Identifying Climate Vulnerabilities and Prioritizing Adaptation Strategies for Eulachon Populations in the Chilkoot and Chilkat River and the Application of Local Monitoring Systems

FINAL PROGRESS REPORT

Prepared by:
The Chilkoot Indian Association

Prepared for:
North Pacific Landscape Conservation Cooperative &
Alaska Climate Science Center

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1. ADMINISTRATIVE INFORMATION:

Grantee: Chilkoot Indian Association

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Project Title: Identifying climate vulnerabilities and prioritizing adaptation strategies for Eulachon populations in the Chilkoot and Chilkat rivers and the application of local monitoring systems.

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2. PUBLIC SUMMARY:

The Chilkoot Indian Association (CIA) assessed the climate change vulnerability and adaptation strategies of eulachon (*Thaleichthys pacificus)* in the Chilkoot and Chilkat rivers near Haines, Alaska. Population data was collected for the eulachon on the Chilkoot River using a mark-recapture technique and environmental DNA (eDNA). In addition a tribal stakeholder group was convened to analyze climate change projections, apply traditional knowledge, and prioritize adaptation strategies. The greatest threat to the sustainability of the northern Lynn Canal eulachon population was a lack of monitoring and the continuation of the eulachon population estimate was deemed the most important climate change adaptation strategy at this time.

Eulachon populations across the Pacific Northwest and in the upper Lynn Canal area of Southeast Alaska still suffer from incomplete baseline understandings of population health. The results of this project identified and prioritized adaptation strategies for eulachon populations and continued the development of a scientific eulachon population baseline.

3. EXECUTIVE SUMMARY:

The objective of this project was to advance tribally directed eulachon population research along the Chilkoot and Chilkat Rivers near Haines, Alaska, analyze data alongside the highest resolution climate projections available, and initiate a local working group of tribal experts and other stakeholders to identify and rank eulachon climate vulnerabilities and adaptation strategies, culminating in an effort to energize tribal landscape level conservation and sustainable resource management. These objectives were met through two primary activities; (1) the continuation of a eulachon population baseline data-set for the Chilkoot River, and (2) the development of a Tribal Working Group consisting of tribal leaders focused on eulachon climate change adaptation strategies.

The eulachon population estimate on the Chilkoot River followed a mark-recapture method. The Chilkoot Indian Association began monitoring the Chilkoot eulachon population in 2010 and has

developed the longest eulachon population baseline data-set in northern Southeast Alaska. The data has shown that the run size returning to the Chilkoot annually varies greatly. The largest run was in 2011 with an estimate of 12.6 million fish returning to spawn. The lowest run was in 2015 and estimated 319,000 fish returning.

The large range in eulachon sawners documented through this research has necessitated the need for continued population data. The need for continued monitoring was also the single greatest threat to the eulachon population, as identified by the Tribal Working Group. Eulachon in the Chilkoot and Chilkat Rivers are not managed by a federal or state agency and there are no restrictions on harvest amounts of eulachon, which was also identified by the Tribal Working Group as a threat to the sustainability of the eulachon population. Additionally, eulachon are thought to have a low fidelity to their natal streams and may choose a spawning river from within a region rather than their specific natal stream. This regional approach to spawning also necessitates the need for a broader population estimate across the northern Southeast region.

Special acknowledgement to the North Pacific Landscape Conservation Cooperative and the Alaska Climate Science Center for providing funding for this project.

4. PURPOSE AND OBJECTIVES:

Eulachon, a small anadromous smelt, are a highly nutritious fish (20% fat) that are culturally significant to the Chilkat and Chilkoot peoples of the Tlingit nations. Chilkoot Indian Association (CIA) members traditionally fish for eulachon in the lower ten miles of the Chilkat River and the lower mile of the Chilkoot River, both in close proximity to the town of Haines, Alaska. While the local perception is that eulachon populations are low, there has been little scientific investigation as to the size of the population[i,ii]. It is important for CIA members to understand eulachon population health as the eulachon fishery in Haines is primarily regulated by Tlingit citizen harvesters rather than by external state or federal regulations[iii]. This study aimed to provide scientific data to better inform Tribal leaders in future management of the eulachon population in addition to enhancing and documenting the traditional ecological knowledge associated with the local eulachon populations.

The objective of this project was to advance tribally directed eulachon population research along the Chilkoot River, analyze data alongside the highest resolution climate projections available, and initiate a local working group of tribal experts and other stakeholders to identify and rank eulachon climate vulnerabilities and adaptation strategies, culminating in an effort to energize tribal landscape level conservation and sustainable resource management.

