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Susitna-Watana Hydroelectric Project
(FERC No. 14241)

Study of Fish Distribution and Abundance in the Middle and Lower Susitna River
Study Plan Section 9.6

2014-2015 Study Implementation Report

Prepared for

Alaska Energy Authority

SUSITNA-WATANA HYDRO
Clean, reliable energy for the next 100 years.

Prepared by

R2 Resource Consultants Inc.
LGL Alaska Research Associates, Inc.

November 2015

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LIST OF ACRONYMS, ABBREVIATIONS, AND DEFINITIONS

Abbreviation	Definition
ADF&G	Alaska Department of Fish and Game
AEA	Alaska Energy Authority
AWC	Anadromous Waters Catalog
BW	backwater
CIRWG	Cook Inlet Regional Working Group
CPUE	catch-per-unit-effort
CWP	clearwater plume
DIR	direct sample tributary
ELH	early life history
FA	Focus Area
FDA	fish distribution and abundance
FERC	Federal Energy Regulatory Commission
GRTS	generalized random tessellation stratified samples
FL	fork length
ILP	Integrated Licensing Process
In	inches
IP	Implementation Plan
ISR	Initial Study Report
LR	Lower River
MC	main channel
Mm	millimeters
MR	Middle River
PIT	passive integrated transponder
PRM	Project River Mile
Project	Susitna-Watana Hydroelectric Project
RP	river productivity
RSP	Revised Study Plan
SC	side channel
SPD	study plan determination
SS	side slough
TM	tributary mouth
Trib	tributary
TWG	technical workgroup
US	upland slough
USR	Updated Study Report

1. INTRODUCTION

This Study of Fish Distribution and Abundance in the Middle and Lower Susitna River, Section 9.6 of the Revised Study Plan (RSP) approved by the Federal Energy Regulatory Commission (FERC) for the Susitna-Watana Hydroelectric Project, FERC Project No. 14241, focuses on describing the current fish assemblage including spatial and temporal distribution, and relative abundance by species and life stage in the Susitna River downstream of the proposed Watana Dam (AEA 2012).

A summary of the development of this study, together with the Alaska Energy Authority's (AEA) implementation of it through the 2013 study season, appears in Part A, Section 1 of the Initial Study Report (ISR) filed with FERC in June 2014 (AEA 2014). As required under FERC's regulations for the Integrated Licensing Process (ILP), the ISR describes AEA's "overall progress in implementing the study plan and schedule and the data collected, including an explanation of any variance from the study plan and schedule." (18 CFR 5.15(c)(1)).

On October 15, 2014, AEA held an ISR meeting for the Study of Fish Distribution and Abundance in the Middle and Lower Susitna River. Since filing the ISR in June 2014, AEA has continued to implement the FERC-approved plan for the Study of Fish Distribution and Abundance in the Middle and Lower Susitna River. Study efforts applied to the Study of Fish Distribution and Abundance in the Middle and Lower Susitna River subsequent to the ISR include the filing of the following documents:

- *2013-2014 Winter Fish Study Technical Memorandum* filed September 17, 2014 (R2 Resource Consultants, Inc. and LGL Alaska Research Associates, Inc. 2014);
- *Appendix 3. Protocol for Site-Specific Gear Type Selection; Version 5* filed November 14, 2014 (R2 Resource Consultants 2014a);
- *Draft Chinook and Coho Salmon Identification Protocol* filed November 14, 2014 (R2 Resource Consultants 2014b).

The 2014 sampling efforts in the Middle and Lower River focused on:

- Completion of the first full study year of Winter Fish Studies;
- Completion of the second study year of Salmon Early Life History (ELH) sampling;
- Continuation of resident fish radio tagging and tracking;
- Fish distribution and abundance sampling at sites that were not sampled or partially sampled in 2013 due to land access restrictions to fulfill and complete the first study year of data collection.

In furtherance of the next round of ISR meetings and FERC's SPD expected in 2016, this report describes AEA's overall progress in implementing the Study of Fish Distribution and Abundance in the Middle and Lower Susitna River since that reported in June 2014. Rather than a comprehensive reporting of all field work, data collection, and data analysis since the beginning of AEA's study program, this report is intended to supplement and update the information presented in Part A of the ISR for the Study of Fish Distribution and Abundance in the Middle and Lower Susitna River. It describes the methods and results implemented, and includes a discussion of the results achieved.

2. STUDY OBJECTIVES

As established in RSP Section 9.6.1 (Table 2-1), there are seven study objectives. The following components of those objectives were addressed by activities carried out in 2014:

1) Describe the seasonal distribution, relative abundance (as determined by CPUE, fish density, and counts) and fish habitat associations of juvenile anadromous salmonids, non-salmonid anadromous fishes and resident fishes.
2) Describe seasonal movements of juvenile salmonids and selected fish species such as Rainbow Trout, Dolly Varden, Humpback Whitefish, Round Whitefish, Northern Pike, Arctic Lamprey, Arctic Grayling, and Burbot, with emphasis on identifying foraging, spawning and overwintering habitats within the mainstem of the Susitna River.
    b. Describe seasonal movements using biotelemetry (passive integrated transponder [PIT] and radio-tags).
3) Describe early life history, timing, and movements of anadromous salmonids.
    a. Describe emergence timing of salmonids.
    b. Determine movement patterns and timing of juvenile salmonids from spawning to rearing habitats.
    c. Determine juvenile salmonid diurnal behavior by season.
    d. Collect baseline data to support the Stranding and Trapping Study.
4) Document winter movements and timing and location of spawning for Burbot, Humpback Whitefish, and Round Whitefish.
5) Document the seasonal age class structure, growth, and condition of juvenile anadromous and resident fish by habitat type.
6) Document the seasonal distribution, relative abundance, and habitat associations of invasive species (Northern Pike).
7) Collect tissue samples from juvenile salmon and opportunistically from all resident and non-salmon anadromous fish to support the Fish Genetic Baseline Study (Study 9.14).

3. STUDY AREA

The RSP established the Middle and Lower River study area as the Susitna River from RM 61 upstream to the proposed Watana Dam site (RM 184, RSP Figure 9.6-1). The downstream boundary of the study area was subsequently adjusted in the Final Fish Distribution and Abundance Implementation Plan (IP; AEA 2013) to PRM 32.3 (HRM 28.3) immediately upstream of the confluence with the Yentna River upstream to the Watana Dam Site (PRM 187.1[RM 184], Figure 3-1).

In 2014, study efforts occurred in the Middle and Lower Susitna River from Montana Creek (PRM 80.8) upstream to the proposed Watana Dam site (PRM 187.1). Excluding PIT antenna array operation during the Winter Fish Studies (R2 Resource Consultants and LGL Alaska

Research Associates 2014) at Montana Creek (PRM 80.8) and aerial tracking of radio tags (Table 4.2-2), 2014 study efforts were concentrated in the Middle River Segment.

4. METHODS

This study employed a variety of field methods to build on the existing information related to the distribution and abundance of fish species in the Middle and Lower Susitna River consistent with the Study Plan except for specific variances as described below. The following sections provide brief descriptions of study site selection, sampling frequency, the approach, and suite of methods that were used to accomplish each objective of this study.

Fish Distribution and Abundance Implementation Plan

A final sampling scheme was developed as part of the detailed Fish Distribution and Abundance Implementation Plan (IP, AEA 2013) for Studies 9.5 and 9.6 which was approved by FERC, with modifications, on April 1, 2013. Implementation in 2014 included updating the Protocol for Site-Specific Gear Type Selection (filed with FERC November 2014; R2 Resource Consultants 2014a). The gear selection protocol is a working document provided to field crews summarizing the sampling approach using multiple gear types. Sampling methods by objective are presented below and in Table 2-1. Brief descriptions of each sampling technique are provided in Section 4.12.

4.1. Study Site Selection

AEA implemented site selection as described in the IP as well as the Study Plan modifications presented in ISR, Part C, Section 7.1.2 (AEA 2014). Field sampling sites in 2014 occurred for: the study of salmon early life history, the study of fish distribution and abundance, radio-telemetry tagging and tracking, and winter study sites. AEA implemented the site-selection methods as described in the Study Plan with the exception of the variances explained below in Section 4.1.5.

4.1.1. Early Life History Sites

Salmon early life history (ELH) sampling took place every two weeks between ice break-up (May 3, 2014) and July 1 in six Middle River Focus Areas downstream of Devils Canyon (Table 4.1-1; Figures A1-A6). During ELH sampling events, study locations in selected Focus Areas included three 40-meter (131-feet) long sampling units immediately downstream of a documented Chinook, Chum, or Coho Salmon spawning area (tributary mouths or side sloughs) and three 40-meter (131-feet) sampling units that provided rearing habitat.

4.1.2. Fish Distribution and Abundance Sites

4.1.2.1. Middle River Tributaries above Devils Canyon

Tributaries selected for fish distribution and abundance sampling between the downstream end of Devils Canyon (PRM 153.9) and the proposed Watana Dam Site (PRM 187.1) included all known Chinook Salmon-bearing tributaries and other tributaries that were not listed in ADF&G's Anadromous Waters Catalog (AWC; ADF&G 2012). Initially seven tributary streams were selected for sampling based on: AWC catalog listings, drainage basin, historical and 2012 sampling efforts, and the potential for impact from the proposed Project (Table 4.1-2).

As described in the IP, a direct sampling methodology was implemented on these seven tributary streams. An average effort of two 100 m (328 ft) sites were sampled over a two day period. Because of land access constraints, only two streams were fully sampled in 2013, Fog Creek and Fog Creek Tributary; Tsusena and Chinook Creeks received partial sampling. In 2014, Tsusena and Chinook Creeks were re-sampled; Unnamed Tributary 184, Devil Creek, and Cheechako Creek were also sampled (Tables 4.1-2 and 4.1-4). The goal of sampling was to distribute two days of sampling effort over the accessible study area in several locations that represented multiple habitat types. Efforts were focused in the lower reaches, immediately upstream of the tributary mouth, and below documented anadromous fish passage barriers (Figures A-10, A-11, A-13).

4.1.2.2. Mainstem Middle River

Mainstem sampling followed GRTS site selection that occurred in 2013 (AEA 2014). In 2013, a total of 162 sites were sampled from the 177 targeted sites in the Middle River including 76 sites within Focus Areas and 86 sites outside of Focus Areas. In 2014, AEA sampled sites that were inaccessible or partially sampled in 2013 because of land access constraints. This included 12 locations within Focus Areas and 15 outside of Focus Areas (Tables 4.1-3 and 4.1-4). Combining efforts from 2013 and 2014, a total of 182 sites were sampled from a target of 177; the sampled number exceeds the target because additional backwater and clearwater plume habitats were sampled when encountered. Sampling locations for 2014 are depicted in Figures A7-A13.

4.1.3. Radio Telemetry Sites and Surveys

Fixed radio telemetry stations were installed at seven locations in the Middle Susitna River in 2014 (Table 4.1-5). The primary objective of six stations was to track the movements of radio-tagged fish in the mainstem of the Susitna River (Lane Creek [PRM 117; near the mouth of Lane Creek], Gateway [PRM 130; upstream of Curry], Cheechako Creek [PRM 157.4], Chinook Creek [PRM 160.5], Devils Island [PRM 167; upstream of Devil Creek], and near the Watana Dam Site [PRM 186.8]). The seventh station, Indian River station, provided coverage of the mainstem of the Susitna as well as Indian River (PRM 142.1). Tagging efforts in 2014 focused on the Upper River, however limited tagging of Arctic Grayling (7) and Burbot (5) did take place in the Middle River above Devils Canyon (Table 4.4-2). Aerial tracking of fishes radio tagged in 2014 and 2015 in the Middle and Lower River extended from the Lower Susitna River near the mouth to the Watana Dam site (Table 4.2-2).

4.1.4. Winter Study Sites

Given the limited number of daylight hours and potential for extreme weather, sampling efforts for the Winter Fish Study were limited to the reach of the Middle and Lower Susitna River easily accessible from Talkeetna by snow machine, snowshoe, or railroad. The study area included the lower reaches of Montana Creek (PRM 80.8) and the Susitna River between PRM 104.4 and PRM 142.4. Three Focus Areas, FA-104 (Whiskers Slough), FA-128 (Slough 8A), and FA-138

(Gold Creek), served as activity centers for intensive sampling (R2 Resource Consultants and LGL Alaska Research Associates 2014). Supplemental sampling took place at five additional locations including: the Cut (an upland slough between the Susitna and Chulitna Rivers), Slough 14, Gold Creek, Indian River, and Slough 17 (R2 Resource Consultants and LGL Alaska Research Associates 2014). A site list by location, habitat, and sampling event is provided in Table 4.1-6. PIT tag antenna arrays were operated at Montana Creek (PRM 80.8), Whiskers Slough (FA-104) and Slough 8A (FA-128) during the 2013-2014 Winter Fish Study (R2 Resource Consultants and LGL Alaska Research Associates 2014).

4.1.5. Variances from Study Plan

Several 2013 variances related to study sites that were described in ISR Part A, Section 4 continued in 2014. In addition, implementation of the Study Plan in 2014 resulted in two new variances related to radio telemetry fixed receiver and winter study sites. Unlike 2013, the 2014 Study Plan implementation includedaccess to Cook Inlet Regional Working Group (CIRWG) and Alaska Railroad Corporation lands and the addition of Winter Study sites.

4.1.5.1. Early Life History Study Sites

The following variances from the Study Plan for site selection in 2014 were also implemented in 2013 (Study 9.6 ISR, Part A, Section 4.1.7) and were also proposed as Study Plan modifications (Study 9.6 ISR, Part C, Section 7.1.2).

- The Study Plan specified ELH sampling at six sites in each of five Middle River Focus Areas (IP Section 5.5). However, with the addition of FA-113 (Oxbow I) following IP development, sampling took place at six sites in each of six Focus Areas (Study 9.6 ISR Part A, Section 4.1.7.1; Table 4.1-1). Expansion of ELH sampling is anticipated to enhance AEA’s ability to meet the study objectives.
- FERC’s SPD recommended that AEA sample mainstem habitats using separate strata for main channel, split main channel and multi-split main channels. However, based on licensing participants’ recommendations during the study plan development and ongoing discussions in the Fish and Aquatic TWG meetings regarding the potential to extend an unbalanced effort in these habitats, these three channel forms were sampled as a single strata designated as main channel. During sampling, field crews noted macrohabitat type (e.g., main channel, split channel, or multi-split main channel). This variance resulted in 30 fewer mainstem sites being sampled (Study 9.6 ISR Part A, Section 4.1.7.2, Table 4.1-3). This may have decreased the ability to evaluate the distribution, abundance and habitat associations for rare species in mainstem habitats; but is consistent with NMFS and FWS concerns that there were too many level 3 and level 4 mainstem habitat classifications. NMFS and FWS also stated that AEA’s proposed level 4, split main channel and braided channel habitat types are a geomorphic classification and do not provide habitat characteristics or values that should be distinguished at the macrohabitat level (FERC SPD April 1 , 2013). This variance is not anticipated to impact AEA’s ability to meet the seasonal distribution component of Objective 1; however, the degree to which fish relative abundance and habitat associations vary among main channel habitat types will be further analyzed.

4.1.5.2. Fish Distribution and Abundance Sites

Land ownership and accessibility influenced fish sampling in discrete areas of the Middle River in 2013. In 2014, access was permitted on CIRWG and Alaska Railroad Corporation ARRC lands resulting in sampling of 27 GRTS target locations and five direct sample tributaries that were either not sampled or partially sampled in 2013. AEA completed a first year of sampling as proposed in the study plan, but over two study years. While some interannual variability is expected across all study sites, it is anticipated that the 2013 and 2014 datasets can be combined for comparative analysis and study objectives relative to fish distribution and abundance can be met.

Sampling in 2014 took place at 27 Middle River GRTS sites, bringing the total number sampled to 182 sites and exceeded the target of 177 sites (Table 4.1-3). Additionally, between 2013 and 2014, 42 locations were sampled in 7 direct sample tributaries in and above Devils Canyon (Table 4.1-2) bringing the total number of Middle River fish distribution and abundance sites to 224. This variance is expected to improve AEA's ability to determine fish distribution, abundance, and habitat associations in the Middle River.

4.1.5.3. Radio Telemetry Fixed Receiver Sites

In 2014, 10 total fixed receiver sites were used to monitor resident fish tags (Table 4.1-5). This includes seven sites in the Middle River (Lane, Gateway, Indian River, Cheechako, Chinook, Devils, and Watana Dam site) and three new stations that were added to the Lower River: Montana Creek weir, Susitna at Sunshine, and Talkeetna River. Stations proposed (Section 5.8.2.1 of the IP) but not monitored in 2014 included: 4th of July Creek, Indian River weir, Slough 21, Montana Creek confluence, Whiskers Creek confluence, Portage Creek confluence, and Fog Creek confluence. This reduction of fixed of fixed stations resulted in a similar number of arrays to that used in 2013 and, as in 2013, was accompanied by an increase in the frequency of mobile surveys from one survey per month during the non-salmon season as indicated in the Study Plan, to one survey every 20 days. Surveys during the salmon season increased from one survey per week to a minimum of two surveys per week. A preliminary analysis of the 2013 detection data showed that this study design allowed for more detail on the timing and location of tagged fish than would have been collected with more fixed stations and fewer mobile surveys. The increased frequency of mobile surveys more than compensated for operating fewer fixed telemetry sites as it added more observations on seasonal timing and distribution. Thus, this variance enhanced AEA's ability to meet study objectives for radio-telemetry.

4.2. **Sampling Frequency**

AEA implemented the sampling frequency methods as described in the Study Plan with the exception of the variances explained below in Section 4.2.1. Sampling frequency varied among sites based on study objectives. Winter fish sampling occurred monthly from February through April 2014 and was coordinated with the intergravel temperature monitoring, and the underwater fish observation using sonar (R2 Resource Consultants and LGL Alaska Research Associates 2014). Following the 2014 Winter Fish study, sampling occurred seasonally during the ice-free period. Biweekly ELH sampling began following break-up (May 3, 2014) and continued into late June in an attempt to capture critical juvenile salmon out-migration from natal tributaries to rearing habitats (Table 4.1-1). Fish distribution and abundance sampling in 2014 was completed during three sessions: early summer (June 30 to August 11), late summer (August 12 to September 9) and fall (September 15 to October 8). Stationary radio receivers were operated between May 2 and July 8 (Table 4.1-5) and were monitored for operational efficiency on a weekly basis (Table 4.2-1). Aerial radio telemetry surveys were conducted approximately every 20 days from January 5 until June 12, 2014 two to five times per week from mid- June through October 17, 2014 and approximately monthly from mid-October, 2014 to July 6, 2015 (Table 4.2-2).

4.2.1. Variances from Study Plan

Land ownership and site/weather conditions influenced the frequency of fish sampling in discrete areas of the Middle River in 2013. In 2014, access was permitted on CIRWG and ARRC lands; however the timing of final permit approval resulted in 10 of 27 GRTS sites and 3 of 5 direct sample tributaries not being sampled during the early summer sampling period (Table 4.1-4). Because data were successfully collected during subsequent sampling events, this variance is not anticipated to affect AEA's ability to meet the study objectives.

In 2013, aerial surveys occurred approximately weekly from July through October. At other times of the year, the frequency and location of aerial surveys was at least monthly. In 2014, AEA increased the frequency of the mobile surveys from weekly during the salmon monitoring period and monthly during the non-salmon period (ISR Part A Section 5.8.2.2) to a minimum of two times per week and every 20 days, respectively. An analysis of the 2013 telemetry data indicated that the mobile data provided more detail on fish timing and distribution than would have been provided by a lower frequency of mobile tracking and higher number of fixed telemetry stations as proposed in the Study Implementation Plan, such that the variance did not effect accomplishing the study objectives.

4.3. Objective 1: Fish Distribution, Relative Abundance, and Habitat Associations

AEA implemented the methods as described in the IP including updates made to the Protocol for Site-Specific Gear Type Selection (R2 Resource Consultants 2014a) with the exception of variances explained below (Section 4.3.3). The general sampling approach was to gather data on relative abundance as determined by catch per unit effort and density; complementary data on fish size, life stage, and condition factor were also collected. For all sampling, main channel, off-channel, and tributary habitats were further characterized in the field to the mesohabitat level (pool, riffle, glide, etc.) for sampling purposes and for study of fish-habitat associations. The sampling locations and fish capture methods (e.g., number of passes, amount of soak time, use of block nets when feasible) were standardized such that they were repeatable on subsequent sampling occasions.

In 2013 field crews reported difficulty with differentiating juvenile Chinook and Coho salmon in the Middle and Lower River below Devils Canyon. In particular, larger juveniles undergoing smoltification in upland sloughs were reportedly challenging and difficult to distinguish. This issue was also raised by certain licensing participants during their review and comments on the ISR (NMFS 2014; FWS 2014). In 2014, identification challenges continued but were substantially reduced (Appendix B) as crews received: (1) additional training at locations where both species co-occurred and were difficult to distinguish, (2) the results of 2013 genetic collections, (3) review and feedback on photos of field specimens, and (4) established a voucher reference library to gage field calls with meristic characteristics. In 2014, crews continued to collect genetics samples from Chinook and Coho salmon (Table 4.9-1; R2 Resource Consultants 2015 Table 4.7-1) as well as photos for senior review and AEA was able to implement components of the proposed QAQC protocol for field determinations of these species (Appendix B). Moving forward, AEA has proposed to implement the full suite of actions in the identification protocol as described in the *Draft Chinook and Coho Salmon Identification Protocol* (R2 Resource Consultants 2014b), filed with FERC November 14, 2014. These actions will improve field identification in future study years and will provide a means of continued evaluation the accuracy of field calls for juvenile Chinook and Coho salmon.

4.3.1. Tasks A and B: Fish Distribution and Relative Abundance Surveys

Fish distribution and abundance surveys included three seasonal sampling events during the ice-free seasons with year-round sampling in select Focus Areas. Various methods were chosen based on target species, life stage, and water conditions. Snorkeling and electrofishing were preferred methods for juvenile fishes in clearwater areas where velocities were safe. Minnow traps, beach seines, and fyke nets were employed as alternatives in deeper waters and in habitats with limited access, low visibility, or high velocities. For larger fishes, gillnets, seines, hoop traps, and angling were used. Whereas snorkeling, minnow trapping, backpack electrofishing, and beach seines were applicable to sloughs and other slow-moving waters, gillnetting, boat electrofishing, hoop traps, and trot lines were more applicable to the main channel. Two or more survey methods were selected for each site based on target species and life stages (R2 Resource Consultants 2014a). The decisions about what methods to apply were made by field crews after initial site selection following guidance outlined in the gear selection protocol (R2 Resource Consultants 2014a) and in accordance with state and federal fish sampling permit requirements. Basic site and habitat information was collected for each mesohabitat sampled and detailed records were kept on the level of sampling effort including soak times, sampling duration, number of units, and specifications of gear used. Lastly, methods varied seasonally with the extent of ice cover. Methods for winter sampling were based on winter 2012–2013 pilot studies and included sonar imaging, underwater video, minnow traps, electrofishing, fyke nets, and trot lines (R2 Resource Consultants and LGL Alaska Research Associates 2014).

4.3.2. Task C: Fish Habitat Associations

In conjunction with Tasks A and B, data were collected for fish distribution and abundance by mesohabitat type nested within macrohabitats.

4.3.3. Variances from Study Plan

The following variances from the Study Plan related to sampling methods for fish distribution, relative abundance and habitat association samplint that occurred in 2013 and were presented in

9.6 ISR Section 4.4.4. These variances, which were also proposed as Study Plan modifications in 9.6 ISR, Part C, Section 7.1.2, were continued in 2014:

- 200 meter (565 ft) sampling length for all methods in main channel and side channel habitats except for boat electrofishing and drift gill netting which consisted of 500 meter (0.3 mi) sample lengths;
- Single pass sampling for electrofishing, snorkeling, and minnow trapping
- The use of block nets was limited to habitats where feasible;
- Overnight soak duration for fyke nets and hoop traps;
- Use of one gear type to survey some mesohabitats (approximately 5 percent) where additional gears were not appropriate due to habitat conditions.
- Soak time for drift gill nets set was up to 15 minutes due to currenets transporting the net out of the sampling area.

Implementation of the Study Plan in 2014 did not result in any new variances for fish distribution, relative abundance, and habitat association sampling methods. As described in the Study 9.6 ISR, Part C (Section 7.1.2.6) these variances are not anticipated to detract from AEA's ability to meet the study objectives. An analysis of sampling sufficiency presented therein describes the effectiveness of 2013 sampling methods with respect to capturing 92-100 percent of species present in each geomorphic reach and the adequacy of characterizating baseline distribution, relative abundane, and habitat associations in the Middle and Lower River.

4.4. Objective 2: Seasonal Movements

AEA implemented the methods for Objective 2 as described in the Study Plan with the exception of the variances explained in Section 4.4.2.

4.4.1. Task A: Describe seasonal movements using biotelemetry.

4.4.1.1. Field Methods

Biotelemetry techniques included radio telemetry and Passive Integrated Transponder (PIT) technology. Half duplex PIT tags (12 and 23 mm) were surgically implanted in fish greater than 60 mm (2.4 in) to monitor movement and growth. Fish for PIT tagging were captured opportunistically during fish distribution and abundance sampling.

PIT tagging in the Middle River took place from February through mid-September, 2014 and focused on fish in proximity to intensive winter fish study locations and Focus Areas. Recaptured fish provided information on the time and distance travelled and growth since the fish was last handled. PIT tag antenna arrays with automated data logging were installed and operated at Montana Creek, FA-104 (Whiskers Slough) and FA-128 (Slough 8A) during the winter study period and were removed prior to ice breakup in 2014 (R2 Resource Consultants and LGL Alaska Research Associates 2014). During the 2014 field season (November 2013-October 2014), a total of 2,004 PIT tags were implanted in nine different fish species in the Middle River (Table 4.4-1). Coho Salmon were the most frequently tagged species (n=1,193), followed by juvenile Chinook Salmon (n=349). A total of 236 in-hand recaptures of PIT tagged fish occurred in the Middle River in 2014 providing information on movements and growth (Table 4.4-1).

