

# CAKN Stream Monitoring Program

## 2013 Field Season Report



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On the cover: Tokositna River and Tokositna Glacier, DENA. Several streams in this area were sampled in 2013 as part of the stream monitoring program.

## Summary

The 2013 field season was marked by numerous difficulties that sharply curtailed data collection. Wilderness compliance issues interfered with several planned backcountry sampling campaigns in WRST and YUCH. Denial of helicopter use in some areas where it had been permitted in previous years prevented any sampling in those areas. Aviation procurement problems derailed several other planned trips in WRST. Compounding these problems was a serious shoulder injury sustained by the aquatic ecologist that prevented even road-based field work for much of the late summer and fall, including the sole remaining sampling trip planned for YUCH. Despite these difficulties, during the 2013 field season the Central Alaska Network (CAKN) Stream Monitoring Program made 88 site visits to 40 unique stream sites in DENA and WRST (Figure 1), with each site being sampled one to four times from early May through late September. However, no data were collected from YUCH. The data collected included instantaneous water chemistry, stream flow, water chemistry samples, benthic macroinvertebrates, stable isotope samples, habitat data and environmental DNA samples. Continuous year-round temperature monitoring at 22 sites across the network is ongoing. Active layer depth and continuous soil temperature data were collected for the 5<sup>th</sup> year at one of the two CALM plots in WRST. A time-lapse camera was installed for the second year at Jack Creek in WRST to monitor flow, turbidity and the timing of freeze-up and break-up. Four site visits were made to the cooperative stream gage on the Nabesna River just outside of WRST to perform station maintenance and collect discharge data. This gage is operated as a cooperative effort between CAKN, The US Fish and Wildlife Service and the NOAA River Forecast Center. A final version of the CAKN Stream Monitoring Program 2011 Annual Report will be available as a Natural Resources Technical Report soon (Annual Reports for 2006-2010, along with a number of Resource Briefs, are available at the CAKN Streams and Rivers website - <http://science.nature.nps.gov/im/units/cakn/vitalsign.cfm?vsid=72>). The CAKN Stream Monitoring Protocol, including a Protocol Narrative and 19 Standard Operating Procedures, is in peer review; a final version should be in publication as a Natural Resource Report within several months.



