Susitna-Watana Hydroelectric Project
(FERC No. 14241)

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

Study Plan Section 9.6

Initial Study Report

Prepared for

Alaska Energy Authority

SUSITNA-WATANA HYDRO

Clean, reliable energy for the next 100 years.

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

APPENDICES

LIST OF ACRONYMS, ABBREVIATIONS, AND DEFINITIONS

Abbreviation	Definition
ADF&G	Alaska Department of Fish and Game
AEA	Alaska Energy Authority
AWC	Anadromous Waters Catalog
BIC	Bar Island Complex
CIRWG	Cook Inlet Regional Working Group
CPUE	catch per unit effort
ELH	early life history
FA	Focus Area
FDA	Fish Distribution and Abundance
FERC	Federal Energy Regulatory Commission
FL	fork length
HSC	habitat suitability criteria
ILP	Integrated Licensing Process
IP	Implementation Plan
ISR	Initial Study Report
LR	Lower River
MC	Main Channel
MR	Middle River
NTU	nephelometric turbidity unit
PIT	passive integrated transponder
PRM	Project River Mile
Project	Susitna-Watana Hydroelectric Project
RP	river productivity
RSP	Revised Study Plan
RST	rotary screw traps
Rt-VW	radio tagging
SANPCC	Southcentral Alaska Northern Pike Control Committee
SC	Side Channel
SCC	Side Channel Complex
SPD	study plan determination
TWG	Technical Workgroup
USR	Updated Study Report

EXECUTIVE SUMMARY

Study of Fish Distribution and Abundance in the Middle and Lower Susitna River (9.6)	
Purpose	The goal of this study is to characterize the current distribution, relative abundance, run timing, and life history of resident and non-salmon anadromous fish species as well as freshwater rearing life stages of anadromous salmonids in the Middle and Lower Susitna River. Seven specific objectives have been developed for this study and include multiple tasks. Data collected as part of this study will be used to provide a baseline characterization of fish assemblages in the Susitna River, to identify and evaluate potential Project-induced effects on fish assemblages, and inform development of any necessary protection, mitigation, and enhancement measures.
Status	Data collection is complete for the first year of this multiyear study. Initial database quality assurance and quality control was completed to compile preliminary summary statistics and preliminary data analysis for the Initial Study Report. Database quality assurance and quality control, data analysis, and coordination with interdependent studies are ongoing iterative processes. A second study year of data collection is planned.
Study Components	Major study components include the following seven objectives: • Describe the seasonal distribution, relative abundance, and fish habitat associations of juvenile anadromous salmonids, non-salmonid anadromous fishes and resident fishes. • 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. • Describe early life history, timing, and movements of anadromous salmonids. • Document winter movements and timing and location of spawning for burbot, humpback whitefish, and round whitefish. • Document the seasonal age class structure, growth, and condition of juvenile anadromous and resident fish by habitat type. • Document the seasonal distribution, relative abundance, and habitat associations of invasive species (northern pike). • 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).
2013 Variances	AEA implemented the methods as described in the Study Plan with the exception of the following variances. The significance of these variances is discussed within the ISR.

	• adjustments to Focus Area locations (Section 4.1.7.1); • adjustments to rotary screw trap, PIT array, radio telemetry fixed receiver, winter sampling, early life history sampling, and fish distribution and abundance sampling locations (Section 4.1.7); • adjustments to the number of fixed receiver and winter sampling locations(Section 4.1.7);adjustments to the timing of fish distribution and sampling efforts(Section 4.2.1);grouping select Middle and Lower River macrohabitat classifications (Sections 4.1.7.2 and 4.4.4.3); • adjustments to sample unit lengths (Section 4.4.4.1); • adjustments to gear type applications (e.g., numbers of passes, soak times; Section 4.4.4.2); • refinements to estimating the detection efficiency of PIT tag interrogation systems (Section 4.5.3.1); • adjustments to the timing of radio-tag implementation and aerial survey methods for tracking resident fish (Sections 4.5.3.2 and 4.5.3.3; and • utilizing size instead of age to evaluate habitat associations of juvenile anadromous and resident fish (Section 4.8.1).
Steps to Complete the Study	[As explained in the cover letter to this draft ISR, AEA's plan for completing this study will be included in the final ISR filed with FERC on June 3, 2014.]
Highlighted Results and Achievements	In 2013, sixteen species were captured in the Middle and Lower Susitna River. In the Middle River, over 43,500 fish were observed during three seasonal surveys at over 160 sites covering 4 tributaries above Devils Canyon and approximately 84.7 miles of the Susitna River. Juvenile coho salmon, threespine stickleback, adult pink salmon, and sculpin were the most abundant species. Both the total number of species and the relative abundance of all species except Arctic grayling and Dolly Varden were notably higher downstream of Devils Canyon. In the Lower River, over 11,900 fish were observed during three seasonal surveys at 44 sites representing 70.1 miles of the Lower Susitna River. Threespine stickleback were the most abundant species comprising over 35 percent of all fish observations. Northern pike were not observed in the Middle River. Northern pike were observed only in Geomorphic Reach LR-4 of the Lower River (PRM 32.3-PRM 44.6). Over 5,600 fish were tagged for biotelemetry studies of fish movement in both the Middle and Lower River. Sampling in 2013 met all first-year study goals and objectives.

1. INTRODUCTION

On December 14, 2012, Alaska Energy Authority (AEA) filed its Revised Study Plan (RSP) with the Federal Energy Regulatory Commission (FERC or Commission) for the Susitna-Watana Hydroelectric Project (FERC Project No. 14241), which included 58 individual study plans (AEA 2012). Included within the RSP was the Study of Study of Fish Distribution and Abundance in the Middle and Lower Susitna River, Section 9.6. RSP Section 9.6 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.

On February 1, 2013, FERC staff issued its study plan determination (February 1 SPD) for 44 of the 58 studies, approving 31 studies as filed and 13 with modifications. FERC requested additional information before issuing a SPD on the remaining studies. The Susitna River Fish Distribution and Abundance Implementation Plan (FDA IP) was filed with FERC on January 31, 2013 and was subsequently presented and discussed during a Technical Work Group (TWG) meeting on February 14, 2013. With consideration of the comments and suggestions received from licensing participants, the FDA IP was filed with FERC on March 1, 2013. On April 1, 2013 FERC issued its study determination (April 1 SPD) for the remaining 14 studies; approving 1 study as filed and 13 with modifications. RSP Section 9.6 was one of the 13 approved with modifications. In its April 1 SPD, FERC recommended the following:

Middle and Lower River Mainstem Sample Unit Length

> *- We recommend that sampling unit lengths for all main channel and side channel habitat units be equal to 20 times the wetted channel width of the habitat unit, the entire length of the habitat unit, or 500 meters, whichever is less.*
>
> *- We recommend that sampling unit lengths for all slough macrohabitats encompass the entire length of the slough, a distance equal to 20 times the wetted channel width of the slough, or 200 meters, whichever is less. We also recommend that slough sampling be initiated at the downstream end of the slough.*
>
> *- We recommend that, to the extent possible based on site-specific field conditions, AEA sample all main channel and side channel macrohabitat units with boat electrofishing methods.*
>
> *- We recommend that AEA's proposed tributary mouth sampling unit lengths include the backwater area within the tributary, if present, and extend a distance 200 meters downstream of the tributary mouth/confluence with the mainstem.*

Timing of Sampling

> *- We recommend that the proposed summer sampling events be conducted in mid-July, and again in either late August or early September. We recommend that the proposed autumn sampling occur in late September to early October.*

Catch Per Unit Effort from Electrofishing Macrohabitats

> *- We recommend that calculation of CPUE from electrofishing data be based only on the first pass, as requested by NMFS and FWS.*
>
> *- We recommend that minnow traps be soaked for 24 hours and placed within locations most likely to capture fish (e.g., low-velocity habitat in close proximity to cover).*

PIT Tag Antenna Array at Whiskers Creek

> *- We recommend that, if feasible given site-specific conditions, AEA locate the PIT tag array downstream of the confluence of the side slough and Whiskers Creek, or at the mouth of Whiskers Creek. Should these locations not be feasible for deployment, AEA should consult with the TWG and select an appropriate location for the PIT tag array at Whiskers Slough.*

Radio Tagging of Resident Fish

> *- To the extent possible given the constraints of field sampling conditions, we recommend that AEA target its fish sampling to meet the following specific objectives: (1) a minimum of 10 tags per species be allocated for tagging adult grayling and rainbow trout of sufficient size for spawning at tributary mouths during the spring sampling event; (2) a minimum of 10 tags be allocated for tagging adult Dolly Varden of sufficient size for spawning at tributary mouths during a late summer or early fall sampling event; (3) a minimum of 10 tags be allocated for tagging adult whitefish prior to spawning in early September; and (4) a minimum of 10 tags be allocated for tagging burbot in the early fall prior to fall or winter spawning migrations.*

In accordance with the April 1 SPD, AEA has adopted the FERC requested modifications in the FDA IP. Following the first study season, FERC's regulations for the Integrated Licensing Process (ILP) require AEA to "prepare and file with the Commission an initial study report describing its 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)). This Initial Study Report (ISR) on Fish Distribution and Abundance Middle and Lower Susitna River has been prepared in accordance with FERC's ILP regulations and details AEA's status in implementing the study, as set forth in the RSP, FDA IP, and as modified by FERC's April 1 SPD (collectively referred to herein as the "Study Plan")."

2. STUDY OBJECTIVES

The overarching goal of this study is to characterize the current distributions, relative abundances, run timings, and life histories of all resident and non-salmon anadromous species encountered including, but not limited to Dolly Varden, eulachon, humpback whitefish, round whitefish, arctic grayling, northern pike, burbot, and Arctic lamprey, as well as freshwater rearing life stages of anadromous salmonids (fry and juveniles) in the Middle and Lower Susitna River. Specific objectives include the following (Table 2-1):

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.
    a. Document the timing of downstream movement and catch using out-migrant traps.
    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 Middle and Lower study area (Figure 3-1) encompasses the Susitna River from PRM 32.3 immediately upstream of the confluence with the Yentna River upstream to the proposed Watana Dam site (PRM 187.1). The Middle and Lower fish distribution and abundance study area includes the entire Middle River Segment and the majority of the Lower River Segment.

The Middle River Segment includes the mainstem Susitna River from the proposed Watana Dam Site (PRM 187.1) downstream to the confluence of the Talkeetna and Chulitna Rivers (Three Rivers Confluence) at PRM 102.4. This segment is subdivided in eight distinct geomorphic reaches. The Middle River Segment contains ten Focus Area (FA) study sites which are intended to serve as specific geographic areas of the river that will be the subject of intensive investigation by multiple resource disciplines.

The Lower River Segment extends from the Three Rivers Confluence to Cook Inlet. The study area within the Lower River consists of approximately 70 miles of river between the Three Rivers Confluence and Yentna River and is further subdivided into four geomorphic reaches (Figure 3-1).

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. This study was initiated during the winter of 2012/13 and will continue in the next study year.

Fish Distribution and Abundance Implementation Plan

A final sampling scheme was developed as part of the detailed Fish Distribution and Abundance Implementation Plan (IP) which was approved by FERC, with modifications, on April 1, 2013. The final IP consists of (1) a summary of relevant fisheries studies in the Susitna River, (2) an overview of the life-history needs for fish species known to occur in the Susitna River, (3) a review of the preliminary results of habitat characterization and mapping efforts in 2012 (Study 9.9), (4) a description of site selection and sampling protocols, (5) development of field data collection forms, (6) development of database templates that complied with 2012 AEA QA/QC procedures, and (7) FERC's requested modifications included in the April 1 SPD. The Implementation Plan includes the level of detail sufficient to instruct field crews in data collection efforts. In addition, the plan includes protocols and a guide to the decision making process in the form of a chart or decision tree that was used in the field, specific sampling locations, details about the choice and use of sampling techniques and apparatuses, and a list of field equipment needed. The Implementation Plan addresses the random selection of sampling locations and helps to ensure that fish collection efforts occurred in a consistent and repeatable fashion across field crews and river segments. 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

Study sites in the Middle and Lower Susitna River covered multiple objectives using various techniques and technologies over a 155-mile study reach. The intensity of sampling effort also varied based on proximity to the proposed Project, habitat availability, and historic habitat utilization by anadromous and resident fishes. Field sampling sites included those for: the study of salmon early life history, the study of fish distribution and abundance, rotary screw traps, PIT tag interrogation sites, fixed radio telemetry stations, and winter study sites. AEA implemented the site-selection methods as described in the Study Plan with the exception of the variances explained in Section 4.1.7.

4.1.1. Early Life History Sites

Early life history (ELH) sampling took place every two weeks between ice break-up and July 1 in six Middle River Focus Areas downstream of Devils Canyon, a tributary and headwater lake upstream of Devils Canyon, and select Lower River tributaries and sloughs (Table 4.1-1). During ELH sampling events, study locations in selected Focus Areas included three 40-meter long sampling units immediately downstream of a documented Chinook, chum, or coho salmon spawning area (these were tributary mouths or side sloughs at some Focus Area locations) and three 40-meter long rearing habitat sampling units. Additional sampling occurred in Fog Creek, a lake in the Fog Creek basin, and in select spawning and rearing habitats (tributaries, tributary mouths, and sloughs) in the Lower River (Table 4.1-1). Sampling unit lengths in tributaries above Devils Canyon were 100 m (328 ft), in the Lower River sampling effort included three, 40 m (131 ft) segments within 200 m (656 ft) sampling reaches.

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 upstream of Devils Canyon (PRM 153.9 to169.6) and below 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/inundation from the proposed Project (Table 4.1-2). Prior to field sampling these tributaries were screened for accessibility based on stream gradient, channel morphology (i.e., confined canyon), tributary mesohabitat type (rapid and cascade) and physical access. The screening resulted in three tributaries that were inaccessible (Unnamed Tributary 184, Devil Creek, and Cheechako Creek) and four tributaries where access was unknown (Tsusena Creek, Fog Creek, Fog Creek Tributary, and Chinook Creek).

A direct sampling methodology was implemented on the four tributary streams with unknown access (Table 4.1-2). For these four streams, an average effort of two, 100 m (328 ft) sites were sampled over a one to two day period. The goal of sampling was to distribute effort over the accessible study area in several locations that represented geomorphic reaches or habitat features. Where aerial still or video imagery was available, proposed sample locations were identified and reviewed prior to field activity. Habitat observed from the remote imagery at identified locations was documented and field teams attempted to sample pre-identified tributary mesohabitat units (pool, riffle, glide, etc.). Where imagery was unavailable, sampling location and effort was determined during the first sampling effort for each tributary.

4.1.2.2. Mainstem Middle River

The Middle River habitat mapping effort completed in early 2013 provided delineation of habitat units in the main channel and off-channel areas of the Susitna River (ISR Study 9.9). A hierarchical and nested classification system developed specifically for the Susitna River with input from the Fish and Aquatics Technical Working Group (TWG) was used to classify habitat. A summary of the Middle River habitat mapping results can be found in Section 4.4 of the Implementation Plan or in the Middle Susitna River Segment Remote Line Habitat Mapping Technical Memorandum (AEA 2013). The following habitat strata were used for Middle River Fish Distribution and Abundance sampling: (1) main channel, (2) side channel, (3) backwater, (4) side slough, (5) side slough with beaver complex, (6) upland slough, (7) upland slough with beaver complex, (8) tributary and (9) tributary mouth. Furthermore, each time sampling occurred at a slough site the slough mouth was inspected for backwater influence from the main channel of the Susitna and selected for sampling if an appropriate backwater unit was present.

Clearwater plumes were present at several tributary mouths and upland slough confluences and provided habitat conditions distinct from the surrounding habitat unit. Fish sampling targeted clearwater plumes as distinct sampling units when encountered.

Main channel habitat varied by geomorphic reach within the Middle River and generally increased in complexity (islands and side channels became more frequent) from upstream to downstream locations. The habitats associated with the confluence of tributaries with the main channel river included tributary mouths and clearwater plumes; however not all tributaries that entered the Middle River had tributary mouth or clearwater plume habitats. Small tributaries where the vegetation line was close to the mainstem did not fan out and create the areas classified as tributary mouth habitat. In addition, small tributaries or tributaries that flowed into fast moving or turbulent sections of the mainstem did not produce clearwater plume habitats.

Off-channel habitat was assigned to three habitat types observed: upland sloughs, side sloughs, and backwaters. In addition to other unique characteristic features, sloughs were differentiated from backwater habitat by clear water. Beaver complexes were consistently associated with slough habitats and as such were not categorized as a habitat type but were noted as a characteristic of slough habitat units. Beaver dams were rarely present in side slough habitat, and slightly more prevalent in upland sloughs.

The length data associated with the habitat unit delineation line mapping facilitated the use of a Generalized Random Tessellation Stratified (GRTS) sampling approach in the Middle River. The GRTS design produced a spatially balanced random sample with design-based variance estimators. In addition, the GRTS sampling method provided an over-sample of sample sites to accommodate field implementation issues (e.g., a location was not accessible or was too deep to be sampled and was skipped). Each unit to be sampled was placed in random order so that the random order was preserved if a sample needed to be skipped.

In the Middle River, the GRTS design was used to select study sites based on a habitat stratified sampling scheme nested within Middle River geomorphic reaches MR-1, MR-2, MR-5, MR-6, MR-7, and MR-8. It is important to note that not all habitat types were found within each geomorphic reach. Sampling was not safe or feasible in the geomorphic reaches in Devils Canyon (MR-3 and MR-4).

Within each geomorphic reach sampled, two strata were formed: 1) the combined Focus Areas within the reach; and 2) the remainder of the reach not in Focus Areas. Within each of these strata, the total length of habitat in each habitat type (main channel, split main channel, multiple split main channel, side channel, upland slough with beaver complex, upland slough without beaver complex, side slough with beaver complex, and side slough without beaver complex) was represented by line segments from the remote habitat mapping in 2012. For selection of sampling units, these line segments for each habitat type were partitioned into 200 m (656 ft) and 500 m (1640 ft) units for main and side channels. In contrast, tributaries (mouth to upper extent), tributary mouths, clearwater plumes, and backwaters, were selected as GRTS samples as point locations. For both line segment and point sampling, three sampling units were selected for each habitat type within each stratum (Focus Areas and non-Focus Areas within each geomorphic reach). When three or fewer sampling units existed within the sample stratum, all available units were selected for sampling. All of the selected sample sites within Focus Areas were sampled for relative abundance. Outside of Focus Areas, all selected sites were sampled for fish distribution and one of the selected sites for each available habitat type was also sampled for relative abundance.

A GRTS model was used to randomly select fish sampling segments from those in the population. Table 4.1-3 presents the GRTS selected and field attained sample units by stratum. A total of 162 sites were sampled from the 177 targeted sites in the Middle River including 76 sites sampled for relative abundance within Focus Areas, and 86 sites outside of Focus Areas. The selected sample sites are displayed by geomorphic reach in Figures 4.1-2 through 4.1-7.

The IP identified sampling site targets based on sampling unit lengths of 40 m (131 ft) for off-channel habitats and 240 m (787 ft) for main channel habitats (IP Section 5.3). When AEA adopted the SPD recommendations for increased sampling unit lengths, these longer sampling units reduced the number of replicates for some rare sampling strata (e.g, side channels above Devils Canyon). Thus, when GRTS was rerun the overall number of sampling targets was reduced by four (Table 4.1-3). Sample unit lengths for off-channel, Middle River tributary, and special main channel sampling units (backwater, clearwater plume) were 20x the wetted channel width or 200 m (656 ft), whichever was less. Sampling unit length for main and side channel sampling units where boat electrofishing and drift gill nets were employed was 20x the wetted channel width, 500 m (1640 ft), or the complete unit, whichever was less. Boat electrofishing was employed in main channel habitats whenever feasible. When sample methods other than boat electrofishing were also feasible, the sample length for other gear types was 200 m (656 ft).

4.1.2.3. Mainstem Lower River

Fish distribution and relative abundance sampling in the mainstem Lower Susitna River was conducted from PRM 32.3 to 102.4. This survey area included Geomorphic Reaches LR-1 (PRM 102.4-87.9), LR-2 (PRM 87.9-65.6), LR-3 (PRM 65.6-44.6), and LR-4 (PRM 44.6-32.3). Due to channel morphology in the Lower River and corresponding limitations of the geomorphic based habitat mapping therein, a systematic random transect approach was adopted whereby fish sampling sites were selected within habitat units encountered along transects. Using a random start for the Lower River study area, ten equally spaced transects were located at 7.4-mile intervals (Table 4.1-4). Across each transect, one habitat unit of each type encountered was selected for sampling. Many transects spanned multiple habitat types (e.g., main channel, side channel, upland slough, and side slough) because of the complex nature of the Lower River (Figure 4.1-8). The IP (Table 5.4-1) estimated that the ten transects would contain a total of 44[1] habitats based on the available remote habitat information. Where multiple habitat units of the same type occurred, units were randomized and one was selected for sampling.

Fish distribution and abundance sampling was conducted starting at the downstream end for a distance equal to 20x the wetted channel width or 500 m (1640 ft), whichever was smaller for main channel, side channel, side channel complex, and bar island complex habitats. Boat electrofishing was employed in main channel habitats whenever feasible, though due to

[1] Total habitats in IP Table 5.4-1 sum to 44, despite reported total of 42.

restrictions around electroshocking adult salmonids, was not fully deployed (for the entire 500 m site length) at most sites until the autumn sampling event. When boat electrofishing or drift gillnetting was not feasible, a 200 m (656 ft) sampling unit was sampled with other techniques. If the randomly selected habitat unit was totally inaccessible to field crews or dewatered during the first sampling event, then a second randomly-selected habitat unit was sampled. Off-channel, Lower River tributary, and special mainstem mesohabitat sampling units (e.g. backwaters, clearwater plumes) were sampled at units equal to 20x the wetted channel width or 200 m, whichever was less.

For the Lower River, Table 4.1-4 shows the habitat units sampled along each random transect. One transect within each geomorphic reach was sampled for relative abundance, with the remaining transects sampled for distribution only. The transect with the most habitat units was selected for abundance sampling in each reach. A total of 44 habitats were sampled seasonally along the 10 transects.

4.1.3. Rotary Screw Trap Sites

Final site selection for the Middle River rotary screw traps (RSTs) was determined using the following criteria: 1) a suitable location downstream of documented adult or juvenile Chinook salmon distribution; 2) land ownership, eliminating river reaches where landowners would not allow access; 3) accessibility, rotary screw trap locations needed to be accessible by helicopter; 4) depth, a minimum depth of 1.25 m (4.1 ft) during low-flow periods; and 5) hydraulic conditions, consistent laminar flow with velocities in the range of 0.6-2 m/s (2-6.6 ft/s). Site reconnaissance included review of aerial videography from summer 2012, a pre-bank-ice-break-up site visit to a short list of locations on May 24, 2013 and final pre-installation site visits on June 7, 2013.

In the Middle River, trap locations included the Indian River (PRM 142.1) at its confluence with the Susitna River, the mainstem Susitna River at Curry Station (PRM 124), and the mainstem Susitna River at Talkeetna Station (PRM 106.9) (Figure 4.1-3). The Indian River was selected because it is a primary tributary to the Middle River and is heavily used by Chinook and coho salmon and a diversity of resident fish species (ADF&G 1984; HDR unpublished). In addition, the lower Indian River near its confluence with the Susitna River has historically been a focus of Middle River sampling efforts (ADF&G 1984). The two mainstem river sites were selected, because they offered good hydraulic conditions for rotary screw trap operation and are located downstream of important Middle River spawning tributaries including Portage Creek and the Indian River. The site at Talkeetna Station has the added benefit of being associated with historic data from outmigrant trapping efforts in the 1980s (Roth et al. 1986). In 1985, inclined plane traps at Talkeetna Station had significantly higher catch rates on the west bank of the Susitna River than on the east bank (Roth et al. 1986); thus, the rotary screw trap for the 2013 study was located in a similar position. Lastly, each of the three proposed Middle River trapping locations were located in close proximity to other field efforts; this co-location of sites helped to facilitate site accessibility, field logistics, safety, and effective trapping operations.

In the Lower River, an outmigrant trap was located in Montana Creek (PRM 80.8) near Tributary River Mile 2.2. Montana Creek was selected because it is one of the major salmon-producing tributaries in the Lower River study area and has a diverse resident fish assemblage.

