National Institute of Environmental Health Sciences | **Superfund Basic Research Program**

RESEARCH BRIEF 128

Identifying Predictors of Mercury Burdens in Fish

Background: Mercury occurs naturally in the environment and is emitted by coal-fired power plants, municipal waste combustion, medical waste incineration and chlorine production. While atmospheric concentrations are generally very low, mercury is deposited by wet and dry processes to forest ecosystems, from which it can be transported to and bioaccumulate in the food chain of aquatic ecosystems. Although anthropogenic mercury emissions in the United States have dropped 50% since 1990, mercury burdens in fish continue to exceed levels of concern in many lakes and 48 states currently issue advisories against consumption of fish.

The northeastern United States receives some of the highest levels of atmospheric mercury deposition of any region in North America and fish from many lakes in this region carry mercury burdens that present health risks to both human and wildlife. Interestingly, there is much unexplained variation in mercury levels in fish from lakes within the region. Dr. Celia Chen and Dr. Carol Folt of the Dartmouth College SBRP are conducting studies to identify the attributes of lakes that could serve as predictors of high mercury burdens in fish.

Advance: As part of a regional effort in the northeastern United States and eastern Canada (the Northeastern Ecosystem Research Cooperative Mercury Consortium), Drs. Chen and Folt collaborated with an international group of scientists in assembling, analyzing, and interpreting mercury data to establish biogeographic patterns of environmental mercury. In their recent paper published in a special mercury volume in *Ecotoxicology*, Drs. Chen and Folt and their co-authors investigated the patterns of mercury bioaccumulation and trophic transfer in aquatic food webs by comparing four separate multi-lake studies containing data on mercury burdens in biota, chemical, physical, land use, and ecological variables. The more than 150 lakes studied represent a gradient of environments ranging from watersheds in remote, pristine areas to watersheds impacted by Superfund sites.

Their statistical studies identified a set of common variables that is consistently related to mercury in fish. In agreement with earlier studies, Drs. Chen and Folt found that key chemical covariates (pH, acid neutralizing capacity, dissolved organic carbon and SO_4) were negatively correlated with mercury bioaccumulation in the biota. In addition, the Dartmouth researchers identified several important factors that had not been previously recognized. They found that negative correlations with adjacent land use (e.g., residential, agricultural, commercial/industrial) and ecological variables (primarily zooplankton density) were as strong as chemical variables in identifying lakes with high mercury bioaccumulation.

Drs. Chen and Folt noted that certain predictors were unique to individual datasets. They believe that the variation in findings is likely the result of differences in sampling protocols, fish species studied and lake population characteristics. While this work highlights several fundamental complexities of comparing datasets over different environmental conditions, it also underscores the utility of such comparisons for revealing key drivers of mercury trophic transfer among different types of lakes.

By evaluating data from four multi-lake studies, Drs. Chen and Folt found that lake types associated with the greatest mercury bioaccumulation are poorly buffered, low pH, low productivity lakes in forested watersheds with minimal human land use – that is, remote lake ecosystems where forests and wetlands enhance mercury transport from watersheds to lakes, and atmospheric transport and deposition are the major sources of mercury.

Significance: This work represents significant progress in our efforts to understand, at a mechanistic level, the vital links between environmental and human health. The identification of common attributes of lakes that serve as predictors of high mercury burdens in fish could provide public health and environmental protection officials with information required to formulate ***site-specific*** fish consumption advisories. Moreover, the findings suggest that mercury bioaccumulation and biomagnification may be the greatest in the most pristine, undeveloped lake ecosystems.

To learn more about this research, please refer to:

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