Coastal and Marine Mercury Ecosystem Research Collaborative (C-MERC)

Charles T. Driscoll[1], Celia Y. Chen[2], Kathleen F. Lambert[3], Robert P. Mason[4], Elsie M. Sunderland[5], Catherine V. Schmitt[6], David C. Evers[7]

Most human exposure to mercury in the U.S. derives from the consumption of marine fish and shell fish, yet many important uncertainties and gaps exist in our understanding of the sources of methylmercury in marine ecosystems and the pathways to human and wildlife exposure. The Coastal and Marine Mercury Ecosystem Research Collaborative (C-MERC), sponsored by the Dartmouth College Toxic Metals Superfund Research Program, has convened a team of scientists and stakeholders to elucidate key processes related to the inputs, cycling and trophic transfer of mercury in marine ecosystems. The C-MERC effort has resulted in a series of papers on the state of the knowledge with respect to mercury in marine ecosystems. The papers examine mercury sources, transport, bioavailability and effects in six marine ecosystems (open ocean, Arctic Ocean, Gulf of Mexico, Gulf of Maine, San Francisco Bay, tropical oceans), mercury policy issues in the context of an international treaty, mercury-nutrient linkages in marine ecosystems, and mercury exposure and health effects. Inputs of mercury occur due to direct emissions from human activities (e.g., incineration, electric utilities, mining), re-emissions of previously deposited mercury (e.g., biomass burning, photovolatization, soil respiration) and natural release of mercury from geogenic sources (e.g., volcanoes, soil). Mercury emissions are generally deposited to the Earth's surface as inorganic mercury (ionic, elemental). In reducing environments (wetlands, sediments, water column), ionic mercury can be converted to methylmercury, the form that is readily transferred up the food chain resulting in exposure to wildlife and humans. The diverse marine systems studied in C-MERC exhibit variable pathways of inorganic and methylmercury supply. For inorganic mercury, dominant inputs can be derived from direct atmospheric deposition, riverine inflows or inputs from the open ocean. Major inputs of methylmercury can include supply from the open ocean, riverine inflows or internal methylation from the water column or coastal sediments. These different pathways of mercury supply suggest that marine ecosystems will be highly variable in their response times to changes in atmospheric mercury emissions and deposition, and that open ocean food webs from which much of our seafood is harvested will likely benefit from decreases in atmospheric emissions. Exposure of mercury can occur through two categories of consumers: the general consumer who largely obtains fish from global sources (e.g., tuna, pollack) and the local consumer who consumes local fish. Understanding contrasting pathways of mercury transport and exposure will be central to the development of effective policies to limit mercury exposure and to the accurate interpretation of monitoring results.

[1]Department of Civil and Environmental Engineering, Syracuse University, Syracuse NY, 13244, USA, ctdrisco@syr.edu (Hubbard Brook LTER)
[2]Department of Biological Sciences, Dartmouth College, Hanover NH, 03755, USA, Celia.Y.Chen@Dartmouth.edu
[3]Harvard Forest, Harvard University, Petersham, MA 01366, USA, klambert01@fas.harvard.edu
[4]Department of Marine Sciences, University of Connecticut, 1080 Shennecossett Road, Groton, CT 06340, USA, robert.mason@uconn.edu
[5]Harvard School of Public Health, Harvard University, 401 Park Drive, Boston, MA 02215, USA, elsie_sunderland@harvard.edu
[6]Maine Sea Grant, University of Maine, Orono, ME 04469, USA, Catherine_Schmitt@umit.maine.edu
[7]Biodiversity Research Institute, 652 Main Street, Gorham ME, 04038, USA, david.evers@briloon.org