These objectives were met, in part, through the continuation of the eulachon mark-recapture population estimate on the Chilkoot River. This population estimate was expanded upon with the addition of environmental DNA (eDNA) to establish a population index using a less invasive and labor intensive manor. The use of eDNA to determine population is still very new, but during the three years of eDNA data collection in conjunction with the mark-recapture population estimate we believe eDNA could be a promising technique for documenting eulachon abundance across a large region with much less effort than a full mark-recapture study.

In addition to the Chilkoot population research a eulachon Tribal Working Group (TWG) was established. This group met on a quarterly basis to evaluate eulachon climate change adaptations. The TWG identified tribal leaders to continually monitor and document the eulachon run and harvest including tribal uses of eulachon annually. Additionally, the TWG analyzed climate change projections in relation to their traditional knowledge of eulachon behavior.

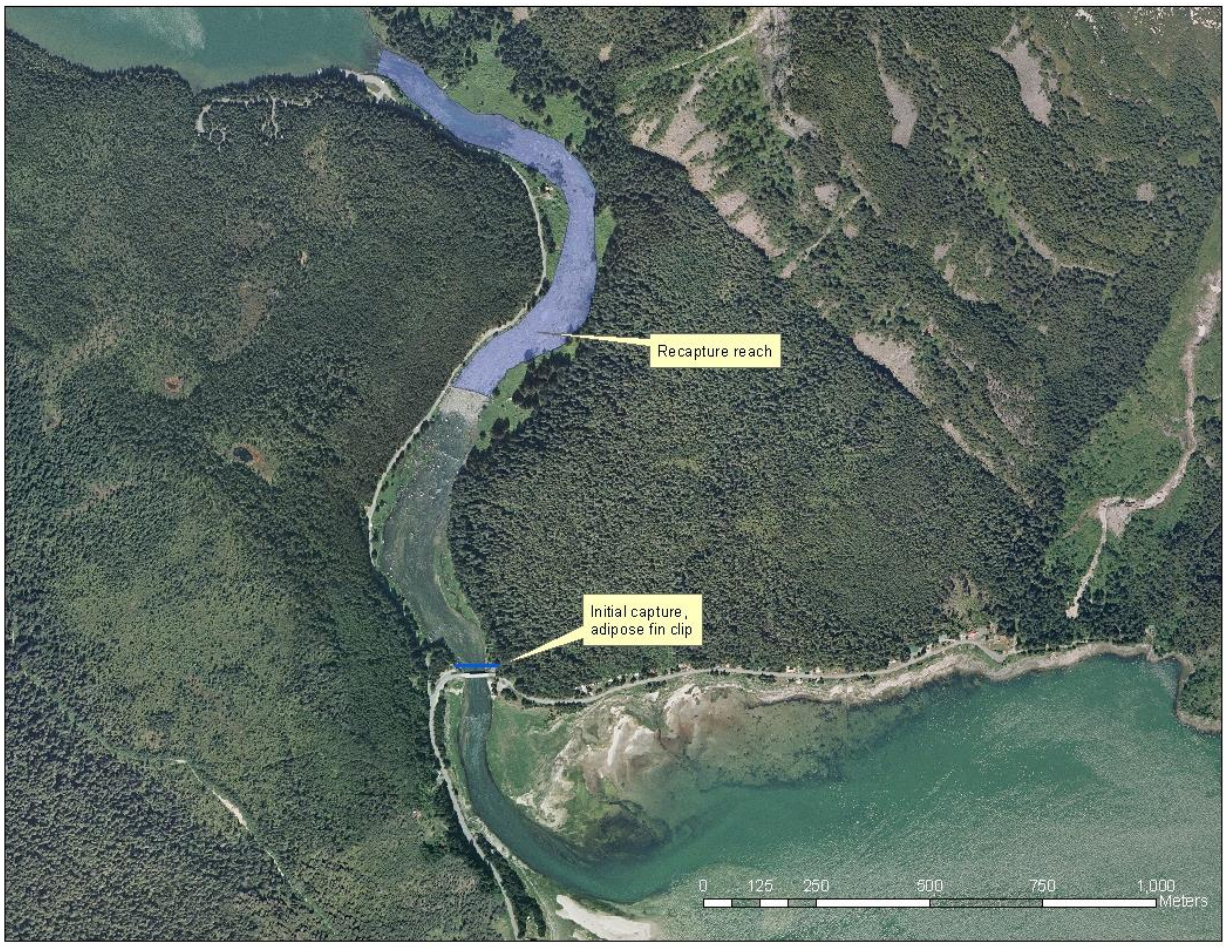
5. METHODS, ORGANIZATION AND APPROACH:

