Interim Performance Report

1. PROJECT INFORMATION

Title	Strategic plan for voluntary, network-based water temperature monitoring of salmon habitat in the Kodiak Archipelago, Alaska
LCC Project ID (Award No.)	WA2014-31 (NA/001)
Report period	January 1 to December 31, 2016
Project End Date	September 31, 2017
Report Submission Date	December 27, 2016
Authors of Report	Bill Pyle in collaboration with Cooperators of the Kodiak Archipelago Water Temperature Monitoring Network (Bobbi Anne Barnowksy, Alutiiq Tribe of Old Harbor; Heather Finkle, Alaska Department of Fish and Game; Mary Nelson, Larsen Bay Tribal Council; Thomas Lance, Sun'aq Tribe of Kodiak, and Trenten Dodson, Kodiak Regional Aquaculture Association).

Principal Investigator and Recipient Organization:
Bill Pyle, USFWS Kodiak National Wildlife Refuge, Bill_Pyle@fws.gov, 907-487-0228

2. PROJECT OVERVIEW

a. Briefly (4-5 sentences) describe both the project purpose and the underlying need for this project.

In December 2014, the Western Alaska LCC approved a strategic plan for implementation of voluntary network-based water temperature monitoring of salmon habitat in the Kodiak Archipelago (Pyle et al. 2014). As stated in this plan, the goals of the network are to "Coordinate the acquisition of water temperature data that meets the salmon management needs of cooperating (networked) organizations, meets minimum data collection standards, and is publically-accessible." Our focus on monitoring water temperature reflects recognition of the importance of salmon to the economy and ecosystem of the archipelago; the pervasive influence of temperature on salmon; and the need to provide reliable time-series data to support development of proactive approaches to management of salmon in response to climate warming.

b. List the objective(s) of the project, exactly as described in your Statement of Work.

- Maintain capacity to monitor water temperature at 21 reference sites (i.e., monitoring sustained at least 20 years) variously located in stream and lake habitat of salmon in the Kodiak Archipelago. Reference sites, and the organizations responsible for data collection at reference sites, are identified in Appendix A of the strategic plan.
- Increase network capacity by providing (a) information on the network, and (b) facilitating data collection by new cooperators.
- Expand the scope of water temperature monitoring to include additional accessible sites where a short-term (i.e., 10 years) record can be acquired to address identified gaps in monitoring of thermal responses of salmon habitat to climate change.
- Strive to maintain a balanced ratio of temperature monitoring sites in streams and lakes (i.e., 50+10%).
- Collection of water temperature data at stream and lake sites will conform to an established protocol; adaptation of protocol to suit local conditions is permitted so long as it is documented in detail.
- Apply and meet or exceed statewide minimum standards for network-based continuous collection of time-series stream temperature data (Mauger et al. 2014). These standards shall also apply, until superseded, to lake temperature monitoring except for stream-specific selection criteria for monitoring sites.
- Upgrade temperature monitoring, as appropriate, to conform to protocol and data standards at sites where monitoring has occurred and where continued monitoring is expected (e.g., salmon weirs).
- To facilitate quality control, develop, distribute, and use a database application to summarize data (daily mean minimum, mean maximum, mean for a given period of record) in tabular and graphical output.
- Submit updated project metadata to the statewide project metadata clearinghouse (i.e., AK-OATS) by the end of each calendar year.
- Absent a statewide data clearinghouse, transmit electronic copies of data to individuals/organizations upon request via a fillable electronic form (accessed at the website maintained by the project metadata clearinghouse).

3. PROGRESS SUMMARY

a. Describe report period progress.

Through 2016 we continued monitoring at the 21 reference sites designated in the 2014 strategic plan and operationally established in 2015. At non-reference sites, the goal is to maintain continuous monitoring for for a sufficient minimum duration 5-10 years) required to establish a statistical relationship between short-term and long-term (reference) monitoring sites.

Network capacity was maintained through the following actions: (a) Pyle was approved to serve another two-year term as Network Coordinator through 12/31/2018; (b) the Refuge continued administration of cooperative agreements with six organizations; (c) the Coordinator maintained routine correspondence with Cooperators including distribution of information on annual work objectives and updating of monitoring standards; and (e) we reviewed and discussed accomplishments, experiences, and future plans at an end-of-year meeting.