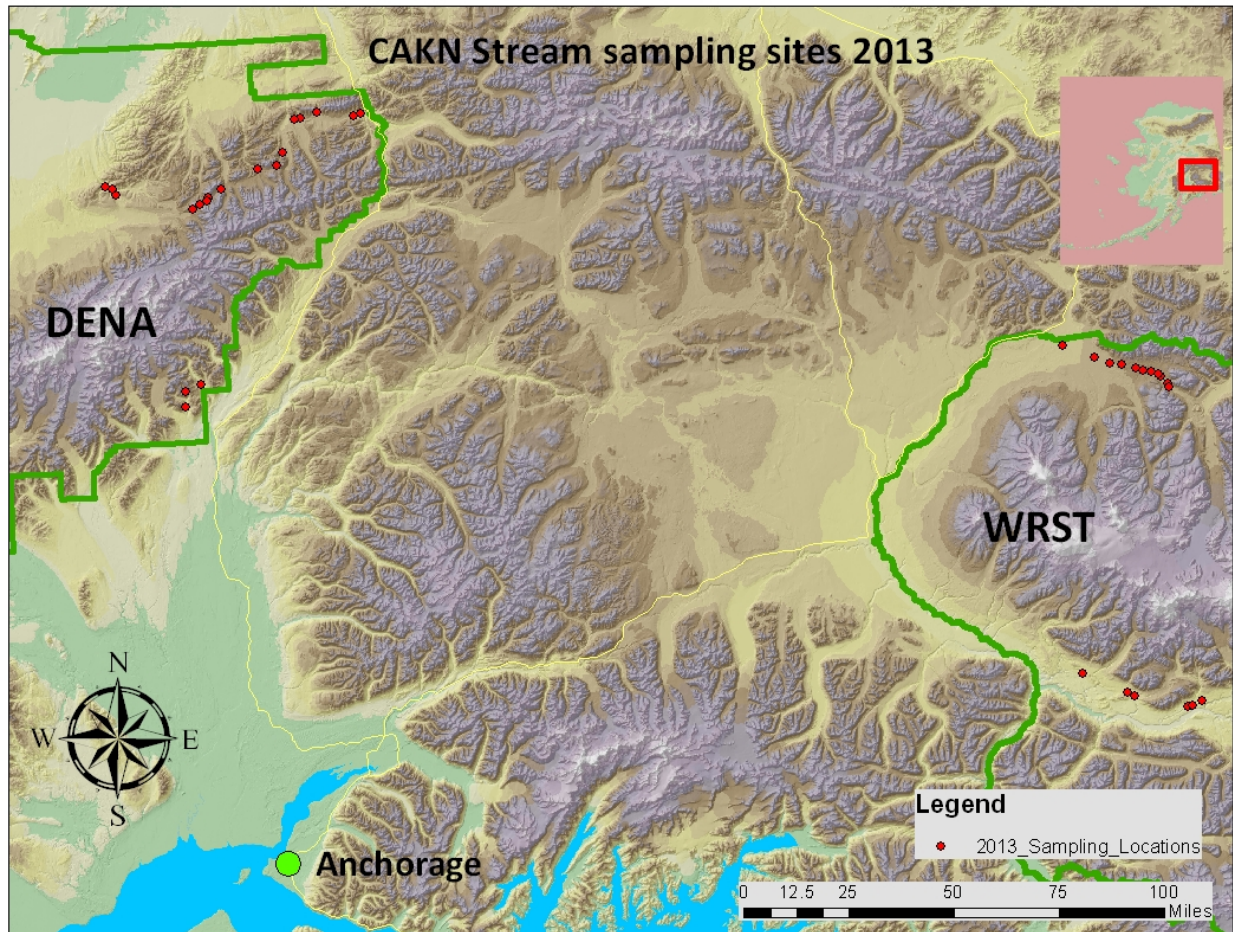


**Figure 1.** Locations of sites sampled by the stream monitoring program during 2013. Individual sites were sampled as many as 4 times from May to September.

### **Denali National Park and Preserve**

There were two basic components to the field season in DENA in 2013. First, beginning in 2008, continuously recording temperature loggers have been deployed in streams along the Park Road. At present, there are temperature loggers deployed at 12 sites (Table 1). Loggers are changed out every 2 years. In 2013, 6 recorders were changed out, and a new one was deployed at Moose Creek, where the existing data recorder was lost or destroyed. A second recorder was lost at the Stony Creek tributary site (DENA-GRTS-003), but was not replaced due to very low water. Continuous temperature data is critical for allowing us to detect changes in the temperature regimes of park streams over time.

Secondly, as part of the ongoing stream monitoring program, 46 sampling visits were made to 22 unique sites in the park (Figure 1, Table 2). Data collected during these sampling visits included instantaneous water chemistry, habitat characteristics and stream flow, as well as water chemistry samples, stable isotope samples, and invertebrate samples. Starting in 2012, we have also been collecting samples of environmental DNA from both lakes and streams, which will be analyzed using an amplicon-based next-generation DNA sequencing approach to detect the presence of fish species and other aquatic organisms. In 2013 we purchased a high-throughput

peristaltic pump and filtration system, which has allowed us to filter volumes as large as 25 liters of stream or lake water to obtain DNA. These larger-volume samples (hand-pumped Table 1. Locations of currently-deployed continuous temperature recorders in DENA

| Site Code     | Site Name             | Notes      |
|---------------|-----------------------|------------|
| DENA-001      | Rock Creek            | since 2009 |
| DENA-008      | Little Stony Creek    | since 2008 |
| DENA-017      | Tattler Creek         | since 2009 |
| DENA-021      | Hogan Creek           | since 2008 |
| DENA-022      | Savage River          | since 2008 |
| DENA-029      | Lake Creek            | since 2008 |
| DENA-033      | Gorge Creek spring    | since 2009 |
| DENA-034      | Wonder Lake inflow    | since 2012 |
| DENA-GRTS-003 | Stony Creek trib      | since 2011 |
| DENA-GRTS-010 | Moose Creek           | since 2008 |
| DENA-GRTS-014 | E.F. Toklat tributary | since 2009 |
| DENA-GRTS-084 | Igloo Creek           | since 2008 |
| DENA-GRTS-104 | Sanctuary River       | since 2008 |

