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Ecological Indicators of Mercury in the Environment: Results from the Western Airborne Contaminants Assessment Project (WACAP) and the Disconnect between Deposition & Effects

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Accumulation of mercury in aquatic food webs and its toxic effects on aquatic biota are of growing concern both for the health of the fish and the piscivores that prey upon them. This is of particular significance for high latitude and high altitude national parks because it is known that mountainous and Arctic areas are sinks for some contaminants. Therefore, the National Park Service initiated the Western Airborne Contaminants Assessment Project (WACAP) in 2002 to evaluate the risk to park ecosystems from airborne contaminants. Concentration of airborne contaminants (e.g., mercury, pesticides) in air, snow, water, sediment, lichen, conifer needles, and fish was determined in 8 core parks; more limited assessment focusing on vegetation was conducted in 12 secondary parks. Concentrations of contaminants measured in fish were also compared to human and/or wildlife contaminant health thresholds. Atmospheric deposition and flux of contaminants was measured via snowpack samples and lake sediment cores.

Mercury concentrations in fish exceeded human health thresholds in 20 of 169 fish sampled at 6 of 14 lakes in 5 of 8 parks (Noatak, Gates of the Arctic, Olympic, Mount Rainier, and Sequoia) between 2003 and 2005. Concentrations of mercury also exceeded risk thresholds for health impacts to piscivorous birds and mammals. Deposition fluxes of mercury in snow ranged from 336 $ng/m^2/yr$ at Denali to 3600 $ng/m^2/yr$ at Olympic, while sediment profiles at Olympic, Mount Rainier, Rocky Mountain, Glacier, and Sequoia National Parks show stabilization at fairly high percent enrichment values. Concentrations of mercury in fish were not always directly related to levels in atmospheric deposition and flux, however. For instance, mercury bioaccumulation in the arctic aquatic foodwebs was higher (ca. 175 ng/g ww Hg) although sediment data indicated that mercury deposition was relatively low (ca. 3 $\mu g/m^2/yr$) in those Arctic parks. This finding is likely due to in-lake biological processes that vary among lakes, and supports the usefulness of fish as a key indicator of mercury in the environment and subsequent impacts to food webs.

The mercury-methylating environment (microbes that convert deposited mercury into the bioavailable methylmercury) and food web structure control bioaccumulation and biomagnification of mercury, effectively disconnecting the link between mercury concentrations measured in snow and sediment from mercury concentrations in fish. While measuring mercury deposition may provide useful information for emissions regulation and source attribution, WACAP results suggest that fish sampling provides further evidence of actual effects upon the environment.

Presentation preference: Oral or Poster (whatever is preferred for your sessions)