Eklutna Hydroelectric Project

Fish Species Composition and Distribution Study

Year 1 Interim Report

DRAFT

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Terms, Acronyms, and Abbreviations

1991 Agreement	1991 Fish and Wildlife Agreement
ADFG	Alaska Department of Fish and Game
ADNR	Alaska Department of Natural Resources
AWWU	Anchorage Water and Wastewater Utility
C	Celsius
cfs	cubic feet per second
DO	dissolved oxygen
ft	feet
in	inch
m	meter
mm	millimeter
NMFS	National Marine Fisheries Service
NTU	nephelometric turbidity unit
NVE	Native Village of Eklutna
QA	Quality Assurance
QC	Quality Control
RM	river mile
TEK	Traditional Ecological Knowledge
TWG	Technical Work Group
USACE	U.S. Army Corps of Engineers
USFWS	U.S. Fish and Wildlife Service

1 INTRODUCTION

The Fish Species Composition and Distribution Study was initiated in 2021 in accordance with Section 3.3 of the May 2021 Final Study Plans (FSP) (MJA 2021). As noted in the FSP and based on early outreach efforts, the main goals of the agencies and interested parties relative to the fisheries study is to find a new balance amongst the uses of water in the Eklutna River basin, including power production, potable water supply, and fish habitat. Potential fisheries related protection, mitigation, and enhancement (PME) measures involve providing a flow regime into the Eklutna River that would accomplish habitat restoration and increase the anadromous fish assemblage of the river. The FSP provides additional background information and context for the Fish Species Composition and Distribution Study.

This Year 1 Interim Report describes the methods used and a summary of the data and information collected during the first year of the Fish Species Composition and Distribution Study, covering the period from June 2021 through October 2021. The report results are limited to direct observations and measurements obtained during the execution of study objectives in 2021. Additional study components are scheduled for 2022. No analysis has yet been completed, and no discussion or interpretation of results are provided at this time. Analysis of 2021 and 2022 study data will be presented together in the Year 2 Final Report.

1.1. Goals

The goal of this study is to characterize the current composition and distribution of all fish species using the freshwater portions of the Eklutna River. In addition, data was collected to provide information on salmon run timing, life histories and habitat use of all resident and anadromous species encountered.

- **Task 1: Eklutna River Fish Community.** The objective was to describe the seasonal composition, distribution, and habitat use for juvenile anadromous salmonids, non-salmonid anadromous fishes, and resident fishes.
- **Task 2: Adult Salmon Spawning Surveys.** The objective was to:
  - Index temporal abundance of spawners; and
  - Determine the spawning distribution.

1.2. Study Area

The study area for Task 1, Eklutna River Fish Community included approximately 11.3 miles of the Eklutna River from the beaver complex at the extent of tidal influence (RM 0.35) to the Eklutna Lake Dam spillway plunge pool (RM 11.6) (Figure 1.2-1).

The study area for Task 2, Adult Salmon Spawning Surveys included approximately 4.4 miles of the Eklutna River from just upstream of the beaver complex and extent of tidal influence to the downstream end of the Anchorage Water and Wastewater Utility (AWWU) access road, approximately 1.4 miles above the lower dam site. Adult salmon surveys also took place in Thunderbird Creek from the confluence with the Eklutna River upstream to Thunderbird Falls, a documented anadromous fish barrier (ADFG 2019; Geifer and Blossom 2020) (Figure 1.2-2).

