Ecotoxicological Effects of Sediment Pollution in the Estuaries of Elbe and Odra

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Introduction

Estuaries are among the most productive ecosystems in the world and are critical to the life history and development of many aquatic species. Despite their ecological importance these systems are intensely used and impacted by human activities [1].

Industrial and mining activities in the Elbe catchment area 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.

Objective: To identify and compare the impact of chemical stressors between the Elbe and the Odra estuaries

Methods

Impact of chemical stressors

- Application of a test battery of 5 standardized bioassays

Data shown here:

- Algae growth inhibition test (AGI) with elutriates acc. to ISO 8692
- Bacterial contact test (BCT) with sediments acc. to DIN 38412-48
- Chemical analysis

Sampling: Odra Estuary
Surface sediment
Sampling by boat with grab sampler

Sampling: Elbe Estuary
Surface sediment and
Freshly deposited material
Sampling from shore
Settled suspended material

1. Hypothesis: The concentrations of historical contaminants in the Elbe estuary are higher than in the Odra estuary

2. Hypothesis: The high historical contaminant load leads to higher sediment ecotoxicity in the Elbe estuary compared to the Odra estuary

Results

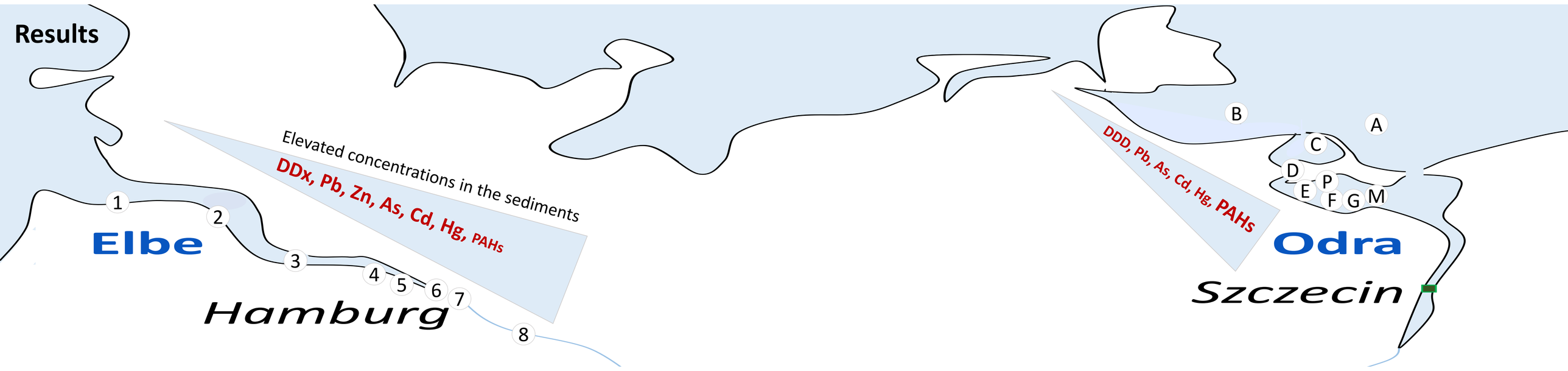

Fig. 1: Sampling stations in the Elbe and Odra estuary in 2021 & 2022. Chemical analyses of sediment samples confirmed higher concentrations of historical contaminants in the Elbe estuary than in the Odra for all contaminants except **PAHs** which were higher in the Szczecin Lagoon.