Radio telemetry efforts for resident fish were focused on the Upper River in 2014, limited tagging of Arctic Grayling (16) and Burbot (5) in the Middle River above Devils Canyon took place in 2014 (Table 4.4-2). Many of the tags deployed in 2013 remained active during all or a portion of 2014; depending on radio tag model and specifications, tag life ranged from 80 to over 900 days (IP Table 5.8-2). Using minimum tag life estimates, 135 of 158 tags released in the Middle and Lower River in 2013 were anticipated to continue transmitting during a portion or all of 2014. Aerial surveys were partitioned into mainstem Susitna and tributary zones (Study 9.6 ISR Part A, Appendix B, Figures B20 and B21). A target of 30 Arctic Grayling, Burbot, Dolly Varden, Longnose Sucker, Northern Pike, Lake Trout, Rainbow Trout, Humpback Whitefish, and Round Whitefish was set for radio-tagging during non-spawning periods. During 2013-2014, target numbers for radio tagging in the Middle/Lower River study area were met for Arctic Grayling (51) and Rainbow Trout (44) and nearly met for Longnose Sucker (28) and Round Whitefish (21) (Table 4.4-2). Targets have not been reached for less abundant species, including Lake Trout that have not been captured during any sampling in the Middle or Lower River. Summary information for tags at large (Table 4.4-3) indicate how many fish were actively tracked by month in the Middle/Lower River from January 2014 through June 2015.

4.4.2. Variances from Study Plan

The following variances from the Study Plan related to biotelemetry occurred in 2013 (ISR, Part A, Section 4.5.3). These variances, which were also proposed as Study Plan modifications in ISR, Part C, Section 7.1.2, were continued in 2014.

- Because of channel size and configuration and power supply requirements, antennas could not be arranged in a longitudinal series; instead, a single antenna system wasused at most locations (Study 9.6 ISR Part A, Section 4.5.3.1).
- AEA measured the read range antennas with 12 and 23 mm tags to determine the detection efficiency of PIT tag interrogation systems (Study ISR, Part A, Section 4.5.3.1).
- The timing of implantation of radio tags as recommended by FERC was not adopted (SPD B-135). The timing of fish tagging was based on minimizing impact to individual fish and in particular to pre-spawning fish (Study 9.6 ISR, Part A, 4.5.3.2).
- The number of fixed telemetry stations and frequency of mobile surveys were adjusted as reported in Study 9.6 ISR Part A, Section 4.1.7.4 and described previously in Sections 4.1.5.3 and 4.2.1 of this SIR. The increased frequency of mobile surveys more than compensated for operating fewer fixed telemetry sites as it added more observations on seasonal timing and distribution. These variances combined to enhance AEA's ability to meet study objectives for radio-telemetry.
- For resident fish, manual tracking, directed searching, or identification of habitat type was not conducted during the period when adult salmon were being tracked (Study 9.6 ISR Part A, Section 4.5.3.3), but these activites were conducted during the period when adult salmon tags were not present. This variance in aerial telemetry survey method did not effect meeting the stated objectives of the radio-telemetry component of the study because the number and accuracy of the geographic positions of the tags were sufficient to characterize the seasonal distribution and timing of resident fish. Range testing of the mobile telemetry antenna

array demonstrated that all sections of river would be scanned during a survey for each frequency. Further, the increased occurrence of surveys during both periods of when salmon were present and not present (relative to that proposed in the IP), provided a higher likelihood to detect tags.

4.5. Objective 3: Early Life History

In 2014, the second complete year of salmon ELH sampling, AEA implemented the second complete year of salmon ELH sampling methods for Objective 3 as described in the Study Plan with the exception of the variances explained below in Section 4.5.5.

4.5.1. Task A: Describe emergence timing of salmonids.

In conjunction with the Intergravel Monitoring component of the Fish and Aquatics Instream Flow Study (Study 8.5), salmon redds in selected side channels and sloughs were monitored on a monthly basis throughout the winter in Focus Areas: FA-104 (Whiskers Slough), FA-128 (Slough 8A), FA-138 (Gold Creek), and FA-144 (Slough 21). Studies included monitoring of surface and intergravel water temperatures and spawning substrate composition. This task was conducted as part of the Fish and Aquatics Instream Flow Study (Study 8.5) with methods presented in Study 8.5 ISR, Part A, Section 4.5.1.2.1.

4.5.2. Task B: Determine movement patterns and timing of juvenile salmonids from spawning to rearing habitats.

Bi-weekly sampling to document the distribution of newly emerged salmon in select Focus Areas occurred from breakup (May 3, 2014) through July 1. Six Focus Areas, FA-104 (Whiskers Slough), FA- 113 (Oxbow 1), FA-128 (Slough 8A), FA-138 (Gold Creek), FA-141 (Indian River), and FA-144 (Slough 21), met the criteria of having both spawning and rearing habitat and were selected for sampling (Table 4.1-1). Electrofishing, seining, and Fyke nets, were the methods for collecting Salmon during the early life stage sampling. Visual observations of salmon fry were noted by field crews. Three sampling events took place mid-May through late June as described above in Section 4.2.

4.5.3. Task C: Determine juvenile salmonid diurnal behavior over season.

In the Study Plan (RSP Section 9.6.4.3.3) AEA proposed that sampling schedules would encompass daylight, twilight, and evening periods. In 2014, this was accomplished during the winter by passive sampling techniques (underwater video, sonar imaging, minnow traps, fyke nets, and PIT interrogation sites) during the night and crepuscular periods. During ELH, this was accomplished by the use of active sampling techniques during the day and fyke netting overnight.

4.5.4. Task D: Collect baseline data to support the Fish Stranding and Trapping Study.

The focus of this task was to provide baseline distribution and abundance data to support the stranding and trapping component of the Fish and Aquatics Instream Flow Study (Study 8.5). Fish distribution sampling occurred at six Focus Areas FA-104 (Whiskers Slough), FA- 113

(Oxbow 1), FA-128 (Slough 8A), FA-138 (Gold Creek), FA-141 (Indian River), and FA-144 (Slough 21), and at representative habitat units to identify seasonal timing, size, and distribution among habitat types for fish (particularly less than 50 mm [2 in]). Electrofishing, seining, and fyke nets, were the methods for collecting salmon fry.

4.5.5. Variances from Study Plan

During ELH sampling, large pulses of newly emerged salmon fry were frequently collected during sampling in particular with fyke nets. In 2014, in order to manage large volumes of fish (Table 5.2.1) while minimizing impacts and returning them to the stream in a safe and timely manner, chum and sockeye fry were grouped together. To differentiate between the emergent fry and early parr of these two species in the field when they co-occurred would have required holding these fragile life stages in buckets for extended periods while handling every fish and it is unnecessary to document habitats protective of early life history stages of salmon. This variance will not affect AEA's ability to meet objective 3.

4.6. Objective 4: Document Winter Movements and Timing and Location of Spawning for Burbot, Humpback Whitefish, and Round Whitefish

AEA implemented the methods for Objective 4 as described in the Study Plan. Radio tags were surgically implanted in nine Burbot, seven Humpback Whitefish, and twenty-one Round Whitefish in 2013. These individuals were tracked during the 2013-2014 winter period (Table 4.4-3). During the 2014 open water season, an additional five Burbot were tagged in the Middle River above Devils Canyon and tracked during the 2014-2015 winter (Table 4.4-3).

4.7. Objective 5: Document the Seasonal Size/Life stage Structure, Growth, and Condition of Juvenile Anadromous and Resident Fish by Habitat Type

AEA implemented the methods for Objective 5 as described in the Study Plan with the exception of the variances explained in Section 4.7.1. In conjunction with Objectives 1 and 3, captured fish were identified to species and classified to life stage or smolt index when possible. A summary of fish length-at-maturation for the region was used as a basis for assigning life stages (Table 4.7-1). Each time a gear was used for sampling, a random sample of 25 individuals per species, life stage, and site were measured for fork length (FL) in mm and measured in grams. For species without a forked tail (e.g., sculpin and Burbot), total length was measured laterally along the mid-line from the anterior edge of the snout to the posterior edge of the tail. Total sample sizes of fish measured for length and weight by Study Component are presented in Table 4.7-2. Species were classified by life stage (Table 4.7-1) and when sample sizes were sufficient, natural breaks in length-frequency were used to further refine size bins with an emphasis on anadromous salmon less than 50 mm (2 in). Recaptured PIT-tagged fish (Objective 2 Task B) provided growth information. The number of fish PIT-tagged and recaptured is presented in Table 4.4-1. Parameters recorded in each habitat unit included the number of fish by species and life stage; fork length; weight; global positioning system (GPS) location of sampling unit; time of sampling; weather conditions; water temperature; water transparency; behavior; and the location and distribution of observations.

4.7.1. Variances from Study Plan

The following variances from the Study Plan occurred in 2013 (ISR, Part A, Section 4.8.1) and are summarized below. These variances, which were also proposed as Study Plan modifications in ISR, Part C, Section 7.1.2, were continued in 2014.

- Each time sampling gear was checked, 25 individuals of each species and life stage were randomly selected to be measured for length and weighed. The sample size of 25 measurements per species per life stage per site was consistent with collecting the data necessary to evaluate length frequency distributions and condition factor for sampled fish and will not affect AEA's ability to meet objective 5 (Study 9.6 ISR Part C, Section 7.1.2.6.3).
- Ages were not assigned based on fish length. The objective of documenting the seasonal age-class structure of juvenile anadromous and resident fish by habitat type (RSP Section 9.6.4.3.5) was replaced with documenting seasonal size-structure by habitat type (ISR, Part A, Section 4.8.1). Evaluating habitat associations by size instead of age will continue to meet the objective of documenting the seasonal life stage use, growth, and condition of species by habitat type and will not affect AEA's ability to meet objective 5.

4.8. Objective 6: Document the Seasonal Distribution, Relative Abundance, and Habitat Associations of Invasive Species (Northern Pike)

Tracking of Northern Pike that had been radio tagged in 2013 continued in 2014; however, no sampling for, or additional tagging occurred in the Lower River within the known distribution of the species. Five Northern Pike were radio-tagged and tracked in the Lower River in 2013 and 2014 (Table 4.4-3).

4.8.1. Variances from Study Plan

Tagging and tracking target numbers (30) for Northern Pike were not met during the first study year in the Middle/Lower River (Study 9.6 ISR Part A, Section 4.9). This study has completed one of two years, based on their abundance, AEA anticipates tagging goals for Northern Pike will be met in the next year of study. This 2014 variance is not anticipated to affect AEA's ability to document fish movements under Objective 4.

4.9. Objective 7: Collect Tissue Samples from Juvenile Salmon and Resident and Non-Salmon Anadromous Fish

AEA implemented the methods for Objective 7 as described in the Study Plan. In support of the Genetic Baseline Study for Selected Fish Species (Study 9.14), fish tissues were collected opportunistically in conjunction with all fish capture events. The target species and number of total samples were reported in the Study Implementation Report for Study 9.14. Tissue samples included an axillary process from all adult salmon, caudal fin clips and swab samples from fish greater than 60 mm (2.4 in), and whole fish less than 60 mm (2.4 in). In 2014, genetic samples from juvenile and adult Chinook salmon were collected opportunistically from locations between Devils Canyon Impediment 1 and the proposed Watana Dam location. A summary of tissues collected in 2014 for genetic baseline development and for species identification purposes as part of this study is presented in Table 4.9-1.

In support of the River Productivity (Study 9.10) trophic modeling, scales, tissue samples, and stomach contents of target species were collected opportunistically in conjunction with fish capture events at select Focus Areas: FA-104 (Whiskers Slough), FA-141 (Indian River), FA-173 (Stephan Lake Complex), and FA-184 (Watana Dam). A summary of fish collected for stomach content sampling in 2014 is presented in Table 4.9-2.

4.9.1. Variances from Study Plan

In addition to tissue samples collected in support of the Genetic Baseline Study for Selected Fish Species (Study 9.14) genetics samples of Coho Salmon and Chinook Salmon were collected in the Middle River consistent with the species identification protocol filed with FERC in November 2014 (R2 Resource Consultants 2014b) and to inform the accuracy and improvement of species identification in the field (Table 4.9-1; Appendix B).

4.10. Winter Sampling Approach

Prior to developing recommendations for the winter 2013/2014 study efforts in the ISR (AEA 2014) and consistent with the Study Plan, AEA discussed a proposed approach and gathered input from licensing participants at the Fish and Aquatic Resources Technical Work Group Meetings on September 23 and December 4, 2013 (R2 Resource Consultants 2013a and 2013b) and the Fisheries Technical Meeting March 20, 2014 (R2 Resource Consultants 2014c). Based on licensing participant feedback, a review of existing information, and pilot study efforts, AEA developed the following specific winter fish sampling objectives with the goal to increase knowledge of the winter ecology of fish species in the Middle Susitna River (Study 9.6 ISR Part A, Appendix C):

1) Describe overwintering habitat associations of juvenile anadromous salmonids, non-salmonid anadromous fishes and resident fishes.
2) Describe winter movements of juvenile salmonids and selected fish species such as Arctic grayling, burbot, Dolly Varden, lamprey, northern pike, rainbow trout, humpback whitefish, and round whitefish within select Focus Areas.
    a. Describe seasonal movements using biotelemetry
3) Describe early life history, timing, and movements of anadromous salmonids.
    a. Determine juvenile salmonid diurnal behavior by season.
4) Document the seasonal age class structure, growth, and condition of juvenile anadromous and resident fish by habitat type.
5) Collect tissue samples from juvenile salmon and opportunistically from all resident and non-salmon anadromous fish to support the Fish Genetic Baseline Study (Study 9.14).

To the extent practical based on ice conditions, sampling took place at the same stratified macrohabitat locations randomly selected using the GRTS method for the fish distribution and abundance sampling conducted July through October 2013. Each sampling event included sampling in three replicate sites of each off-channel macrohabitat type within each of the three Focus Areas: FA-104 (Whiskers Slough), FA-128 (Slough 8A), and FA-138 (Gold Creek) (R2 Resource Consultants and LGL Alaska Research Associates 2014). Each 200 m (656 ft) GRTS panel was evaluated, beginning at the downstream end, to determine if a 40 m (131 ft) segment had conditions suitable for sampling. Other satellite locations outside of GRTS panels at FA-141 (Indian River) were sampled opportunistically (R2 Resource Consultants and LGL Alaska Research Associates 2014).

4.10.1. Variances from Study Plan

In the technical memorandum describing the winter fish study (Study 9.6 ISR Part A, Appendix C), AEA indicated that sampling would not occur during the window of ice formation and extremely short photoperiod between November and January. Extremely low flows and very cold temperatures in November 2013 allowed for a limited duration sampling effort during early winter. This additional sampling will increase knowledge regarding winter habitat use by fish in the Middle River and will enhance AEA's ability to meet winter fish studies objectives.

4.11. Fish Sampling Techniques

A combination of gillnet, electrofishing, angling, trot lines, minnow trapping, hoop trapping, snorkeling, fishwheels, beach seining, and fyke netting techniques were used to sample or observe fish in the Middle River, and those fish moving in and out of selected sloughs and tributaries flowing into the Susitna River. Techniques used at a sampling site varied based on habitat characteristics, season, and target species/life stage. All fish sampling and handling techniques described within this study were selected in consultation with state and federal regulatory agencies and sampling has been conducted under state collection permits. Limitations on the use of some methods during particular time periods or locations (e.g., no electrofishing when adult salmon are present) played a role in the selection of sampling techniques. Study efforts in 2014 followed the gear specifications and descriptions of field application outlined in the IP (AEA 2013) and supplemented by an updated version of IP Appendix 3, additional guidance for gear selection (R2 Resource Consultants 2014a).

4.11.1. Fish Handling

Fish handling was done as described in the IP (AEA 2013). All captured or observed fish were identified to species and life stage when possible. During ELH sampling it was not uncommon to catch hundreds of newly emerged fry at a site. To quickly process and return fish to the water, small Sockeye Salmon and Chum Salmon, very similar in appearance, were grouped together for rapid count estimates. Following the 2014 field season, a Chinook and Coho Salmon identification protocol was developed to address the wide range of phenotypic variation encountered by field crews (R2 2014b).

4.11.2. Winter Sampling Techniques

Multiple fish sampling techniques were utilized to sample multiple fish species, life stages, habitat types, and various ice conditions. Sampling methods included minnow traps, backpack electrofishing, fyke nets, trotlines/setlines, sonar and underwater video (R2 Resource Consultants and LGL Alaska Research Associates 2014). Two techniques were typically used at each site to sample a diversity of species and life stages. Because sampling efforts occurred in both open-water leads and ice-covered sites, methods varied depending on conditions (ice coverage, ice thickness, depth, velocity, and conductivity). In ice-covered sites, sampling methods included setlines, trotlines, minnow traps, and underwater video. In open-water sites, methods included baited minnow traps, trotlines, electrofishing, and fyke nets. To characterize diel behavior, in addition to overnight minnow trapping and fyke netting, a select subset of sites sampled during the day (three to four per Focus Area) were revisited during the night and sampled by electrofishing. Night sampling sites were selected based on safe ice conditions and proximity to winter spike camps.

5. RESULTS

Analysis of data collected in 2014 is not a component of this Study Implementation Report. Some very general results in terms of counts and observations are presented in this section. Data developed in support of the 2014 SIR is available for download at: http://gis.suhydro.org/SIR/09-Fish_and_Aquatics/9.6-Fish_Dist_and_Abund_Mid_Lower_Susitna/.

5.1. Objective 1: Fish Distribution, Relative Abundance, and Habitat Associations

5.1.1. Task A: Fish Distribution

In 2014, seventeen fish species were documented in the Middle Susitna River (Table 5.1-1). Consistent with 2013, Northern Pike were not observed in Middle River collections (Tables 5.1-1 and 5.1-2). Eighteen fish species were documented in the Middle and Lower Susitna River study area over both the 2013 and 2014 study seasons (Table 5.1-1). These species include all five of the North American Pacific Salmon species (i.e., Chinook, Chum, Coho, Pink, and Sockeye Salmon), six other salmonid species (i.e., Arctic Grayling, Dolly Varden, Rainbow Trout, Bering Cisco, and Humpback and Round Whitefish), and seven non-salmonid species (i.e., Burbot, lamprey, Longnose Sucker, Northern Pike, sculpin, and Ninespine and Threespine Stickleback). Sculpin and lamprey were not always identified to the species level during field surveys; therefore, they are reported herein as sculpin and lamprey spp. Furthermore, when sculpin and lamprey were identified to species, identifications were limited to Slimy Sculpin and Arctic Lamprey, respectively.

The accuracy of field identification of Chinook and Coho salmon in 2014 was improved to approximately 95% with photo QC (Appendix B). However, given the uncertainty associate with Coho Salmon identifications in some Middle River habitats, AEA will combine data collected on Chinook and Coho salmon from 2013 and 2014 collections to characterize the distribution, relative abundance and habitat associations of these two juvenile salmon species. Where appropriate, AEA also will make use of the verified species identifications to look for species-specific patterns in growth and movements. Futher discussion of the 2013 Coho Salmon identification issue and management implications is presented in Appendix B.

Within the Middle River study area, Devils Canyon (i.e., Geomorphic Reaches MR-3 and MR-4), and more specifically Impediment 1 (PRM 155.1) appeared to limit the distribution of several resident and juvenile anadromous fish species (Table 5.1-1). While 18 species have been documented within the Middle and Lower River study area downstream of Devils Canyon, only eight species (i.e., Chinook Salmon, Arctic Grayling, Burbot, Dolly Varden, Longnose Sucker, Rainbow Trout, sculpin, and Round Whitefish) have been documented upstream of Impediment 1 (PRM 155.1) within Devils Canyon. Although Humpback Whitefish were not observed in MR-1 or MR-2, they were documented in the Upper River study area (ISR Study 9.5 Section 5.1.1). Four fish species, Chum, Chinook, Coho, and Sockeye salmon, have been documented in MR-5 immediately downstream of Devils Canyon (PRM 155.1) and are widespread in the Middle River below the Devils Canyon and the Lower River (Table 5.1-1). The most notable Middle Susitna River fish distribution findings in 2014 were:

(1) The presence of a single Ninespine Stickleback in Whiskers Creek (MR-8) expanding the range of the species upstream and into the Middle River;
(2) The presence of Bering Cisco at PRM 122.6 (MR-7) during gill net sampling under the Salmon Escapement Study (9.7), expanding the range of this anadromous species upstream and into the Middle River;
(3) The documentation of juvenile Chinook Salmon at new locations in the Middle River above Devils Canyon including lower Unnamed Tributary 184 and Geomorphic Reach MR-1 immediately below the proposed Watana Dam site.
(4) The observation of a single Rainbow Trout in Devil Creek (FDA-MR4-DEV-DIR2). The individual had presumably dispersed from High Lake which drains into Devil Creek at RM 2.2 near where the observation took place (Appendix A). High Lake is reported by locals as containing a good fishery for rainbow trout (http://www.highlakelodge.com). Rainbow Trout were not previously known to be present in the Susitna River basin within or above Devils Canyon. Devil Creek joins the Susitna River in Devils Canyon just upstream of anadromous salmon Impediment 3 (PRM 164.7).

5.1.2. Task B: Relative Abundance

Fish observations from three seasonal fish distribution and abundance sampling events in the Middle River totaled 7,898 fish (Table 5.1-2). These data will be used for future estimates of relative abundance and species-habitat associations.

5.2. Objective 3: Early Life History

A combination of juvenile anadromous and resident fish species were captured during three ELH sampling events between May and June, 2014 (Table 5.2-1). Juvenile Pacific salmon were abundant in Focus Area sites, especially newly emerged Coho, Chinook, and Chum/Sockeye salmon fry (Table 5.2-1). Salmon fry were most numerous in the following locations: 1) FA – 104 (Whiskers Creek), site ELH-104-Spawning 2; 2) FA-128 (Slough 8A), site ELH-128-Rearing 2; 3) Slough 11, site ELH-138-Spawning 1; 4) FA-141 (Indian River), site ELH-141-

Spawning 1; and 5) Slough 20, site ELH-144-Rearing 1 (Appendix A). Catch of resident fishes primarily consisted of Longnose Sucker, sculpin, and Threespine Stickleback (Table 5.2-1). Other species present in lower numbers included Arctic Grayling, Arctic Lamprey, Burbot, Dolly Varden, Rainbow Trout, Ninespine Stickleback, Humpback Whitefish, and Round Whitefish (Table 5.2-1).

Although AEA was not able to document precise emergence timing, evidence about emergence timing was collected for all five Pacific salmon species. While, a few Chum/Sockeye salmon alevin were documented in mid-March during the Winter Fish Study (R2 Resource Consultants and LGL Alaska Research Associates 2014), Coho, Pink and Chum/Sockeye Salmon alevin were also collected during the first ELH sampling event in mid-May (Table 5.2-1).

5.3. Objective 4: Document winter movements and timing and location of spawning for Burbot, Humpback Whitefish, and Round Whitefish.

Documentation of winter movements and spawning locations for Burbot, Humpback Whitefish, and Round Whitefish occurred during the 2013-2014 winter; three Burbot, and eleven Round Whitefish had active tags and were alive in the Middle and Lower River study area in November 2013 (Table 4.4-3). Additionally, five Burbot and fifteen Round Whitefish tagged in the Upper River study area were alive with active tags in November 2013. Ongoing efforts, including analysis of aerial survey data will be used to address this objective.

5.4. Objective 6: Document the seasonal distribution, relative abundance, and habitat associations of invasive species (Northern Pike).

No Northern Pike were collected in 2014. Northern Pike radio tagged in 2013 were tracked in 2014 and 2015 (Table 4.4-3).

5.5. Objective 7: Collect tissue samples from juvenile salmon and all resident and non-salmon anadromous fish.

Fish tissues were collected opportunistically in conjunction with all fish capture events in support of the Fish Genetic Baseline Study (Study 9.14). Tissue samples consisted of an axillary process of the pelvic fin from all adult salmon, caudal fin clips from fish greater than 60 mm (2.4 in), and whole fish less than 60 mm (2.4 in). A summary of fish collected for genetic baseline development and for identification purposes (R2 2014b) as part of this study is presented in Table 4.9-1.

6. DISCUSSION

The current status of the Study of Fish Distribution and Abundance in the Middle and Lower Susitna River is ongoing. As indicated in Section 4, tasks associated with each of the seven study objectives were initiated in 2013. The 2014 study year was focused on the following study components:

(1) Completion of the first full year of Winter Fish Studies (R2 Resource Consultants and LGL Alaska Research Associates 2014);
(2) Completion of a second year of study under Salmon Early Life History (Objective 3);
(3) Continuation of radio telemetry tracking of resident fish tagged in 2013, with limited tagging effort taking place in the Middle River above Devils Canyon (Objective 2b);
(4) Fish Distribution and Abundance sampling at sites that were not sampled, or only partially sampled, in 2013 due to land access restrictions. Sampling in 2014 was intended to complete the first year of data collection under Objective 1;
(5) Development of a standardized identification protocol for Chinook and Coho salmon and field guide specific to the Susitna River (R2 2014b).

Data from 2013 and 2014 will be combined with a second year of study for a comprehensive baseline description in the Updated Study Report and impact analysis.

