Southeast Alaska Stream Temperature Monitoring Network

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NORTH PACIFIC LANDSCAPE
CONSERVATION COOPERATIVE

SOUTHEAST ALASKA WATERSHED COALITION
CONNECT - INFORM - PARTICIPATE

Outline

1. Why measure water temperature?
2. Network history
3. Network update
4. Examples of data use
5. Input from you…
6. Methods

WHY MEASURE WATER TEMPERATURE?

Temperature influences aquatic life

- Organisms' growth rates
- Dissolved oxygen concentrations
- Nutrient cycling rates
- Metal toxicity

Stream temperature can affect development of Chinook salmon. The five salmon fry above are from the same family and emerged on the same day, but, as eggs, were exposed to different temperature treatments.

Image from, "Stream Temperature Variability: Why it Matters to Salmon", USFS Pacific Northwest Research Station

Study by Steel & Beckman, USFS PNW Research Station

AK Water temperature standards for fish use

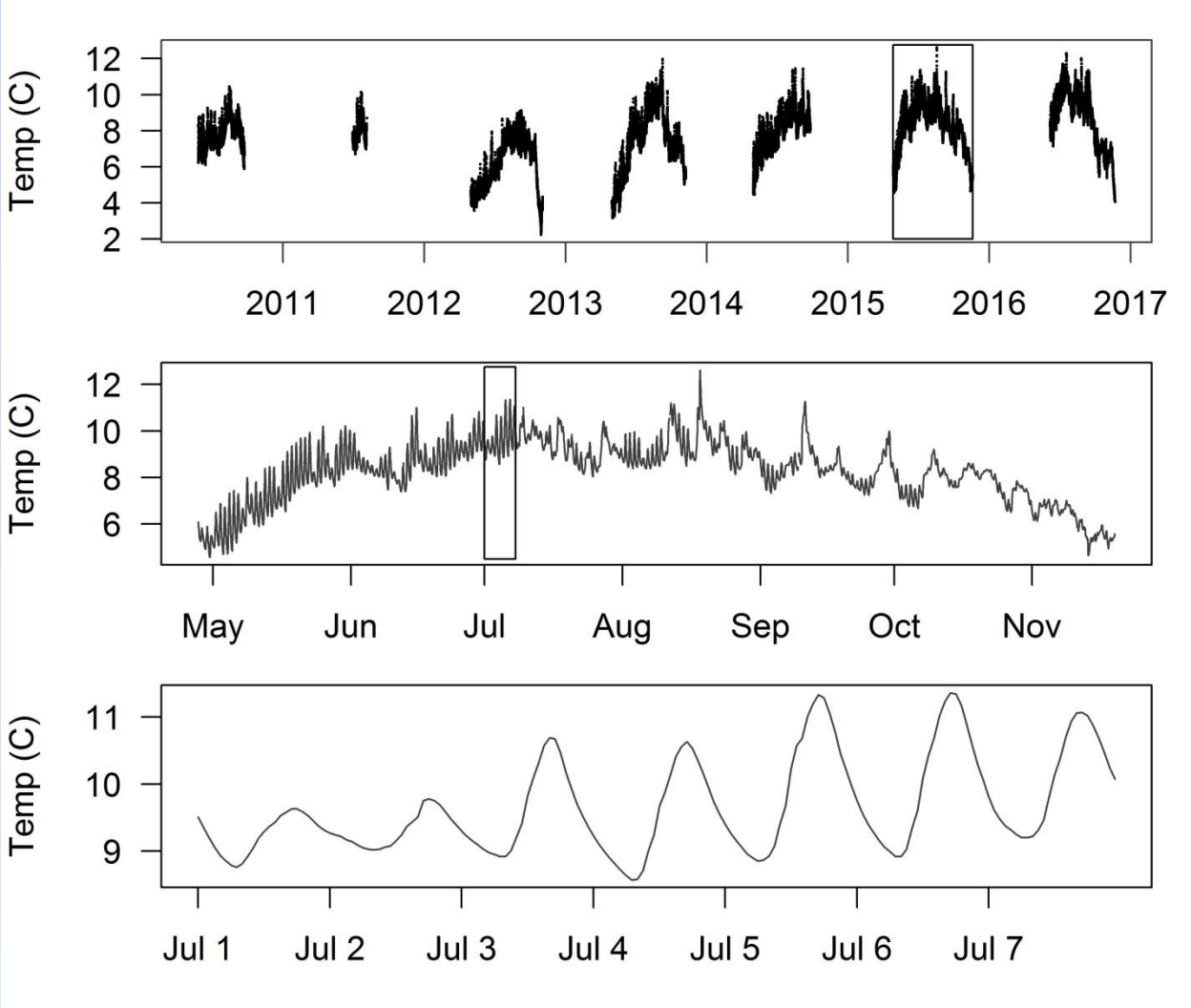
Conditions	Maximum Temp (°C)
Egg and fry incubation	13
Spawning areas	13
Migration routes	15
Rearing areas	15
At any time	20