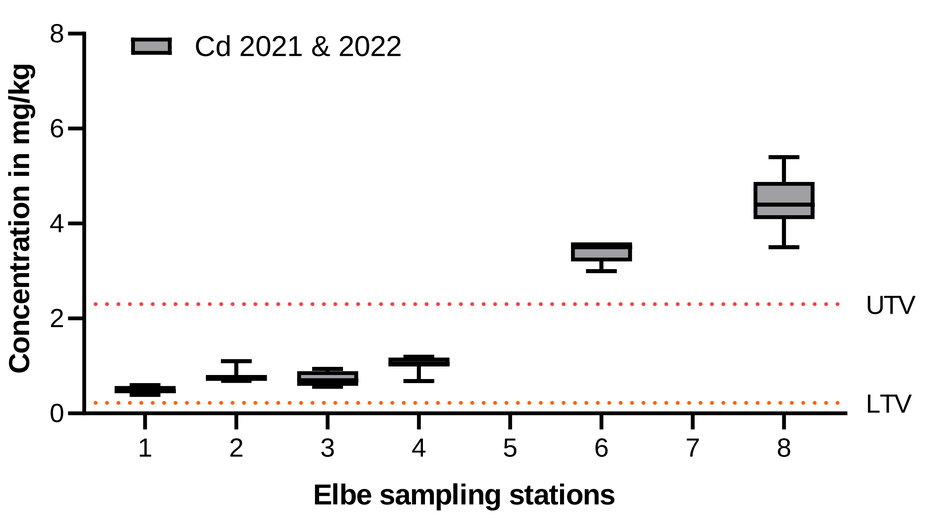

Fig. 2: Trend of heavy metal concentrations in Elbe sediments. Exemplary shown in cadmium. UTV & LTV (Upper/Lower Threshold Value) [3] .

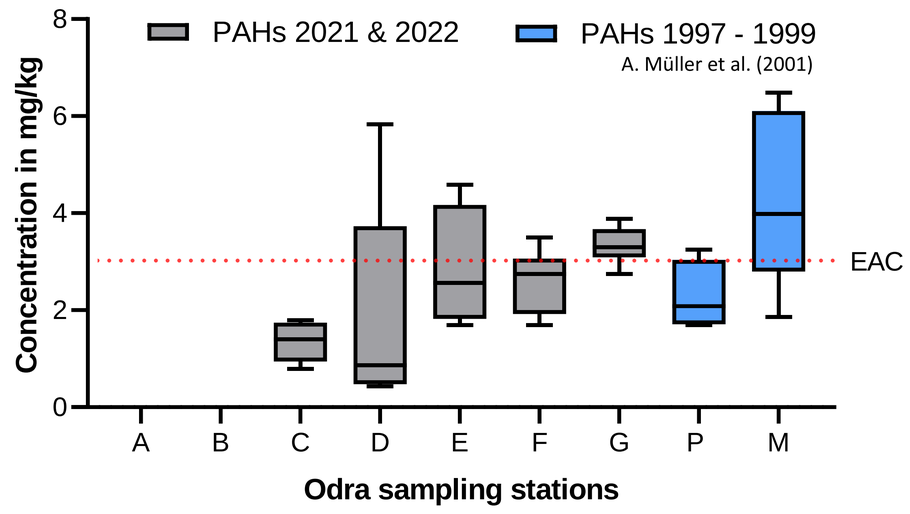

Fig. 3: Trend of PAHs concentrations in Odra sediments. A total of 16 PAHs were measured. EAC (Environmental Assessment Criteria) [5].

