ABSTRACT

ASSESSING TOXICITY AND INTERACTION IN A MIXTURE OF URBAN STORM WATER CONTAMINANTS: PHENANTHRENE, ESFENVALERATE, AND COPPER

by

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Extensive natural waterway pollution from sources such as urban stormwater runoff is difficult to manage largely because of the complexity of analyzing chemical mixture toxicity. To avert further aquatic habitat destruction, a simple and reliable protocol is needed to assess the threat a chemical mixture poses to aquatic species in the environment. This study assembled a method to determine an ecologically protective exposure level of the common urban stormwater contaminants phenanthrene, esfenvalerate, and copper using Cellular Energy Allocation (CEA) methodology and a no observable effect concentration (NOEC) endpoint. Model properties were investigated and differences between a calculated toxicity from individual chemical data and mixture data were statistically analyzed to detect deviation from an additivity model to find
interactions. Though problems with the lipid analysis prevented complete modeling and interaction analysis, calculations were made where lipid values were non-negative. At 30-μg/L of copper, a 30 percent decrease was observed in available energy relative to the control group. In contrast, phenanthrene and esfenvalerate at 0.05 and 0.12 μg/L concentrations, respectively, did not register an effect outside of the 13 percent test error. In a repeat test at higher concentrations, copper produced a more complex response as shown by the non-linear responses in the CEA components. Despite the 50 percent error in this test, phenanthrene exposure at 200 μg/L caused a significant impact to the available energy with an increase of 88 percent. Hyperactivity below the toxicity threshold may account for this. Statistical analysis of the CEA components associated with respiration, protein, carbohydrates, and lipids showed that both protein and carbohydrate assays produced high scatter about their means with kurtosis greater than –2.0. ETS (respiration) had less scatter about the mean but still a broad response curve as shown in a - 0.77 kurtosis value. The cumulative scatter in the CEA calculation caused a wide response range from the control group. This made the test less sensitive in detecting an impact. CEA is sensitive enough to detect non-lethal impacts to *D. magna.* Improvements such as those suggested in this study add reliability and accuracy to the method.