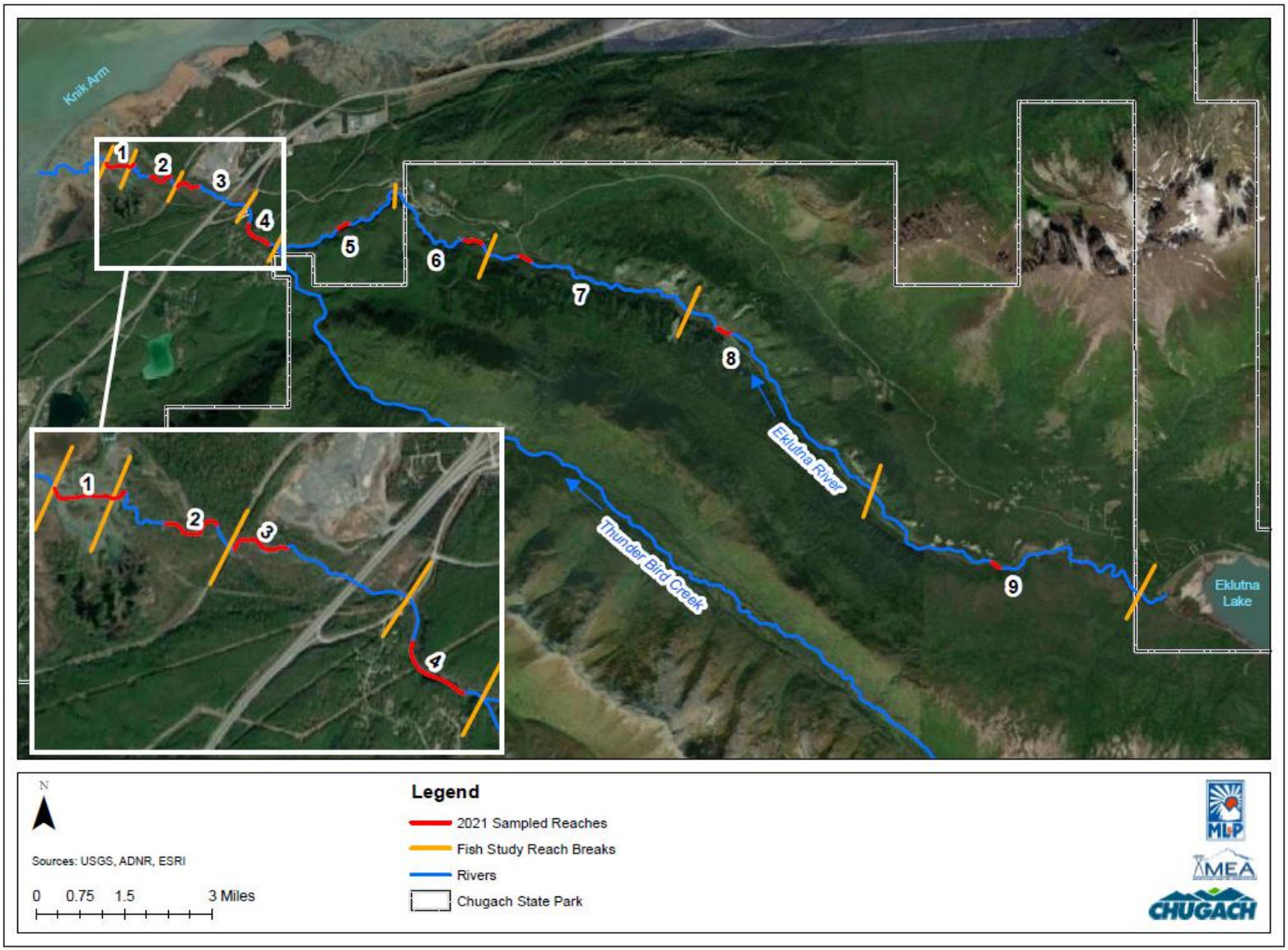

Figure 1.2-1. Task 1 Eklutna River Fish Community study area including reach breaks (1-9), sub-reaches that were investigated for fish presence and assessed for habitat characteristics.

Figure 1.2-2. Task 2 Adult Salmon Spawning Surveys study area including reach breaks (1-5) indicated by black and white bars, and the anadromous waters catalog anadromous extent (2020) shown in blue dotted lines.

2 METHODS

The methodology used for all sampling efforts in 2021 was consistent with those outlined in the May 2021 Final Study Plans (FSP). Some methods for capture (gill nets, seines) proposed in the study plan were not implemented during 2021 sampling.

2.1. Task 1: Eklutna River Fish Community

To document resident and juvenile anadromous fish community composition and species distributions, seasonal sampling of reaches measuring 40x wetted channel width (minimum 325 ft. maximum of 1312 ft.) was conducted. The starting location or habitat unit for sampling within each reach was selected at random prior to the first survey using a random number table. River fish sampling took place over three sample periods in 2021: Spring (May 25- 29); Summer (July 27- August 3); and Fall (October 7 – 15).

This collection window allowed surveys to cover the majority of time that anadromous fish were expected to be migrating through, or residing in, the Eklutna River. Sampling was stratified among nine defined reaches including: 1) single channel reach and side channel complex beginning near the upstream extent of tidal influence; 2) multi-channel reach up to the railroad bridge; 3) railroad bridge to the Old Glenn Highway; 4) Old Glenn Highway to Thunderbird Creek confluence; 5) Thunderbird Creek confluence to the old dam site; 6) old dam site to the downstream end of the AWWU access road; 7) lower AWWU access road reach; 8) mid AWWU access road reach; and 9) upper AWWU access road reach. Sub-reaches and habitat units selected for sampling are displayed in Figure 1.2-1 (above). Representative images of each sampled sub-reach are presented in Figure 2.1-1 (below).

Study reaches 1-9 were identified during study planning and collaboratively agreed to with the Aquatics TWG. Habitat units within each reach to be sampled were selected based on the first habitat break identified at each reach when surveyed from downstream to upstream. Each initial habitat unit was identified by habitat type, and the wetted width of the unit was measured. Total target reach length was determined based on a calculation of 40x the initial wetted width measurement (or until the next habitat break) at habitat unit #1 in each reach.

Figure 2.1-1. Representative photos of the nine sub-reaches sampled for Task 1 Fish Species Composition and Distribution

Each reach was sampled using single-pass backpack electrofishing and baited minnow traps. Use of electrofishing as a fish capture technique is regulated by ADFG. Consistent with recommendations, electrofishing was not conducted when adult anadromous salmon were present. ADFG-recommended target voltage settings for juvenile salmonid sampling in cold water were used as a reference at the onset of sampling (Bales and Geifer 2015), as well and the Quick-Setup feature of the LR-24 Smith-Root Backpack Electrofishing unit which calculates recommended voltage settings based on ambient conductivity and water temperature. All backpack electrofishing activities followed NMFS (2000) Guidelines for Electrofishing Waters Containing Salmonids Listed Under the Endangered Species Act.

