Title: Evaluating the Effectiveness of Passive Sampling as a Surrogate for Organism Bioaccumulation

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Abstract:

Measurement of hydrophobic organic contaminants (HOCs) and the subsequent evaluation of their ecological and human health risks are common endpoints in aquatic environmental monitoring. Due to their hydrophobicity, many anthropogenic HOCs will partition from the water into organic matter as well as into aquatic organism lipids. As such, the HOC concentrations in organismal tissues are often measured to evaluate bioavailability and the risks these HOCs can pose. Similar to lipid partitioning, HOCs have been found to partition into polymers – also known as passive samplers. Over the past several decades, passive sampling has become a widely accepted technique for quantifying the freely dissolved concentrations (C_{free}) of HOCs in the water column and sediment pore water. Polymers including polydimethylsiloxane (PDMS), low-density polyethylene (LDPE), and polyoxymethylene (POM) have become popular for quantifying C_{free} of HOCs. In recent studies these passive samplers have been co-deployed with biomonitoring and toxicity testing organisms. This work presents the results of a critical review comparing the concentrations accumulated in passive samplers with lipid concentrations of co-deployed organisms for several environmentally relevant HOCs (e.g., PCBs, PAHs, and halogenated pesticides). Studies where the polymers PDMS, LDPE, or POM were directly compared to lipids from organisms including aquatic worms, bivalves, and midges were the primary focus of the review. Results from a literature search provided 47 individual reports where PDMS, LDPE, or POM were co-deployed with a living organism in the marine or freshwater environment or in the

laboratory. Of these publications, over 20 direct comparisons of tissue concentrations and PSD concentrations illustrated how passive sampler uptake of HOCs positively correlates to the bioaccumulation of HOCs by traditional biomonitoring and toxicity testing organisms in the marine and freshwater environments. Linear regressions between lipid and polymer concentrations showed positive and statistically significant relationships where lipids had 1-20 times higher HOC concentrations (ng/g) than the polymers and the r^2 values ranged from 0.3 – 0.99. These data suggest that in some applications, passive samplers could be used as surrogates for biomonitoring organisms.