7. CONCLUSION

In 2014, AEA continued to conduct baseline documentation studies of fish distribution and abundance in the Middle and Lower Susitna River. The field work, data collection, data analysis, and reporting for the Study of Fish Distribution and Abundance in the Middle and Lower Susitna River has provided data pertinent to addressing all study objectives in the FERC-approved Study Plan. With this 2014 report, AEA has now completed at least the first year of data collection for all study objectives for the Study of Fish Distribution and Abundance in the Middle and Lower Susitna River. The Salmon Early Life History Sampling under Objective 3 and radio telemetry under Objective 2b are exceptions to the previous statement. ELH has completed two full years of sampling while and radio telemetry has completed one year of tagging and two years of data collection on tracking. AEA expects that with the continued execution of the Study Plan with variances noted, will result in fully meeting all study objectives and provide data needed for impact assessment.

7.1. Modifications to Study Plan

AEA plans to implement the modifications identified in the Study 9.6 ISR, Part C, Section 7.1.2. In addition, AEA proposes the following two modifications to the Study Plan.

1) AEA plans to collect additional tissue samples for genetic analysis and to implement the Chinook and Coho salmon identification protocol as presented in R2 Resource Consultants (2014b).

2) AEA plans to minimize handling impacts to newly emerged fry and small parr during future winter or early spring sampling. When large numbers of individual fish are collected in samples a sub-sample of 100 individuals from the collection will be identified to species, while the remaining fish will be grouped by guild for example Sockeye/Chum or Coho/Chinook.

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9. TABLES

Table 2-1. Methods by objective, task, species, and life stage, 2014.

Obj	Task	Species/ Life Stage	Study Sites	Methods Used by Season
1A	Distribution and Relative Abundance	Juvenile Salmon, non-salmon anadromous, resident	Focus Areas + representative habitat types	Ice Free Season: • Single pass sampling • Selection of methods will be site-specific, species-specific, and life-stage-specific. • For juvenile and small fish sampling, electrofishing, snorkeling, seining, Fyke nets, and angling where feasible and appropriate. • For adults, directed efforts with seines, gillnets, trot lines, and angling. • To the extent possible, the selected transects will be standardized and the methods will be repeated during each sampling period at a specific site to evaluate temporal changes in fish distribution. • Additional info from radio telemetry studies (Objective #2).
			Select Focus Areas (accessible)	Winter: • Based on winter 2012-2013 pilot studies • Sonar Imaging, underwater video, minnow traps, e-fishing, fyke netting, and trot lines.
1B	Fish habitat associations	Juvenile Salmon, non-salmon anadromous, resident	Focus Area study sites+ representative habitat types	• Analysis of data collected under Objective 1: Distribution. Combination of fish presence, distribution, and density by mesohabitat type by season.

Obj	Task	Species/ Life Stage	Study Sites	Methods Used by Season
2	Describe seasonal movements using biotelemetry (PIT and radio tags)	All species		Ice-Free Season: • PIT tags: tags opportunistically implanted in target species from a variety of capture methods in Focus Areas. • Radio tags surgically implanted in up to 30 individuals of sufficient body size of each target species distributed temporally and longitudinally. . Winter: • Based on winter 2012-2013 pilot studies. • DIDSON, video camera, minnow traps, electrofishing, seines and trot lines. • PIT arrays at Montana Creek, FA-104, and FA-128 • Aerial tracking of radio tags (adults).
3A	Describe emergence timing of salmonids	Juvenile salmonids	Select Focus Areas	• Bi-weekly sampling using fyke nets, seines, electrofishing and minnow traps in Salmon spawning and rearing areas within Focus Areas.
3B	Determine movement patterns and timing of juvenile salmonids from spawning to rearing habitats	Juvenile salmonids	Focus Areas	• Focus on timing of emergence and movement of newly emergent fish from spawning to rearing areas or movement of juvenile fish <50 mm in winter (i.e., the post-emergent life stages most vulnerable to load-following operations) • DIDSON or underwater video to monitor movement into or out of specific habitats
3C	Determine juvenile salmonid diurnal behavior by season	Juvenile salmonids	Focus Areas	• Stratified time of day sampling to determine whether fish are more active day/night • DIDSON and/or video camera methods to observe fish activity • Potentially electrofishing and seining
3D	Collect baseline data to support the Stranding and Trapping Study		Focus Areas + supplement with additional representative habitat types as necessary.	• Opportunistic support to ID seasonal timing, size and distribution among habitat types for fish <50 mm in length. • Estimate presence/absence, relative abundance, and density using similar methods as Objectives 1A, 1B, 1C, and 2 for fish <50 mm • Focus on slough and other mainstem lateral habitats • DIDSON, video camera, electrofishing, seines, out-migrant traps and fyke nets. • Monthly measurements of fish size/ growth

Obj	Task	Species/ Life Stage	Study Sites	Methods Used by Season
4	Winter movements, timing, and location of spawning	Burbot, Humpback Whitefish, and Round Whitefish	Mainstem habitats	• Radio tags surgically implanted in up to 30 fish of sufficient body size of each species distributed temporally & longitudinally. • To capture Burbot for radio-tagging, use hoop traps late Aug-early Oct following methods by Evenson (1993). • To capture whitefish for radio-tagging, use fish wheels opportunistically and directed efforts including angling, seines & gillnets. • Use aerial tracking of radio tags to pinpoint winter aggregations of fish; sample these areas with trot lines (similar to 1980s). • Collect, examine, and preserve gonads to determine spawning status.
5	Document growth, and condition by season	juvenile anadromous and resident fish	Focus Area study sites+ representative habitat types	• Stock biology measurements- length from captured fish up to 100 individuals per season per species per life stage and up to 30 fish per month per species per habitat type in Focus Areas. • Emphasis placed on juvenile salmonids <50mm. • Opportunistically support Stranding and Trapping Study
6	Seasonal presence/absence and habitat associations of invasive species	Northern Pike	All study sites	• Same methods as #1 and #2 above. • The presence/absence of Northern Pike and other invasive fish species will be documented in all samples • Additional direct efforts with angling as necessary
7	Collect tissue samples to support the Genetic Baseline Study	All	All study sites in which fish are handled	• Opportunistic collections in conjunction with all capture methods listed above. • Tissue samples include axillary process from all adult Salmon, caudal fin clips from fish >60 mm, and whole fish <60 mm.

Table 4.1-1 Salmon early life history sampling effort, 2014. (Maps of sampling locations in Appendix A)

Location	ELH Event 1		ELH Event 2		ELH Event 3	
	Start Date	End Date	Start Date	End Date	Start Date	End Date
	5/19/2014	5/26/2014	6/2/2014	6/9/2014	6/18/2014	6/25/2014
	Number of Sites		Number of Sites		Number of Sites	
Middle River						
Devils Canyon (PRM 153.9-169.6)						
FA-144 (Slough 21)	6		6		6	
FA-141(Indian River)	6		6		6	
FA-138 (Gold Creek)	6		6		6	
FA-128 (Slough 8A)	6		6		6	
FA-113 (Oxbow I)	6		6		6	
FA-104 (Whiskers Slough)	6		6		6	
Grand Total	**36**		**36**		**36**	

Table 4.1-2. Direct tributary sampling effort for fish distribution in the Middle River above Devils Canyon by geomorphic reach, 2013 and 2014. (Maps of sampling locations in Appendix A). The lower portions of Tsusena Creek and Chinook Creek could not be accessed in 2013 and were repeat sampled in 2014.

Target Tributary	Geomorphic Reach	PRM	Listed in AWC	Average Wetted Width (m)	Drainage Basin Area (km2)	Sample Type	Number of Sites 2013	Meters Sampled 2013	Number of Sites 2014	Meters Sampled 2014
Watana Dam (PRM 187.1)										
Tsusena Creek	MR-2	184.6	No	30.7	374.3	Direct	2	200	8	709
Unnamed Tributary	MR-2	184	No	15.1	NA	Direct	-		4	287
Fog Creek	MR-2	179.3	Yes	9	381.2	Direct	5	231	-	-
Fog Trib	MR-2	N/A	Yes	NA	NA	Direct	6	417	-	-
Devils Creek	MR-4	164.8	No	21.2	190.6	Direct	-		6	554
Impediment 3 Devils Canyon (PRM 164.7)										
Chinook Creek	MR-4	160.5	Yes	12.3	58.3	Direct	2	200	5	426
Cheechako Creek	MR-4	155.9	Yes	15.9	94.3	Direct	-		4	221
Impediment 1 Devils Canyon (PRM 155.1)										

Table 4.1-3. Habitat types and number of sites sampled for distribution and relative abundance sampling in the Middle River, 2013 and 2014.

Focus Stratum	Habitat Stratum	Geomorphic Reach												Total	
		MR-1		MR-2		MR-5		MR-6		MR-7[d]		MR-8			
		Targeted	Sampled	Targeted	Sampled	Targeted	Sampled	Targeted	Sampled	Targeted	Sampled	Targeted	Sampled	Targeted	Sampled
Focus Areas	Main Channel	3	2	3	3	2[e]	2 (1[g])	3	1	3	1	3	3	17	17
	Split Main Channel[f]		1						1		1				
	Multi-Split Main Channel[f]								1		1				
	Side Channel	2[e]	2	3	3			3	3	3	3	3	3	14	14
	Side Slough			3	3			3[b]	1[b]			3	3	12	12
	Side Slough Beaver Complex							3	5[c]						
	Upland Slough			3	0[a] (3)			3	3	3[b]	1[b]	3[b]		18	18
	Upland Slough Beaver Complex							3	3	3[d]	5[c]		3[c]		
	Backwater				1			1	1	2	2 (1[g])			3	4
	Tributary			1	0[a] (1)	1	0[a] (1)	2	2 (1[g])	3[d]	3 (2[g])	1	1	8	8
	Tributary Mouth			1	1	1	0[a] (1)	2	2	1[d]	1			5	5
	Clearwater Plume				1	1	1 (1[g])	1	1		1			2	4
	Subtotal Focus Areas	**5**	**5**	**14**	**16**	**5**	**5**	**24**	**24**	**18**	**19**	**13**	**13**	**79**	**82**
Non Focus Areas	Main Channel	3	3	3	1 (1)	3	2	3	3	3	1	3	2	18	18
	Split Main Channel[f]				1		1				2		1		
	Multi-Split Main Channel[f]														
	Side Channel	1[e]	1	3	3			3	3	3	3	3	3	13	13
	Side Slough			3	3	3	3	3	3	3	3	3	3	18	18
	Side Slough Beaver Complex									3	3				
	Upland Slough			3	0[a] (3)			3	2[a] (1)	3	1[b]	3	3	18	18
	Upland Slough Beaver Complex							3	3	3	5[c]				
	Backwater			1	1			3	3	1	1	1	1	6	6
	Tributary			3	0[a] (3)			3	2[a] (1)	3	3 (1[g])			9	9
	Tributary Mouth			3	2 (1)	1	0[a](1)	3	3	2[d]	2			9	9
	Clearwater Plume			3	3 (1)		(1)	3	2 (1)	1	1			7	9
	Subtotal Non-Focus Areas	**4**	**4**	**22**	**23**	**7**	**8**	**27**	**27**	**25**	**25**	**13**	**13**	**98**	**100**
Total number of sampling sites		**9**	**9**	**36**	**39**	**12**	**13**	**51**	**51**	**43**	**44**	**26**	**26**	**177**	**182**

Notes:

a site not accessible in 2013 to sample CIRI Lands or Alaska Railroad Corporation.

b Sloughs w/o Beaver Complexes were found upon visitation to support beaver activity and were reclassified.

c Sloughs with Beaver Complexes were added due to observed beaver activity in classified Upland Sloughs or Side Sloughs w/o Beaver Complexes.

d number of target sites per strata modified from IP table 5.3-1 with inclusion of FA-113 in MR-7, May 2013.

e number of target sites modified from IP Table 5.3-1 due to sample unit length increases.

f This strata combined into Main Channel for sites selection purposes.

g Site re-sampled in 2014 due to partial sample in 2013 (land access).

() sites in parenthesis were sampled in 2014.

Table 4.1-4. Sites sampled for fish distribution and abundance in the Middle Susitna River by season, 2014 (Maps of sampling locations in Appendix A).

Sample Type	SITE ID	Early Summer	Late Summer	Fall	Total Samples
GRTS Sample Selection	Watana Dam Site (PRM 187.1)				
	FDA-MR2-184-NF3-Trib*	X	X	X	3
	FDA-MR2-184-P12-MC	X	X	X	3
	FDA-MR2-182-P112-CWP	X	X	X	3
	FDA-MR2-182-P112-TM	X	X	X	3
	FDA-MR2-181-NF6-TRIB	X	X	X	3
	FDA-MR2-178-P20-US	X	X	F	2
	FDA-MR2-176-P21-US	X	D	F	1
	FDA-MR2-176-P22-US	X	X	F	2
	FDA-MR2-175-NF4-TRIB	X	X	X	3
	FDA-MR2-173-P19-TRIB	X	X	X	3
	FDA-MR2-173-P21-US	X	X	X	3
	FDA-MR2-173-P22-US	X	X	F	2
	FDA-MR2-173-P23-US	X	X	F	2
	Impediment 1 (PRM 155.1) - Impediment 3 (PRM 164.7) Devils Canyon				
	FDA-MR5-153-P55-CWP	NS	X	X	2
	FDA-MR5-153-P55-TM	X	X	X	3
	FDA-MR5-151-P25-MC	NS	X	X	2
	FDA-MR5-151-P46-CWP	X	X	X	3
	FDA-MR5-151-P49-TRIB	X	X	X	3
	FDA-MR5-151-P50-TM	X	X	X	3
	FDA-MR6-148-NF2-Trib	NS	X	X	2
	FDA-MR6-143-PO62-US	NS	X	X	2
	FDA-MR6-130-P086-CWP	NS	X	X	2
	FDA-MR6-128-P73-TRIB	NS	X	X	2
	FDA-MR7-115-P176-TRIB	NS	X	X	2
	FDA-MR7-115-P2-BW	NS	X	X	2
	FDA-MR7-113-P143-TRIB	NS	X	X	2
	FDA-MR7-110-NFOS1-TRIB	NS	X	X	2
Direct Sample Tributary	Watana Dam Site (PRM 187.1)				
	FDA-MR2-TSU-DIR1	X	X	X	3
	FDA-MR2-TSU-DIR2	X	X	X	3
	FDA-MR2-TSU-DIR3	X	X	X	3
	FDA-MR2-TSU-DIR4	X	X	X	3
	FDA-MR2-184-DIR1*	X	X	X	3
	FDA-MR2-184-DIR2	X	X	X	3
	FDA-MR2-184-DIR3	X	X	X	3
	FDA-MR2-184-DIR4	X	X	X	3
	FDA-MR4-DEV-DIR1	NS	X	X	2
	FDA-MR4-DEV-DIR2	NS	X	I	1
	FDA-MR4-DEV-DIR3	NS	X	X	2
	Impediment 3 Devils Canyon (PRM 164.7				
	FDA-MR4-CHI-DIR1	NS	X	X	2
	FDA-MR4-CHI-DIR2	NS	X	X	2
	FDA-MR4-CHI-DIR3	NS	X	X	2
	FDA-MR4-CHI-DIR4	NS	X	X	2
	FDA-MR4-CHE-DIR1	NS	X	X	2
	FDA-MR4-CHE-DIR2	NS	X	I	1
	FDA-MR4-CHE-DIR3	NS	X	I	1
	Impediment 1 Devils Canyon (PRM 155.1)				
Total Sites Sampled		**24**	**43**	**36**	**103**

Notes:

NS: not sampled, D: dry site, F: frozen site, I: inaccessible site

* Designates the same site that applies to both GRTS and Direct Sample Tributary

Table 4.1-5. Antenna orientation for fixed telemetry receiver stations in the Middle and Upper Susitna River, 2014.

Station	PRM	Install Date	Removal Date	Antenna Orientation			Rationale
				Antenna 1	Antenna 2	Antenna 3	
Lower River							
Montana Creek weir	NA	-	-	Down Montana Creek	Up Montana Creek		Salmon spawning stream
Susitna River at Sunshine	83	-	-	Down Susitna	Up Susitna		Monitor fish in the Lower River
Talkeetna River	NA	-	-	Down Talkeetna River	Up Talkeetna River		Salmon spawning stream
Middle River							
Lane Creek	116.8	May 10	Oct 3	Down Susitna	Up Susitna	Across Susitna	Monitor for Curry tagged fish moving downstream; Monitor for Lower River tagged fish moving into Middle River
Gateway	130.1	Jun 14	Sep 23	Down Susitna	Up Susitna		Monitor for Curry tagged fish moving upstream
Indian River	142.1	May 2	Oct 28	Down Susitna	Up Susitna	Up Indian River	Salmon spawning stream
Impediment 1 Devils Canyon (PRM 155.1)							
Cheechako Creek	157.4	Jun 13	Oct 9	Down Susitna	Up Susitna		Monitor site for fish passing above Impediment 1
Chinook Creek	160.5	Jun 13	Oct 2	Down Susitna	Up Susitna		Monitor site for fish passing above Impediment 2
Impediment 3 Devils Canyon (PRM 164.7)							
Devils Island	166.9	Jun 13	Dec 3	Down Susitna	Up Susitna		Monitor site for fish passing above Impediment 3
Near Watana Dam Site	186.8	Jul 8	Nov 5	Down Susitna	Up Susitna		Monitor fish moving past proposed dam site
Proposed Watana Dam Site (PRM 187.1) Upper River Boundary							
Watana Creek	196.9	Jun 14	Oct 10	Down Susitna	Up Susitna	Up Watana Creek	Large accessible tributary within impoundment zone
Kosina Creek	209.1	Apr 30	Nov 4	Down Susitna	Up Susitna	Up Kosina Creek	Salmon spawning stream
Watana Reservoir Low Pool 222.5							
Watana Reservoir Full Pool 232.5							
Oshetna River	235.1	May 20	Oct 9	Down Susitna	Up Susitna	Up Oshetna River	Monitor site for fish in mainstem Susitna River and entering Oshetna River

Table 4.1-6. Habitat types sampled during 2013/14 winter study by gear type and month.

Site ID	Focus Area	Macro Habitat	Gear Type	Nov	Feb	Mar	Apr
WFS-104.5-OP1	NFA	Upland Slough	Minnow Trap		X	X	X
WFS-104-154	FA-104[a]	Side Channel	Electrofish	X	X	X	X
			Minnow Trap	X	X	X	
			Video	X	X	X	
WFS-104-156	FA-104	Side Slough	Fyke Net			X	X
			Minnow Trap	X	X	X	X
WFS-104-157	FA-104	Side Slough	Minnow Trap	X	X	X	X
			Video		X	X	X
			Sonar		X	X	X
WFS-104-159T2	FA-104	Tributary	Electrofish			X	
			Fyke Net		X	X	X
			Minnow Trap		X		X
WFS-104-159T3	FA-104	Tributary	Minnow Trap		X		
WFS-104-159T4	FA-104	Tributary	Electrofish			X	X
WFS-104-159	FA-104	Tributary	Fyke Net	X	X	X	X
			Minnow Trap	X	X	X	X
			Video		X	X	X
			Sonar		X	X	X
WFS-104-160	FA-104	Upland Slough	Minnow Trap	X	X	X	X
			Video	X		X	X
WFS-104-161	FA-104	Upland Slough	Minnow Trap	X		X	X
			Video		X	X	X
			Sonar		X	X	X
WFS-104-162	FA-104	Upland Slough	Minnow Trap	X	X	X	X
			Video	X	X	X	X
WFS-104-OP1	FA-104	Upland Slough	Electrofish			X	X
WFS-104-OP2	FA-104	Side Channel	Electrofish		X	X	X
WFS-104-OP3	FA-104	Side Slough	Minnow Trap			X	X
			Video			X	
WFS-128-115	FA-128[b]	Side Channel	Minnow Trap	X			
			Video	X			
WFS-128-156	FA-128	Upland Slough	Minnow Trap		X	X	X
			Video		X	X	X
WFS-128-157	FA-128	Upland Slough	Electrofish		X	X	X
			Minnow Trap		X	X	X
			Video		X		
WFS-128-158	FA-128	Upland Slough	Minnow Trap		X	X	X
			Video				X
WFS-128-63OP2	FA-128	Side Channel	Minnow Trap	X			
WFS-128-63	FA-128	Side Channel	Minnow Trap	X			
WFS-128-64	FA-128	Side Channel	Electrofish				X
			Fyke Net			X	
			Minnow Trap		X	X	X
WFS-128-69	FA-128	Side Slough	Electrofish			X	X
			Minnow Trap		X	X	X
WFS-128-71	FA-128	Side Slough	Electrofish		X		
			Fyke Net			X	X
			Minnow Trap	X	X	X	X
			Video	X		X	X
WFS-128-73	FA-128	Tributary Mouth	Video		X		
WFS-128-O70	FA-128	Side Slough	Electrofish		X	X	
			Minnow Trap	X	X	X	

Site ID	Focus Area	Macro Habitat	Gear Type	Nov	Feb	Mar	Apr
WFS-128-OP1	FA-128	Main Channel Backwater	Fyke Net		X	X	X
			Trotline		X	X	
			Video		X	X	
WFS-128-OP2	FA-128	Side Slough	Electrofish			X	X
WFS-128-OP3	FA-128	Upland Slough	Electrofish		X	X	X
			Video		X		
WFS-128-WO109	FA-128	Side Slough	Electrofish		X	X	
			Video			X	
WFS-128-WO112	FA-128	Side Channel	Trotline			X	
WFS-128-WO118	FA-128	Side Channel	Trotline		X	X	
			Video		X		
WFS-128-WO119	FA-128	Side Channel	Electrofish		X		
WFS-128-WO120	FA-128	Side Channel	Electrofish				X
			Fyke Net				X
WFS-128-WO121	FA-128	Side Channel	Minnow Trap	X			
			Video	X			
WFS-128-WO150	FA-128	Side Slough	Fyke Net				X
			Minnow Trap	X			X
WFS-138-102	FA-138[c]	Side Channel	Minnow Trap		X	X	X
			Trotline				X
WFS-138-108	FA-138	Side Channel	Electrofish	X	X		
			Minnow Trap	X	X	X	X
			Video	X		X	X
WFS-138-11	FA-138	Side Channel	Electrofish		X		
			Trotline		X		
			Video		X	X	X
			Sonar		X	X	X
WFS-138-134	FA-138	Side Slough	Electrofish	X	X		
			Fyke Net				X
			Minnow Trap	X	X	X	X
WFS-138-134UP	FA-138	Side Slough	Electrofish		X	X	X
WFS-138-161	FA-138	Upland Slough	Minnow Trap		X	X	X
			Video				X
WFS-138-65	FA-138	Side Channel	Electrofish				
			Minnow Trap	X		X	X
WFS-138-66	FA-138	Side Slough	Minnow Trap	X	X	X	X
			Video		X		X
WFS-138-67	FA-138	Side Slough	Minnow Trap	X	X	X	X
			Video	X	X	X	X
WFS-138-76	FA-138	Upland Slough	Minnow Trap		X	X	X
WFS-138-O77	FA-138	Upland Slough	Minnow Trap	X			
			Video	X			
WFS-138-OP1	FA-138	Side Slough	Video		X	X	X
			Sonar		X	X	X
WFS-138-OP2	FA-138	Side Channel	Electrofish		X		
			Minnow Trap		X		
WFS-138-OP3	FA-138	Side Slough	Minnow Trap		X		
			Video		X	X	X
			Sonar		X	X	X
WFS-138-OP4	FA-138	Main Channel, Single	Trotline			X	
WFS-138-OP5	FA-138	Upland Slough	Minnow Trap			X	X
			Video			X	X

Site ID	Focus Area	Macro Habitat	Gear Type	Nov	Feb	Mar	Apr
WFS-138-OP6	FA-138	Main Channel, Multi Split	Electrofish		X		
			Minnow Trap		X		
WFS-138-WO127	FA-138	Side Channel	Electrofish			X	X
			Fyke Net				X
			Minnow Trap			X	X
WFS-140-OP1	NFA	Main Channel, Clearwater Plume	Fyke Net				X
			Minnow Trap		X	X	X
			Trotline		X	X	
			Video		X		
WFS-141-58	FA-141[d]	Main Channel, Backwater	Fyke Net			X	
			Minnow Trap			X	X
			Video		X		
WFS-141-75	FA-141	Tributary Mouth	Fyke Net				X
			Minnow Trap		X	X	X
			Trotline		X	X	
			Video		X	X	X
WFS-141-81	FA-141	Upland Slough	Minnow Trap			X	X
			Video			X	X
WFS-141-OP1	FA-141	Main Channel	Electrofish				X
			Video				X
WFS-141-OP2	FA-141	Tributary	Electrofish		X		

Notes:
a FA-104 (Whiskers Creek)
b FA 128 (Slough 8A)
c FA-138 (Gold Creek)
d FA-141 (Indian River)

Table 4.2-1. Monitoring efficiency (percent operational) of fixed radio telemetry receiver stations in the Susitna River drainage in 2014, by week.

