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New Study Focuses On Mercury Cycling In Great Bay Ecosystem

Rebecca Zeiber
NH Sea Grant

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DURHAM, N.H. - A new study funded by the New Hampshire Sea Grant at the University of New Hampshire is helping researchers learn how aquatic organisms, water and sediment impact the movement of the heavy metal mercury in the intricate Great Bay estuarine food web and how it could impact humans near the seacoast.

"We're trying to tease apart multiple components of this issue," said Celia Chen, a research associate professor of biological sciences at Dartmouth College. "We want to determine how much mercury is in the water and bound to sediments, how much is available to species that live in the mud, and how much is eaten by organisms higher in the food chain," she said.

Chen is collaborating with Aria Amirbahman from the University of Maine and Mary Voytek from the U.S. Geological Survey to conduct chemical and molecular analyses on sediment and biological samples for this N.H. Sea Grant-funded project. Humans are exposed to mercury mostly through the consumption of fish, and high levels of this neurotoxin can impair motor coordination and sensory ability. Estuaries such as Great Bay are ideal locations for the accumulation of contaminants like mercury that settle out from inputs of the surrounding watershed.

The main sources of mercury in the New England environment include atmospheric deposition from coal-fired power plants and incinerators, and other point sources such as wastewater treatment plants that discharge waste directly into waterways. Some mercury arrives on air currents from regions further west, including the Ohio River Valley and as far away as Asia, Chen said.

Mercury deposits on the land and eventually enters the waterways, settling into the sediment. Tiny organisms called sulfate-reducing bacteria transform mercury into methylmercury, which can be absorbed or consumed by other organisms that live near the sediment. Polychaete worms and other bottom-dwellers mix the top sediment layers and can potentially affect methylmercury cycling and eventual uptake, Amirbahman said.

Preliminary results indicate that methylmercury concentrations in polychaete worms, mummichogs - a small estuarine fish - and green crabs were higher for those collected in the Squamscott River channel at Great Bay in Stratham than at the Piscataqua River near Seavey Island in Kittery, Chen said. However, mercury levels were higher in both channels than in nearby salt pannes - the small pools in a salt marsh that retain water during low tide.

"The mercury levels in Great Bay in general are not alarmingly high, but they are about half as high as a very contaminated site located in New Jersey," Chen said. "Our sampling site with the lowest mercury levels is in the Wells Estuary in Maine."
"The Great Bay sediments are not any more contaminated than the Penobscot River sediments, which have been subject to point-source contamination," Amirbahman added.

Tom Niejadlik, administrator for the N.H. Department of Environmental Services (DES) Environmental Health Program, said that mercury deposition in Great Bay is similar to levels found across the northeastern U.S. "This isn't just a local problem," he said, "Although some places have 'hot spots' where mercury deposition is slightly higher, in general the levels are about the same throughout the northeast."

Tidal cycles, water circulation, surrounding land use and the presence of carbon and iron at the sites could contribute to the differences in mercury and methylmercury levels. Researchers will conduct more sampling this year to determine why the site differences are occurring. Results from this study will be used to help inform environmental policy recommendations made by local and regional agencies.

N.H. Sea Grant, housed at the University of New Hampshire, provides support, leadership and expertise for marine research, education and extension. A component of the National Sea Grant College Program, it is one of a network of 30 programs promoting the understanding, development, wise use and conservation of our ocean and coastal resources.

The University of New Hampshire, founded in 1866, is a world-class public research university with the feel of a New England liberal arts college. A land, sea and space-grant and community-engaged university, UNH is the state's flagship public institution, enrolling 11,800 undergraduate and 2,400 graduate students.

Photograph available to download:
Caption: Deenie Bugge, a technician who works with Celia Chen at Dartmouth College, digs for small polychaete worms in the Squamscott River mud. A new study is examining how these worms and other organisms affect mercury cycling in Great Bay.
Credit: Rebecca Zeiber, N.H. Sea Grant