Temperature is an indicator

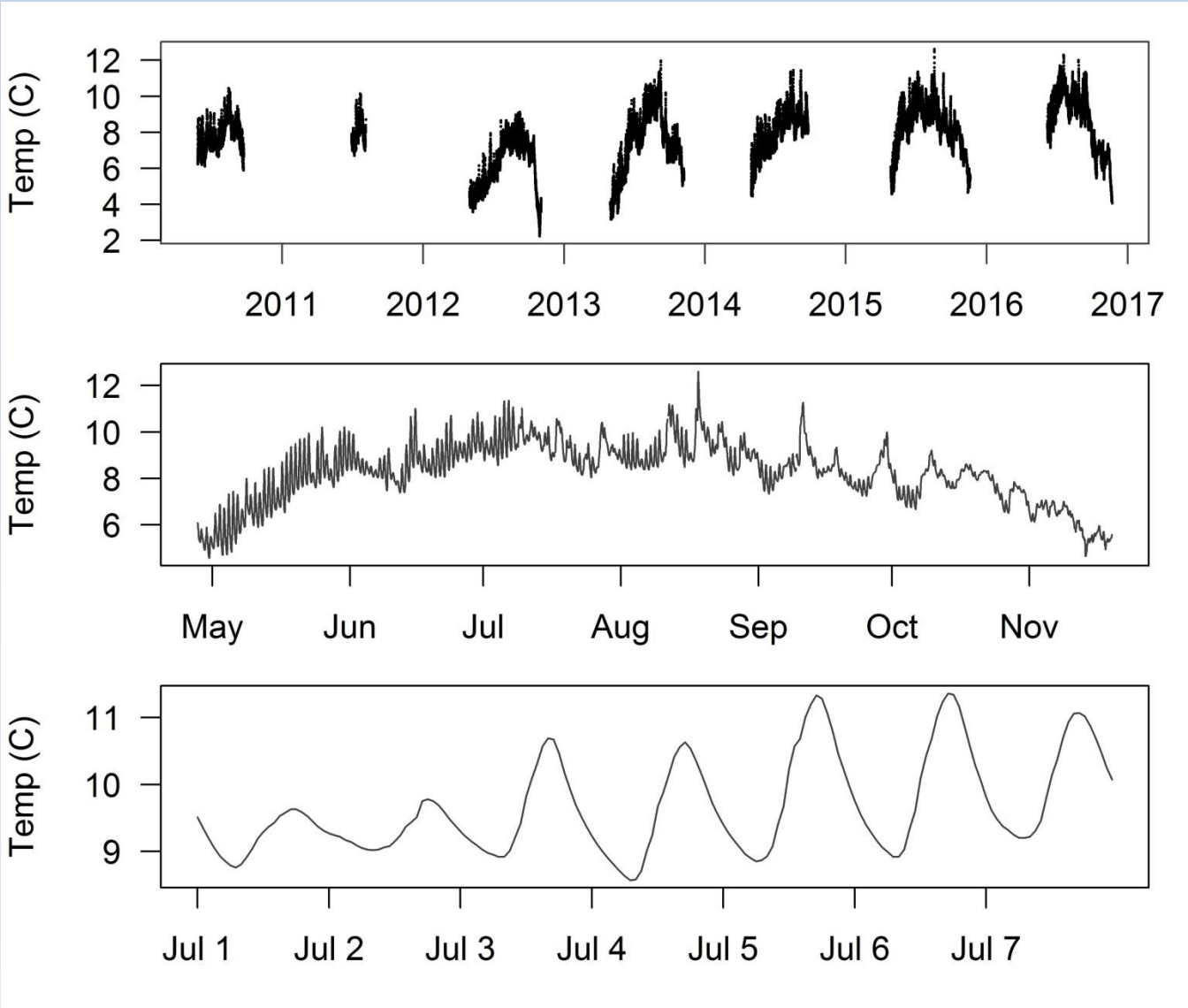
- Integrates effects of watershed characteristics
  - Elevation
  - Slope
  - Air temperature
  - Land cover – wetlands, forests, urbanization
  - Water sources – snow, rain, glacier-melt, ground water
- Changes reflected in water temperature

Temporal Water Temperature Dynamics

- Inter-annual
- Seasonal
- Diurnal



High resolution, long-term monitoring required to capture variability



Why collect stream temperature data now?

- Understand:
  - Suitability of habitat for salmon
  - Intra-annual and spatial variability
  - Inform conservation and restoration priorities

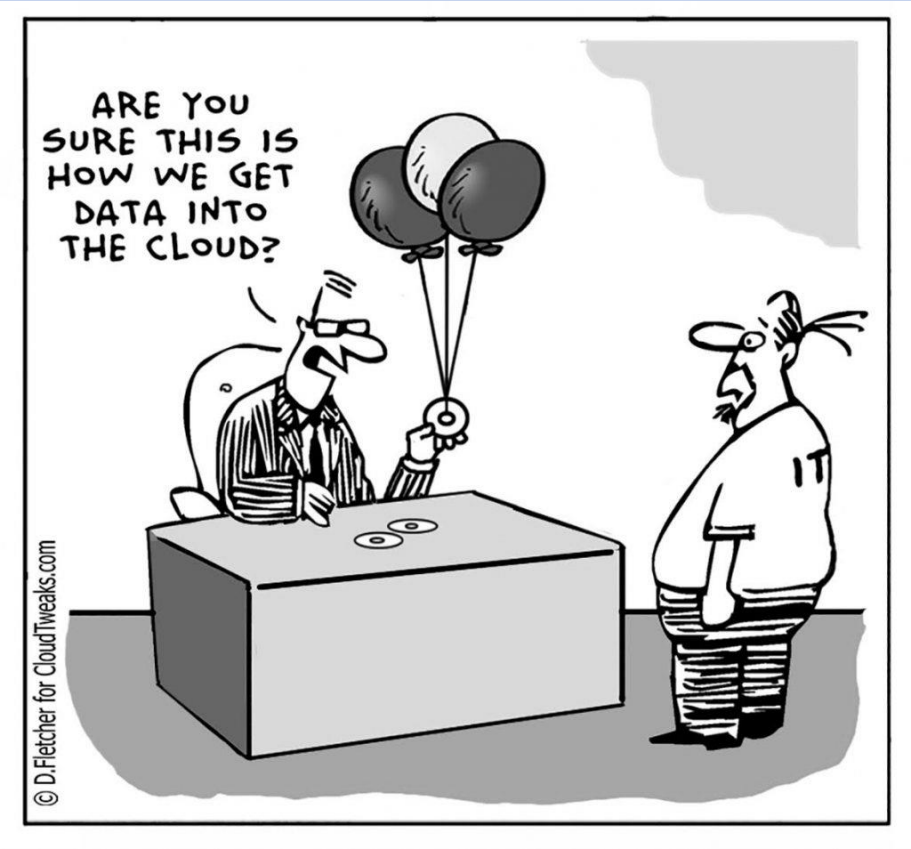
- Baseline to:
  - Define “natural” or “background” conditions
  - compare with future data

What are long-term data useful for?

- Quantifying inter-annual variability
- Tracking change
  - Climate
  - Land cover
  - Restoration
- Correlate with other variables
  - Salmon productivity, migration

To address these questions…

- Data need to be accessible to researchers, managers, stakeholders
- Data need to be high quality and comparable
- We need to capture multiple years of data