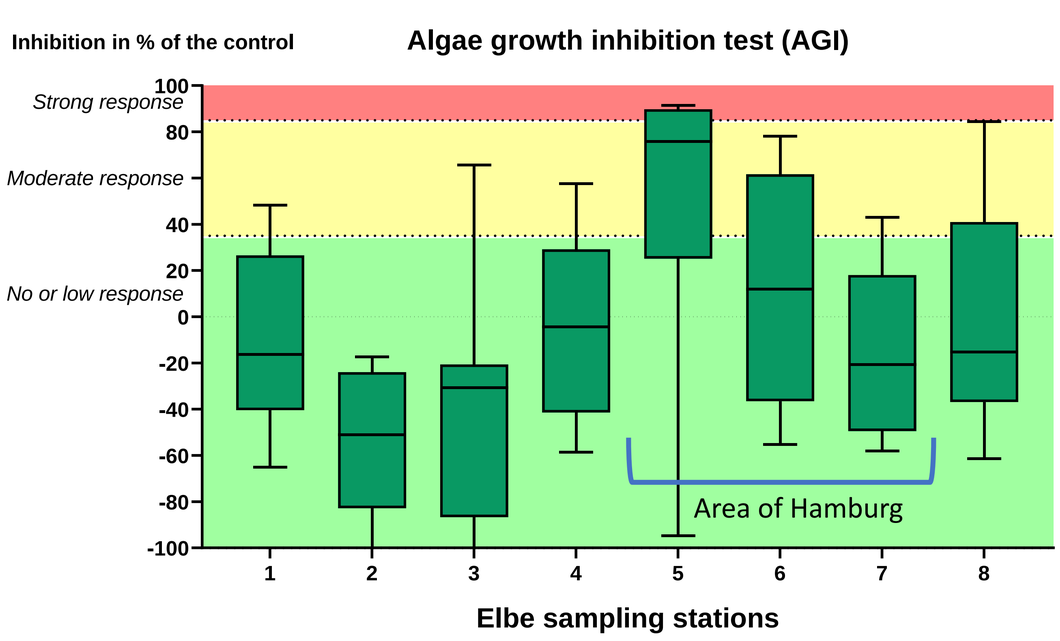

Fig. 4: Ecotoxicological effects of Elbe sediments in AGI in 2021 & 2022. Toxicity categories acc. to Ahlf & Heise, 2005 [6].

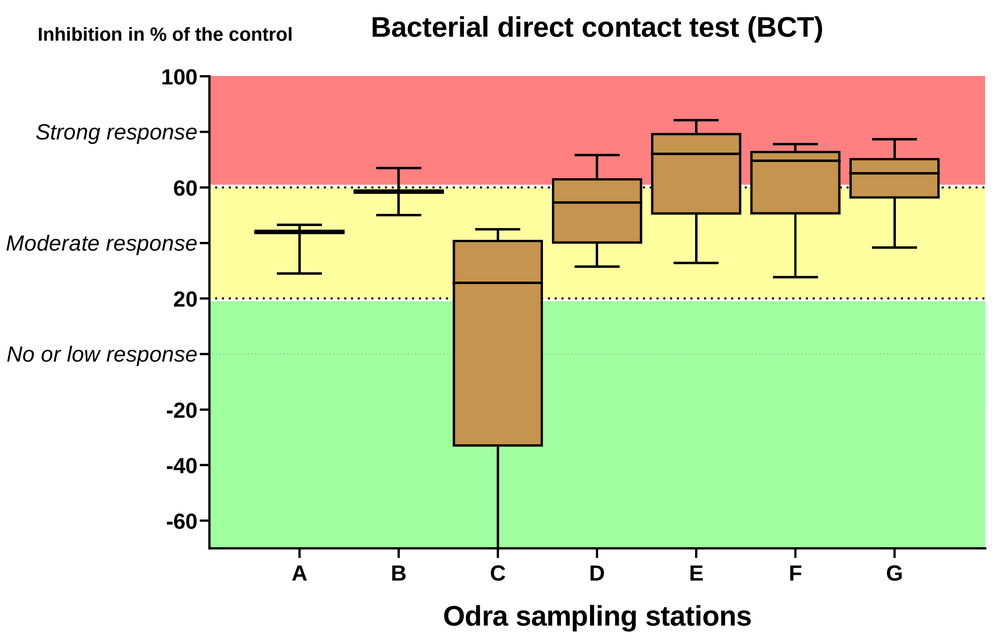

Fig. 5: Ecotoxicological effects of Odra sediments in BCT in 2021 & 2022. Toxicity categories acc. to Ahlf & Heise, 2005 [6].

Discussion

- The elevated algae inhibition at the most upstream Elbe stations (up to strong response) reflects the chemical gradient within the estuary.
- An increase of algae toxicity over the area of Hamburg (station 7 to 5) could be caused by heavy metal concentrations due to e.g. urban and industrial emissions or resuspension of sediments from dredging.
- Decrease of algae inhibition downstream of Hamburg is a consequence of dilution with marine sediments which is also reflected by the chemical gradient.
- PAH concentrations in the Odra estuary are still comparable to 1997-1999 data and can be attributed to pyrogenic sources based on Ant/(Ant+Phe) ratios[7] (data not shown).
- To what extent PAHs contribute to the toxicity in the BCT will be studied in the future by determining the toxic units for the test species.

References

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