

Central Alaska Network

National Park Service
U.S. Department of the Interior

Alaska Region
Inventory & Monitoring Program

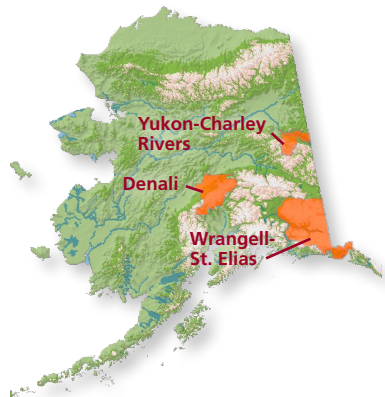


Denali NP & Pres. • Wrangell-St. Elias NP & Pres. • Yukon-Charley Rivers NP

July 2017

Streams & Rivers Resource Brief

Using Environmental DNA to Monitor Aquatic Species: Fisheries Surveys in a Bottle



Map: Streams and rivers are being monitored in **all 3** Central Alaska Network parks.

Freshwater and anadromous fish species are key players in the aquatic ecosystems of the Central Alaska Network, as well as being important for subsistence and recreational fisheries. We can expect that climate change and other human activity will affect fish communities in network parks in various ways. In order to understand how fish communities may be changing, we need to collect field data on the current composition of fish communities, and continue to collect that data into the future. Unfortunately, conducting traditional fisheries surveys, in which field crews may spend several days at a site, catching and identifying fish, is too expensive to institute at a large scale such as the Central Alaska Network.

Since 2012, the Central Alaska Network has been working with the USGS Molecular Ecology Laboratory to create robust tools to allow us to detect the presence of multiple fish species in a stream or lake by analyzing environmental DNA (eDNA) that we recover from water samples through filtration. eDNA consists of DNA that is shed by aquatic organisms into the water in which they live, and it can be present in very high concentrations under the right conditions. We have developed a novel method of analyzing this recovered DNA, which we call “amplicon-based next generation sequencing”, that allows us to identify the fish species present in an eDNA mixture by determining the sequences of small, specific sections of that

DNA and comparing them to a database that contains DNA sequences from each of the 42 fish species we expect to occur in Alaska. Matches between the recovered DNA sequences and those in the database allow us to determine which fish species were present at the time of sampling.

So far, we have tested this method using samples collected in DENA and WRST from sites where the fish species present are known, as well as known samples collected by other agencies outside the parks. We have shown that we can correctly identify the presence of multiple fish species in both lakes and streams from a single water sample. The ability to conduct “virtual fisheries surveys” using water samples will greatly reduce the cost of monitoring fish communities. It will also allow us to turn to citizen scientists for assistance in expanding the range of habitats we survey, by having them collect eDNA samples following a simple protocol.



Images: (top) chinook salmon, photo NOAA, (far right) NPS conducting a traditional fisheries survey, photo NPS

Why Is This Vital Sign Important	Streams and rivers are vital components of network ecosystems. They provide habitat for fish, including all 5 species of salmon. Fish in turn are important food sources not only for park wildlife, but also for people. For example, the world-famous Copper River sockeye salmon spawn in Wrangell-St. Elias NP & Pres. All 3 parks support subsistence and recreational fisheries as well. The aquatic insects that live in streams are an important food source for both fish and birds.	Streams and rivers are constantly reshaping the landscape, creating a diverse array of landforms and habitats that are important for both terrestrial and aquatic species. These changes can be either gradual, like the slow growth of a river delta, or dramatic, like the destruction of riparian forests during a large flood. The end result of these processes is a dynamic mosaic of habitats that increases the diversity of terrestrial vegetation and wildlife.
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What We Want To Know About This Vital Sign	• Determine long-term trends in chemical and biological measures of water quality • Determine long-term trends in the composition and spatial distribution of aquatic communities, including macroinvertebrates and diatoms • Monitor changes in the distribution of anadromous and resident fish species in	network parks • Determine long-term trends in annual and seasonal flow patterns in selected streams and rivers • Develop tools for park managers to assess biological water quality in selected streams and rivers
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How We Monitor This Vital Sign	To monitor ecological change in streams and rivers, the Central Alaska Network uses a wide variety of information. This includes biological, chemical and physical measurements collected during field visits, and also data derived from satellite and airborne instrumentation. Data are collected each year from a small number of easily-accessed sentinel streams in each network park, as well as from a large number of remote streams that are visited only once every 10 years or so. At each stream, network scientists collect data on the species composition and abundance of aquatic insects, and diatom and fish communities. Because these organisms are in the streams year-round, their responses to the stream environment serve as biological indicators of ecological change that scientists may not be able to detect when collecting other types of data. Detailed chemical and physical information about each stream is collected as well.	 Collecting a sample for eDNA extraction, photo University of Zurich. By combining these various types of information, network scientists will be able to detect changes in how stream ecosystems are behaving, not just at the small percentage of streams that are being studied, but across all 21 million acres of the vast and remote Central Alaska Network.
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How Monitoring This Vital Sign Can Help Park Managers	• Assess water quality in park streams and rivers • Improve management of subsistence and recreational fisheries	• Provide early detection of aquatic invasive species • Improve modeling and prediction of high flows in park streams and rivers
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