Comparing Conventional and Integrative Concepts for Sediment Classification Systems

Sonja Faetsch[1], Sebastian Höss[2], Susanne Heise[1]

[1]Hamburg University of Applied Sciences (HAW), Department of Applied Aquatic Toxicology, Hamburg, Germany, [2]Ecological Sediment and Soil Assessment (ECOSSA), Starnberg, Germany; contact: sonja.faetsch@haw-hamburg.de

Background

Environmental regulations and guidelines in Europe for assessing the quality of aquatic sediments and dredged material predominantly demand chemical data. Decision making mostly still does not integrate the information from different lines of evidence (LOEs) (1, 2). Ecotoxicological data requirements are often limited, with the final classification not preserving the information of all biotests applied (3). Improved, holistic characterization of sediments and dredged material is needed, to enable a better risk assessment that conserves the ecological quality and is practical and economically feasible at the same time.

Aim

Work package 3 “Sediment Assessment” of the Interreg Project ‚Sullied Sediments‘ offers the chance to collect a wide range of data on sediment samples from three catchment areas in the North Sea region. The sites are all facing individual but severe management problems related to polluted sediments. In a sediment quality triad approach (4) the quality of the sediments will be assessed with data from different LOEs (Fig. 2). The study will address the many criticisms of the implementation of ecotoxicological data in sediment quality assessments in environmental decision making.

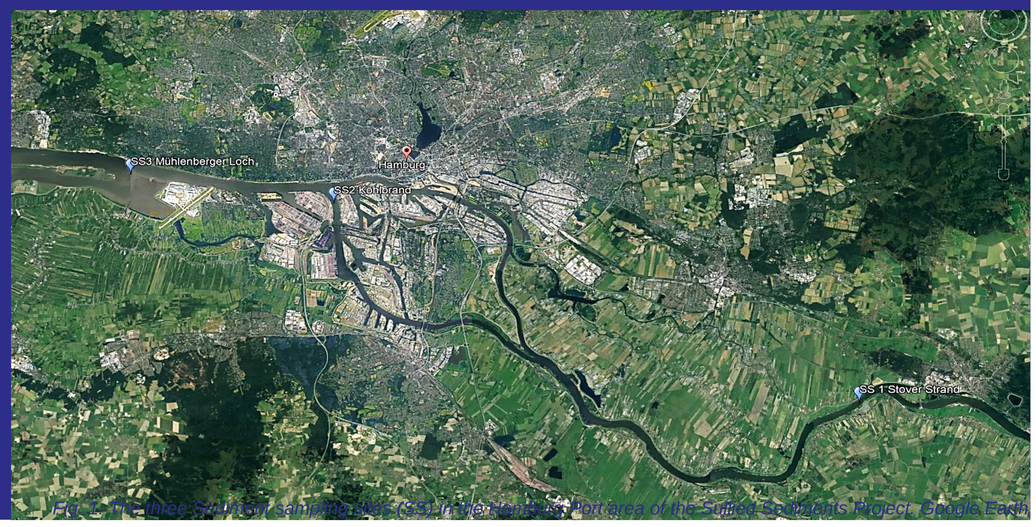

Fig. 2: The three Sediment sampling sites (SS) in the Hamburg Port area of the Sullied Sediments Project. Google Earth

Addressing the Criticism of Environmental Decision Makers

point of criticism	approach
lack of reproducibility and alleged unreliability of biotest systems	distinguish between actual reproducibility and variances of test results due to other factors (e.g. inter-species differences in test responses)
inter-laboratory differences	laboratory-specific evaluation of test responses
mismatch between chemical data and (contradictory) biological responses	communication of the triad principle to stakeholders (e.g. organisms react differently to chemicals)

Reconsidering the Criteria for Biotest Batteries

Efficiency Which combination of biotests is the most practical for the assessment? → time, effort and costs

Flexibility Which combinations of biotests deliver the same results for the sediment assessment? → laboratories can apply their individual biotest batteries

Non-Redundancy Which biotests in the test battery do not provide an added value? → skip tests that do not improve assessment

