# Assessment of sediment contamination in an impacted estuary: differential effects and adaptations of sentinel organisms and implications for biomonitoring

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**Introduction:** Estuarine pollution is reflected in the concentration of toxicants in sediments, depending on their geochemical properties, since sediments trap substances from the water column, either dissolved or bound to suspended matter [1]. However, determining risk of sediment contaminants to biota has many constraints. For such reason, integrative approaches are keystone. Taking the Sado estuary (SW Portugal) as a case study, contrasted to a reference estuary (the Mira) within the same geographical location, the present study aimed at integrating sediment contamination with the effects and responses to pollutants in distinct benthic organisms with commercial and ecological value.

**Methods:** Sediment samples were collected from different sites of each estuary and surveyed for geochemical parameters and contaminants (metals, PAHs and organochlorines). The Sediment Quality Guideline Quotient [2] was estimated as measure of risk, following available Sediment Quality Guidelines [3]. Clam (*Ruditapes decussatus*); flatfish (*Solea senegalensis*) and cuttlefish (*Sepia officinalis*), were collected from the Sado estuary and reference locations and analyzed for effects and responses at different levels of biological organization.

**Results and Discussion:** Results show that the Sado Estuary is divided into northern (urban/industrial) and southern (riverine/rural) areas (Fig. 1). Highest contamination risk was found in sediments collected from the industrial area (sample $SN_3$), especially by metals and PAHs [4]. One site in the Mira estuary, in an aquaculture main inlet channel (sample $M_1$), was also contaminated by metals and caused deleterious effects to clams there collected. The least contaminated samples were obtained from sandy shellfish beds at the northern Sado ($SN_1$ and $SN_2$) and at Mira ($M_2$). In accordance, different effects and responses to stressors were observed between the three species, part owing to distinct behaviours (foraging versus burrowing), part caused by differential abilities to cope with toxicants. Oxidative damage and histopathological alterations were overall consistent indicators of contamination, yielding a distinction between industrial and rural areas of the Sado Estuary, in fish and cuttlefish.

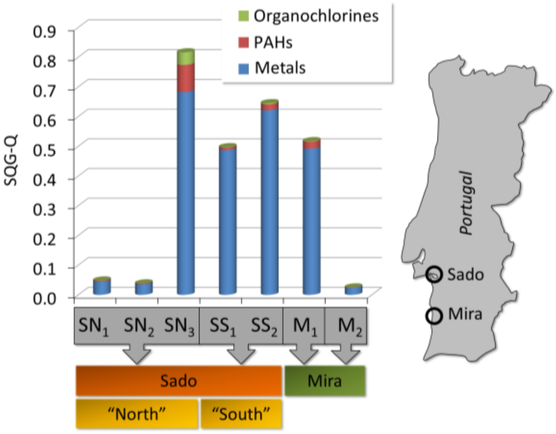


**Fig. 1:** Sediment Quality Guideline Quotients (SQG–Qs) obtained for sediments from the Sado (S) and Mira (M) estuaries, impacted and reference respectively. SN, Sado North (industrial); SS, Sado south (Rural). Samples $SN_3$, $SS_1$, $SS_2$ and $M_1$ were classified as "moderately impacted".

While the cuttlefish deployed adequate responses to contamination, fish collected from the industrial area revealed metabolic impairment. The clams' responses were correlated to local sediment contamination but failed to provide a results consistent the overall impact endured by a wider biogeographical unit, unlike its foraging molluscan counterpart and fish. The study shows that sediment contamination is primarily dependent on hydrodynamics and other factors affecting particle deposition and highlights the importance of a careful survey of representative sampling sites and adequate sentinel organisms from intricate ecosystems.

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