

## Session J6: Bioaccumulation of Methylmercury in Aquatic Ecosystems

Room C120-122

1:00 – 2:30 pm

**0369**

**J6-1**

### **It's Not What It Looks Like: Short and Long Term Temporal Trends in Fish Tissue Mercury Levels**

James Glover

*South Carolina Dept. of Health and Environmental Control, Columbia, S.C., USA*

The South Carolina Department of Health and Environmental Control (SCDHEC) developed a comprehensive fish tissue monitoring program in 1976 and has issued fish consumption advisories for various waterways since that time. While the primary purpose of the program was to provide fish consumption advice, this large dataset has allowed for the investigation of trends in fish tissue mercury (Hg) contamination. Using censored regression techniques a conceptual model has been developed that suggests a major driver in fish Hg levels is landscape drying and rewetting events. Drought years followed by years of high precipitation reveal trends in tissue Hg that supports research showing a flux of Hg methylation after reinundation of a dried landscape. Mercury increased in fish one year after the drought and rewetting cycle of 2002-2003 followed by a decrease in subsequent years. The alteration of the historic operation of a large reservoir in the state provided additional evidence of the phenomena. But in this instance the “drought” was created when water levels were kept low for over a year to allow for reservoir dam repair. Fish tissue Hg from a narrow portion of the reservoir showed temporal trends similar to those observed statewide while fish from the pool end of the reservoir, near the dam, showed an opposite response. Intuitively it is tempting to associate trends in fish tissue Hg with anthropogenic loadings. Indeed numerous researchers have demonstrated this relationship from waterways across the globe. However it is suggested here that this sort of extrapolation should be done with caution and only with known physical, chemical, and biological variables serving as a backdrop.

**0527**

**J6-2**

### **Methylmercury Accumulation in the Base of an Estuarine Food Web; Sinclair Inlet, WA**

Patrick Moran<sup>1</sup>, Robin Stewart<sup>2</sup>, Amy Klechner<sup>2</sup>, Jason Toft<sup>3</sup>, Jeff Cordell<sup>3</sup> and Anthony Paulson<sup>1</sup>

<sup>1</sup>US Geological Survey, Tacoma, Wash., USA, <sup>2</sup>US Geological Survey, Menlo Park, Calif., USA, <sup>3</sup>Univ. of Washington, Seattle, Wash., USA

As a part of a larger study evaluating mercury in Sinclair Inlet, WA, methylmercury was examined in the base of the estuary foodweb. Sinclair Inlet is a shallow (< 15 m), terminal arm of Puget Sound and is also the location of the Bremerton naval complex. Previous studies have indicated that the inlet has mercury concentrations in sediment and Rockfish that are among the highest in Puget Sound. As uptake of mercury into the base of the food web is a critical step and we examined seasonal and spatial variability in methylmercury concentrations in zooplankton as well as methylmercury content of their food (suspended particles). Methylmercury (MeHg) was measured in dissolved (0.45µm filtered), particulate and composite samples of individually picked zooplankton at four sites in Sinclair Inlet every month for a year and at an additional three sites around Puget Sound once in August of 2009. Factors known to influence the bioavailability and uptake of MeHg into the base of the food web were also measured, including phytoplankton (as chlorophyll a), TSS, DOC, particulate carbon and nitrogen and their stable isotopes. Mean zooplankton MeHg concentrations in the summer and fall of 2008 from Sinclair Inlet were generally less 50 ng/g dry weight and similar to those measured in other locations in Puget Sound in August 2008. Large seasonal variability of chlorophyll and zooplankton abundance were observed; with chlorophyll levels ranging from > 70 µg/L in late summer to < 2 µg/L in winter. However, filtered methylmercury concentrations and DOC levels in the water remained consistently low; the former often below the 0.04 ng/L detection limit. Further analysis of this data and its relationship to watershed and benthic sources will be discussed.

**0218**

**J6-3**

### **Does Dietary Carbon Source Influence Methylmercury Bioaccumulation by Macroinvertebrates and Fishes in Small Streams?**

Karen Riva-Murray<sup>1</sup>, Paul Bradley<sup>2</sup>, Barbara Eikenberry<sup>3</sup>, Mark Brigham<sup>4</sup>, Daniel Button<sup>5</sup>, Celeste Journey<sup>2</sup> and Michele Lutz<sup>3</sup>

<sup>1</sup>US Geological Survey, Troy, N.Y., USA, <sup>2</sup>US Geological Survey, Columbia, S.C., USA, <sup>3</sup>US Geological Survey, Middleton, Wis., USA, <sup>4</sup>US Geological Survey, Mounds View, Minn., USA, <sup>5</sup>US Geological Survey, Columbus, Oh., USA

