Alternative Zooplankton Species for Elutriate Toxicity Tests

Dredging Operations Environmental Research (DOER) Program

U.S. ARMY CORPS OF ENGINEERS BUILDING STRONG®

Problem

This research addresses recurring issues encountered in water column evaluations for open water placement of Dredged Material (DM) that result in significant operations and management costs to the US Army Corps of Engineers (USACE) and the Nation. Dredging of ports and harbors is necessary to maintain navigable waterways. However, DM placement is managed under Federal Regulations. The Marine Protection Research and Sanctuaries Act (MPRSA) requires physical, chemical, and toxicological evaluation of DM to determine if it is suitable for unrestricted open water placement, beneficial use, or if special management strategies are necessary. Toxicological evaluations for open water placement of DM involve testing the potential for short-term impacts of the DM while settling through the water column (elutriate toxicity tests). Generally MPRSA requires testing of fish, invertebrates and zooplankton. Currently used test methods for zooplankton involve mussel or urchin embryo development tests that are extremely sensitive to non-persistent contaminants such as ammonia. The combination between using this development test, its sensitivity to ammonia, associated use of inappropriate application (safety) factors compounded with use of larger hopper dredges for open water placement has restricted use of the most cost efficient open water placement methods.

Study Description

This effort will provide more appropriate water column evaluation test methods using holozooplankton (zooplankton for entire life cycle) species to satisfy MPRSA dredge material evaluation requirements, emphasize protection from persistent contaminants of concern, de-emphasize the importance of ammonia toxicity, and save millions (annually) in USACE operations costs by disseminating rationale for removal of inappropriate and overly conservative, precautionary assumptions. Specifically, the objectives are to disseminate availability of more appropriate zooplankton species for MPRSA evaluations to USACE project managers, improve and correct current utilization of overly conservative application factors, and generate technical data to support the recommendations. The first task identified candidate zooplankton species, methods and standards that were more appropriate for use in DM evaluations than current practice. The second task obtained test species in the laboratory, and developed culture methods and to build toxicity reference value control charts. The third task generates high quality metals and ammonia sensitivity to build species sensitivity distributions and justify use of these zooplankton species.

Products

The following products are a direct result of this effort. A Technical Note (TN) "*Dredged Material Evaluations: Review of Zooplankton Toxicity Test Methods for Marine Water Quality Evaluations*" published in FY16 describes the problem and available alternative methods for zooplankton testing. A journal article (JA) "*Life stage sensitivity of the marine mussel Mytilus edulis to ammonia*" (published in *Envion Toxicol Chem;* FY16) provides technical data indicating the current application factor approach is inappropriate for development toxicity tests and suggests alternatives. A TN "Copepod Elutriate Toxicity Test Method" and a JA article "Copepod Sensitivity to Metals and Ammonia" will be available in FY17 and FY18, respectively. The scientific methods developed may be transitioned to standardization organizations (American Society for Testing Materials), and dredging guidance revisions (Ocean Testing Manual; Southeast Regional Implementation Manual). An ASTM work unit was started to standardize these methods and requires additional support to complete.

Summary

The zooplankton elutriate toxicity tests developed from this research involved acquisition of four marine copepod species and one cladoceran. Selected organisms were shown sensitive to persistent contaminants of concern (e.g., copper) but less confounded by non-persistent contaminant (ammonia) and handling stress relative to development toxicity tests. Further, these organisms were successfully cultured in the laboratory, which is not possible for development tests, making them readily available year round to avoid project delays. The expected results are widespread use of these methods in 103 dredging evaluations and savings to USACE in reduced management costs due to removal overly restrictive Limiting Permissible Concentrations for open water placement operations.

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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