samples collected in 2012 were generally limited to less than one liter) should substantially increase our ability to detect even relatively rare species. Together these data are used to evaluate status and trends in water quality, biodiversity and ecological integrity in park streams. Three types of sites are sampled – sentinel sites, GRTS sites, and judgment sites. Sentinel sites, all of which are along the park road, are sampled annually to maximize our ability to detect change. Many of these sites were originally part of the LTEM monitoring program. GRTS sites are selected using a probabilistic algorithm, allowing us to use data collected at these sites to infer conditions at sites that have not been sampled. Although some of these sites are also sentinel sites (due to a coincident location with an existing sentinel site), most are in the backcountry and are sampled approximately once every 10 years. Judgment sites are selected on an *ad hoc* basis, and for a variety of reasons. For example, the so-called “Travertine stream” along the park road near Stony Creek has been sampled occasionally due to its unusual water chemistry. Lake Creek was selected for annual sampling to ensure that a lake outlet stream was included in the set of sentinel sites, since their biogeochemistry and ecology are often quite different from those of other stream types.

In 2012, we revisited 4 remote sites that were part of the 1994-1996 water chemistry study. In 2013, we revisited another 3 remote sites from that study. Eight additional sites from the 1994-1996 study located along the Park Road are sampled regularly and 4 others are sampled occasionally. The goal here is to collect enough data to be able to address questions about whether water chemistry in Denali streams has changed over the last two decades.

In addition to the benthic invertebrate samples that have been collected since 2007, in 2013 we collected riparian insect samples from several sites. The goal is to collect adult specimens that correspond to the benthic insect larvae that occur at each site. Because benthic invertebrate samples consist almost entirely of larvae, they can be difficult to identify to species. Normally, this is a relatively minor issue, as invertebrate community data representing a mix of species- and genus-level identifications are sufficient to address most ecological questions in aquatic

ecosystems. However, there are currently several questions concerning aquatic insects in the CAKN that require species-level information. First, to date we have collected what we believe to

Table 2. List of sites sampled in DENA in 2013

| Site Code     | Site Name             | Notes                                     |
|---------------|-----------------------|-------------------------------------------|
| DENA-001      | Rock Creek            | Sampled annually, first LTEM site         |
| DENA-004      | Travertine stream     | Unusual water chemistry, near Stony Creek |
| DENA-008      | Little Stony Creek    | Sampled annually, LTEM site               |
| DENA-017      | Tattler Creek         | Sampled annually, LTEM site               |
| DENA-021      | Hogan Creek           | Sampled annually, LTEM site               |
| DENA-029      | Lake Creek            | Sampled most years                        |
| DENA-011      | Gorge Creek spring    | Sampled some years                        |
| DENA-033      | Hines Creek tributary | New site, will be sampled some years      |
| DENA-035      | Eureka Creek          | Legacy mining impacts**                   |
| DENA-GRTS-003 | Stony Creek tributary | GRTS site, sampled annually               |
| DENA-GRTS-010 | Moose Creek           | Sampled annually, GRTS site, LTEM site**  |
| DENA-GRTS-014 | E.F. Toklat tributary | Sampled annually, GRTS/LTEM site          |
| DENA-GRTS-027 | E.F. Toklat River     | Sampled annually, GRTS/LTEM site          |
| DENA-GRTS-060 | Savage River          | GRTS site, will be sampled annually       |
| DENA-GRTS-071 | Stony Creek           | GRTS site, sampled annually               |
| DENA-GRTS-084 | Igloo Creek           | Sampled annually, GRTS/LTEM site          |
| DENA-GRTS-104 | Sanctuary River       | Sampled annually, GRTS/LTEM site          |
| DENA-GRTS-122 | Highway Pass Creek    | Sampled annually, GRTS/LTEM site          |
| DENA-GRTS-128 | Coffee River          | GRTS site                                 |
| DENA-GRTS-196 | Alder Creek           | GRTS site, also part of 1994-96 WQ study  |
| DENA-WQ-017   | Cloud Creek           | Part of the 1994-96 water quality study   |
| DENA-WQ-056   | Slide Creek           | Part of the 1994-96 water quality study   |

"GRTS sites" are sites that were selected using an algorithm that generates a probabilistic, spatially-balanced list of potential sampling locations to maximize inference to conditions at unsampled sites.

be 3 previously undescribed insect species from streams in both DENA and WRST; however, absent adult specimens we cannot rigorously document these findings. Secondly, there are several "species complexes" of aquatic insects that are found in both DENA and WRST; these complexes consist of multiple related species that are morphologically ambiguous. Resolving these complexes will require the capture of adult specimens. Because we have constructed a DNA barcode library for all taxa collected in the CAKN, we will be able to match adult and larval specimens using DNA barcodes. Finally, we have collected several larval specimens that appear morphologically to match known taxa, but whose DNA barcodes do not match those taxa. Resolving these taxa will also require the capture of adults.

