Nematode species at risk - A metric to assess pollution in soft sediment of freshwaters

Sebastian Höss[1], Walter Traunspurger[2], Peter Carsten von der Ohe[3], Marvin Brinke[2], Evelyn Claus[4], Peter Heininger[4]

[1]Ecossa, Giselastr. 6, 82319 Starnberg, Germany
Phone: +49-(0)-8151-5509172
[2]University of Bielefeld, Morgenbreede 45, 33615 Bielefeld, Germany
E-mail: hoess@ecossa.de
[3]Helmholtz Centre for Environmental Research (UFZ), Permoserstr. 15, 04318 Leipzig, Germany
[4] Federal Institute of Hydrology (BfG), Am Mainzer Tor 1, 56068 Koblenz, Germany

Introduction: Pollution of aquatic ecosystems with anthropogenic chemicals poses a serious risk to the inhabiting biota. Direct and indirect effects of toxic chemicals can cause alterations in the structure of communities of all trophic levels and, thus, disturb the functioning of the whole ecosystem. Taking care of this risk, the EU water framework directive (EU WFD) aims at a good chemical and ecological status of European water bodies until the year of 2015. However, to assess the impact of anthropogenic pollution on ecological status, suitable tools are required that indicate pollution induced changes in aquatic communities. For macro-invertebrates, the SPEAR (SPEcies At Risk)-index has shown to be a promising tool for distinguishing effects of anthropogenic pollution from effects of other sources of stress [1]. However, in soft sediments that are particularly of interest due to their ability to accumulate chemicals, macrobenthic communities often show a low diversity, delimiting their suitability for bio-indication. In soft sediments, meiobenthic invertebrates, such as nematodes, are more abundant and species rich and play an important role for the benthic food web.

Methods: Thus, in this study, an index for nematodes, based on the SPEAR concept, was developed to assess the impact of chemicals on benthic communities in soft sediments. For this purpose, a large data set of nematode assemblages from unpolluted and polluted German river and lake sediments was analyzed using multivariate methods (canonical correspondence analysis; CCA), in order to correlate the occurrence of nematode species with the toxic potential of the sediment associated metals and organic pollutants (expressed as toxic units). On the basis of this analysis, nematodes were then classified in sensitive and tolerant species towards toxic stress of metals and organic pollution. The NemaSPEAR[%] of a certain sample was determined by calculating the percentage of species at risk.

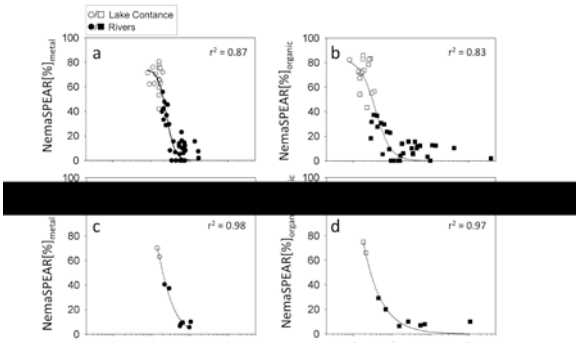

Fig. 1: Correlations of NemaSPEAR[%]$_{metal}$ (a, c) and NemaSPEAR[%]$_{organic}$ (b, d) with the respective toxic units (TU) of independent samples (a, b), or the mean values for the sites (c, d).

Results: The nematode community structure was influenced by the toxic potential and the grain size distribution of the sediment samples. However, the CCA showed, that the influence of the factors could clearly be distinguished, so that nematode species could be classified according to their sensitivity towards toxic stress. From the total number of 279 identified species, 67 and 60 species were classified as species at risk for metals and organic pollutants, respectively.

Discussion: The results of this study showed that the NemaSPEAR[%] is a suitable index to assess the toxic stress for benthic communities in soft sediments. Applying the index to an independent data set of field nematode communities that was not used for classifying the species, very good correlations could be found with the toxic potential of the sediments (Fig. 1). Also for nematode communities from experimental microcosm studies with cadmium and ivermectin [2, 3] the Nema-SPEAR$_{metal/organic}$ was able to reflect the chemical induced changes in the nematode communities.

References: [1] Liess and Von der Ohe et al. (2005) *Environ. Toxicol. Chem.* **5**:50-61; [2] Brinke et al. (2010) *Environ. Toxicol. Chem.* **30**, 427-438; [3] Brinke et al. (2010) *Aquat. Toxicol.* **99**, 126-137.