Mercury Contamination of Aquatic Ecosystems: An Overview

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The potential consequences of mercury contamination of aquatic food webs were first recognized in the 1950s and 1960s in Minamata and Niigata, Japan, where human consumers of contaminated fish were severely poisoned. These and other tragic incidents prompted widespread reductions in direct releases of mercury into surface waters in many countries. Mercury levels in fish in affected waters typically declined during the years after point-source loads declined, leading to a widespread perception that the "mercury problem" had been solved. Since about 1985, however, widespread mercury contamination of aquatic biota has become evident in systems remote from obvious anthropogenic mercury sources. Investigations at these sites have shown that in most cases atmospheric transport and low rates of mercury deposition are responsible for the observed mercury contamination levels, and virtually any aquatic ecosystem is potentially affected. In some cases, concentrations in fishes from these remote sites have equaled or exceeded those in fishes from waters heavily contaminated by direct industrial discharges. Mercury concentrations in aquatic biota are often elevated, for example, in fish from low-alkalinity or humic freshwaters, newly flooded reservoirs, and surface waters that adjoin wetlands. However, we lack sufficient information to predict reliably which aquatic ecosystems will contain mercury-contaminated biota.

Unlike most contaminants, some natural processes in the environment actually increase mercury toxicity by the conversion to methylmercury. Methylmercury comprises nearly all the mercury found in the top levels of aquatic food webs, yet it rarely exceeds 10 percent of the total mass of mercury in sediment or water. Gaps in our understanding of the processes and factors controlling exposure to methylmercury (methylation, demethylation and biotic uptake) are a key challenges facing scientists investigating the mercury problem. Several information gaps currently exist in the environmental mercury science basis, including: (1) availability of reliable, multi-media (biota, sediment and water) mercury data from diverse ecosystem settings, including methylmercury determinations; (2) knowledge of the relative importance of factors controlling mercury methylation and bioaccumulation (mercury loading rates, mercury source type, ecosystem setting, and water and sediment chemistry); (3) a better understanding of the toxicological significance of methylmercury exposure on wildlife, and (4) current challenges on how to integrate the state of scientific understanding into policy considerations of law makers.

This presentation will focus on recent findings from several research projects that the USGS is involved with in the Everglades of Florida, the Experimental Lakes Area of Canada, and elsewhere. Findings related to recently discovered phenomenon, such as the new mercury versus old mercury reactivity in the environment will be discussed, and its ramifications for improvements in environmental contamination levels.