A Smith-Root LR-24 backpack electrofishing unit was operated by a trained field crew leader who was assisted by two people with dipnets. Each backpack unit was fitted with a standard Smith-Root cathode and a single anode pole with a steel ring. Single-pass electrofishing surveys

were conducted through the selected study reach moving in an upstream direction. All stunned fish were captured with dipnets away from the electric field and held in buckets for later processing. Backpack electrofisher settings were determined in the field based on water quality conditions, professional judgment, and the overall goal of minimizing impacts to fish health (Temple and Pearsons, 2007). Prior to electrofishing, ambient water chemistry was recorded including conductivity (µS), turbidity (nephelometric turbidity unit [NTU]), and surface water temperature (°C) with a digital meter at the downstream end of the sampling site to help determine initial backpack electrofishing unit settings. In all cases, the electrofishing unit was operated and configured with settings consistent with guidelines established by the manufacturer (Smith-Root 2009), ADFG (Bales and Geifer 2015), and NMFS (2000). Personnel operating electrofishing units were trained and certified per ADFG permit requirements. The location of each habitat unit electrofished was mapped using handheld Global Positioning System (GPS) units and marked on high-resolution aerial photographs. Start and stop times and total effort (in seconds) was recoded to quantify and standardize effort between seasonal surveys.

Gee-type minnow traps (17.5 in. x 9 in. with ~1 in. openings and ¼ in. mesh) were baited with sterilized, commercially preserved salmon eggs (or disinfected with a 10-minute soak in a 1/100 Betadyne) and soaked overnight at a density of 1 trap/ 69 ft. sample length. Distances between traps depended on available habitat, reach length, water depth, and complexity, and traps were set more densely in complex habitats with appropriate depth (Bryant 2000). Minnow traps were set in habitats with slow water and/or cover to maximize catch and left overnight for a period ranging from sixteen to twenty-four hours. The number of traps deployed and their locations were recorded to maximize trap recovery. Trap retrieval lines were tethered to streamside vegetation or staked and marked with fluorescent flagging that included a trap identification number and required ADFG permit information.

Fish collected within each mesohabitat unit were counted and processed separately and to the extent possible, fish capture methods were repeated with a similar level of effort between seasonal surveys. Fish were identified to species, measured for fork length (mm), and released alive near the point of capture. The resources "Fish Identification of Coastal Juvenile Salmonids" by Pollard et al. (1997) and "Juvenile Salmonid and Small Fish Identification Guide" by Weiss (2003) were used for field verification of juvenile salmonid species in addition to the ADFG guide. Sculpin were recorded as "*Cottus* sp.". A dip net was used when catching fish to be measured. Hands, dip nets, and measuring boards were wetted before coming in contact with fish. Length measurements were taken on a clean, smooth, wet PVC cradle with easy-to-read gradations in millimeters. Ancillary data including fish condition, sex (if determined), presence of spawning colors, and any injuries or mortalities was recorded on field forms.

A standard suite of physical habitat data and descriptive information was collected where fish sampling occurred within each geomorphic reach. These parameters were taken from the USFS Aquatic Habitat Tier One survey (USFS 2001, Chapter 20). Channel morphology characteristics for each survey reach were documented at one single channel riffle, or where no significant side channels were present, and included:

- channel type
- channel pattern

- average bankfull width (m/ft.)
- bankfull maximum depth (m/ft.)
- water surface gradient (%)
- riparian vegetation
- location/type/area of off-channel habitats width and status of side channels

Habitat units that fell within survey reaches were delineated. Habitat types were classified as follows: backwater pool (PL-bw), scour pool (PL-sc), beaver pond (BP), glide (GL), riffle (RF), boulder riffle (BR), rapid (RP), chute (CH), cascade (CS), falls (FS), dry channel (DC), and puddled (PD) (Appendix 1). Photographs of representative habitat as well as any special habitat features were taken at each survey reach. For each habitat unit the following data were collected:

- unit type and number
- unit length (m/ft.)
- location of the downstream and upstream endpoints using a GPS receiver
    - (latitude/longitude in decimal degrees in the WGS84 datum)
- average wetted width (m/ft.) based on three measures
- average wetted depth (m/ft.) based on three measures
- maximum pool depth (m/ft.) if applicable
- modified Wentworth substrate composition (%)

2.2. Task 2: Adult Salmon Spawning Surveys

Adult salmon spawning and carcass surveys were conducted weekly from early July to the end of October in collaboration with NVE who also surveyed staging and spawning activity of Pacific salmon weekly. No adult salmon were observed near the downstream end of the AWWU access road; therefore, surveys were not continued beyond this point in 2021.

To support comparison with previous years' survey efforts (NVE 2002, 2003, USACE 2007), count data were summarized by the following survey reaches (Task 2 study area Figure 1.1-2)

1. Eklutna River upstream of the beaver pond complex and zone of tidal influence to the railroad bridge (~0.7 mi.)
2. Eklutna River from the railroad bridge to the Old Glenn Highway bridge (~0.7 mi.).
3. Eklutna River from the Old Glenn Highway bridge to the confluence with Thunderbird Creek (~0.5 mi.).
4. Eklutna River above the confluence with Thunderbird Creek to the downstream end of the AWWU access road approximately 1.4 mi. upstream of the lower dam site (~2.5 mi.).
5. Thunderbird Creek from the confluence with the Eklutna River to Thunderbird Falls (~0.5 mi.).

Pedestrian surveys were conducted from a downstream to upstream direction to enumerate live adult salmon by species in each survey reach. Where multiple stream channels were present in reaches 1 and 2, each channel was surveyed and adult salmon counts were separated into right

side braids, left side braids, and single channel. In the field, data were entered on prepared forms. GPS locations of observed salmon spawning and established redds were collected using a Global Positioning System (GPS) receiver (latitude/longitude in decimal degrees in the WGS84 datum). The species and number of fish in spawning areas was described on field forms. Information collected for each survey included total salmon count by species and reach, location and number of redds by species, and opportunistic photographs of spawning areas, redds, and adult fish.

