Intergravel Temperature Monitoring

R2 Resource Consultants, Inc.

Michael Mazzacavallo, Jerry George & Kai Steimle

Special Thanks

- The MatSu Borough
- Sue Mauger
- Sam Ivey
- Jon Gerken
- Chancy Boatman
- Nancy and Jay Dulany
- Beaded Streams

R2 Resource Consultants, Inc.

Background

- Regional stream temperature monitoring coordinated by Cook Inletkeeper has identified Cook Inlet salmon streams vulnerable to negative effects of climate change.
- Many streams in the Matsu Borough have been identified as exceeding Alaska's Water Quality Standards and being sensitive to the increases in air temperature predicted by climate models (Mauger et al. 2016).
- Increases in summer temperatures are forecast to have sub-lethal effects on salmon including:
  - poor egg and fry incubation survival,
  - low juvenile growth rates, and
  - pre-spawning mortality

Background

- Understanding thermal landscape can aid managers in prioritizing targeted management to increase resilience to climactic warming.
- Most pink, chum, and Chinook salmon populations and many sockeye salmon populations spawn during July and August and have incubating eggs from late summer through spring.
- Salmon may select groundwater-influenced locations within streams for spawning.

- **Currently unknown how regional patterns in summer surface water temperatures are reflected in winter surface water and intergravel conditions.**

Objectives

Over the course of 2 spawning and incubation cycles (2016-2018):

- Monitor surface and intergravel water temperatures at salmon spawning sites
- Describe how intergravel temperatures relate to air and surface water temperatures
- Describe how summer stream temperature patterns relate to incubation temperatures

Site Selection

- Monitoring locations with fish spawning activity
- 3 warm, high sensitivity sites
- 3 cold, low sensitivity sites

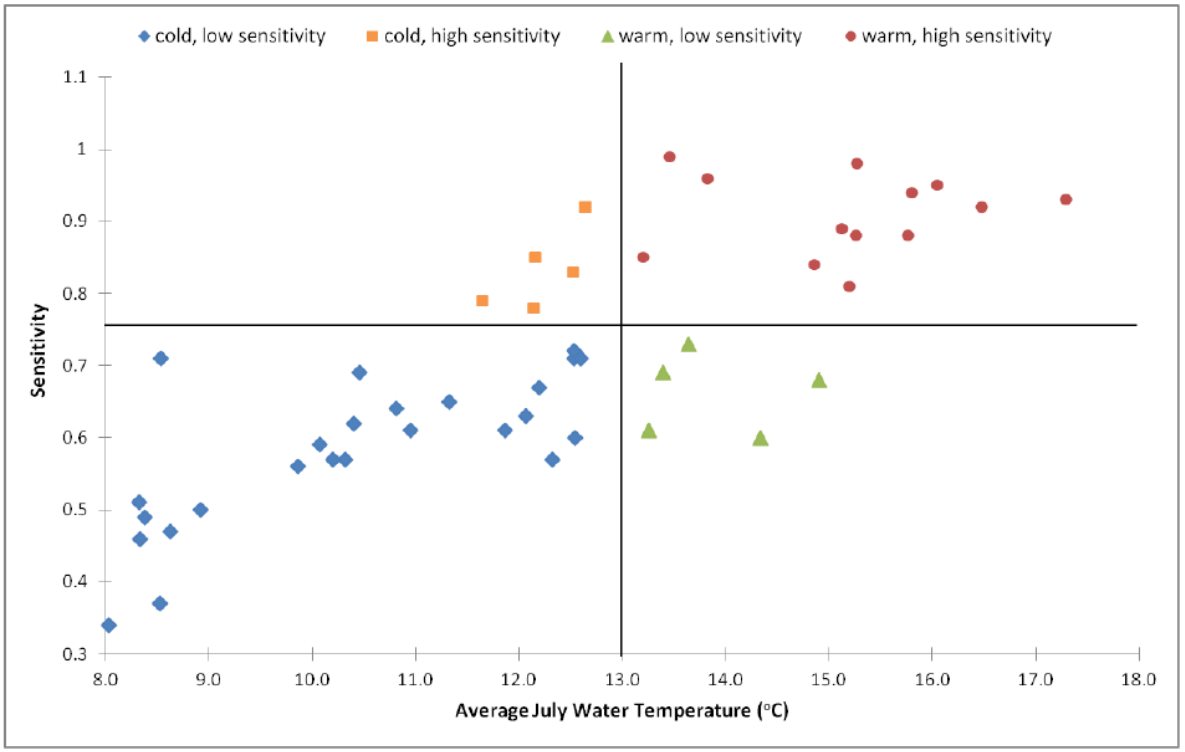


Figure 3. Framework for assessing climate change vulnerability based on threshold values of 13°C for average July water temperature and 0.75 for sensitivity.

Cook Inletkeeper stream classification (Mauger 2013)

R2 Resource Consultants, Inc.

Temperature Sensitive Sites

Meadow Creek

- Sockeye spawning site
- Above Big Lake
- Medium gravel to sand and silts

Herkimer Creek

- Sockeye observed and potential Coho spawning site
- Above Big Lake
- Medium Cobble to sand and silts

Fish Creek

- Coho spawning site
- Below Big Lake
- Small to medium gravel

R2 Resource Consultants, Inc.