Scope of continuous monitoring was maintained at 52 sites established in 2015, consistent with the expansion objective identified in the network's strategic plan (Appendix A). The Refuge integrated an additional four stream sites established by a cooperative research project in 2015. Presently there are 25 lake temperature monitoring sites and 31 stream temperature monitoring sites. This ratio is generally consistent with the objective ratio for lake and stream monitoring sites identified in the strategic plan.

All continuous temperature monitoring has been implemented in accordance with published protocols for Alaskan streams (Mauger et al. 2015) and lakes (Shearer et al. 2015). Documentation of protocols including site-specific details has been ongoing since 2015.

Minimum data collection standards prescribed by Mauger et al. (2015) have been met or exceeded at all sites where continuous temperature monitoring was implemented. Cooperators continued to accrue experience with site-specific monitoring issues and requirements. Where issues were identified, corrective measures taken, and experiences with problem correction shared among cooperators. For details refer to cooperator meeting summary, Appendix B.

As previously reported, monitoring was upgraded in 2015 from manually-operated analog equipment to automated data loggers, and from low frequency (once/day) to high frequency (hourly), at selected sites such as salmon counting weir sites and lake sites subject to long-term limnology sampling.

No database application was developed or distributed as originally planned to facilitate management of temperature data including, especially post-deployment quality control. Accomplishment of this objective has been deferred pending re-establishment of the USFWS data manager position. Meantime we recommend Cooperators purchase and use Hoboware®, propriety software developed for use in conjunction with temperature data loggers, to facilitate accomplishment of post-deployment quality control of data.

Project metadata currently housed in the project metadata clearinghouse (i.e., AK-OATS) is up-to-date except for the Refuge. Five additional sites were submitted by the Refuge and inclusion in the database is presently pending completion of processing by the database manager.

A fillable data request form has been prepared and will be submitted to the AK-OATS clearinghouse in January 2016.

b. Describe preliminary results.

Preliminary results are described in section 3.a. Moreover, results of this project consist of the collective actions taken by the Coordinator and Cooperators to implement the network's strategic plan. Under the terms of this award and project all Cooperators have agreed to make their data available to the public but none are systematically required to externally report results from analyses of continuously collected water temperature data.

c. Publications, conference papers, and presentations.

Network products from 2016 included: a summary of the network meeting held on 22 November 2016 (Appendix B); development and distribution of a comprehensive list of monitoring equipment and supplies; and updating of stream and lake data collection forms. Hosted by the LCC, a public webinar was presented by Sue Mauger and Bill Pyle featuring overviews of Kodiak and Bristol Bay Networks on 10 February 2016.

d. Education and outreach.

Outreach and education in 2016 included distribution of technical information on temperature monitoring, youth participation in data collection activities in Old Harbor, and shared experiences among cooperators at the annual meeting. .

e. Other products resulting from the project.

Nothing to report**.**

f. Data management.

In this project each Cooperator has organization-specific responsibility for management and curation of data. Cooperators have agreed to comply with strategic plan objectives pertaining to protocols and standards that will determine the quality, consistency, and reliability of water temperature datasets. As appropriate, the Coordinator may recommend guidelines and provide tools that facilitate the efficiency of data management, including quality control, as well as data curation. One of the principal values of networked coordination, as described in our MOU, is ongoing communication of data collection and management experience.

g. Describe any concerns you may have about your project's progress.

The primary concern is establishment of funding sources and commitments that can sustain year-to-year temperature monitoring. It is likely that Tribal cooperators will derive some funding support from the Environmental Protection Agency pending approval of quality assurance plans that include water temperature monitoring within a larger framework of water quality monitoring. A cooperative research proposal under development the Alaska Department of Fish and Game (ADF&G) would, if approved, provide partial support of four lake sites monitored by the Kodiak Regional Aquaculture Association (KRAA) and Refuge. Pending availability of dedicated funds, the ADF&G, KRAA, and Refuge have committed to maintain monitoring at sites requiring access for other management purposes.

h. Request for LCC assistance.

Yes, we would appreciate the LCC's continued assistance with partial funding support and identification of potential funding sources of funding.