Water temperature (^{o}C), visibility (ft), and turbidity (NTU) were collected during each survey at established locations in the Eklutna River downstream of the Old Glenn Highway bridge, and in both the Eklutna River and Thunderbird Creek upstream of their confluence. Water visibility was estimated with a survey rod to measure the visible depth to the stream substrate. Eklutna River stream stage (feet) near the Old Glenn Highway bridge at RM 2.3 and RM 2.5, and above Thunderbird Creek at RM 2.9 was recorded for each survey. When possible, surveys were initiated mid-morning to minimize shadow effects on visibility. Polarized glasses were worn by observers and any survey conditions that affected visibility and salmon counts including water color/turbidity, weather, and cloud cover were recorded. Two carcass samples (heads) were collected from dead Chinook and Coho salmon encountered and delivered to ADFG for otolith analysis.

2.3. Data Management and QA/QC

The goals of data management were to establish a data quality assurance/quality control (QA/QC) protocol to be applied at logical stages of data collection and processing, and to ultimately create a database of all QC'd fish composition and distribution data collected for the project. Five levels of QC (QC1 to QC5) are underway to govern data collection efforts and ensure a rigorous and high-quality product. Each QC level is tracked either within tabular datasets (Excel and database tables), or within file path names (as for raw field data files). This allows for quick determination of the QC status of all data. A data dictionary describing the database entities and attributes was compiled to accompany the database and to provide an understanding of data elements and their use by anyone querying or analyzing the database deliverable to be provided in 2023 following completion of all data collection and analysis. All original field data will be preserved during the QA/QC process as well as complete documentation of any adjustments (e.g., conversion of units) or qualifiers as to the appropriate use of data for analysis.

The five QC documentation steps are as follows:

- **QC1 Field Review**: Review of field forms before leaving the field, or the QC level of raw data collected via field equipment such as cameras, GPS units, etc. The goal of QC1 was to identify errors and omissions and correct them under similar field conditions prior to leaving the field. Review was done on 100% of data and included completeness, legibility, codes, and logic on all information recorded. This was typically completed in the field daily. Paper and electronic field forms were backed up nightly in the field by scanning and downloading to a storage unit.

- **QC2 Data Entry**: Data from paper forms was entered into an electronic format and verified by a second party against the field forms. The goal of QC2 was to verify correct, complete, and consistent data entry. Verification was done on 100% of data entered and included extrapolation of shorthand codes that were used in the field into longhand or standard codes during data entry.
- **QC3 Senior Review:** Final review by senior professional before submitting field data, or the QC level of raw data cleaned up for delivery. Data was reviewed by a senior professional on the consultant team, checking for logic, soundness, and adding qualifiers to results if warranted. Calculated results were also be added at this time.
- **QC4 Database Validation**: Tabular data files was verified to meet project database standards. Data was verified for completeness, project standards (codes, field name conventions, date formats, units, etc.), calculated and derived fields, QC fields, etc. The data files were incorporated into the project database schema, splitting into normalized tables as necessary, and all primary and foreign keys checked.
- **QC5 Technical Review**: Data revision or qualification by senior professionals when analyzing data for reports. Data calculations may be stored with the data. Some data items may get corrected or qualified within the database, while others are only addressed in report text. QC5 may be iterative, as data are analyzed in multiple years.

3 RESULTS

Results presented in this interim report are preliminary and will be supplemented by additional data and associated analysis.

3.1. Task 1: Eklutna River Fish Community

3.1.1. Reach Habitat Characteristics

Total reach lengths sampled for fish ranged from 475 ft. to 1,312 ft. with the longer reaches occurring in the lower portion of the Eklutna River (reaches 1-4) where the channel morphology is less constrained as compared to the canyon reaches. Documented wetted habitat units were generally wider in these longer, lower river reaches (Table 3.1-1). Riffle and glide habitat were the most commonly observed habitat type by length with limited occurrence of backwater, side channel, or pool habitat upstream of the Old Glenn Highway bridge. Habitat complexity was highest in reaches 1 and 2 where scour pools, backwaters, and side channels were present.

Table 3.1-1. Physical habitat characteristics of habitat units within reaches 1-9 sampled for fish species abundance and distribution between May and October of 2021. Physical habitat data are presented for the dominant habitat type in the reach and averaged between habitat surveys completed in May and October (no surveys were completed in the summer)

Reach Habitat Characteristics	R-1	R-2	R-3	R-4	R-5	R-6	R-7	R-8	R-9
Unit Length (ft)	1312	1312	1000	1312	475	702	541	597	475
Ave. Bankfull Depth (ft)	--[1]	2.95	1.6	2.29	1.64	3.6	4.26	3.28	1.64

Reach Habitat Characteristics	R-1	R-2	R-3	R-4	R-5	R-6	R-7	R-8	R-9
Ave. Bankfull Width (ft)	45.9	39.0	31.8	49.5	28.5	32.4	40.4	27.9	36.1
Ave. Wetted Width (ft)	45.9	27.9	20.7	30.5	10.5	14.4	13.1	15.1	28.5
Water Gradient (%)	0.3	1.5	3.4	2.3	2.6	3.4	2.0	2.0	2.0
Channel Type	Simple	Complex	Split	Single	Single	Single	Single	Single	Single
Dominant Habitat Type (by length)	Glide (61%)	Riffle (38.3%)	Riffle (79%)	Riffle (100%)	Riffle (100%)	Riffle (52%)	Glide (70%)	Riffle (83%)	Pocket (68%)

Notes: [1] No average presented for R1 Bankfull depth because depth was highly variable across the transect.