Less Temperature Sensitive Sites

Deception Creek

- Chinook spawning site
- Below ADF&G weir
- Medium cobble to large gravel

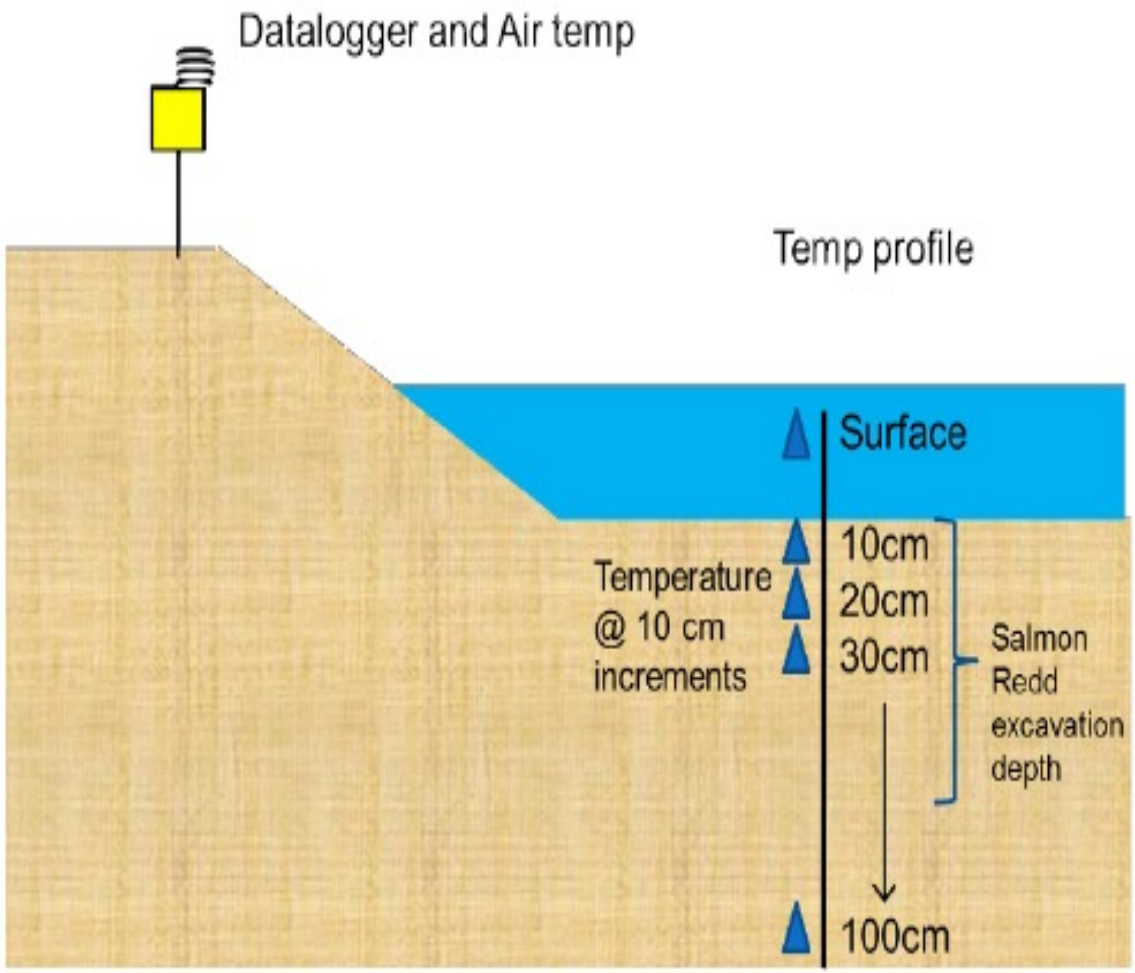
Willow Creek

- Chinook spawning site
- Boulders to large gravel

Montana Creek

- Chinook, Chum, and Pink spawning site
- Near old ADF&G weir location
- Medium cobble to small gravel