Week 2014	Montana Weir	Sunshine Mouth (PRM 83.8)	Talkeetna Station	Lane Station (PRM 116.8)	Gateway (PRM 130.1)	Indian River (PRM 142.1)	Impediment 1 Devils Canyon (PRM 155.1)	Cheechako (PRM 157.4)	Chinook (PRM 160.5)	Impediment 3 Devils Canyon (PRM 164.7)	Devils Station (PRM 166.9)	Watana Dam Site (PRM 186.8)
4/28 - 5/4	nd	nd	nd	nd	nd	100		nd	nd		nd	nd
5/5 - 5/11	nd	nd	nd	nd	nd	100		nd	nd		nd	nd
5/12 - 5/18	nd	nd	nd	nd	nd	100		nd	nd		nd	nd
5/19 - 5/25	nd	100	nd	100	nd	100		nd	nd		nd	nd
5/26 - 6/1	nd	100	100	100	nd	100		nd	nd		nd	nd
6/2 - 6/8	100	100	100	100	nd	100		nd	nd		nd	nd
6/9 - 6/15	100	100	100	100	100	100		100	100		32b	nd
6/16 - 6/22	100	100	100	100	100	100		100	100		93b	nd
6/23 - 6/29	100	100	100	9a	100	100		100	100		100	nd
6/30 - 7/6	100	100	100	94a	58a	100		100	100		100	nd
7/7 - 7/13	100	100	100	100	100	100		100	100		100	100
7/14 - 7/20	100	100	100	100	100	100		100	100		100	100
7/21 - 7/27	100	100	100	100	100	100		100	100		100	100
7/28 - 8/3	100	100	100	100	100	100		100	100		74b	100
8/4 - 8/10	100	100	100	100	100	100		100	100		100	100
8/11 - 8/17	100	100	100	100	100	100		100	100		100	100
8/18 - 8/24	100	100	100	100	100	100		100	100		100	100
8/25 - 8/31	100	100	100	100	100	100		100	100		100	100
9/1 - 9/7	100	100	100	100	100	100		100	100		100	30a
9/8 - 9/14	100	100	100	100	100	100		100	100		100	94a
9/15 - 9/21	100	100	100	100	100	100		100	100		100	100
9/22 - 9/28	100	100	100	100	100	100		100	100		100	100
9/29 - 10/5	nd	nd	nd	100	nd	100		100	100		100	100
10/6 - 10/12	nd	nd	nd	nd	nd	100		100	nd		100	100
10/13 - 10/19	nd	nd	nd	nd	nd	100		nd	nd		100	100
10/20 - 10/26	nd	nd	nd	nd	nd	100		nd	nd		100	100
10/27 - 11/2	nd	nd	nd	nd	nd	100		nd	nd		100	39b
11/3 - 11/9	nd	nd	nd	nd	nd	nd		nd	nd		88b	0b
11/10 - 11/16	nd	nd	nd	nd	nd	nd		nd	nd		65b	nd
11/17 - 11/23	nd	nd	nd	nd	nd	nd		nd	nd		95b	nd
11/24 - 11/30	nd	nd	nd	nd	nd	nd		nd	nd		8b	nd
12/1 - 12/7	nd	nd	nd	nd	nd	nd		nd	nd		0b	nd
12/8 - 12/14	nd	nd	nd	nd	nd	nd		nd	nd		nd	nd

Notes:

Percentages were calculated as the number of hours of recorded receiver activity divided by the number of hours in the week; "-" = 'not deployed'. Receivers were considered active in a given hour if at least one fish detection, beacon hit, or noise event was recorded during the hour.

a receiver not scanning

b low power/dead battery

Table 4.2-2. Summary of aerial surveys of radio-tagged fish in the Lower and Middle Susitna River, 2014-2015 (1 of 3).

Zone	From PRM	To PRM	Zone Number	Jan 6,7	Jan 28,29,30	Feb 17,18,19	Mar 18,19,20	Apr 8,9	Apr 30, May 1	May 20,21	Jun 10	11-Jun	Jun 16,17,18	Jun 21,22	Jun 24,25,26	Jun 28,29	Jul 1,2	Jul 4,5	Jul 6	Jul 10,11	Jul 12	Jul 13,14	Jul 16,17	Jul 19,20	Jul 22,23	Jul 25,26	Jul 28,29	Jul 31, Aug 1	Aug 3,4	Aug 6,7	Aug 9,10	Aug 12,13	Aug 15,16,17	Aug 18,19	Aug 21,22	Aug 24,25	Aug 27,28	Aug 29,30,31	Sep 2,3	Sep 5,6	Sep 8,9	Sep 10	Sep 14,15	Sep 17,18	Sep 20,21	Sep 24,25	Sep 30, Oct 1	Oct 1	Oct 7,8	Oct 9	Oct 14,15,16	Oct 17	Oct 28,29,30	Nov 4	Dec 3	Dec 16,17	Jan 6	Feb 2	Feb 4	Feb 19	Mar 3	Mar 25	Apr 14	Apr 23	May 20	Jun 3,4	Jun 23	Jul 6
Lower River																																																																				
Beyond Confluence	-	-	4																			H								H	H		H	H						H									H		H		H															
Confluence - Yentna	3.5	32.4	5		H			H				H	H		H	H		H				H	H	H	H		H	H		H	H		H	H	H	H		H	H	H	H		H		H	H	H		H		H		H															
Yentna River	32.4	-	22	H	H	H	H	H	H			H	H		H	H		H				H	H	H	H		H	H		H	H		H	H	H	H		H	H	H	H		H		H	H	H		H		H		H													H		
Yentna - Deshka	32.4	45	35	H	H	H	H	H	H			H	H	H	H	H		H				H	H	H	H		H	H		H	H	H	H	H	H	H		H	H	H	H		H		H	H	H		H		H		H													H		
Deshka River	44.9	-	42		H		H	H	H			H	H	H	H	H		H				H	H	H	H		H	H		H	H	H	H	H	H	H		H	H	H	H		H		H	H	H		H		H		H													H		
Willow and L. Willow Cr	52.2	55.6	53				H					H	H	H	H	H		H				H	H	H	H		H	H		H	H	H	H	H	H	H		H	H	H	H		H		H	H	H		H		H		H													H		
Kashwitna River	64.7	-	54				H					H	H	H	H	H		H				H	H	H	H		H	H		H	H	H	H	H	H	H		H	H	H	H		H	H	H	H	H		H		H		H						H							H		
Deshka - Kashwitna	45	64.7	55	H	H	H	H	H	H			H	H	H	H	H		H				H	H	H	H		H	H		H	H	H	H	H	H	H		H	H	H	H		H		H	H	H		H		H		H													H		
Caswell Creek	67.4	-	62											H										H	H		H	H		H	H	H	H		H	H		H	H	H	H		H		H	H	H		H		H		H													H		
Sheep Creek	70.1	-	63										H		H			H				H	H	H	H	H	H	H		H	H	H	H	H	H	H		H		H	H		H	H	H	H	H		H		H		H						H							H		
Goose Creek	76.9	-	64						H					H								H	H	H		H	H	H		H	H	H	H	H	H	H	H	H	H	H	H		H	H	H	H	H				H		H													H		
Kashwitna - Montana	64.7	80.7	65	H	H	H	H	H	H			H	H		H	H		H				H	H	H	H	H	H	H		H	H	H	H	H	H	H	H	H	H	H	H		H	H	H	H	H		H		H		H			H			H				H			H		H
Montana Creek	80.9	-	71		H	H	H		H			H	H	H	H	H		H				H	H	H	H	H	H	H		H	H	H	H	H	H	H	H	H	H	H	H		H	H	H	H	H		H		H		H			H			H							H		H
Montana - Sunshine	80.7	88.5	75	H	H	H	H	H	H			H	H	H	H	H		H				H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H		H	H	H	H	H		H		H		H			H			H				H			H		H
Sunshine Creek	88.1	-	76		H							H	H	H	H							H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H		H	H	H	H	H		H		H		H			H										H		H
Rabideux Creek	87.4	-	77		H				H			H	H	H	H	H		H				H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H		H	H	H	H	H		H		H		H			H			H							H		H
Birch Creek	93.5	-	79																						H	H	H	H	H		H	H	H	H	H	H	H	H	H	H	H		H	H	H	H	H				H		H			H			H							H		H
Talkeetna River	101	-	81		H		H	H	H	H		H	H	H	H	H		H	H			H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H		H	H	H	H	H		H		H		H			H			H					H				H
Chulitna River	101.7	-	83	H	H	H	H	H	H	H		H		H	H	H		H	H			H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H		H	H		H	H	H	H	H		H		H		H			H			H							H		H
Sunshine - Talkeetna	88.5	102.3	85	H	H	H	H	H	H			H	H	H	H	H	H	H	H			H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H		H	H	H	H	H		H		H		H			H			H							H		H

Table 4.2-2. Summary of aerial surveys of radio-tagged fish in the Lower and Middle Susitna River, 2014-2015 (2 of 3).

Zone	From PRM	To PRM	Zone Number	Jan 6,7	Jan 28,29,30	Feb 17,18,19	Mar 18,19,20	Apr 8,9	Apr 30, May 1	May 20,21	Jun 10	11-Jun	Jun 16,17,18	Jun 21,22	Jun 24,25,26	Jun 28,29	Jul 1,2	Jul 4,5	Jul 6	Jul 10,11	Jul 12	Jul 13,14	Jul 16,17	Jul 19,20	Jul 22,23	Jul 25,26	Jul 28,29	Jul 31, Aug 1	Aug 3,4	Aug 6,7	Aug 9,10	Aug 12,13	Aug 15,16,17	Aug 18,19	Aug 21,22
Middle River (PRM 102.4)																																			
Talkeetna - Lane	102.3	116.8	95	H	H	H	H	H	H	H		H	H	H	H	H	H	H	H	H		H	H	H	H	H	H	H	H	H	H	H	H	H	H
Whiskers Creek	104.8	-	97		H	H	H	H	H	H		H		H	H	H	H	H	H	H		H	H	H	H	H	H	H	H	H	H	H	H	H	H
Trib off zone 95	110.5	-	98																												H		H		
Lane - Gateway	116.8	130.1	105	H	H	H	H	H	H	H		H	H	H	H	H	H	H	H	H		H	H	H	H	H	H	H	H	H	H	H	H	H	H
Lane Creek	117.1	-	106			H	H	H	H	H			H	H		H		H	H	H			H	H	H	H	H	H	H	H	H	H	H	H	H
5th of July Creek	127.3	-	108							H										H			H			H					H			H	H
Slough 8A	129.2	129.8	109	H	H	H	H	H	H	H			H	H	H	H		H	H	H		H	H	H	H	H	H	H	H	H	H	H	H	H	H
Gateway - 4th of July	130.1	134.3	111	H	H	H	H	H	H	H			H	H	H	H	H	H	H	H		H	H	H	H	H	H	H	H	H	H	H	H	H	H
Slough 9	131.4	133.5	112		H			H	H	H			H	H	H			H	H	H		H	H	H	H	H	H	H	H	H	H	H	H	H	H
Sherman Creek	134.1	-	114																																
4th of July Creek	134.3	-	116			H	H	H	H	H			H	H	H	H	H	H	H	H		H	H	H	H	H	H	H	H	H	H	H	H	H	H
4th of July - Slough 11	134.3	140.2	117	H	H	H	H	H	H	H			H	H	H	H	H	H	H	H		H	H	H	H	H	H	H	H	H	H	H	H	H	H
Slough 11	138.6	-	118		H	H	H	H	H	H			H	H	H	H		H	H	H							H	H	H	H	H	H	H	H	H
Gold Creek	140.1	-	119				H			H			H	H	H	H	H	H	H	H		H	H	H	H	H	H	H	H	H	H	H	H	H	H
Slough11 - Indian	140.1	142.1	125	H	H	H	H	H	H	H			H	H	H	H	H	H	H	H		H	H	H	H	H	H	H	H	H	H	H	H	H	H
Indian trib	141.8	-	132		H	H	H	H	H	H			H	H	H	H	H	H	H	H		H	H	H	H	H	H	H	H	H	H	H	H	H	H
Indian - Slough 21	142.1	145.7	135	H	H	H	H	H	H	H			H	H	H	H	H	H	H	H		H	H	H	H	H	H	H	H	H	H	H	H	H	H
Slough 21	145.1	145.6	136			H							H	H	H	H	H	H	H	H		H	H	H	H	H	H	H	H	H	H	H	H	H	H
above Powerline	145.7	146	138			H	H	H	H	H			H	H	H	H	H	H	H	H		H	H	H	H	H	H	H	H	H	H	H	H	H	H
abv Powerline - Portage	146	152.3	145	H	H	H	H	H	H	H			H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H
Jack Long Creek	148.2	-	146												H	H	H		H	H		H	H	H	H	H	H	H	H	H	H	H	H	H	H
Portage trib	152.3	-	152		H	H	H	H	H	H			H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H

Zone	Aug 24,25	Aug 27,28	Aug 29,30,31	Sep 2,3	Sep 5,6	Sep 8,9	Sep 10	Sep 14,15	Sep 17,18	Sep 20,21	Sep 24,25	Sep 30, Oct 1	Oct 1	Oct 7,8	Oct 9	Oct 14,15,16	Oct 17	Oct 28,29,30	Nov 4	Dec 3	Dec 16,17	Jan 6	Feb 2	Feb 4	Feb 19	Mar 3	Mar 25	Apr 14	Apr 23	May 20	Jun 3,4	Jun 23	Jul 6
Middle River (PRM 102.4)																																	
Talkeetna - Lane	H	H	H	H	H	H		H	H	H	H	H		H		H	H				H			H							H		H
Whiskers Creek	H	H	H	H	H	H		H	H	H	H	H		H		H	H	H			H			H							H		H
Trib off zone 95																																	
Lane - Gateway	H	H	H	H	H	H	H	H	H	H	H	H		H	H	H	H	H			H			H		H	H				H		H
Lane Creek	H	H	H	H	H	H	H	H	H	H	H	H		H		H	H	H						H		H					H		H
5th of July Creek		H	H		H	H	H	H																							H		
Slough 8A	H	H	H	H	H	H	H	H	H	H	H	H		H	H	H	H	H						H			H						H
Gateway - 4th of July	H	H	H	H	H	H	H	H	H	H	H	H		H	H	H	H	H			H			H		H	H				H		H
Slough 9	H	H	H	H	H	H	H	H	H	H	H	H		H	H	H	H	H			H												
Sherman Creek																																	
4th of July Creek	H	H	H	H	H	H	H	H	H	H	H	H		H	H	H		H			H			H		H	H		H		H		H
4th of July - Slough 11	H	H	H	H	H	H	H	H	H	H	H	H		H	H	H	H	H			H			H		H	H		H		H		H
Slough 11	H	H	H	H	H	H	H	H	H	H	H	H		H	H	H	H	H			H			H									
Gold Creek	H	H	H	H	H	H	H	H	H	H	H	H		H	H	H															H		H
Slough11 - Indian	H	H	H	H	H	H	H	H	H	H	H	H		H	H	H	H	H			H			H		H	H		H		H		H
Indian trib	H	H	H	H	H	H	H	H	H	H	H	H		H	H	H	H	H			H			H		H	H		H		H		H
Indian - Slough 21	H	H	H	H	H	H	H	H	H	H	H	H		H	H	H	H	H			H			H		H	H		H		H		
Slough 21	H	H	H	H	H	H	H	H	H	H	H	H		H	H	H	H	H															
above Powerline	H	H	H	H	H	H	H	H	H	H	H	H		H	H	H	H	H			H			H		H	H		H		H		
abv Powerline - Portage	H	H	H	H	H	H	H	H	H	H	H	H		H	H	H	H	H			H			H		H	H		H		H	H	
Jack Long Creek	H	H	H	H	H	H	H	H	H	H	H	H		H	H	H																	
Portage trib	H	H	H	H	H	H	H	H	H	H	H	H		H	H	H	H	H			H			H		H	H		H				

Table 4.2-2. Summary of aerial surveys of radio-tagged fish in the Lower and Middle Susitna River, 2014-2015 (3 of 3).

Zone	From PRM	To PRM	Zone Number	Jan 6,7	Jan 28,29,30	Feb 17,18,19	Mar 18,19,20	Apr 8,9	Apr 30, May 1	May 20,21	Jun 10	11-Jun	Jun 16,17,18	Jun 21,22	Jun 24,25,26	Jun 28,29	Jul 1,2	Jul 4,5	Jul 6	Jul 10,11	Jul 12	Jul 13,14	Jul 16,17	Jul 19,20	Jul 22,23	Jul 25,26	Jul 28,29	Jul 31, Aug 1	Aug 3,4	Aug 6,7	Aug 9,10	Aug 12,13	Aug 15,16,17	Aug 18,19	Aug 21,22	Aug 24,25	Aug 27,28	Aug 29,30,31	Sep 2,3	Sep 5,6	Sep 8,9	Sep 10	Sep 14,15	Sep 17,18	Sep 20,21	Sep 24,25	Sep 30, Oct 1	Oct 1	Oct 7,8	Oct 9	Oct 14,15,16	Oct 17	Oct 28,29,30	Nov 4	Dec 3	Dec 16,17	Jan 6	Feb 2	Feb 4	Feb 19	Mar 3	Mar 25	Apr 14	Apr 23	May 20	Jun 3,4	Jun 23	Jul 6
Lower Extent Devils Canyon (PRM 153.9)																																																																				
Portage - Impediment1	152.3	155.2	153	H	H	H	H	H	H	H			H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H			H			H		H	H		H		H	H	
Impediment1 - Cheechako	155.2	157.4	157	H	H	H	H	H	H	H			H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H		H			H			H		H	H		H		H	H	
Cheechako Creek	155.9	-	158				H						H		H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H		H		H		H						H		H							
Cheechako - Impediment2	157.4	160.2	163	H	H	H	H	H	H	H	H		H	H		H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H		H		H		H			H			H		H	H		H		H	H	
Impediment2 - Chinook	160.2	160.5	167	H	H	H	H	H	H	H	H		H	H		H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H		H		H		H			H			H		H	H		H		H	H	
Chinook Creek	160.4	-	168														H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H				H		H						H		H							
Chinook - Impediment3	160.5	164.8	173	H	H	H	H	H	H	H	H		H	H		H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H		H		H		H		H	H			H		H	H		H		H	H	
Devils Creek	164.8	-	176			H	H			H					H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H				H		H	H					H							H		
Impediment3 - Devil Stn	164.8	166.9	177	H	H	H	H	H	H	H	H		H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H		H		H		H	H	H	H	H		H	H	H	H		H		H	H	
Upper Extent Devils Canyon (PRM 166.1)																																																																				
Devil Stn - Fog	166.9	179.4	185	H	H	H	H	H	H	H	H		H	H	H	H				H			H		H	H		H	H	H			H	H	H	H	H	H		H				H				H			H			H	H	H	H		H	H	H	H	H	H		H	H	
Fog Creek	179.3	-	192	H		H	H	H	H	H	H		H	H	H	H				H			H			H		H	H	H			H	H	H	H	H	H		H				H				H			H			H	H	H	H	H		H	H	H	H	H	H	H	H	
Fog - Dam Site	179.4	186.8	195	H	H	H	H	H	H	H	H		H	H	H	H				H			H		H	H		H	H	H			H	H	H	H		H		H				H				H			H			H	H	H	H	H		H	H	H	H	H	H	H	H	
Tsusena Creek	184.5	-	197		H	H	H	H	H	H	H		H	H	H	H				H			H			H		H	H	H			H	H	H			H						H				H			H			H		H	H	H		H	H	H	H	H	H	H	H	

Table 4.4-1. Summary of PIT tagging implants and in-hand recaptures in the Middle and Lower River Study Area, 2014.

	Chinook Salmon		Chum Salmon	Coho Salmon		Sockeye Salmon		Arctic Grayling		Burbot		Dolly Varden		Humpback Whitefish		Lake Trout	Pacific Salmon, Unspecified	Rainbow Trout		Round Whitefish		Whitefish, Unspecified		
Study Component	Implant	Recapture	Implant	Implant	Recapture	Implant	Recapture	Implant	Recapture	Implant	Recapture	Implant	Recapture	Implant	Recapture	Implant	Implant	Implant	Recapture	Implant	Recapture	Implant	**Implant Total**	**Recapture Total***
2014 FDA, ML Early Life History	28	24		384	71	13		2		12	1			1				11		24	3	1	**476**	**99**
2014 FDA, ML Seasonal Sampling	202	5		169	21	24		45	3	46	5	64					5	35	4	37	3		**627**	**41**
2014 FDA, ML River Productivity	42			34				44	2	3								14		19		1	**157**	**2**
2014 FDA ML, Winter Studies	77	13		606	78	36	3	1		15		1					4	2		2			**744**	**94**
2014 Middle/Lower River Total	**349**	**42**		**1,193**	**170**	**73**	**3**	**92**	**5**	**76**	**6**	**65**		**1**			**9**	**62**	**4**	**82**	**6**	**2**	**2,004**	**236**
2013 Middle/Lower River Total	**1,696**	**223**	**13**	**2,092**	**352**	**81**	**8**	**378**	**42**	**223**	**32**	**70**	**10**	**86**	**1**			**309**	**74**	**300**	**23**		**5,248**	**765***
Middle/Lower River Total	**2,045**	**265**	**13**	**3,285**	**522**	**154**	**11**	**470**	**47**	**299**	**38**	**135**	**10**	**87**	**1**		**9**	**371**	**78**	**382**	**29**	**2**	**7,252**	**1,001**

Notes:

* Recapture total includes individual fish detected on PIT antennas in 2013.

Table 4.4-2. Radio tag allocation by season and location, Middle and Lower Susitna River, 2014.

Species	Tags Applied					Total Applied by Location			
	May/June	July	August	Sept	Total	Middle River Above Devils Canyon	Devils Canyon (PRM 153.9 - 169.6)	Middle River Below Devils Canyon	Lower River
Arctic grayling	16 (11)	0 (17)	0 (1)	0 (6)	16 (35)	27		15	0
Burbot	0 (2)	0 (0)	0 (5)	5 (2)	5 (9)	5		3	6
Dolly Varden	0 (1)	0 (6)	0 (2)	0 (0)	0 (9)	0		3	6
Humpback whitefish	0 (3)	0 (4)	0 (0)	0 (0)	0 (7)	0		7	0
Lake trout	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0		0	0
Longnose sucker	0 (13)	0 (8)	0 (6)	0 (1)	0 (28)	0		25	3
Northern pike	0 (0)	0 (0)	0 (5)	0 (0)	0 (5)	0		0	5
Rainbow trout	0 (11)	0 (17)	0 (3)	0 (13)	0 (44)	0		23	21
Round whitefish	0 (11)	0 (3)	0 (0)	0 (7)	0 (21)	0		20	1

Format: tags applied in 2014 (tags applied in 2013). No tags applied in 2015. Tagging during spawning periods conducted at the discretion of the surgeon as based on fish condition.

Table 4.4-3. Resident fish relocated by study month (2014-2015) with active radio tags that were tagged and released in Middle and Lower Susitna River.

Species	Jan '14	Feb '14	Mar '14	Apr '14	May '14	Jun '14	Jul '14	Aug'14	Sep'14	Oct '14	Nov '14	Dec '14	Jan '15	Feb '15	Mar '15	Apr '15	May '15	Jun '15
Arctic Grayling	9	9	9	9	8	14	10	9	9	8	8	7	7	7	7	7	7	6
Burbot	2	2	2	1	1	1	1	1	6	6	6	5	4	4	4	4	4	3
Dolly Varden	2	2	2	2	2	2	1	0	0	0	0	0	0	0	0	0	0	0
Longnose Sucker	4	3	3	3	2	1	1	0	0	0	0	0	0	0	0	0	0	0
Rainbow Trout	21	21	21	21	18	17	16	13	11	10	10	10	10	10	10	9	9	7
Humpback Whitefish	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Round Whitefish	9	9	8	7	5	3	3	1	1	1	1	1	1	1	1	1	1	0
Lake Trout	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Northern Pike	4	4	4	3	3	3	3	3	2	2	2	2	2	2	2	2	1	0

Table 4.7-1. Summary of size-at-life stage index used to classify Susitna River species, 2014.

Species	Life stage			Source
	Juvenile	Juvenile-or-adult	Adult	
Chinook Salmon	alevin, fry, parr, smolt index			
Chum Salmon	alevin, fry, parr, smolt index			
Coho Salmon	alevin, fry, parr, smolt index			
Pink Salmon	alevin, fry, parr, smolt index			
Sockeye Salmon	alevin, fry, parr, smolt index			
Alaska Blackfish	<42	42–113	>113	Kirsch et al. (2014)
Arctic Grayling	<190	190–328	>328	Kirsch et al. (2014)
Arctic Lamprey	<125	125-219	>219	Heard 1966; Docker 2009; Vladykov and Kott 1978
Burbot	<280	280–498	>498	Kirsch et al. (2014)
Dolly Varden	<83	≥83	-	Kirsch et al. (2014)
Eulachon	<165		>165	HDR and LGL (2014)
Longnose Sucker	<188	188–348	>348	Kirsch et al. (2014)
Northern Pike	<330	330–448	>448	Kirsch et al. (2014)
Sculpin (slimy)	<51	51–68	>68	Kirsch et al. (2014)
Threespine Stickleback	<40	40-70	>70	ADFG 1981
Lake Trout	<300	300-430	430	Burr 1993
Rainbow Trout	<200	200-325	>325	Russell 1977, Adams 1999
Bering Cisco	Not Applicable			
Whitefish, Humpback	<280	280–363	>363	Kirsch et al. (2014)
Whitefish, Round	<199	199–318	>318	Kirsch et al. (2014)
Whitefish, Unspecified	<199	199-363	>363	

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Table 4.7-2. Summary of fish with length and weight measurements collected in the Middle and Lower Susitna River by hydrologic segment and study component, 2014.

Study Component	Chinook Salmon	Chum Salmon	Coho Salmon	Pink Salmon	Sockeye Salmon	Chum Salmon / Sockeye Salmon	Pacific Salmon, Unspecified	Arctic Grayling	Arctic Lamprey	Burbot	Dolly Varden	Humpback Whitefish	Lamprey, Unspecified	Longnose Sucker	Ninespine Stickleback	Rainbow Trout	Round Whitefish	Salmonid, Unspecified	Sculpin, Unspecified	Threespine Stickleback	Whitefish, Unspecified	**Grand Total**
FDA, ML Early Life History	562	28	1,259	165	185	1,949	21	3	3	21	1	2	17	321	1	27	32	1	517	171	17	**5,303**
FDA, ML Seasonal Sampling	721	1	968		132	77	7	82	27	129	134	1	12	114		139	153	2	585	92	10	**3,386**
FDA, ML River Productivity	216		170					116		3	1					18	32				1	**557**
FDA ML, Winter Studies	160	85	1,025		180		18	1	2	15	1		55	8		6	4	3	622	17		**2,202**
2014 Middle/Lower River Total	**1,659**	**114**	**3,422**	**165**	**497**	**2,026**	**46**	**202**	**32**	**168**	**137**	**3**	**84**	**443**	**1**	**190**	**221**	**6**	**1,724**	**280**	**28**	**11,448**

Table 4.9-1. Summary of Fish Distribution and Abundance tissue collection for genetic baseline development and field species calls, 2014.