4.1.4. PIT Interrogation Antenna Sites

Final locations for PIT tag antenna arrays were determined using the following criteria: 1) suitable location downstream of documented anadromous salmon spawning and rearing areas or historic resident fish habitat; 2) land ownership, eliminating river reaches where landowners would not allow access; 3) accessibility, PIT antenna materials had to be transported and serviced by helicopter; 4) depth, a maximum depth of around 0.5 m (1.64 ft) was desired for reasonable swim-over antenna performance; and 5) hydraulic conditions, lower velocity areas were selected where installation and maintenance could be done safely under a range of flow conditions. Three stationary PIT tag interrogation sites were installed in the Middle River Segment: Indian River approximately 0.1 mi upstream from its confluence with the Susitna River (PRM 142.1), Slough 8A (PRM 129), and Whiskers Slough downstream of the confluence of the side slough and Whiskers Creek (PRM 105) (Figure 4.1-3). These sites were selected based on historic fish use data and to co-locate PIT arrays with Focus Areas and radio-telemetry arrays. The Indian River is a primary tributary of the Middle River and is heavily used by both Chinook and coho salmon and a diversity of resident fish species targeted for PIT tagging (ADF&G 1984a; HDR unpublished). The Indian River is a large, dynamic tributary and main channel widths and hydraulic conditions in the main channel exceeded the capabilities of half-duplex PIT interrogation antenna length. This necessitated seasonal adjustments of antenna location between a split-main channel location (river left channel approximately 100 m [328 ft] upsteam of the mouth) and partial coverage of the main channel when the system could be safely installed, maintained, and operated at a pool tailout approximately 90 m upstream of mouth. The site location at Slough 8A was approximately 200 m (656 ft) upstream of the confluence with a side channel. These side channel and side slough habitats historically supported high levels of juvenile salmon and resident fish use. Whiskers Slough, between the confluence of Whiskers Creek and the slough mouth, was selected for its proximity to spawning and juvenile rearing habitat and it represents a location where resident fish were historically abundant. During the 1980s, the following target species were present in Whiskers Slough: juvenile Chinook salmon, juvenile coho salmon, juvenile sockeye salmon, Arctic grayling, Arctic lamprey, burbot, Dolly Varden, rainbow trout, humpback whitefish, and round whitefish (Schmidt et al. 1983).

In the Lower River, one stationary interrogation system was installed in Montana Creek (PRM 80.8) approximately 2.2 river miles upstream of the confluence with the Susitna. This location was selected because Montana Creek is one of the major salmon-producing tributaries in the Lower River study area and provides habitat for a diversity of resident species. The antenna was co-located with a rotary screw trap on a parcel of State of Alaska land with foot access from the Parks Highway after a thorough review of landownership, recreation pressure, vandalism risk, and hydraulic conditions.

4.1.5. Fixed Radio Telemetry Sites

Fixed radio telemetry stations were installed at nine locations in the Lower and Middle Susitna River (Table 4.1-5; Figure 4.1-10). The primary objective of four 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], Powerline [PRM 146; between Indian River and Portage Creek], and Devils Island [PRM 167; upstream of Devil Creek). Two stations offered coverage of the mainstem of the Susitna as well as a tributary (4^{th}

of July Creek [PRM 134] and Indian River [PRM 142]). The station at Whiskers Creek (PRM 105) offered coverage of Whiskers Creek and slough and limited coverage of the mainstem Susitna River. Montana Creek and Upper Indian River stations monitored movements in their respective tributary exclusively. The spatial and temporal distribution of radio tags within each river segment was determined by the sampling schedule of the Fish Distribution and Abundance Study program and the availability of fish of each target species.

4.1.6. Winter Study Sites

In 2013, winter pilot studies were conducted at FA-104 (Whiskers Slough, PRM 104.8-106) and FA-128 (Slough 8A, PRM 128.1-129.7) in the Middle River Focus Areas. These Focus Areas were selected based on their accessibility from Talkeetna, the diversity of habitat types present, and their documented use as spawning and rearing habitats for salmonids in the 1980s and 2012. Whiskers Slough (FA-104) contains a diverse range of habitat, which is characteristic of the braided, unconfined Geomorphic Reach MR-8 in the Middle River. FA-104 (Whiskers Slough) was selected for study because its habitats supported juvenile and adult fish use and a range of habitat modeling methods were used in side channel and side slough areas. FA-128 (Slough 8A) consisted of side channel, side slough and tributary confluence habitat features that are characteristic of the braided Geomorphic Reach MR-6 in the Middle River. Ice coverage was variable and both study areas contained open-water leads and groundwater-influenced upwelling areas. Site selection for the pilot study occurred in the field based on the availability of water under ice to sample or the presence of open-water leads. Pilot holes were drilled with an ice auger to determine whether sites were suitable for sampling. A variety of habitats were selected for testing winter techniques including: tributary, tributary mouth, upland slough, side slough, slough mouth, side channel, main channel and other off-channel habitats (Table 4.1-6).

4.1.7. Variances from Study Plan

4.1.7.1. Early Life History Sites

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 Implementation Plan development, sampling took place at six sites in each of six Focus Areas (Table 5.1-1). Furthermore, when AEA adopted the FERC recommendation of seasonal sampling in mid-July and late August/early September and late September/early October in the Middle and Lower River, additional ELH sampling locations were added in tributaries and lakes upstream of Devils Canyon and the tributaries and sloughs in the Lower River to gather information on juvenile salmon life history during the period from ice break-up to July 1. Expansion of Early Life History sampling is anticipated to enhance AEA's ability to meet the study objectives.

4.1.7.2. Fish Distribution and Abundance Sites

The lower reaches of tributaries of the Susitna River upstream of Devils Canyon are typified by high-gradient, confined canyons, with dense vegetation. These conditions, particularly in the smaller tributaries, limited helicopter access. Other factors that influenced sampling times or locations included dangerous sampling conditions (high water, high wind, and icy conditions) and dry target sites.

The IP was filed before the tenth Focus Area was designated within the Middle River. The Adjustments to Middle River Focus Areas Tech Memo filed in May 2013, placed the tenth Focus Area in Geomorphic Reach MR-7 (AEA 2013b). This change added six sites to sampling targets within Focus Areas for fish abundance sampling and moved one tributary mouth site previously outside of a Focus Area in MR-7 into FA-113 (Oxbow I).

Land ownership and accessibility influenced fish sampling in discrete areas of the Middle River. Access was not permitted for Middle River tributary and upland slough sites on Cook Inlet Regional Working Group (CIRWG) and Alaska Railroad Corporation lands. CIRWG lands included the entire non-navigable section of the Susitna River from the mouth of Portage Creek (PRM 152.3) to the mouth of Devil Creek (PRM 164.8) and areas above ordinary high water mark (OHWM) from the mouth of Devil Creek to the proposed dam site (PRM 187.1). The main channel habitat within FA-151 (Portage Creek) was restricted; therefore the upstream end of site FDA-151-48-MC1 was established approximately 200 m (656 ft) downstream of the original site boundary. Similarly, sampling the entire clearwater plume habitat within FA-151 (Portage Creek) was limited due to land access restrictions. Therefore the upstream end of site FDA-151-46-CWP was established approximately 100 m (328 ft) downstream of the original site boundary. Alaska Railroad Corporation lands influenced site selection for Middle River tributaries and upland slough sites along the river left (east) bank of the Susitna River between PRM 107.7 and 140.0. In most cases, GRTS oversamples were used to replace sites on Alaska Railroad Corporation lands. However one tributary and one upland slough site could not be accessed or replaced and were not sampled (Table 4.1-3).

Prior to sampling in July, the target sites (177 GRTS sites, 10 Lower River mainstem transects [IP Section 5.4]) and direct sample tributaries were visited and assessed for safety. Following the reconnaissance visit, target GRTS sites deemed not conducive to sampling were replaced consistent with GRTS protocol.

The SPD recommended that AEA sample mainstem habitats using separate strata for main channel, split main channel and multi-split main channels. However, based on stakeholder 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 (Table 4.1-3). This may have decreased the ability to evaluate the distribution, abundance and habitat associations for rare species in mainstem habitats. However, "NMFS and FWS state that AEA's level 3 mainstem habitat classification results in too many habitat classes, limiting adequate replication. NMFS and FWS state 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.

Sampling took place at 162 Middle River GRTS sites and 44 sites along 10 Lower River mainstem transects for a total of 206 target sites (Tables 4.1-3 and 4.1-4). Additionally, 15 locations were sampled in 4 direct sample tributaries above Devils Canyon (Table 4.1-2). The 15 GRTS sites that were not sampled or replaced with oversamples were located on Cook Inlet Regional Working Group (CIRWG) or Alaska Railroad Corporation lands where access was not permitted. Due to land ownership, Unnamed Tributary 184, Devil Creek, and Cheechako Creek were not sampled and site locations within the sampled tributaries were limited to non CIRWG lands. CIRWG lands between Portage Creek (PRM 152.3) and the proposed Watana Dam site (PRM 187.1) include a corridor through Devils Canyon and along the Susitna River extending several miles from both the right and left bank. Tributary sampling in this reach including: Tsusena Creek, Fog Creek, a Fog Creek Tributary, and Chinook Creek, was limited to the tributary reaches upstream of this boundary. This variance is not anticipated to impact AEA's ability to determine fish distribution, abundance, and habitat associations in the Middle River below Devils Canyon and in the Lower River. However, in the Middle River above Portage Creek, where access was most restricted in 2013; the impact of this variance is subject to future land access and sampling results.

4.1.7.3. Rotary Screw Trap and PIT Interrogation Sites

The IP proposed that the Indian River downstream migrant trap would be located near TRM 1 (Section 5.7.1). After reconnaissance of the area, a location with better conditions for trap installation and operation at the mouth of Indian River was selected. The IP proposed that the Montana Creek trap would be located near the confluence of the Susitna (Section 5.7.1). Due to land ownership, high recreation use, an elevated potential for vandalism, and the shallow, braided character of the channel near its confluence with the Susitna, a location was selected on State of Alaska lands approximately 2.2 tributary miles upstream from the confluence. The final locations improved AEA's ability to meet study objectives by improving trap performance and reducing conflicts with other river users that could interfere with trap operation. Corresponding stationary PIT tag interrogation sites (IP Section 5.6.5) were moved in coordination with the rotary screw traps.

4.1.7.4. Radio Telemetry Fixed Receiver Sites

In Section 5.8.2.1 of the Implementation Plan, AEA proposed that nine fixed-station receivers be operated in the Middle River in coordination with the Salmon Escapement Study (Study 9.7) including: Lane Creek Station (PRM 116.7), Gateway (PRM 130.1), Fourth of July Creek (PRM 134.3), Indian River (PRM 142.1), Slough 21 (PRM 144), Portage Creek (PRM 152.3), Cheechako Station (PRM 155.9), the Chinook Creek confluence (PRM 160.5), and Devils Station (PRM 167 located upstream of the Devil Creek confluence). Six additional stations were proposed for resident fish at the Montana Creek confluence (PRM 77), Whiskers Creek confluence (PRM 105.1), Indian River confluence (PRM 142.1), Portage Creek confluence (PRM 152.3), Fog Creek confluence (PRM 179.3), and Watana dam site (PRM 187.1).

However, the lack of access to CIRWG land necessitated a number of changes to the quantity and location of telemetry fixed stations in the Middle River during 2013. Fixed stations planned for the Portage Creek, Cheechako station, Chinook Creek, and Fog Creek were not installed due to a lack of land access. The Slough 21 station was moved to a new location slightly upstream (Powerline, PRM 146) to get as close to the CIRWG boundary as feasible (Figure 4.1-3). Specific telemetry sites were not identified in the RSP, but were discussed in Section 5.8.2.1 of the Implementation Plan. The variance in fixed telemetry sites did not have a negative effect on meeting the study objectives because regular, almost daily, aerial surveys were flown to mitigate for the absence of these sites. Higher geographic resolution and greater numbers of fish detections were obtained with the frequent aerial surveys.

4.1.7.5. Winter Study Sites

Figure 5.11-1 in the Implementation Plan depicted locations for winter sampling in FA-104 (Whiskers Slough). A few of the final sites selected in the field based on ice conditions were altered from the proposed locations, including the addition of sites outside the Focus Area, and a second Focus Area was sampled. Additional sites in and around FA-128 (Slough 8A) were also made based on habitat type and ice conditions. These changes in sampling sites improved the ability to evaluate the effectiveness of winter sampling techniques by increasing the number of sampling sites and targeting suitable habitats for fishes.

4.2. **Sampling Frequency**

AEA implemented the sampling frequency methods as described in the Study Plan with the exception of the variances explained in Section 4.2.1. Sampling frequency varied among sites based on study objectives. Winter fish sampling occurred monthly from February through April 2013 and was coordinated with the intergravel temperature monitoring, the underwater fish observation using sonar (Appendix A, Section 3), the detectability of PIT and radio tags through ice (Appendix A, Sections 4 and 5), and substrate characterization components. Following the 2013 winter fish distribution and abundance pilot study, sampling occurred seasonally during the ice-free period. Break-up in 2013 was unusually late across Southcentral and Interior Alaska. Sustained record-cold weather in April and May prevented substantial snowmelt or ice decay until late May. Ice break-up activity was concentrated between May 25 and May 29 and the Susitna River at Gold Creek was above flood stage from May 28 to June 4. Biweekly ELH sampling was initiated prior to break-up (April 28 to May 3) and continued after ice-out and into late June in an attempt to capture critical juvenile Chinook salmon out-migration from natal tributaries to rearing habitats (Table 4.1-1). Fish distribution and abundance sampling was completed during three sessions: July 7 to August 10, August 11 to September 4 and September 10 to October 4 in 2013. PIT tag interrogation antennas at Montana Creek, Whiskers Slough, Slough 8A, and Indian River were installed between June 15 and June 21 and were operated nearly continuously until early October (Figure 4.2-1). Rotary screw traps at Montana Creek, Talkeetna Station, Curry Station, and Indian River were installed between June 8 and June 22 and operated on a 48-hours-on/72-hours-off schedule until late September and October (Figure 4.2-2). Stationary radio receivers were installed at the Montana Creek, Whiskers Creek, Lane Creek, Gateway, 4th of July Creek, Indian River, Upper Indian, Powerline, and Devils Island sites between June 4 and June 27 (Table 4.1-5). Fixed radio telemetry monitoring efficiency was tested on a weekly basis (Table 4.2-1). Aerial surveys were conducted approximately weekly June 22 through October 7 (Table 4.2-2) and continued monthly thereafter. The monthly schedule is planned to continue through April 2014. .

4.2.1. Variances from Study Plan

Early life history (ELH) sampling was proposed to occur every two weeks from break-up to July 1 (RSP Section 9.6.4.2). However, alevin and fry emergence was documented during April prior to ice-out so an abbreviated sampling event (10 sites) was conducted in late April and early May to gather additional information during this period. Thus, ELH sampling began in April and continued into June. Sampling was conducted biweekly with the exception of one bi-weekly event that was missed due to break-up and associated flood conditions.

IP Section 5.7.3 stated that rotary screw traps would be operated throughout the ice free period. However, the Indian River trap sustained damage due to high flow conditions in early September. The Curry rotary screw trap was used to replace the Indian River trap on September 10 due to the much higher catch rates at Indian River. This decision minimized the impact of late-season trap damage on the study objectives by maintaining rotary screw trap operation in the locations with the highest catch rates.

4.3. Fish Sampling Approach

The initial task of this study consisted of a focused literature review in the IP to guide selection of appropriate methods by species and habitat type, sampling event timing, and sampling event frequency. Products from the literature review included the following:

- A synthesis of existing information on life history, spatial and temporal distribution, and relative abundance by species and life stage.
- A review of sampling strategies, methods, and procedures used in the 1980s fish studies.
- Periodicity charts for each species within the study area (timing of adult migration, holding, and spawning; timing of incubation, rearing, and out-migration).
- A summary of mainstem Susitna River habitat utilization for each species, by riverine habitat type (main channel, side channel, side slough, upland slough, tributary mouth, tributary).
- A summary of existing age, size, and genetics information.
- A summary of distribution of invasive species, such as northern pike.

Knowledge of behavior and life history of the target species is essential for effective survey design. Fish sampling methods varied based on habitat characteristics, season, and species/ life history of interest (Table 2-1). Timing of surveys depended on the study objectives and the behavior of the target fish species. Since life stage-specific information was desirable, timing of the surveys was matched to the use of the surveyed habitat.

A summary of relevant existing fish and aquatic habitat information collected in the Susitna River study area was provided in the final Fish Distribution and Abundance Implementation Plan filed with the FERC on March 1, 2013. The literature review focused on five study topics: (1) resident and juvenile fish distribution and abundance in the Upper Susitna River (1980s and 2012); (2) adult salmon escapement and distribution (1980s and 2012); (3) salmon and trout incubation and emergence (1980s); (4) aquatic habitat delineation (2012); and (5) open-water flow routing modeling (2012). Although an abundance of data has been collected, the information summarized was selected primarily to guide site selection and the development of sampling techniques that would be used to implement the Study of Fish Distribution and Abundance in the Upper and Middle and Lower Susitna River (Studies 9.5 and 9.6).

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

AEA implemented the methods for Objective 1 as described in the Study Plan with the exception of the variances explained in Section 4.4.4. Two general approaches to fish sampling were used. The first focused on gathering data on general fish distribution (presence). This sampling involved a single pass with appropriate gear types without using block nets. To the extent possible, the selected site locations and transects were standardized and the fish capture and observation methods were repeated during each sampling event at a specific site to evaluate temporal changes in fish distribution. The second sampling approach was to gather data on relative abundance as determined by CPUE and density; complementary data on fish size, life stage, and condition factor was also collected. Relative abundance sampling used block nets whenever feasible to isolate each mesohabitat type (e.g., pool, riffle, glide) for sampling. Like distribution sampling, the selected sites and transects, and fish capture and observation methods (i.e., number of passes, amount of soak time, use of block nets) was standardized such that they were repeatable on subsequent sampling occasions. 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 (appropriate gear selection, IP Appendix 3) and for study of fish-habitat associations.

4.4.1. Task A: Fish Distribution Surveys

4.4.1.1. Field Methods

Fish distribution surveys included 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, set nets, 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, trotlines, hoop traps, and angling were used along with the opportunistic use of fishwheels in conjunction with the Salmon Escapement Study (ISR Study 9.7). 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. The decisions about what methods to apply were made by field crews after initial site selection in coordination with Fish Distribution and Abundance Study Lead and the Fish Program Lead and in accordance with state and federal fish sampling permit requirements. Lastly, methods varied seasonally with the extent of ice cover. Methods for winter sampling were based on winter 2012–2013 pilot studies and included DIDSON, underwater video, minnow traps, electrofishing, fyke nets, and trot lines.

4.4.1.2. Analytical Methods

For the purposes of describing juvenile salmon and resident fish distribution in the Middle and Lower River, locations where species were documented during the various study components of this study were pooled with other available information from 2012 and 2013 AEA fish tasks within the study area. The list of data sources included: 2013 winter studies, 2013 early life history sampling, 2013 rotary screw trapping, 2013 fish distribution and abundance sampling, 2013 PIT array detections, 2013 resident fish radio telemetry detections, 2013 directed fish sampling efforts for interrelated studies, 2012 fish distribution sampling (AEA 2013a), 2013 resident fish catch at fish wheels (Study 9.7), and 2013 habitat suitability sampling (Study 8.5). To describe seasonal distribution, fish collections were then assigned the following seasons: winter (February 1 to April 14), salmon early life history (April 15 to June 30), early summer (July 1 to August 10), late summer (August 11 to September 9), and fall (September 10 to October 12).

4.4.2. Task B: Relative Abundance

4.4.2.1. Field Methods

Relative abundance surveys included seasonal events during the ice-free seasons using block nets when feasible. When velocity, depth and width allowed, block nets were used to partition off-channel habitats and tributaries into mesohabitat units (e.g. pool, riffle, glide, etc.) for relative abundance sampling and gear appropriate for each mesohabitat type was selected based on IP Appendix 3. Fish were processed in groups associated with the mesohabitat where they were captured or observed. As mentioned above, methods were selected based on target species, life stage, and water conditions. All methods were conducted with a level of effort consistent with generating estimates of CPUE that facilitated comparison of counts or densities of fish over space and time. This included calibration and quality control of methods and documentation of conditions that affected sampling efficiency (such as visibility and turbidity, water temperature, and conductivity) to ensure that consistent effort was applied within and among sampling units and sampling events. 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.

4.4.2.2. Analytical Methods

The sampling design, as proposed in the Study Plan, included specific fish distribution (one-pass sampling) and abundance sampling sites, where multiple pass sampling efforts were to be conducted. Sites identified as distribution sampling and relative abundance sampling have been combined for estimates of CPUE because multiple pass sampling was not employed, thus yielding a larger overall sample size.

The approach used to estimate CPUE was generally similar among the four types of relative abundance protocols in the Middle and Lower River: Middle River Focus Area sampling, Middle River non-Focus Area sampling, Middle River direct-sampling tributaries, and Lower River mainstem transects. Mainstem CPUE estimates were derived for each mesohabitat type within a macrohabitat unit and then averaged among macrohabitat units within each mainstem geomorphic reach and in the Middle River, separate averages were derived for habitats within and outside of Focus Areas. For direct-sampling tributaries, CPUE was calculated specific to mesohabitat type and then averaged among direct sample sites for each tributary. Although the sampling design for the Middle and Lower River mainstem did not distinguish between various main channel types (i.e., main channel, split main channel, and multiple split main channel), average CPUE estimates for the main channel macrohabitat types have been generated at this finer level of classification. When sampling within a mainstem macrohabitat site or a direct sampling site included multiple mesohabitat units of the same type (e.g., two distinct pools), catch and effort were summed at the mesohabitat level prior to averaging. In all cases, estimates were derived specific to the each of the three Fish Distribution and Abundance sampling events (i.e., early summer, late summer, and fall).

Although CPUE estimates were derived in a similar manner across the four types of relative abundance sampling in the Middle and Lower River study area, it is important to note that these study components had different study designs and utilized different site selection processes. Therefore, caution should be used when making quantitative comparisons among areas where different protocols were used. Tributaries sampled in the Middle River study area were non-randomly selected and thus should not be used to draw inferences about other Middle River tributaries. Furthermore, direct sampling sites were not randomly selected with a tributary, and therefore, the relevance of the averaged CPUE estimates to the unsampled portions of a direct sample tributary is unknown.

Gear-specific CPUE estimates were derived for each species, as well as Pacific salmon life stages. For the purposes of this ISR, the seven most commonly employed gear types were used to determine CPUE including: backpack electrofishing, boat electrofishing, seining, snorkeling, fyke netting, hoop trapping, and minnow trapping. Additional gear types including angling, dip netting, gillnetting, and trot lining will be analyzed for the Updated Study Report. For backpack and boat electrofishing, CPUE was estimated as the number of fish captured per hour of electrofishing pulse time. Snorkeling and seining CPUE estimates were standardized as the number of fish captured or observed per 1,000 m^2 sampled. For passive sampling techniques (i.e., fyke nets, hoop traps, and minnow traps), CPUE was calculated as the number of fish captured per trap or net. Additional details regarding CPUE calculations and associated gear-specific sample sizes can be found in Appendix E.

4.4.3. 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. For the purposes of demonstrating progress in the ISR, fish observations were used for preliminary reporting of geomorphic reach-specific mesohabitat habitat associations by season. Fish observations included catch and observational data from spring early life history sampling and seasonal systematic fish distribution and abundance sampling including Middle River GRTS and Lower River transect sites.

4.4.4. Variances from Study Plan

4.4.4.1. Sampling Unit Length

Fish distribution and abundance sampling unit lengths for main channel, side channel, side channel complex, and bar island complex habitat types along transects and GRTS locations was 500 m (0.3 mi) when boat electrofishing or drift-netting was feasible as recommended in the April 1, 2013 Study Plan Determination. However, the level of effort required to effectively cover and gather a representative sample of units 500 m (0.3 mi) in length using techniques other than boat electrofishing or drift-netting was deemed to not be practical in the field. Therefore, when these techniques were not feasible, sampling units were shortened to 200 m (656 ft) for main channel units.

The Fish Distribution and Abundance sampling effort included 61 main channel units and 101 off-channel units that were sampled during each of three sampling events using multiple gear types. Each event required approximately 100 crew-days to complete even with the shortened sampling unit lengths for selected gear-types in the main channel habitats. Sampling 500 m (0.3 mi) with every gear type in main channel habitats would have added an additional 50 crew-days to each sampling period, compromising AEA’s ability to adhere to the seasonal sampling regime.

