraints, especially related to the complex geochemical nature of the sediment matrix and to the potential existence of multiple classes of contaminants. The Sado Estuary will be presented as a case study. In order to contribute to a weight-of-evidence approach to assess the ecological risk of estuarine sediments, an integrated methodology was implemented, based in bioassays, both in situ and in the laboratory and/or in monitoring natural populations. In any case, ecological relevant species were used, namely the fish *Solea senegalensis*, the mollusks *Ruditapes deussatus* and *Sepia officinalis* and the crustacean *Gammarus locusta* and batteries of complementary biomarks, from biochemical and genetical to histopathological and individual responses were analyzed. The integration of biological responses with sediment parameters revealed that the biomarkers that in essence reflect some measure of lesion allow a much more consistent distinction between contaminated and uncontaminated sediments. In addition, molecular biomarkers permitted inferring patterns of metabolic change and assess how these changes contribute to the impairment of the response machinery to chemical insult, from apoptosis to anti-oxidative defense, among others. It was demonstrated that even moderately contaminated sediments can cause adverse effects to organisms and trigger responses that reflect the intricate machinery beneath exposure to complex mixtures of xenobiotics, either for monitoring or for mechanistic studies, especially when the existence of multiple contaminants tends to dilute biomarker specificity. Finally a special attention to frequent confounding factors, such as parasites and species physiological condition, which should be accounted for in environmental monitoring research.