Network Origins

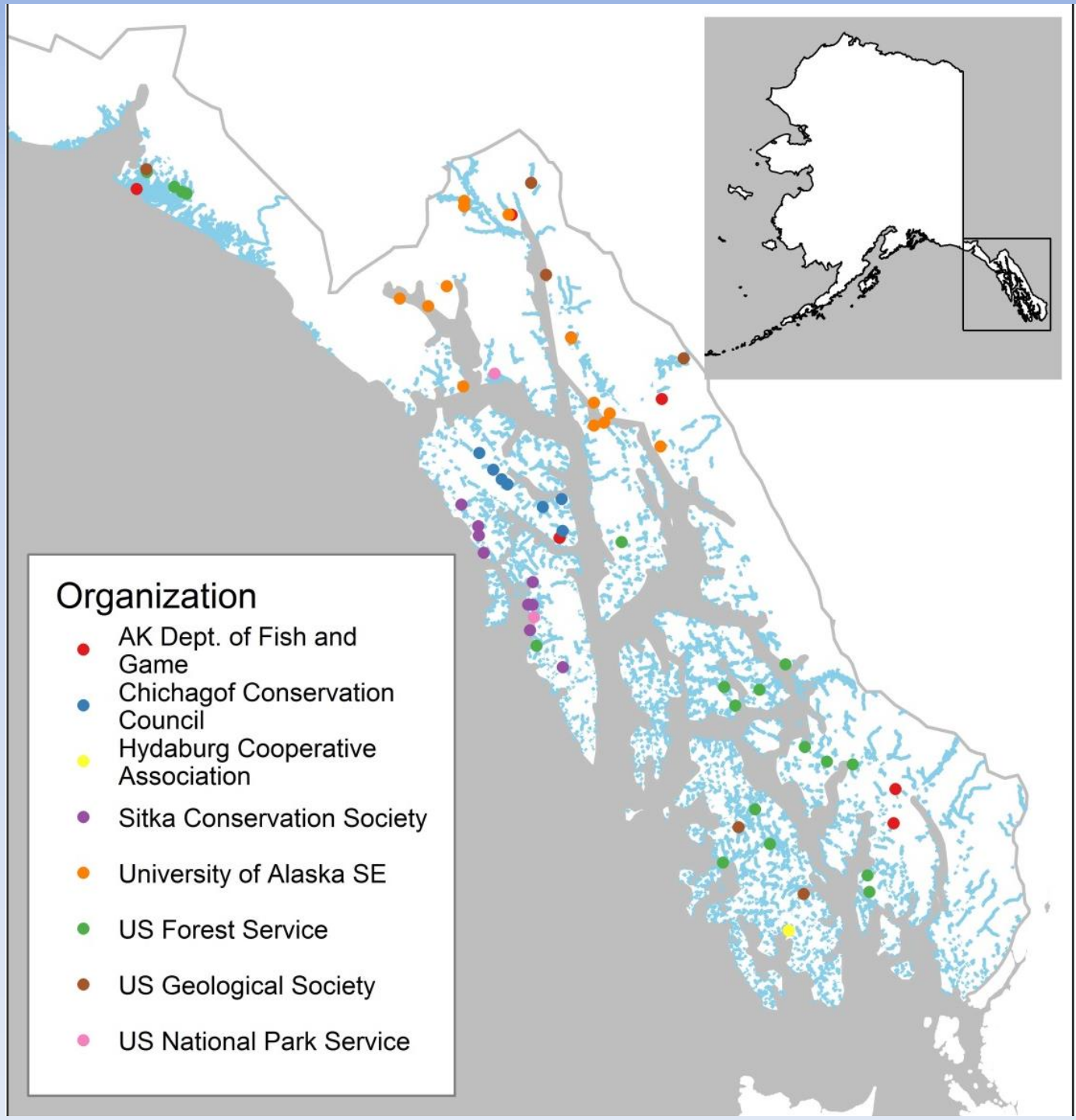
- 2016 Southeast Alaska Climate Workshop –
  - Many people are collecting stream and lake temperature data
  - No easy way to share or access data
  - No agreed-upon methods to ensure data quality across efforts
  - No strategic plan
  - We need baseline data now!

Network Origins

- North Pacific Landscape Conservation Cooperative has provided funds to
  - Engage partners
  - Prevent data loss
  - Adopt minimum standards
  - Formalize the network

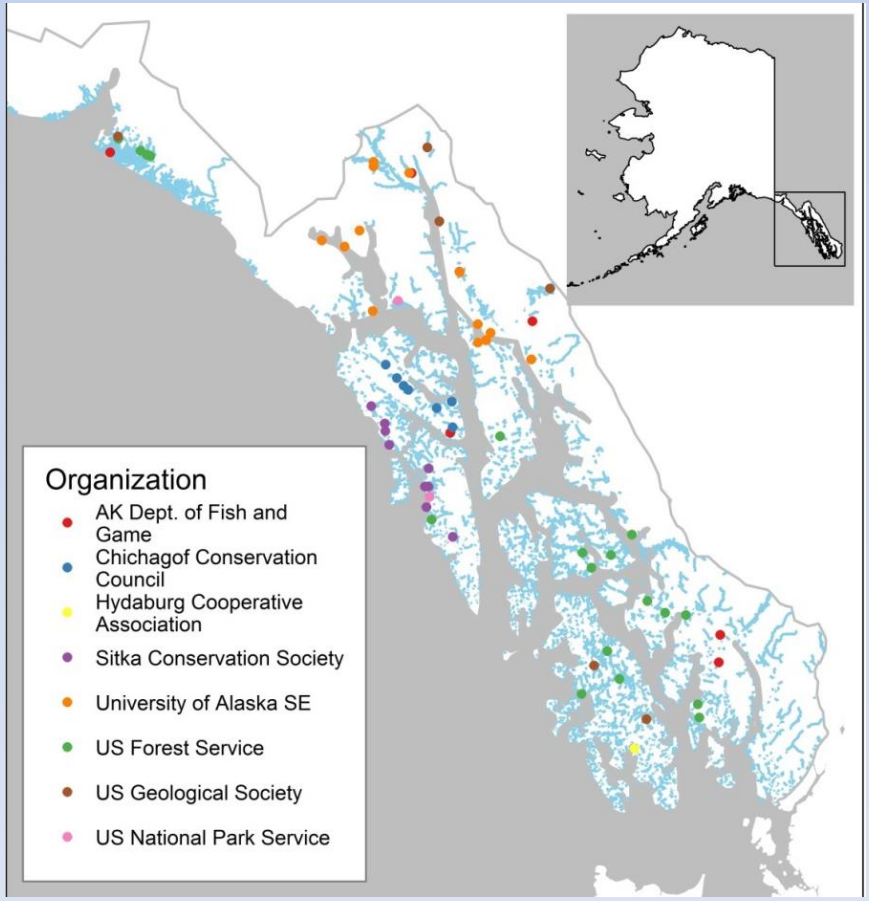
NETWORK UPDATE

Current Sites



Outreach

- Federal
  - Forest Service
  - Park Service
  - Geological Survey
- State
  - Department of Fish and Game
  - University of Alaska SE
- Non-profits and Tribes
  - Chichagof Conservation Council
  - Chilkat Indian Village
  - Chilkoot Indian Association
  - Hoonah Indian Association
  - Hydaburg Cooperative Association
  - Ketchikan Indian Community
  - Sitka Tribe of Alaska
  - Skagway Traditional Council
  - SE AK Watershed Coalition
  - Taiya Inlet Watershed Council
  - Takshanuk Watershed Council
  - Wrangle Cooperative Association



Formalizing the Network

- Identifying Goals
- Memorandum of Understanding
- Strategic Sampling Plan
- Implementation Plan

Regional Networks

- Cook Inlet
- Bristol Bay
- Kodiak Archipelago
- NorWeST (WA, OR, ID, MT, WY)

Western Alaska LCC

Southwest Alaska Salmon Habitat Partnership

Clean Water · Healthy Salmon · Inletkeeper

Bristol Bay Heritage Land Trust

Bristol Bay Native Association

Bristol Bay Regional Economic Development Association

Kodiak Regional Aquaculture Association

NorWeST Stream Temp

Regional Database and Modeled Stream Temperatures

Great Northern Landscape Conservation Cooperative · ACEMS · UAS · USGS science for a changing world · NASA · NOAA · Trout Unlimited · North Pacific Landscape Conservation Cooperative