3.1.2. Fish Community

Relative abundance and distribution of fish species was surveyed in all established reaches (1-9) and all habitat sub-units (i.e., riffle, glide, cascade) within those reaches. Electrofishing and deployment of gee-type minnow traps were both effective methods for capture of juvenile fish in the Eklutna River. A total of eleven fish species were identified which ranged from ubiquitous (Dolly Varden) to rare (Alaska blackfish and Eulachon, single exemplars captured). Species richness decreased with distance upstream. It was greatest in reach 1, was representative of the number of anadromous salmonid species in reaches 2-5 and was limited to Dolly Varden in reaches upstream of the lower dam site (reaches 6-9) (Table 3.1-2). Reference photographs of commonly encountered species and life history stages are presented in Figure 3.1-1.

Table 3.1-2. Juvenile anadromous and resident fish species distribution as observed at Reaches 1-9 during electrofishing and minnow trapping efforts in May, July/August, and October 2021.

Juvenile/ Resident Fish Species Present by Reach	R-1	R-2	R-3	R-4	R-5	R-6	R-7	R-8	R-8	R-9
Chinook Salmon	**X**	**X**	**X**	**X**	**X**					
Coho Salmon	**X**	**X**	**X**	**X**	**X**					
Chum Salmon	**X**	**X**	**X**	**X**						
Pink Salmon	**X**									
Sockeye Salmon	**X**									
Kokanee										**X**[1]
Dolly Varden	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**
Sculpin	**X**	**X**	**X**	**X**	**X**					
3 Spine Stickleback	**X**									
9 Spine Stickleback	**X**									
Alaska Blackfish	**X**									
Eulachon	**X**									

Notes:
1 Adult kokanee that were washed into the upper Eklutna River above the upstream-most beaver dam during the flow releases and were captured at reach 9 in mid-October.

Relative abundance of fish species in the Eklutna River reaches changed longitudinally from the lower to upper river. Coho Salmon and both 3- and 9-spine stickleback accounted for over 75% of the total fish sampled in reach 1. From reach 2 to reach 5, the proportion of Coho Salmon and

Chinook Salmon decreased from more than 50% (reach 2) to less than 25% of the total sample (reach 5) while the proportion of Dolly Varden captured increased proportionally. In reaches 6-9, the sampled fish population in all seasons included only Dolly Varden[1] (Figure 3.1-2).

Figure 3.1-1. Representative photographs of fish species encountered during 2021 electrofishing and minnow trap sampling at Eklutna River reaches 1-9 during May – October.

[1] Adult kokanee were washed into the upper Eklutna River above the beaver dam during the flow releases and were captured at reach 9 in mid-October.

