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Mercury Emissions Threaten Aquatic Environments

New mercury emissions seem to be more of a threat than the mercury already out there from previous emissions, according to some scientists

By Brian Bienkowski and Environmental Health News | Friday, January 18, 2013 | 1 comments

As United Nations delegates end their mercury treaty talks today, scientists warn that ongoing emissions are more of a threat to food webs than the mercury already in the environment.

Greenlanders are highly exposed to mercury because their diet is almost completely reliant on contaminated marine life. *Image: Flickr/Kristine Riskær*

At the same time, climate change is likely to alter food webs and patterns of mercury transport in places such as the Arctic, which will further complicate efforts to keep the contaminant out of people and their food.

University of Wisconsin researchers recently found that mercury added to a lake reached top predators faster than the mercury that already existed in their environment.

"It was amazing how fast the mercury got into the fish," said James Hurley, project researcher and director of the university's Water Resources Institute in Madison.

And this was no lab experiment – researchers put mercury into Lake 658, part of the Experimental Lakes area in Ontario, Canada. Over a year, they put about three times the amount normally received through rainfall and nearby wetlands.

For mercury to show up in top lake predators, it has to be converted to methylmercury – mercury's toxic form -- by organisms. Then it has to move up through the food web.

At Lake 658, this happened within months.

"We started seeing the isotope we added in June accumulate in yellow perch by early fall," Hurley said. "By the start of the second year, we were clearly seeing it even in predatory fish."

Before this study, researchers didn't have any idea about how long it took for mercury to move through the environment, said David Krabbenhoft, a research hydrologist with the U.S. Geological Survey's Wisconsin Water Science Center.

Once researchers stopped adding mercury, the concentrations in fish dropped quickly.

The discovery that new mercury seems to be more of a threat than old mercury could add impetus for reducing global emissions. Critics of mercury rules often say that because mercury is an element that recirculates, new emissions have minimal impact compared with

historic and natural ones.

The United Nations today adjourns a meeting in Geneva where governments of about 130 nations have been debating a mercury reduction treaty.

Asia is by far the largest source of new mercury emissions, and coal-burning power plants are the top contributor. Small-scale gold production and residential heating from other fossil fuels are other major sources.

Exposure to high levels of mercury, often from consumption of fish and other seafood, can damage developing brains, reducing children's IQs. It also has been linked to cardiovascular effects in some adults and children.

The UN released a report leading up to the conference that showed the amount of mercury in the world's oceans has doubled in the past century.

And global emissions are rising. An increase equivalent to about one-quarter of the 2005 human-caused mercury emissions, or about 500 tons per year, is expected by 2020 if there are no major changes in economic trends or emissions, according to a 2011 report by the Arctic Monitoring and Assessment Programme.

Climate change complicates transport

Human-driven emissions of another kind – carbon – are expected to further complicate how mercury makes its way around the planet, especially in the Arctic.

Since 1979, average Arctic sea ice has declined about 7.5 percent per decade. Loss of ice would mean more mercury in the air would land directly on water, instead of bouncing back as a gas. Conversely, the waters may purge more mercury as a gas. The net effect of these two factors is unknown.

"Thawing permafrost is already releasing significant masses of largely inorganic mercury to lakes and the Arctic Ocean," wrote the authors of a 2011 study from Canada's Freshwater Institute.

Warmer water coupled with the increased nutrients from permafrost and soil runoff could bolster aquatic life. More bacteria would hasten mercury turning into its dangerous form.

Harvard researchers found that twice as much of the mercury in the Arctic Ocean originates from the rivers as from the atmosphere, according to a 2012 study.

"At this point we can only speculate as to how the mercury enters the river systems, but it appears that climate change may play a large role," said Daniel Jacob, a co-author of the study, in a prepared statement. "As global temperatures rise, we begin to see areas of permafrost thawing and releasing mercury that was locked in the soil."

Climate could alter the feeding habits of ocean creatures. A longer food chain for top predators such as polar bears, belugas and walruses means they would be more highly exposed to mercury, since it magnifies each step up.

For some fish, temperature change would bolster growth rates, decreasing mercury accumulation. For other cold-loving fish, such as char and lake trout, growth could be stunted, increasing their mercury concentrations.

Persistent in food webs, people

Living in a region that acts as a sink for global pollutants and relying on wildlife for their diet, Arctic people have long been exposed to some of the highest levels of mercury.

Inuit pregnant women, mothers and women of childbearing age had about seven times more mercury in their blood than what the U.S. Environmental Protection Agency says will cause health problems for their children, according to a 2011 study. In some parts of Greenland, about 90 percent of women of childbearing age had blood mercury levels over the EPA's limit.

Mercury has been linked to attention problems, reduced IQs and altered heart rates in children living in the Arctic and sub-Arctic.

But it's not just a problem in the far north.

Between 1.5 and 2 million European children are born each year with mercury exposures above what the World Health Organization considers safe, according to a study in this month's Environmental Health journal. Human health impacts are the reason an emissions treaty is so vital, experts say.

"For ocean fish and people eating them, it may take decades to see the benefits," said Noelle Selin, an engineering professor at the Massachusetts Institute of Technology. "But without a treaty, things are only going to get worse."

David Streets, a senior scientist who studies historic mercury emissions at the Argonne National Laboratory in Illinois, said mercury emissions have gone down in the United States and Europe, but a rush in coal use in some fast-growing countries like China, and a resurgence of artisanal gold mining in places like Africa, is offsetting the reductions.

In 2005, the top emitter of human-caused mercury was Asia, at 65 percent of global emissions. Next highest was North America at 8.3 percent, according to U.N. data.

"This stuff cycles around so much, comes to the ground, goes back into the air, gets in people," Streets said. "A treaty is a good start."

Using available control technologies for coal, global mercury emissions could be reduced by up to 60 percent by 2020 compared with today's practices, according to the 2011 Arctic Monitoring and Assessment Programme report.

Despite climate question marks, Hurley points to his recent research as evidence of what decreasing emissions could do.

"Global reductions would mean less mercury in fish, lakes and people," Hurley said. "And, as we demonstrated, it would happen pretty quickly."

This article originally ran at Environmental Health News, a news source published by Environmental Health Sciences, a nonprofit media company.