Development of a quality triad assessment method for brackish sediments in Flanders

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Introduction: In sediment risk assessment, analysis of the pollutant concentrations is essential in determining the degree and nature of sediment contamination. However, chemical analyses provide no evidence of biological effects in situ as, for example, mixture effects are not accounted for. The sediment quality triad method, which was developed by Long and Chapman in de mid-1980s [1] incorporates measures of various chemical parameters, toxicological effects and benthic community structure in view of conducting an integrated assessment of sediment quality. In this study a quality triad assessment method was developed for the evaluation of brackish sediments in Flanders. In the course of this study 40 sediment samples were taken along the Scheldt estuary (Lower Scheldt (Flanders) and Western Scheldt (the Netherlands)) and other brackish aquatic systems in Flanders in 2015-2016, of which the chemical variables, ecotoxicological effects and benthic community structure were assessed.
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Methods: Based on a literature inventory of existing quality guidelines, sediment quality guidelines for micropollutants for Flemish brackish sediments were derived. Sediment mixture samples were taken from 40 locations along the Scheldt estuary (subtidal and intertidal) and other brackish aquatic systems in Flanders (e.g. canals, brackish polder streams, docks of the Port of Antwerp) in 2015 and 2016. A 28-day sediment contact bioassay with the polychaete worm *Hediste diversicolor* was performed on a selection of the samples, with growth and mortality being evaluated. A 10-day sediment contact bioassay with the amphipod *Corophium volutator* and a 24h pore water test with the rotifer *Brachionus plicatilis*, evaluating mortality, were carried out on all the samples. Micropollutant concentrations (metals and organic micropollutants) and sediment characteristics (particle size, organic content) of the sediment samples were analysed. For the biological component of the triad method, comprising an evaluation of the benthic invertebrate community, a separate evaluation method is proposed for brackish oligohaline non-estuarine aquatic systems, and for brackish sediments in the different ecotopes of the Scheldt estuary. For the latter the M-ABMI [2,3]. ('Multivariate AMBI', Bald et al., 2005; Muxika et al., 2007) and the Buckland Arithmetic Occurrence Intactness Index [4] are tested for their suitability as biological index in a triad method for the evaluation of Scheldt estuarine sediments.

Results: The preliminary selected sediment quality guidelines were applied to appoint the samples into 4 quality classes based on measured micropollutant concentrations (with class 1 representing very good quality). Based on the chemical component of the triad quality assessment 36%, 47%, 10% and 7% of the sampling locations was appointed respectively to class 4, 3, 2 and 1. For the sediment sample taken in 2015 observed mortalities varied between 0%-33% for *H. diversicolor*, 1%-22% for *Corophium volutator* and 10%-43% for *B. plicatilis*. Control tests with reference sediments showed mortalities lower than 10% for the 3 tests. For *H. diversicolor* an average growth rate of 5% day^{-1} was found.

Discussion: The 3 performed bioassays showed to be applicable for the ecotoxicological evaluation in the framework of a quality triad assessment method for brackish sediments in Flanders. Based on a literature inventory sediment quality guidelines and biological indices were selected for the chemical and biological evaluation. The applicability of the selected biological indices will be tested on extra core sediment samples that will be taken in 2017. These samples will be evaluated by integration of the 3 components of the quality triad assessment method.

References:

[1] Chapman, P.M. et al. (1997) *Marine Pollution Bulletin* **34**: 368-372; [2] Bald, J. et al. (2005) *Marine Pollution Bulletin* **50**: 1508-1522; [3] Muxika, I. et al. (2007) *Marine Pollution Bulletin* **55**: 16-29; [4] Buckland, S.T. et al. (2005) *Philosophical Transactions of the Royal Society B* **360**: 243-254.