River algae affecting mercury pollution at Superfund site, study shows

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A Dartmouth-led study shows periphyton -- a mixture of algae, bacteria and other natural material living on submerged surfaces - is helping to transform mercury pollution from a Superfund site along a New Hampshire river into a more toxic form of the metal. Credit: Kate Buckman

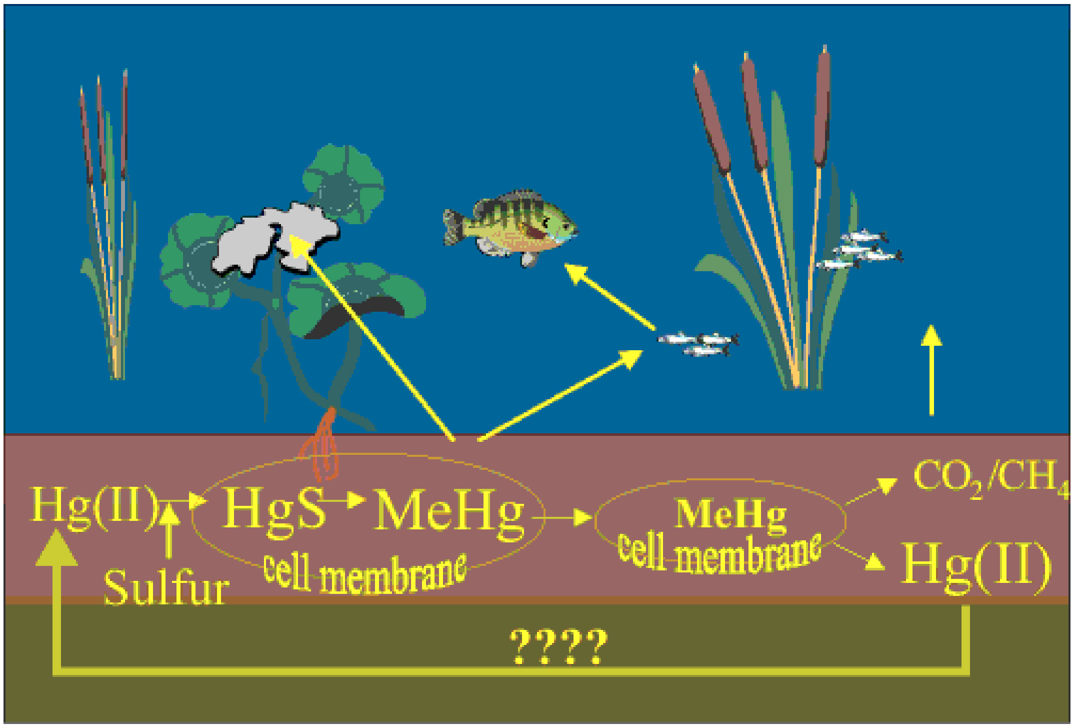
Dartmouth scientists and their colleagues have found that periphyton—a community of algae, bacteria and other natural material living on submerged surfaces - is helping to transform mercury pollution from a Superfund site along a New Hampshire river into a more toxic form of the metal.

The study also found lower than anticipated levels of methylmercury in crayfish, mayflies and small fish downstream from the former chemical plant along the Androscoggin River in Berlin, N.H., despite elevated methylmercury in the sediment, water and periphyton.

The results, which shed light on mercury dynamics within rivers and their food webs, appear in the journal *Environmental Toxicology & Chemistry*.

Methylmercury is a highly toxic form of mercury and the form that most easily passes up the food chain where it can reach high concentrations in predator fish. In aquatic systems, mercury is transformed into methylmercury in a complex biogeochemical process mediated by bacteria. Periphyton, which consists of algae, bacteria, fungi and detritus attached to submerged rocks, plants and other surfaces, is a fundamental part of aquatic ecosystems and can be a primary food source for small fish and invertebrates.

Researchers at Dartmouth and the U.S. Geological Society set out to determine whether mercury originating from the Superfund site enters the lower levels of the river's food chain. The mercury comes from a chlor-alkali facility that produced chlorine used in the manufacture of paper at the adjacent pulp mill from 1898 to the 1960s. They found surface sediment next to the site had methylmercury levels up to 40 times higher and total mercury levels up to 30 times higher than other reaches of the river. Mercury concentrations in the water next to the site were up to five times higher than downstream.



Methylmercury is a highly toxic form of mercury and the form that most easily passes up the food chain where it can reach high concentrations in predator fish. Credit: USGS

The potential for periphyton to produce methylmercury was highest next to the site as a result of high bacterial activity and low periphyton density, though periphyton methylmercury production rates in other reaches of the river were close to or below reporting limits. Methylmercury concentrations within the periphyton significantly increased from upstream to downstream. Contrary to the scientists' expectations, methylmercury concentrations in crayfish, mayflies and shiners didn't increase downstream from the site like large adult fish concentrations shown in previous studies. Total mercury and methylmercury bioaccumulation in small fish and invertebrates varied with no clear patterns of distribution downstream.

It's not clear why bioaccumulation patterns are different between predator fish and the smaller creatures they eat, but the researchers say the leaking mercury's impact may be more localized than they originally expected. "While our study clearly demonstrates that the chlor-alkali Superfund site is impacting this section of the Androscoggin River, future studies could investigate whether other factors such as dams, river grade, wetlands or upland drainage influence the patterns of bioaccumulation," says senior author Celia Chen, a research professor of biological sciences and principal investigator in Dartmouth's Toxic Metals Superfund Research Program. "An even greater potential may exist for mercury bioaccumulation downstream of the Shelburne Dam, where the river broadens and slows even further."

Provided by Dartmouth College

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