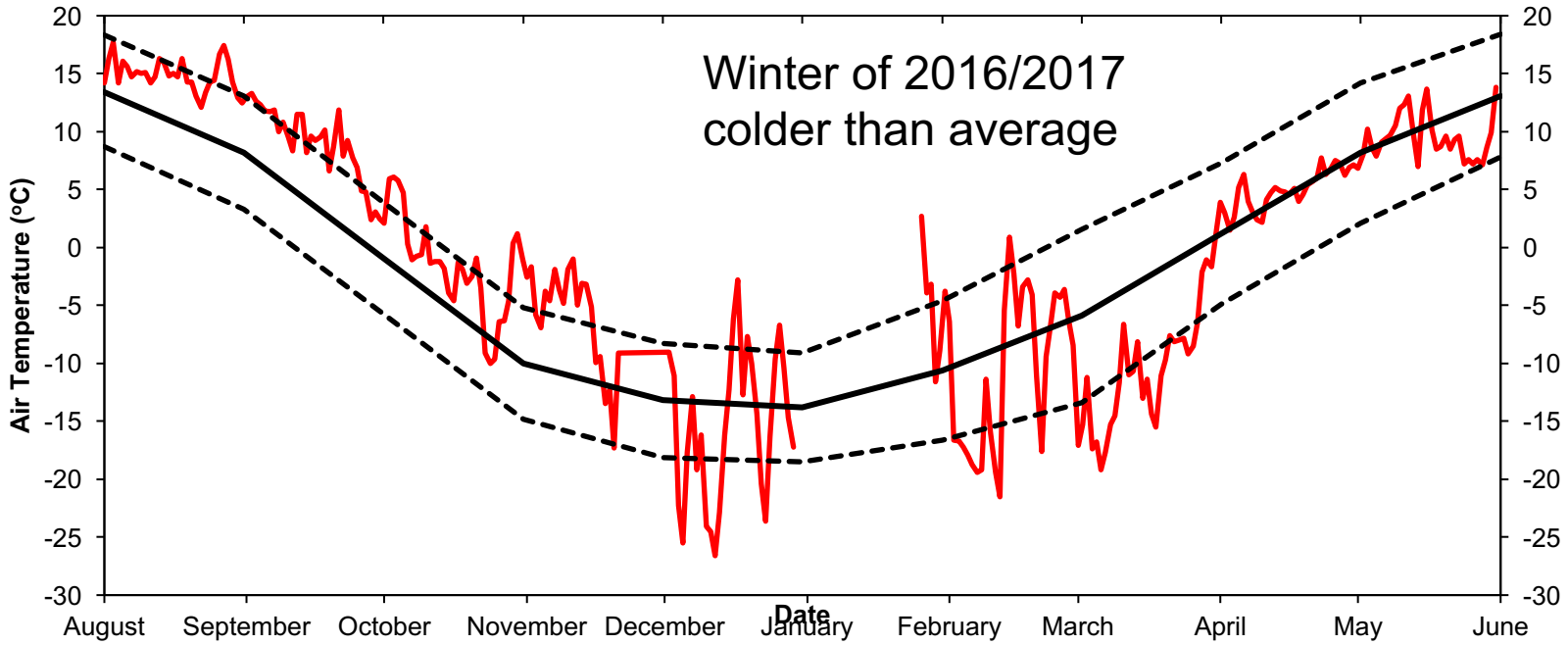
Sensor Installation Aug 2016



R2 Resource Consultants, Inc.

A Look Into The First Year

Daily Average Air Temperature from August 2016 though May 2017 and Historical Monthly Mean, Minimum, and Maximum Temperatures Willow, Alaska



Willow Alaska Station # USR0000AWLL. Data was accessed through NOAA's National Centers for Environmental Information

R2 Resource Consultants, Inc.

Cold, Low Sensitivity Sites

- Willow Creek (top) and Deception Creek (bottom)
- Relatively low summer surface temperatures (mean <13C)
- Little groundwater influence above 60cm

Warm, High Sensitivity Sites

- Herkimer Creek (top) and Fish Creek (bottom)
- Relatively high summer surface temperatures (mean >15C)
- Small discernable groundwater influence at Fish Creek

Meadow Creek

- Classified by CI as warm, high sensitivity
- Relatively low summer mean temperature (13C)
- Clear groundwater influence on intergravel temperatures

Summary

- Intergravel temperature strings with telemetry successful: limited data loss and survived ice break-up

R2 Resource Consultants, Inc.

Summary

- Summer surface water observations of temperature sensitivity similar to Cook Inletkeeper's at most locations

- Average summer surface water and intergravel temperatures >15°C at most locations in Big Lake Basin Streams and <12 °C in study streams draining W side of Talkeetna Mountains

- Most monitoring sites had little groundwater influence (<1°C during winter) emergence of surviving embryos most likely delayed

Summary

- Two monitoring locations in streams identified by Cook Inletkeeper's as high-temperature sensitive did not have buffering groundwater

- One monitoring location (Meadow Creek) identified as high-temperature sensitive was Groundwater influenced year-round resulting in cooler summer water surface temperatures and warmer winter intergravel temperatures at egg incubation depths

- Spatial variability of groundwater influence may provide important refugia for salmonids during summer /winter temperature extremes in air temperature sensitive MatSu streams

Questions?

R2 Resource Consultants, Inc.

- Zimmerman, C.E. and Finn, J.E. 2012. A simple method for in situ monitoring of water temperature in substrates used by spawning salmonids. Journal of Fish and Wildlife Management, 3(2), pp.288-295.
- Mauger, S. 2013. Stream Temperature Monitoring Network for Cook Inlet Salmon Streams 2008-2012. Synthesis Report for Alaska Department of Environmental Conservation and U.S. Fish and Wildlife Service. 33 pp.
- Mauger, S. Shaftel, R, Leppi, J.C., and D. Rinella. 2016. Summer temperature regimes in southcentral Alaska streams: watershed drivers of variation and potential implications for Pacific salmon. Canadian Journal of Fisheries and Aquatic Sciences, 2017, 74:702-715.