



Final Performance Report for USFWS Agreement F13AC00355

Date: December 29, 2015

Report submitted by: Sue Mauger, Cook Inletkeeper

Reporting Period: June 1, 2013 – August 30, 2015

Due Date: December 29, 2015

Project Title: Pilot Project to Establish Real-time, Year-round, Long-term Kenai Peninsula Stream Temperature Sites

Project Background

The objectives of this project are to:

- 1) Prioritize key watersheds in the Kenai Peninsula Borough with stream gages and fish weirs or other escapement counting capabilities and create a strategic plan, identifying potential long-term funding, to establish real-time temperature monitoring stations;
- 2) Collaborate with BeadedStream LLC in Anchorage to refine a prototype using paired air and water sensors with a real-time, online interface; and
- 3) Establish one real-time monitoring station with online access to in-season information for fisheries managers and Alaskans in the highest priority watershed.

Interim performance reports were submitted on September 24, 2014 and September 23, 2015. This report covers project performance for the entire project period.

Project Activities

Cook Inletkeeper conducted the following activities:

- Contacted local area fisheries managers, researchers, and fishing enthusiasts to select a location for the first real-time temperature monitoring station.
- Selected the Anchor River and submitted design plans and a multi-agency permit application to the Kenai River Center for a site on the Old Sterling Highway Bridge. ADOT&PT approved the design and Kenai Peninsula Borough Floodplain Permit, Alaska State Parks Special Use Permit, and ADF&G Fish Habitat Permit were secured.
- Collaborated with staff at BeadedStream LLC to design a new prototype using their digital temperature cables to meet the needs of anticipated users.
- Installed a real-time, year-round stream temperature site on the Anchor River on September 7, 2013 with volunteer field support from the Kenai Peninsula Chapter of Trout Unlimited.

- Developed a webpage portal to allow public access to the Anchor River data, time series graphs and a summary of current conditions: <http://inletkeeper.org/healthy-habitat/real-time-temperature-sites/anchor-river>
- Coordinated with the Alaska Ocean Observing system to have the Anchor River data incorporated on their real-time sensor portal: <http://data.aos.org/maps/sensors/>
- Shared the on-line link via Cook Inletkeeper's facebook page (4,838 followers) and 2014 summer quarterly newsletter (500 households in Southcentral Alaska) as well as direct communication with fisheries managers, researchers and fishing enthusiast at the 2015 Kachemak Bay Science Symposium.
- Hosted a field trip to the Anchor River to share our temperature work and show off the real-time site as part of the Kachemak Bay Science Conference. See Homer news article: <http://homernews.com/homer-news/local-news/2015-03-18/variety-of-groups-join-forces-to-preserve-the-anchor-river>
- Conducted six site visits for firmware upgrades and quality assurance checks and fixed a software memory problem which caused us to lose a week of data (8/29/2014, 3:00 am to 9/7/2014, 5:45 pm).
- Discussed priorities with USFWS biologists, ADF&G managers and local sport fishers for additional real-time temperature monitoring locations.

Project Accomplishments

- Acquired 24 months of stream and air temperature data for the Anchor River and provided online access to in-season information for fisheries managers and Alaskans in this high priority watershed through two data portals.
- Secured funding and all permits required through the Kenai River Center to continue the Anchor River site until September 2016.
- Provided an analysis of the real-time data in comparison with other data loggers to assess the accuracy of the BeadedStream technology for climate change modeling.
- Determined the highest priorities for additional real-time temperature monitoring stations on the Kenai Peninsula.
- Acquired funding through the Kenai Peninsula Fish Habitat Partnership for a new real-time temperature sensor on the Russian River.

Brief Budget Summary for the reporting period

Cook Inletkeeper has used the Department of the Interior's Automated Standard Application Payments (ASAP) process to draw down funds totaling \$1,953 since the last reporting period. Please see the attached SF425 and Expenditure Summary Report for details about how these funds were spent to achieve project objectives. Match requirements were met during the last reporting period.