Factors controlling mercury (Hg) concentrations in fish and macroinvertebrates of streams are complex and not well understood. Contributing factors include environmental (mainly aqueous) methylmercury (MeHg; the bioavailable and most toxic form of Hg) concentrations, rates of MeHg uptake at the food web base, and rates of biomagnification (*i.e.*, trophic transfer efficiencies) through the food web. The food web base in riverine ecosystems includes carbon of terrestrial and aquatic origin, but the relative importance of each form to MeHg bioaccumulation in streams is not clear. We examined the influence of dietary carbon source on methylmercury bioaccumulation in macroinvertebrates and fishes of small streams (basin area < 80 km<sup>2</sup>) in NY and SC during 2007-09. Three sites were sampled in the Fishing Brook basin (Adirondack Mountains, NY); one site, McTier Creek, was sampled in the Coastal Plain, SC. Detritus, seston, periphyton, macroinvertebrates, forage fish, and predatory game fish were collected seasonally. Seston, periphyton, and macroinvertebrates were analyzed for MeHg, and fish were analyzed for THg (assumed to be > 95% MeHg). Most samples collected were also analyzed for stable isotopes of carbon ( $\delta^{13}\text{C}$ ) and nitrogen ( $\delta^{15}\text{N}$ ), to assess, respectively, diet source and trophic position. Consumer (macroinvertebrates and fishes)  $\delta^{13}\text{C}$  was most enriched at the narrow, highly shaded, McTier Creek, where it was similar to  $\delta^{13}\text{C}$  of detritus, indicating greater influence of terrestrial dietary carbon. Consumer  $\delta^{13}\text{C}$  was the most depleted at Sixmile Brook, a shallow, high-wetland, open-canopy site in FB<sub>NY</sub>, indicating increased influence of aquatic dietary carbon. MeHg in primary consumers (*i.e.*, scraper, shredder, and filterer macroinvertebrates), after normalization to  $\delta^{15}\text{N}$  (to control for inter-specific variation in omnivory), was negatively correlated with  $\delta^{13}\text{C}$  at each site, indicating higher MeHg with greater dietary carbon of aquatic origin. These results suggest that MeHg bioaccumulation in small streams can be affected by the relative importance of terrestrial and aquatic carbon in the diets of consumer organisms.

0468  
J6-4

#### Variability in Mercury Bioaccumulation Factors (BAFs) for Riverine Fish across the United States

Barbara Scudder Eikenberry<sup>1</sup>, Lia Chasar<sup>2</sup>, Karen Riva Murray<sup>3</sup>, Paul Bradley<sup>4</sup> and Mark Brigham<sup>5</sup>

<sup>1</sup>US Geological Survey, Middleton, Wis., USA, <sup>2</sup>US Geological Survey, Tallahassee, Fla., USA, <sup>3</sup>US Geological Survey, Troy, N.Y., USA, <sup>4</sup>US Geological Survey, Columbia, S.C., USA, <sup>5</sup>US Geological Survey, Mounds View, Minn., USA

Methylmercury (MeHg) in the water of aquatic ecosystems is bioaccumulated in aquatic food webs to reach highest levels at the top of the food web, such as in top-predator fish. MeHg is the most toxic form of mercury (Hg) and the form most likely to accumulate in organisms; most (> 95 percent) Hg in fish is MeHg. Guidelines for the implementation of USEPA water quality criterion for MeHg recommend that states and tribes use (1) a criterion of 0.3 mg MeHg per kg fish tissue (wet-weight), or (2) a water-column MeHg value derived from fish Bioaccumulation Factors (BAFs), or (3) a combination of these two methods. Fish BAFs are the ratios of the concentration of MeHg in tissue to MeHg in water and may in turn be used to develop Total Maximum Daily Loads (TMDLs) for mercury-impaired waters. Fish BAFs are influenced by environmental setting (*e.g.*, mercury source strength, extent and proximity of contributing wetlands, stream biogeochemistry, and hydrodynamics); foodweb structure; and the physiology and life-history of target species; as well as sample timing and number of samples collected. The US Geological Survey completed intensive studies of mercury (Hg) in stream water and aquatic biota in Oregon, Wisconsin, New York, South Carolina, and Florida from 2002-2009 that inform the application of BAFs to develop MeHg water quality criteria in rivers. Atmospheric deposition was the primary source of Hg in all cases. Study basins spanned large gradients in watershed size, environmental setting, and stream biogeochemistry. Results will be described in relation to frequency of sampling, target fish species and trophic positions, stream geochemistry, basin characteristics, and other factors that may influence the application of Hg BAFs and TMDLs for protection of human and ecosystem health.