4.4.4.2. Sampling Approach

In the Revised Study Plan (Section 9.6.4.3.1), AEA proposed that relative abundance sampling would include multiple-pass sampling when electrofishing, snorkeling, and minnow trapping were employed. However due to ADF&G permit stipulations limiting electrofishing efforts to one pass, the April 1 FERC SPD recommendation that minnow traps be set for 24-hrs, and the extensive level of effort involved in three pass snorkeling 200 m (656 ft) long sampling units, single-pass sampling was conducted. Study teams experimented with comparing three-pass depletion minnow trapping to 24-hour sets for relative abundance sampling during the July sampling event and found that the level of effort required to return to sites to check and re-bait traps impeded the progress of sampling. Ultimately the FERC recommendation of 24-hour or overnight soaks was adopted. The FERC Study Plan Determination recommended placing minnow traps at a density of 20 traps per 200 m (656 ft) of habitat sampled and placing traps strategically in places most likely to catch fish. To increase catch and account for more complex habitats, field crews were given the option to place 1 or 2 minnow traps per 10 m (33 ft) of sampling unit. To streamline sampling, after initial sampling with varying soak times for different gear types, fyke net and hoop trap soak times were adjusted to a sampling regime that matched that of minnow trapping: a 24-hour overnight soak. Relative abundance sampling did involve the isolation of the sampling unit with block nets whenever feasible and a generally greater level of effort (e.g. more frequent seine pulls) than distribution sampling. The time fished for all drift gillnet sets was significantly less than 30 minutes, with the longest drift recorded being 15 minutes. This is a variance from the Implementation Plan (Section 8.1) which suggested a standard time of 30 minutes or until the net was saturated with fish. The short drift time recorded in the field was due to the speed of the current carrying the drifting net through the prescribed area. The set duration for hoop traps was consistently greater than the recommended 12 hours or less. The majority of hoop traps set were soaked between 15 and 22 hours. The logistics of setting overnight traps and retrieval within 12 hours was difficult, based on the travel distance between sites and boat launches.

In Appendix 3 of the Implementation Plan, Protocol for Site-Specific Gear Type Selection, AEA recommended that three or more sampling techniques be used at each site, but a minimum of two sampling techniques were to be attempted per habitat (or mesohabitat) type. However, during implementation there were times when only one sampling technique was used in a habitat (or mesohabitat) unit. This occurred in habitats that were not conducive to multiple sampling techniques (e.g., shallow habitats with high water temperatures and low specific conductivity and high aquatic vegetation cover were only minnow trapped or very shallow, high velocity riffles were only backpack electrofished). The decision to use applicable methods was made in the field based on site conditions while using the Gear Selection Appendix as a guide. This meant that sampling techniques were not forced into habitat where they would not be effective (e.g., placing baited minnow traps where the velocity was too high).

The Implementation Plan (Section 5.1) describes the use of a clove oil bath as anesthesia during handling and transferring fish when necessary. Clove oil anesthesia was used for sensitive or difficult to handle fish such as juvenile salmon or lamprey. Anesthesia was not used for all fish before handling. A clear, water-filled viewing chamber with an attached ruler was used to measure small fish and fish were weighed within a small tub of water. The larger fish were handled as little as possible, transferring them onto the measuring board where they were scanned for PIT tags and tissue was removed for genetic analysis before they were weighed. Field observations of mortality from anesthesia and attempted recovery were documented.

4.4.4.3. Lower River Habitat Classification

After the initial field visit and review of the habitat units across each transect, the following changes were made to the Lower River habitat classification. The habitat types of Main Channel (MC) and Bar Island Complex (BIC), and the habitat types of Side Channel (SC) and Side Channel Complex (SCC), were each combined to form two larger habitat type groups (MC/BIC and SC/SCC), due to their degree of similarity in the field. On a given transect, multiple MC, SC, SCC and BIC habitats were encountered but only one was sampled (e.g. one MC or one BIC habitat was sampled and one SC or one SCC was sampled per transect) so as to not over represent main channel habitat types. The distribution of habitat types sampled among the 44 sites varied from that originally proposed (Table 4.1-4). Pre-field site selection review indicated that the original site selection would sample 81.8 percent main and side channel habitat and 18.2 percent off-channel habitat. Since the 1980s data indicated that fish would likely be using much of the off-channel habitat, the width of transects was increased to 2 km to allow for inclusion of the rarer “clearwater” off-channel habitat types (sloughs and tributaries). This increased the selection of off-channel habitats from 18.2 percent to 54.5 percent. There were no tributary deltas (as defined in the IP Section 4.4.4 based on geomorphic mapping) present within any of the transects, but tributary mouths were included as off-channel habitat types. Upland slough mouths were added as a habitat type. Abundance transects were originally outlined in the IP (Section 5.4) as Transects PRM 100.3, PRM 70.8, PRM 56.1 and PRM 34.0, but with the inclusion of slough mouths, the transect with the most habitat unit in reach LR-2 was PRM 63.5. This transect replaced Transect PRM 56.1 for relative abundance sampling in LR-2.

4.5. 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 4.5.3.

4.5.1. Task A: Document the timing of downstream movement and catch for all fish species using out-migrant traps.

As described in Section 4.1.3 and Section 4.2, four rotary screw traps were deployed in the Middle and Lower River shortly after ice break-up (Figure 4.1-10). In addition to collection of data on migratory timing, size-at-migration, and growth, rotary screw traps served as a source for PIT tagging juvenile fish (Objective 2, Task B), collecting fish for radio-tagging (Objective 2, Task B), collecting fish for stomach content analysis in support of the River Productivity Study (Study 9.8), and collecting tissue samples to support other studies (Objectives 4, 5 & 7) including the Genetic Baseline Study for Selected Fish Species (Study 9.14).

4.5.2. Task B: Describe seasonal movements using biotelemetry.

4.5.2.1. 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, targeted sampling for juvenile Chinook salmon, and by rotary screw traps.

PIT tagging in the Middle and Lower River was focused in proximity to array antennas and included the Focus Areas, the Susitna between PRM 102.4 and 152.3, and rotary screw traps. Recaptured fish provided information on the time and distance travelled since the fish was last handled and growth. PIT tag antenna arrays with automated data logging were installed and operated at Montana Creek, Whiskers Slough, Slough 8A, and Indian River (Figure 4.1-10). During the 2013 open-water period (June to October), a total of 5,657 PIT tags were implanted in 11 different fish species in the Middle and Lower River (Table 4.5-1). Coho salmon were the most frequently tagged species (n=2,092), followed by juvenile Chinook salmon (n=1,696), Arctic grayling (n=378), rainbow trout (n=309), round whitefish (n=300), and burbot (n=223).

For selected species, radio transmitters were surgically implanted in adult fish of sufficient body size. Collections of fish for tagging were distributed temporally and spatially in the Lower and Middle River to describe seasonal movements. Radio-tagged fish were tracked from July through October 7, 2013 using weekly aerial surveys in conjunction with the Salmon Escapement Study (Study 9.7) to describe seasonal movements (Table 4.2-2). Aerial srveys continued on a monthly schedule thereafter. Aerial surveys were partitioned into mainstem Susitna and tributary zones (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. Target numbers for radio tagging were met for Arctic grayling (35) and rainbow trout (44) and nearly met for longnose sucker (28) and round whitefish (21) (Table 4.5-2). Targets were not reached by

September for less abundant species, but tagging efforts will continue in the next year of study. Lake trout have not been captured during any sampling in the Middle or Lower River. A detailed description of tagging location by species is found in Appendix B. All tags released from June through August 31 had sufficient battery life to broadcast a signal through August 31. According to the manufacturer, the earliest date the battery life of a tag may stop it from broadcasting a signal is September 25. Using minimum tag life estimates, up to 23 tags released in the Middle and Lower River could stop transmitting by the end of 2013.

4.5.2.2. Analytical Methods

Analysis of radio tag detections was conducted in accordance with the Study Plan (IP Section 5.8.2)

4.5.3. Variances from Study Plan

4.5.3.1. PIT Tag Interrogation System

The IP proposed that the detection efficiency of PIT tag interrogation systems be determined using indirect methods as described by Connolly et al. (2008). This approach relies on the detection of fish at multiple locations (i.e., antennas located upstream and downstream) to identify missed detections of fish passing a given antenna. However, the limited availability of appropriate sites for antenna placement in 2013 precluded this approach because antenna sites could not be arranged in a longitudinal series; instead antennas were installed at a single site within a given tributary or slough. Handheld detections of fish upstream or downstream of a given PIT tag antenna during initial tagging and following recapture by rotary screw trap, electrofishing, or other methods may provide some relative indication of the detection efficiency of that antenna. Whether the number of such recaptures is adequate to provide an estimate of detection efficiency will be determined during ongoing analysis and will be presented in the Updated Study Report (USR).

As an alternative approach for estimating detection efficiency, AEA measured the read range of an antenna for a given tag size. This information, combined with the antenna dimensions, water depth over the antenna (for a swim-over configuration), and wetted channel width was used to estimate the percentage of the channel's cross-sectional area in which a tag would be detected. This information was routinely recorded during site visits to download data. This approach did not account for behavioral factors that could influence detection, such as fish position relative to the channel bottom or margins, or swimming speed relative to the antenna. Nonetheless, this approach offered a means of quantifying the probability of a fish being detected as it moved past an antenna.

In addition, detection efficiency was evaluated by drifting neutrally buoyant test tags past an antenna and calculating the percentage of tags that were detected. Again, this approach did not account for behavioral factors that would influence detection, but it did offer an additional means of estimating the probability of detection. This effort occurred during site visits to demobilize and winterize antennas in October 2013.

4.5.3.2. Radio Tagging Targets

The following FERC recommendation (SPD B-135) was not adopted by AEA:

> "To the extent possible given the constraints of field sampling conditions, we recommend that AEA target its fish sampling to meet the following specific objectives: (1) a minimum of 10 tags per species be allocated for tagging adult grayling and rainbow trout of sufficient size for spawning at tributary mouths during the spring sampling event; (2) a minimum of 10 tags should be allocated for tagging adult Dolly Varden of sufficient size for spawning at tributary mouths during a late summer or early fall sampling event; (3) a minimum of 10 tags should be allocated for tagging adult whitefish prior to spawning in early September; and (4) a minimum of 10 tags should be allocated for tagging burbot in the early fall prior to fall or winter spawning migrations."

The FERC-recommended approach targets fish when they will potentially be at a phase of their life history (pre-spawning development) when they are more energetically taxed (as a result of limited food availability during the winter months) and potentially more sensitive to the stresses associated with handling. In particular, rainbow trout and Arctic grayling spawn in the early spring and allocate the majority of their pre-winter energetic gain toward development of gametes. They have limited energy reserves remaining for metabolic processes in the spring. Further, sexually maturing fish have less space in their abdominal cavity due to enlarged sex organs; there is less room for insertion of a tag and there is a higher chance of internal injuries during the surgical procedure. Surgically tagging these species in close temporal proximity to their spawning migration (e.g., "immediately prior") may have too high a metabolic cost and a higher risk for injury that could increase post-tagging mortality relative to fish tagged outside this life history phase. The average tag life, in days, for rainbow trout and Arctic grayling tags is 450, 652, and 901 for the smallest to the largest tags, respectively. AEA recommended that the primary period for tagging these fish be the summer or fall; the time when they are at an energetic maximum and likely to be most resilient to the stresses associated with handling. The available tag life should allow data to be collected the following year on spawning migrations and spawning habitat destinations. Tagging the identified species during the specified periods was done based on the surgeon's discretion (4.5-3).

4.5.3.3. Aerial Surveys

Section 5.8.2.2 of the Implementation Plan stated: "The proposed frequency of aerial surveys would provide a means of focusing a higher-resolution and time-intensive tracking effort on identifying exact locations of spawning and holding fish. To do this, the most recent observed river locations (to the nearest 1 kilometer [0.62 mile]) of all fish "at large" would be made available to the aerial survey team. During the survey, the location of all detected fish would be compared to the last seen location from previous surveys to ascertain whether its position had changed by more than 2 kilometers (1.25 miles). When tagged fish were within 2 kilometers of their last seen location, the helicopter would circle at a lower altitude to pinpoint the fish location to mainstem, side channel, or slough habitats."

Survey methods for radio-tagged resident fish were modified from the Implementation Plan to accommodate the high number of frequencies that needed to be scanned for salmon and resident fish. Resident tag frequencies were programmed into a receiver and scanned automatically. No manual tracking, directed searching, or identification of habitat type was conducted during the period when adult salmon were being tracked. Resident tag frequencies were tracked manually during the period when adult salmon tags were not present. Specific aerial survey methods were not identified in the RSP, but were described in Section 5.8.2.2 of the Implementation Plan. The variance in aerial telemetry survey method may not have had a negative effect on meeting the stated objectives of the study because geographic positions of the tags could be related to digital habitat classifications made by other studies in AEA's program. However, the lack of directed effort at pinpointing tag locations (accuracy less 100 yd for some resident fish tags) may make habitat use inferences less accurate if habitat delineations were much smaller than the resolution of the tag positions.

4.6. **Objective 3: Early Life History**

AEA implemented the methods for Objective 3 as described in the Study Plan with the exception of the variances explained in Section 4.6.5.

4.6.1. 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. 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 Section 4.5.1.2.1 of that ISR.

4.6.2. 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 ice-out through July 1 (Figure 4.1-1). Six Focus Areas met the criteria of having both spawning and rearing habitat and were selected for sampling (Table 4.1-1). Sampling sites included three designated 40 m (131 ft) sampling units immediately downstream of a documented Chinook, chum, coho or sockeye spawning area (these were tributary mouths or side sloughs at some Focus Area locations) and three 40 m (131 ft) rearing habitat sampling units. Electrofishing, seining, fyke nets, and minnow traps were the primary methods for collecting salmon during the early life stage sampling. Sampling events took place from April through June as described in Section 4.2.

4.6.3. 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 2013, this was accomplished by passive sampling techniques (minnow traps, fyke nets, hoop traps, trotlines, rotary screw traps, PIT interrogation sties, stationary radio telemetry receivers) during the night and crepuscular periods.

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

The focus of this task was to support the stranding and trapping component of the Fish and Aquatics Instream Flow Study (Study 8.5). Fish distribution sampling occurred at Focus Areas 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, fyke nets, and minnow traps were the primary methods for collecting salmon fry. Additionally, downstream migrant traps (Objective 2, Task A) were used to monitor the size of fish over the season to identify the timing associated with fish exceeding the 50 mm (2 in) length threshold.

4.6.5. Variances from Study Plan

The RSP and Implementation Plan did not include an objective for salmon early life history sampling outside of Middle River Focus Areas or in the Lower River (IP Section 5.5). When AEA adopted the FERC recommendation of seasonal sampling in mid-July and late August/early September, additional locations were added to gather information during the period from ice break-up to July.

4.7. 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 with no variances. Radio tags have been surgically implanted in seven burbot, seven humpback whitefish, and fourteen round whitefish in 2013 (Table 4.5-2). Fish capture methods included fishwheels, rotary screw traps, beach seines and hoop traps. Ongoing tagging and tracking will be conducted in accordance with the Study Plan.

4.8. 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 4.8.1. 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 4.8-1). 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 River Segment are presented in Table 4.8-2. Species were classified by life stage (Table 4.8-1) 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 50mm (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 4.8-3.

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.

For the ISR, condition factors have been compared by habitat for Chinook salmon and Arctic grayling only. Prior to analysis of fish condition by habitat type, outliers that might skew comparisons were identified and removed. A log-log regression on length vs. weight for all measured fish within a species was fitted, including fish captured in migrant traps. The Grubbs test (Grubbs, 1950, Lukasz, 2011) was then used for sequentially identifying outliers in the residuals from these regressions. The experiment-wise error for the outlier removal for each species was maintained at 0.05 by using alpha of 0.05 divided by the total number of outliers for each sequential test. The resulting condition factors were also evaluated to ensure there were no obvious differences among size or age classes of fish before combining. Fish condition, or wellbeing, was estimated using Fulton's condition factor where the coefficient of condition, K-FL was derived from the formula: K-FL = W x 105/L3, where K-FL = condition factor by fork length, W = weight of fish in grams, and L = fork length of fish (mm). Specific growth rates were estimated as SRG= 100*(ln(L2) –ln(L1))/(d2 - d1), where L2 = mean length on day (d) 2 and L1 = mean length on day (d) 1, and (d2 - d1) is the number of days between measurements. When all data were combined, fish condition factors were relatively stable across life stages, although estimates for fry were more variable and perhaps higher for Arctic grayling (Figure 4.8-1). Therefore, life stages were combined for the habitat analysis, but fry (less than 50mm (2 in) for Chinook; less than 60 mm (2.4 in) for arctic grayling) were not included. The total sample sizes of fish included in the condition factor analysis by Geomorphic Reach or Tributary are included in Table 4.8-4. Note that fish from distribution and abundance sampling (Objective 1, Section 4.4), ELH studies (Objective 3, Section 4.6), and some opportunistic sampling with associated habitat data were included in this analysis.

4.8.1. Variances from Study Plan

The Study Plan stated that each time sampling gear was checked, a random sample of 25 individuals per species, life stage, and site would be measured for fork length (FL) and weighed (IP Section 5.1.5). However, the FERC SPD mistakenly interpreted AEA's study plan as proposing to measure and weigh all fish and no modifications were recommended (SPD p. B-130). Due to ADF&G fish collection permit restrictions on fish handling; only the first 25 individuals of each species were weighed and measured during each check of a rotary screw trap. 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.

As an initial step towards assigning age-classes to the 2013 fish collections, a literature review was conducted compiling information collected in the Susitna Basin during the 1980s hydropower licensing efforts and relevant studies from Alaska. The literature review revealed substantial individual variability in growth and overlap in sizes among age classes, particularly for fish two years of age and older. The review also found considerable variability in growth and size-at-age from different locations or regions within the basin adding further ambiguity to the task of assigning size-based ages. AEA determined that ages could not be assigned with certainty to Susitna River fish based on 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 therefore replaced with documenting seasonal size-structure by habitat type. 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.

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

AEA implemented the methods for Objective 6 as described in the Study Plan with no variances. Northern pike were likely established in the Susitna River drainage in the 1950s through a series of illegal introductions (Rutz 1999). The proliferation of this predatory species is of concern owing to their negative effect on salmonids and other species such as stickleback. Rutz (1999) investigated movements of northern pike in the Susitna River using radio telemetry and investigated northern pike predation on salmonids by analyzing stomach contents of juvenile pike captured with minnow traps. Both of the fish capture methods used by Rutz (1999) were used in the current study, as well as angling, and other methods to capture northern pike. The presence and habitat associations of northern pike and other invasive fish species were documented during fish capture and observation sampling events associated with Objectives 1 and 2. Five northern pike were radio-tagged and tracked in the Lower River in 2013. The target size for radio-tagging is 30 fish; tagging efforts are ongoing.

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

AEA implemented the methods for Objective 7 as described in the Study Plan with no variances. 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 are reported in the ISR for Study 9.14. Tissue samples included an axillary process 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 tissues collected for genetic baseline development as part of this study is presented in Table 4.10-1.

4.11. Winter Sampling Approach

AEA implemented the methods for winter sampling as described in the Study Plan with no variances. In 2013, winter pilot studies were conducted at FA-104 (Whiskers Slough) and FA-128 (Slough 8A) in the Middle River. These sites were selected based on their accessibility from Talkeetna, diversity of habitat types, and because sampling in the 1980s and 2012 revealed that these sites were used for spawning as well as rearing by salmonids. Three winter pilot studies were initiated in February 2013 focusing on (a) intergravel temperature, dissolved oxygen, and water-level monitoring; (b) winter fish observations using DIDSON and underwater video; and (c) winter fish sampling techniques. Summary results and recommendations for winter fish sampling using a variety of techniques; underwater observations using DIDSON and underwater video; and evaluation of PIT and radio tags detectability under ice in cold temperatures are presented in Appendix C.

Overall study objectives for the winter pilot study were to:

1. Evaluate the effectiveness and feasibility of winter sampling methods for each study including: underwater fish observations via DIDSON sonar and underwater video, and fish population estimates using minnow traps, seines, electrofishing, trotlines, PIT tags, and radio tags.
2. Assess winter sampling logistics. This included safety, sampling methods in different habitat types under varying degrees of ice cover, transportation and access to and from sample sites, travel time, and winter-specific gear needs.
3. Evaluate the feasibility of sampling during spring break-up.
4. Develop recommendations for winter 2013/2014 study efforts.

4.12. Fish Sampling Techniques

A combination of gillnet, electrofishing, angling, trot lines, minnow trappings, snorkeling, fishwheels, out-migrant trapping, beach seining, and fyke netting techniques were used to sample or observe fish in the Lower River and Middle River, and those fish moving in and out of selected sloughs and tributaries flowing into the Susitna River. Techniques selected 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 and federal biological 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.

4.12.1. Gillnets

Variable mesh gillnets (7.5-ft-deep panels with 1-inch to 2.5-inch stretched mesh) were deployed in appropriate habitat. In open water and at sites with high water velocity, gillnets were deployed as drift nets, while in slow water sloughs, gillnets were deployed as set (fixed) nets. The location of each gillnet set was mapped using hand-held GPS units and marked on high-resolution aerial photographs. To reduce variability among sites, soak times for gillnets were standardized; all nets were retrieved a maximum of 30 minutes after the set was completed. The following formula was used to determine drifting time:

$$T = ([(\text{set time} + \text{retrieval time})/2] + \text{soak time})$$

4.12.2. Electrofishing

4.12.2.1. Backpack Electrofishing

A Smith-Root LR-24 backpack electrofishing unit was operated by a trained field crew leader who was assisted by two people with dipnets. Each backpack unit was fitted with a standard Smith-Root cathode and a single anode pole with a steel ring. Electrofishing was often paired with snorkel surveys, where snorkel surveys were conducted first as a reconnaissance to make sure there were no large salmonids in the area. Single-pass fish distribution electrofishing surveys were conducted through the selected study reach moving in an upstream direction. Block nets were used for relative abundance sampling when sites conditions allowed. Depending on stream width, an additional crew leader sometimes operated a second electrofishing unit. All stunned fish were captured with dipnets away from the electric field and held in buckets for later processing.

All backpack electrofishing procedures followed NMFS (2000) Guidelines for Electrofishing Waters Containing Salmonids Listed Under the Endangered Species Act. Personnel operating electrofishing units were trained and certified as per ADF&G permit requirements. Backpack electrofisher settings were determined in the field based on water quality conditions, professional judgment, and the overall goal of minimizing impacts to fish health (Temple and Pearsons 2007). Prior to electrofishing, ambient water chemistry was recorded including conductivity (microSiemens), turbidity (nephelometric turbidity unit [NTU]), and surface water temperature (°C) with a digital meter at the downstream end of sampling site to help determine initial backpack electrofishing unit settings. In all cases, the electrofishing unit was operated and configured with settings consistent with guidelines established by the manufacturer (Smith-Root 2009), ADF&G (Buckwalter 2011) and NMFS (2000). An ADF&G-generated table that recommends target voltage settings for juvenile salmonid sampling in cold water was used as a reference at the onset of sampling (Buckwalter 2011). The location of each electrofishing unit was mapped using hand-held GPS units and marked on high-resolution aerial photographs. Start and stop times were recorded to quantify sampling effort between surveys. Habitat measurements were collected at each study site location. All captured fish were identified to species, measured for length, and returned to the stream unharmed. For each sample unit, fish capture data and sampling effort (e.g., electrofishing 'power on' recorded in seconds) was documented separately so that CPUE could be calculated. One of the ADF&G Fish Resource Permit stipulations in 2013 was that electroshockers could not be used in anadromous waters in the presence of adult salmonids including trout or char. ADF&G further stipulated that electrofishing would be limited to one pass.

4.12.2.2. Boat Electrofishing

Boat-based electrofishing was conducted while drifting in a downstream direction by an experienced three- or four-person field crew. Above Devils Canyon, a 16 ft cataraft mounted with a Smith-Root Inc. Type IV electroshocking unit was deployed with one person on the netter's platform and one person operating the electrofishing units and guiding the boat using oars or a small outboard motor. In the main channels and side channels from MR-5 downstream, a Smith-Root Inc. high-output Generator Powered Pulsator (GPP 5.0) or a Type IV electroshocker unit was operated out of a 160-200 HP outboard jet-drive riverboat manned by a three-person crew; two netters and an boat operator. The electroshocking procedure consisted of maneuvering the boat downstream along the shoreline of each sample site while occasionally detouring towards the thalweg to avoid shoreline hazards. Two crew members positioned on a netting platform at the bow of the boat, netted stunned fish while a third individual operated the boat and electroshocking unit. The two netters attempted to capture all fish observed near the boat. Captured fish were immediately placed into an onboard live-well. Fish species that avoided capture were enumerated and recorded as "observed".

Boat electrofisher settings were determined in the field based on water quality conditions following Buckwalter 2011, professional judgment, and the overall goal of minimizing impacts to fish health (Temple and Pearsons 2007). Prior to electrofishing, ambient water chemistry was recorded including conductivity (microSiemens), turbidity (NTU), and surface water temperature (°C) with a digital meter at the downstream end of sampling site to help determine initial unit settings (Temple and Pearsons 2007). In all cases, the electrofishing unit was operated and configured with settings consistent with guidelines established by the manufacturer and ADF&G (Buckwalter 2011). The field team recorded a GPS location at the upstream start of each stream or sample segment prior to moving downstream to sample. Start and stop times were recorded to quantify sampling effort between surveys. Habitat measurements were also collected at each study site location. At deep-water sites, boat electroshocking was conducted along the channel margin. All captured fish were identified to species, and a subsample was measured for length, and returned to the stream unharmed. For each sample unit, fish capture data and sampling effort (e.g., electrofishing 'power on' recorded in seconds) was documented separately so that CPUE could be calculated. One of the ADF&G Fish Resource Permit stipulations in 2013 was that electroshockers could not be used in anadromous waters in the presence of adult salmonids including trout or char. ADF&G further stipulated that electrofishing would be limited to one pass. Because of safety concerns, electrofishing surveys were only conducted during daylight hours.