The population estimate methodology was based off of a previous Chilkat Indian Association (CIA) grant from the U. S. Fish and Wildlife Service's Tribal Wildlife Grant titled *Run timing and population estimates for eulachon Thaleichthys pacificus in the Chilkat and Chilkoot Rivers in S.E. Alaska 2010-2012*.

Population estimates of eulachon in the Chilkoot River were estimated using a mark recapture formula of (N= [(M+1)(C+1)/(R+1)]-1) where N= total population size, M= marked initially, C= total in second sample, and R= marked recaptures. The 95% confidence intervals were calculated using the equation N=+/- (1.96)(SE) where SE = standard error. The population was estimated for an annual population.

The initially marked groups were captured within 25 meters of the Lutak Bridge (Figure 1.) using modified fyke net traps and dip nets. The modified fyke net traps were the same ones used in the previous CIA eulachon study (Figure 2.). These traps were modeled after traps used by the USDA Forest Service, Juneau Ranger District biologists to trap eulachon on the Antler River in Berners Bay, AK. The captured eulachon were transferred in small groups to plastic dishpans where they could be easily handled to clip the adipose fin using retina scissors (Figure 3.) and returned directly to the river. The adipose fin was clipped so that it left a "shark fin" looking remnant attached to the fish (Figure 4.). To avoid excessive increases in temperature and reduce the possibility of disease transmission, the water in the dishpan was changed between each group and the retina scissors were dipped in a betadine solution after each clip. No anesthetic was used because many of the clipped fish were being harvested by subsistence fisherman the same day and the readily available anesthetic is not approved for consumption by the FDA.

Figure 1. Lower Chilkoot River with initial mark and release site and the recapture reach.



To allow time for the marked fish to mix with the unmarked fish the recapture groups were capture between 0.75 Km upstream of the Lutak Bridge at the ADF&G fish weir and the outflow of Chilkoot Lake. Two capture methods were used for the recapture group. When sufficient numbers of subsistence users were present the fish collected for subsistence use within the designated area were examined. When subsistence users were not present, crews of two wadded the river with dip nets making sure to sample all portions of the river. The captured fish were then examined for a clipped adipose fin before releasing. To avoid repetitive sampling the same fish, the sampling crews would start at a downstream point and work their way upstream.

Figure 2. The trap is 2m long, 0.6m wide and 1.2 meters high. There is a 6 cm slit the height of the

trap 1/3 up from the downstream end of the trap. There are two wings 2.4m long that extend from the sides of the trap to guide the fish in. The upstream end of the trap had a solid plywood bow to provide a refuge from the current. Three doors were cut into the traps so that they could be opened to allow fish to move out of the trap when concentrations of fish were too high or when the trap was not being monitored.

Figure 3. adipose fin being clipped with retina scissors

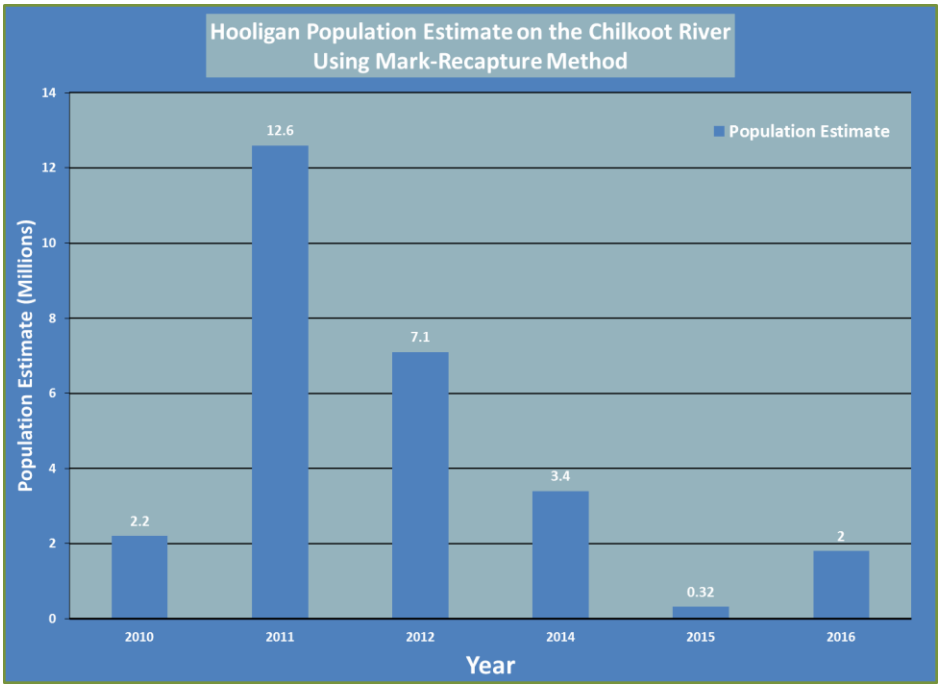
Figure 4. "Shark fin" left after clipping

