



# Freshwater Contaminants

Mercury is a toxic element with no known essential biological function. It occurs naturally as a solid in various minerals and as a gas in volcanic eruptions. It is also released into the environment as a gas by human activities, particularly mining and coal burning. Gaseous elemental mercury can be transported atmospherically to areas far from its original emission sources. Then it can be oxidized and deposited on the earth's surface in the form of rain or snow. Under anaerobic conditions, typically in wetland sediments, bacteria can convert this deposited inorganic mercury to organic methylmercury, which is five to ten times more toxic. Methylmercury tends to accumulate to greater concentrations in aquatic (rather than terrestrial) organisms. In fish, methylmercury readily crosses biological membranes, excretes slowly relative to its rate of uptake, and accumulates to concentrations vastly exceeding those in surface waters.



NPS/Evan Boother

Lake trout (*Salvelinus namaycush*) is a widespread, long lived top predator in southwest Alaska lakes. These lake trout were collected for mercury analysis from Kulik Lake in Katmai National Park and Preserve.

## Findings

The National Park Service (NPS) partnered with the U.S. Geological Survey (USGS) in a multi-year study of the factors controlling fish mercury levels at thirteen lakes in Katmai and Lake Clark national parks and preserves. The first two years of the study involved sampling water, sediment, plankton, and fish—both lake trout (resident) and sockeye salmon (migratory). Preliminary results suggest that lake trout exhibit a wide range of mercury concentrations among parks and among lakes (Figure 1). Also, median mercury

concentrations of lake trout in six of the thirteen lakes exceed the State's guidance on unlimited consumption of Alaska-caught fish by at-risk groups (200 ng/g wet weight or 16 meals/month; Hamade 2014). By comparison, median mercury concentrations of sockeye salmon are consistently low and exhibit little variability. Differences in mercury levels between these two species are likely due to differences in age. Sockeye salmon rarely live past six years. Lake trout age in this study ranged from seven to twenty-six years.



## Methods

We collected samples from thirteen lakes selected to represent a range of local factors capable of influencing the distribution of distantly derived mercury (Nagorski et al. 2014; Figure 2). Samples were then analyzed for total mercury, methylmercury, and other analytes including

stable isotopes of mercury, carbon, and nitrogen. We are currently developing quantitative models to relate mercury in lake trout with potential local drivers. We are also drafting a protocol for long-term monitoring of mercury in lake trout in Southwest Alaska lakes.

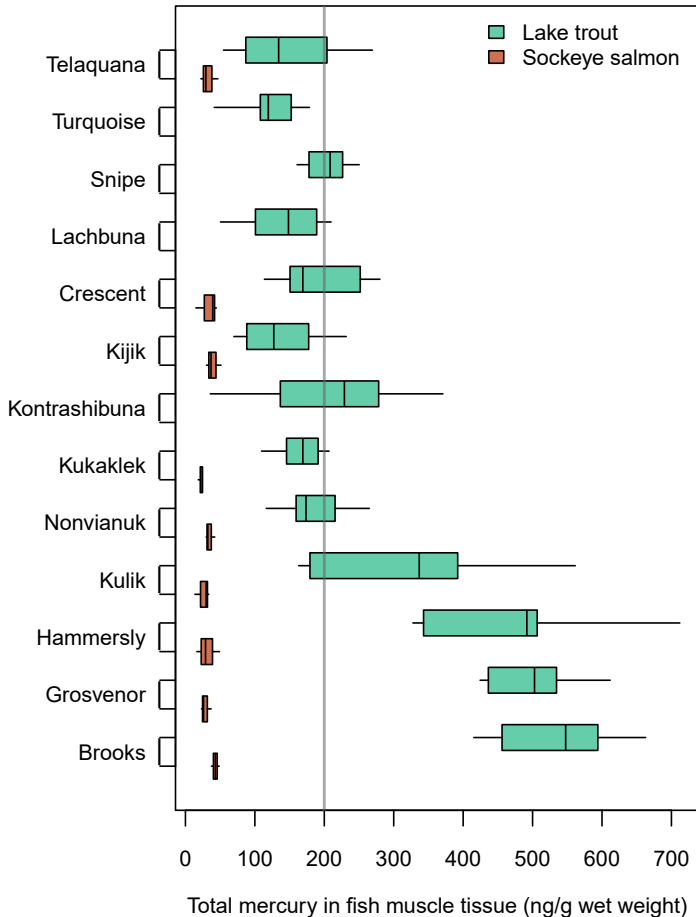


**Figure 1.** Boxplots of mercury in lake trout and sockeye salmon, arranged from the north-most lake at the top to the south-most lake at the bottom. The midline of each box signifies the median value of 10 lake trout or 3 sockeye salmon per lake. The gray line represents the upper limit for unlimited human consumption of Alaska-caught fish, specifically for women of childbearing age, nursing mothers, and children under the age of 12 (Hamade 2014).



**Figure 2.** Drivers of mercury levels in resident lake fish include distant and local factors. Distant factors are predominantly atmospheric emissions (A). Local factors include melting glaciers, which contain latent reservoirs of atmospherically deposited mercury (B); nearby wetlands, which convert atmospherically deposited mercury to methylmercury through bacterial respiration (C); and spawning salmon, which import methylmercury acquired while at sea (D).

## References

Hamade, A.K. 2014. Fish consumption advice for Alaskans: A risk management strategy to optimize the public's health. State of Alaska, Section of Epidemiology. Anchorage, Alaska.

Nagorski, S. A., and others. 2014. Spatial distribution of mercury in southeastern Alaskan streams influenced by glaciers, wetlands, and salmon. *Environmental Pollution* 184:62-62.

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