The Impact of Contaminated Sediment in the Estuaries of Elbe and Odra

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Introduction: Estuaries rank among the most heavily impacted aquatic systems on Earth. Because of their exceptional resources and economic value, these coastal systems are sites of intense human activity and are subject to high levels of disturbance from multiple stressors [1]. Industrial and mining activities in the Elbe catchment area have a very long history, and caused contamination of sediments for centuries [2]. While the Elbe has been intensively studied in terms of historic chemical contamination, relatively little is known about the Odra. One objective within the Blue Estuaries project (BluEs) is to estimate the ecological stress from sediment-bound contaminants in the Elbe and Odra estuaries. To our knowledge, this is one of the few studies that has addressed the chemical contamination and the ecotoxicological assessment of sediments in the Odra delta.

Methods: Surface sediments were sampled 12 times in the Elbe Estuary and 6 times in the Odra delta at several sites over the course of two years. The sampling sites were chosen along a presumed contamination gradient in both estuaries. To detect the ecotoxicological effects of the sediment samples, a biotest battery was applied comprising assays in direct sediment contact and with elutriates. The meiobenthos composition was determined via the Nema-Spear-Index at some freshwater sites. Sediment samples were chemically analysed for metals and organic historic contaminants.

Results: The results of the chemical analyses confirmed higher concentrations of historic contaminants in the Elbe estuary than in the Odra for all contaminants except PAHs which were higher in the Szczecin Lagoon. In both estuaries, concentrations of historical contaminants decreased downstream. The bioassays responded differently to the sediment samples, probably reflecting different contamination patterns. In the Elbe estuary, the algae growth inhibition test showed a moderate inhibition at the upstream Elbe stations, which are more strongly contaminated. In the Odra estuary, the algae growth inhibition test did not show any effects. But the bacteria in the direct sediment contact test were strongly inhibited in some samples from the Szczecin Lagoon. The other tests did not show any effects.

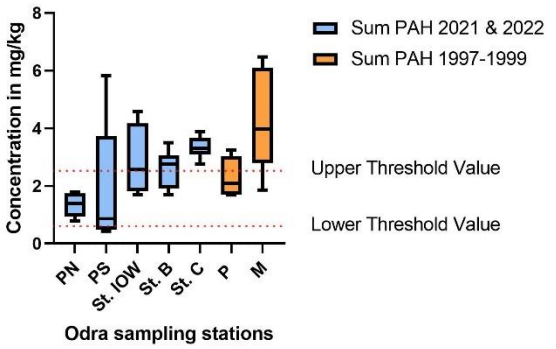

***Figure 1**: PAHs concentrations in the Odra estuary. A total of 16 PAHs were measured. The stations PN & PS are located in Peenestrom. St. IOW to M are located in the Szczecin Lagoon. Station P is close to St. IOW, B and C. Station M is located further upstream.*

Discussion: While contamination with historic contaminants in the tidal Elbe Estuary is continuously decreasing, PAH concentrations in 2021 & 2022 have remained similar to data from 1997-1999 in the Szczecin Lagoon [3]. Based on the Ant/(Ant+Phe) ratio, the PAH contamination in the Odra estuary can be attributed to pyrogenic sources. The decreasing trend in the concentration is reflected in the bacterial direct contact test. The two eluate tests (with microalgae und with luminescent bacteria (microtox)) did not show any effects, indicating either that contaminants may not be remobilized from the sediment during elutriation, or a lower sensitivity of the test organisms to the substances. The sensitivity of the test organisms to single substances to determine the respective toxic units, especially to PAHs, is currently looked into and will be elaborated upon during the presentation.

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References: [1] Kennish (2002) Environmental Conservation 29:78-107; [2] Netzband et al. (2002) JSS – J Soils & Sediments 2 (3) 112 – 116. [3] Müller et al. (2001) International Odra Project Subproject 7.