U.S. Fish & Wildlife Service

SUN'AQ Tribe of Kodiak

Draft Goals

1. increase **data collecting capacity** in Southeast Alaska

2. institute **minimum data collection standard**s to produce data useful for the analysis of local and regional trends

Draft Goals

3. prioritize resources to **initiate and maintain monitoring sites** in streams that
   - support subsistence resources
   - are at risk of climate-change impacts
   - fill critical information gaps in terms of watershed characteristics and spatial distribution

Draft Goals

4. update and submit site-specific metadata annually
5. provide public access to water temperature data
6. compliment and leverage other monitoring efforts

Draft MOU

Signatories agree to:

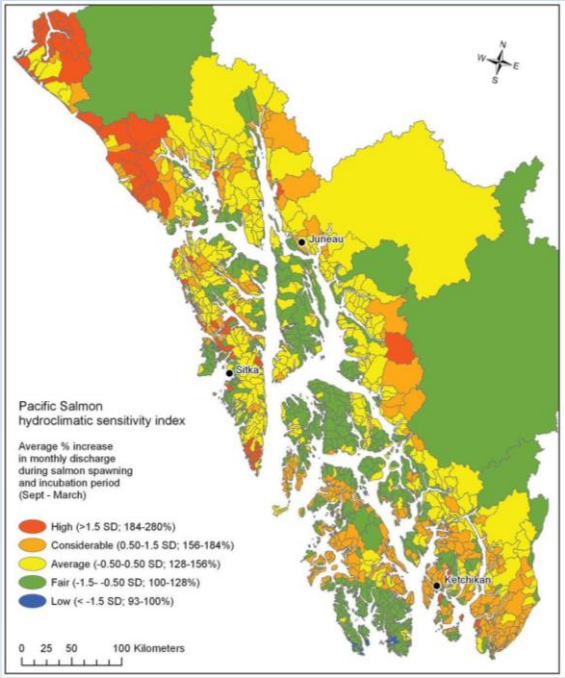
- Goals and objectives
- Meet minimum standards
- Share data and metadata regularly

Are responsible:

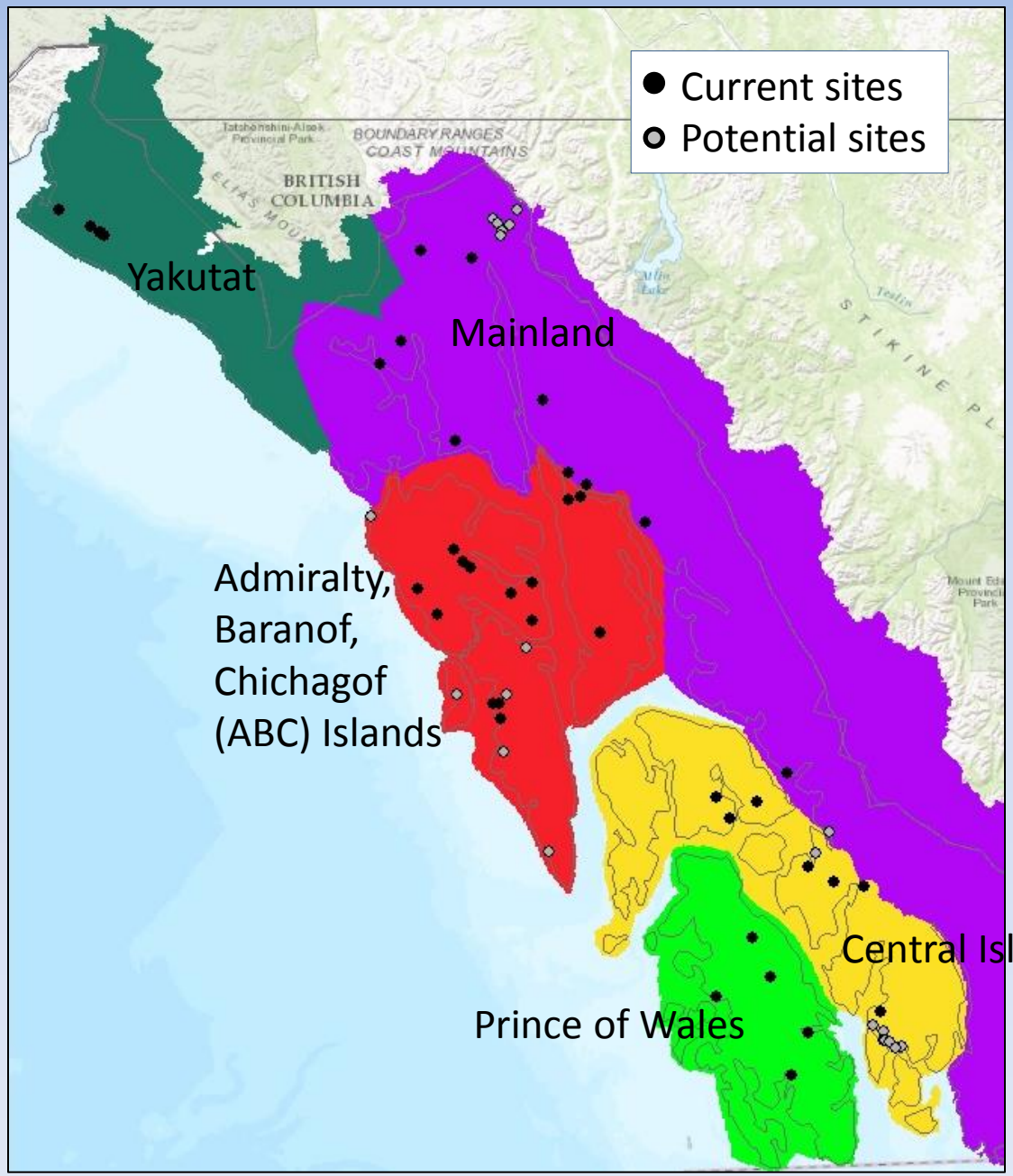
- To own governing body
- For own funds, equipment, personnel

Strategic Sampling Plan

- Multiple criteria and priorities:
  - Importance to local communities
  - Accessibility
  - Climate vulnerability
  - Fill gaps in types of systems regionally
    - E.g. elevation, land cover