4. PROGRESS STATUS

a. Overall progress

Primary accomplishments of 2016 included continued success at network plan implementation and improvement in data integrity based on increased understanding of operational requirements of monitoring at different stream and lake sites. Most objectives were accomplished and scheduled commitments were met. Our success is attributed to a well-designed collaboratively developed plan, LCC provision of initial implementation funding, the outstanding cooperation and commitment of networked organizations, and the systematic communication and support provided by a Coordinator. We look forward to continued success and growth of the network in 2017 and beyond.

In 2017, the Coordinator will continue to support collaborative implementation of the network's plan. Increased emphasis will be placed on scoping potential sources of funding to sustain monitoring The Coordinator will continue to serve as the network's representative and liaison regarding statewide efforts to develop a web-based portal for harvesting and hosting publically-accessible water temperature data.

b. Detailed progress made towards completion of tasks and deliverables.

Task/Deliverable	Progress (% completed)
Facilitates network operation via monitoring and coordination of the network's strategic plan.	100
Communicates with Cooperators and interested parties via email, phone, and meetings regarding needs and status of plan implementation, as well	100

as new developments pertaining to data standards, data clearinghouse, cooperator and network functions, etc.	
Organizes training in standards and methods for monitoring stream and lake water temperature consistent with the strategic plan.	100
Develops and deploys a database application tool for quality control evaluation of temperature data collected by the Cooperators.	20
Serves as liaison between the Cooperators and regional entities such as the Western Alaska LCC and, if established, data clearinghouse personnel.	100
Identifies funding opportunities, assists with grant applications as requested, and coordinates any USFWS assistance agreements approved to support implementation of the strategic plan.	80
Accomplishes data collection objectives identified for Kodiak NWR in the strategic plan.	100
In consultation with Cooperators, annually issues a progress report to the LCC and interested parties by December 31. Issues final summary report at the end of the performance period.	100

c. How can the LCC highlight the value of this project?

Current LCC actions and publicity sufficient.

5. LITERATURE CITED

Mauger S, Shaftel R, Trammel EJ, Geist M, Bogan D. 2015. Stream temperature data collection standards for Alaska: Minimum standards to generate data useful for regional-scale analyses. Cook Inletkeeper, Homer, AK and Alaska Natural Heritage Program, UAA, Anchorage, AK.

Mauger S, Shaftel R, Trammel EJ, Geist M, Bogan D. 2015. Stream temperature data collection standards for Alaska: Minimum standards to generate data useful for regional-scale analyses. J. Hydrology: Regional Studies 4:431-438.

Pyle B, Finkle H, Dodson T, Lance T. 2014. Strategic plan for voluntary, network-based monitoring of water temperature of salmon habitat in the Kodiak Archipelago, Alaska. US Fish and Wildlife Service, Kodiak National Wildlife Refuge, Kodiak, AK.

Shearer J, Moore C, Bartz KK. 2015. Monitoring freshwater systems in the Southwest Alaska Network: Protocol narrative. Natural Resource Report NPS/SWAN/NRR—2015/925. National Park Service, Fort Collins, CO.

Appendix A. Continuous stream and lake temperature monitoring sites[1] in the Kodiak Archipelago, Alaska, 2015.

Waterbody Name	Reference Site[2]	Air Temperature Monitoring Site[3]	Administrating Organization[4]
Afognak Lake			ADF&G
Afognak River	yes	yes	USFWS/OSM
Akalura Lake[5]	yes		USFWS/NWR
Akalura River	yes	yes	USFWS/NWR
Ayakulik River	yes	yes	USFWS/NWR
Bear Creek			STK
Big Creek		yes	ATOH
Big Kitoi Lake	yes	yes	KRAA
Buskin Lake[5]	yes		STK
Buskin Lake Trib #1			STK
Buskin Lake Trib #2			STK
Buskin River (bridge 2)	yes	yes	USFWS/OSM
Buskin River (bridge 7)			ADF&G
Canyon Creek	yes		USFWS/NWR
Cascade Creek			USFWS/NWR
Connecticut Creek	yes		USFWS/NWR
Crescent Lake		yes	KRAA
Devils Creek			STK
Dog Salmon Creek (lower weir)	yes	yes	ADF&G
Dog Salmon Creek (upper weir)		yes	ADF&G
East Fork Thumb River			USFWS/NWR
Falls Creek			USFWS/NWR
Frazer Lake			KRAA
Hidden Lake		yes	KRAA
Horse Marine Lake[5]		yes	USFWS/NWR
Karluk Lake[5]	yes	yes	USFWS/NWR
Karluk River (portage)		yes	LBTC
Karluk River (weir)	yes	yes	ADF&G
Lake Catherine[5]			STK
Lake Louise[5]			STK
Little Kitoi Lake			KRAA