The TWG was convened from a group of tribal leaders that have been continually monitoring and subsistence fishing for eulachon in the Chilkoot and Chilkat Rivers. The group shared insights on the environmental factors important to eulachon, the changes already observed underway among the Chilkoot and Chilkat populations, and their responses to Alaska-wide and Southeast-specific climate change projections. The TWG meet quarterly throughout the grant period. In addition to the TWG meetings, the TWG and tribal members were trained in the Alaska Native Tribal Health Consortium's Local Environmental Observations (LEO) program. The LEO program trains local observers and topic experts to share knowledge about unusual animal, environment, and weather events. The LEO network connects the eulachon TWG with a wider community to share environmental observations, raise awareness about climatic events, and find answers to local environmental questions.

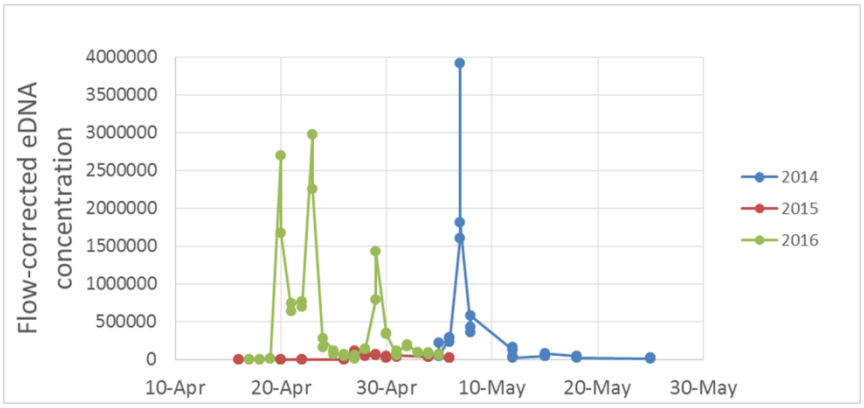
6. PROJECT RESULTS: Present your project results. Include both quantitative results (numerical and/or statistical data) and qualitative results (descriptions of how well or poorly something worked) if appropriate for your project. Tables, graphs and other figures representing your data are excellent ways to summarize data and present them in an accessible way.

The CIA began the Chilkoot eulachon mark-recapture population estimate in 2010 and has completed the estimate annually except for in 2013 due to a lapse in project funding. The three years of study that were funded through NPLCC (2014-2016) showed a wide range in eulachon population.

