Streamlining Sediment Bioaccumulation Bioassay Methods and Evaluation Approaches

Dredging Operations Environmental Research (DOER) Program

U.S. ARMY CORPS OF ENGINEERS BUILDING STRONG®

Problem

Bioaccumulation testing of dredged material targeted for disposal in freshwater aquatic systems use the freshwater test use the oligochaete *Lumbriculus variegatus* as test organism because this species is laboratory cultured and is known to poorly metabolize hydrophobic organic compounds. Other species of freshwater invertebrates are rarely used as they are only obtainable by field collection at limited localities and times of the year. While *L*. *variegatus* is available year-round, their small size and frail soft body poses challenges when initiating (i.e., obtaining sufficient biomass, sometimes in excess of 50 g per replicate) and terminating (i.e., formidable effort to separate from debris and course sediment particles) bioassays.

In addition to using improved and less costly biossay methods, projects would greatly benefit from a reduced list of contaminants of concern (COC) for the evaluation of bioaccumulation. Freshwater projects would benefit the most because of the challenges associated with obtaining large masses of the small-sized *L*. *variegatus*. Presently dredging evaluations frequently require the benthic bioaccumulation evaluation of contaminants that are considered of low relevance concerning potential impacts to benthivorous animals and their predators up the food chain, including humans, because ingested contaminants are effectively biotransformed (e.g., PAHs) or have low bioaccumulation potential and poor correlation with the bulk concentration in the dredged material (most metals). For metals, it is generally accepted that food chain transfer and biomagnification is a concern only for mercury.

Study Description

The small size and frail body of *L*. *variegatus* poses challenges when obtaining the target tissue mass requirement for analytical chemistry, sometimes in excess of 50 g per replicate. At exposure termination, sieving to separate organisms from fine sediment particles result in a mixture of worms and debris and sand particles. Currently the only known method to separate worms from debris and sand is to thinly spread the material retained on the sieve over many large trays and to laboriously pick animals up with a plastic pipette. Preliminary studies have shown that worms will move into a layer of pea gravel placed on top of debris layer from which they could be easily sorted. This project will evaluate alternate methods of separating *L*. *variegatus* from detritus. This project will also generate literature summary overview of on trophic transfer and biomagnification potential of metals, PAHs, and TBT and related compound toward justifying their exclusion from the list of COC for the bioaccumulation potential evaluation of dredged material.

Products

The initial results of the laboratory studies will be communicated initially through a technical note. Complete results and methodological recommendations will later be published as a peer-reviewed publication ("*Improved method for separating Lumbriculus variegatus from detritus and sand following exposure to whole sediment*"). The revised methods will be incorporated into the revised Inland / Ocean Testing Manual. District personnel will have an opportunity to provide input on proposed methodology prior to publication. A detailed overview of the potential for PAHs, TBT and related compounds and metals to bioaccumulate in the benthos and in higher trophic levels via predation of infaunal invertebrates will published as a technical report. This TR will provide a recommendation regarding the inclusion of those classes of contaminants as COC for benthic bioaccumulation and will recommend an overall approach for project-specific selection of COC.

Summary

The goal of this work is to reduce costs associated with sediment bioaccumulation testing on USACE dredging projects by streamlining the list of COC for body burden determination on bioassay organism and follow-up evaluation and by reducing the cost while optimizing bioassay methodology. Specifically, this project will provide an approach for evaluating only those COCs with a potential to result in an undesired impact arising from benthic bioaccumulation. Bioassay methodology will also be improved by proposing new methods efficiently obtain large masses of *L*. *variegatus* following whole-sediment exposures.

Balancing operational and environmental initiatives and meeting complex challenges of dredging and dredged material placement in support of the navigation mission.

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