Appendix A. (continued)

Status & Waterbody Name	Reference Site	Air Temperature Monitoring Site	Administrating Organization[2]
Little Waterfall Creek		yes	KRAA
Lower Jennifer Lake			KRAA
Lower Olga Lake	yes		KRAA
Margaret Lake			KRAA
Mayflower Lake			KRAA
Olga Creek (upper station)	yes	yes	ADF&G
O'Malley Lake			KRAA
O'Malley River			USFWS/NWR
Pauls Creek (fish pass)		yes	ADF&G
Pillar Creek	yes	yes	KRAA
Pinnell Creek	yes	yes	USFWS/NWR
Red Lake[5]	yes		USFWS/NWR
Red Lake River	yes		USFWS/NWR
Russian River			STK
Ruth Lake			KRAA
Salonie Creek		yes	STK
Sargent Creek			STK
Southeast Creek			USFWS/NWR
Spiridon Lake			KRAA
Telrod Creek	yes	yes	KRAA
Terror River	yes	yes	USGS
Thumb Lake			KRAA
Uganik Lake		yes	ADF&G
Upper Jennifer Lake			KRAA
Upper Malina Lake		yes	KRAA
Upper Olga Lake[5]	Yes	yes	KRAA

[1]Water temperature recorded hourly throughout year at most sites; otherwise hourly temperature monitoring restricted to the open-water season.
[2]Objective is to maintain monitoring for 20 years or more.
[3]Air temperature recorded hourly throughout year at land-based-situated station in waterbody vicinity.
[4]ADF&G (Alaska Department of Fish and Game); ATOH (Alutiiq Tribe of Old Harbor); KRAA (Kodiak Regional Aquaculture Association); LBTC (Larsen Bay Tribal Council); STK (Sun'aq Tribe of Kodiak); USFWS/NWR (U.S. Fish and Wildlife Service/Kodiak National Wildlife Refuge); USFWS/OSM (U.S. Fish and Wildlife Service/Office of Subsistence Management; USGS (U.S. Geological Survey).
[5]Data loggers distributed at multiple lake depths.

Appendix B. Meeting summary, Kodiak Archipelago Water Temperature Monitoring Network, Kodiak, Alaska, 22 November 2016.

All Cooperators presented results of 2016 monitoring actions at the meeting. Below find written summaries provided to the Network Coordinator.

Participants

- Bill Pyle (Network Coord., USFWS/Kodiak National Wildlife Refuge)
- Bobbi Anne Barnowsky (Alutiiq Tribe of Old Harbor)
- Heather Finkle (Alaska Dept. Fish & Game)
- Kelly Krueger (Sun'aq Tribe of Kodiak)
- Mary Nelson (Larsen Bay Tribal Council)
- Tom Lance (Sun'aq Tribe of Kodiak)
- Trenten Dodson (Kodiak Regional Aquaculture Assoc.)

Written Summaries

Alaska Dept. Fish & Game.

Project performance measure: Project task 17. Prepare and deliver to Network Coordinator a ½-1 page written summary of 2016 monitoring actions and recommendations.

Alaska Dept. Fish & Game report. Nine monitoring sites were established by combination of weir and limnological sampling crews. All stream sites were monitored by field staff located at each weir from May through September. All lake sites were checked during each monthly limnological sampling event. Data collected over the 2015-2016 winter monitoring period were down loaded from all loggers when field camps were deployed in late May, 2016. The intact air logger at the Dog Salmon weir was dislodged from its bracket by a fallen tree and was repositioned on another tree in the same location in May, 2016. The Karluk weir air logger was also dislodged from where it was deployed at the weir site and remounted near the cabin site on May 25, 2016. Assurance tests were performed on temperature loggers used to replace existing loggers that were lost (Ayakulik water) or swapped out for data download (Upper Station air).

