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Spatial and Temporal Variability in Sediment Toxicity Identification Evaluations

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EXECUTIVE SUMMARY

The State Water Resources Control Board Enclosed Bays and Estuaries Plan (EBE) specifies that for sites not achieving the SQO to protect aquatic life, the cause of the impacts should be determined through a process termed Stressor Identification (SI). SI often includes multiple components, including the review of existing data as a prelude to collecting new data. The most widely used and most effective method of SI is the Toxicity Identification Evaluation (TIE). The EBE Plan does not provide guidance regarding TIE study design or interpretation of the results, however. The objectives of this study were to: summarize information on TIE results variability and interpretation, investigate TIE variability for sediments in the Los Angeles Region, and provide recommendations regarding TIE study design and interpretation for use in future studies. This project included a literature review and field study to collect data to be used in design guidance. This report describes results from the field study and provides recommendations for the design of future TIE studies.

The field study was conducted in three stages: Stage I was a screening of several sites in the Los Angeles/Long Beach Harbor complex, seeking locations with sufficient toxicity to perform TIEs. This stage detected high levels of sediment toxicity in Consolidated Slip (Los Angeles Harbor) and ten stations within this site were selected for study in subsequent stages. In Stage II, comprehensive whole sediment and pore water TIE characterization tests were conducted at three stations within Consolidated Slip. In Stage III, whole sediment TIE characterization using a smaller number of targeted treatments was conducted at 10 stations. Concentration of trace organics and metals were measured in sediment samples from both stages.

Overall results from the TIEs were similar in Stages II and III, with a determination that sediment toxicity was caused by nonpolar organics, specifically pyrethroid pesticides and PAHs. These identifications were based on interpretation of the characterization results using standardized evaluation thresholds and Toxic Unit calculations based on sediment concentrations of pyrethroid and fipronil pesticides, as well as PAHs. Metals, chlordanes, DDTs, and PCBs, although present at high concentrations in Consolidated Slip, were ruled out as likely causes of toxicity.

Variable patterns in the TIE characterization results were present among the stations and sampling periods. Out of the 13 samples evaluated in both stages, the characterization results fell into three patterns: 1) seven stations where organic contaminants were identified, with pyrethroids probably accounting for most of the toxicity; 2) three stations where organics could not be identified as a cause, but pyrethroids were still indicated; and 3) three stations where organic contaminants were identified, but pyrethroids were not indicated as a cause. These

patterns were further summarized into two categories: 10 stations where nonpolar organic chemicals were identified as a cause and three stations where the cause was not certain. None of these patterns was contradictory to the overall TIE conclusions for Consolidated Slip. However, use of a weight of evidence approach for data interpretation, consisting of TIE characterization, chemical analysis, and comparison to literature-based toxicity thresholds was essential for resolving inconsistencies in the results and improving confidence in data interpretation.
Statistical analyses of the results were conducted to estimate the probability of obtaining a successful TIE characterization result with different numbers of samples analyzed. Two scenarios of success were evaluated. The first scenario defined success as obtaining an effective
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TIE characterization result for a majority of the tested samples. Under this scenario, analysis of seven samples yielded a 95% probability of success. The second scenario defined success as obtaining at least one effective TIE characterization outcome among the samples tested. For the second scenario, analysis of two samples resulted in a 95% probability of success, and analysis of five samples resulted in nearly 100% chance of success.
The overall TIE conclusion for Consolidated Slip was the same for each timepoint. The magnitude of toxicity, sediment chemical concentrations, and TIE characterization patterns were similar between sampling events. For this study, including multiple timepoints was not necessary to determine the cause of sediment toxicity.

Full Text

http://ftp.sccwrp.org/pub/download/DOCUMENTS/TechnicalReports/1014_SpatialTemporalVariabilityInSediment.pdf