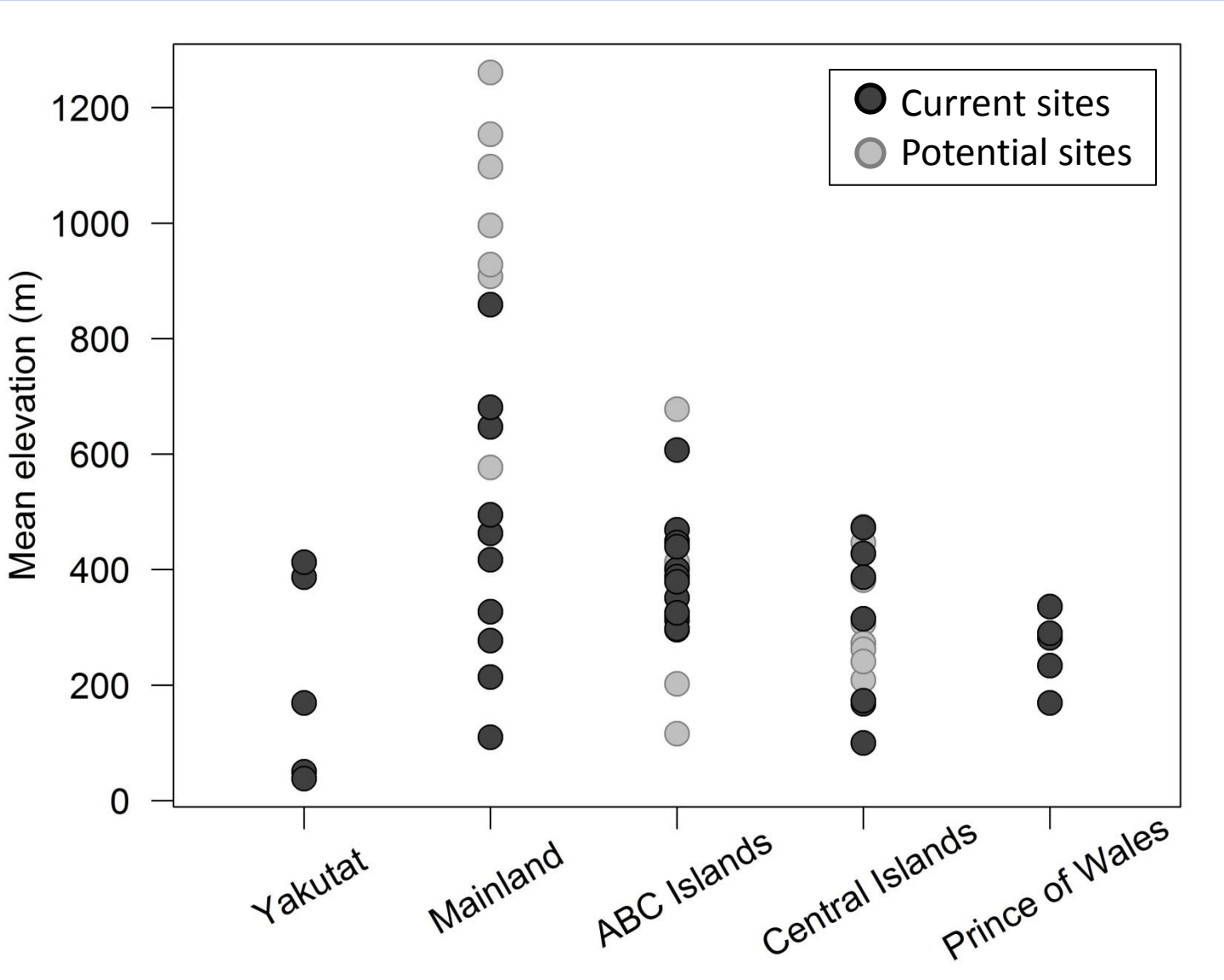


Spatial Stratification

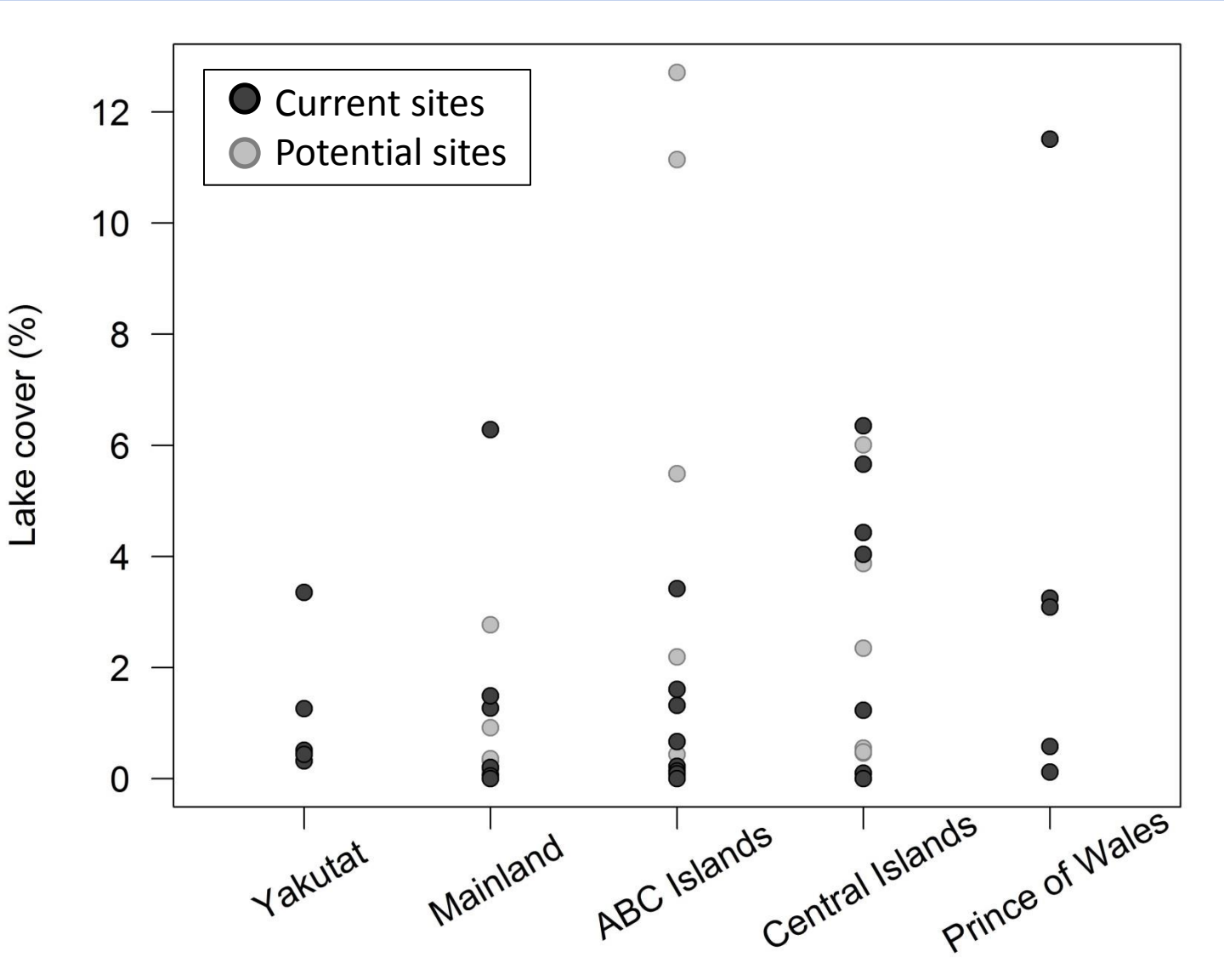


Biogeoclimatic Zones (TNC, Shanley et al. 2015)

Elevation


Current sites
Potential sites
Mean elevation (m)
0
200
400
600
800
1000
1200
Yakutat
Mainland
ABC Islands
Central Islands
Prince of Wales

Lake cover


Current sites
Potential sites
Lake cover (%)
0
2
4
6
8
10
12
Yakutat
Mainland
ABC Islands
Central Islands
Prince of Wales

What about Lakes?