### **Wrangell-St. Elias National Park and Preserve**

The field season in WRST in 2013 was similar to that in DENA, although no remote sites could be sampled, so all sampling occurred along the Nabesna and McCarthy Roads. As in DENA, continuously-recording temperature loggers have been deployed since 2008 at a number of sites in WRST along the Nabesna and McCarthy roads. At present, there are temperature loggers deployed at 10 sites (Table 3). Loggers are changed out every 2 years. In 2013, seven recorders were changed out (Crystal Creek, Gilahina River, Rufus Creek, Long Lake Creek, Little Jack

Creek, Rock Creek and Chalk Creek). Continuous temperature data will allow us to detect changes in the temperature regimes of park streams over time.

Secondly, as part of the ongoing stream monitoring program, 42 sampling visits were made to 18 unique sites in the park (Figure 1, Table 4). Data collected during these sampling visits included instantaneous water chemistry, habitat characteristics and stream flow, as well as water chemistry samples, stable isotope samples, invertebrate samples and environmental DNA.

Table 3. Locations of currently-deployed continuous temperature recorders in WRST.

| Site Code     | Site Name         | Notes                              |
|---------------|-------------------|------------------------------------|
| WRST-004      | Chalk Creek       | Since 2008                         |
| WRST-006      | Rock Creek        | Since 2008                         |
| WRST-013      | Gilahina River    | Since 2008                         |
| WRST-015      | Little Jack Creek | Since 2008                         |
| WRST-036      | Rufus Creek       | Since 2009                         |
| WRST-039      | Caribou Creek     | Since 2008                         |
| WRST-051      | Long Lake Creek   | Since 2008                         |
| WRST-060      | Paco Creek        | Since 2011, @ Mile 27 Nabesna Road |
| WRST-GRTS-032 | Crystal Creek     | Since 2010                         |
| WRST-GRTS-130 | Jack Creek        | Since 2008                         |

These data are used to evaluate status and trends in water quality, biodiversity and ecological integrity in park and network streams. Three types of sites are sampled – sentinel sites, GRTS sites, and judgment sites. Sentinel sites, all of which are along the McCarthy and Nabesna Roads, are sampled annually to maximize our ability to detect change. Some of these sites are also sampled multiple times per year as a way to help quantify seasonal variability in ecological metrics. GRTS sites are selected using a probabilistic algorithm, allowing us to use data collected at these sites to infer conditions at sites that have not been sampled. Although a few of these sites are also sentinel sites (due to a coincident location with an existing sentinel site), most are in the backcountry and are sampled approximately once every 10 years. Judgment sites are selected on an *ad hoc* basis, and for a variety of reasons. For example, in 2012 I sampled a tributary to Toby Creek because it was a small clearwater stream (sourced in a rock glacier) in a high-elevation glacial valley. Similarly, we sampled Hidden Creek because it should be relatively ecologically isolated by the Kennicott Glacier. In both of these cases I was attempting to broaden the ecological scope of streams that have been sampled. This is a critical aspect of the overall sampling approach of the Stream Monitoring Program, because probabilistic sampling schemes do not necessarily capture the full range of ecological conditions across a landscape, something that is important for ecological modeling. In 2013 one new judgment site (Long Lake inflow) was sampled to increase the representation of small low-gradient meadow streams in the dataset. As in DENA, we also collected riparian adult insects from several sites in WRST in 2013, for reasons discussed above.

Thirdly, 2012 marked the 4<sup>th</sup> year of data collection at the Circumpolar Active Layer Monitoring (CALM) plots established in 2009 at two sites along the Nabesna Road in cooperation with the USGS. The global CALM network, established in 1991, is part of the NSF Arctic Observing Network (AON). The CALM network is an international effort containing more than 150 sites

from 15 countries around the globe where long-term responses of the active layer and near-surface permafrost are observed. The two CALM plots in WRST are among the southernmost plots in North America. Each September, at the time of maximum thaw, 121 active-layer depth measurements are made in a grid overlaid on the one-hectare CALM plots in WRST. In addition, dataloggers deployed near the center of each plot record continuous soil temperature data at depths of 0.1, 0.5, 1 and 1.5 meters. The data are submitted to the CALM network and are publicly available at the CALM website (<http://www.gwu.edu/~calm/>). Site identifiers for the WRST sites are U40A – Mentasta Fen and U40B – Tanada Muskeg.