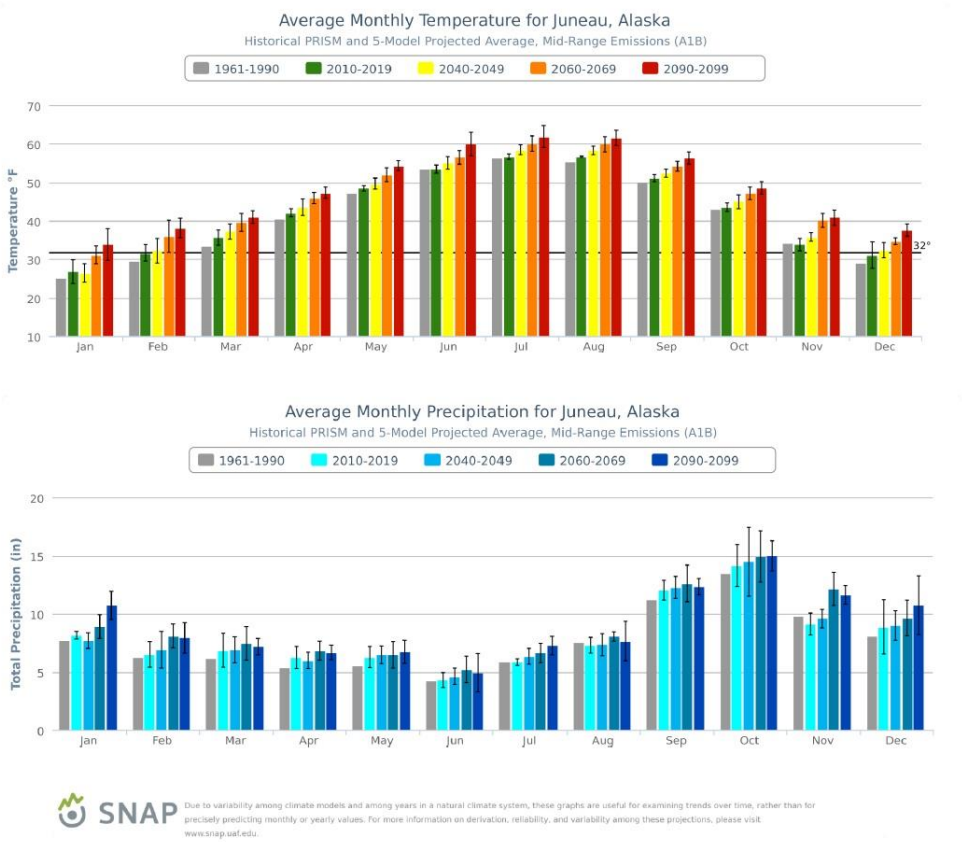
Table 1. Eulachon population estimates for the Chilkoot River using mark recapture techniques for a closed population.						
Measurement	**2010 Migration**	**2011 Migration**	**2012 Migration**	**2014 Migration**	**2015 Migration**	**2016 Migration**
M = Marked Initially-adipose clipped	8,017	49,814	27,525	24,084	306	9,384
C = Total in second sample captured above weir	20,210	143,444	48,376	19,886	3,122	8,865
R = Marked recaptures above weir with clip	72	568	186	140	2	45
N1 = Population Estimate	2.2 Million	12.6 Million	7.1 Million	3.4 Million	319,586	1.8 Million
SE^2 = Standard Error	256,415	521,961	516,583	283,226	158,934	262,518
CI^3 = 95% Confidence Interval	1.7 to 2.7 Million	11.5 to 13.6 Million	6.1 to 8.1 Million	2.9 to 3.9 Million	8,074 to 631,098	2.3 Million to 1.3 Million
1: Equation used for population estimate. [N = [(M+1)(C+1) / (R+1)] - 1]						
2: Equation used to calculate Standard Error. [SE = sqrt { [(M+1)(C+1)(M-R)(C-R)] / $(R+1)^2(R+2)$ }]						
3. Equation used to calculate the 95% confidence intervals. [95% CI=N +or- (1.96*SE)]						



The eDNA data collection began in 2014 and has mirrored the population trend determined through the mark-recapture estimate. It is necessary to continue to determine if eDNA can be a reliable index of population.



The TWG discussed the various climate change projections for Alaska and Southeast-specific. An alarming statistic noted by the TWG is that the Southeast Alaska region is expected to experience the largest increase in the number of days above freezing in all of North America. This fact, in addition to the temperature and precipitation projections developed by the Scenarios Network for Alaska and Arctic Planning (SNAP) at the University of Alaska Fairbanks offered insight into possible climate change trends.



The overarching feedback from the TWG in relation to eulachon climate change projections was focused on the importance of management and monitoring. Currently there is no regulation on harvest for eulachon. It is a heavily-caught subsistence species that is crucial to the Tlingit culture, but is also becoming valued among other Alaskan residents. The TWG unanimously agreed that the single greatest threat for the eulachon populations of the Chilkoot and Chilkat Rivers in the near term is the lack of baseline knowledge of the species, and specifically understanding of eulachon population dynamics.

7. FINDINGS AND CONCLUSIONS:

A major conclusion of this research is that the Chilkoot eulachon population varies greatly from year to year. The eulachon population data that has been collected by the CIA represents the longest eulachon population baseline in northern southeast Alaska, and this data only includes population estimates for the Chilkoot River. Since eulachon are thought to be unlike salmonids in that they have a low fidelity to their natal streams it is necessary to monitor eulachon population on a regional scale to better document population trends.