Study Component	Location	Chinook Salmon	Coho Salmon	Pacific Salmon, Unspecified	Total
FDA, ML Seasonal Sampling	Unnamed Tributary 184	1			**1**
FDA, ML Seasonal Sampling	Susitna River PRM 173-184	2			**2**
FDA, ML River Productivity	Susitna River PRM 173-184	4			**4**
FDA, ML Seasonal Sampling	Devil Creek	14			**14**
Impediment 3 Devils Canyon PRM 164.7					
FDA, ML Seasonal Sampling	Chinook Creek	55			**55**
ADF&G Genetics (Study 9.14)	Chinook Creek	6			**6**
FDA, ML Seasonal Sampling	Cheechako Creek	44			**44**
ADF&G Genetics (Study 9.14)	Cheechako Creek	11			**11**
Impediment 1 Devils Canyon PRM 155.1					
FDA, ML Early Life History	Middle River below Devils Canyon	61	22		**83**
FDA, ML Seasonal Sampling	Middle River below Devils Canyon	16	4	2	**22**
FDA, ML River Productivity	Middle River below Devils Canyon	117	76		**193**
FDA ML, Winter Studies	Middle River below Devils Canyon	19			**19**
Lower River PRM 102.4					
FDA, ML River Productivity	Lower River	46	43	1	**90**
ADF&G Genetics (Study 9.14)	Lower River Tributaries	11			**11**
2014 Middle/Lower River Total		**407**	**145**	**3**	**555**

Table 4.9-2 Summary of fish collection for River Productivity (Study 9.8) scale, tissue and/or stomach content sampling, 2014.

Station	Sampling Site	Habitat Type	Chinook Salmon	Coho Salmon	Arctic Grayling	Rainbow Trout	Grand Total
Watana Dam PRM 187.1							
FA-184 (Watana Dam)	RP-184-1	Tributary Mouth			16		16
	RP-184-2	Side Channel	3		13		16
	RP-184-3	Main Channel			9		9
FA-173 (Stephan Lake Complex)	RP-173-1	Tributary Mouth			18		18
	RP-173-2	Main Channel	1		15		16
	RP-173-3	Side Channel			4		4
	RP-173-4	Side Slough			9		9
	RP-173-5	Upland Slough					0
Devils Canyon Impediments 1-3 (PRM 155.1-164.7)							
FA-141 (Indian River)	RP-141-1	Tributary Mouth	16	7	1	11	35
	RP-141-2	Side Channel	20	1			21
	RP-141-3	Main Channel	24		6		30
	RP-141-4	Upland Slough	9			3	12
FA-104 (Whiskers Slough)	RP-104-1	Tributary Mouth	17	23	1	3	44
	RP-104-2	Side Slough	3	21			24
	RP-104-3	Main Channel	16		13		29
	RP-104-4	Upland Slough	7	24			31
	RP-104-5	Side Channel	16	12	5		33
Lower River							
Montana Creek Mouth	RP-81-1	Upland Slough	5	29		1	35
	RP-81-2	Tributary Mouth	7	15	1	1	24
	RP-81-3	Main Channel	17	7			24
	RP-81-4	Side Channel	15	1	3		19
Grand Total			**176**	**140**	**114**	**19**	**449**

Table 5.1-1. An updated summary of fish distribution by Geomorphic Reach the in Middle and Lower Susitna River, where ◊ indicates new locations from 2014.

Location[a]	PRM	Chinook Salmon	Chum Salmon	Coho Salmon	Pink Salmon	Sockeye Salmon	Salmon, Unspecified	Arctic Grayling	Burbot	Dolly Varden	Lake Trout	Lamprey	Longnose Sucker	Northern Pike	Rainbow Trout	Sculpin, Unspecified	Stickleback, Ninespine	Stickleback, Threespine	Whitefish, Bering Cisco	Whitefish, Humpback	Whitefish, Round	Whitefish, Unspecified
Upper River Study Area	187.1-234.5	X						X	X	X	X		X			X				X	X	X
Watana Dam PRM 187.1																						
MR-1	184.6-187.1	◊						X	X	X			X			X					X	X
Tsusena Creek	184.6	X						X		X			◊			X					X	
MR-2	169.6-184.6	X						X	X	X			X			X					X	X
Unnamed Tributary	184	◊						◊	◊	◊						◊						
Fog Creek	173.9	○								X						X						
MR-3[b]	166.1-169.6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Devil Creek	164.8	◊								◊					◊	◊						
Impediment 3 Devils Canyon (PRM 164.7)																						
Chinook Creek	160.5	◊								X						X						
Cheechako Creek	155.9	◊						◊		◊						◊						
MR-4[b]	153.9-166.1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Impediment 1 Devils Canyon (PRM 155.1)																						
MR-5[a]	148.4-153.9	X	X	X	X	X	X	X	X	X			X		X	X				X	X	X
MR-6[a]	122.7-148.4	X	X	X	X	X	X	X	X	X			X		X	X		X		X	X	X
MR-7[a]	107.8-122.7	X	X	X	X	X	X	X	X	X		X	X		X	X		X	◊	X	X	X
MR-8[a]	102.4-107.8	X	X	X	X	X	X	X	X	X		X	X		X	X	◊	X		X	X	X
Middle / Lower River (PRM 102.4)																						
LR-1[a]	87.9-102.4	X	X	X	X	X	X	X	X	X		X	X		X	X	X	X	○	○	X	X
LR-2[a]	65.6-87.9	X	X	X	X	X	X	X	X	X		X	X		X	X	X	X	X	○	X	X
LR-3[a]	44.6-65.6	X	X	X	X	X	X	X	X	X		X	X		X	X	X	X	○	○	X	X
LR-4[a]	32.3-44.6	X	X	X	X	X	X	X	X	○		X	X	X	X	X	X	X	X	X	X	X

Notes:

Includes the following data sources: 2013 & 2014 early-life history sampling, 2013 & 2014 habitat stratified randomized sampling (GRTS), 2013 & 2014 direct tributary sampling, 2013 rotary screw trap catch, 2013 resident fish catch at Curry fishwheel (PRM 124), 2013 & 2014 opportunistic sampling , 2013 & 2014 targeted sampling for radio tagging, 2013 & 2014 river productivity sampling, 2013 & 2014 habitat suitability criteria sampling, and 2014 resident fish catch during gill net sampling for escapement (9.7).

X Species observed during FDA 2013 surveys, ◊ species observed in 2014 suveys but not 2013.

A Geomorphic reaches MR-1, MR-5, MR-6, MR-7, MR-8, LR-1, LR-2, LR-3, and LR-4 include sites located in the mainstem Susitna River and its associated off-channel and tributary habitats within the Zone of Hydrologic Influence (ZHI). Directed sampling efforts outside of the ZHI did not occur in these reaches.

B The mainstem Sustina River in geomorphic reaches MR-3 and MR-4 were not sampled during on-the-ground surveys in 2013 or 2014.

○ Species present during 1980s licensing efforts (Delaney et al 1981) or ADF&G Inventory 2003-2012 (Kirsch et al. 2014).

Table 5.1-2. 2014 Middle Susitna River fish observations by life stage and site. Includes the seasonal sampling events from the following data sources: habitat stratified randomized sampling (GRTS), direct tributary sampling, and opportunistic sampling (1 of 2).

	Chinook Salmon								Chum Salmon		Coho Salmon							Pink Salmon	Sockeye Salmon		Chum Salmon / Sockeye Salmon	Pacific Salmon, Unspecified				
Site ID	Fry	Parr	Smolt	Juvenile	Jack	Adult	Carcass	Not Recorded	Juvenile	Adult	Fry	Parr	Smolt	Juvenile	Adult	Carcass	Not Recorded	Adult	Parr	Smolt	Fry	Parr	Smolt	Juvenile	Carcass	Not Recorded
FDA-MR1-184-P2-MC			1																							
FDA-MR2-TSU-DIR		1																								
FDA-MR2-184-P12-MC																										
FDA-MR2-184-NF3-TRIB		1																								
FDA-MR2-184-DIR																										
FDA-MR2-182-P112-TM																										
FDA-MR2-182-P112-CWP		1																								
FDA-MR2-181-NF6-TRIB																										
FDA-MR2-178-P020-US																										
FDA-MR2-178-OP1-US																										
FDA-MR2-176-P021-US																										
FDA-MR2-175-NF4-TRIB																										
FDA-MR2-173-P23-US																										
FDA-MR2-173-P22-US																										
FDA-MR2-173-P21-US																										
FDA-MR2-173-P20-TM		1		2																						
FDA-MR2-173-P19-TRIB																										
FDA-MR2-173-P012-US																										
FDA-MR4-DEV-DIR		94				1	1																			
Impediment 3 Devils Canyon PRM 164.7																										
FDA-MR4-CHI-DIR		244																								
FDA-MR4-CHE-DIR		146				5		3																		
Impediment 1 Devils Canyon PRM 155.1																										
FDA-MR5-153-P55-TM																										
FDA-MR5-153-P55-CWP																										
FDA-MR5-151-P50-TM	117	559							1	165	213	227						1			33	1				92
FDA-MR5-151-P49-TRIB	22	25			1	3				22	25							5			14	6				2
FDA-MR5-151-P46-CWP	4	33								448	8	6						2			1					
FDA-MR5-151-P25-MC		4	1							1																
FDA-MR6-148-NF2-TRIB		40				1					1	33		31												2
FDA-MR6-144-P68-SS		35		2								39	1							1						
FDA-MR6-143-PO62-US		102	3	1			1					160	72	1					106	24		90	72	5	1	
FDA-MR6-141-P81-US			5									51	10							1						
FDA-MR6-130-P086-CWP		2																								
FDA-MR6-128-P73-TRIB		55	4								2	66			2							1				
FDA-MR7-115-P2-BW		1									32	128			2				265		140			1		
FDA-MR7-115-P176-TRIB		4									1	217				1	1							1		2
FDA-MR7-115-P121-US												213														
FDA-MR7-113-P143-TRIB		10										108			1									13		
FDA-MR7-110-NFOS1-TRIB		7									30	111	5	245	47				1							
Grand Total	143	1,365	14	5	1	10	2	3	1	636	312	1,359	88	277	52	1	1	8	372	26	188	98	72	20	1	98

Table 5.1-2. Middle Susitna fish distribution and abundance sampling observations, 2014 by site. Includes the seasonal sampling events from the following data sources: habitat stratified randomized sampling (GRTS), direct tributary sampling, and opportunistic sampling (2 of 2).

	Arctic Grayling				Arctic Lamprey			Burbot			Dolly Varden				Fish, Species Unspecified	Lamprey, Unspecified	Longnose Sucker		Rainbow Trout				Salmonid, Unspecified	Sculpin, Unspecified	Stickleback, Threespine	Whitefish, Humpback	Whitefish, Round			Whitefish, Unspecified	Grand Total
Site ID	Juvenile	Juvenile/Adult	Adult	Not Recorded	Juvenile	Juvenile/Adult	Adult	Juvenile	Juvenile/Adult	Not Recorded	Juvenile	Juvenile/Adult	Carcass	Not Recorded	Not Recorded		Juvenile	Juvenile/Adult	Juvenile	Juvenile/Adult	Adult	Not Recorded				Juvenile	Juvenile	Juvenile/Adult	Not Recorded		
FDA-MR1-184-P2-MC	7	6	3	12											3		4						1	66			14			2	119
FDA-MR2-TSU-DIR	16	81	25	3				11		1		24		1			1						2	170			1				337
FDA-MR2-184-P12-MC	8	5	3																												16
FDA-MR2-184-NF3-TRIB	2	2						2															1	51			1				60
FDA-MR2-184-DIR	7	18									4	29		2									1	34							95
FDA-MR2-182-P112-TM																								20							20
FDA-MR2-182-P112-CWP	1							2		1														16							21
FDA-MR2-181-NF6-TRIB								1			10	5												3							19
FDA-MR2-178-P020-US																															-
FDA-MR2-178-OP1-US								4		1							9														14
FDA-MR2-176-P021-US																															-
FDA-MR2-175-NF4-TRIB														1										11							12
FDA-MR2-173-P23-US								3									21							14							38
FDA-MR2-173-P22-US								16									1							1							18
FDA-MR2-173-P21-US																								1							1
FDA-MR2-173-P20-TM								1																8							12
FDA-MR2-173-P19-TRIB	2							2				5											1	5							15
FDA-MR2-173-P012-US								1									5							2							8
FDA-MR4-DEV-DIR											1	152	1	1	2					1				4							258
Impediment 3 Devils Canyon PRM 164.7																															
FDA-MR4-CHI-DIR											25	84		8									2	22							385
FDA-MR4-CHE-DIR		1									3	31		1										5							195
Impediment 1 Devils Canyon PRM 155.1																															
FDA-MR5-153-P55-TM																								1							1
FDA-MR5-153-P55-CWP																								2							2
FDA-MR5-151-P50-TM			8								3	1							9	1			1	25							1,457
FDA-MR5-151-P49-TRIB	1	11	10									6					1		5	2	4			75				4			244
FDA-MR5-151-P46-CWP		10	7									5							1		3			4							532
FDA-MR5-151-P25-MC	1																	1					1	8				1			18
FDA-MR6-148-NF2-TRIB																			14	1		2	1	19							145
FDA-MR6-144-P68-SS								13	2								20										29			2	144
FDA-MR6-143-PO62-US								27	1								24	1						13			73				777
FDA-MR6-141-P81-US								16	1								5	12						1	2		13	1			118
FDA-MR6-130-P086-CWP																								6							8
FDA-MR6-128-P73-TRIB																			1	1			1	43							176
FDA-MR7-115-P2-BW								7	3								7	2	3	1				23	9	1	28	4	26	8	768
FDA-MR7-115-P176-TRIB									1										38					59							325
FDA-MR7-115-P121-US																									454						667
FDA-MR7-113-P143-TRIB								1											183				2	1							319
FDA-MR7-110-NFOS1-TRIB					16	9	2	14	2						3	12	3		8	9	1			28	1						554
Grand Total	45	134	56	15	16	9	2	121	10	3	46	342	1	14	8	12	101	16	262	16	8	2	14	741	543	1	159	10	26	12	7,898

Table 5.2-1. Observations of juvenile anadromous and resident fish during three Early Life History sampling events in the Middle Susitna River (1 of 2).

ELH Site	Gemorphic Reach	Chinook Salmon				Chum Salmon			Coho Salmon				Pink Salmon		Sockeye Salmon		Chum Salmon/ Sockeye Salmon		Pacific salmon, unspecified		
		Fry	Parr	Smolt	Juvenile	Parr	Smolt	Juvenile	Alevin	Fry	Parr	Smolt	Alevin	Fry	Parr	Smolt	Alevin	Fry	Fry	Parr	Juvenile
ELH-104-Rearing 1	MR-8	18	15							223	27			7	13			30	86		
ELH-104-Rearing 2	MR-8	15	2							73	84	11		3	44	1		372			
ELH-104-Rearing 3	MR-8	20								34	4							60	66		
ELH-104-Spawning 1	MR-8	2	1							4	2			9		1		29			
ELH-104-Spawning 2	MR-8	3	39		1					299	82	293		21	4			14	200	30	
ELH-104-Spawning 3	MR-8	17						1		83	2				1			321	296		
ELH-113-Rearing 1	MR-7										27	1									5
ELH-113-Rearing 2	MR-7	35	6	3		3				4	139	17			8			38	2		
ELH-113-Rearing 3	MR-7	17	2							7	3				2			21	30	15	
ELH-113-Spawning 1	MR-7	12	11	1		1				4	22	14			8			46	2		
ELH-113-Spawning 2	MR-7	4								71	4				1			87	85		4
ELH-113-Spawning 3	MR-7	5								78	8	35						7	42		
ELH-128-Rearing 1	MR-6	1								1	1				3			39	43		
ELH-128-Rearing 2	MR-6	1							3	110					3		3	723	1,157		
ELH-128-Rearing 3	MR-6									71	12							340	72		
ELH-128-Spawning 1	MR-6	3	1	1		2				5	5	1			2			316	1		
ELH-128-Spawning 2	MR-6	4	2							12	4			1	2			554	320		
ELH-128-Spawning 3	MR-6					7	6			6	1				7			254	355		
ELH-138-Rearing 1	MR-6	8								4	3					4		1	9		
ELH-138-Rearing 2	MR-6										26	13			1	5					
ELH-138-Rearing 3	MR-6										92	17			1						
ELH-138-Spawning 1	MR-6	2								1	1							2,000	1,250		
ELH-138-Spawning 2	MR-6	26	1							1								179	53		
ELH-138-Spawning 3	MR-6	1									2							112	2		
ELH-141-Rearing 1	MR-6	13	1							1	10		1	32				60			
ELH-141-Rearing 2	MR-6	70	3				5									4		589	1		
ELH-141-Rearing 3	MR-6			72							10	71							1		
ELH-141-Spawning 1	MR-6	118	1							1	2			168	1			782	901		
ELH-141-Spawning 2	MR-6	98								2	9			19			22	489	85	1	
ELH-141-Spawning 3	MR-6	9	2								1			1				172	213		
ELH-144-Rearing 1	MR-6	6								2				2				1,425	1		
ELH-144-Rearing 2	MR-6		1	1							12	28			12	2		2			
ELH-144-Rearing 3	MR-6			7			4				5	56			53	23		2			
ELH-144-Spawning 1	MR-6	11	1							9				1			6	118	101		2
ELH-144-Spawning 2	MR-6	10									2			1				152			
ELH-144-Spawning 3	MR-6	8									3							474			
Total		537	89	85	1	13	15	1	3	1,106	605	557	1	265	166	40	31	9,808	5,374	46	11
Grand Total		**712**				**29[A]**			**2,271**				**266**		**206[A]**		**9,839[A]**		**5,431[B]**		

Notes:

A Newly emerged Chum Salmon and Sockeye Salmon were not differentiated to species

B 5,393 (99%) unspecified Pacific Salmon were estimated from visual observations.

Table 5.2-1. Observations of juvenile anadromous and resident fish during three Early Life History sampling events in the Middle Susitna River (2 of 2).

Site Id	Geomorhpic Reach	Arctic Grayling	Arctic Lamprey	Lamprey, Unspecified	Burbot	Dolly Varden	Longnose Sucker	Rainbow Trout				Salmonid, Unspecified	Sculpin, Unspecified	Stickleback, Ninespine	Stickleback,Threespine	Whitefish, Humpback	Whitefish, Round	Whitefish, Unspecified	**Grand Total**
		Juvenile	Adult			Juvenile		Fry	Juvenile	Juvenile/Adult	Adult								
ELH-104-Rearing 1	MR-8				1		1			1			5	1	4				**414**
ELH-104-Rearing 2	MR-8												14		21				**625**
ELH-104-Rearing 3	MR-8				2		2						82		44				**294**
ELH-104-Spawning 1	MR-8			4	1		2						62		2			40	**157**
ELH-104-Spawning 2	MR-8	2	4	15	1			1	1	7	5		9		7		3		**1,038**
ELH-104-Spawning 3	MR-8						3	1	2			1	10		7				**728**
ELH-113-Rearing 1	MR-7						3								28				**64**
ELH-113-Rearing 2	MR-7				7		40						2		5		9		**283**
ELH-113-Rearing 3	MR-7					1							7						**88**
ELH-113-Spawning 1	MR-7						55		2	1			7		4	1	1		**180**
ELH-113-Spawning 2	MR-7												20						**272**
ELH-113-Spawning 3	MR-7														1				**171**
ELH-128-Rearing 1	MR-6												11						**98**
ELH-128-Rearing 2	MR-6						1						81						**2,081**
ELH-128-Rearing 3	MR-6						3						17						**515**
ELH-128-Spawning 1	MR-6						3			1			28						**366**
ELH-128-Spawning 2	MR-6				2		2				1		1						**901**
ELH-128-Spawning 3	MR-6												80						**716**
ELH-138-Rearing 1	MR-6											1	52						**74**
ELH-138-Rearing 2	MR-6												7						**52**
ELH-138-Rearing 3	MR-6						26								124				**260**
ELH-138-Spawning 1	MR-6												33						**3,285**
ELH-138-Spawning 2	MR-6												13						**247**
ELH-138-Spawning 3	MR-6						1						2						**119**
ELH-141-Rearing 1	MR-6												4						**109**
ELH-141-Rearing 2	MR-6									1			1					2	**606**
ELH-141-Rearing 3	MR-6	1			3		10										17		**185**
ELH-141-Spawning 1	MR-6												5						**1,861**
ELH-141-Spawning 2	MR-6								2			1	49						**679**
ELH-141-Spawning 3	MR-6				1		19		1	1						1		1	**413**
ELH-144-Rearing 1	MR-6								1	1			1						**1,433**
ELH-144-Rearing 2	MR-6						149						2				2		**211**
ELH-144-Rearing 3	MR-6						52											2	**204**
ELH-144-Spawning 1	MR-6				1		2	1					53						**295**
ELH-144-Spawning 2	MR-6						1						13						**169**
ELH-144-Spawning 3	MR-6				2		1						8						**488**
Total		3	4	19	21	1	376	3	9	13	6	3	679	1	247	2	32	45	**20,218**
Grand Total		**3**	**4**	**19**	**21**	**1**	**376**	**31**				**3**	**679**	**1**	**247**	**2**	**32**	**45**	

10. FIGURES

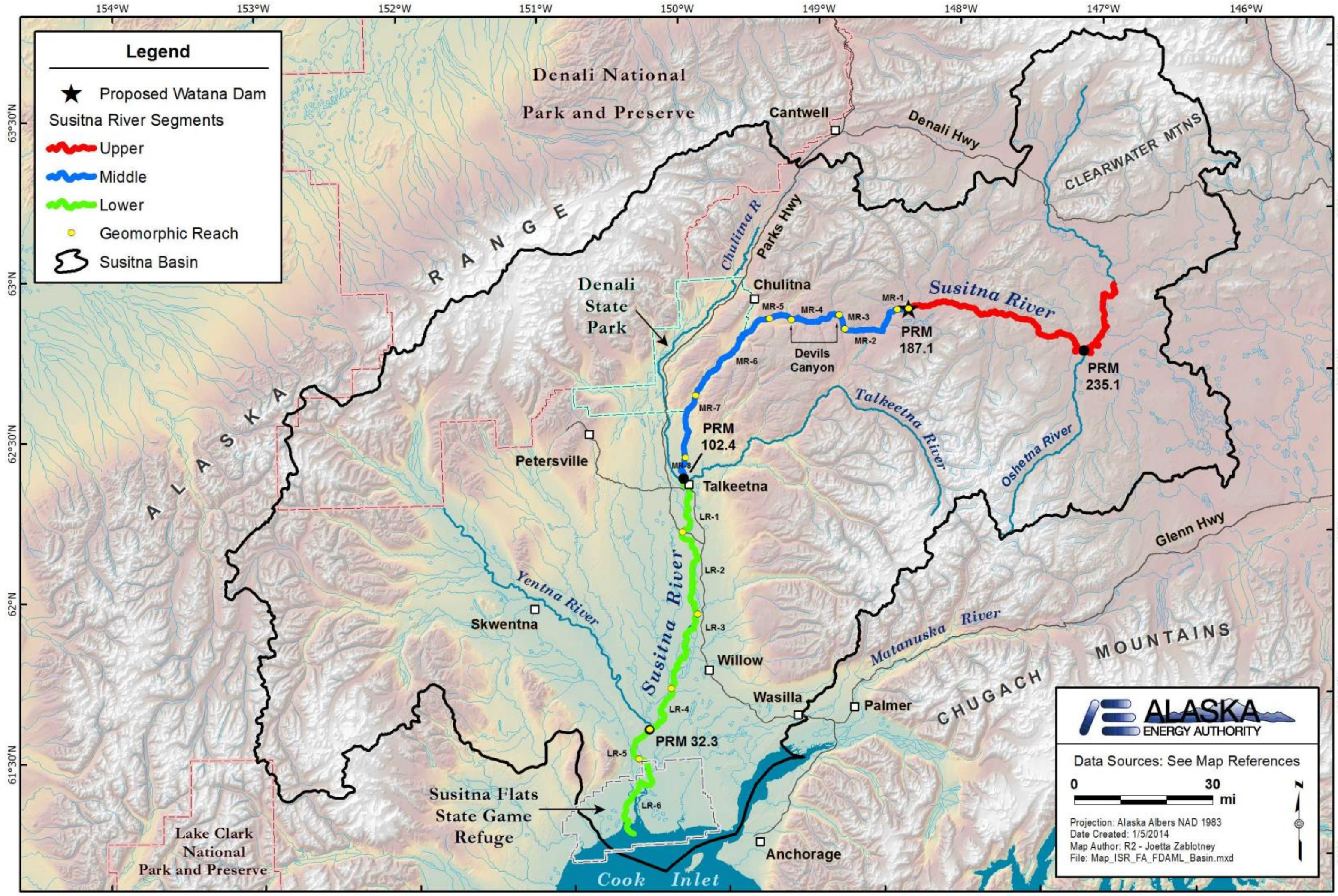

Figure 3-1. Susitna River fish distribution and abundance study area.