Table 4. List of sites sampled in WRST in 2012.

| Site Code     | Site Name            | Notes                                       |
|---------------|----------------------|---------------------------------------------|
| WRST-004      | Chalk Creek          | Sampled annually                            |
| WRST-006      | Rock Creek           | Sampled annually                            |
| WRST-011      | Rock Creek tributary | Sampled annually                            |
| WRST-013      | Gilahina River       | Sampled most years                          |
| WRST-015      | Little Jack Creek    | Sampled most years                          |
| WRST-036      | Rufus Creek          | Sampled most years                          |
| WRST-039      | Caribou Creek        | Sampled most years                          |
| WRST-040      | Chokosna River       | Sampled occasionally                        |
| WRST-043      | Lakina River         | Sampled occasionally                        |
| WRST-051      | Long Lake Creek      | Sampled occasionally                        |
| WRST-060      | Paco Creek           | Sampled most years, at Nabesna Road mile 27 |
| WRST-069      | Trail Creek          | Sampled most years                          |
| WRST-070      | Lost Creek           | Sampled most years                          |
| WRST-071      | Boyden Creek         | Sampled most years                          |
| WRST-073      | Long Lake inflow     | First time sample                           |
| WRST-GRTS-021 | Caribou Creek        | GRTS site, sampled most years               |
| WRST-GRTS-030 | Strelna Creek        | GRTS site, sampled most years               |
| WRST-GRTS-126 | Upper Strelna Creek  | GRTS site                                   |
| WRST-GRTS-130 | Jack Creek           | GRTS site                                   |

"GRTS sites" are sites that were selected using an algorithm that generates a probabilistic, spatially-balanced list of potential sampling locations to maximize inference to conditions at unsampled sites.

2013 also marked the second full field season for the collaborative operation of the Nabesna River gaging station. This station, located a few miles downstream of WRST in Tetlin NWR, has been operated by the USFWS Water Resources Branch since 2007, but was scheduled to be removed in 2012. However, the CAKN Stream Monitoring Program has entered into a collaboration with the USFWS Water Rights Branch, Tetlin NWR and the NOAA River Forecast Center to maintain the station indefinitely. Under this agreement, the CAKN Stream Monitoring Program is responsible for field data collection and station maintenance, Tetlin NWR provides staff time and logistical support, and the Water Rights Branch and NOAA are responsible for data management and analysis. In 2013, we made 4 visits to the gaging station (a 5<sup>th</sup> is tentatively scheduled for early December). During the March visit, a discharge measurement was made through the ice using a hand-held current meter. During visits in May, July and September, discharge measurements were made using a boat-mounted acoustic Doppler current profiler, and routine station maintenance was performed. Discharge data from this station, the only currently operating gage within or downstream of a network park, will be used to assess hydrologic conditions upstream in WRST. Real-time stage and temperature data from this station are

available at <http://amazon.nws.noaa.gov/cgi-bin/hads/interactiveDisplays/displayMetaData.pl?table=dcp&nwsli=NABA2>. Real time stage and discharge data can be accessed through the Alaska-Pacific River Forecast Center ([http://aprfc.arh.noaa.gov/index\\_rivs.php](http://aprfc.arh.noaa.gov/index_rivs.php)).

Finally, in 2012 the Stream Monitoring Program launched a pilot effort to determine the feasibility of monitoring various aspects of river phenology, including the dates of freeze-up and break-up, as well as obtaining continuous qualitative estimates of flow and turbidity, using low-cost digital time-lapse cameras. The first camera was deployed in September 2012 on Jack Creek and recorded high-quality images once per hour. An initial freeze-up occurred in late November, but this was followed by a thaw that resulted in areas of open water in early December. Unfortunately, the batteries gave out around that time, so the dates of freeze-up and break-up could not be determined. The batteries were replaced in early May, and the camera provided a very nice record of several high-flow events during the ensuing months. Turbidity could also be easily, albeit qualitatively, monitored. In September, higher-quality lithium batteries were installed to provide better performance during cold weather. Should these batteries prove inadequate, it may be necessary in the future to visit any deployed cameras one or more times during the winter to ensure that freeze-up and break-up can be captured. Once these performance issues have been addressed, the program hopes to deploy a network of cameras across all 3 CAKN parks.