USGS science for a changing world

Toxic Substances Hydrology Program

Headlines

Some Ecosystems will Respond to Reductions in Mercury Emissions

Applying a solution of water and a stable isotope of mercury (^{202}Hg) on the shores of a lake in the Experimental Lake Area (ELA) in Ontario, Canada. An international team of scientists tracked the applied mercury isotope to study the movement of mercury from the watershed into the lake and fish. (Larger version)

An international team of scientists investigating mercury cycling in an experimental watershed in Ontario, Canada, conclusively demonstrated at the ecosystem scale that changes in mercury loadings are expected to result in proportional or near proportional changes in mercury bioaccumulation in fish. Policies to reduce atmospheric emissions of mercury are intended to reduce mercury bioaccumulation in fish, and thus the exposure of humans and fish-eating wildlife. Effective policies will require a robust and accurate scientific understanding of the anticipated ecosystem response to reduced mercury loading; specifically, whether reduced mercury emissions will in turn reduce mercury concentrations in fish consumed by people and wildlife.

Before this study, the response of mercury concentrations in fish to changes in mercury deposition was difficult to anticipate. This uncertainty was primarily due to a lack of understanding as to whether the high levels of mercury that historically accumulated in watersheds might sustain elevated fish mercury levels for extended periods after emission reductions. The USGS-led portion of the study evaluated linkages between terrestrial (soil) pools of mercury and the downslope lake. Our results show that fish mercury levels in aquatic ecosystems that predominantly receive mercury inputs from direct atmospheric deposition will respond rapidly and significantly to reductions in mercury loading. Ecosystems that receive significant mercury contributions from watershed runoff, however, will respond

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more slowly over extended time periods, and recovery may be decades to centuries.

By artificially increasing the mercury load to the lake being studied and the different parts of its watershed using various enriched stable mercury isotopes, the team was able to distinguish between experimentally applied mercury and mercury already present in the ecosystem. The study team then examined the bioaccumulation of mercury deposited to the different parts of the watershed. Fish mercury concentrations responded proportionally to changes in mercury deposition over the first 3 years of study. Virtually all of the increase in fish mercury concentrations came from mercury deposited directly to the lake surface. Less than 1 percent of the mercury isotope deposited in the watershed was exported to the lake, and the isotope was not detected in sport fish.

Other recent findings by these scientists provide novel insights into how the atmosphere and terrestrial forests and soils exchange and store mercury in watersheds. Forest canopies were found to be very active interfaces that accumulate atmospheric mercury. Year-round studies showed that with the onset of the annual autumn leaf fall, a substantial influx of mercury (heretofore greatly underestimated as a terrestrial mercury source) is introduced to the land surface, soils, and the watershed in general. Mercury researchers across the globe are now reevaluating whether deposition monitoring in the form of precipitation in open settings is a reliable estimate of mercury loadings to watersheds.

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- Mercury in Aquatic Ecosystems
- USGS National Mercury Research Laboratory

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