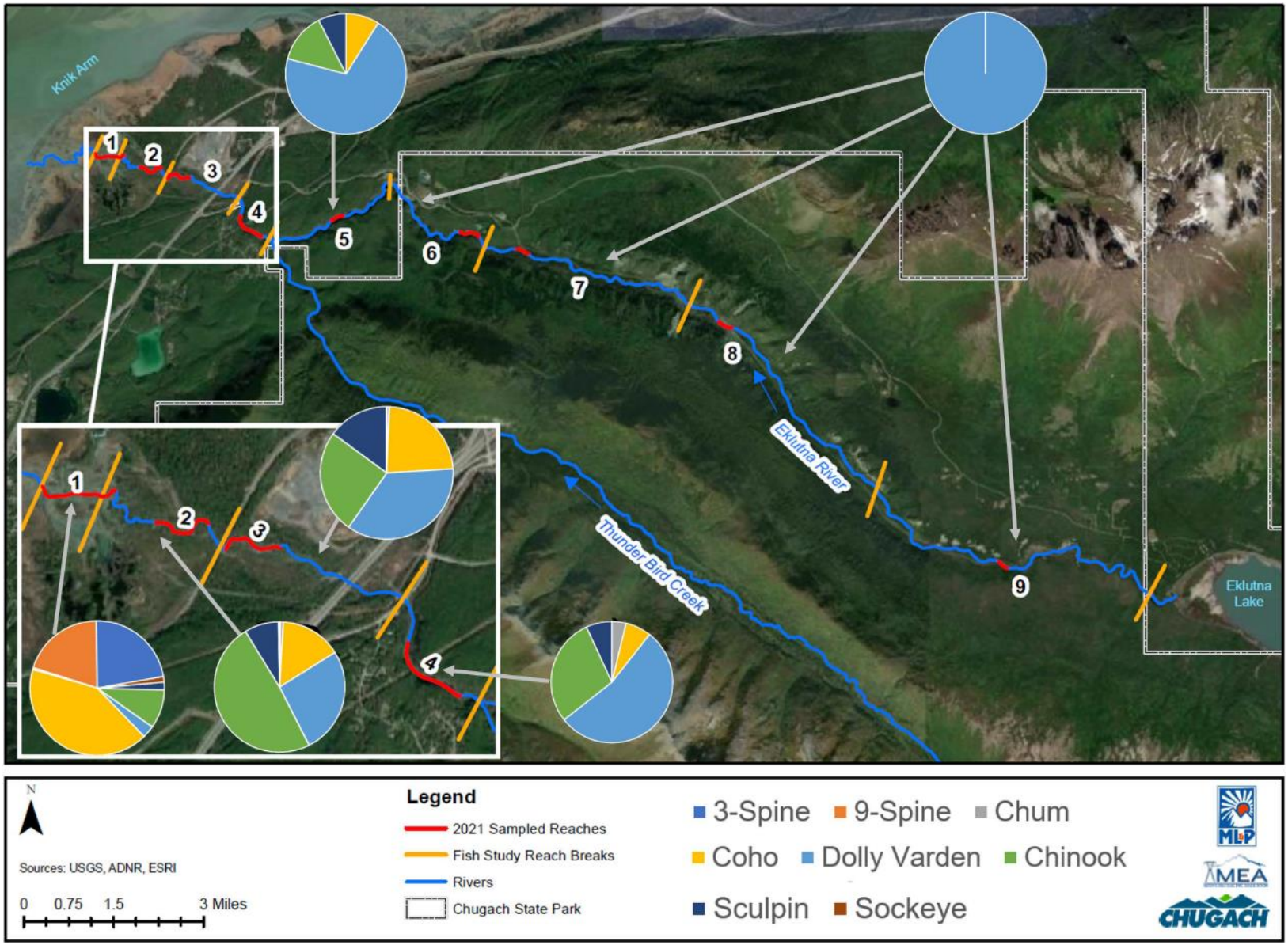

Figure 3.1-2. Relative abundance of juvenile fish species encountered during all seasons by reach.

Electrofishing and minnow trap sampling in reaches 1-5 resulted in capture of both juvenile Chinook and Coho Salmon, and Dolly Varden that included representatives of multiple age classes ranging from emerging young-of-year to smolts to mature adults (Dolly Varden). The changing size distribution of Chinook and Coho juveniles observed from May to July/August to October may be indicative of factors including within-basin redistribution, smolt out-migration, and growth (Figure 3.1-3).

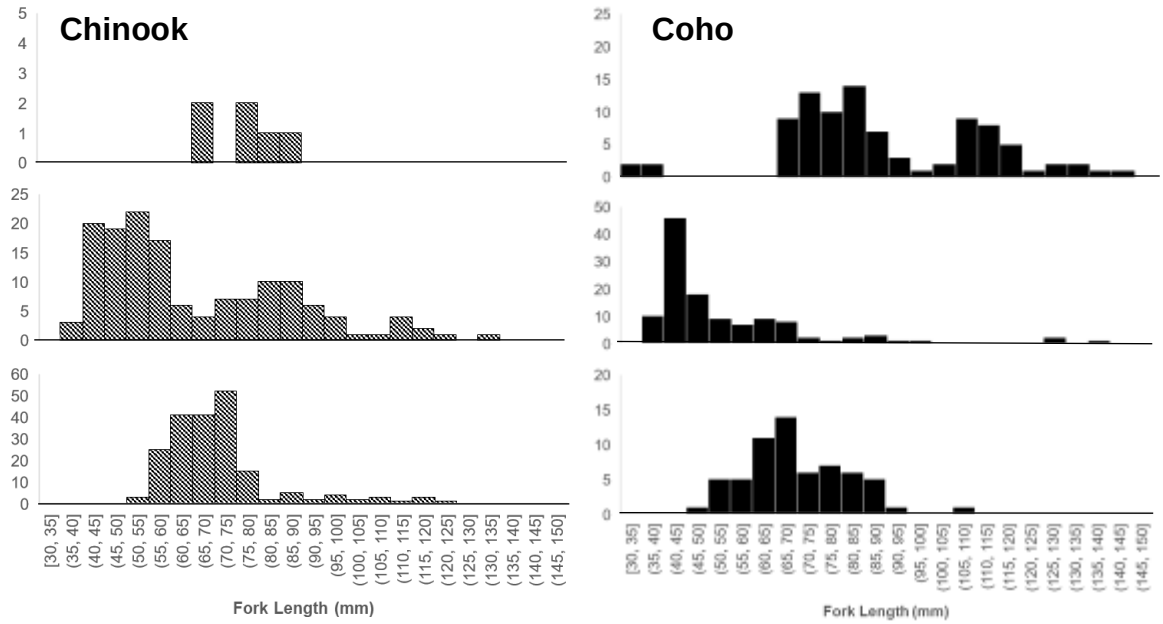

Figure 3.1-3. Length Frequency histograms for spring (upper panel), summer (middle panel), and fall (lower panel) Chinook Salmon (grey bars), and Coho Salmon (black bars). The x-axis indicates Fork Length in mm and the Y-axis is frequency. The presence of multiple peaks suggests age stratification among captured fish. Data compiled from both minnow trapping and electrofishing sampling in reaches 1-5.

3.1.3. Fish Habitat Use

Within reaches, each habitat unit was individually sampled using minnow trapping and electrofishing for presence of juvenile fish to determine habitat preferences by species and age class. The greatest habitat diversity was observed in reaches 1-3 and fish sampling indicates that fish occupied available habitats, though distribution of species among habitat varied. For salmonid species including Chum Salmon, Coho Salmon, Chinook Salmon, and Sockeye Salmon, occurrence in reach 1 was greatest in riffle habitats and side channels where cover was available. In reaches 2 and 3, Coho Salmon, Chinook Salmon, and Dolly Varden were present in all habitat types while incidental Chum Salmon and Sockeye Salmon were present only in riffle and pool habitat, respectively. In reaches 4 and 5 where predominantly riffle habitat is available, all fish were documented in a single habitat type. Table 3.1-3 shows relative abundance of salmonid juveniles captured in dominant habitat types by reach, including total capture number by species for all seasons sampled in 2021.

Table 3.1-3. Relative abundance of salmonid juveniles captured in dominant habitat types by reach, and total capture number ("Total N", electrofishing and minnow trapping) by species for each reach. Habitat Type category "other" includes scour pool, pool, and backwater habitats. Data for reaches 6-9 where only Dolly Varden were present are not shown. Data are compiled from all seasons.