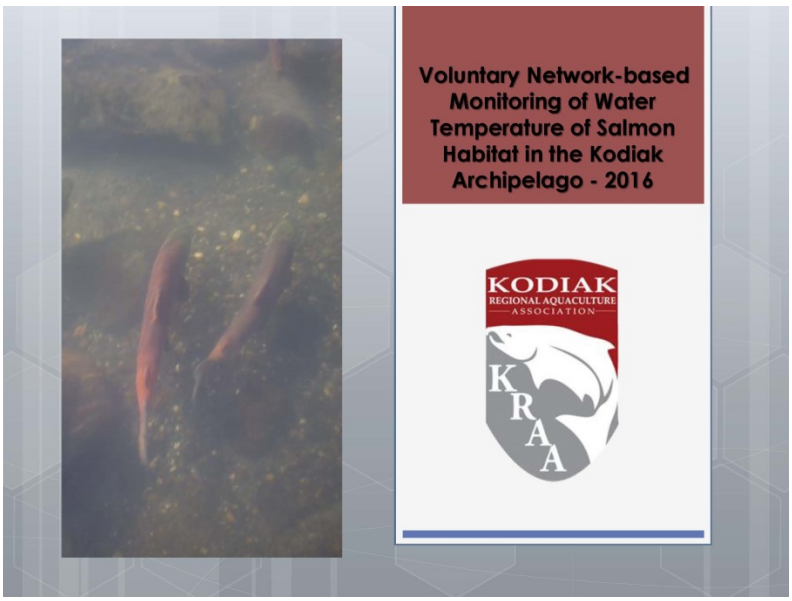
A problem occurred with the Ayakulik air logger during the end of season download causing the crew to return the entire unit. A readout error was occurring and in order to retrieve the data the file had to be sent to an Onset technician. Onset was able to recover the data but there was only one year (exactly 365 days) of data. The dates on the data need to be resolved: the download day shows as having occurred in 2017. We are still looking into the cause of the error.

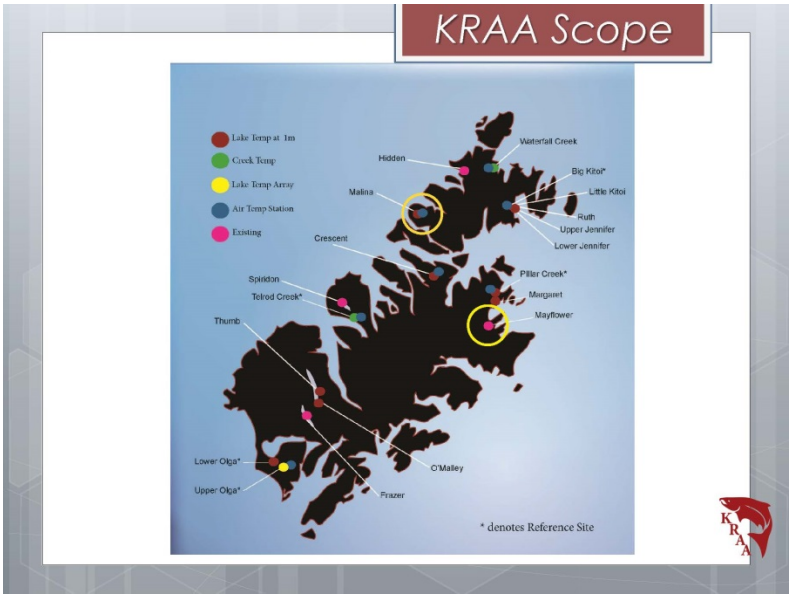
Afognak River, Frazer fish pass, Pauls Bay, and Dog Salmon Creek water temperature loggers survived the initial winter of deployment. Thus, all river water loggers were left to over-winter in 2016, excluding the loggers at Ayakulik and Upper Station. These loggers proved to be vulnerable to fall and winter flooding and a dynamic stream bed, respectively, and were pulled for the winter.
Throughout the field season, weir crew downloaded logger data on roughly a monthly basis. While this increases the amount of data to manage, it did ensure that the loggers were positioned and functioning properly. The only other downside to this is, on rare occasion, there may be small data gaps of a couple days if the logger requires remounting and is not replaced immediately.