APPENDIX A: 2014 SAMPLING SITE MAPS

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Figure A1. Salmon early life history sampling locations FA-104 (Whiskers Slough), 2014.

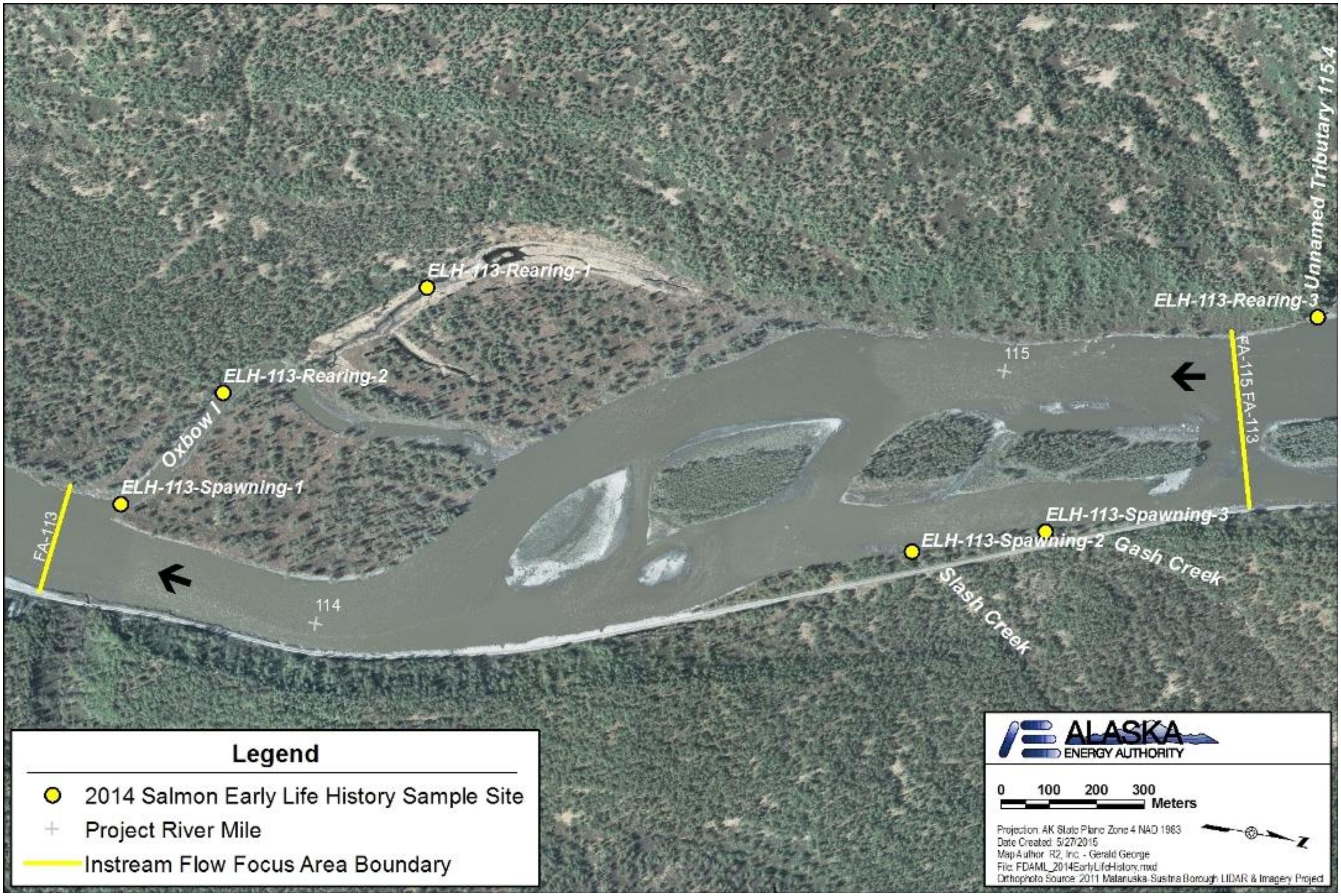

Figure A2. Salmon early life history sampling locations FA-113 (Oxbow I), 2014

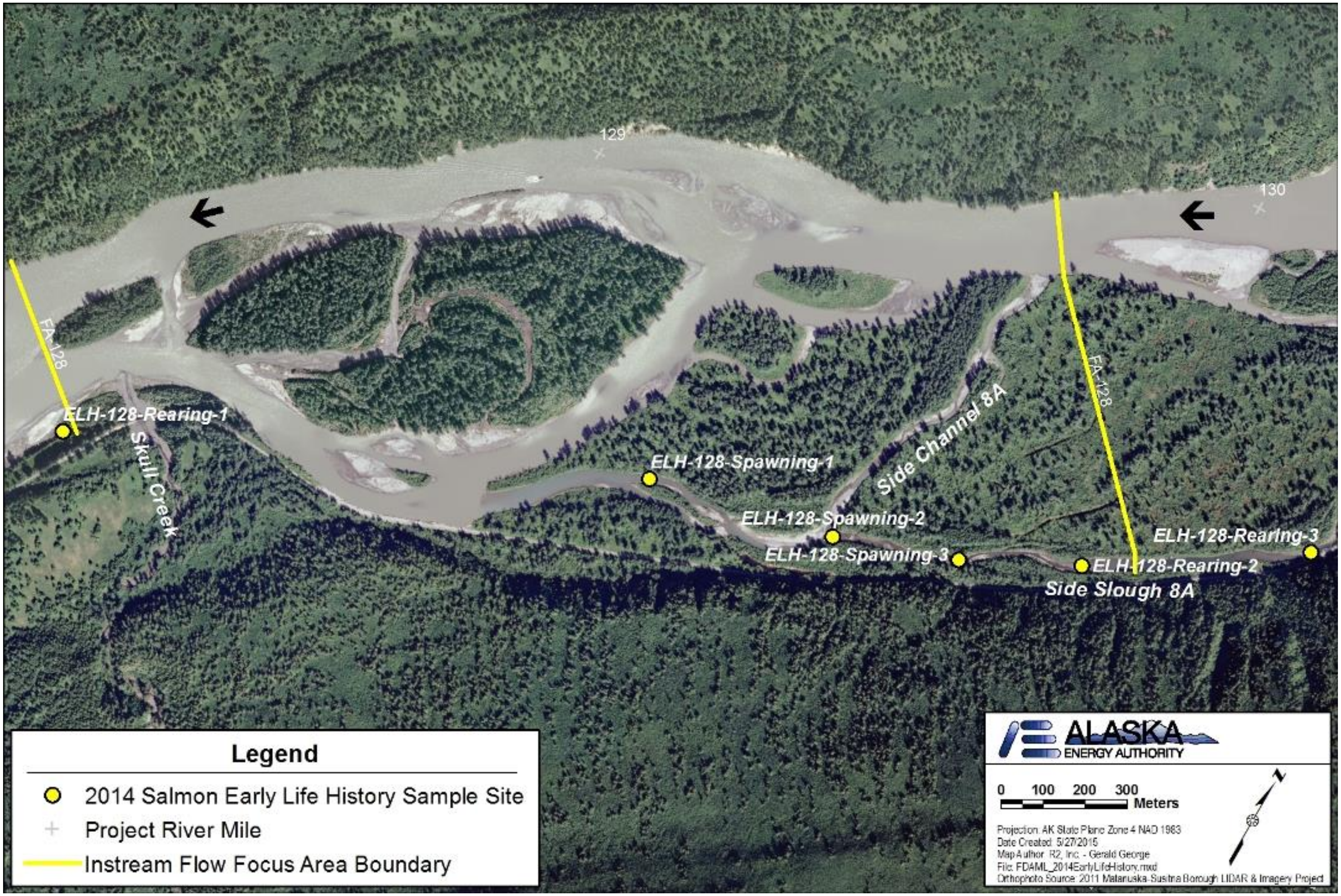

Figure A3. Salmon early life history sampling locations FA-128 (Slough 8A), 2014.

Figure A4. Salmon early life history sampling locations FA-138 (Gold Creek), 2014.

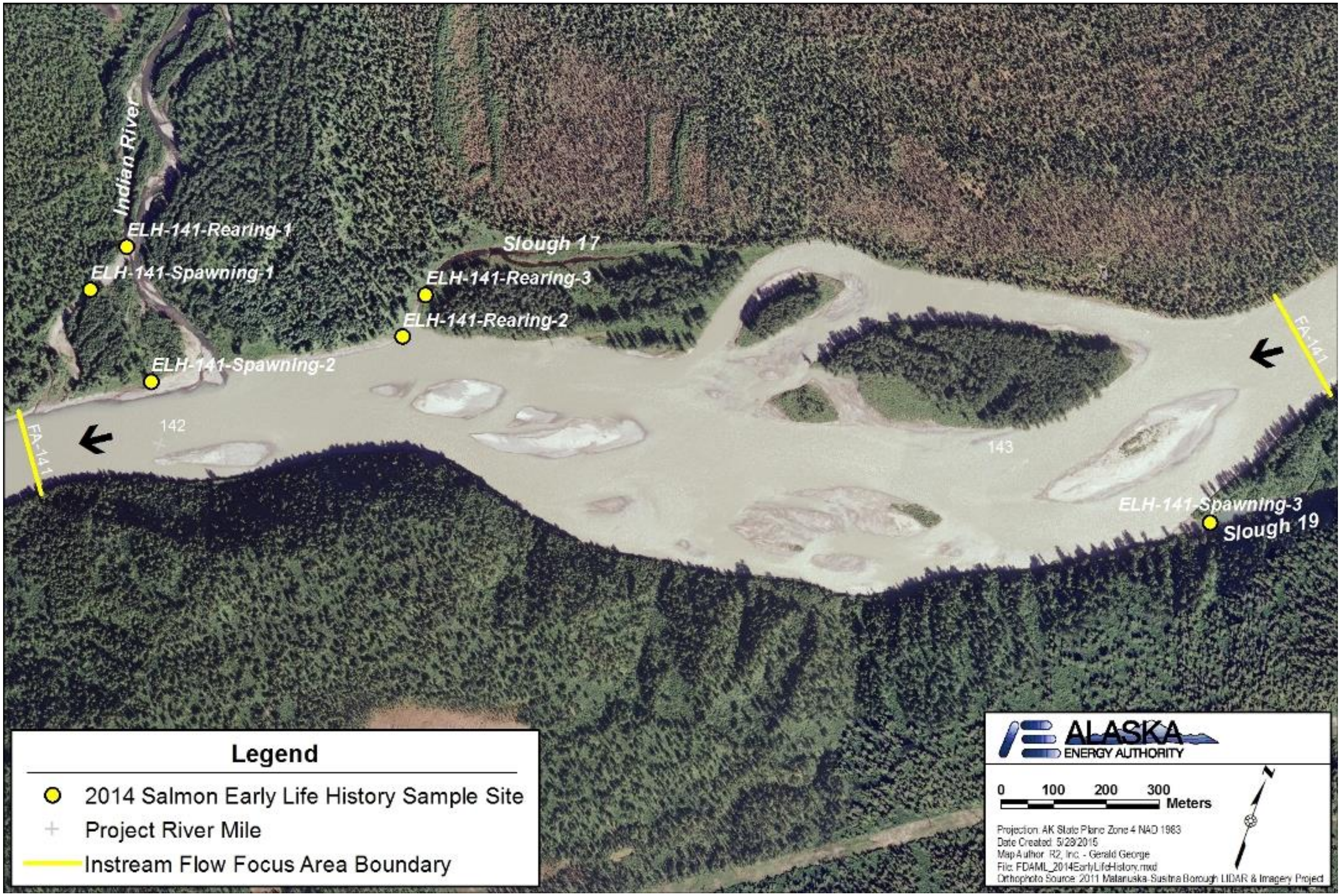

Figure A5. Salmon early life history sampling locations FA-141 (Indian River), 2014.

Figure A6. Salmon early life history sampling locations FA-144 (Slough 21), 2014.

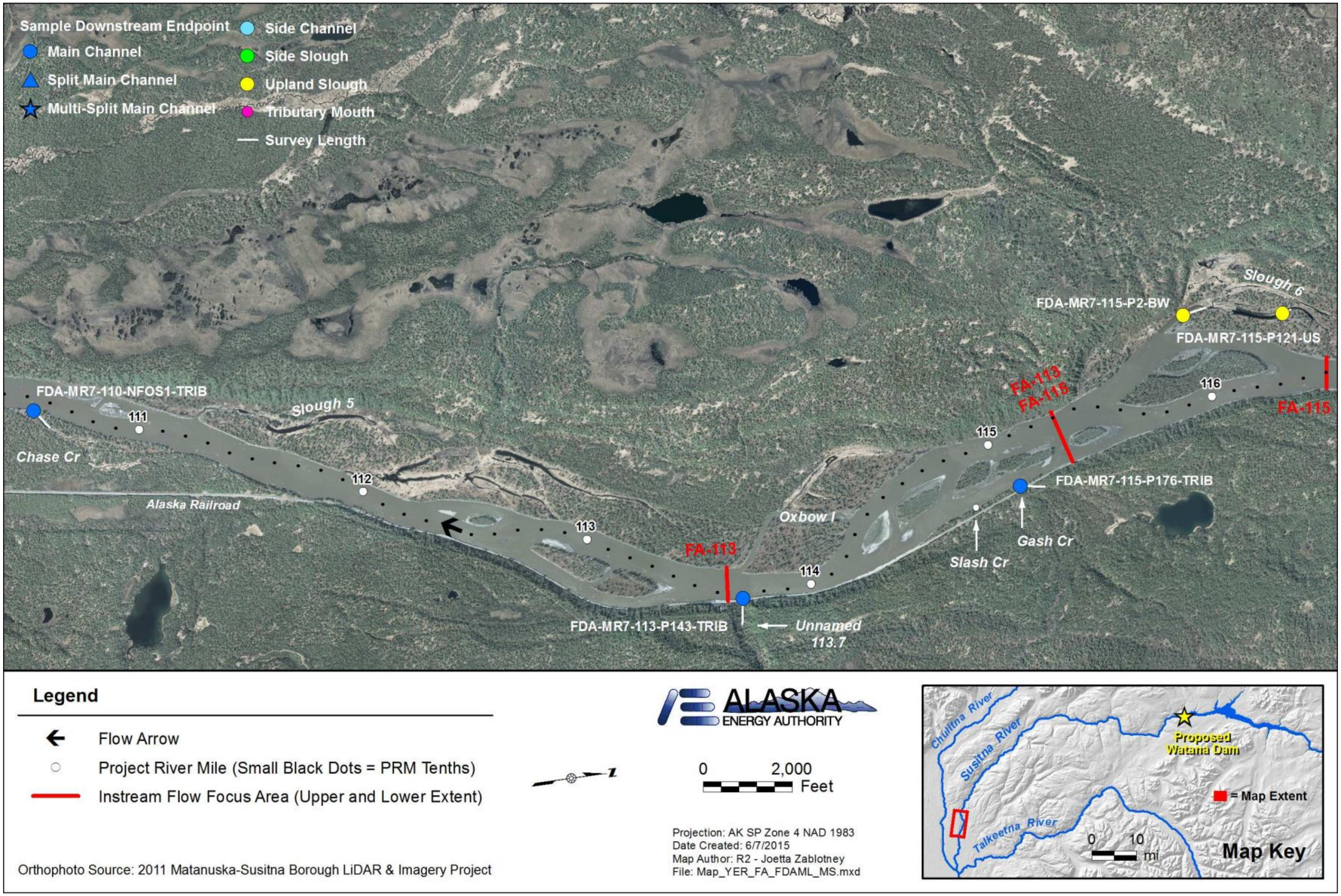

Figure A7. Seasonal GRTS and opportunistic fish distribution and abundance sampling locations PRM 110-116, 2014.

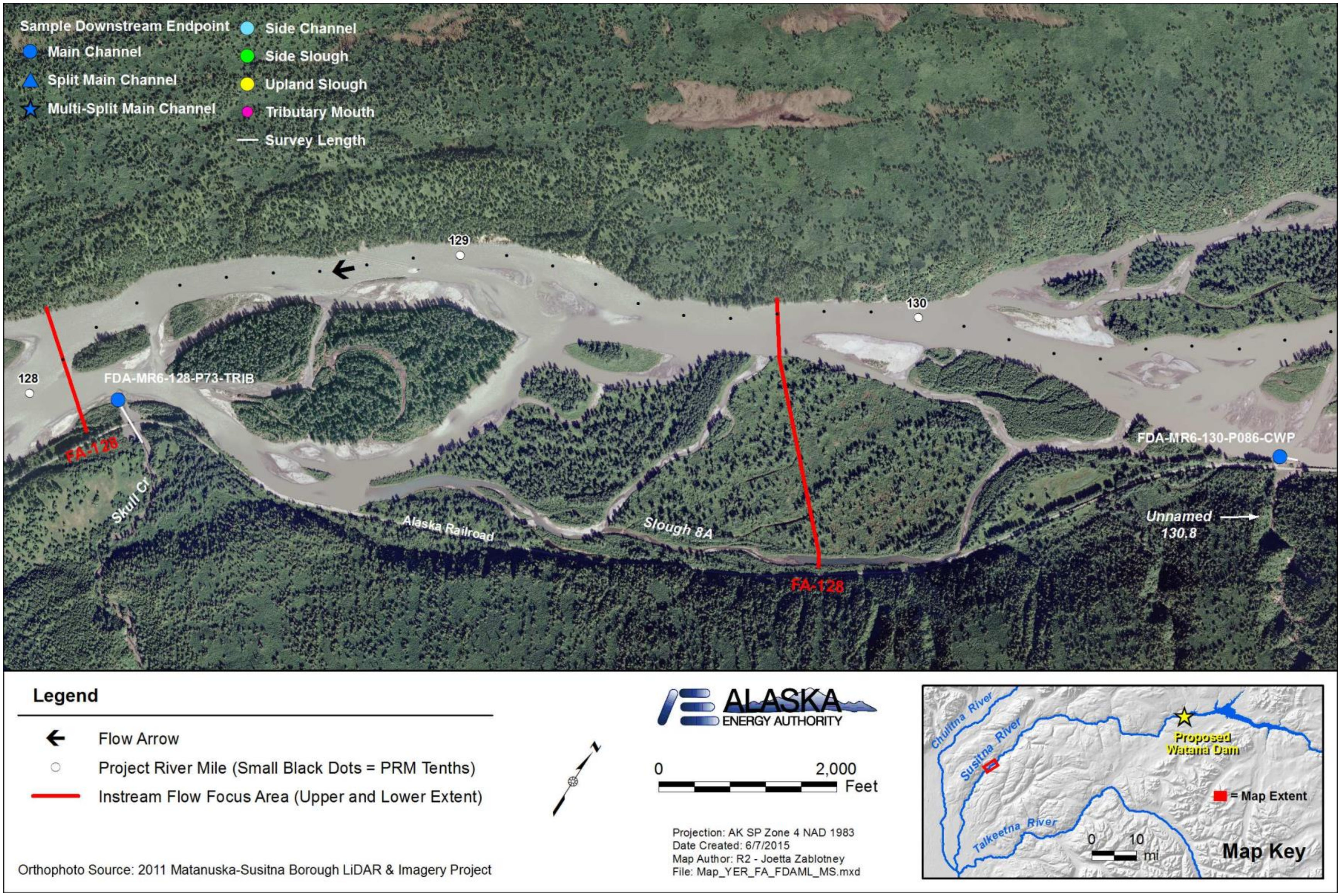

Figure A8. Seasonal GRTS and opportunistic fish distribution and abundance sampling locations PRM 128-131, 2014.

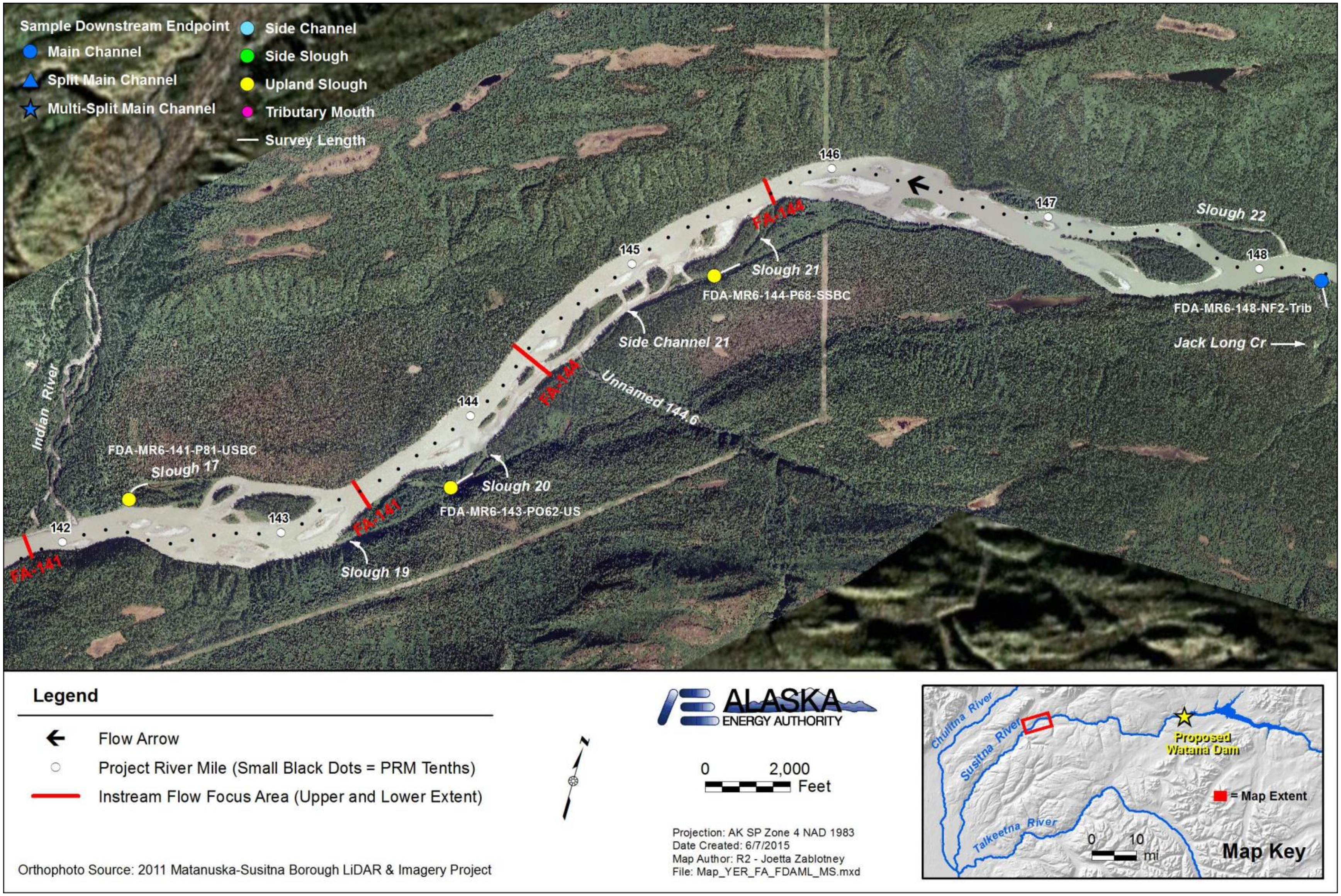

Figure A9. Seasonal GRTS and opportunistic fish distribution and abundance sampling locations PRM 142-148, 2014.

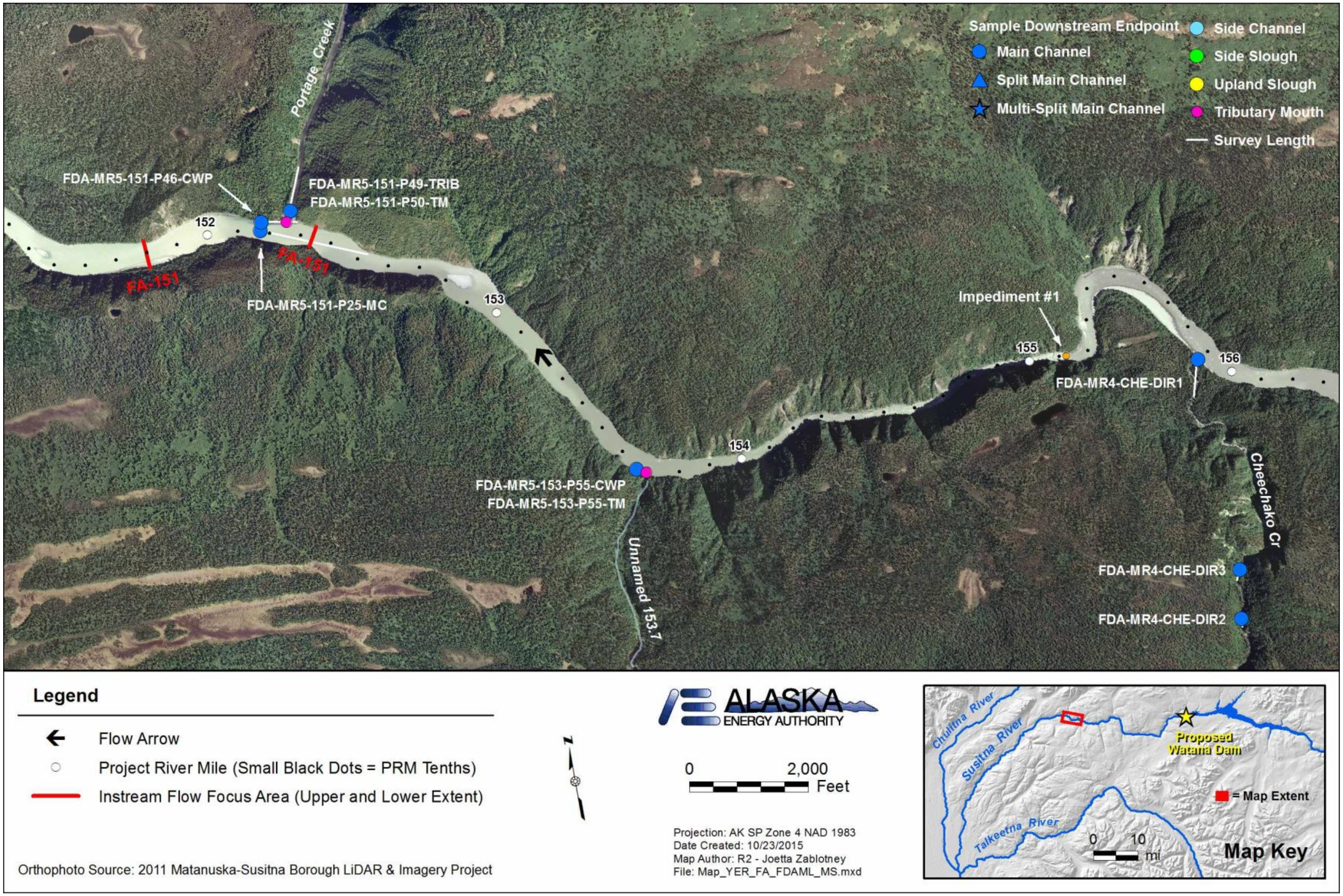

Figure A10. Seasonal GRTS, and opportunistic fish distribution and abundance sampling locations PRM 152-156, and direct tributary sampling at Cheechako Creek, 2014.

