Bioaccumulation of Organic Contaminants by *Diporeia* spp.: Kinetics and Factors Affecting Bioavailability

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This Project Ended in 1999

Accumulation of contaminants by benthic organisms may occur several ways: (1) by ingestion of sediment particles, (2) by respiration of the interstitial water, (3) by respiration of the overlying water, (4) by ingestion of freshly deposited food particles, and/or (5 through physical contact with any of the above. Resolving the factors and routes of accumulation are necessary to develop accurate predictions of bioaccumulation (amount of contaminant that accumulates in an organism). Recent attempts to include the benthic food web in bioaccumulation models indicate that benthos contribute significantly to the food web transfer of organic contaminants. Attempts to model the bioaccumulation of polycyclic aromatic hydrocarbons (PAH) by *Diporeia* , a major benthic food web component in the Great Lakes, suggests that there are substantial seasonal changes in the concentration of contaminants, but these seasonal changes have not yet been incorporated into more complex food chain models. This work focuses on how temperature, sediment composition, and feeding on fresh detritus affect bioaccumulation in benthic organisms.

This project also provides specific data related to the needs of the EPA-sponsored Lake Michigan Mass Balance Study (LMMB), which seeks to determine a mass balance of inputs and outputs of select contaminants for Lake Michigan and to predict their concentrations in the upper food web. The LMMB Study is designed to answer questions posed in the amended Clean Air Act, and to assist environmental managers in developing and implementing the Lake Michigan Lakewide Management Plan.

1999 Plans

Manuscripts on the finding of this research will be written and submitted.

1999 Accomplishments

The data analysis was completed and a manuscript drafted and reviewed in house. The manuscript will be submitted early in FY2000. This project is completed.

1998 Accomplishments

To augment our understanding of the dynamics of contaminant transfer of PCBs to the foodweb, samples of sediment, water, sediment-trap material and *Diporeia* were collected monthly from two stations. These materials have been analyzed for PCB concentrations. The data is undergoing quality assurance. The goal is to model the accumulation of PCBs by this important benthic amphipod to better predict the food web transfer of PCBs in Lake Michigan. In addition to the field-collected samples, the toxicokinetics of *Diporeia* for PCB congeners was determined in a series of laboratory studies for which a report was provided to the US EPA. These data demonstrated for the first time the role of temperature and organism size on the

dynamics of accumulation and loss of contaminants from contaminated sediment. Preliminary analysis indicates that *Diporeia* is likely near steady state for PCB congeners in the sediment. However, the accumulation appears to be out of thermodynamic equilibrium with the lower chlorinated congeners accumulated less that would be expected and the higher chlorinated congeners accumulated to a greater extent (Figure 1). These predictions from the laboratory compare well with the data from one field sample. When the monthly field data are complete, a model comparing predictions from laboratory findings with the field data will help confirm the preliminary comparison.

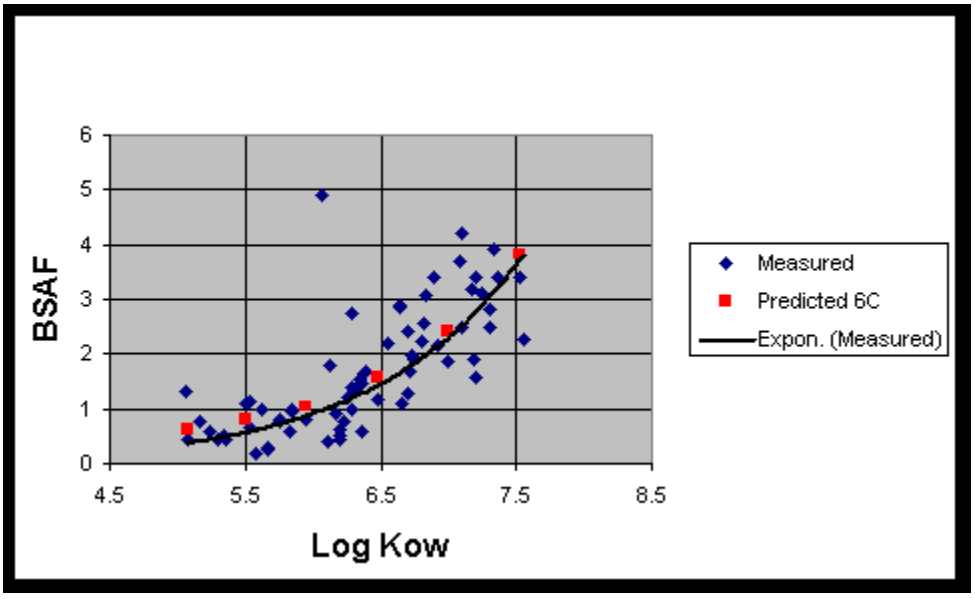

Figure 1*: Biota-sediment accumulation factor (BSAF) for PCB congeners in the amphipod Diporeia spp., comparison of field measured values to laboratory model predictions.*

Products

Landrum, P.F., and T.F. Nalepa. 1998. A review of the factors affecting the ecotoxicology of *Diporeia* spp. *J. Great Lakes Res*. 24:889-904.

Landrum, P.F., S. Kane Driscoll, E. Tigue, D. Gossiaux, M. Gedeon, and M. Adler. 1998. *Toxicokinetics of polychlorinated biphenyl congeners by Diporeia spp.:Effects of temperature and organism size. NOAA Technical Memorandum, ERL GLERL-106*, Great Lakes Environmental Research Laboratory, NOAA, Ann Arbor, MI, 21 pp.