4.12.3. Angling

Angling with hook and line was an effective way to collect fish samples for select target species under certain conditions. During field trips organized for other sampling methods, hook-and-line angling was conducted on an opportunistic basis using artificial lures or flies with single barbless hooks. The primary objective of hook-and-line sampling was to capture fish for radio-and PIT tagging and to determine presence; a secondary objective was to evaluate seasonal fish distribution. Because it was labor and time intensive, angling was best used as an alternative method if other more effective means of sampling were not available. Angling was also used in conjunction with other methods, particularly if information on the presence and size of adult fish was required.

4.12.4. Trot Lines

Trotlines consisted of a long line with a multitude of baited hooks and were typically anchored at both ends and set in the water for a period of time. Trot line sampling was one of the more frequently used methods during the 1980s and was the primary method for capturing burbot; however, because trot lines are generally lethal, their use was infrequent and limited to two summer sampling events in the Middle and Lower River. Trot lines consisted of 14 to 21 ft of seine twine with six leaders and hooks lowered to the river bottom. Trot lines were checked and re-baited after 24 hours and pulled after 48 hours. Hooks were baited with salmon eggs, herring, or whitefish. Trot line construction and deployment followed the techniques used during the 1980s studies as described by ADF&G (1982). As per ADF&G Fish Resource Permit stipulations, all salmon eggs used as bait were commercially sterilized or disinfected with a 10-minute soak in a 1/100 Betadyne solution prior to use.

4.12.5. Minnow Traps

Both wire and fabric collapsible minnow traps were used in 2013. The wired two-piece minnow traps were 16.5 in long, with a 9 in diameter, and had a 1 in opening. The collapsible traps had a length of 18 in and a width of 10 in. The openings of the collapsible trap were 2.5 in diameter. Minnow traps were baited with commercially processed salmon roe. As per ADF&G Fish Resource Permit stipulations, all salmon eggs used as bait were commercially sterilized or disinfected with a 10-minute soak in a 1/100 Betadyne. After roe was sterilized, 1 Tbsp of roe was measured out and placed in a 1-ounce plastic Whirl-Pak bag (Fort Atkinson, WI, USA) or plastic canister. Filled plastic bags were perforated using a fork or utility knife before bait was placed inside the trap.

One to two minnow traps were deployed for every 10 m (33 ft) sampled depending on habitat unit size and complexity. The unit was divided into quadrants and the number of traps was equally distributed among quadrants. Traps were placed in low-velocity areas with cover most likely to contain fish. Traps were placed on the stream bottom, parallel to stream current. To prevent loss, each trap was anchored to the stream bank by a tether line and flagged. Baited and set minnow traps were soaked overnight for 18 to 24 hours. Following the overnight soak, captured fish were identified to species, measured, and released in same site where they were captured.

4.12.6. Snorkel Surveys

Single-pass snorkel surveys (Dolloff et al. 1993) were conducted by a three or four-person field crew trained in snorkel survey methods and fish species identification. Climatological and hydrological conditions, such as air and water temperatures, cloud cover, and water clarity/visibility, were documented before beginning a survey and snorkeling was only conducted if conditions were adequate based on Appendix 3 of the Implementation Plan. Snorkelers used a plastic salmonid silhouette with parr marks to evaluate visibility as the horizontal underwater distance at which the parr marks were visible. As the snorkeler approached the model, the distance at which the parr marks on the silhouette became visible was measured. Similarly, during retreat, the distance at which the parr marks were no longer visible was measured, and visibility was calculated as the average of these two distances (Thurow 1994). Habitat units were snorkeled by starting at the downstream end of the sample area and working upstream unless water velocity precluded upstream movement. Snorkeled distance depended on the length of the habitat unit or mesohabitat being sampled.

Snorkel surveys consisted of a single snorkeler when wetted stream widths were less than 5 m (16.4 ft). Observations were collected by counting fish on both sides of the stream channel while alternating from left to right counts. For streams with wetted widths greater than 5 m (16.4 ft), the entire area of the stream was sampled by two or more snorkelers moving upstream in tandem. Snorkelers visually identified and counted all species encountered, and fish counts were grouped by species and size class bins estimated in 20 mm (0.8 in) increment bins (e.g., 1-20 mm, 21-40 mm, etc.). Snorkel observations were called out to a non-snorkeling team member and recorded. For most of the snorkel surveys in this study, two experienced biologists were designated snorkelers, while a field technician acted as a recorder. A hand-held GPS unit was used to record the downstream and upstream extent of the area surveyed and the location was marked on high-resolution aerial photographs.

To facilitate comparison of relative abundance estimates from snorkel surveys with estimates from other sampling methods (e.g., minnow trapping or electrofishing), block nets were used to ensure a closed population within a single habitat unit and prevent fish from leaving or entering the unit (Hillman et al. 1992). The survey length and average wetted width of the sample area were recorded to facilitate estimation of relative fish abundance.

4.12.7. Fyke/Hoop Nets

Fyke/hoop nets were deployed to collect fish in tributaries, sloughs, and side channels with moderate water velocity (i.e., less than 3 ft per second). After a satisfactory location was identified at each site, the same location was used during subsequent collection periods. The fyke nets were approximately 40 ft long and consisted of two rectangular steel frames (3 ft wide by 2.5 ft high), and four steel hoops, all covered by 0.25-in delta stretch mesh nylon netting. A 26 ft long by 4.1 ft deep leader net made of 0.33 in delta stretch nylon netting was sometimes attached to a center bar of the first rectangular frame (net mouth). The second rectangular frame had two 4-in wide by 28-in high openings, one on each side of the frame's center bar. The four hoops followed the second frame. The throats, 4-6 inches in diameter, were located between the second and third hoops. The net ended in a cod end bag 8 ft long with an 8-in opening at the end, which was tied shut while the net was fishing. Each fyke/hoop net was configured with two wings, set perpendicular to the shore, to guide the majority of water and fish to the net mouth. Where possible, the guide nets were configured to maintain a narrow open channel along one bank. Where the channel size or configuration did not allow an open channel to be maintained, the area below the fyke/hoop net was checked regularly to assess whether fish were blocked and unable to pass upstream. A live car was located at the downstream end of the fyke/hoop net throat to hold captured fish until they were processed. The fyke/hoop net wings and live car were checked at least once per day while fishing, to record and measure captured fish. The locations of the fyke/hoop net sets were mapped using a hand-held GPS unit and marked on high-resolution aerial photographs. Fyke nets were set overnight for 18 to 24 hours.

4.12.8. Hoop Traps

Hoop traps had either 4 or 7 hoops. Smaller traps consisted of four 0.25-in steel hoops with diameters tapered from 3 ft at the entrance to 2.25 ft at the cod end. Larger traps consisted of seven 0.25-in-thick steel hoops inside with diameters tapered from 2 ft at the entrance to 1.5 at the cod end. Both the four- and seven-hooped traps had two necks inside and were made up of 0.25-in-diameter knotless delta mesh. Hoop traps were generally set overnight for 18 to 24 hours depending on logistical constraints.

4.12.9. Beach Seines

Seining methodology was dependent on habitat type and the target species. Typically, speed and coordination were an essential part of successful seining. The size and swiftness of the target fish influenced both the length of the seine used and the speed at which it was deployed and retrieved. In wadeable systems, smaller nets were used and deployed by hand with one end of the net anchored to the shore and the other end extended out from shore and then looped around to encircle the fish as the ends were pulled in against the beach or gravel bar. Once all fish were withdrawn from the net, the net was cleaned of all leaf litter, sticks, rocks, and other debris, checked for damage, and reloaded for the next set. Damage to seines was repaired following instructions in Gebhards (in Murphy and Willis 1996).

Seine nets of various sizes were available for use that ranged from 14 to 120 ft long, 3 to 6 ft wide, and had mesh diameters that ranged from 0.125 to 1 in. The largest and smallest available nets were 120 ft x 5 ft x 0.5 in mesh and 14 ft x 6 ft x 0.125 in mesh, respectively.

With this range in net sizes a large variety of fish and habitats were sampled; comparisons could be made because the area sampled was noted, the net size was noted, and the nets were deep enough to fill the water column. The location of beach seining was recorded using a hand-held GPS unit, in addition to being marked on high-resolution aerial photographs. The area seined was delineated using fiberglass measuring tapes and/or a marked wading rod.

4.12.10. Out-Migrant Traps

Rotary screw traps were useful for determining the timing of emigration by downstream migrating juvenile salmonids and resident fish (Objective 2). Four rotary screw traps were located in the Middle and Lower River (Section 4.1.3). Flow conditions permitting, traps were fished on a cycle of 48 hours (two days and nights) on, 72 hours off throughout the ice-free period (Figure 4.2-2). Each trap was checked at least daily. When checked, fish were removed from the live-boxes for processing using dip and minnow nets. To reduce fish losses from the live-box, fish refuge structures, flow deflectors, and debris separators were sometimes installed to dissipate water velocities and reduce predation. Before fish were removed from the live-box, floating and large submerged debris was removed.

Once removed from the live-box, fish were sorted by species and size class and placed in 5-gallon buckets with supplemental aeration or a holding pen situated in flowing water. For juvenile anadromous salmonids a life stage index was be used for grouping life stage classes (alevin, fry/parr/smolt). Standard fish handling procedures (Section 4.12.12) were followed. Any additional processing and data collection (e.g., tissue sampling, PIT tagging) was also performed if applicable to the species, life stage, and site location. Fish were held until fully recovered, and the time and water temperature (°C) at release was recorded.

4.12.11. Fishwheels

Fishwheels were deployed to capture anadromous salmon as part of the Adult Salmon Escapement Study (Study 9.7). Non-salmon species collected by the fishwheels were used opportunistically as a source of fish for tagging studies and tissue sampling. Two fishwheels were operated in the Lower Susitna River; one on the west bank at PRM 33.4, and the second on the east bank at PRM 34.2. In addition, two fishwheels were used on the lower Yentna River (TRM 6). In the Middle Susitna River near Curry (PRM 123-126) three fishwheels were used to capture adult salmon and resident fishes for radio tagging in 2013.

4.12.12. Fish Handling

Special care was taken to ensure that all fish were handled properly and that unintended mortalities were minimized. In general, fish were kept in cool, well-oxygenated water, and the amount of time spent away from the river environment was minimized to the extent possible.

Strategies to minimize fish stress and mortality included the following:

1. Minimizing handling to that necessary to meet Project objectives.
2. Minimizing the time fish were held.
3. Minimizing the time fish were held in anesthetic.
4. Starting with low concentrations of anesthetic and then increasing as necessary. Fish were anesthetized only to the point at which they could be handled easily without strain.
5. Removing smaller or more sensitive fish from anesthetic first, followed by larger, less sensitive species.
6. Holding fish in fresh or flow-through river water during examination.
7. Using wet transfers.
8. Monitoring water temperatures and dissolved oxygen concentrations in closed systems regularly and adjusting as necessary.

Field crews recorded the date, start and stop times, and level of effort for all sampling events, as well as water temperature and dissolved oxygen at sampling locations. All captured or observed fish were identified to species and life stage when possible. For juvenile anadromous salmonids, a life stage index was used for grouping life stages (e.g., alevin, fry/parr/smolt). When possible, resident fishes were grouped as young-of-year (0+), juvenile (typically age 1+ and 2+), and adult (typically age 3+). Each time a gear was sampled, a random sample of 25 individuals per species, life stage, and site were measured for fork length (FL) in mm and weighed (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. The remaining fish of each species and age class were then enumerated.

For methods in which fish were observed but not captured (i.e., snorkeling, DIDSON, and underwater video), an attempt was made to identify all fish to species. For snorkeling, fork length of observed fish was estimated to 20-mm (0.8 in) bins of sizes. If present, observations of poor fish condition, lesions, external tumors, or other abnormalities were noted. All juvenile salmon, Arctic grayling, burbot, Dolly Varden, rainbow trout, and whitefish greater than 60 mm (2.4 in) in length were scanned for PIT tags using a portable tag reader and a PIT tag was implanted in untagged fish. Radio tags were surgically implanted in targeted fish as described in Section 4.12.13.

4.12.13. Remote Fish Telemetry

Remote telemetry techniques included radio telemetry and PIT tags. Both of these methods were intended to provide detailed information from relatively few individual fish. PIT tags were surgically implanted in small fish greater than 60 mm (2.4 in); radio transmitters were surgically implanted in adult fish of sufficient body size of selected species distributed temporally and spatially in the Lower and Middle River. The target species to radio-tag included Arctic grayling, burbot, Dolly Varden, longnose sucker, northern pike, lake trout, rainbow trout humpback whitefish, and round whitefish. Radio-tracking provided information on fine and coarse spatial scales related to location, speed of movement, and habitat use by surveying large areas and relocating tagged individuals during aerial surveys. PIT tags were used to document relatively localized movements of fish as well as growth information from tagged individuals across seasons and years. However, the "re-sighting" of PIT-tagged fish was limited to the sites where antenna arrays were placed. To determine movement in and out of side sloughs or tributaries required that tagged fish pass within several feet of an antenna array, thereby limiting array use to sufficiently small water bodies. To characterize growth rates, recaptured fish were measured.

4.12.13.1. Radio Telemetry

The primary function of the telemetry component was to track tagged fish spatially and temporally with a combination of fixed station receivers and mobile tracking. Time/date stamped, coded radio signals from tags implanted in fish were recorded by fixed station or mobile positioning. All telemetry gear (tags and receivers) was provided by ATS, Inc. (Advanced Telemetry Systems, www.atstrack.com).

The types of behavior to be characterized include the following:

- Arrival and departure timing at specific locations/positions
- Direction of travel
- Residence time at specific locations/positions
- Travel time between locations/positions
- Migratory, holding, and spawning time and locations/positions
- Movement patterns in and between habitats in relation to water conditions (e.g., discharge, temperature, turbidity)

Relocation data from the radio telemetry component of this study was used to characterize the timing of use and degree of movements among macrohabitats and over periods during which the radio tags remain active (potentially two or three years for large fish). This objective is being achieved by the use of long-life tags (e.g., greater than one year) and shorter life tags (e.g., three-month tags) applied to appropriate-sized fish over time. In general, successful radio telemetry studies use a tag weight to fish weight guideline of 3 percent (with a common range of 2 to 5 percent depending on the species).

Tags were surgically implanted in fish of sufficient body size, distributed temporally and spatially in the Lower and Middle River with a goal of 30 per-species. These fish were captured during sampling events targeting adult fish and with directed effort using a variety of methods. Larger tags accommodated the greatest battery life and therefore were used when fish were large enough, but smaller, shorter life tags were used across the range of adult body sizes. Four different-sized radio tags were used with expected operational lives ranging from 180 to 901 days. The ATS model 1810C, 1815C, 1820C, and 1830C tags have minimum tagging weights of 200, 233, 267, and 367 g, respectively. The tags used for this study were programmed to operate in "slow pulse" mode with approximately 12 pulses-per-minute in order to extend the operational life of the tags as much as possible. All tags were equipped with a motion sensitive sensor to alert biologists when a tag has remained motionless for 24 consecutive hours. Due to the number of tags planned for release seven radio frequencies were needed for this study.

Locating radio-tagged fish was achieved by fixed receiver stations and aerial surveys. In conjunction with the Salmon Escapement Study (Study 9.7) fixed-station receivers were operated at nine strategic locations in the Middle and Lower River (Section 4.1.5). During the installation of the fixed-receiver sites, a reference radio tag was used to calibrate each receiver and verify that they were capable of detecting tags passing along the opposite river bank. Antennas were oriented to allow for determination of a fish's direction of migration, be it upstream, downstream, or in some cases into a tributary.

The Salmon Escapement Study (Study 9.7) provided approximately weekly aerial survey coverage of the study area (approximately July through October; Table 4.2-2). At other times of the year, the frequency and location of aerial surveys was at least monthly and bi-weekly during critical species-specific time periods (e.g., burbot spawning).

4.12.13.2. PIT Tag Antenna Arrays

Half-duplex PIT tags, either 12 or 23 mm in length, were used depending upon the size of the fish. For increased performance and data collection, fish were tagged with the largest tag size that their body size could carry. Each PIT tag had a unique code that allowed for identification of individuals. The target species for PIT tagging were juvenile Chinook and coho salmon and the following juvenile and adult fish species: Arctic grayling, Arctic lamprey, burbot, Dolly Varden, northern pike, rainbow trout, humpback whitefish, and round whitefish.

Fish for PIT tagging were captured opportunistically during fish distribution and abundance sampling. To increase the probability of collecting information on fish movements, fish were captured and tagged in relatively close proximity to interrogation sites. Several arrays were located in Focus Area study sites where increased effort was directed towards tagging fish.

PIT tag antenna arrays with automated data logging were used at selected sites to detect movement of tagged fish into or out of off-channel habitats or tributaries habitats. Each PIT tag interrogation system consisted of a power source, data logger, antenna and tuning capacitor. A solar panel and controller was used to power the reader and charge the battery bank. Data loggers were downloaded every two to four weeks, depending on the weather and water conditions, the need to monitor power supply, and the reliability of logging systems. A total of four stationary PIT tag interrogation systems were installed in the Middle and Lower River (Section 4.1.4, Figure 4.2-1).

5. RESULTS

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

5.1.1. Task A: Fish Distribution

Eighteen fish species were documented in the Middle and Lower Susitna River study area in 2013 (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. Eight of the 18 species in the Middle and Lower River study area were also found in the Upper Susitna River study area during 2012 and 2013 field studies (Table 5.1-1; ISR Study 9.5 Section 5.1.1). Northern pike were the only non-native or invasive species observed in the study area.

Within the Middle River study area, Devils Canyon (i.e., MR-3 and MR-4) appeared to limit the distribution of several species to geomorphic reaches downstream of the canyon (Table 5.1-1). Each of the 18 species observed within the Middle and Lower River study area in 2013 was observed downstream of the canyon, yet only seven species (i.e., Chinook salmon, Arctic grayling, burbot, Dolly Varden, longnose sucker, sculpin, and round whitefish) were documented in geomorphic reaches MR-1 and MR-2. 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), and it is possible that the undifferentiated whitefish observations in MR-1 and MR-2 included humpback whitefish (Table 5.1-1). Five of the 11 species that were not observed upstream of Devils Canyon were documented in each of the Middle and Lower River study area reaches downstream of the canyon; these species include chum, coho, pink, and sockeye salmon, and rainbow trout (Table 5.1-1). This pattern suggests that Devils Canyon influences the distribution of these migratory species. Dolly Varden and sculpin were the only species observed in the geomorphic reaches that include Devils Canyon (i.e., MR-3 and MR-4 (Table 5.1-1).

Additional information regarding the spatial and seasonal distribution of each of the 18 documented species is provided in the subsections that follow. Seasonal distribution patterns are discussed relative to five distinct sampling events that occurred in 2013. These events were: winter (February 1 to April 14), spring Early Life History (ELH) sampling (April 15 to June 30), early summer (July 1 to August 10), late summer (August 11 to September 9), and fall (September 10 to October 12). A more detailed analysis of seasonal movement patterns for several of these species is provided in Section 5.2.2.

Data developed in support of the ISR is available for download at http://gis.suhydro.org/reports/isr (ISR_9_6_FDAML_FishObservations).

5.1.1.1. Chinook salmon

During the 2013 fish surveys in the Middle and Lower Susitna River study area, Chinook salmon were documented in all surveyed geomorphic reaches with the exception of MR-1 and MR-4 (Table 5.1-1). The spatial distribution of adults and juveniles was similar in all reaches, except in MR-7, where only juveniles were observed (Tables 5.1-2 and 5.1-3).

As expected for this anadromous species, the seasonal distribution of Chinook salmon differed between the juvenile and adult life stages (Table C1). Within the geomorphic reaches where Chinook salmon were observed, juveniles were documented during all sampling events with the exception of the spring, late summer, and fall events in MR-2. Adult Chinook salmon were observed seasonally in early summer and less commonly during the spring and late summer events.

5.1.1.2. Chum salmon

Chum salmon were documented in all geomorphic reaches surveyed downstream of Devils Canyon (Table 5.1-1). The spatial distribution of adults and juveniles was similar in all reaches, except in MR-5 and LR-3, where only adults and juveniles were observed, respectively (Tables 5.1-2 and 5.1-3).

Similar to Chinook salmon, the seasonal distribution of chum salmon differed between the juvenile and adult life stages (Table C2). Among the geomorphic reaches where juvenile chum salmon were observed, juveniles were consistently documented during the spring, early summer, and late summer events with the exception of LR-4. In this downstream-most reach of the Middle and Lower River study area, chum salmon juveniles were only observed during the late summer event. Juveniles were also observed during the winter sampling event in MR-8 and the fall sampling event in LR-2. In five of the seven reaches with documented adult chum salmon presence (i.e., MR-6, MR-8, LR-1, LR-2, and LR-4), adults were observed during the early summer, late summer, and fall events. In MR-5, adult observations occurred only during early summer, and in MR-7, observations were limited to the early and late summer events.

5.1.1.3. Coho salmon

As with chum salmon, coho salmon were documented in every geomorphic reach sampled downstream of Devils Canyon (Table 5.1-1). Both juvenile and adult coho salmon were observed in each of these reaches (Tables 5.1-2 and 5.1-3).

The seasonal distribution of coho salmon differed between the juvenile and adult life stages (Table C3). Among the eight geomorphic reaches where coho salmon were observed, juveniles were consistently documented during all survey events, including the winter sampling event in MR-6 and MR-8. Adult coho salmon were observed during the late summer event in all reaches downstream of Devils Canyon. Adults were also documented in five of these reaches during the fall sampling event (i.e., MR-5, MR-6, MR-8, LR-1, and LR-2) and in three of the reaches during the early summer event (i.e., MR-6, MR-7, and MR-8).

5.1.1.4. Pink salmon

Pink salmon were also documented in every surveyed geomorphic reach downstream of Devils Canyon (Table 5.1-1). Adults were observed in each of these reaches, whereas juveniles were observed in only five of the eight reaches (Tables 5.1-2 and 5.1-3). Reaches where juvenile pink salmon were documented included MR-5, MR-6, MR-7, MR-8, and LR-2.

Like other Pacific salmon species, the seasonal distribution of pink salmon differed between life stages (Table C4). Among the geomorphic reaches where juvenile pink salmon were observed, juveniles were most consistently observed during the early summer event. They were also documented during spring sampling in MR-6, MR-8, and LR-2 and during winter in MR-8. Adult pink salmon were observed in all eight reaches downstream of Devils Canyon during the early summer event. Adults were also present in five of the eight reaches during late summer period (i.e., MR-5, MR-6, MR-8, LR-1, and LR-2) and in a single reach during the fall sampling event (i.e., LR-3).

5.1.1.5. Sockeye salmon

Similar to the other Pacific salmon species in the Middle and Lower River study area, sockeye salmon were documented in all geomorphic reaches downstream of Devils Canyon (Table 5.1-1). Juvenile sockeye salmon were found in all reaches, and adults were observed in all reaches with the exceptions of LR-2 and LR-3 (Tables 5.1-2 and 5.1-3).

The seasonal distribution of sockeye salmon differed between life stages (Table C5). In every geomorphic reach downstream of the canyon, juveniles were observed during all sampling events with the exceptions of the winter event in MR-8, the late summer event in MR-5, and the fall event in LR-2 and LR-4. Adults were most consistently observed among reaches during the early and late summer events. Early summer observations occurred in MR-5, MR-6, MR-7, MR-8, and LR-1, and late summer observations were made in MR-6, MR-7, MR-8, LR-1, and LR-4. Adult sockeye salmon were also observed during the fall sampling event in MR-6, MR-8, and LR-1.

5.1.1.6. Arctic grayling

Arctic grayling were widely distributed throughout the Middle and Lower Susitna River study area and were present upstream and downstream of Devils Canyon (Table 5.1-1). Their spatial distribution extended from LR-4 to MR-1, although their presence within reaches MR-3 and MR-4 was not documented during the 2013 fish studies.

Among sampling events, the presence of Arctic grayling was largely consistent, particularly from early summer through fall (Table C6). Prior to early summer, the distribution of Arctic grayling was more limited. The species was not documented during winter sampling, and during the spring event, Arctic grayling were observed in only two of the eight reaches surveyed (i.e., MR-6 and MR-8).

5.1.1.7. Burbot

Similar to Arctic grayling, burbot were widely distributed throughout the Middle and Lower Susitna River study area and were present upstream and downstream of Devils Canyon (Table 5.1-1). Their spatial distribution extended from LR-4 to MR-1, although their presence within reaches MR-3 and MR-4 was not documented during the 2013 fish surveys.