- We’re not ignoring them!
- Not explicitly included in the strategic sampling plan
- Region-wide methods for these haven’t been “accepted”
- Data and metadata can be included in repositories

Data Sharing

- Statewide –
  - Alaska Online Aquatic Temperature Site (AKOATS) for metadata
  - National Center for Ecological Assessment and Synthesis (NCEAS) project to house data

SOUTHEAST ALASKA GIS LIBRARY

- Regional – SE AK GIS Library (University of Alaska Southeast)
  - will house metadata AND data for regional partners

Participation

- Voluntary cooperation
- Provide input on how the network should operate
- Monitor own sites and/or support other sites

Please return survey if interested…

Adoptable Sites – Haines area

Adoptable Sites – Juneau area

Adoptable Sites – Prince of Wales Island

EXAMPLES OF DATA USE

Tenakee Inlet

Chichagof Conservation Council

Goals:

- Document observed changes in snowmelt and summer stream temperatures
- Protect cold-water watersheds from logging

Now have 10 + years of data – quantitative information about how streams are functioning

Regional Stream Temperature Drivers

UAS, Forest Service

- Region-wide study with 47 watersheds
- 1 year of data
- Lake and forest cover, watershed slope were primary drivers
- air temperature sensitivity related to slope and lake cover

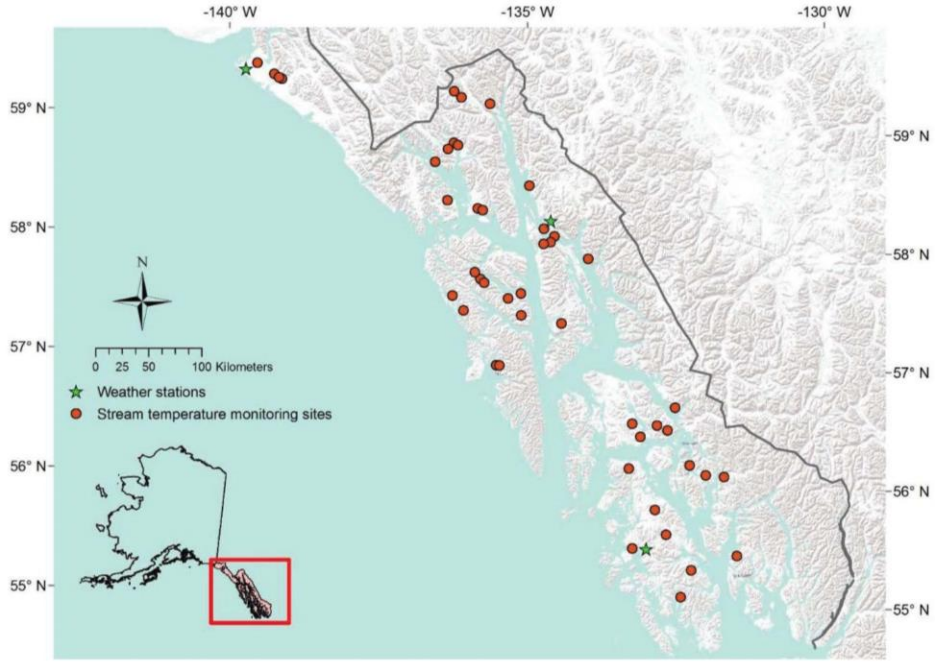


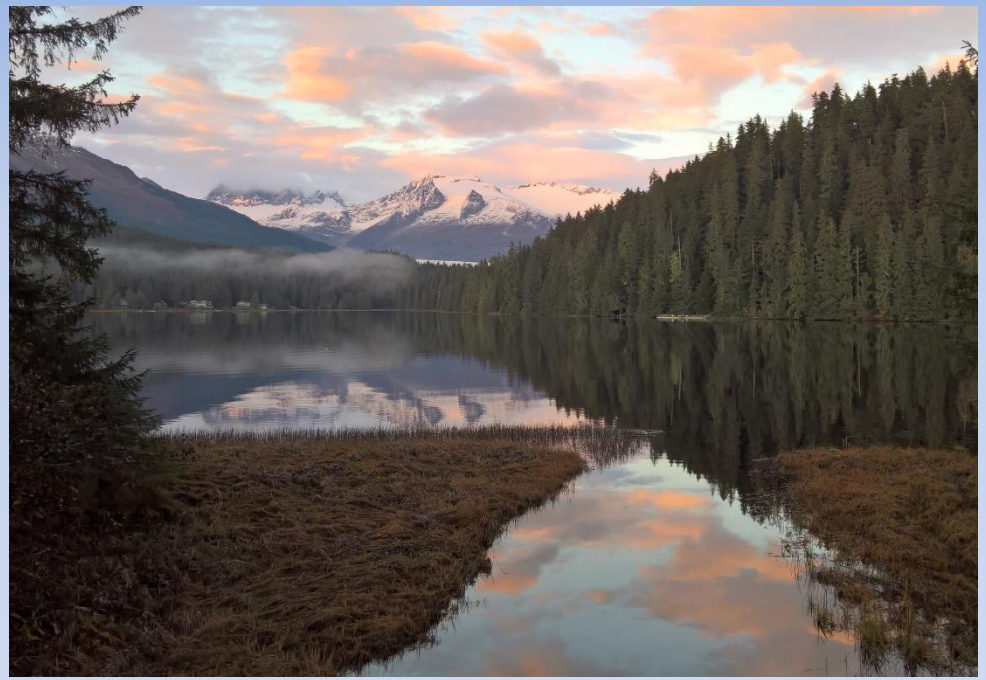
Figure 1. Study site locations and National Weather Service climatological stations in southeast Alaska.