Appendix B. (continued)

Following the 2016 summer season of deployment for ADF&G sites, the temperature data were, on a whole, successfully collected. It is recommended to continue monthly data downloads to ensure logger integrity along with deploying a second logger as a redundancy.

Kodiak Regional Aquaculture Association





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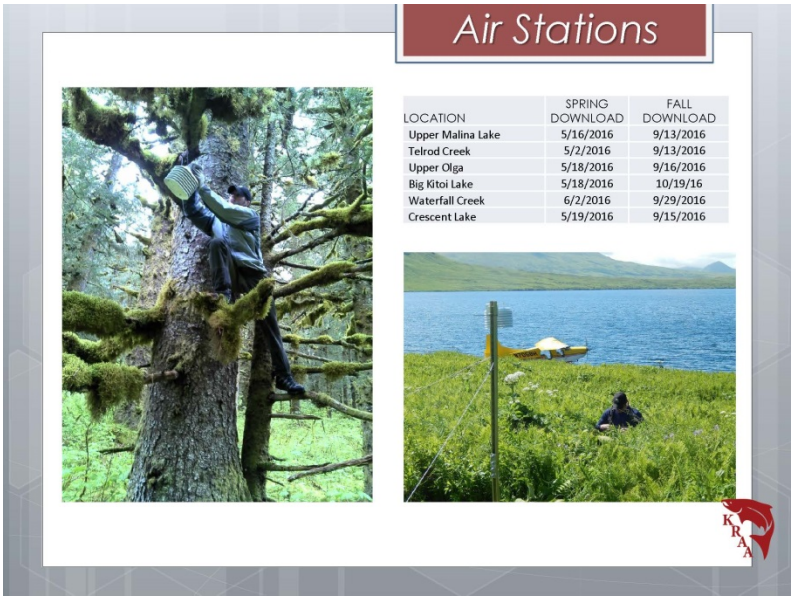