The seasonal distribution of burbot was also largely similar to that observed for Arctic grayling (Table C7). Burbot were documented in each surveyed reach during the early summer, late summer, and fall events. They were also observed in winter in MR-8 and during the spring event in MR-6, MR-7, and MR-8.

5.1.1.8. Dolly Varden

Dolly Varden were documented in 10 of the 11 geomorphic reaches surveyed within the Middle and Lower River study area (Table 5.1-1). They were found in both reaches upstream of Devils Canyon (i.e., MR-1 and MR-2), in 7 of the downstream reaches (i.e., MR-5, MR-6, MR-7, MR-8, LR-1, LR-2, and LR-3), and in Chinook Creek (i.e., MR-4) upstream of the Zone of Hydrologic Influence.

The presence of Dolly Varden within geomorphic reaches was largely consistent across sampling seasons (Table C8). For example, five of the eight reaches that were surveyed during the spring, early summer, late summer, and fall events supported Dolly Varden during each of these events; these reaches include MR-2, MR-6, MR-7, MR-8, and LR-2. Dolly Varden were also present in Chinook Creek (i.e., MR-4) during the early summer, late summer, and fall events. Other observations of Dolly Varden occurred in MR-5 and LR-3 during early summer and in MR-1 and LR-1 during late summer.

5.1.1.9. Lamprey

Within the Middle and Lower River study area, lamprey were observed only in the six downstream-most geomorphic reaches (Table 5.1-1). These reaches include MR-7, MR-8, LR-1, LR-2, LR-3, and LR-4.

The distribution of lamprey was largely consistent among seasons (Table C9). In MR-8, LR-1, LR-2, LR-3, and LR-4, lamprey were observed during all sampling events except early summer in LR-1 and LR-4. In MR-7, the opposite pattern was observed; that is, lamprey were observed only during the early summer period.

5.1.1.10. Longnose sucker

Similar to Arctic grayling, burbot, and Dolly Varden, longnose suckers were distributed throughout the Middle and Lower Susitna River study area and were present upstream and downstream of Devils Canyon (Table 5.1-1). Their spatial distribution extended from LR-4 to MR-1, although their presence within reaches MR-3 and MR-4 was not documented during the 2013 field studies.

The distribution of longnose suckers was largely consistent among seasons (Table C10). In all 11 of the geomorphic reaches sampled in the Middle and Lower River study area, this species was observed during all events with the exception of: the winter sampling event in MR-6 and MR-8, the Spring event in MR-2 and LR-1, and the early summer, late summer, and fall sampling events in Chinook Creek (i.e., MR-4).

5.1.1.11. Northern pike

Among the 18 species documented in the Middle and Lower Susitna River study area, northern pike were the only non-native species and were the least commonly observed and most narrowly distributed (Table 5.1-1). Their spatial distribution was limited to only the lowermost geomorphic reach within the study area (i.e., LR-4).

The distribution of northern pike did not vary among seasons (Table C11). Northern pike were observed in LR-4 during the spring, early summer, late summer, and fall sampling events. More information regarding accounts of northern pike is presented in Section 5.6.

5.1.1.12. Rainbow trout

The distribution of rainbow trout in the Middle and Lower Susitna River study area was similar to that observed for chum, coho, pink, and sockeye salmon (Table 5.1-1). Rainbow trout were documented in all geomorphic reaches downstream of Devils Canyon yet were not observed upstream of the canyon.

There was little variation in the seasonal distribution of rainbow trout (Table C12). The species was observed during the majority of sampling events in reaches downstream of Devils Canyon. Exceptions included winter sampling in MR-6, spring sampling in LR-1 and LR-4, late summer sampling in MR-5, LR-3, LR-4, and fall sampling in LR-1 and LR-4.

5.1.1.13. Sculpin

Similar to Arctic grayling, burbot, Dolly Varden, and longnose suckers, sculpin were distributed throughout the Middle and Lower Susitna River study area and were present upstream and downstream of Devils Canyon (Table 5.1-1). Their spatial distribution extended from LR-4 to MR-1, although their presence within reaches MR-3 and MR-4 was limited to Chinook Creek.

The distribution of sculpin was almost entirely consistent among seasons (Table C13). In all 11 of the geomorphic reaches sampled in the Middle and Lower River study area, sculpin were observed during all sampling events except for late summer in Chinook Creek (MR-4).

5.1.1.14. Ninespine stickleback

Similar to northern pike, the presence of ninespine stickleback was limited to the Lower River (Table 5.1-1). Their spatial distribution extended from LR-4 to LR-1.

The distribution of ninespine stickleback varied somewhat among seasons (Table C14). Ninespine stickleback were most common during the early summer event when they observed in all four of the Lower River reaches within the study area. They were also present during the spring event in LR-2 and LR-3, during late summer in LR-1, LR-3, and LR-4, and during fall in LR-3 and LR-4.

5.1.1.15. Threespine stickleback

The distribution of threespine stickleback in the Middle and Lower Susitna River study area was similar to that observed for chum, coho, pink, and sockeye salmon and rainbow trout (Table 5.1-1). The main difference between the distribution of threespine stickleback and these other species is that threespine stickleback were documented in LR-4 through MR-5, whereas the other species were documented in LR-4 through MR-6.

There was little variation in the seasonal distribution of threespine stickleback (Table C15). The species was observed during all sampling events in MR-7, MR-8, LR-1, LR-2, LR-3, and LR-4. In MR-6, observations occurred only during early and late summer.

5.1.1.16. Bering cisco

Similar to northern pike and ninespine stickleback, Bering cisco were limited to the Lower River (Table 5.1-1). Their spatial distribution included LR-2 and LR-4.

The distribution of Bering cisco appears to have varied among seasons (Table C16). All Bering cisco observations occurred during the fall sampling event. However, the observed seasonal pattern should be viewed with caution due to the relatively few Bering cisco observations in the study area.

5.1.1.17. Humpback whitefish

The distribution of humpback whitefish differs from other species encountered in the Middle and Lower Susitna River study area in that it was observed primarily in the Middle River (Table 5.1-1). The species was observed in all four Middle River geomorphic reaches downstream of Devils Canyon (i.e., MR-5, MR-6, MR-7, and MR-8) as well as a single reach in the Lower River (i.e., LR-4). As noted earlier, it is possible that humpback whitefish were also present upstream of Devils Canyon in MR-1 and MR-2, given the presence of undifferentiated whitefish species in these reaches (Table 5.1-1).

The distribution on humpback whitefish was variable on a seasonal basis (Table C17). They were most commonly observed during the spring and early summer sampling events in the Middle River geomorphic reaches. Late summer observations were made in MR-6 and MR-8, and all observations in the Lower River occurred during the fall sampling event in LR-4.

5.1.1.18. Round whitefish

Similar to Arctic grayling, burbot, Dolly Varden, longnose suckers, and sculpin, round whitefish were widely distributed throughout the Middle and Lower Susitna River study area and were present upstream and downstream of Devils Canyon (Table 5.1-1). Their spatial distribution extended from LR-4 to MR-1, although their presence within reaches MR-3 and MR-4 was not documented during the 2013 fish distribution and abundance study.

The distribution of round whitefish was largely consistent among sampling events although some variation in seasonal distribution was observed (Table C18). Round whitefish were present in each geomorphic reach surveyed during the late summer and fall sampling events. A nearly identical pattern was observed for the early summer event, although the species was not detected in MR-1 or LR-4 during this season. Occurrences during the spring sampling event were less common but still included five of the eight geomorphic reaches surveyed during this time period (i.e., MR-6, MR-8, LR-1, LR-3, and LR-4). Round whitefish were also observed during winter sampling in MR-8.

5.1.2. Task B: Relative Abundance

5.1.2.1. Middle River

Fish observations from all fish sampling efforts in the Middle River combined totaled 45,899 fish (Table 5.1-2). While this provides a relative scale of the study program, only a subset of this larger dataset, that portion collected during systematic fish distribution and abundance sampling, was suited to calculating catch-per-unit-effort (CPUE) for comparable estimates of fish relative abundance. The fish counts that were used to calculate CPUE are summarized for fish distribution and abundance sampling within (Table 5.1-4) and outside (Table 5.1-5) Middle River Focus Areas. The majority of fish observations were made when sampling with five gear types within and three gear types outside of Focus Areas.

Total fish observations and relative abundance, as determined by CPUE analysis, are presented by species below. CPUE was calculated to be species- and gear-specific using catch data from distribution and abundance sampling as described in Section 4.4.2.1 and was averaged across mesohabitats within a macrohabitat for discussing relative abundance. The CPUE analysis also distinguished between adult and juvenile Pacific salmon, although adult salmon observations during the Fish Distribution and Abundance surveys were considered to be incidental based on study objectives and sampling design. Middle River CPUE summaries and tables of CPUE by gear type are presented in Appendix E.

Data developed in support of the ISR is available for download at http://gis.suhydro.org/reports/isr (ISR_9_6_FDAML_FishObservations, and ISR_9_6_FDAML_FishCPUEData).

5.1.2.1.1. Adult Chinook Salmon

During 2013, 52 adult Chinook salmon were observed during all sampling in the Middle River (Table 5.1-2). The majority of observations of adult Chinook salmon occurred incidentally while snorkeling; they were absent from 99 percent of the sites sampled in the Middle River (Table E1). The highest average CPUE was 6.8 fish per 1,000 m^2 in tributary run habitat within MR-6 (Table E11).

5.1.2.1.2. Juvenile Chinook Salmon

During 2013, 3,300 juvenile Chinook salmon were observed during all sampling in the Middle River (Table 5.1-2). Averaged CPUE for juvenile Chinook salmon was generally low to moderate across sampling locations and methods, although a few notably high estimates were observed (Tables E9 through E14). Averages ranged from 0, at 84 percent of sites, to 351.1 fish per 1,000 m^2 in glide habitat within MR-8 upland slough habitat (Table E11). This high CPUE was obtained by seining in early summer. Seining at the same upland slough in late summer also produced a high average CPUE of 130.5 fish per 1,000 m^2 (Table E10). In general, Middle River CPUE averages for juvenile Chinook salmon were similar in magnitude to estimates of CPUE for Upper and Lower River sites. The CPUE data indicated that snorkeling, seining, backpack electrofishing, and fyke netting were effective capture techniques for juvenile Chinook salmon (Table E1).

5.1.2.1.3. Adult Chum Salmon

During 2013, 898 adult chum salmon were observed during all sampling in the Middle River (Table 5.1-2). Adult chum salmon were absent from 94 percent of the CPUE sites in the Middle River (Table E1) Where they were found, the majority of adult chum salmon observations occurred while snorkeling. The greatest average CPUE was 183.3 fish per 1,000 m^2 in run habitat associated with the Indian River tributary mouth in MR-6 (Table E17).

5.1.2.1.4. Juvenile Chum Salmon

During 2013, 1,394 juvenile chum salmon were observed during all sampling in the Middle River (Table 5.1-2). Averaged CPUE was variable among habitats (Tables E15 to E17) and across sampling events. CPUE ranged from 0 at 98 percent of sites (Table E1) to 104.3 fish per 1,000 m^2 in tributary mouth glide habitat in MR-6 (Table E17). This maximum CPUE was in the same tributary mouth (Indian River) where the greatest abundance of adults was observed. Juvenile chum salmon CPUE values were higher and more frequent across all habitats in early and late summer sampling as compared to fall. Effective gear types for capturing juvenile chum salmon included seining, backpack electrofishing, and snorkeling (Table E1).

5.1.2.1.5. Adult Coho Salmon

During 2013, 554 adult coho salmon were observed during all sampling in the Middle River (Table 5.1-2). Similar to other Pacific salmonid adults, the majority of observations of adult coho salmon during systematic fish distribution and abundance sampling occurred incidentally while snorkeling. Adult coho salmon were absent from 97 percent of the sites sampled in the Middle River (Table E1). The greatest average CPUE was 52.7 fish per 1,000 m^2 in pool habitat within MR-8 tributary habitat (Table E23).

5.1.2.1.6. Juvenile Coho Salmon

Juvenile coho salmon were the most frequently observed species in the Middle River in 2013; a total of 8,738 juvenile coho salmon were observed during all sampling (Table 5.1-2). Averaged CPUE was highly variable among habitats (Tables E20 to E26) and ranged from 0 at 73 percent of sites (Table E1) to 4,553.8 fish per 1,000 m^2 in run habitat located within MR-7 upland slough habitat in Focus Areas (Table E22). At several sites, CPUE was greater than 1,000 fish per 1,000 m^2 (Tables E22 and E23). These high CPUE values occurred only during early summer sampling. All methods except for hoop traps were effective for capturing juvenile coho salmon. (Table E1).

5.1.2.1.7. Adult Pink Salmon

During 2013, 4,683 adult pink salmon were observed during all sampling in the Middle River (Table 5.1-2). Similar to other Pacific salmonid adults, the majority of observations of adult pink salmon during systematic fish distribution and abundance sampling occurred incidentally while snorkeling. Adult pink salmon were absent from 95 percent of the sites sampled in the Middle River (Table E1). The greatest average CPUE values occurred during snorkeling in the Indian River in early summer. Specifically, CPUE averages of 4,553.8 and 1,113.3 fish per 1,000 m^2 were observed in pool and glide mesohabitats, respectively, within this tributary located in MR-6 (Table E30).

5.1.2.1.8. Juvenile Pink Salmon

During 2013, 427 juvenile pink salmon were observed during all sampling in the Middle River (Table 5.1-2). The average CPUE was 0 at greater than 99 percent of sites (Table E1). For the CPUE analysis, juvenile pink salmon were detected only during early summer sampling at two sites. Boat electrofishing within a mainstem backwater pool in MR-7 yielded an average CPUE of 12.5 fish per hour (Table E28), and backpack electrofishing within a side slough glide in MR-5 yielded a catch of 1.6 fish per hour (Table E27). Both of these sites were located outside of Focus Areas.

5.1.2.1.9. Adult Sockeye Salmon

During 2013, 236 adult sockeye salmon were observed during all sampling in the Middle River (Table 5.1-2). The majority of these observations of adult sockeye salmon during systematic fish distribution and abundance sampling occurred while snorkeling. Averaged CPUE for sockeye salmon adults was 0 in 98 percent of the sites (Table E1). The greatest average CPUE was 14.7 fish per 1,000 m^2 in run habitat within MR-6 side sloughs in Focus Areas (Table E35).

5.1.2.1.10. Juvenile Sockeye Salmon

During 2013, 2,594 juvenile sockeye salmon were observed during all sampling in the Middle River (Table 5.1-2). Averaged CPUE for juvenile sockeye salmon was highly variable among habitats (Tables E32 to E37). Averaged CPUE ranged from 0 at 86 percent of sites (Table E1) to 948.8 fish per 1,000 m^2 in tributary pool habitat in MR-6 Focus Areas (Table E34). Although two tributary pool habitats were seined during early summer in MR-6 Focus Areas (Table E4), all of the juvenile sockeye salmon observations occurred in a single tributary (Indian River). This site was also the location with the highest CPUE for juvenile coho salmon. Sockeye salmon CPUE was similar across sampling events. Compared to the Lower River, average CPUE values for the Middle River were an order of magnitude higher. Effective gear types included seining, snorkeling, fyke netting, and backpack and boat electrofishing (Table E1).

5.1.2.1.11. Arctic Grayling

During 2013, 2,665 Arctic grayling were observed during all sampling in the Middle River (Table 5.1-2). Averaged CPUE for Arctic grayling was highly variable among habitats and ranged from 0 at 75 percent of sites to 378.1 fish per 1,000 m^2 in clearwater plume habitat within MR-2 Focus Areas (Table E40). Generally, averaged CPUE values in the Middle River were an order of magnitude lower than in the Upper River and an order of magnitude greater than in the Lower River. CPUE data indicated that seining, backpack electrofishing, boat electrofishing, snorkeling, and fyke netting were effective capture techniques (Table E1).

5.1.2.1.12. Burbot

During 2013, 472 burbot were observed during all sampling in the Middle River (Table 5.1-2). Averaged CPUE for burbot was low to moderate across sampling locations and methods (Tables E45 to E50). In the Middle River, burbot CPUE was 0 at 78 percent of sites (Table E1), and averaged CPUE ranged from 0 to a maximum of 18.5 fish per trap in beaver pond habitat located within MR-6 upland sloughs in Focus Areas (Table E48). It is interesting to note that burbot CPUE values were similar among all Middle River geomorphic reaches, including those upstream of Devils Canyon (i.e., MR-1 and MR-2), and similar to those calculated for Upper River and Lower River habitats. The CPUE data indicated that backpack and boat electrofishing, fyke netting, and seining were effective capture techniques for burbot (Table E1).

5.1.2.1.13. Dolly Varden

During 2013, 574 Dolly Varden were observed during all sampling in the Middle River (Table 5.1-2). Averaged CPUE for Dolly Varden in the Middle River was highly variable across sampling locations and methods (Table E51 to E57). In the Middle River, Dolly Varden were observed at 9 percent of sampling sites (Table E1), and averaged CPUE ranged from 0 to 243.5 fish per 1,000 m^2 in tributary mouth glide habitat in MR-6 (Table E54). Averaged CPUE values for the Middle River were of similar magnitude to those in the Upper River, yet they were much higher than those observed in the Lower River, where the maximum average CPUE was 4.3 fish per hour (Table E152). The CPUE data indicated that snorkeling and backpack electrofishing were effective capture techniques for Dolly Varden (Table E1).

5.1.2.1.14. Lamprey

During 2013, 79 lamprey were observed during all sampling in the Middle River (Table 5.1-2). In the Middle River, lamprey COUE was 0 at 98 percent of sites (Table E1), and systematic fish distribution and abundance sampling only observed lamprey in MR-7 and MR-8. Averaged CPUE ranged from 0 to 39.1 fish per hour in riffle habitat within side sloughs in the MR-8 Focus Areas (Table E58). Similar CPUE values for lamprey were observed between the Middle and Lower River. Backpack electrofishing was the most effective capture techniques for lamprey (Table E1).

5.1.2.1.15. Longnose Sucker

During 2013, 2,059 longnose sucker were observed during all sampling in the Middle River (Table 5.1-2). Averaged CPUE ranged from 0 at 72 percent of sites to 328.8 fish per hour in side slough riffle habitat within MR-8 (Table E62). The values were low to moderate in all geomorphic reaches except for MR-8 where several averaged CPUE values were an order of magnitude greater than those observed elsewhere in the Middle River. Low to moderate values were also observed in the Upper and Lower River. CPUE data indicated that backpack electrofishing, seining, snorkeling, boat electrofishing, and fyke netting were effective capture techniques (Table E1).

5.1.2.1.16. Sculpin

Sculpin were the third most abundant species group in the 2013 Middle River fish sampling with 5,789 sculpin observed (Table 5.1-2). Sculpin were also observed at more sites than any other species in the Middle River. Averaged CPUE was highly variable and ranged from 0 at 34 percent of sites to 569.3 fish per 1,000 m^2 in tributary pool habitat within MR-6 Focus Areas (Table E71). A similar range of relative abundance was observed for sculpin in the Upper and Lower River. CPUE data indicated that all methods except hoop traps were effective capture techniques (Table E1).

5.1.2.1.17. Lake Trout

Lake trout were not observed in the Middle River during 2013 sampling.

5.1.2.1.18. Ninespine Stickleback

Ninespine stickleback were not observed in the Middle River during 2013 sampling.

5.1.2.1.19. Threespine Stickleback

Threespine stickleback were the second most abundant species in the 2013 Middle River fish sampling with 7,604 fish observed (Table 5.1-2). Similar to the Lower River, averaged CPUE for threespine stickleback in the Middle River was generally low to moderate, and ranged from 0 at 89 percent of sites to 503 fish per trap in upland slough beaver pond habitat within MR-7 Focus Areas in late summer (Table E79). The CPUE data indicated a trend for lower averaged values in fall as compared to early and late summer. Effective capture techniques included backpack electrofishing, fyke nets, seining, and minnow traps (Table E1).

5.1.2.1.20. Rainbow Trout

During 2013, 457 rainbow trout were observed during all sampling in the Middle River (Table 5.1-2). Averaged CPUE was low to moderate, ranged from 0 at 91 percent of sites to 38 fish per trap in tributary pool habitat within the Focus Area in MR-8 (Table E85), and varied among habitats. Rainbow trout were overall more abundant in the Middle River as compared to the Lower River. CPUE data indicated that snorkeling, fyke nets, and backpack and boat electrofishing were effective capture techniques for rainbow trout (Table E1).

5.1.2.1.21. Bering Cisco

No Bering cisco were observed during Middle River fish distribution and abundance sampling in 2013.

5.1.2.1.22. Humpback Whitefish

During 2013, 165 humpback whitefish were observed during all sampling in the Middle River (Table 5.1-2). Averaged CPUE was generally low and ranged from 0 at 99 percent of sites to 33.6 fish per 1,000 m^2 in backwater pool habitat within the Focus Area in MR-8 (Table E89). Humpback whitefish were overall more abundant in the Middle River as compared to the Lower

River. CPUE data indicated that seining and boat electrofishing were effective capture techniques for humpback whitefish (Table E1).

5.1.2.1.23. Round Whitefish

During 2013, 643 round whitefish were observed during all sampling in the Middle River (Table 5.1-2). Averaged CPUE was generally low to moderate and ranged from 0 at 83 percent of sites to 249.5 fish per 1,000 m^2 in backwater pool habitat within MR-7 Focus Areas (Table E93). Middle River averaged CPUE values for round whitefish were generally similar to those in the Upper and Lower River, although the observed maximum in the Middle River was a magnitude greater than the Upper and Lower River maxima, as well as most CPUE averages in the Middle River. CPUE data indicated that seining, boat and backpack electrofishing, snorkeling, and fyke nets were effective capture techniques for round whitefish (Table E1).

5.1.2.2. Lower River

During 2013 all Lower River fish sampling, a total of 8,649 fish were captured or observed (Table 5.1-3). Table 5.1-6 lists total counts for relative abundance sampling for all three sampling events for which CPUE was estimated. Minnow traps, seines and hoop traps accounted for 84 percent of the total Lower River catch (Table 5.1-6).

Data developed in support of the ISR is available for download at http://gis.suhydro.org/reports/isr (ISR_9_6_FDAML_FishObservations, and ISR_9_6_FDAML_FishCPUEData).

5.1.2.2.1. Adult Chinook Salmon

During 2013, seven adult Chinook salmon were observed during all sampling in the Lower River (Table 5.1-3). The averaged CPUE was 0 at 98 percent of the sites sampled in the Lower River (Table E1). The greatest average CPUE was 2.5 fish per 1,000 m^2 in tributary glide habitat within LR-1 (Table E115).

5.1.2.2.2. Juvenile Chinook Salmon

During 2013, 1,655 juvenile Chinook salmon were observed during all sampling in the Lower River (Table 5.1-3). Average CPUE values were low to moderate and ranged from 0 at 74 percent of sites to 43.7 fish per hour in clearwater plume habitat in LR-3 (Table E112). Averaged CPUE values were greater in LR-1 and LR-3 than in LR-2 and LR-4 (Tables E112 to E114 and E116 to E118). In general, Lower River CPUE averages for juvenile Chinook salmon were similar in magnitude to estimates of CPUE for Upper and Middle River sites. Fyke nets, hoop traps, seining, and backpack and boat electrofishing were effective capture techniques for juvenile Chinook salmon in the Lower River (Table E1).

5.1.2.2.3. Adult Chum Salmon

During 2013, 304 adult chum salmon were observed in the Lower River (Table 5.1-3). Averaged CPUE was 0 at 94 percent of the sites sampled (Table E1). The highest average CPUE was 25 fish per 1,000 m^2 in clearwater plume habitat in LR-1 (Table E121).

5.1.2.2.4. Juvenile Chum Salmon

During 2013, 877 juvenile chum salmon were observed during all sampling in the Lower River (Table 5.1-3). Overall, averaged CPUE values were low to moderate (Tables E119 to E120 and E122 to E124) and ranged from 0 at 92 percent of sites (Table E1) to 16 fish per 1,000 m^2 in side slough pool habitat in LR-1 (Table E120). In contrast to the Middle River, juvenile chum salmon CPUE did not appear to vary across seasonal sampling events in the Lower River. Effective gear types for capturing juvenile chum salmon included seining and backpack electrofishing (Table E1).

5.1.2.2.5. Adult Coho Salmon

During 2013, 72 adult coho salmon were observed during all sampling in the Lower River (Table 5.1-3). Adult coho salmon averaged CPUE was 0 for 95 percent of the Lower River sites (Table E1). Similar to adult chum salmon, the highest average CPUE was 62.5 fish per 1,000 m^2 in clearwater plume habitat in LR-1 (Table E127).