Expenditure Summary Report

Pilot Project to Establish Long-term Stream Temperature Sites
(F13AC00355)

Grant Award	\$11,703.00
Previous Reporting Period Draws	\$ 9,750.00
Draw 08/28/2015	\$ 1,953.00
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Balance	\$ 0.00

This report summarizes drawdowns from August 28, 2015, which covered expenses incurred from July 1, 2015 through August 30, 2015.

Direct Costs:

Wages (Science Director)	\$ 1,953.00
Total Direct Costs	\$ 1,953.00
Indirect Costs	\$ 0.00
Total Costs	\$ 1,953.00

Explanation of Expenditures as related to Grant Objectives

1. CIK's Science Director (50 hours x \$39.20 = \$1,960; Objectives 1 and 3)

Technical Report

(USFWS Agreement F13AC00355)

Introduction

The goals of this project are to make stream temperature data more accessible to fisheries managers and Alaskans and useful for future climate change analysis. Real-time monitoring stations can provide in-season information for fisheries managers in key watersheds and long-term (>20 years) monitoring stations, using paired air and water sensors to establish the relationship between air and water temperature, will improve our ability to predict future water temperature conditions based on climate scenarios. By serving up data online in real-time, we hope to provide in-season information for local fishers, weir operators and fisheries managers to increase our understanding of the relationship between fish movement and water temperature. On September 7, 2013 we installed a real-time station on the Anchor River with staff from BeadedStream LLC and volunteer field support from the Kenai Peninsula Chapter of Trout Unlimited.

Site Information

The monitoring equipment was deployed on the Old Sterling Highway Bridge downstream of the ADF&G weir and confluence of the north and south forks of the Anchor River (Figure 1). The equipment, which includes a battery and micro-solar charger unit, is attached to both a vertical and horizontal bridge girder. One digital temperature cable extends into the air above the unit and within a solar radiation shield to collect air temperature. A second cable is snaked through the existing riprap and out into the stream below the water surface to record water temperature. The cable is secured to the stream bottom with a weight to keep the sensor in place during high flows and ice movement.



Figure 1. Location of the real-time monitoring site and photo of the monitoring equipment. (Latitude 59.7724134°, Longitude -151.83665552°)

Data Summary

Data collection began on September 7, 2013 and continued uninterrupted until August 24, 2014 when a software memory problem resulted in a week of lost data. BeadedStream staff notified Cook Inletkeeper of the problem quickly and provided excellent technical support to fix the problem. Cook Inletkeeper was able to upload new firmware on site and the problem has not reoccurred.

To assess the accuracy of the real-time sensor, we deployed a TidBiT v2 data logger (Onset Corp.) instream at the site. Based on a side-by side comparison of the two sensors, the average difference was 0.13°C for daily mean, 0.14°C for daily minimum temperature and 0.11°C for daily max temperature (Figure 2). The real-time sensor consistently recorded 0.1°C lower than the Onset data logger (Figure 3), which has a stated accuracy of $\pm 0.2^\circ\text{C}$. The BeadedStream sensor has a $\pm 0.1^\circ\text{C}$ accuracy specification. By examining differences in monthly values, there appears to be a greater difference particularly in minimum values by May 2015 (Figure 4). It is not clear which of the sensors experienced the most significant drift. Quality assurance checks using a hand-held probe checked against a NIST thermometer prior to going into the field recorded instantaneous temperature readings above the Onset logger (0.0–0.4°C) and real-time sensor (0.1–0.4°C). Air temperature values were not assessed for accuracy.

One challenge of providing real-time data delivery is the need for consistent power through a micro-solar charger unit. During winter months, we have not always been able to attain the 6 volts needed to provide hourly microbursts to the Iridium satellite system. During these periods, BeadedStream has reduced the recording interval. Since this is occurring only in the winter months we are unlikely to be missing significant daily variation with fewer than 24 hourly readings. However, we recommend using Onset data loggers in addition to the BeadedStream sensors to generate data accurate enough for climate change analysis (± 0.25 accuracy, Mauger et al. 2015). The added function of real-time data delivery is valuable for engaging decision-makers and local Alaskans in the implication of climate change on our freshwater salmon habitat.

