The Use of Meiofauna in Freshwater Sediment Assessments: Community Responses to Contamination

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Introduction: The pollution of sediments with chemical contaminants is a major environmental concern. Soft (fine and sandy) sediments provide a habitat for a very diverse fauna and considerably contribute to important ecosystem services of aquatic ecosystems. Meiofaunal organisms usually prevail in these ecosystems and their assessment can aid in identifying the causes of environmental stress and the implementation of measures to improve the health of the respective ecosystems. Among the meiofauna, nematodes are by far the most abundant and species-rich taxon [1]. In the present study, freshwater microcosms were used to investigate the effects of eight different metals and polycyclic aromatic hydrocarbons (PAHs), applied as single compounds and in mixtures, on natural meiofaunal assemblages with special emphasize on nematodes. As relevant ecological endpoints, structural, functional and diversity parameters of the respective communities were assessed and compared in terms of their suitability for sediment quality assessment. Accompanying to ecological assessment, sediments and overlying waters were characterized chemically and ecotoxicologically to estimate the bioavailability and direct toxicity of the tested compounds.

Methods: Natural, pristine sediment was used for the microcosm experiments and spiked with the chemical compounds in two concentrations. The impacts of the tested contaminants on the meiobenthic communities were monitored over 180 days, with samples taken at three occasions. Meiofaunal communities were characterized by abundance, biomass and secondary production of the major taxa (e.g. nematodes, rotifers, oligochaetes), whereas nematodes were identified to species level. Multivariate statistics (Principle Response Curves; PRCs) on taxa, species and feeding type composition were performed, and ecotoxicologically relevant community indices (NemaSPEAR[%]; [2]) were calculated. Ecotoxicological tests with sediments and overlying waters were performed with *Caenorhabditis elegans* (ISO 10872).

Results: Structural parameters of meiofaunal communities were found to be more valuable indicators than functional measurements, with more pronounced effects observed on the taxon level than on total meiofauna. Among the meiofaunal taxa considered in this study, nematodes were of particular utility as early indicators of chemical stress in freshwater soft sediments. Within nematode communities, chemically induced alterations in the species composition were found to be most valuable in indicating chemical stress in sediments. *C. elegans* detected negative effects of the various chemical compounds more sensitively than overall community parameters.

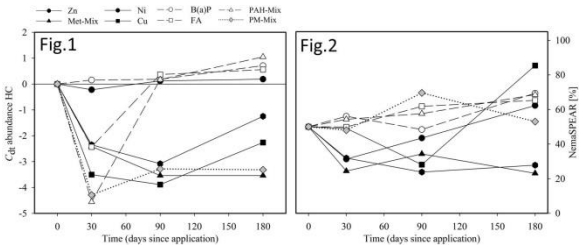

Figure 1: PRCs (Cdt) resulting from the comparison of the abundances of meiofaunal taxa in treated microcosms compared to the respective controls

Fig. 2: NemaSPEAR[%]-index calculated for nematode communities

Discussion: In summary, this study demonstrated the general suitability of meiofaunal organisms to assess the chemical status of soft sediments. Generally, the investigated parameters were more sensitive on a taxon-level than on the level of total meiofauna, and structural parameters were more valuable than functional measurements as indicators of contamination. Among the meiofauna taxa investigated in this study, nematodes were particularly vulnerable to chemical stress. This study indicates that, along with other lines of evidence (e.g. standardized toxicity tests), the analyses of in situ nematode communities can contribute to a reliable, weight-of-evidence-based retrospective risk assessment for fine, cohesive sediments, e.g. in the context of the EU WFD. This is also confirmed by recent field studies, using meiofauna as biomonitoring tools [2, 3]. Additionally, the present results underline the value of standardized toxicity tests with *C. elegans* in the prospective risk assessment of chemicals, being protective for meiofaunal communities in freshwater sediments.

References: [1] Heip et al. (1990) J Sea Res 26:333–342 ; [2] Höss et al. (2017) Ecol Indic 73:52-60 ; [3] Sonne et al. (in prep.)