Onondaga Lake Recovery: Declining Mercury in Water and Fish

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Background/Objectives. Onondaga Lake in Syracuse, New York is a 4.6-square-mile lake impacted by a long history of municipal and industrial activity, including two mercury cell chlor-alkali plants. Following upgrades to the Metropolitan Sewage Treatment Plant, the lake has experienced significant improvements in water quality, including reductions in phosphorus and ammonia concentrations since 2004. Honeywell completed remediation of the Onondaga Lake Superfund Site in 2016, including dredging and capping of contaminated sediments and, since 2011, the annual addition of nitrate to the hypolimnion to limit methylmercury release from profundal sediment. Natural recovery continues in profundal sediment below 9 meters (m) water depth. The 2005 Record of Decision included remedial goals for mercury in fish tissue for protection of ecological receptors (0.14 part per million [ppm]) and human health (0.2 and 0.3 ppm). Long-term monitoring of water and fish tissue will track the progress of the remedy in achieving these goals.

Approach/Activities. Water and fish monitoring was conducted from 2008 to 2011 to document baseline conditions, continued through 2016 during remedial action, and now continues as part of the nitrate addition and long-term monitoring programs. To support the nitrate addition program, water sampling for mercury and methylmercury occurs from mid-May to mid-November, weekly during stratification (approximately mid-June to mid-October) and biweekly otherwise. Samples are collected at 2, 12, 16, and 18 m water depth during stratification and 2, 12, and 18 m otherwise. Several species of sport fish, including smallmouth bass, walleye, pumpkinseed, and common carp, as well as white sucker, and various small prey fish species are sampled each year and analyzed for mercury and organic contaminants of concern.

Results/Lessons Learned. Mercury and methylmercury concentrations in water and fish have showed an ongoing downward trend following remediation of sources to the lake and the subsequent remediation of the lake bottom. Methylmercury concentrations in water at all depths in 2016 were below 0.2 nanograms per liter (ng/L), compared to concentrations exceeding 2.5 ng/L at 2 m and 10 ng/L at 18 m in the 1990s and early 2000s. Mean mercury concentrations in sport and prey fish have been generally declining since 2008. Since 2010, mean mercury concentrations in pumpkinseed and common carp have been at or below 0.3 ppm, the U.S. EPA's Methylmercury Water Quality Criterion (expressed as a fish tissue value) and one of the two human health goals for the lake. For prey fish, which are indicative of localized conditions due to small home ranges and which exhibit rapid responses to system changes due to their short life cycles, mean mercury concentrations declined to below 0.14 ppm (the ecological goal) by the end of dredging and capping in 2016 at all sampling locations in the lake; variability in mercury concentrations also declined at all locations.

Due to longer life cycles and their position higher in the food chain, species such as smallmouth bass and walleye will take longer to recover than water and prey fish. Based on the lower mercury concentrations in water and prey fish observed post-remedy, continued reductions in adult sport fish are expected, albeit in the context of elevated mercury concentrations in sportfish statewide due to atmospheric deposition of mercury. Continued monitoring of water and fish, as well as other potentially influential variables, will assist in understanding the trajectory of recovery of Onondaga Lake.