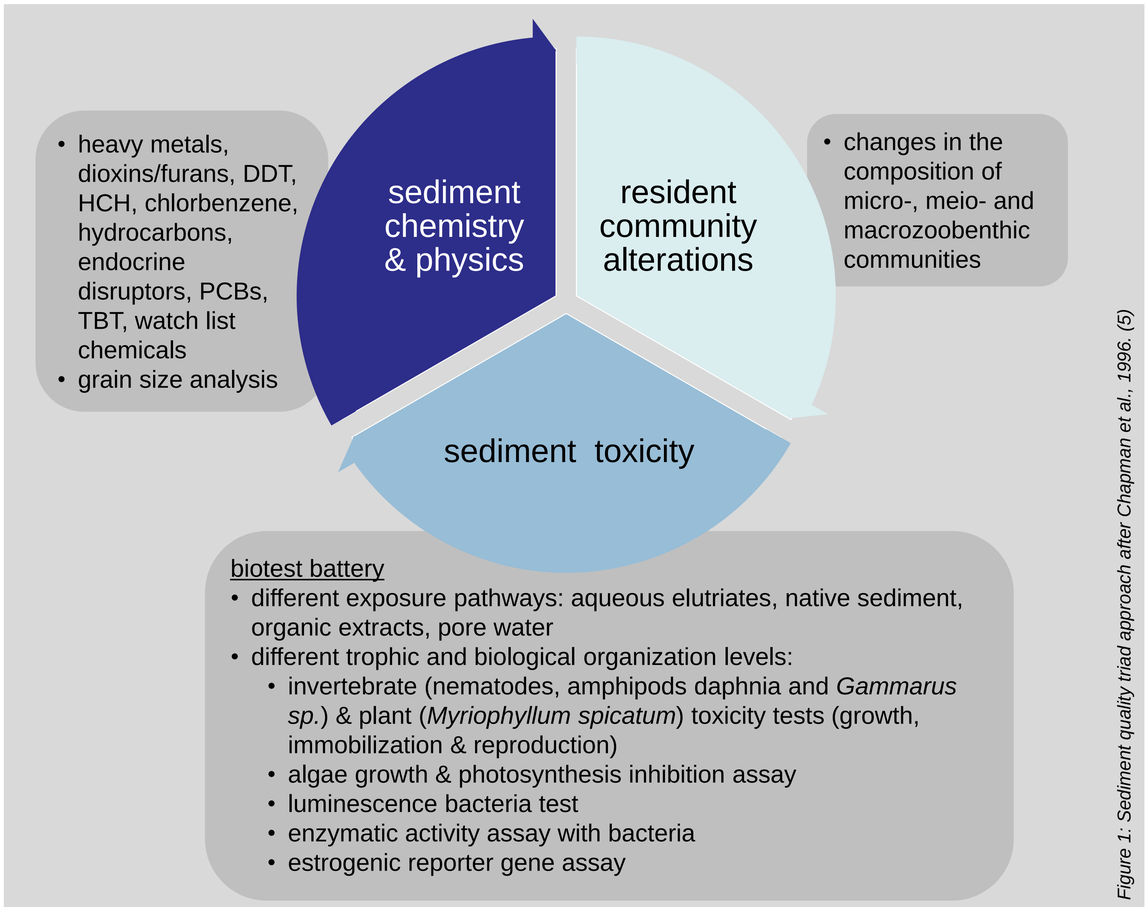

Figure 1: Sediment quality triad approach after Chapman et al., 1996. (5)

Developing an Integrative Expert System

- development of a science-based, integrative sediment assessment and classification system consisting of the following steps:

1. Data Collection
- LOE approach: Investigate sediment quality with data from different LOEs
- determine suitable biotest battery

2. Effect Classes
- establish effect classes for the individual test results
- consider reaction spans and sensitivities to evaluate the results appropriately

3. Integrative Assessment
- develop a biostatistical tool to integrate the data from all LOEs
- interpret the relations between variables

4. Sediment Classi-fication
- assign toxicity classes to the sediment samples
- de-fuzzification of data for final assessment
- aggregate all information into an overall information

Conclusion & Outlook:

- establish an **optimal sediment quality triad** → improved, purposeful combination of biotests (step 1)
- identify suitable methods for an improved data assessment in steps 2- 4

This will result in the development of a **science-based** and **integrative** sediment assessment and sediment classification system that

- is **biological effects-based** of sediments & **site-independent**
- **incorporates uncertainties:** reproducibility, precision, biological variability, organism and endpoint dependent test-specific sensitivities, ecological relevance of biotest systems and how to weigh them → **weight-of-evidence approach**
- integrates data from different lines of evidences → interpreting the associations established by the multivariate analyses with **expert knowledge** to avoid establishing false “cause and effect” relations between variables (5).

References:

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Interreg North Sea Region Sullied Sediments European Regional Development Fund
EUROPEAN UNION
Sullied Sediments Project
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