Eklutna River Reach (1-5)	Habitat Type	Chum	Coho	Chinook	Sockeye	Dolly Varden
1	*Glide (61.3%)*	33.3	56.7	19.1	10.0	50.0
1	*S. Channel (38.7%)*	66.7	43.3	80.9	90.0	50.0
Total N		3	584	89	10	22
2	*Glide (20.3%)*	0.0	19.7	22.9	--	34.5
2	*Riffle (38.3%)*	100.0	37.9	22.4	--	45.5
2	*S. Channel (22.4%)*	0.0	6.1	30.8	--	7.3
2	*Other (19.0%)*	--	36.4	23.8	100.0	12.7
Total N		3	66	208	1	121
3	*Glide (6.4%)*	--	--	--	--	1.8
3	*Riffle (79.0%)*	--	54.1	94.9	--	75.4
3	*S. Channel (5.5%)*	--	5.4	--	--	12.3
3	*Other (9.1%)*	100.0	40.5	5.1	--	12.3
Total N		1	37	39	0	57
4	*Riffle (100%)*	100.0	100.0	100.0	--	100.0
Total N		6	11	46	--	86
5	*Riffle (100%)*	--	100.0	100.0	--	100.0
Total N		--	6	9	--	47

3.2. Task 2: 2021 Adult Salmon Spawning Surveys

Spawning surveys occurred approximately weekly from July 9, 2021 to October 28, 2021. Surveys in mainstem spawning reaches (1-4) were not completed on September 18 or 23 during the 150 cubic feet per second (cfs) flow release (September 13-24) because extreme turbidity associated with released sediment and dangerous flow conditions precluded safe execution of the survey. Thunderbird Creek (spawning reach 5) continued to be surveyed during the study flow releases. Spawning surveys were completed on Thursday or Friday of each week to the extent possible, though survey dates varied due to weather, schedule conflicts, and coordination with NVE who also completed weekly spawning surveys during the same period. NVE completed spawning surveys on Tuesdays and used identical methods so that data sets could be comparable. The NVE and MJA weekly surveys were staggered to ensure that no staging and spawning activity of Pacific salmon would be missed. 2021 MJA Survey dates were as follows:

- July 9, 16, 22, 31
- August 6, 11, 20, 26
- September 3, 11, 18 (Thunderbird only), 23 (Thunderbird only), 29

- October 5, 14, 22, 28

No spawning salmon or Dolly Varden were observed during the first survey on July 9 nor on the last survey on October 28.

Spawning activity of anadromous salmon observed included presence of adult fish, active digging or guarding of redds, constructed or partially constructed redds, and presence of post-spawned carcasses. Characteristic photographs were taken when water clarity allowed to document spawning activity, as shown in Figure 3.2-1 for a Chinook Salmon redd.

Figure 3.2-1. Example of Chinook Salmon redd photographed upstream of the New Glenn Highway bridges on July 16, 2021.

The period during which adult fish of each species were observed in the Eklutna River and Thunderbird Creek is as follows:

- Chinook Salmon: July 16 – August 6, 2021
- Pink Salmon: July 31 – September 09, 2021
- Chum Salmon: August 20 – September 03, 2021

- Coho Salmon: September 03 – October 14, 2021
- Dolly Varden (resident): September 23 – October 22, 2021

Pink Salmon were the most abundant anadromous species with a range of 20 – 120 individuals observed per spawning survey from July 31 – September 9, 2021, and a total of 98 Pink Salmon redds observed over the same period. Chinook and Coho salmon were equally scarce with 1-2 individuals observed per spawning survey from July 16 – August 6, 2021. Two Chinook Salmon and one Coho Salmon redd were observed in the mainstem Eklutna, while a further one Chinook and six Coho redds were documented in Thunderbird Creek. The distribution of observed spawning activity indicates the preference of Chum and Pink salmon for habitats in the downstream reaches, while Chinook and Coho were observed using habitat in further upstream reaches including the clearwater Thunderbird Creek. Figure 3.3-2 indicates the GPS position of all anadromous salmon redds documented in 2021, most of which were identified to species by presence of adult fish.

