OPTIMIZING FISH AND STREAM-WATER MERCURY METRICS FOR CALCULATION OF FISH BIOACCUMULATION FACTORS

Paul Bradley, Karen Riva Murray, Barbara C. Scudder Eikenberry, Christopher D. Knightes, Celeste A. Journey, Mark A. Brigham[1]

Mercury (Hg) bioaccumulation factors (BAFs; ratios of Hg in fish [Hgfish] and water [Hgwater]) are used to develop Total Maximum Daily Load and water quality criteria for Hg-impaired waters. Protection of wildlife and human health depends directly on the accuracy of site-specific estimates of Hgfish and Hgwater and the predictability of the relation between these parameters. BAF variability can be viewed as resulting from two conceptual drivers: 1) ecological variability (signal) due to ecosystem-specific differences in Hg uptake and accumulation and 2) methodological variability (noise). Thus, minimizing methodological variability in Hgfish (numerator) and Hgwater (denominator) estimates is critical to BAF-based Hg risk management.

Data collected by fixed protocol from 11 streams in 5 states distributed across the US were used to assess the effects of Hgfish normalization/standardization methods and fish sample numbers on BAF numerator estimates. Fish length, followed by weight, was most correlated to adult top-predator Hgfish. Site-specific BAFs based on length-normalized and standardized Hgfish estimates demonstrated up to 50 percent less variability than those based on non-normalized Hgfish. Permutation analysis indicated that length-normalized and standardized Hgfish estimates based on at least 8 trout or 5 bass resulted in mean Hgfish coefficients of variation less than 20 percent.

The influences of water sample timing, filtration, and mercury species on the modeled relation between game fish and water mercury concentrations were evaluated across the same 11 sites, in order to identify optimum Hgwater sampling approaches for BAF denominator estimation. Each model included fish trophic position, to account for a wide range of species collected among sites, and flow-weighted Hgwater estimates. Models based on methylmercury (filtered [FMeHg] or unfiltered) performed better than total mercury models. Models including mean annual FMeHg were superior to those with mean FMeHg calculated over shorter time periods throughout the year. FMeHg models including metrics of high concentrations (80th percentile and above) observed during the year performed better, in general. These higher concentrations occurred most often during the growing season at all sites.

[1]Paul Bradley, Hydrologist, US Geological Survey, Columbia, SC 29210
Karen Riva Murray, Ecologist, US Geological Survey, Troy, NY 12180
Barbara C. Scudder Eikenberry, Hydrologist, US Geological Survey, Middleton, WI 53562
Christopher, D. Knightes, Environmental Engineer, US Environmental Protection Agency, Athens, GA 30605
Celeste A. Journey, US Geological Survey, Columbia, SC 29210
Mark A. Brigham, Hydrologist, US Geological Survey, Mounds View, MN 55112

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