Figure from M. Winfree thesis, 2017

Auke Creek
UAF, NOAA

- Stream temperature and salmon migration timing monitored for decades

- Earlier migration of adult coho and juvenile pink correlated with increasing temperatures



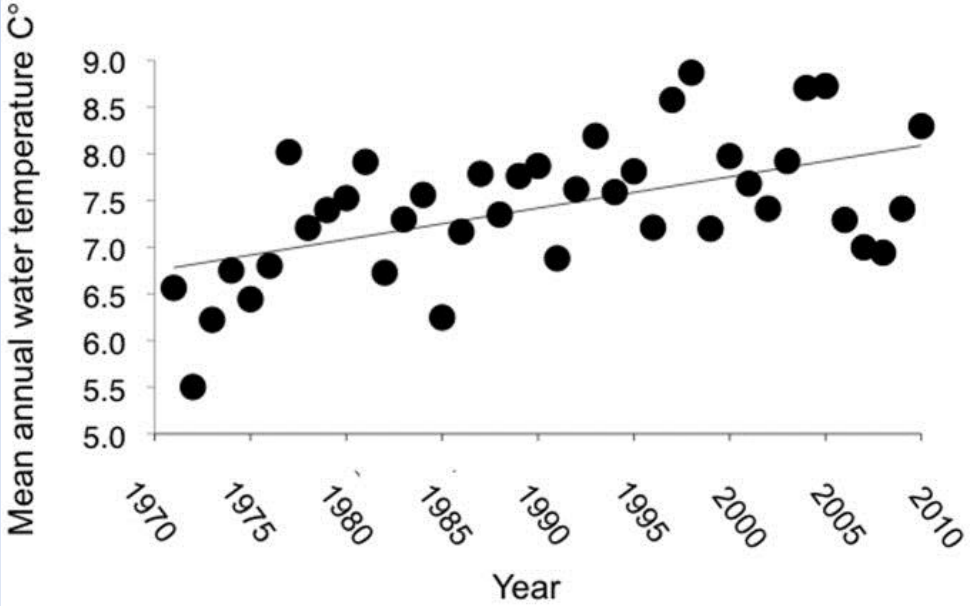


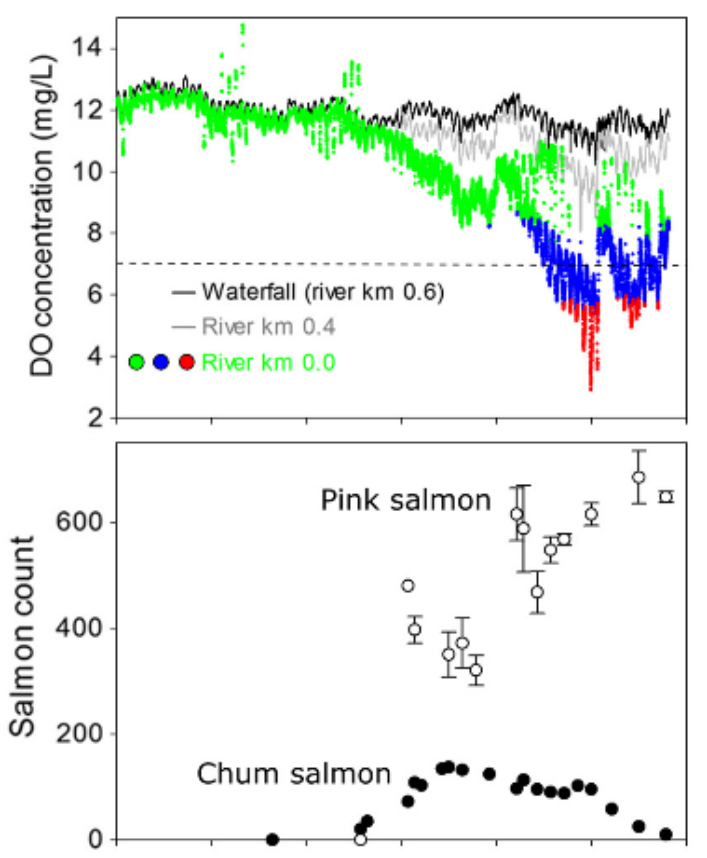
Figure from Kovach et al. 2013, PloS One

Indian River and Sawmill Creek

NPS, Forest Service, UAF, UBC

- 1-5 years of data – temp, DO, fish counts, stream flow

- Hypoxic events related to
  - warm temperatures +
  - low flow +
  - high salmon densities



Sergeant et al., 2017, EcoSphere

Potential Future Uses

- How are stream temperatures changing regionally?
- How will future climate change affect local and regional aquatic resources?
- Which watersheds are expected to be resistant to climate change, and should we prioritize them for protection?
- Can restoration activities mitigate risk in other watersheds?

QUESTIONS?

GOALS AND OBJECTIVES

The goal of the Southeast Alaska Stream Temperature Monitoring Network is to collect water temperature data which meet the information needs of individual cooperators while simultaneously generating data that contributes to an understanding of regional temperature patterns and trends.

Short-term (3-5 year) objectives

- increase data collecting capacity in Southeast Alaska;
- institute the use of minimum data collection standards to produce data useful for the analysis of local and regional trends;
- prioritize resources to initiate and maintain monitoring sites in streams that
  - support subsistence resources
  - are at risk of climate-change impacts
  - fill critical information gaps about relationships between geomorphic characteristics and temperature patterns
- update and submit site-specific metadata annually to the Alaska Online Aquatic Temperature Site project (a statewide metadata clearinghouse) and metadata and data to the Southeast Alaska GIS Library (a regional clearinghouse for spatial data);
- provide public access to water temperature data;
- compliment and leverage other monitoring efforts.

Longer term (5-20 year) objectives

- describe current temperature patterns across a range of stream types;
- identify geomorphic controls on thermal profiles;
- describe projected water temperature trends under different climate scenarios;
- understand impacts on salmon and other species of regional significance; and
- provide reliable temperature data to support development of proactive approaches to managing salmon stocks in response to climate change.

MOU Text

- The purpose of this Memorandum of Understanding (MOU) is to establish a framework for cost-efficient communication and coordination of a network among public and private sector organizations that have interest in acquisition of water temperature data in Southeast Alaska. Signatories of this MOU, hereafter referred to as “Cooperators” may consist of private, municipal, state, federal, and tribal entities with an interest in stream temperature data collection. Cooperators will benefit from shared resources, combined expertise, shared responsibilities, unified strategy, consistency of methods, and collective results.

Areas of Agreement

Signatories shall agree to support Goals and Objectives as outlined in "Implementation Plan: Southeast Alaska Water Temperature Monitoring Network" as well as share knowledge and resources where feasible.

Furthermore, they shall agree to:

- Meet minimum standards and protocols to ensure the quality and comparability of water temperature data;
- Share metadata and data:
  - Provide metadata and data to the Southeast Alaska GIS library (a Southeast-specific library of spatial data maintained by the University of Alaska Southeast);
  - Update and submit site-specific metadata annually to the Alaska Online Aquatic Temperature Site (a statewide metadata clearinghouse) and the Southeast Alaska GIS library (a Southeast-specific library of spatial data maintained by the University of Alaska Southeast);
  - If a statewide Data Clearinghouse is established, copies of metadata and data will be provided to the organization responsible for operation of the Clearinghouse;
  - Provide copies of metadata and quality-controlled data to requesting entities and members of the public and/or direct them to the Southeast Alaska GIS library, which will make metadata and data available;
- On behalf of Cooperators, the Network Coordinator may lead development of grant applications and subsequent coordination of approved grant funds to support implementation of the network plan.

Independent Responsibilities

Each Cooperator is:

- Responsible to its own governing body;
- Responsible and accountable for its own funds, equipment, and personnel;
- Shall assume no responsibility for network-scale analysis of data or reporting of results from such analysis.

Modification and Termination

- This agreement will be effective from the date of signature of at least two Cooperators. Any Cooperator may terminate their involvement via written notice to the Network Coordinator.