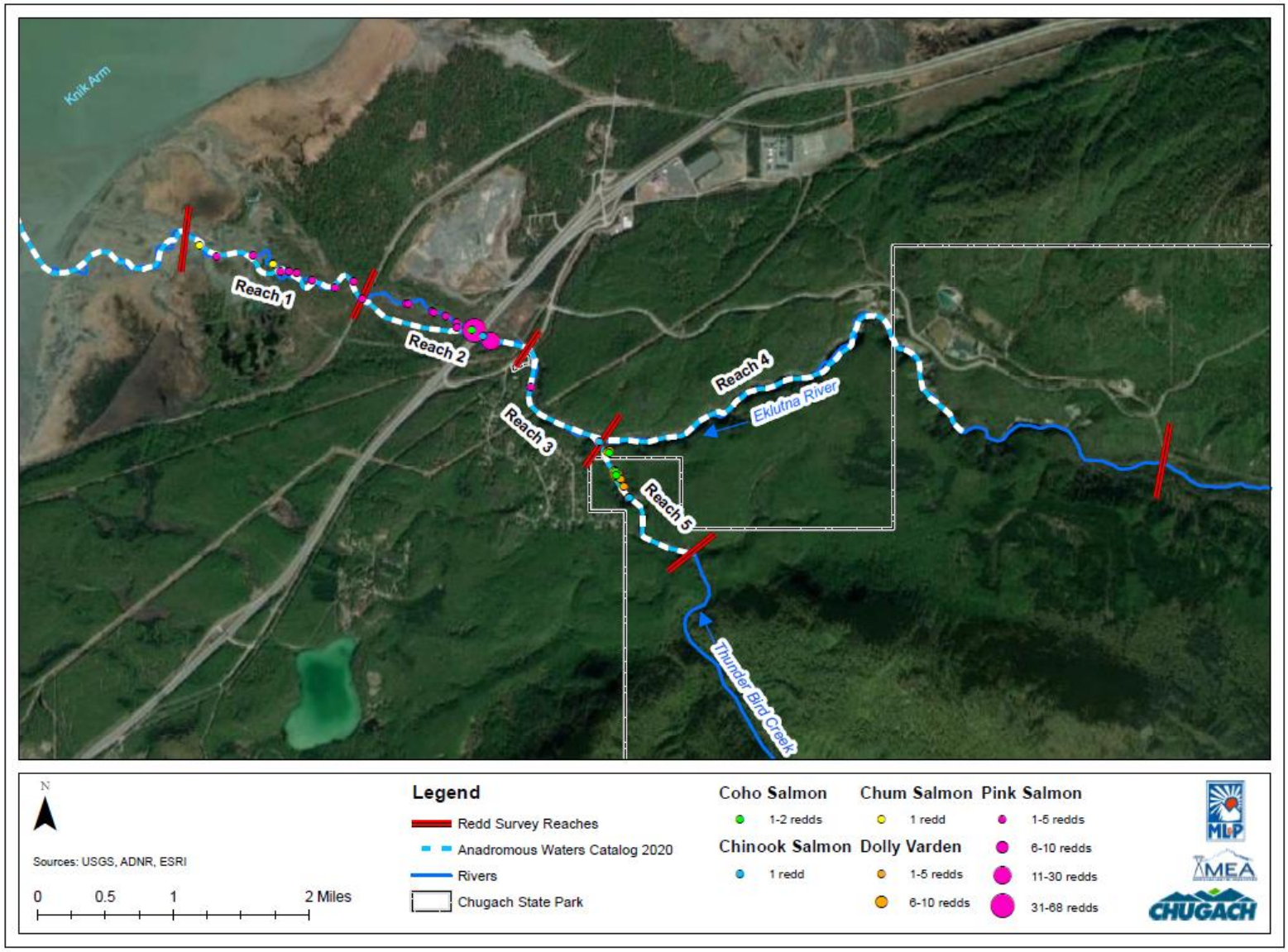

Figure 3.3-2. Distribution of observed redds by species in Spawning Reaches 1-5. Relative size of markers indicates relative abundance of redds at that GPS location.

4 CONCLUSIONS

Supplemental data will be collected in 2022. Therefore, final analysis, a discussion of results, and conclusions will be provided in the Year 2 Final Report.

5 VARIANCES FROM FINAL STUDY PLAN AND PROPOSED MODIFICATIONS

In 2021, we collaborated with NVE on spawning surveys to corroborate findings, and coordinate schedules. Furthermore, some of the sampling methods approved in the 2021 Study Plans for capturing fish including hand seining were not required to complete study objectives in 2021 field work. No other variances from the final approved study plan were required during execution of 2021 field work.

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Appendix A: Stream Habitat-Type Classifications

Table A.1-1 Meso habitat unit types for fish composition and distribution studies.

Macro-scale Habitat Type	Meso-scale Habitat types	Description
Slow Water	Backwater Pool (PL-BW)	Found along channel margins, created by eddies around obstructions such as boulders, root wads, or woody debris. Alcoves included
	Scour Pool (PL-SC)	Formed by flow impinging against a stream bank, partial obstruction (logs, root wad, or bedrock), or substrate. Includes both lateral and mid-channel scour pools.
	Beaver Pond (BP)	Water impounded by the creation of a beaver dam
Fast Water	Glide (GL)	An area with generally uniform depth and flow with no surface turbulence. Glides may have some scour areas but are distinguished from pools by their overall homogeneity and lack of structure.
	Riffle (RF)	Fast, turbulent, shallow flow over submerged or partially submerged gravel and cobble substrates.
	Boulder Riffle (BR)	Same flow and gradient as Riffle, but with numerous boulders than can create sub-unit sized pools or pocket water created by scour.
	Rapid (RP)	Swift, turbulent flow including small chutes and some hydraulic jumps swirling around boulders. Exposed substrate composed of individual boulders, boulder clusters, and partial bars. Lower gradient and less dense concentration of boulders and white water than Cascade. Moderate gradient; usually 2.0 -4.0 percent slope, occasionally 7.0 – 8.0 percent.
	Chute (CH)	An area where most of the flow in constricted to a channel much narrower than the average channel width. Laterally concentrated flow in generally created by a channel impingement or a laterally asymmetric bathymetric profile. Flow is fast and turbulent.
	Cascade (CS)	Fast water habitat with turbulent flow; many hydraulic jumps, strong chutes, and eddies and between 30-80 percent white water. High gradient; usually greater than 4.0 percent slope. Much of the exposed substrate composed of boulders organized into clusters, partial bars, or steep-pool sequences.
	Falls (FS)	Steep near vertical drop in water surface elevation greater than approximately 5 feet over a permanent feature, generally bedrock.
Special Case Units	Dry Channel (DC)	Section of the stream channel that is completely dry at the time of survey.
	Puddled (PD)	Nearly dry channel but with sequence of small isolated sour pools less than one channel width in length or width.