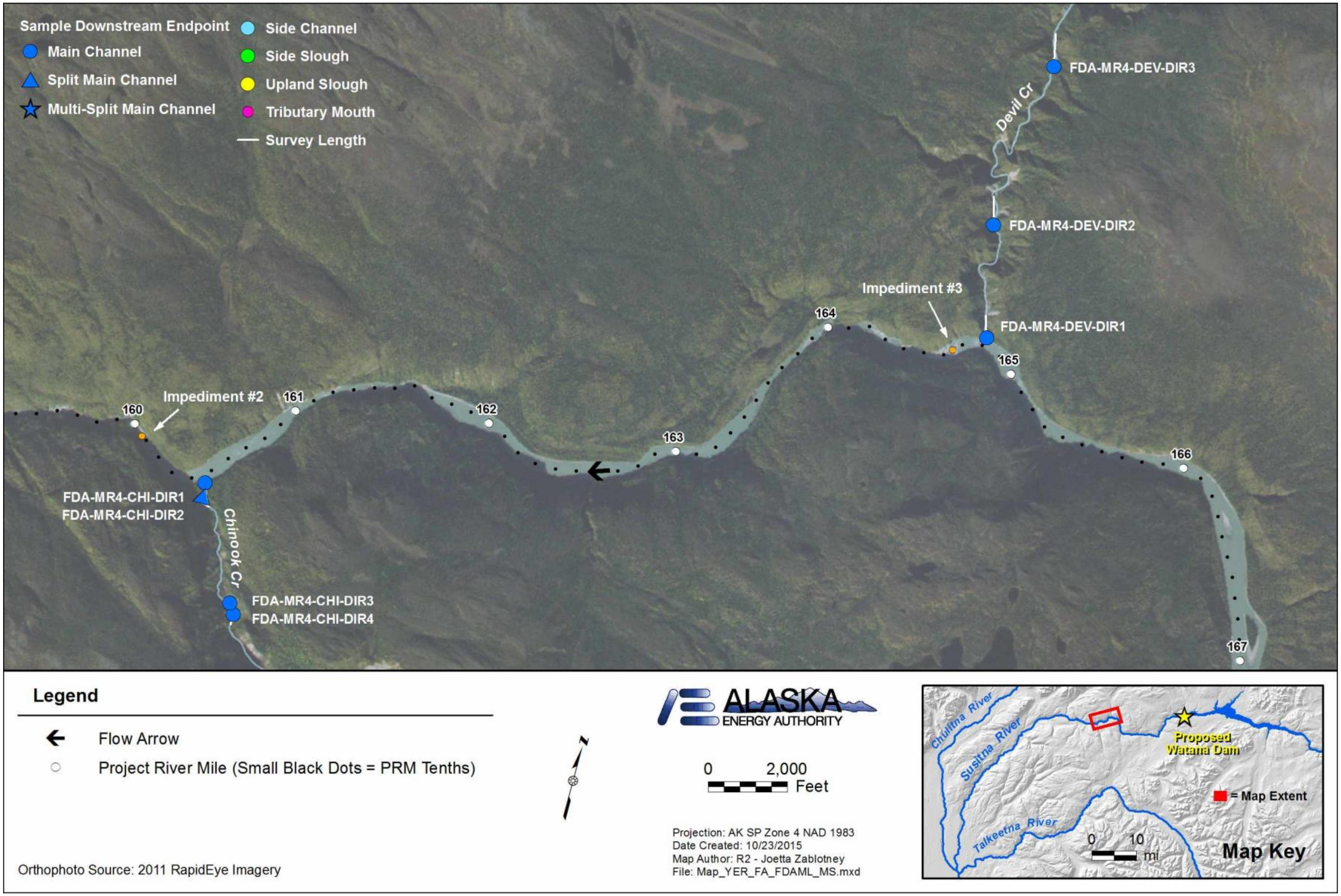

Figure A11. Seasonal direct tributary fish distribution and abundance sampling locations, Chinook Creek and Devil Creek, 2014.

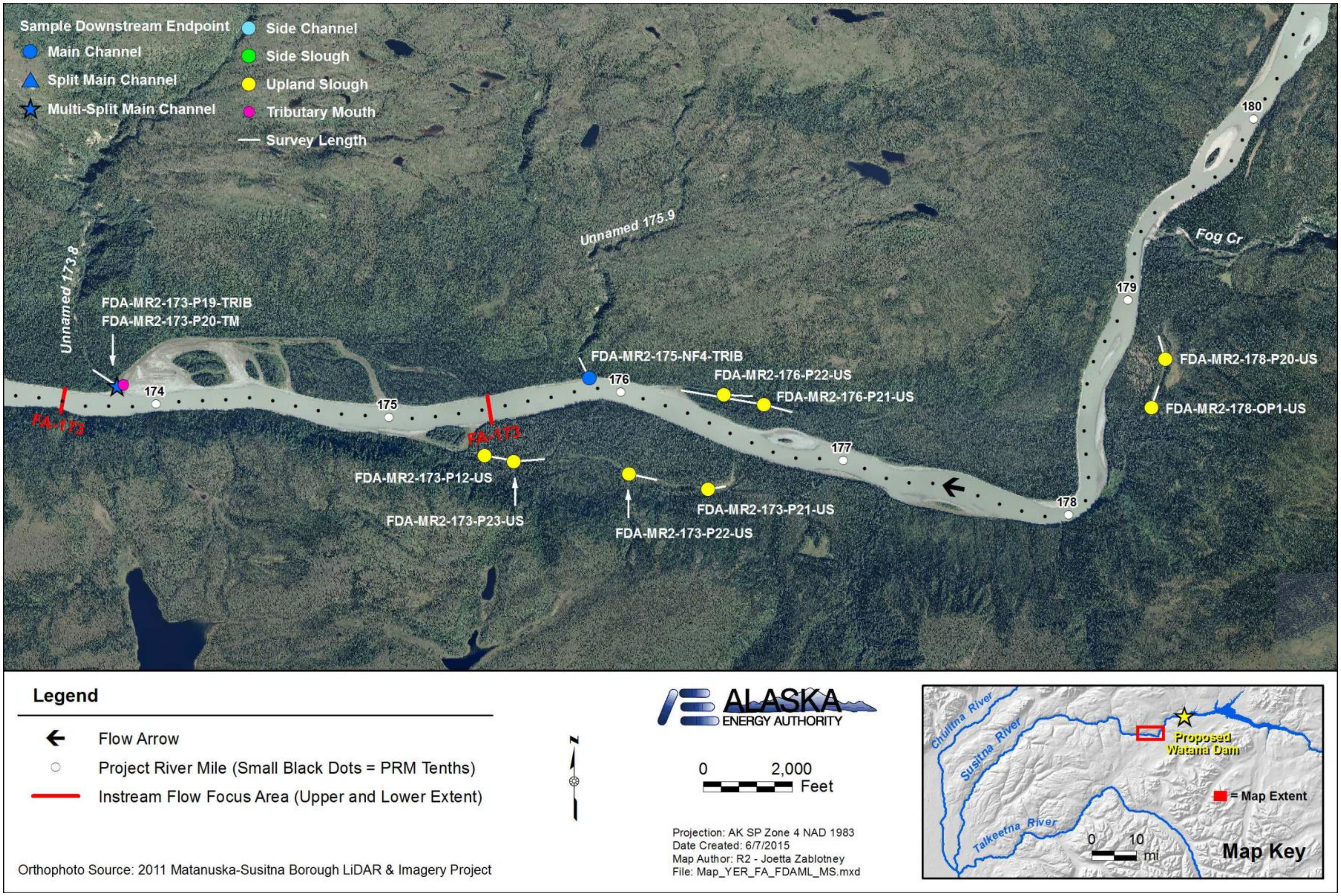

Figure A12. Seasonal GRTS, and opportunistic fish distribution and abundance sampling locations, PRM 173-180, 2014.

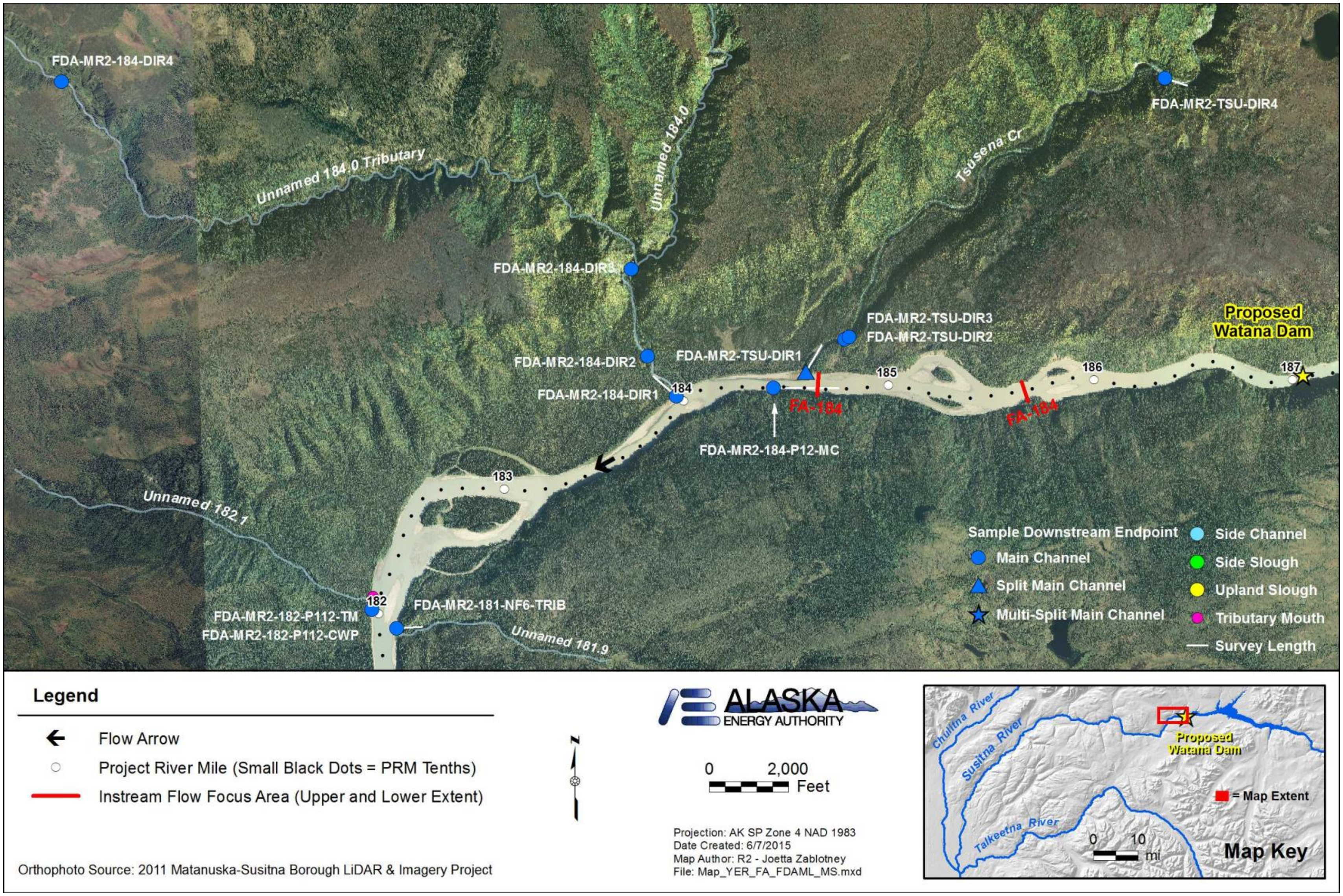

Figure A13. Seasonal GRTS and opportunistic fish distribution and abundance sampling locations PRM 182-187 and tributary direct sampling locations for Unnamed Tributary 184.0 and Tsusena Creek, 2014.

APPENDIX B: JUVENILE CHINOOK AND COHO SALMON IDENTIFICATION ACCURACY

Susitna-Watana Hydroelectric Project
(FERC No. 14241)

Study of Fish Distribution and Abundance in the Middle and Lower Susitna River
Study Plan Section 9.6

2014-2015 Study Implementation Report
Appendix B: Juvenile Chinook and Coho Salmon Identification Accuracy

Prepared for

Alaska Energy Authority

SUSITNA-WATANA HYDRO

Clean, reliable energy for the next 100 years.

Prepared by

R2 Resource Consultants Inc.
LGL Alaska Research Associates, Inc.

November 2015

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1. INTRODUCTION

In 2014, certain licensing participants expressed concern about the amount of sampling error apparent in AEA's fish distribution and abundance studies. This appendix addresses that general concern, and more specifically, the concern that level of error associated with Chinook and Coho Salmon species identifications by AEA's fish study teams was higher than acceptable within the fisheries profession and therefore, compromises the use of the study results to support management decisions. To do so within this appendix, available literature that addresses error in ecological field sampling and fish identifications is summarized. Then, the accuracy of the fish collections from Studies 9.5 and 9.6 Fish Distribution and Abundance in the Upper and Middle and Lower Rivers, respectively, is reviewed, and the efficacy of the QAQC protocol that AEA proposed to improve accuracy is evaluated. Finally and most importantly, the management implications associated with having a known level of uncertainty around species identifications of juvenile Chinook and Coho salmon is discussed.

Although it is not often estimated or even discussed, sampling error is ubiquitous in all ecological sampling and observer bias is widespread in studies that rely upon humans to collect data (Elphick 2008). While it is often assumed that the degree of error can be attributed to a lack of training and experience of observers, studies have shown that training and experience can reduce or change the type of sampling error that occurs (Fitzpatrick et al. 2009), but cannot eliminate observer error (Elphick 2008, Kirsch et al. 2014). Understanding the bias/error associated with ecological data sets allows researchers to take steps to potentially reduce that error, but more importantly, to evaluate the influence of the uncertainty imposed by error might have on the use of the data for management decisions. Since error is unavoidable, it is important to know what implications, if any, the error would have for use of the data.

For fish surveys, field crews are often asked to identify fish to genus or species where possible. Field identification of fishes relies on phenotypes (such as coloration, or fin shape) and meristics (countable traits such as fin rays), and natural variations in these traits can make field identification challenging (Moyle 2002). A literature search for studies that addressed uncertainty in species identification based on phenotypes revealed only one study with freshwater fishes.

A recent experimental study conducted by the USFWS estimated error associated with the identification of fish species in California (Kirsch et al. 2014). This study demonstrated an overall average accuracy of 84 percent for all observers. In addition, although accuracy increased with observer experience (accuracy was approximately 60 percent for inexperienced observers and 80 percent for observers with approximately 18 months of experience in the region), it remained highly variable among observers ranging from 85 to 95 percent for even the most experienced observers (15 years of experience) demonstrating that there is an individual human component to bias that experience and training do not affect. It is important to note, that during this experiment the identification of test specimen had to be agreed upon by four expert California fish scientist and the specimen for which the experts could not agree were excluded from the experiment. Thus, these results might be underestimates of identification error for difficult determinations where considerable overlap in phenotypic variation occurs. This study by Kirsch et al. provides a basis of comparison for documented observer error during fish species identification.

2. ACCURACY OF CHINOOK AND COHO SALMON SPECIES IDENTIFICATION

During 2013 field sampling for Study 9.6, field crews identified that a proportion of the juvenile salmon catch were challenging to identify to species due to high variability in color patterns and meristics that overlapped across species. In particular for juvenile Chinook and Coho salmon, large variation among individuals with respect to species defining characteristics: 1) the spacing of parr marks, 2) the coloration of the leading edge of the fins, and 3) the shape of the anal fin, resulted in a large amount of uncertainty in identifying some fish to species (Figure C-1). To address this concern, in 2014 additional onsite training was provided to field crews, crews were instructed to increase photo-documentation of challenging fish, and laboratory confirmation of field identification through collection of tissue samples for DNA analysis was initiated to provide feedback and evaluate field identification accuracy. Field identifications were reviewed for quality control based on photo documentation and a final QC3 species determination was made.

There are two terms that we can use to characterize the uncertainty in species identifications that were made during 2012-2013 fish surveys. The first term, **sampling accuracy**, characterizes the correctness of the species determinations when the fish are taken from a mixed pool of unknown species, and is calculated as the correct number of Chinook and Coho salmon determinations by the study team divided by the known number of each species in the collection as determined by DNA analysis. The second term is **species-specific accuracy** and describes the error around the study team identifying a species as itself in the field, in other words, identifying a Chinook Salmon a Chinook and, likewise, calling a Coho Salmon a Coho. Species-specific error is determined by dividing the number of correct field identifications for each species by the genetically verified number of that species. This term is important to evaluate because it helps us to understand where the identification error is arising from, such as misidentification of one species, the other, or both.

The results of the genetic analysis from 1,226 fish confirmed that fish crews had an overall sampling accuracy when identifying Chinook and Coho salmon of 86 percent (Table C-1), with 84 percent and 90 percent sampling accuracy for Chinook and Coho salmon, respectively. Genetic analysis also showed that species-specific accuracy was one-directional in 2013 (Table C-2). In 2013, observers identified true Chinook Salmon with high species-specific accuracy of 96 percent (only 12 out of 320 verified Chinook Salmon were called Coho Salmon); but, they erroneously identified 122 out of 290 verified juvenile Coho Salmon as Chinook resulting in a species-specific accuracy rate of 57 percent. The species-specific error numbers indicated that it was the incorrect assignment of Coho Salmon that caused the problem in 2013. Photographic QAQC confirmed that it was the variation of distinguishing characteristics of Coho Salmon and how they overlapped with those used to distinguish Chinook Salmon that caused the error in 2013.

In 2014, species-specific accuracy remained stable for Chinook Salmon and improved dramatically for Coho Salmon, such that no directional error was evident. The 2014 species-specific accuracy rates were 95 percent for Chinook Salmon (22 errors out of 403 verified Chinook) and 96 percent for Coho Salmon (7 errors out of 186 verified Coho). This improvement likely is related to additional training and feedback provided to field crews about specific characteristics of Coho Salmon in the Middle Susitna River as well as implementation of photographic QAQC of field identification as is discussed below.

It is important to note that this problem was isolated to the Middle River below Devils Canyon and in the Lower River. The juvenile salmon collected in the Middle River within Devils Canyon (between Impediment 1 and 3) and above Impediment 3, as well as in the Upper River were phenotypically distinct and were assigned as Chinook Salmon with 100 percent accuracy (Table C-3) in all survey years 2012-2014. This high level of accuracy was likely related to the facts that 1) there were no Coho Salmon collected in any of the samples within and above the Canyon and there was no co-occurrence of juvenile Pacific Salmon upstream of Impediment 1 in Devils Canyon, although this was not known with certainty prior to initiation of AEA's recent field surveys and genetic sampling.

Even within the Middle and Lower River Segments, the results of genetic analysis show that the species identifications were similar to or greater than accuracy levels reported elsewhere (USFWS 2014) except in two Middle River Segment reaches, MR-6 and MR-7 (Table C-3). Importantly, the lowest accuracy of 33 percent, evident in MR-7, was based on a small sample size of nine genetically verified Chinook Salmon that came from two habitats: the Oxbow side channel and a side slough at PRM 117. This information points to localized areas where the phenotypic variation among juvenile salmon is high and poses challenges for species identification. Photographic review of juveniles collected in Oxbow side-channel showed the fish to be in the process of smoltification and confirmed the difficultly in species identification due to a lack of distinguishing characteristics. This was the only reach where photographic review was less than 90 percent accurate when compared to genetically verified specimen (Table C-4).

3. EVALUATION OF AEA'S PHOTOGRAPHIC QA/QC FOR FIELD IDENTIFICATIONS OF JUVENILE SALMONIDS

In 2014, AEA developed and filed with FERC a proposed protocol entitled *Fish Distribution and Abundance in the Upper and Middle/Lower Susitna River (Studies 9.5 and 9.6): Draft Chinook and Coho Identification Protocol* (R2 2014) to improve the accuracy of species determinations for juveniles of these two salmon species. The protocol consists of five components: 1) site-specific training in areas where these species have co-occurred and identification has proven challenging; 2) standardized genetic verification across habitats; 3) collection of up to 20 voucher specimen of each species for meristic analysis by field crews; 4) collection and senior review of photographs for all undifferentiated Pacific salmon and all PIT-tagged Chinook and Coho salmon and 5) development of a Susitna specific identification guide for use by field crews. In 2013, an evaluation of the photographic QA/QC was implemented on 317 juvenile salmon that had both photos and genetic tissue samples taken at the time of capture. A comparison of the 2014 QC3 species determination (final study team determination after photographic quality control of field identifications) showed that species identification from photo QA/QC was accurate for 96 percent of the Chinook Salmon identifications and 98 percent for Coho Salmon (Table C-4). This high level of accuracy supports the use of photographic review for verifying field identifications in AEA's future studies downstream of Devils Canyon. Further support for AEA's proposed protocol comes from Moyle (2002) who recommended the use of photographic review of recently caught field specimen and collection of voucher specimens to improve fish identification accuracy and account for natural variation in morphology and human perception.

Finally, the value of AEA's field protocol extends beyond reducing any misidentification of juvenile Coho or Chinook salmon. In some habitats, such as Slough 6A, 2013 field crews were only able to identify large numbers of juvenile salmonids to genus, based on phenotypic characteristics, and thus called them Undetermined Pacific Salmon (SAMs). This resulted in SAMs in preliminary datasets. Use of photographic QA/QC has allowed AEA to re-classify the majority of these SAMs. For example, in Slough 6A the number of SAMS was reduced from 335 to 14 after implementing the QA/QC verification protocol. Through application of AEA's QA/QC protocol, presence of both juvenile Coho and Chinook salmon has been positively documented within many habitat features surveyed including upland sloughs with active beaver dams (Table C-5). Finally, application of AEA's QA/QC verification protocol confirmed results documenting age 2 juvenile Chinook Salmon rearing in the Middle River Segment of the Susitna River. Because this age class has not been evident in previous sampling, licensing participants expressed concern during the October 2014 Initial Study Report meetings that the larger sized juvenile Chinook Salmon collected by field crews in 2013 were misidentified Coho Salmon and questioned the accuracy of the 2013 field data. AEA's protocol allowed for confirmation of the presence of larger sized, age 2 Chinook Salmon, documenting new information about the life history diversity of this species in the Middle River Segment. Application of AEA's species identification protocol has proven valuable at reducing observer error, and substantiating findings from 2012-2014 fish studies.

4. MANAGEMENT IMPLICATIONS

As discussed above, all ecological sampling has inherent error and studies that rely upon humans to collect data will have observer bias. Understanding this error is important, but the significance of the error is determined by considering how the error may affect use of the study results. How might observer bias in calling a juvenile Coho Salmon a juvenile Chinook Salmon affect an analysis of AEA's potential impact and subsequent management decisions? To address this, the ecology of juvenile Chinook and Coho salmon in the Susitna River basin needs to be understood. The following description is based largely on analysis of photographically and genetically-verified juvenile Chinook and Coho salmon from FDA 2013 and 2014 databases (Study 9.6), and analysis of juvenile Chinook and Coho salmon identified in 2013 and 2014 and recorded in the HSC database (Study 8.5).

Data from 2013 and 2014 field studies suggest that juvenile Chinook and Coho salmon in the Middle and Lower Segments of the Susitna River show considerable overlap in ecological niches during the open water period. Data from fish sampling indicate that these juveniles occupy similar habitats within the Middle Susitna River and co-occurred in 87 percent of the habitat features where species identification were verified (Table B-5). In addition, site-specific habitat suitability criteria data collected by Study 8.5 show that juvenile Chinook and Coho salmon are keying in on similar habitat conditions such as shallow water depths, and water velocities less than 0.5 feet per second and temperature (Figure B-2). Within these habitats, the isotopic data collected under Study 9.8 indicates that these fish rely upon similar food resources both across habitats and across seasons (Figure B-3). Finally, the size distributions of the genetically-verified juvenile Chinook and Coho salmon show considerable overlap in size (Figure B-4) and support AEA's finding from scale analysis that both species exhibit life history diversity that includes freshwater rearing for more than one year (Figure B-5). Based on these data from the Middle River Segment, many juvenile Chinook and Coho salmon are rearing in the same habitats during open-water periods, are exposed to similar microhabitat conditions, depend upon similar food resources, grow to similar sizes, and are of similar ages while rearing in mainstem freshwater habitats.