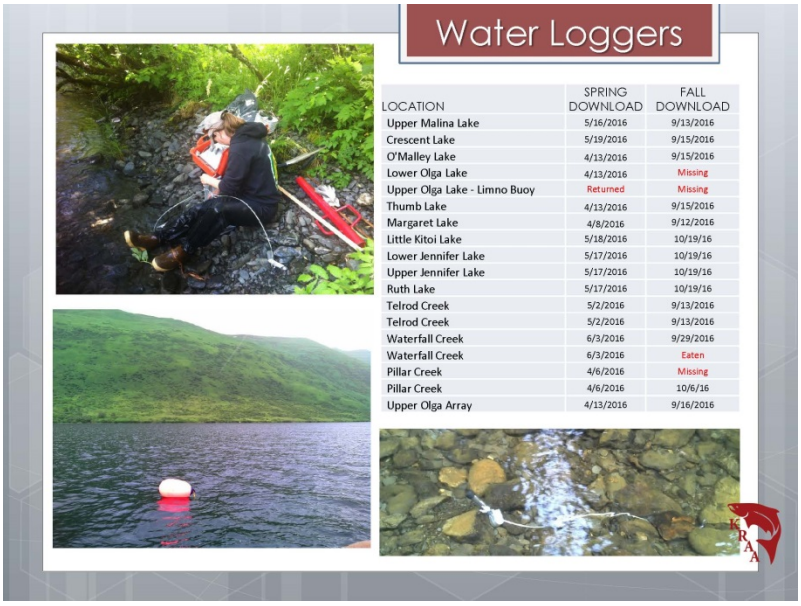

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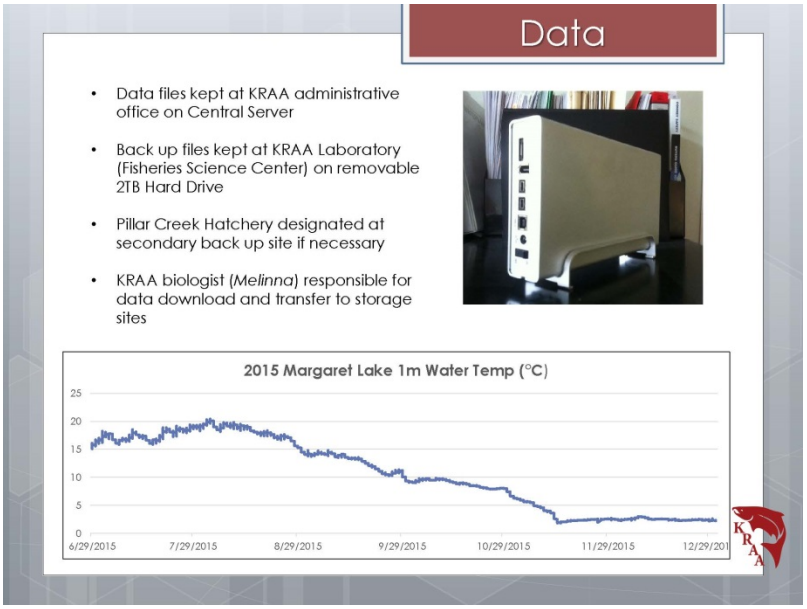

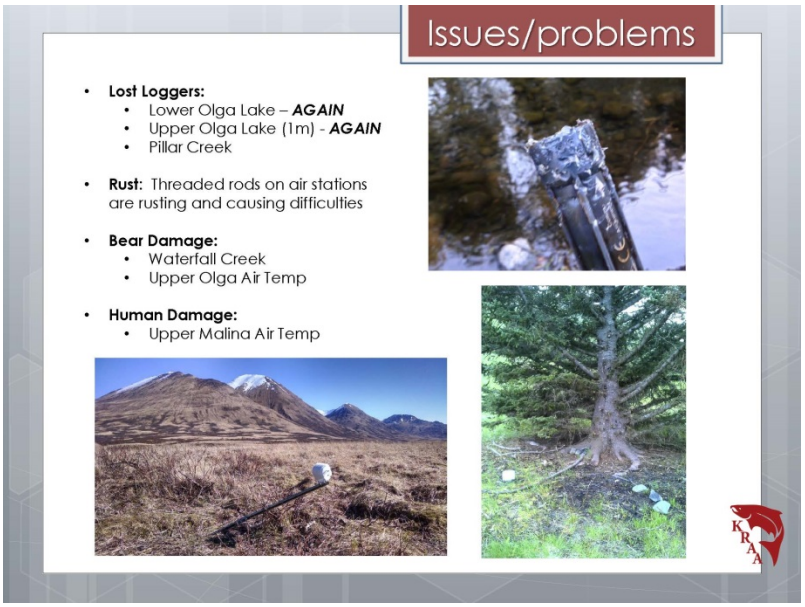

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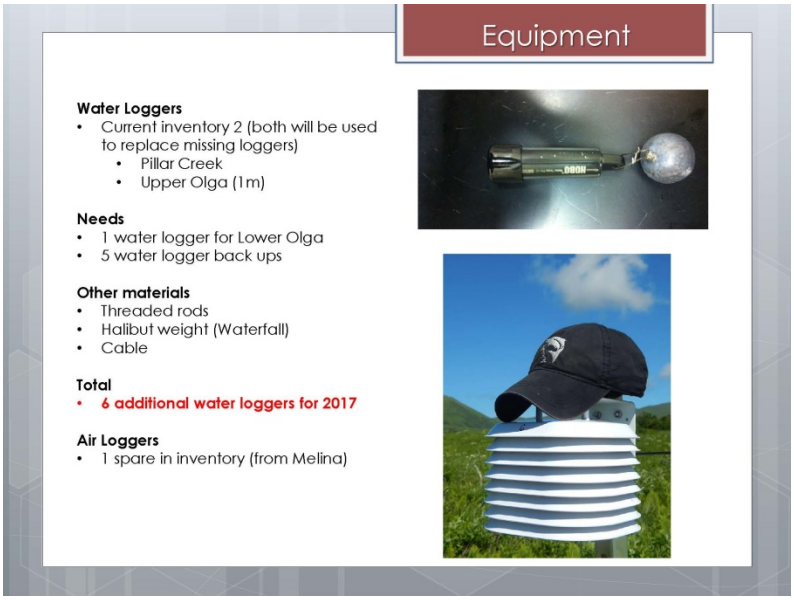

Sun'aq Tribe of Kodiak

Monitoring Actions

Sun'aq Tribe of Kodiak (STK) conducted a quality assurance test of data loggers on April 18. This was followed by the first seasonal maintenance visit, data logger swap and data download on April 26. During this first visit, loggers were located at Salonie Creek (both water and air) and Devils Creek. During a subsequent visit of the other STK sites on May 13, loggers were located at Bear Creek and Buskin Tributary 1.