5.1.2.2.6. Juvenile Coho Salmon

During 2013, 607 juvenile coho salmon were observed during all sampling in the Lower River (Table 5.1-3). Overall, averaged CPUE values were low to moderate (Tables E125, E126, and E128 to E130) and ranged from 0 at 76 percent of sites (Table E1) to 45 fish per trap (Tables E128 and E129). This maximum was observed on two occasions, once in late summer within upland slough glide habitat (Table E128) and once during fall sampling in upland slough beaver pond habitat (Table E129). In general, the averaged CPUE for juvenile coho salmon was substantially less than that observed for this species and life stage in the Middle River. Effective gear types for juvenile coho salmon included hoop traps, fyke nets, backpack electrofishing, and seining (Table E1).

5.1.2.2.7. Adult Pink Salmon

During 2013, 422 adult pink salmon were observed during all sampling in the Lower River (Table 5.1-3). Averaged CPUE ranged from 0 at 94 percent of sites (Table E1) to 15 fish per 1,000 m^2 in tributary glide habitat in LR-2 (Table E132).

5.1.2.2.8. Juvenile Pink Salmon

During 2013, only six juvenile pink salmon were observed during all sampling in the Lower River (Table 5.1-3). All of these observations were associated with downstream migrant trapping in Montana Creek. Thus, there are no data available to estimate CPUE for juvenile pink salmon in the Lower River.

5.1.2.2.9. Adult Sockeye Salmon

During 2013, seven adult sockeye salmon were observed during all sampling in the Lower River (Table 5.1-3). Averaged CPUE ranged from 0 at 97 percent of sites (Table E1) to 1.7 fish per 1,000 m^2 in side channel complex run habitat in LR-2 (Table E136).

5.1.2.2.10. Juvenile Sockeye Salmon

During 2013, 444 juvenile sockeye salmon were observed during all sampling in the Lower River (Table 5.1-3). Averaged CPUE for juvenile sockeye salmon was highly variable among habitats (Tables E135, E136, E138-E140). Averages ranged from 0 at 77 percent of sites (Table E1) to 280 fish per 1,000 m^2 in side slough run habitat within LR-1 (Table E136). Compared to the Middle River, average CPUE values for the Lower River were an order of magnitude lower. Effective gear types included seining, backpack electrofishing, and fyke netting (Table E1).

5.1.2.2.11. Arctic Grayling

During 2013, 39 Arctic grayling were observed during all sampling in the Lower River (Table 5.1-3). Averaged CPUE for Arctic grayling was generally low, particularly when compared to the Upper and Middle River segments. Values ranged from 0 at 87 percent of sites to 8.6 fish per hour in side channel run habitat within LR-4 (Table E142). CPUE data indicated backpack and boat electrofishing, and in some cases, seining were effective capture techniques (Table E1).

5.1.2.2.12. Burbot

During 2013, 154 burbot were observed during all sampling in the Lower River (Table 5.1-3). Similar to the Upper and Middle River, averaged CPUE for burbot was low to moderate across sampling locations and methods (Table E146 to E151). Averaged CPUE ranged from 0 to 23.8 fish per hour in side slough run habitat within LR-4 (Table E147). The CPUE data indicated that backpack and boat electrofishing, fyke nets, hoop traps, and seining were effective capture techniques for burbot (Table E1).

5.1.2.2.13. Dolly Varden

During 2013, 30 Dolly Varden were observed during all sampling in the Lower River (Table 5.1-3). Averaged CPUE values for Dolly Varden in the Lower River was low and ranged from 0 at 96 percent of sampling sites (Table E1) to 4.3 fish per hour in side channel complex riffle habitat in LR-1 (Table E152). Averaged CPUE values for the Lower River were two orders of a magnitude less than those in the Middle and Upper River. Effective gear types included backpack electrofishing, seining, and fyke nets (Table E1).

5.1.2.2.14. Lamprey

During 2013, 133 lamprey were observed during all sampling in the Lower River (Table 5.1-3). Averaged CPUE was low to moderate and varied among habitats and geomorphic reaches and ranged from 0 at 81 percent of sites to 28.6 fish per hour in clearwater plume habitat within LR-3 (Table E155). Similar CPUE values for lamprey were observed between the Lower and Middle River. Backpack and boat electrofishing were the most effective capture techniques for lamprey in the Lower River (Table E1).

5.1.2.2.15. Longnose Sucker

During 2013, 1,115 longnose suckers were observed during all sampling in the Lower River (Table 5.1-3). Averaged CPUE ranged from 0 at 37 percent of sites to 188 fish per trap in upland slough run habitat within LR-4 (Table E163). When longnose suckers were detected, averaged CPUE values were generally moderate. These values tended to be slightly less than and slightly greater than those in the Middle and Upper River, respectively. CPUE data indicated that backpack and boat electrofishing, seining, hoop traps, and fyke nets were effective capture techniques (Table E1).

5.1.2.2.16. Northern Pike

During 2013, 62 northern pike were observed during all sampling in the Lower River (Table 5.1-3). Averaged CPUE ranged from 0 at 97 percent of sites to 40 fish per 1,000 m^2 in tributary glide habitat within LR-4 (Table E169). During Lower River transect sampling, northern pike were found only during early and late summer in LR-4. They were not detected in LR-1, LR-2, or LR-3. Effective gear types included backpack and boat electrofishing, seining, snorkeling, and minnow traps (Table E1).

5.1.2.2.17. Sculpin

During 2013, 897 sculpin were observed during all sampling in the Lower River (Table 5.1-3). Similar to the Middle and Upper River, sculpin were detected at more sites than any other species in the Lower River, and averaged CPUE was highly variable among geomorphic reaches and sampling events. Values ranged from 0 at 37 percent of sites to 1,009.8 fish per hour in clearwater plumes within LR-2 (Table E171). CPUE data indicated that backpack electrofishing, seining, and hoop traps were effective capture techniques (Table E1).

5.1.2.2.18. Lake Trout

Lake trout were not observed in the Lower River during 2013 sampling.

5.1.2.2.19. Ninespine Stickleback

During 2013, 144 ninespine stickleback were observed during all sampling in the Lower River (Table 5.1-3). Averaged CPUE for ninespine stickleback in the Lower River was generally low and ranged from 0 at 89 percent of sites to 34 fish per 1,000 m^2 in pool habitat within LR-3 additional open water habitat (Table E177). Catch per unit effort was consistently low in LR-1, and the species was not detected in LR-2. Effective capture techniques included backpack electrofishing, fyke nets, and seining (Table E1).

5.1.2.2.20. Threespine Stickleback

Threespine stickleback were the most abundant species in the 2013 Lower River fish sampling with 4,469 fish observed (Table 5.1-3). Similar to the Middle River, averaged CPUE for threespine stickleback in the Lower River was generally low to moderate; but in the Lower River this species was more frequently present. Averaged CPUE ranged from 0 at 66 percent of sites to 495 fish per trap in upland slough beaver pond habitat within LR-3 (Table E185). Threespine stickleback CPUE varied across Lower River geomorphic reaches, with lower observed averages in LR-1 and LR-2 compared to LR-3 and LR-4. Effective capture techniques included backpack electrofishing, fyke nets, seining, and hoop traps (Table E1).

5.1.2.2.21. Rainbow Trout

During 2013, 165 rainbow trout were observed during all sampling in the Lower River (Table 5.1-3). Averaged CPUE ranged from 0 at 93 percent of sites to 25.9 fish per hour in upland slough backwater habitat within LR-4 (Table E187). Low CPUE values were observed in LR-1 and LR-2, whereas those observed in LR3 and LR-4 were low to moderate. These Lower River CPUEs were generally similar between to those calculated for the Middle River. Backpack electrofishing was the most effective capture techniques for rainbow trout in the Lower River (Table E1).

5.1.2.2.22. Bering Cisco

During 2013, only two Bering cisco were observed during all sampling in the Lower River (Table 5.1-3). Averaged CPUE was generally low and ranged from 0 at 98 percent of sites to 4.3 fish per hour in side slough run habitat within LR-4. Bering cisco were not detected in any other geomorphic reach (Table E192). CPUE data indicated that backpack and boat electrofishing were effective capture techniques for Bering cisco (Table E1).

5.1.2.2.23. Humpback Whitefish

During 2013, eight humpback whitefish were observed during all sampling in the Lower River (Table 5.1-3). Similar to Bering cisco, averaged CPUE was generally low, and humpback whitefish were detected only in LR-4. Average CPUE values ranged from 0 at 98 percent of sites to 14.7 fish per hour side slough run habitat (Table E193). Lower River humpback whitefish CPUE values were similar to those calculated for the Middle River. CPUE data indicated that seining and boat electrofishing were effective capture techniques for humpback whitefish (Table E1).

5.1.2.2.24. Round Whitefish

During 2013, 112 round whitefish were observed during all sampling in the Lower River (Table 5.1-3). Averaged CPUE was generally low to moderate in each Lower River geomorphic reach and ranged from 0 at 77 percent of sites to 12.9 fish per hour in clearwater plumes within LR-1 (Table E196). Lower River averaged CPUE values for round whitefish were generally similar to those in the Upper and Middle River, although the observed maxima in the Lower and Upper River were a magnitude less than the Middle River maximum. CPUE data indicated that seining and boat and backpack electrofishing were effective capture techniques for round whitefish (Table E1).

5.1.3. Task C: Habitat Associations

Because 2013 data QA/QC and analysis is ongoing, fish observation data were used to provide a preliminary look at fish-habitat associations in the Middle and Lower River.

Data developed in support of the ISR is available for download at http://gis.suhydro.org/reports/isr (ISR_9_6_FDAML_FishObservations).

5.1.3.1. Middle River

Combining counts from available data sources, a total of 45,889 fish observations were made in the Middle River. This includes observation from three direct sample Middle River tributaries above Devils Canyon and six mainstem Middle Susitna River geomorphic reaches (Table 5.1-2) during four sampling events. The highest total counts of fish were obtained in off-channel habitats in MR-7, largely driven by high numbers of threespine stickleback documented during distribution and relative abundance sampling (Tables F1, F2, F43, F44). High fish counts, including juvenile salmon, were obtained in off-channel and tributary habitats in MR-6 and the mainstem Susitna River in MR-8 (Table 5.1-2). In general, more fish were observed in off-channel habitats and tributaries than in the mainstem reaches. More fish were also observed inside of Focus Areas (Table F1) than outside of Focus Areas (Table F2).

To begin to understand species-specific patterns in habitat use, species counts are presented by mesohabitat unit and sampling event in Appendix F for the Middle River (Tables F4 to F52) and Lower River Tables (F54 to F80). The following general patterns are evident from this early data.

- Adult Chinook salmon were observed primarily in early summer and were associated with riffle and run mesohabitats within clearwater plume, tributary, and tributary mouth macrohabitats (Tables F3 and F4). Most adult Chinook salmon observed in the Middle River were associated with spawning tributaries: Tsusensa Creek, Portage Creek, and Indian River. Counts overall were low overall (22) and were not different inside and outside of Focus Areas (Tables F3 and F4)

- Juvenile Chinook salmon were found in much higher numbers inside of Focus Areas (Table F5) than outside of Focus Areas (Table F6). Juvenile Chinook were observed during all seasons in a variety of habitats including tributaries, the main channel Susitna River, and off-channel Susitna River. Among macrohabitat types, juvenile Chinook counts were highest in upland slough beaver complexes, tributaries, and side channels. Among mesohabitats, counts were highest in slow water habitats, e.g. beaver ponds, glides, and pools (Table F5).

- Adult chum salmon were primarily observed in early to late summer with similar numbers inside and outside of Focus Areas (Tables F7 and F8). Adult chum were observed in a variety of habitats including tributaries, the main channel Susitna River, and off-channel Susitna River. The highest counts of chum salmon were in glide habitat in spawning tributaries and side sloughs in MR-5 and MR-6 (Tables F7 and F8).

- Juvenile chum salmon were primarily observed during the spring Early Life History sampling inside of Focus Areas in MR-6 (Tables F9 and F10). Counts were highest in run and beaver pond mesohabitats within the Slough 11 side slough beaver complex in MR-6.

- Adult coho salmon were primarily observed during the late summer in MR-7 and MR-8 (Tables F11 and F12). The highest counts of adult coho salmon were in glide, run, and pool habitats in spawning tributaries and side sloughs (Tables F11 and F12). Counts were more than twice as high inside of Focus Areas (Table F11) as compared to outside Focus Areas (Table F12).

- Juvenile coho salmon were observed in all seasons with higher counts inside of Focus Areas (Table F13) as compared to outside Focus Areas (Table F14). Observations were primarily made in tributary and off-channel habitats in MR-6, 7, and 8. Counts were highest in slow water (e.g. pool and beaver pond) mesohabitats within side slough and upland slough beaver complexes (Tables F13 and F14).

- Adult pink salmon were observed primarily in early summer with higher counts inside of Focus Areas (Table F15) as compared to outside Focus Areas (Table F16). This pattern was driven by large numbers of fish observed in FA-141 (Indian River). Counts were highest in pool, run, and glide mesohabitats in spawning tributaries with lower counts associated with clearwater plumes (Tables F15 and F16).

- Juvenile pink salmon were observed in lower numbers in the spring and early summer (Table F17 and F18). Observations were made in a variety tributary, main channel Susitna, and off-channel Susitna habitats. Counts were similar inside and outside of Focus Areas.

- Adult sockeye salmon were primarily observed in late summer and fall in MR-6 (Tables F19 and F20). Counts were highest in beaver pond and glide mesohabitats in upland sloughs and side sloughs (Tables F19 and F20). Counts were more than twice as high outside of Focus Area as compared to inside Focus Areas.

- Juvenile sockeye salmon were mostly observed in spring and early summer with higher numbers inside of Focus Areas (Table F21) as compared to outside Focus Areas (Table F22). Most observations were made in tributary and off-channel habitats in MR-6 (Table F21). Counts were highest in slow water (e.g. glide and pool) mesohabitats within side sloughs with and without beaver complexes (Tables F21 and F22).

- Juvenile salmon that could not be identified to species were observed during all seasons with higher counts inside of Focus Areas (Tables F23 and F24). Most of these observations were made in one upland slough beaver complex in MR-7 where identification of salmon parr was particularly challenging as individual fish displayed multiple characteristics of more than one salmon species (Table F23).

- Arctic grayling were observed in all seasons in a variety of habitats including tributaries, the main channel Susitna River, and off-channel Susitna River (Tables F25 and F26). Counts were more than twice as high inside of Focus Areas (Table F25) as compared to outside Focus Areas (Table F26). Juvenile Arctic graying counts were highest in MR-2 in slow water mesohabitat types, e.g. pools and backwaters associated with side sloughs and clearwater plumes (Tables F27 and F28). Similar to juveniles, adult Arctic grayling were observed within clearwater plume habitat, but were also associated with riffles and runs in side channel and main channel habitats (Tables F31 and F32).

- Burbot were observed in in all seasons in a wide variety of macrohabitats and mesohabitats in tributaries, the main channel Susitna River, and off-channel Susitna River (Tables F33 and F34). Burbot were widely distributed across habitat types, observations by mesohabitat were low overall. Counts were similar inside and outside of Focus Areas.

- Dolly Varden were observed in lower numbers inside of Focus Areas (Table F35) as compared to outside Focus Areas; however, this pattern was driven by high counts in direct sample tributaries Fog and Chinook Creeks (Table F36). Dolly Varden were observed in a wide variety of fast and slow water mesohabitat types and were primarily associated with tributaries and tributary mouths (Tables F35 and F36).

- Lamprey were observed in all seasons in a variety of fast and slow water mesohabitats in tributary, side channel, and side slough habitats (Tables F37 and F38). Counts were higher inside of Focus Areas (70) as compared to outside Focus Areas (5).

- Longnose sucker were found in all seasons in a variety of main channel and off-channel habitats of the Susitna River and to a lesser extent tributaries (Tables F39 and F40). Highest counts were associated with slow water mesohabitats, e.g. glides, pools, and backwaters, in side channels and side sloughs (Tables F39 and F40). Counts were more than twice as high inside of Focus Areas as compared to outside of Focus Areas.

- Sculpin were found in a wide variety of habitats in the main channel and off-channel Susitna River as well as tributaries (Tables F41 and F42). High numbers of sculpin were observed in both fast and slow water mesohabitat types. Counts were similar inside and outside of Focus Areas.

- Threespine stickleback were observed in all seasons with very high numbers inside and outside of Focus Areas in MR-7 (Tables F43 and F44). High counts were observed in slow water habitats, beaver ponds and pools, in upland slough and upland slough beaver complexes.

- Rainbow trout were observed in a wide variety of slow and fast water mesohabitats in the main channel and off-channel Susitna River with the highest counts made in tributaries (Tables F45 and F46). Counts were higher inside of Focus Areas as compared to outside Focus Areas.

- Humpback whitefish were observed infrequently inside and outside of Focus Areas in main channel and off-channel habitats of the Susitna River (Tables F47 and FD48). They were found predominantly in slow water mesohabitats including backwaters and glides in side channels and side sloughs.

- Round whitefish were observed in a variety of habitats in the main channel, off-channel, and, to a lesser extent, tributaries of the Susitna River. They were found predominantly in low to moderate velocity habitats, e.g. backwaters, glides, and runs within main channel, side channel, and side slough habitats (Tables F49 and F50). Whitefish that were not differentiated species were found in similar habitats to round whitefish (Tables F51 and F52).

5.1.3.2. Lower River

Combining counts from available data sources for the Lower River, a total of 11,889 fish observations were made in Montana Creek (PRM 80.8) and four mainstem Lower Susitna River geomorphic reaches (Table 5.1-3) during four sampling events. The highest total counts of fish were obtained in Montana Creek, largely driven by high catches of juvenile salmon in the rotary screw trap (RST) (Table 5.2.1-1). High fish counts were also obtained in off-channel habitats in LR-3 and 4 (Table F53); with threespine stickleback in late summer accounting for the majority of the observations (Table F75). In general, more fish were observed in off-channel habitats than in the mainstem reaches (Table F53).

- In the Lower River, adult Chinook salmon were observed on rare occasions in early summer and late summer and were associated with run and glide habitat associated with clearwater plumes and tributaries (Table F54).

- Juvenile Chinook salmon were observed in all reaches during every season (Table F55). Juvenile Chinook were primarily associated with runs and glides in tributary and off-channel habitats. Among macrohabitat types, juvenile Chinook counts were highest in tributaries, upland slough beaver complexes, and clearwater plumes (Table F55).

- Adult chum salmon were primarily observed in the fall (Table F56). Highest counts were observed in pool, run, and clearwater plume habitats associated with tributaries and side sloughs (Table F56).

- Juvenile chum salmon were observed in highest numbers during the spring Early Life History sampling (Table F57). Counts were highest in pool, riffle, and run mesohabitats near spawning areas e.g. tributary, tributary mouths, and side sloughs.

- Adult coho salmon were primarily observed during the late summer in LR-1 (Table F58). Highest counts were associated with clearwater plumes and tributaries.

- Juvenile coho salmon were observed in all seasons with most observations from tributary and off-channel habitats in LR-1 and LR-3 (Table F59). Counts were highest in slow to moderate water velocity mesohabitats (e.g. run, glide, beaver pond, and pool) within tributaries and upland sloughs with and without beaver complexes (Table F59).

- Adult pink salmon were observed in low numbers with most observations in early summer within tributary glide habitat in LR-1 (Table F60). No juvenile pink salmon were observed during systematic sampling.

- Adult sockeye salmon were observed in low numbers in a variety of main-channel, off-channel and tributary habitats (Table F61).

- High counts of juvenile sockeye salmon were observed in run, glide and pool mesohabitats within tributary and side slough habitats in LR-1 (Table F62).

- Arctic grayling were observed in early summer through fall in a variety of habitats within tributaries, the main channel Susitna River, and off-channel Susitna River (Table F64). Counts were highest in run and glide habitats in tributaries. Juvenile Arctic grayling were observed in a variety of mesohabitats within side channels, side channel complexes and tributaries (Table F65). Adult Arctic grayling were observed infrequently with the highest counts in clearwater plumes (Tables F66 and F67).

- Burbot were observed in early summer through fall in a wide variety of macro and mesohabitats within tributaries, the main channel Susitna River, and off-channel Susitna River

(Table F68). Counts by mesohabitat were highest in run and glide habitat within side slough, side channel complex and main channel macrohabitats.

- Dolly Varden were observed on rare occasions in the Lower River; most observations were associated with fast water mesohabitat types (riffle, run, and glide) in main and side channels (Table F69).

- Lamprey were observed in all seasons throughout the Lower River study area. The highest counts of lamprey were associated with run, clearwater plume, and glide mesohabitats in both tributary and main channel Susitna River habitats (Table F70).

- Longnose sucker were found in all seasons in a variety of main channel and off-channel habitats of the Susitna River and, to a lesser extent, tributaries (Table F71). The highest counts were associated with moderate velocity mesohabitats, e.g. runs and glides, and with upland slough, side slough, and side slough complex macrohabitats (Table F71).

- Northern pike were found in in a variety of main channel and off-channel habitats of the Susitna River and to a larger extent, tributaries in LR-4 (Table F72). The highest counts were associated with pool and glide habitats in a tributary (Fish Creek, PRM 34) and the clearwater plume at the confluence of Fish Creek with the Susitna River (Table F72).

- Sculpin were found in a wide variety of habitats in the main channel and off-channel Susitna River as well as in tributaries (Table F73). High numbers of sculpin were observed in both fast and slow water mesohabitat types.

- Ninespine stickleback were observed in all seasons with highest counts in slow water pool habitats in tributary, additional open water, and upland slough macrohabitats (Table F74).

- Threespine stickleback were observed in all seasons (Table F75). High counts were observed in slow water habitats, beaver ponds and pools, in upland sloughs with and without beaver complexes and tributaries.

- Rainbow trout were observed in a wide variety of slow and fast water mesohabitats in tributaries, the main channel, and off-channel Susitna River (Table F76). The highest counts were associated with tributary and upland slough macrohabitats both with and without beaver complexes.

- Bering cisco were observed on two occasions in the fall in LR-2 and LR-4. Observations were made in glide and run habitats in side slough and side channel complex macrohabitats (Table F77).

- Humpback whitefish were observed infrequently in off-channel habitats (side sloughs) of the Susitna River and on a single occasion in the mainstem and a tributary (Table F78). They were found predominantly in run and glide mesohabitats.

- Round whitefish were observed in a wide variety of habitats in the main channel, off-channel, and, to a lesser extent, tributaries of the Susitna River. They were found predominantly in low to moderate velocity habitats, e.g. glides, runs, and pools (Table F79). Highest counts of whitefish that were not differentiated species were found in run habitat within slide slough and split main channel macrohabitat (Table F80).

5.2. Objective 2: Seasonal Movements

5.2.1. Task A: Document the timing of downstream movement and catch for all fish species using out-migrant traps.

Eighteen species and over 11,000 individuals were collected at the four rotary screw traps during the 2013 sampling period (Table 5.2-1). The trap at Indian River was the most productive of the four traps, accumulating more than 4,500 individual fish representing 16 species during the 2013 sampling period (Table 5.2-1). This total was 1.6 times greater than the second most productive trap at Montana Creek, where slightly less than 2,900 fish were collected (Table 5.2-1). The tributary traps collected more juvenile fishes than the mainstem Susitna River traps. However, the Susitna River trap at Talkeetna Station (PRM 106.9) was productive collecting nearly 2,700 individuals from all 18 of the species present (Table 5.2-1). In contrast, catch in the Susitna River at the Curry Station (PRM 124) rotary screw trap was low. Less than 1,500 fish were caught between June and September at the Curry Station trap (Table 5.2-1). Pacific salmon species were the most abundant fishes trapped with Chinook, coho, and pink salmon comprising 68 percent of the catch (Table 5.2-1). Most of the salmon caught in traps were juveniles with the exception of pink salmon. Adults accounted for 77 percent of the pink salmon catch (Table 5.2-1). The late deployment of the screw traps in June due to late break-up may have limited the collections of juvenile chum, pink, and sockeye salmon.

The number of juvenile anadromous salmon captured in the four traps by day is shown for each species in Figures 5.2-1 to 5.2-4. The timing of the 10th and 90th percentile of the cumulative frequency of catch for the five pacific salmon species is presented in the following sections and depicted in Figures 5.2-5 to 5.2-8.

Data developed in support of the ISR is available for download at http://gis.suhydro.org/reports/isr (ISR_9_6_FDAML_FishObservations).

5.2.1.1. Chinook Salmon

5.2.1.1.1. Fry

During 2013, there were few Chinook salmon fry collected by rotary screw traps in the mainstem Susitna River either at Curry Station (Figure 5.2-2, PRM 124) or at Talkeetna Station (Figure 5.2-3, PRM 106). Fry were caught in the mainstem soon after trap deployment in mid-June through the end of July (Figures 5.2-2 and 5.2-3). Conversely, Chinook salmon fry were abundant in the tributary catches. The fry size class was observed in the Indian River the day following trap deployment and their peak abundance occurred during late June to early July (Figure 5.2-1). Based on the daily frequency distribution, the 90th percentile of the downstream outmigration had occurred at Indian River by July 21 (Figure 5.2-5). The last fry was observed in the catch by the end of July (Figure 5.2-1).