Given the ecological similarities between juvenile Chinook and Coho salmon in the Middle and Lower Susitna River during the open-water period and the low accuracy with identifying Coho Salmon in some areas in 2013, AEA will combine data collected on Chinook and Coho salmon from 2013 and 2014 collections to characterize the distribution, relative abundance and habitat associations of these two juvenile salmon species when evaluating Project impacts. Where appropriate, AEA also will make use of the verified field identifications to look for species-specific patterns in growth and movements. Evaluations of Project effects using a pooled juvenile Chinook/Coho salmon data may overestimate the distribution, abundance and movement timing for individual species. However, overestimating each species' habitat use or range of movement timing would support more protective measures than could be justified for each species individually. Draft HSC are being developed that may show small differences between juvenile Chinook and Coho salmon (Study 8.5), especially when considering both open-water and ice periods. Final effects analyses may consider an approach where protection of habitats occupied by both juvenile Chinook and Coho lifestages is based on the lifestage that is most susceptible to effects of Project operations. AEA is confident in the integrity of study results and their ability to support a rigorous evaluation of potential Project impacts and where appropriate, development of Protection, Mitigation, and Enhancement measures for these ecologically similar life stages.

5. LITERATURE CITED

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6. TABLES

Table B-1. Accuracy of 2012-2014 QC3 species identification as determined by genetic analysis of tissue.

QC3 Species ID*	N	Species-Genetic Determination				% Correct
		Chum Salmon	Chinook Salmon	Coho Salmon	Sockeye Salmon	
Chinook Salmon	854	3	721	126	4	84.4%
Coho Salmon	371		35	334	2	90%
Pacific Salmon, Unspecified	1		1			-
Total Samples	1,226	3	757	460	6	86.10%

*Includes species identification changes for 53 fish in 2014 data set after review of 317 photos.

Table B-2. Accuracy of QC3 species identification by month and year. Accuracy was determined by genetic analysis tissue samples from N fish.

Year and Month of QC3 ID*	Chinook Salmon				Coho Salmon				Both Species	
	N	Number of Coho	Number of Chinook	% correct	N	Number of Chinook	Number of Coho	% correct	N	% correct
2012 Total	**35**		**35**	**100%**					**35**	**100%**
Aug-12	35	0	35	100%	0				35	100%
2013 Total	**430**	**122**	**308**	**72%**	**170**	**12**	**158**	**93%**	**600**	**78%**
Mar-13	6	2	4	67%	37	0	37	100%	43	95%
Apr-13	22	3	19	86%	2	0	2	100%	24	88%
Jun-13	124	51	73	59%	43	6	37	86%	167	66%
Jul-13	97	14	83	86%	8	0	8	100%	105	87%
Aug-13	116	36	80	69%	42	5	37	88%	158	74%
Sep-13	64	15	49	77%	26	0	26	100%	90	83%
Oct-13	1	1	0	0%	12	1	11	92%	13	85%
2014 Total	**389**	**7**	**381**	**97%**	**201**	**22**	**179**	**89%**	**591**	**94%**
Apr-14	19	2	17	89%	0				19	89%
May-14	33	0	33	100%	39	6	33	85%	72	92%
Jun-14	48	4	44	92%	75	9	66	88%	123	89%
Jul-14	33	`1	32	97%	0				33	97%
Aug-14	167	0	167	100%	37	2	35	95%	204	99%
Sep-14	49	0	49	100%	45	3	42	93%	94	97%
Oct-14	41	0	41	100%	5	2	3	60%	46	93%
Grand Total	**855**		**689**	**84%**	**371**		**337**	**90%**	**1226**	**86%**

*Includes species identification changes for 53 fish in 2014 data set after review of 317 photos.

Table B-3. QC3 Species ID accuracy by geomorphic reach; percent accuracy was determined by genetic analysis of tissue samples from N juvenile fish.

Geomorphic Reach	QC3 Species ID				Total	
	Chinook Salmon		Coho Salmon			
	N	% Correct	N	% Correct	N	% Correct
UR-2	65	100%			65	100%
UR-4	141	100%			141	100%
UR-5	5	100%			5	100%
UR-6	17	100%			17	100%
MR-1	4	100%			4	100%
MR-2	3	100%			3	100%
Impediment 3 PRM 164.8						
MR-4	14	100%			14	100%
Impediment 1 PRM 155.1						
MR-4	151	100%			151	100%
MR-6	219	71%	83	77%	303	73%
MR-7	9	33%	36	89%	45	78%
MR-8	142	63%	176	97%	318	82%
LR-2	85	88%	73	95%	158	91%
LR-3	2	100%			2	100%
Total	857	84%	368	90%	1226	86%

Table B-4. 2014 species ID photo review quality control as determined by comparing photo-based species determination with genetic analysis of tissues from N fish.

Geomorphic Reach	Chinook Salmon		Coho Salmon		Sockeye Salmon		Total	
	N	% Correct	N	% Correct	N	% Correct	N	% Correct
UR-2	2	100%					2	100%
UR-4	9	100%					9	100%
UR-5	1	100%					1	100%
UR-6	15	100%					15	100%
MR-1	4	100%					4	100%
MR-2	3	100%					3	100%
MR-4	105	100%					105	100%
MR-6	54	94%	17	88%	2	0%	73	90%
MR-7	3	0%	19	100%			22	86%
MR-8	24	88%	30	100%			54	94%
LR-2	14	100%	15	100%			29	100%
Grand Total	**234**	**96%**	**81**	**98%**	**2**	**0%**	**317**	**96%**

Table B-5. Documented co-occurrence of verified juvenile Chinook and Coho salmon in 53 of 60 Middle and Lower River habitat features.

Geomorphic Reach	Feature Name	Macrohabitat Type	Chinook Salmon Present	Coho Salmon Present
MR-5	FA-151 Portage Creek Plume	Main Channel-CWP	Yes	Yes
MR-5	FA-151 Portage Creek Mouth	Tributary Mouth	Yes	Yes
MR-5	FA-151 Portage Creek	Tributary	Yes	Yes
MR-5	FA-151 MC	Main Channel	Yes	Yes
MR-6	Slough 14	Upland Slough	Yes	Yes
MR-6	PRM 137 US	Upland Slough	No	Yes
MR-6	PRM 134 US	Upland Slough	No	Yes
MR-6	PRM 130 US	Upland Slough	Yes	Yes
MR-6	Jack Long Creek	Tributary	Yes	Yes
MR-6	FA-144 Slough 21 US	Upland Slough	Yes	Yes
MR-6	FA-144 Slough 21 SS	Side Slough	Yes	Yes
MR-6	FA-144 Slough 20	Upland Slough	Yes	Yes
MR-6	FA-144 Side Channel 21	Side Channel	Yes	Yes
MR-6	FA-141 Slough 19	Upland Slough	Yes	Yes
MR-6	FA-141 Slough 17 BW	Upland Slough-Backwater	Yes	Yes
MR-6	FA-141 Slough 17	Upland Slough	Yes	Yes
MR-6	FA-141 SC	Side Channel	Yes	Yes
MR-6	FA-141 MC	Main Channel	Yes	Yes
MR-6	FA-141 Indian River Mouth	Tributary Mouth	Yes	Yes
MR-6	FA-141 Indian River CWP	Main Channel	Yes	Yes
MR-6	FA-141 Indian River	Tributary	Yes	Yes
MR-6	FA-138 Upper Side Slough 11	Side Slough	Yes	Yes
MR-6	FA-138 Slough Slough 13	Upland Slough	Yes	Yes
MR-6	FA-138 Slough Slough 12	Upland Slough	No	Yes
MR-6	FA-138 Slough 11	Side Slough	Yes	Yes
MR-6	FA-128 US	Upland Slough	Yes	Yes
MR-6	FA-128 Slough 8A	Side Slough	Yes	Yes
MR-6	FA-128 Skull Creek Mouth	Tributary Mouth	Yes	Yes
MR-6	FA-128 Skull Creek	Tributary	Yes	Yes
MR-6	FA-128 Side Channel 8A	Side Channel	Yes	Yes
MR-6	Curry DMT	Main Channel	Yes	Yes
MR-7	PRM 117 SS	Side Slough	Yes	Yes
MR-7	PRM 113 US	Upland Slough	No	Yes
MR-7	FA-115 Unnamed Trib 115.4	Tributary	Yes	Yes
MR-7	FA-115 Slough 6A BW	Upland Slough-Backwater	Yes	Yes
MR-7	FA-115 Slough 6A	Upland Slough	No	Yes

Geomorphic Reach	Feature Name	Macrohabitat Type	Chinook Salmon Present	Coho Salmon Present
MR-7	FA-113 Unnamed Trib 113.7	Tributary	Yes	Yes
MR-7	FA-113 Slash Creek	Tributary	Yes	Yes
MR-7	FA-113 Oxbow I US	Upland Slough	No	Yes
MR-7	FA-113 Oxbow I SS	Side Slough	Yes	Yes
MR-7	FA-113 Oxbow I MC	Main Channel	No	Yes
MR-7	FA-113 Gash Creek	Tributary	Yes	Yes
MR-7	Chase Creek	Main Channel	Yes	Yes
MR-8	PRM 106.9 TKA Station DMT	Main Channel	Yes	Yes
MR-8	PRM 106 US	Upland Slough	Yes	Yes
MR-8	FA-104 Whiskers Unnamed Side Slough	Side Slough	No	Yes
MR-8	FA-104 Whiskers Slough	Side Slough	Yes	Yes
MR-8	FA-104 Whiskers Creek	Main Channel	Yes	Yes
MR-8	FA-104 Slough 3B	Side Slough	Yes	Yes
MR-8	FA-104 Slough 3A	Upland Slough	Yes	Yes
MR-8	FA-104 SC	Side Channel	Yes	Yes
MR-8	FA-104 MC	Main Channel	Yes	Yes
Lower River PRM 102.4				
LR-1	Birch Creek	Tributary	Yes	Yes
LR-2	Montana Creek	Tributary	Yes	Yes
LR-2	Montana Creek Mouth	Tributary Delta	Yes	Yes
LR-2	Sheep Creek Slough	Upland Slough	Yes	Yes
LR-2	Slough near Montana Creek	Upland Slough	Yes	Yes
LR-2	Susitna Main Channel near Montana Creek	Main Channel	Yes	Yes
LR-2	Susitna Side Channel near Montana Creek	Side Channel Complex	Yes	Yes
LR-3	Little Willow Creek	Tributary	Yes	Yes

7. FIGURES

Figure B-1. Examples of morphological variability among juvenile Chinook Salmon (left) and Coho Salmon (right) parr from the Susitna River and lower tributary reaches between PRM 80 and PRM 160.5. Species identification was verified through genetic analysis.

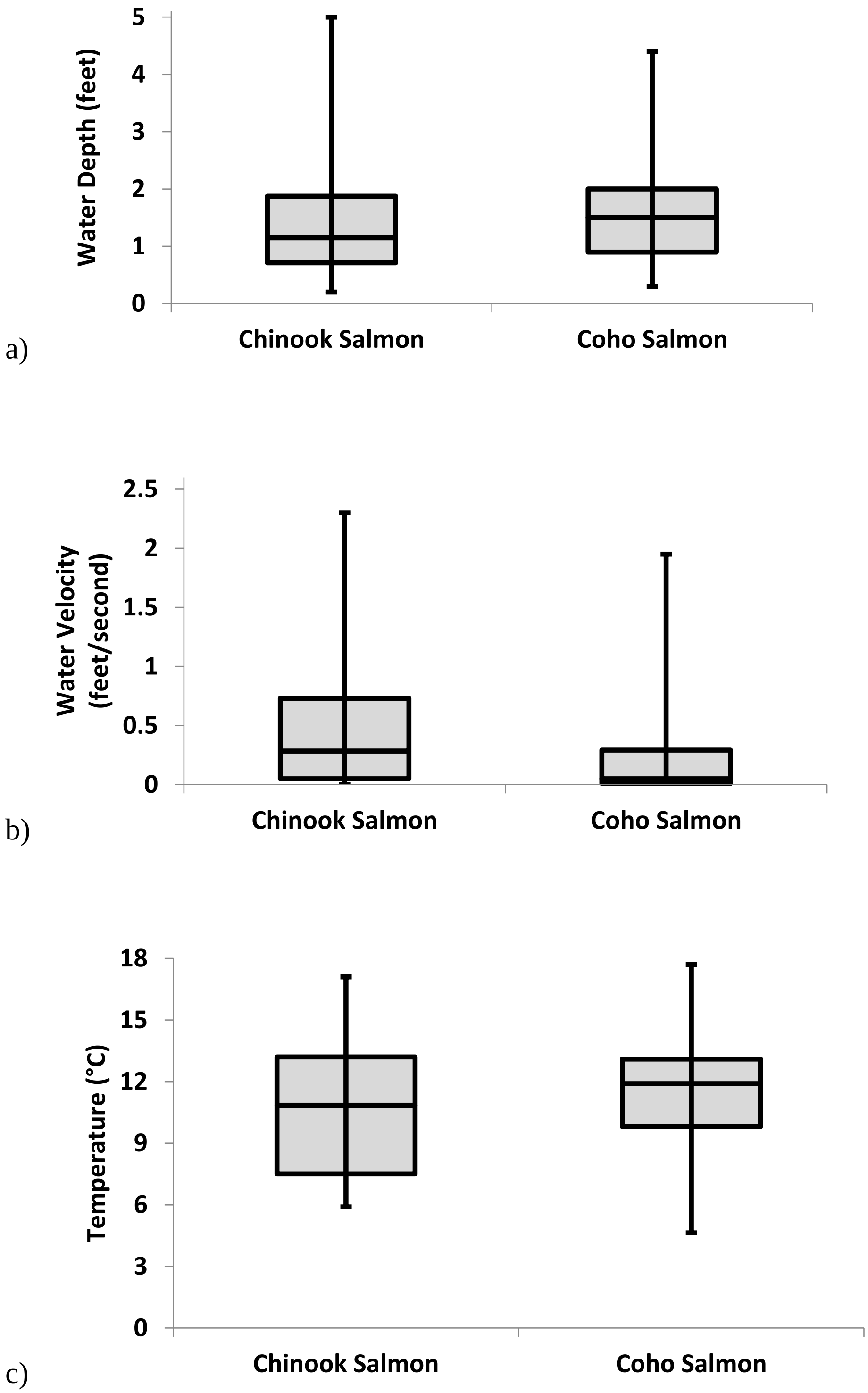

Figure B-2. Distributions of the Susitna River habitat suitability criteria data for the open-water period (median, 25% and 75% interquartile, range) collected for juvenile Chinook and Coho salmon: a) water depth criteria, b) velocity criteria, and c) temperature criteria. (source: 2013 and 2014 habitat suitability criteria microhabitat database http://gis.suhydro.org/SIR/08-Instream_Flow/8.5-Fish_and_Aquatics_Instream_Flow/).

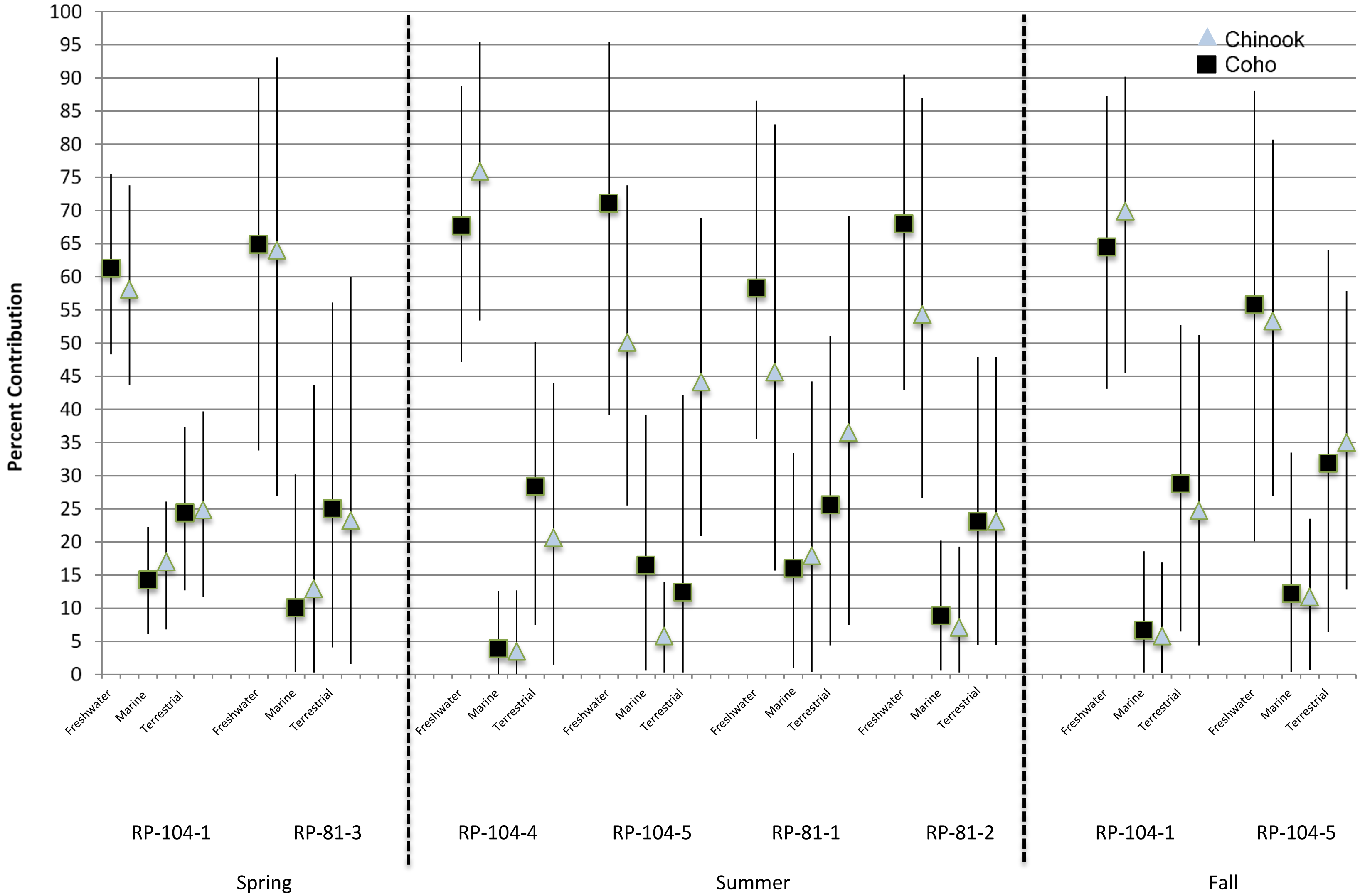

Figure B-3. Results of 2014 isotopic model showing contributions from freshwater, marine, and terrestrial food sources to juvenile Chinook and Coho salmon by site and season (Source: R2 and UAF 2015; Tables 5.4-4, 5.4-5, and 5.4-6).

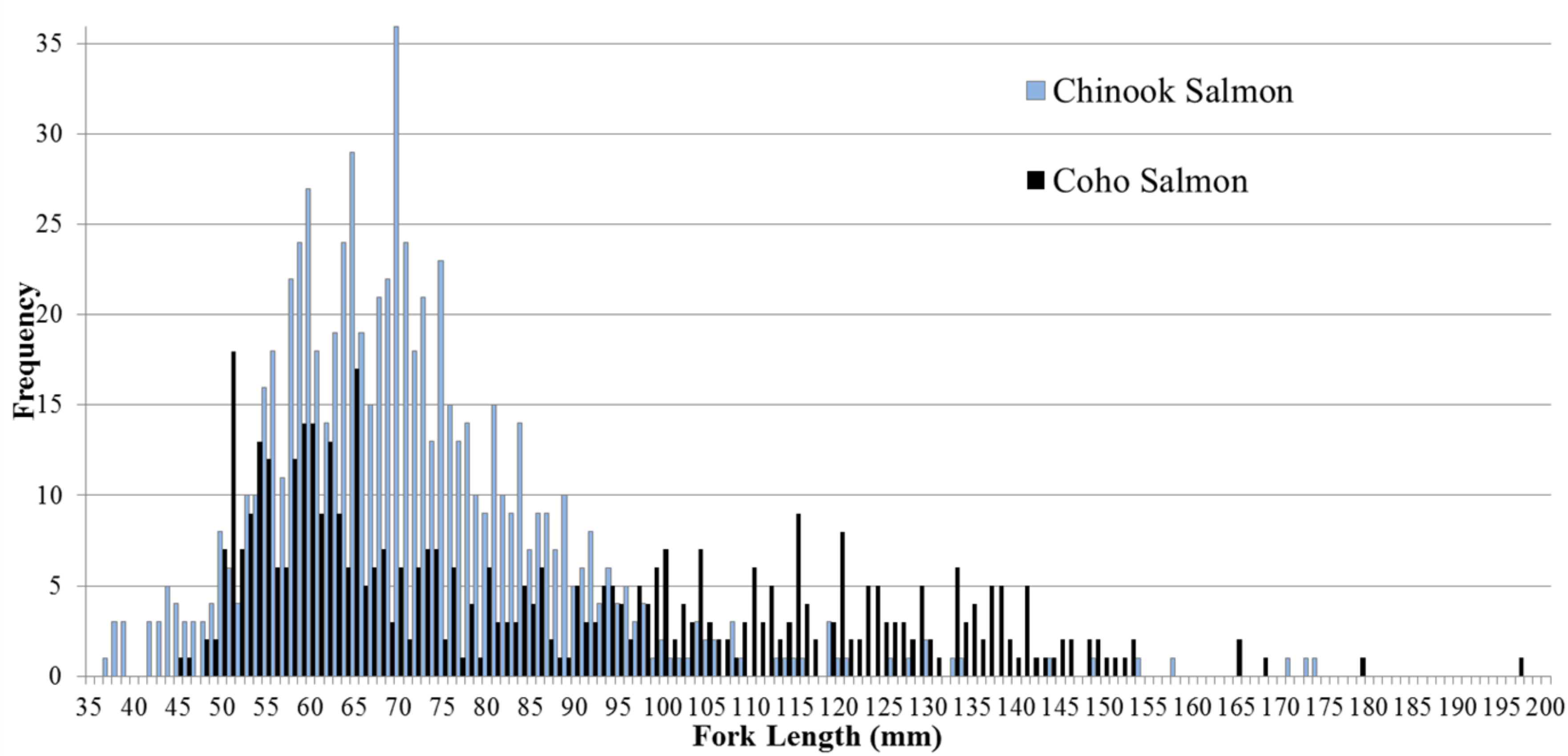

Figure B-4. Size distributions of genetically-verified juvenile Chinook and Coho salmon for the Middle and Lower Susitna Rivers, 2013-2014.

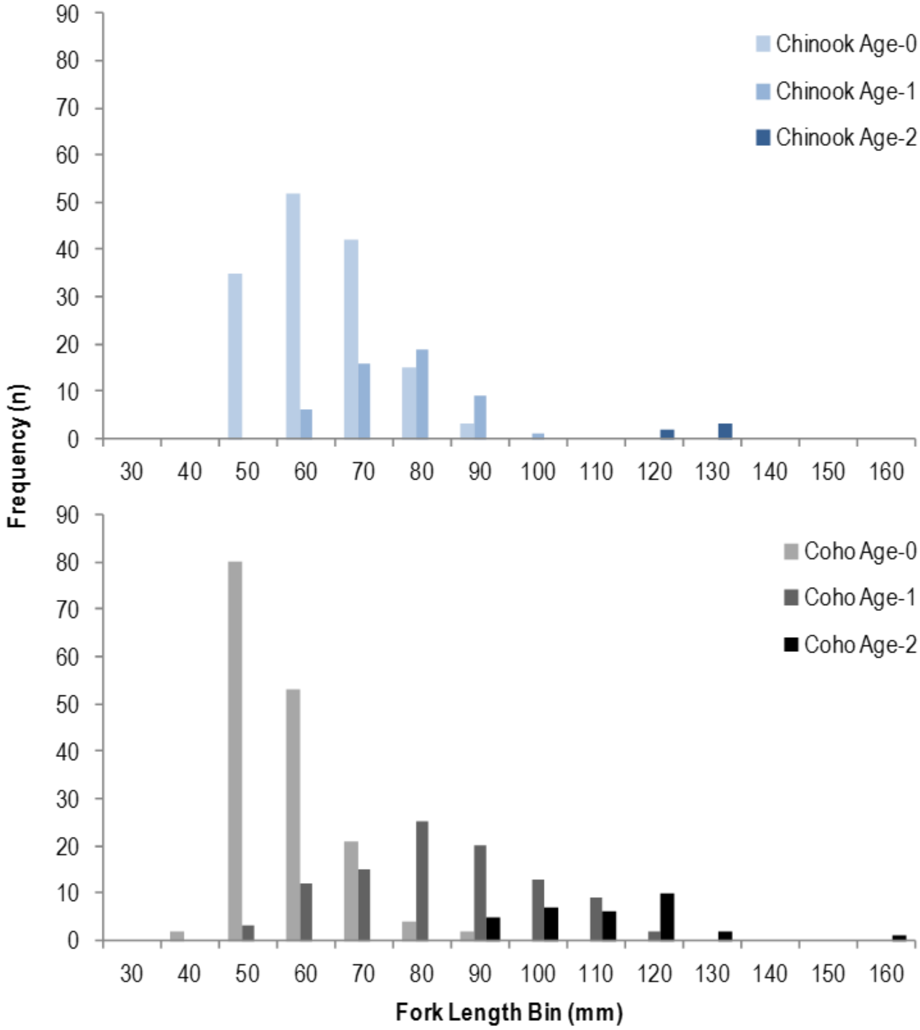

Figure B-5. Age at length of genetically-verified Chinook and Coho salmon based on scale analysis (Source: R2 and UAF 2015; Figures 5.4-5 and 5.4-6).