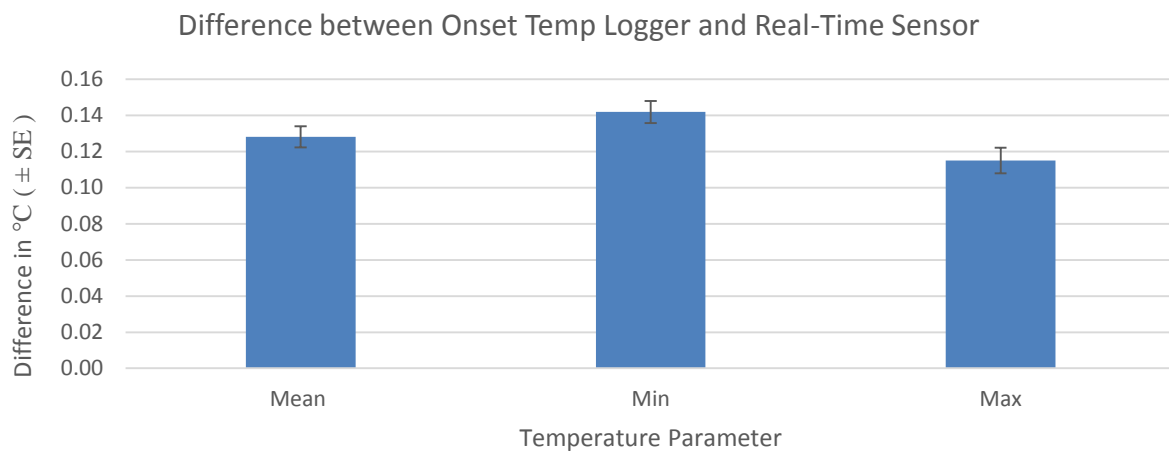


Figure 2. Average difference between the Onset logger and real-time sensor based on daily values.

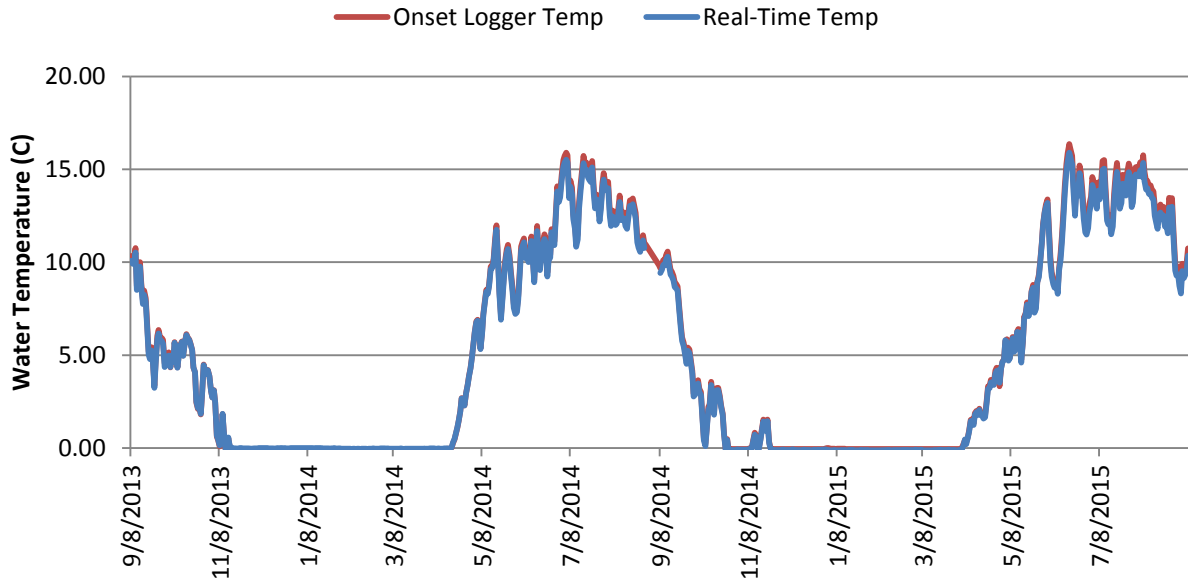


Figure 3. Comparison of water temperature data (daily average) as recorded by an Onset data logger and the BeadedStream real-time sensor.