Chinook salmon fry were abundant in the Montana Creek trap catch upon deployment. Peak observations of fry movement occurred here during the last week of June (Figure 5.2-4). The 90th percentile of the outmigration from Montana Creek had occurred by July 1st (Figure 5.2-8), after which no fry were observed in the Montana trap counts. Based on the cumulative frequency distribution, the outmigration timing from Montana Creek was approximately three to four weeks earlier than from the Indian River site and the outmigration period ended by early-July (Figures 5.2-5 and 5.2-8).

5.2.1.1.2. Juveniles/Parr

Collections of age-1+ size Chinook salmon that did not show physical signs of smoltification occurred throughout the open-water season at all sites. The cumulative frequency distributions and period of these observations extended later in the year than collections of the smolts. This finding suggests their movements might be more in relation to dispersal than outmigration.

5.2.1.1.3. Smolts

During 2013, Chinook salmon smolts were present in the traps upon deployment in mid- and late-June. Large numbers of smolts were collected in the tributary locations as well as in the mainstem Susitna at Talkeetna. Small numbers of Chinook salmon smolts were captured at the Curry Station trap for a brief period during the third week of June.

A protracted period of downstream movement was observed at the Indian River site with peak observations of Chinook salmon smolts occurring during the last week of June and early July (Figure 5.2-1). In contrast to the 1980s data (Roth and Stratton 1985, Roth et al. 1986), more than 40 percent of the cumulative frequency of the outmigration occurred in the Indian River after July 1, 2013. The cumulative frequency of age-1+ Chinook salmon captured in 2013 in the Indian River did not reach 90 percent until September 17th (Figure 5.2-5). Smolt catch continued until the end of September.

Peak observations of Chinook salmon smolts in the mainstem Susitna River at the Talkeetna trap also occurred in late June (Figure 5.2-3). Although the 90th percentile of the movement occurred by July 16, some smolts remained in the Middle River until late September (Figure 5.2-7).

In the Lower River, Chinook salmon smolts in Montana Creek were present upon trap deployment and their abundance peaked during the month of July (Figure 5.2-4). Ninety percent of the downstream movement had occurred by August 11 and some smolts were present until the third week of September (Figure 5.2-8).

5.2.1.2. Chum Salmon

5.2.1.2.1. Fry

Results for chum salmon fry varied during the 2013 outmigration trapping window. Chum salmon fry were present in the catch at the onset of monitoring in mid- to late-June at all four traps. However, their peak movements did not occur in the tributary locations until mid-July (Figures 5.2-1 and 5.2-4). Peak observations in the mainstem Susitna River sites were from late-July to early-August, a week or two later than the peak movements observed in the tributaries

(Figures 5.2-2 and 5.2-3). The outmigration from the tributary sites was largely complete by the end of July or the first week of August and from the mainstem locations by the end of August.

5.2.1.2.2. Juveniles/Parr

Collections of age-0+ chum salmon that did not show physical signs of smoltification were infrequent. The season average smolt-to-parr ratio of the juvenile chum salmon recorded at the four sampling locations ranged from 8:1 at Indian River to 22:1 at Montana Creek (Table 5.2-2). These data show a higher frequency of smolts in trap catch from traps further downstream.

5.2.1.3. Coho Salmon

5.2.1.3.1. Fry

In 2013, coho salmon fry were present in tributary rotary screw traps upon trap deployment, but were not captured in the mainstem traps until early to mid-July. Peak observations occurred in the Indian River from mid-June through late July with the 90th percentile of the downstream movement occurring by August 14 (Figure 5.2-5).

Coho salmon fry movements in the Susitna River at Curry Station peaked between late-July and late-August reaching the 90th percentile of the frequency distribution on August 30 (Figure 5.2-6). Coho salmon fry were present at the Curry Station location until early September. These observations were approximately three weeks earlier than the catch in the Talkeetna Station trap, approximately 18 river miles further downstream. At Talkeetna Station, the cumulative frequency of age-0+ coho salmon captured in 2013 did not reach 90 percent until September 20 (Figure 5.2-7). There were insufficient coho salmon fry collections at the Montana Creek trap to provide a summary of age-0+ movement in tributaries to the Lower River.

5.2.1.3.2. Juveniles/Parr

Large numbers of juvenile coho salmon that did not show physical signs of smoltification were collected throughout the open-water season at most trapping sites. The cumulative frequency distributions and period of these observations was similar to smolt collections. The 90th percentile of the cumulative frequency of recorded juvenile coho salmon and coho salmon parr occurred on the last day of August at Curry Station and on September 20, at Talkeetna Station (Figures 5.2-6 and 5.2-7).

The season average smolt-to-parr ratio of the juvenile coho salmon recorded at the four sampling locations ranged from 0.01:1 at Curry Station to 2:1 at Talkeetna Station and Montana Creek (Table 5.2-2). These data show a slightly higher frequency of coho salmon smolts in the Talkeetna Station and Montana Creek traps as compared to the upstream traps at Indian River and Curry Station.

5.2.1.3.3. Smolts

Coho salmon smolts were collected upon deployment at all four traps. Peak movements were recorded in the tributary locations between late-July and late-August, while peak coho salmon smolt movements in the mainstem sites were a week or two later, ranging from late-August to early-September. The 90th percentiles of the recorded frequency distributions were during the last week of August for Indian River and the Susitna River at Talkeetna Station (Figures 5.2-5 and 5.2-7). Ninety percent of the outmigration did not pass the Montana Creek trap until September 9, 2013 (Figure 5.2-8). Insufficient numbers of coho salmon smolts were captured at the Curry Station trap to provide information on outmigration.

5.2.1.4. Pink Salmon

5.2.1.4.1. Fry/Smolts

Juvenile age-0+ pink salmon were only captured in large numbers at the Indian River trap during 2013. Few collections were reported at the mainstem Susitna traps and at the Montana Creek trap. The mainstem collections were consistent with 1980s studies; the last pink salmon fry was captured at the Talkeetna station on July 26, 2013 (Figure 5.2-3). In 2013, the Indian River trap collected more than 400 fry during the sampling season providing a sufficient sample size to assess outmigration timing. Juvenile pink salmon were present at the site when the trap was deployed on June 17. Peak capture rates were recorded between mid-June through early-July with 90 percent of the outmigration occurring by July 8 (Figure 5.2-5). However, some young-of-the-year fry were captured at the site through the month of July.

5.2.1.5. Sockeye Salmon

5.2.1.5.1. Fry

Few (148) sockeye salmon fry were captured during the 2013 trapping season from the Indian River or mainstem Susitna River traps and none were observed in Montana Creek in the Lower River (Table 5.2-1).

5.2.1.5.2. Juveniles/Parr

Collection of age-1+ size sockeye salmon that did not show physical signs of smoltification was infrequent. The timing of smolts and juvenile catches did not vary markedly among traps during 2013. The season average smolt-to-parr ratio of the juvenile sockeye salmon at Indian River was 7:1; at Talkeetna Station the average ratio was 49:1 (Table 5.2-2). Although the sample size was small, these data are consistent with the pattern observed for other salmon species in which the downstream traps captured a higher percentage of smolts.

5.2.1.5.3. Smolts

Age-1+ sockeye salmon smolts were captured mostly at the Indian River and Talkeetna Station traps during 2013, with a few additional sockeye salmon collected at the Curry Station trap. The outmigration of smolt-size sockeye salmon at Indian River began in early July and peaked late July and early August (Figure 5.2-1). The cumulative frequency of the collections reached 90 percent by August 9 (Figure 5.2-5). The outmigration timing in the mainstem Susitna River at Talkeetna Station was somewhat broader than Indian River during 2013, with smolt-sized catch starting in mid-June, peaking in mid-July through the end of August, and ending by late September. The cumulative frequency distribution reached 90 percent by September 14, a month later than for sockeye salmon smolts that left the Indian River (Figure 5.2-7).

5.2.2. Task B: Describe seasonal movements using biotelemetry

5.2.2.1. Radio Telemetry

The radio telemetry results below include reporting from fish tagged in July and August and tracked through the end of August 2013.

Data developed in support of the ISR is available for download at http://gis.suhydro.org/reports/isr (ISR_9_6_FDAML_RadioTelemetry).

5.2.2.1.1. Arctic grayling

Movement of radio-tagged fish

Arctic grayling radio-tagged in June primarily moved upstream to tributaries (Table B1). For example, Fish 9004 (Figure B2) and Fish 9016 (Figure B3) moved 15 to 20 river miles from their tagging location at Curry to the Indian River and Portage Creek, respectively. Movements were less pronounced in July and August as fish remained within approximately five river miles of their tagging location or prior detection.

Identification of foraging and spawning locations

Arctic grayling were observed at a number of potential foraging areas. Radio-tagged fish resided at the mouths of clear-water streams (Lane, Portage, Fog, and Tsusena creeks and Indian River), and also moved into some tributaries (Portage Creek and Indian River) for portions of the summer. Arctic grayling were not spawning during the analysis period of June through August.

Post-Tagging Survival

As of August 31, 20 of the 29 (69 percent) radio-tagged Arctic grayling were alive. Two of the mortalities occurred within two weeks of the surgery (Table B1).

5.2.2.1.2. Burbot

Movement of radio-tagged fish

Burbot tagged in June moved less than five river miles from their tagging location (Figure B4). Fish radio-tagged at Talkeetna Station moved downstream to the mouth of the Talkeetna River (Figure B5), while fish radio-tagged in the Lower River remained near the mouth of the Yentna River during their short analysis period. The relatively small sample size limits the degree to which patterns can be inferred.

Identification of foraging and spawning locations

Burbot tended to reside in proximity to the confluence of tributaries during the summer which may indicate potential foraging locations. Fish were detected near the confluence of the Chulitna and Susitna rivers, as well as near the confluence of the Yentna and Susitna rivers. Burbot were not spawning during the analysis period of June through August.

Post-Tagging Survival

As of August 31, six of the seven (86 percent) of the radio-tagged burbot were alive (Table B2). The one mortality occurred within two weeks of the fish being radio-tagged.

5.2.2.1.3. Dolly Varden

Movement of radio-tagged fish

A Dolly Varden radio-tagged in June moved 15 river miles upstream in the Susitna and entered the Indian River in early July (Figure B7). This fish stayed in the Indian River for all of July and August and ranged over a distance of approximately five river miles. Six Dolly Varden radio-tagged in early July in the Talkeetna River remained within three river miles of their tag location (Table B3, Figure B8) for the analysis period. Two fish radio-tagged in August showed moderate movement with one moving upstream approximately eight river miles and one moving downstream approximately 20 river miles (Table B3, Figure B6). The relatively small sample size limits the degree to which patterns can be inferred.

Identification of foraging and spawning locations

Potential foraging areas identified for Dolly Varden were Indian River and Clear/Chunilna Creek as based on their tendency to reside in these tributary zones during the summer. Dolly Varden were not spawning during the analysis period of June through August.

Post-Tagging Survival

As of August 31, nine of nine radio-tagged Dolly Varden were alive (Table B3).

5.2.2.1.4. Longnose sucker

Movement of radio-tagged fish

Most longnose sucker remained within two to seven river miles of their tagging location (Table B4), although some migrated upstream 15 to 20 river miles (Figures B10 and B11). In the first week of August, at least three fish displayed movements of substantial distance (greater than10 river miles). These movements included an individual that moved upstream from Curry (PRM 124) to the Susitna River in the vicinity of the Indian River confluence (PRM 142) (Figure B11) and individuals that moved downstream from tagging locations at Indian River and Curry (Figure B9, Table B4).

Identification of foraging and spawning locations

The mouths of Indian River and Portage Creek were identified as potential foraging areas for longnose sucker. Additional mainstem locations that may have been foraging locations were located downstream of Indian River, and both upstream and downstream of the mouth of Lane Creek. Although the general spawning period is considered May through July, no potential spawning locations for longnose sucker were identified during the analysis period of June through August as based on their condition at tagging, and the apparent lack of aggregations.

Post-Tagging Survival

As of August 31, 14 of the 27 (52 percent) radio-tagged longnose sucker were alive (Table B4). Seven of the mortalities occurred within two weeks of the fish being radio-tagged.

5.2.2.1.5. Northern pike

Movement of radio-tagged fish

All of the northern pike remained within one river mile their tag site (Table B5). The relatively small sample size limits the degree to which patterns can be inferred.

Identification of foraging and spawning locations

Northern pike were caught in Fish Creek nears its confluence with Kroto Slough (PRM 34). This is potentially a foraging area based on habitat characteristics. Northern pike were not spawning during the analysis period of June through August.

Post-Tagging Survival

Four of the five (80 percent) northern pike radio-tagged in August were alive at the end of August (Table B5).

5.2.2.1.6. Rainbow trout

Movement of radio-tagged fish

Rainbow trout tagged in the mainstem Susitna during June predominantly migrated upstream 7 to 15 river miles into the lower reaches of tributaries including 4th of July Creek and Indian River (Table B6, Figures B12 and B13), while fish radio-tagged near tributaries in July predominantly stayed within two river miles of their tagging location through August (Table B6, Figures B14 and B15). After the initial upstream movement in June, rainbow trout were primarily located in or near clear-water tributaries (Figure B12).

Identification of foraging and spawning locations

All of the potential foraging locations observed for rainbow trout were in or near clear-water streams. Tributaries that may have been used for foraging include Indian River and 4th of July, Clear/Chunilna, and Montana creeks. Rainbow trout had likely finished spawning before the analysis period as no spawning aggregations were identified. However, with late break-up in 2013, it is possible that upstream movements into tributaries in June could have been related to spawning.

Post-Tagging Survival

As of August 31, 25 of the 31 (81 percent) radio-tagged rainbow trout were alive (Table B6). One of the mortalities occurred within two weeks of the fish being radio-tagged.

5.2.2.1.7. Humpback whitefish

Movement of radio-tagged fish

Most humpback whitefish moved downstream within two weeks after release (Table B7, Figure B16). It is uncertain if this observation was an indication of a handling or surgery effect, or documentation of substantial migrations (20 to 30 river miles). The relatively small sample size from summer tagging limits the degree to which patterns can be inferred. Data from subsequent tagging events will help to clarify this behavior.

Identification of foraging and spawning locations

There were insufficient detections of humpback whitefish to infer potential foraging locations. Humpback whitefish were not spawning during the analysis period of June through August.

Post-Tagging Survival

As of August 31, three of the six (50 percent) radio-tagged humpback whitefish were alive (Table B7). Two of the three mortalities occurred within 2 weeks of the fish being radio-tagged.

5.2.2.1.8. Round whitefish

Movement of radio-tagged fish

Round whitefish radio-tagged in June at Curry displayed a variety of movements. Some fish moved upstream 35 river miles (Fish 9013, Figure B18), while others moved downstream a similar distance (Fish 9011, Figure B19). A few remained within five river miles of where they were radio-tagged (Figure B17). Round whitefish radio-tagged in July remained within five river miles of where they were radio-tagged (Table B8). Little movement was observed in August with most fish located in the mainstem Susitna and a few in tributaries (Talkeetna River and Portage Creek).

Identification of foraging and spawning locations

Round whitefish used two tributaries (Portage and Clear/Chunilna creeks) as potential foraging locations during the analysis period. In the mainstem of the Susitna River, the mouth of Gold Creek and Sloughs 11 and 8A were also potential foraging areas. Round whitefish were not spawning during the analysis period of June through August.

Post-Tagging Survival

As of August 31, 12 of the 14 (86 percent) radio-tagged round whitefish were alive (Table B8). Both mortalities occurred within two weeks of the fish being radio-tagged.

5.2.2.2. PIT Tagging

A total of 5,657[2] PIT tags were implanted in 11 different fish species groups in the Middle and Lower River (Table 5.2-3). Coho salmon were the most frequently tagged species (n=2,092), followed by Chinook salmon (n=1,696), Arctic grayling (n=378), rainbow trout (n=309), round whitefish (n=300), and burbot (n=223). Of the fishes implanted with PIT tags and released, 13 percent (n=782) were subsequently resighted in the Middle or Lower River, either via detection at PIT stream arrays or recaptured during later fish sampling (Table 5.2-3). For the purposes of the ISR, only recaptures of fish identified to species were used for movement analysis. Thus a total number of 723 resightings were used to describe movements of the following 9 species. Coho salmon (n=352) were the species most commonly resighted, followed by Chinook salmon (n=223), rainbow trout (n=74), Arctic grayling (n=42), burbot (n=32), sockeye salmon (n=8), Dolly Varden (n=10), round whitefish (23), and humpback whitefish (1). As a percentage of fish tagged for a given species, rainbow trout (24 percent) and coho salmon (17 percent) were the most commonly resighted species. Individuals from two species, chum salmon (n =13) and longnose sucker (n=11) were tagged and released, but never resighted in 2013.

Movements between macrohabitat types were identified by comparing where fish were tagged and released to where they were subsequently resighted. Detections at fixed arrays (664) accounted for approximately 85 percent of resightings (Table 5.2-4). The Indian River antenna was located in a split tributary channel while the Montana Creek antenna was located in a single tributary channel; these two arrays had moderate numbers of fish detections, 122 and 101 fish respectively. The other two antenna arrays were located in side slough off-channel macrohabitat, but the array in Slough 8a detected only 42 fishes while the Whiskers Slough array detected 404 fishes (Table 5.2-4). Rotary screw traps and PIT antennas were situated in fixed locations, thereby biasing the frequency with which fish were encountered in a given macrohabitat type. Nonetheless, a comparison of the locations at which fish are tagged and subsequently encountered offers a means of documenting movement between macrohabitat types.

Data developed in support of the ISR is available for download at http://gis.suhydro.org/reports/isr (ISR_9_6_FDAML_PITTagData).

5.2.2.2.1. Chinook Salmon

All Chinook salmon resightings occurred within the same geomorphic reach or downstream of the reach in which they were tagged. There was only one juvenile Chinook salmon that moved between stream basins; this 90 mm (3.5 in) fish moved from the Talkeetna Station trap on the Susitna River to Montana Creek where it was detected by the stream array six days after release. Eighteen juvenile Chinook salmon exhibited some limited upstream movement (approximately

[2] Of these deployed tags, 119 were recorded as duplicate implant codes and 53 had conflicting species identifications upon recapture. Until information associated with these tags can be reconciled, they have been excluded from analyses. Thus, the adjusted dataset consisted of 5,485 PIT-tagged fish.

100 m [328 ft]) after being tagged at the Indian River rotary screw trap based on their subsequent detection at the Indian River PIT antenna.

Most of the juvenile Chinook salmon resighted (187) were detected at one of the four PIT antennas located in the Middle and Lower River (Table 5.2-3). In addition, 44 juveniles were recaptured at rotary screw traps or during fish sampling in other habitats. Numbers of Chinook salmon by macrohabitat type in which tagged salmon were released and resighted are displayed in Table 5.2-5. Of the salmon initially captured and released in main channel habitat, 84 percent were subsequently encountered in side slough off-channel habitat. Of the salmon initially captured and released in off-channel habitat, 100 percent of subsequent observations were also in off-channel habitat, primarily in side sloughs (78 percent). Chinook salmon tagged and released from tributary habitat were most commonly encountered in the same tributary (65 percent), although 33 percent were encountered in side slough off-channel habitat in the Susitna River.

5.2.2.2.2. Coho Salmon

All juvenile coho salmon that were resighted were observed within the same geomorphic reach or downstream of the reach in which they were tagged. Likewise, there was no evidence of any tagged coho salmon juveniles moving into a tributary from the Susitna River or between tributaries. Similar to Chinook salmon, 69 tagged juvenile coho salmon exhibited limited upstream movement (approximately 100 m [328 ft]) from the Indian River rotary screw trap to the Indian River PIT antenna.

Most PIT-tagged juvenile coho salmon (286) were resighted at one of the four PIT antennas located in the Middle and Lower River (Table 5.2-3). In addition, 76 juveniles were recaptured at rotary screw traps or during fish sampling in other macrohabitats. Numbers of coho salmon released and resighted by macrohabitat type are presented in, Table 5.2-6. The majority of coho salmon resighted after tagging were found in off-channel habitat (67 percent), primarily side sloughs (56 percent). Of the juvenile coho salmon tagged in tributary habitat, 37 percent were later found in off-channel habitat in the Susitna River while 3 percent were encountered in main channel habitat in the Susitna River. The remaining 60 percent were observed in the same tributary in which they were tagged.

5.2.2.2.3. Sockeye Salmon

A total of eight juvenile sockeye salmon (60-69 mm [2.4-2.7 in]) were resighted after tagging in the Middle River. Three were recaptured by fish sampling in the same habitat either later the same day or the day following tagging in Focus Areas FA-115 (Slough 6A) and FA-128 (Slough 8A). The remaining five salmon were detected by adjacent PIT antennas a few days after release. One of these five salmon (62mm [2.4 in]) was detected in Indian River. The other four, were all detected by the Slough 8A PIT array (PRM 129). While these salmon in Slough 8A were tagged and released on different days (tagging dates September 7, 22, 23), they were all detected downstream at the Slough 8A PIT antenna three to four days after release (detection dates September 10, 26, 27).

5.2.2.2.4. Arctic Grayling

Of the 42 Arctic grayling that were resighted, eight juveniles (mean 94 mm [3.7 in]) were documented moving between stream basins. Six fish tagged and released at the Talkeetna Station rotary screw trap (PRM 106.9) and two fish tagged and released at the Indian River rotary screw trap (PRM 142.1) were detected at the Montana Creek PIT array (PRM 80.9). These fish were tagged between June 20 and July 16, and detected in Montana Creek between July 10 and July 31.

Other movements documented included movements within the mainstem Susitna River and within tributaries. Twenty-two juveniles (mean 82 mm [3.2 in]) tagged in Whiskers Creek on September 21 were detected at the Whiskers Slough PIT antenna (PRM 105) between September 22 and October 5. Of the 34 tagged Arctic grayling resighted in tributaries, approximately 65 percent were found in side slough off-channel habitat in the Susitna River while 35 percent were found in tributaries. Only two PIT-tagged, adult Arctic grayling (mean 370 mm [14.6 in]) were resighted after release. These grayling were released in the Indian River on June 20 and July 16 and detected at the Indian River PIT array between July 17 and August 4.

5.2.2.2.5. Burbot

Thirty one out of the 32 burbot resighted exhibited limited movement and were found in the same geomorphic reach in which they were tagged and released. Three of these resightings were of adult burbot (mean TL=530 mm [20.9 in]) and included the one Burbot that moved between streams. This adult burbot was tagged and released in a Susitna River backwater in MR-7 on August 2 and was recaptured in the Talkeetna Station rotary screw trap (MR-8; PRM 106.9) on August 10. The other two adult burbot were tagged in mainstem Susitna River habitats (side slough and main channel) and were detected post-release at the Whiskers PIT array (PRM 105).

Twenty-two juvenile/adult burbot (mean 409 mm [16.1 in]) were resighted. Of the 10 fish tagged in main channel habitat, 90 percent were resighted in off-channel habitat. The remaining 12 fish were all tagged, released and resighted in off-channel habitat. Most of the juvenile/adult burbot resightings occurred at the Whiskers Slough (n=11; PRM 105) and the Slough 8A PIT (n=9; PRM 129) arrays.

Seven juvenile burbot (mean 177 mm [7 in]) were resighted. Five of these fish were tagged, released and resighted in off-channel habitat. One burbot tagged in main channel habitat was recaptured during fish sampling 14 days later, also in main channel habitat. One other juvenile burbot was tagged in Whiskers Creek and detected the next day at the Whiskers Slough PIT array (PRM 105).

5.2.2.2.6. Dolly Varden

A total of 10 PIT-tagged Dolly Varden were resighted in the Middle and Lower Susitna River. Five Dolly Varden were recaptured by the rotary screw trap at the mouth of the Indian River and then later detected by the Indian River PIT antenna approximately 100m upstream. One adult Dolly Varden (396 mm [15.6 in]) was released in the Indian River and later was detected downstream at the Indian River PIT array. Another Dolly Varden was tagged in a beaver complex adjacent to the Indian River on July 25 and then approximately one month later was recaptured downstream in a different pond but within the same beaver complex.

Three Dolly Varden were detected by the PIT antenna located in Whiskers Slough (RM 105). Two of these fish were tagged upstream in Whiskers Creek while the other fish was originally tagged in a side channel habitat and detected three days later.

Only one Dolly Varden (213 mm [8.4 in]) was detected at the PIT array in Montana Creek (PRM 80.8) in the Lower River. Originally captured by the Montana Creek rotary screw trap on July 31, this fish was detected upstream (~200 m) on two subsequent occasions, once on August 7 and then again on August 14.

One PIT-tagged Dolly Varden (199 mm [7.8 in]) displayed a more extensive movement pattern compared to the localized movements of the others. This fish was captured at the Talkeetna Station rotary screw trap (PRM 106.9) and later detected by the Slough 8A PIT antenna (PRM 129), having traveled 22 miles upstream. It was detected on seven different days between late June and early July.