- This MOU may be amended as necessary by mutual consent of the Cooperators by execution of a written amendment signed and dated by a majority of Cooperators.

- This MOU will be reviewed every three (3) years and updated as necessary.

METHODS

Stream Temperature Data Collection Standards and Protocol for Alaska:

Minimum Standards to Generate Data Useful for Regional-scale Analyses

Alaska Natural Heritage Program
University of Alaska Anchorage

December 2014

Equipment Costs

- For one site – $706
  - 2 loggers per site + NIST-certified logger
  - Housing and cabling for logger installation
  - Shuttle (for downloading data)

- Each additional site – $278
  - 2 loggers and housing/cabling

Methods and Protocols Overview

- Accurate sensors
- Year-round or open-water season data
- Hourly monitoring
- QA/QC procedures for equipment and data handling

Methods and Protocols Overview

Hobo TidbiT V2
$133

Hobo Temp Pro V2 -
$129

Data Logger	Data Collection
Accuracy	Sample Frequency
Range	Duration
+/- 0.25°C	60 minutes
- 4°C to +37°C	minimum 1 month data

Methods and Protocols Overview

Quality Assurance		
Accuracy Checks	Site Selection	Data Evaluation
✓		
checks at 0°C & 20°C pre and post deployment, field checks	5 cross sectional stream temps	remove data errors

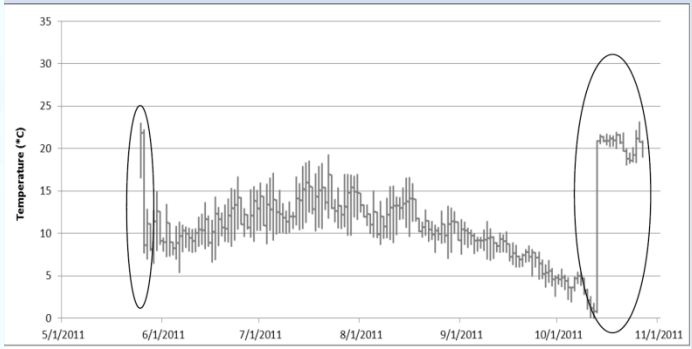
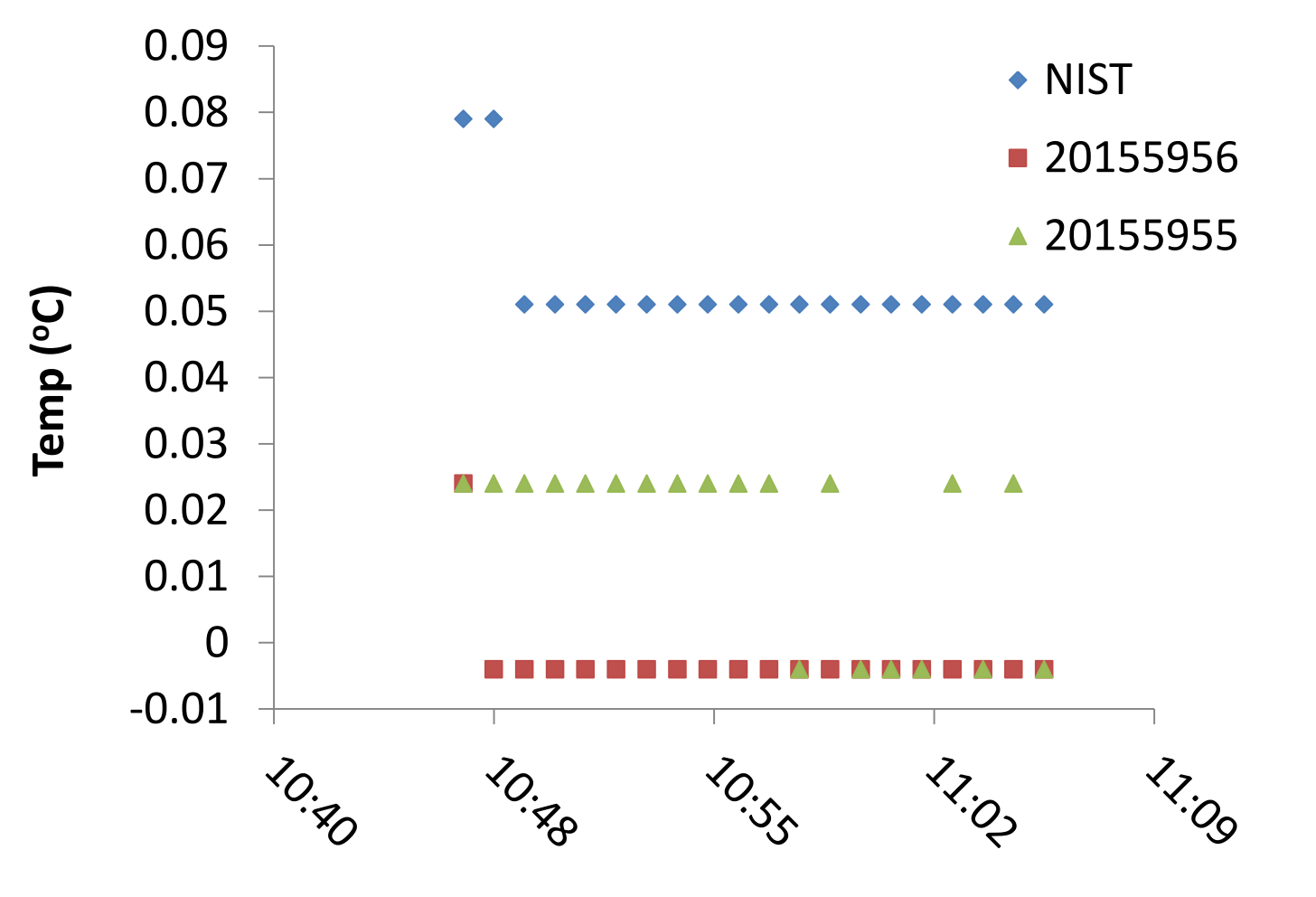
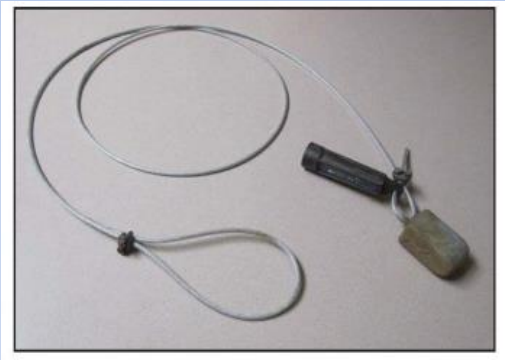


Figure 2. Example of raw water temperature dataset with air temperature data collected before and after the deployment period (circled).

Accuracy Check



Installation



Methods and Protocols Overview

Data Storage		
File Format	Metadata	Sharing
		
.csv format in 2 locations	unique ID, source agency, contact info, lat/long, datum, freq.	quality-controlled hourly data; compiled daily max, mean, min