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 an aquatic organism's 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 non-polar 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}. In recent studies these passive samplers have been co-deployed with biomonitoring organisms. This work presents the results of a critical review comparing biomonitoring organism's lipid concentrations of several environmentally relevant HOCs (e.g., PCBs, PAHs, and halogenated pesticides) with concentrations accumulated by co-deployed passive samplers. 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 over 40 publications illustrated how passive sampler uptake of HOCs

correlates to the bioaccumulation of HOCs by traditional biomonitoring organisms in the marine and freshwater environments. Linear regressions between lipid and polymer concentrations showed positive and statistically significant correlations 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.