Research overturns assumption about mercury in the Arctic

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For years, scientists have assumed that if mercury is high and increasing in fish in the North American and European Arctic, the same is true of fish elsewhere in the Arctic.

But a team of scientists from the U.S., Russia, and Canada has discovered that assumption is wrong in much of the continental Arctic.

In addition to differences in mercury processes as a result of diverse atmospheric, geological, and biological conditions, "It turns out that the economic decline of the former Soviet Union, which collapsed in 1991, appears to have been good for the Arctic environment in that part of the world," said Leandro Castello, an assistant professor of fish and wildlife conservation in the College of Natural Resources and Environment at Virginia Tech.

He is the first author of a study to be published in today's (Dec. 20) issue of *Environmental Science & Technology*, a journal of the American Chemical Society.

Atmospheric mercury comes largely from mining and ore processing, such as smeltering, according to a United Nation's environmental program study. Under certain water conditions, mercury is converted to a special form that can be absorbed by living organisms, through a process called methylation.

"Methylmercury is highly toxic," said Castello.

But the research team determined that burbot fish in two Russian rivers, the Lena and the Mezen, are safe to eat.

The fish from these rivers were compared to burbot from 20 locations along the Pasvik River on the Norwegian-Russian border and along the Mackenzie River in Canada, where decades of studies have found high levels of mercury that make the fish unsafe.

Burbot are cod-like fish found in fresh waters throughout the Arctic. They are long-lived, eat other fish, and are non-migratory.

"The burbot fish was chosen because they are top predators that integrate many bio-geo-chemical processes in the river watersheds," said Castello. "The fish were collected downstream of the watersheds, so that they would present everything that happened upstream."

Sampling was done using an ice-fishing method in the peak burbot season, November and December, by co-author Alexander V. Zhulidov of the South Russian Centre for Preparation and Implementation of International Projects.

"We developed and led an initiative of biological monitoring of the water quality of major rivers of Russia in 1980 and continued to do it until 2001, because we knew it could provide useful information one day. In 2002 the funding was cut and the program was closed. Unfortunately we have no funding to continue collecting such interesting data," said Zhulidov.

Mercury concentrations from fish in the Mezen River were lower than 10 locations, but higher than eight in North America, while mercury levels in burbot in the Lena River were among the lowest.

"Good news since the Lena River is one of the largest watersheds in the

world," said Castello.

Mercury concentrations from fish in the Mezen and Lena rivers also were found to have been on a decline by 2.3 percent a year, whereas in North America they have been increasing by 5 percent a year.

Why the differences? The researchers admit in their paper, "There are no ancillary environmental data from the time period of the study in Russia," but they suggest the differences across the Arctic "may be explained by differences in water quality, geological bedrock formations, and proximity to polluting sources."

Until the 1970s, atmospheric mercury were on the rise as a result of industry in Europe and in North America, but began to decline from those sources due to emission controls, with Asia coming on line as a source, the paper explains.

In Russia, metallurgic industries in Murmansk region and smelter companies in the Pasvik watershed explain high levels of atmospheric mercury in the Pasvik River. The economic decline near the watersheds of the Lena and Mezen lowered polluting activity there.

A confounding factor has been climate change, said Robert Spencer, an associate scientist at the Woods Hole Research Center. In burbot in the Canadian Arctic, mercury concentrations in fish tissue have increased despite declining atmospheric concentrations because rising temperatures appear to increase availability of mercury to fish populations.

"More studies are needed in the Russian Arctic if we are to better understand how mercury moves through this type of environment," Castello said.

More information: The article, "Low and Declining Mercury in Arctic Russian Rivers," was written by Leandro Castello, A.V. Zhulidov, Tatiana Yu. Gurtovaya, Richard D. Robarts, Robert M. Holmes, Daniel A. Zhulidov, Vladimir S. Lysenko, and Robert G. M. Spencer.

Provided by Virginia Tech