Interviews with the tribal working group also documented changes in eulachon spawning timing and abundance. This is thought to be due to climatic changes including earlier springs and lower winter snow pack. It was also documented that the eulachon are a very sensitive species and development and industrial disturbances can pose a substantial impact on eulachon behavior. During 2015 construction near the Chilkoot River for a new ferry terminal included the pounding of piling during the eulachon run. It was documented by the tribal working group that this noise impact could have been the cause of the extremely low run of eulachon on the Chilkoot River in 2015. This was also a year that the Taiya river in Skagway saw a larger than average eulachon run so it was thought that the eulachon choose to spawn in the Taiya over the Chilkoot due to the development disturbance.

8. LESSONS LEARNED AND RECOMMENDATIONS:

The biggest lesson learned throughout this project is that there are so many unknowns associated with eulachon. It can be challenging planning and hiring crews to work when you never know when they'll start exactly or how long the run will last. We've overcome this by hiring crews early and providing training on the mark-recapture protocol. This ensures the crew is ready when the fish do arrive. We also hired crew members to be on the look-out for eulachon and to monitor seabird and marine mammal activity. Collecting this data helps us better prepare other crew members and provide notice to when we expect the eulachon to show up.

The CIA recommends continuation and expansion of the eulachon mark-recapture and eDNA population study across the region. A regional approach to monitoring this species is crucial to truly understanding population trends. Eulachon are a species that is thought to have a low fidelity to their natal streams and choose a river to spawn based on a variety of environmental characteristics. The use of eDNA could provide an economical means for monitoring across a regional scale. In addition to the scientific population data collected it is also necessary to ensure the TEK is documented and valued as a source of necessary information on eulachon population trends and habitat.

In addition to continued and expanded eulachon population monitoring, it is recommended to examine the genetic diversity among eulachon populations within southeast Alaska. This would shed light on the degree to which eulachon have fidelity to their natal streams. In addition to genetic diversity monitoring it would be helpful to fully understand the marine life history of eulachon. It is believe that they only spawn once, however that is not totally certain. Additionally, understanding the marine habitat that they occupy during their 4-5 years of ocean life would be helpful information for management purposes.

9. MANAGEMENT APPLICATIONS AND PRODUCTS:

Eulachon are not managed by a state or federal agency. The main management is through tribal entities ensuring the subsistence harvest is conducted in an appropriate manor. There is no regulation on the

amount of eulachon that can be harvested from any river in northern Southeast Alaska. Management has been identified by the Tribal Working Group as one of the most pressing threats to the eulachon population. To influence possible management actions in regards to the Northern Lynn Canal eulachon population it is essential to continue the monitoring efforts to understand future changes in the population.
Monitoring efforts should include the continuation of the Chilkoot mark-recapture program and the continuation and expansion of the eDNA population monitoring across the entire Southeast Alaska region. These efforts will document trends in the eulachon population and allow for more informed management if that becomes a necessary action to sustain the eulachon population.

In addition to the monitoring efforts, it is recommended to develop a full stock assessment for the eulachon population in Southeast Alaska. In order to accomplish a stock assessment it will be necessary to estimate the total catch that is taken through subsistence across the region. It is recommended that this be conducted in partnership through a Tribal organization since the majority of the harvest is conducted by tribal members. This will ensure that the data collected recognizes the tribal value of the species.

10. PUBLICATIONS AND OUTREACH

The CIA and project partner the Takshanuk Watershed Council (TWC) produced annual newsletter articles highlighting the eulachon population research conducted and the tribal significance. In addition CIA and the TWC produced a final video highlighting the research conducted and the tribal significance of eulachon. There were also several social media posts about the eulachon research project throughout the grant term.

11. Signature: The Agreement Project Manager should sign and date the final report to certify their submittal of the report.

Meredith Pochardt

Chilkoot Indian Association, Project Manager

4/24/17

[i] Bishop DM, Carstensen RL, Bishop GH (1989) A report on the environmental studies at Haines

airport. Environaid, 12175 Mendenhall Loop Road, Jeneau, AK

[ii] Betts M (1994) The subsistence hooligan fishery of the Chilkat and Chilkoot Rivers. Tech Rep No. 213, Alaska Department of Fish and Game, Division of Subsistence, Juneau, AK

[iii] Betts M (1994) The subsistence hooligan fishery of the Chilkat and Chilkoot Rivers. Tech Rep No. 213, Alaska Department of Fish and Game, Division of Subsistence, Juneau, AK