



Alagnak

Aniakchak

Katmai

Kenai Fjords

Lake Clark

Resident Lake Fish

Resident (non-migratory) lake fish are key indicators of ecosystem health in southwest Alaska. They are also important to recreational and subsistence fisheries. Understanding what controls their contaminant levels, therefore, is crucial. Many contaminants accumulate over time in fish tissue, especially in long-lived piscivorous species like lake trout (*Salvelinus namaycush*). When contaminant levels reach certain thresholds, fish consumption can be harmful and safety advisories can be issued for particular lakes or species. Consequently, elevated contaminant levels have human health ramifications, as well as broader ecological consequences.

Findings

The National Park Service (NPS) has sampled more than 300 fish, representing 9 species from 13 lakes in 2 park units since 2005. These



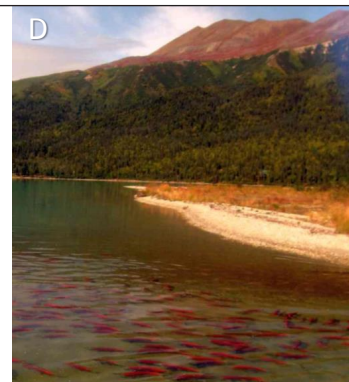
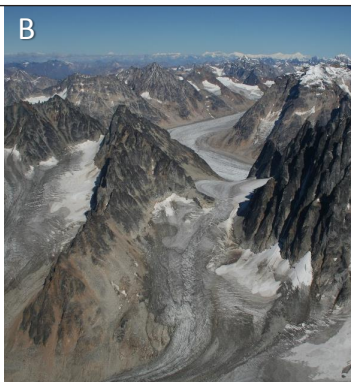
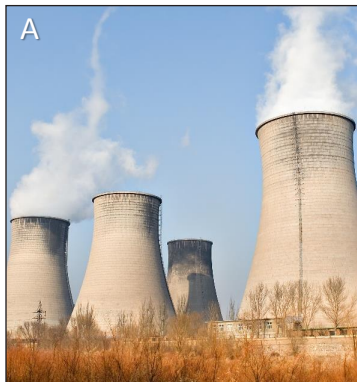
Lake trout collected for mercury analysis.

NPS/S Huffman

samples indicate that some resident fish species in southwest Alaska lakes have elevated concentrations of mercury, the majority of which is methylmercury, a potent neurotoxin. Why do these fish, which inhabit some

of the most pristine and remote waters in North America, have such elevated mercury levels? And what accounts for differences in fish mercury levels among lakes? Factors driving fish mercury levels can be grouped into

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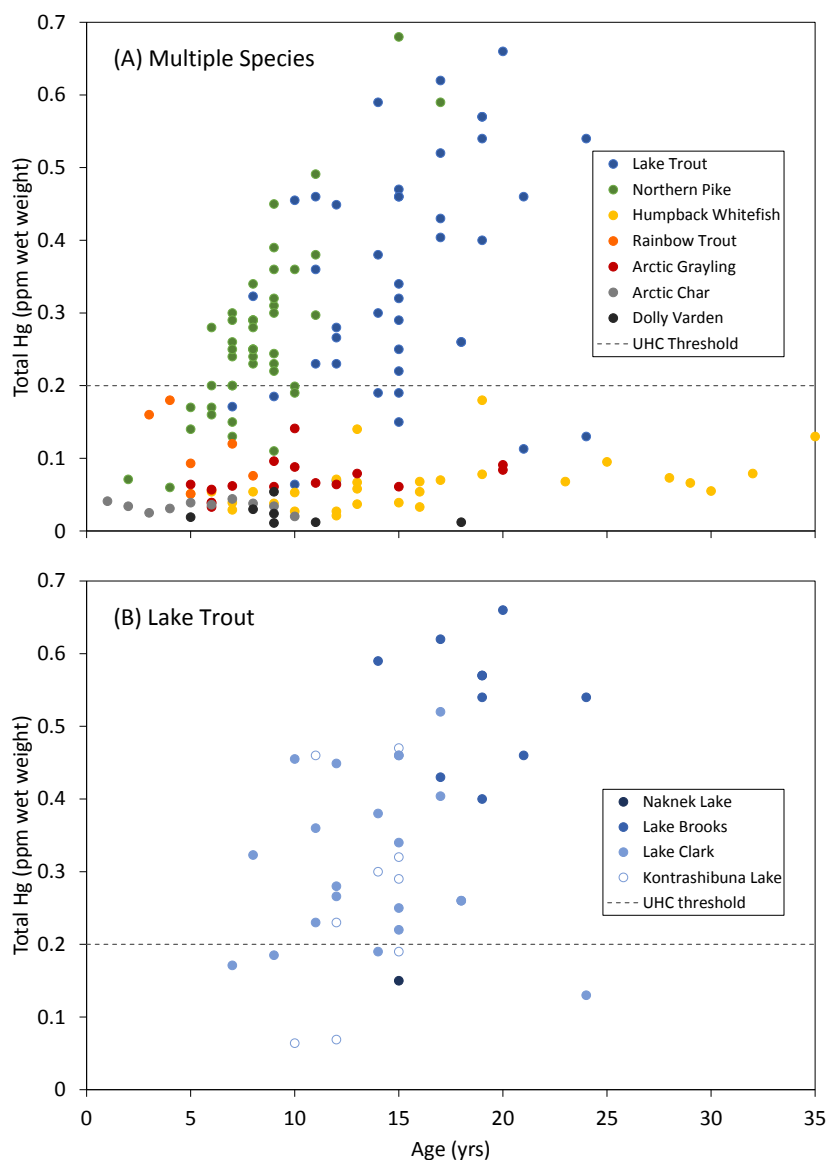
Drivers of mercury levels in resident lake fish include distant and local factors. Distant factors are predominantly atmospheric emissions (A). Local factors include melting glaciers, which contain latent reservoirs of atmospherically deposited mercury (B); nearby wetlands, which convert atmospherically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

two broad categories: distant and local. Distant factors are atmospheric emissions (notably from coal burning), and subsequent long-range transport and deposition. Local factors, such as glaciers, wetlands, and salmon, influence the distribution of distantly derived mercury (Nagorski et al. 2014). Fish age and species also help determine mercury concentrations, in that older top predators tend to have higher concentrations. Understanding the interplay of each of these factors will help make sense of the observed pattern in the mercury levels of fish (see figure, right).

Methods

This year, the NPS will be working with the U.S. Geological Survey (USGS) to better understand the factors controlling mercury levels in lake trout from Katmai and Lake Clark National Parks and Preserves. Together, the NPS and USGS will collect water, plankton, and fish samples from 12 lakes with a range of glacier, wetland, and salmon influences. Samples will be tested for mercury, methylmercury, and other analytes including stable isotopes of mercury, carbon, and nitrogen. The goal of this work is to identify where the mercury is originating and how it is reaching lake trout in these park units.

Collecting fish samples from Hammersly Lake in Katmai National Park and Preserve (below).



Total mercury levels in resident lake fish samples are determined partly by fish age and species (A). Even when age and species are accounted for, however, variability in mercury levels exists among lakes (B). In both graphs, the dashed line represents the upper limit for unlimited human consumption (UHC) of Alaska-caught fish, specifically for women of childbearing age, nursing mothers, and children under the age of 12 (0.20 parts per million (ppm); Hamade 2014).

NPS/E Booher



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.