New temperature loggers (two loggers per site) were installed at Salonie Creek, Russian River, Sargent Creek, and Buskin Tributary 2. Site visits were conducted on May 13 (stream sites), June 8 (Lake Louise and Lake Catherine sites), June 16 (stream sites), September 13 (stream sites) and September 14 (Lake Louise and Lake Catherine sites). The last seasonal maintenance visit to the stream monitoring sites was scheduled for late October, but has not been conducted due to high water levels. STK staff will visit the sites when lower water levels are observed in late November.

In cooperation with Kodiak Regional Aquaculture Association, the Buskin Lake array site was visited monthly from May to October. The last seasonal visit was conducted on October 17, where the surface buoy was removed for the winter months.

Recommendations

Several of the sites, particularly Russian River, have high flows and bedload movement during periods of the year. Due to the flooding events in 2015, the loggers became buried by riverbed substrates. Additionally, in 2015, the loggers within Sargent Creek were lost due to large rock/bedload material scouring and dislocating the rebar attachment points for the cables connected to the loggers. This year, all new loggers were secured to a tree limb or boulder on the stream bank, and the amount of cable extending into the stream was shortened. All sites remain intact as of September 2016.

Appendix B. (continued)

Sun'aq Tribe of Kodiak is still looking for an alternate to the halibut weights used for weighting the loggers to the stream bed.

USFWS/Kodiak NWR

General

- 16 sites monitored
- 4 lakes, 12 streams
- 6 of streams ID in plan, 6 others est. with research project & 3 yr commitment
- Data submitted to FWS regional office for inclusion in regional database
- QC performed on loggers before deployment & after retrieval

Lakes

- 4 lakes monitored including 2 est 9/2011, 2 in 2015
- No major issues encountered
- Main challenge is selecting deepest sites with uniform depth in 200' radius
- Retired old loggers after 5 yr run
- Plan on annual rotation so QC can be performed; item not addressed in NPS protocol
- Given minimal issues, reduced monitoring from twice/yr to once/yr
- To maintain monitoring at ~1m depth, we deployed a logger on 30# mono line; in case of heavy ice cover, the logger may be lost
- Encased 1m logger in white boot to minimize potential temp bias on clear, calm, summer days
- Conclusion: no problems; continue same program

Streams

- Various issues encountered with monitoring at 10 of 12 sites
- Issues included poor site selection, burial, and logger missing due to zip tie break or bears
- We relocated loggers at 4 sites, encountered burial problems at 4 sites, lost 3 booted loggers, and attributed logger loss to zip tie failure at 2 sites
- Major data loss encountered at 2 sites where loggers lost—probably due to zip tie breaks
- Otherwise, apparent that data loss minimized by maintaining 2 loggers per site
- Challenge of most sites we monitored is that they are headwater streams subject to lots of streambed movement due to floods and sockeye spawning
- Also, we advise against using booted loggers in shallow streams used by bears—most were ripped out
- Conclusion:
    - Need a couple more years to evaluate what we can pull-off. We can readily address loss due to bear attraction & zip ties.
    - On the other hand, data loss due to periodic burial is a big concern—we'll see where we end up after another year of monitoring then decide which sites can be maintained with minimal data loss

Air Loggers

- We maintained air loggers at 5 sites

Appendix B. (continued)

- We transferred 2 installations from buildings to trees to minimize potential bias due to building heating
- Another was remounted after it was ripped down by a bear

Network Coordination

- Late winter webinar presentation by Mauger & Pyle on BB & Kodiak networks
- LCC report
- Admin of 5 coop agreements; time-demanding process
- Assisted tribal monitoring in Old Harbor & Larsen Bay
- Assessed potential for EPA future support of Tribal monitoring efforts
- Revised field datasheets for streams; created one for lakes
- Created equipment & supply list
- No new information on planning/establishment of data repository/clearinghouse