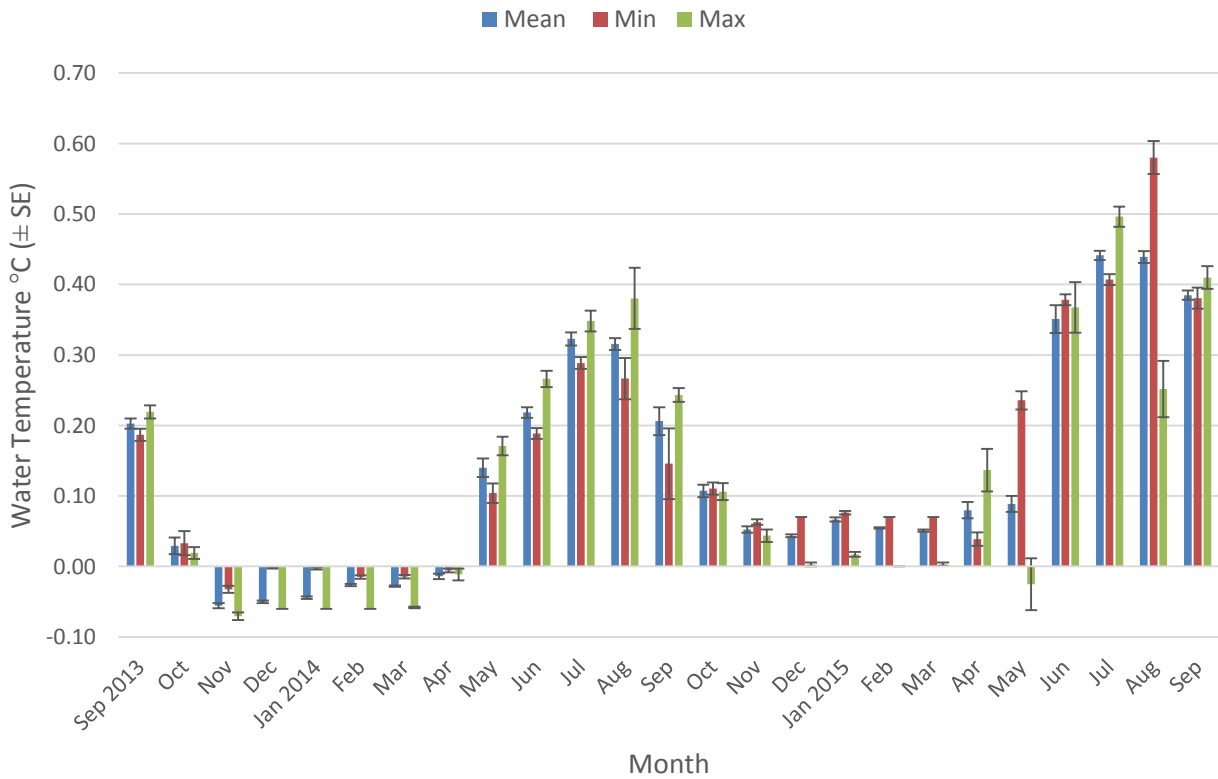


Figure 4. Difference in monthly values with standard error bars between the Onset logger and real-time sensor.

Future Monitoring

Based on discussions with local experts and fishing enthusiasts and evaluation of available fisheries information, we recommend that new real-time sites be established on the Russian River and Crooked Creek. The Russian River provides huge fishing opportunities and, thus, great outreach potential to tourists and Alaskans. The Russian River was not part of the Cook Inlet Stream Temperature Monitoring Network from 2008 – 2012 so we do not know the thermal profile of this system. Real-time temperature data on Crooked Creek would be valuable for ADF&G research interests to establish thermal conditions when they imprint Chinook salmon smolt at the Crooked Creek weir facility before releasing them each June. These hatchery-produced Chinook salmon augment wild runs on the Kasilof River for sport anglers.

Funding has been received through the Kenai Peninsula Fish Habitat Partnership to establish a real-time monitoring site on the Russian River. Once a site is established, annual funding needs are minimal (approximately \$1,000/year). Additional funding from private sport fishing interests and private foundations is anticipated because of the value of real-time data delivery for engaging decision-makers and local Alaskans in the implication of climate change on our freshwater salmon habitat.