5.2.2.2.7. Rainbow Trout

Movements of PIT-tagged rainbow trout were limited. All but one trout were resighted within the same geomorphic reach in which they were tagged. The one exception, a juvenile trout (76 mm [3 in]) was tagged on August 1 in Unnamed Tributary 113.7 (reach MR-7) and was detected approximately 9 miles downstream at the Whiskers Slough PIT array (PRM 105 in reach MR-8) on August 11.

The majority of rainbow trout resightings were in off-channel habitat. Of the fish that were released in main channel habitat, 90 percent (n=9) of those were resighted in off- channel, side slough habitat. Likewise, 56 percent (n=30) of tagged trout released in tributary habitat were resighted in off-channel, side slough habitat.

Five rainbow exhibited movement out of the Susitna River and into tributaries. Two juvenile/adult rainbow trout tagged and released on June 24 in Susitna River off-channel habitat (~PRM 141) were detected at the Indian River PIT array (PRM 142.1); one fish (280 mm [11 in]) was detected 2 days later while the other (227 mm [8.9 in]) was detected on several occasions between June 25 and August 13. An adult trout (370 mm [14.6 in]) was tagged and released in a side channel of the Susitna River (~PRM 128) on June 14 and detected at the Indian River PIT array on several occasions between July 12 and July 27. Two juvenile/adult rainbow trout were tagged and released in a Susitna River side slough near PRM 104 and were resighted in Whiskers Creek. Both of these juvenile/adult trout were recaptured in Whiskers Creek (September 21) in between repeated detections in Whiskers Slough.

5.2.2.2.8. Round Whitefish

A total of 23 PIT-tagged round whitefish were resighted in the Middle and Lower Susitna River. Except for one fish documented in Montana Creek (PRM 80.8) on August 5, all round whitefish were observed in the Middle River. Within in the Middle River, twelve round whitefish were detected by PIT antennas nearby original tagging locations. This movement pattern was observed at Whiskers Slough (PRM 105; n=4), Slough 8A (PRM 129; n=6), and Indian River (PRM 142.1; n=2). Although most of these fish were detected on the same day or shortly after being tagged, one adult round whitefish (335 mm [13.2 in]) was detected at Whiskers Slough two months after tagging.

Another group of 10 round whitefish displayed more extensive movement patterns. Two fish tagged in Slough 11 (PRM 138) side slough habitats in June were detected upstream in the Indian River by the Indian River PIT array, over a month later. Another eight round whitefish that were tagged and released from a wide range of locations were detected post-release by the Whiskers Slough PIT array. This included five round whitefish released at Talkeetna Station (PRM 106.9) who traveled approximately 2 miles downstream, one whitefish released in the mouth of Slough 6A (PRM 115) who traveled approximately 10 miles downstream, one juvenile round whitefish released in Slough 8A side channel habitat (PRM 129) who traveled approximately 24 miles, and juvenile round whitefish who was released from backwater habitat at the mouth of the Indian River (PRM 142.1) and traveled over 37 miles downstream.

5.3. Objective 3: Early Life History

A combination of juvenile anadromous and resident fish species were captured during three Early Life History sampling events between May and June, 2013 (Figure 5.3-1, Table 5.3-1). In the Middle River, Fog Creek was the only site sampled above Devils Canyon; this stream supported resident Dolly Varden char and sculpin (Table 5.3-1). Fish found in Middle River below Devils Canyon included both juvenile salmon and resident fish species. Pacific salmon juveniles were abundant in these sites, especially newly emerged Chinook, chum, coho and sockeye salmon fry (Table 5.3-1). Catch of resident fishes primarily consisted of longnose sucker and sculpin (Table 5.3-1). Other species present in lower numbers included Arctic grayling, burbot, Dolly Varden, lamprey, rainbow trout, threespine stickleback, and humpback and round whitefish (Table 5.3-1).

Juvenile anadromous and resident fish species were also present in the Lower Susitna River. The Lower River fish catch was comprised of juvenile salmon (Chinook, chum, coho, and sockeye), lamprey, longnose sucker, rainbow trout, sculpin, ninespine stickleback, threespine stickleback, and round whitefish (Table 5.3-1). Also of note was the presence of northern pike at the lowermost site (PRM 34) (Table 5.3-1).

Juvenile salmon fry (fork length less than 50 mm [2 in]) were present at the majority of locations visited during Early Life History sampling (Table 5.3-2). Four species of salmon fry (Chinook, chum, coho, and sockeye) were documented during the first Early Life History sampling event in late April to early May. All five species of salmon fry were documented during Events 2 and 3 in June (Table 5.3-2). Chum salmon were the most abundant species of salmon fry documented, followed by sockeye, Chinook, coho and pink salmon (Table 5.3-2). Although the number of sites sampled and gear types varied between sampling events, numbers of salmon fry generally increased between sampling events, with the most fry documented during Event 3 (Table 5.3-2). Fifty-seven fry were observed during Event 1, 576 fry during Event 2, and 920 during Event 3 (Table 5.3-2). Most of the fish observed in June (Events 2 and 3) were chum salmon fry caught in a fyke net in FA-138 (Gold Creek) (Table 5.3-2).

Although AEA was not able to document precise emergence timing, evidence about emergence timing was collected for all five Pacific salmon species. A few chum, pink and sockeye salmon alevin and fry were documented in mid-April during the last Winter Study trip (Appendix C) and Chinook, chum, coho, and sockeye were also collected during the first Early Life History sampling event from late-April to early-May (Table 5.3-2). Average fork lengths of chum, pink and sockeye salmon fry during Event 1 in the mid-30's (mm) indicate that these fish had recently emerged (Table 5.3-3). In contrast, average fork lengths around 40 mm (1.6 in) for Chinook and coho salmon observed during Event 1 were longer than in subsequent sampling events, indicating that some fry emergence for these two species may have occurred later in the open water period (Table 5.3-3).

A late break-up of ice on the main channel of the Susitna River prevented sampling in May. Not being able to collect data during this critical time likely limited AEA's ability to draw conclusions about spring emergence timing of salmon fry. The fact that only four pink salmon fry were caught during Early Life History sampling suggests that these fry likely moved downstream during river break-up (Table 5.3-2).

No clear patterns of movement by salmon fry were observed between spawning and rearing habitats within sites or between Middle and Lower Susitna River sites during Early Life History sampling (Table 5.3-2). Although overall numbers of salmon fry increased between sampling events in the Middle River, many sites in the Lower River were only sampled once, limiting conclusions regarding fish movement at smaller and larger spatial scales (Table 5.3-2).

Data developed in support of the ISR is available for download at http://gis.suhydro.org/reports/isr (ISR_9_6_FDAML_FishObservations).

5.4. 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 is ongoing. As of January 29, 2014, three burbot, two humpback whitefish, and ten round whitefish had active tags and were alive in the Middle and Lower River study area (Table 4.5-3). Additionally, two burbot and nine round whitefish tagged in the Upper River study area were alive with active tags. Ongoing efforts, including monthly aerial surveys to relocate tagged individuals and detections at fixed stations, are gathering information that will be used to address this objective in the Updated Study Report.

Data developed in support of the ISR is available for download at http://gis.suhydro.org/reports/isr (ISR_9_6_FDAML_RadioTelemetry).

5.5. Objective 5: Characterize the seasonal size/ life stage structure, growth, and condition of juvenile anadromous and resident fish by habitat type.

5.5.1. Growth by Habitat Type

The number of PIT-tagged and recaptured fish used in the growth analysis for the Middle and Lower Susitna River is presented in Table 5.5-1. Forty-four (44) juvenile Chinook salmon and two Arctic grayling were recaptured at locations where they could be measured and weighed. Fish recaptures less than seven days in duration were eliminated from the growth analysis. The tally of fish with seven days or more in duration between recapture events resulted in a sample size of 13 Chinook salmon and no Arctic grayling. The site-specific growth rates for juvenile Chinook salmon are described below:

Of the 13 juvenile Chinook salmon that qualified for the growth assessment, nine were recaptured in the mainstem Susitna River. One of the mainstem Chinook was collected from the main channel, while eight were recaptured in off-channel habitat areas including upland sloughs with beaver complexes and a side slough with a beaver complex (Table 5.5-2).

Although the sample size is small, the data suggest that the month and fish size at tagging had the largest influence on specific growth rates (Figure 5.5-1). The date of tag implantation showed a considerable effect on juvenile fish growth. The month of July supported higher growth than August, while growth during September was minimal. The change in water temperature and its influence on fish metabolism is likely the underlying reason for this observation. In addition, small fish grew at a faster rate than large fish (Figure 5.5-1). These findings are consistent with the scientific literature which suggests that the growth rate of fish is primarily controlled by the size of the organism and environmental conditions that impact metabolism.

Juvenile Chinook growth in the Middle and Lower River by habitat types are shown in Figure 5.5-2. Given the small sample size, differential growth rates among habitat types are not discernable. Tagging month and fish size outweighed any influence of habitat types on specific growth rates for juvenile Chinook salmon in the Middle and Lower River.

Data developed in support of the ISR is available for download at http://gis.suhydro.org/reports/isr (ISR_9_6_FDAML_PITTagData).

5.5.2. Condition Factor by Habitat Type

A summary of the condition factors by habitat type is described for the pilot species below.

Data developed in support of the ISR is available for download at http://gis.suhydro.org/reports/isr (ISR_9_6_FDAML_FishCondFactors).

5.5.2.1. Juvenile Chinook Salmon

Juvenile Chinook salmon mean condition factor ranged from 0.88 to 1.59 in the Middle and Lower River (Table 5.5-3, Figure 5.5-3). This condition factor was relatively consistent across habitat types with 93 percent of mean values ranging between 0.9 and 1.2. Overall, mean condition factors were slightly higher in the Lower River compared to those calculated for Middle River habitat types. The highest mean values were found in Middle River upland slough and main channel habitat and in Lower River upland slough, tributary, and side channel habitat. The lowest mean value in the Middle River was in MR-7 side channel habitat. In the Lower River, the lowest three mean values were very similar and were found in main channel, upland slough with beaver influence, and side slough habitat. No relationship between mean condition factor and habitat type was evident for juvenile Chinook salmon in the Middle and Lower River.

5.5.2.2. Arctic Grayling

Arctic grayling mean condition factor was lower and more variable than for juvenile Chinook salmon. It ranged from 0.73 to 1.17 across all Middle and Lower River habitats and similar to Chinook salmon, appeared to be slightly greater in the Lower River as compared to Middle River values (Figure 5.5-4; Table 5.5-4). The highest mean values were found in Middle River main channel and in Lower River clearwater plume and side channel habitat. In the Middle River, the lowest three mean values were close and were found in backwater, side slough, and tributary mouth habitat. The lowest mean value in the Lower River was in tributary habitat. No relationship between mean condition factor and habitat type was evident for Arctic grayling in the Middle and Lower River.

5.6. Objective 6: Document the seasonal distribution, relative abundance, and habitat associations of invasive species (northern pike).

Northern pike were the only invasive fish species documented during 2013 field surveys; 62 northern pike were observed during all sampling in the Lower River (Table 5.1-3). As discussed previously in Section 5.1.1, their documented distribution based on ground surveys was limited to the lowermost geomorphic reach within the study area (i.e., LR-4; Table 5.1.1-1) and did not appear to vary on a seasonal basis (Table 5.1.1-12). Furthermore, observations of northern pike during the early life history and systematic distribution and abundance sampling, which included 42 adults and 15 juveniles, were limited to four sites located in and near Fish Creek (PRM 34.1; Table 5.6-1). During seasonal distribution and abundance sampling, angling accounted for most northern pike observations followed by minnow trapping, snorkeling, boat electrofishing, backpack electrofishing, and seining (Table 5.1-6).

Although five adult northern pike were radio-tagged on August 16, 2013 and subsequently tracked via aerial surveys, there is currently insufficient information to decipher additional seasonal distribution patterns for this species. Additionally, the small sample size and a post-tagging survival rate of 80 percent preclude the interpretation of results (Table 4.5-3). However, it is worth noting that during the August 16 through 31 tracking period, all tagged fish were detected within one mile of their tagging location. Radio-tagging and tracking efforts are ongoing, and additional results will be reported in the Updated Study Report.

Among gear types, angling accounted for the majority of observations of northern pike (Table 5.1-3). Northern pike angling CPUE during the three angling events conducted in LR-4 ranged from 0 to 4.7 pike/hour and 0 to 4.4 pike/50 casts (Table 5.6-2). Angling CPUE was highest for tributary glide habitat. Northern pike CPUE for other gear types presented in the relative abundance results (minnow trapping, snorkeling, boat electrofishing, backpack electrofishing, and seining) ranged from 0 at 97 percent of sites to 40 fish per 1,000 m^2 in tributary glide habitat within LR-4 (Table E169).

During the 2013 surveys, northern pike were documented in side slough, clearwater plume, and tributary habitats (Table 5.6-1; Table D72). Among these 3 habitat types, northern pike were most abundant within the tributary habitat (i.e., Fish Creek), where 50 of the 57 northern pike observations occurred. Six fish were found in the clearwater plume at the confluence of Fish Creek and the Susitna River, and a single juvenile pike was observed in the nearby side slough, Kroto Slough.

At the mesohabitat scale, northern pike were observed in a variety of mesohabitat types including glide, pool, clearwater plume, and run (Table 5.6-1; Table D72). The highest counts for both adults and juveniles were observed in tributary (Fish Creek) glide habitat where 30 and 12 fish were observed, respectively (Table 5.6-1). Eight adults were observed in pool habitat in Fish Creek, and 4 adults were observed in clearwater plume habitat. In addition to the 12 juveniles documented in Fish Creek glide habitat, 2 juveniles were documented in clearwater plume habitat, and 1 juvenile was documented in side slough run habitat (Table 5.6-1).

Data developed in support of the ISR is available for download at http://gis.suhydro.org/reports/isr (ISR_9_6_FDAML_FishObservations, and ISR_9_6_FDAML_FishCPUEData).

5.7. 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). Tissue collections for anadromous salmonid fishes are reported in the ISR for the Genetics Baseline Study Plan (ISR Study 9.14, Tables 4-1 through 4-5). The targeted resident and non-salmonid anadromous species and the number of samples are reported in RSP 9.14 Table 4-6. A summary of fish collected for genetic baseline development as part of this study is presented in Table 4.10-1.

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. Additional work for each of the study objectives will continue in the next year of study.

Detailed information specific to the status of each of the study objectives is provided in the sections that follow. The discussions include: an overview of interdependencies with other ISR studies, the current status of ISR studies that support the specific objectives of the Study of Fish Distribution and Abundance in the Middle and Lower Susitna River, a summary of key findings in 2013, and an assessment of the adequacy of the data collected in 2013 to meet the study objectives. Where applicable, a comparison between 2013 results and previously collected data in the Middle and Lower River study area is also provided.

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

There are three other Susitna-Watana Hydroelectric Project studies that support Objective 1 of the Study of Fish Distribution and Abundance in the Middle and Lower Susitna River. The Geomorphology Study (Study 6.5), Characterization and Mapping of Aquatic Habitats Study (Study 9.9), and the Study of Fish Passage Barriers in the Middle and Upper Susitna River and Susitna Tributaries (Study 9.12) were initiated in 2012 and have been used to inform the site selection process for Fish Distribution and Abundance studies in the Middle and Lower Susitna River study area. These studies also included work conducted in 2013 and will continue through the next year of study. Study variances in 2013 are not anticipated to affect the successful completion of the Study of Fish Distribution and Abundance in the Middle and Lower Susitna River. The Characterization and Mapping of Aquatic Habitats Study (Study 9.9) will also be used to describe fish-habitat associations for the Study of Fish Distribution and Abundance in the Middle and Lower Susitna River.

Work completed under Objective 1 of the Study of Fish Distribution and Abundance in the Middle and Lower Susitna River supports five other Susitna-Watana Hydroelectric Project studies. Fish collections in the Middle and Lower River are being used to: 1) help validate fish periodicity, habitat associations, and selection of target species for reach-specific analyses for the Fish and Aquatics Instream Flow Study (Study 8.5); 2) provide data on fish use of sloughs and tributaries with seasonal flow-related or permanent fish barriers for the Study of Fish Passage Barriers in the Middle and Upper Susitna River and Susitna Tributaries (Study 9.12); 3) and support the River Productivity Study (Study 9.8) through fish diet sample collections and information on fish-habitat associations. In addition, patterns of distribution and abundance from traditional sampling methods will complement information from radio telemetry, fishwheel, and sonar observations of salmon in the Salmon Escapement Study (Study 9.7). Fish distribution and abundance is also being used to complement information about harvest rates and effort expended by commercial, sport, and subsistence fisheries in support of the Fish Harvest Study (Study 9.15).

During the 2013 study year, 18 fish species were documented in the Middle and Lower Susitna River study area: Chinook salmon, chum salmon, coho salmon, pink salmon, sockeye salmon, Arctic grayling, burbot, Dolly Varden, lamprey (Arctic), longnose sucker, northern pike, sculpin (slimy), ninespine stickleback, threespine stickleback, rainbow trout, Bering cisco, humpback whitefish, and round whitefish. Species diversity was highest in the Lower Susitna River and declined in an upstream direction. All of the aforementioned species were observed in the Lower River study area, and with the exception of ninespine stickleback and Bering cisco, all these fishes were documented in the Middle River study area. Within the Middle River, the fish assemblage changed dramatically above Devils Canyon, PRM 153.9-166.1, where a series of three partial velocity barriers are present that restrict access to upstream habitat. Only Chinook salmon, Arctic grayling, burbot, Dolly Varden, longnose sucker, sculpin, humpback whitefish and round whitefish were observed above Devils Canyon.

The species and general distribution documented in 2013 are consistent with historical collection efforts (AEA 2013c) with two exceptions; ninespine stickleback were documented in the Lower River and eulachon were missing from 2013 fish distribution surveys. The timing of 2013 fish distribution surveys was not synched with the eulachon spawning run because there was a separate study (Study 9.16) focused on eulachon in 2013; documentation of the distribution of eulachon up to PRM 52.5 is presented in ISR Study 9.16.

With the exception of northern pike, all fish species observed in the Middle and Lower River study area are considered native to the basin. The distribution of northern pike determined by 2013 surveys was within the distribution described in the 1980s.

Determining the relative abundance of fish species by meso- and macro-habitat was successfully implemented in 2013. Species- and habitat-specific CPUE was determined for systematic sampling events at all ELH and fish distribution survey sites. These results showed general patterns of fish abundance as well as some species-specific patterns.

In general, fish were more abundant in the Middle River than the Lower River and fish in both these river segments were more abundant than in the Upper River. The highest CPUEs calculated were in MR-6 and MR-8, primarily associated with tributaries including Indian River, Whiskers Creek and nearby habitats. In the Lower River the highest CPUEs were in LR-1 and LR-4. These are similar to general abundance patterns documented in the 1980s. Fish appeared to be more abundant in habitats inside of Focus Areas than outside.

The most commonly observed species in the Middle River was coho salmon, followed by threespine stickleback and sculpin. This appears, at first look, to be in contrast with the 1980s reports of coho salmon being present in low densities. A more detailed comparison of the two data sets may help to determine if this apparent discrepancy holds true. In the Lower River threespine stickleback were most common, followed by Chinook salmon juveniles and longnose sucker. In the 1980s, longnose sucker was considered the most abundant fish in the Lower River. Abundance patterns for burbot were similar across studies; they were found in low relative abundance but were widespread across all sampling reaches and habitats. Consistent with 1980s data, juvenile Chinook and sockeye salmon were most abundant in MR-6 in habitats in and downstream of Indian River, while coho salmon juveniles were more abundant in MR-8 in and near to Whiskers Creek and Slough.

Data collected in 2013 allowed AEA to begin to look at species-specific habitat associations. For the purposes of the ISR, this evaluation was based on total fish observations as a preliminary approach with provisional data. Once data QA/QC is finalized the CPUE and habitat specific observational data can be evaluated in concert to develop a species-specific index of habitat use. This analysis will be completed for the USR. To date, the preliminary analysis is very consistent with what was determined in the 1980s. In the Middle and Lower River the greatest numbers of fish observations occurred in off-channel habitats and tributary habitats, predominantly in MR-7 and MR-6. In addition, the habitats where the greatest number of maximum CPUEs occurred were consistent between the Middle and Lower River; for macrohabitat types these were tributaries, upland sloughs and side sloughs and for mesohabitats it was glide/run habitat.

Although sampling with certain gear types resulted in CPUEs equal to zero for many habitat types and many species, other gear used in the same habitats was successful in catching fish. This is indicated by relatively low percentages of sites with no fish captured (Tables E1 and E104). Thus, AEA feels confident that the study design was effective in detecting fish when present. This is best illustrated by the success of the sampling design in documenting both widespread and abundant species like Arctic grayling, widespread and less abundant species such as burbot, and more rare species and life stages including juvenile Chinook salmon in the Upper River and Arctic lamprey in the Lower River.

Work completed in 2013 is on-track for meeting Objective 1. Work will continue during the next year of study to obtain additional data to support this task.

6.2. Objective 2: Seasonal Movements

Objective 2 of the Study of Fish Distribution and Abundance in the Middle and Lower Susitna River is supported by the Salmon Escapement Study (Study 9.7). The Salmon Escapement Study provides movement data for target species and life stages via fixed receiver and aerial tracking of radio-tagged fish. The study is ongoing, and variances in 2013 are not anticipated to affect the successful completion of the Study of Fish Distribution and Abundance in the Middle and Lower Susitna River.

Work completed under Objective 2 of the Study of Fish Distribution and Abundance in the Middle and Lower Susitna River supports two other Susitna-Watana Hydroelectric Project studies. Data collected on movement patterns will be used by the Fish and Aquatics Instream Flow Study (Study 8.5) to identify seasonal timing and fish distribution patterns among habitat types in support of the stranding and trapping study component. Fish movement and migratory timing data will also be utilized by the Study of Fish Passage Barriers in the Middle and Upper Susitna River and Susitna Tributaries (Study 9.12).

In 2013 AEA was successful in documenting fish movements with three different approaches. Rotary screw traps were used to document timing of downstream movements in select locations. Biotelemetry with both radio and PIT tags documented both local and longer distance movements among habitats for target species. These methods will continue through the winter of 2013/2014 and into the next study year to further describe fish behavior and habitat use.

Eighteen species and more than 11,000 fish were captured by four Middle and Lower River rotary screw traps while moving downstream. Traps provided information on Pacific salmon fry and smolt outmigration timing from Indian River and Montana Creek. In 2013 trap deployment was delayed as a late break-up coincided with the initiation of glacial melt. Although the beginning of fry and smolt movements were missed for many species, fry and smolts of all five anadromous salmon species were caught in some numbers and then the catch diminished denoting at the end of the outmigration. For some species and life stages, e.g. sockeye salmon in Indian River, trap catch documented the entire smolt outmigration in 2013. Timing of juvenile salmon movement generally was similar to that reported in the 1980s. One exception was the prolonged outmigration of Chinook salmon smolts. These smolts continued moving downstream several weeks later than suggested by 1980s data. Changes in smolt-to-parr ratios observed in trap catch from upstream to downstream traps over time indicates the possibility that some parr are undergoing physical changes associated with smoltification after leaving the tributaries.

Eight resident fish species were collected from the Middle and Lower River, implanted with radio tags, and tracked. The data presented for these tagged fishes through August showed variable degrees of movement. Tagged northern pike were the most sedentary with all tag detections less than one mile from their release location. Arctic grayling and burbot exhibited more moderated movements, all less than five miles from their release location. Distances traveled by Dolly Varden and rainbow trout were more variable among individual fish, with some fish moving less than 5 miles and others more than 10 miles. Longnose sucker, humpback and round whitefish exhibited the most extensive movements with some tagged fish moving 15 to 35 miles. Round whitefish moved upstream and downstream of release locations, while all humpback whitefish moved downstream. Potential foraging locations were determined for all tagged species, except for humpback whitefish due to a small sample size.

Additional observations of fish movements came from mark and recapture with PIT tags. For PIT-tagged juvenile Chinook and coho salmon that exhibited movements between different macrohabitat types, the most frequently observed movement pattern was from main channel or tributary habitat into off-channel habitat. However, a comparable proportion of resighted Chinook and coho salmon were found in the same tributary they were tagged in with little to no movement observed. This is consistent with findings from the 1980s that indicate that a portion of these juvenile salmon remain in tributaries to rear for a year after emergence.

In contrast to the juvenile salmon, several resident species exhibited movement into tributaries, either from the main channel of the Susitna River or from other tributaries. This movement pattern was documented for Arctic grayling, rainbow trout, and round whitefish. However, for these resident species as well as burbot and Dolly Varden, the most commonly observed movement pattern was from main channel or tributary habitat into off-channel habitat.

Downstream movement between the Upper and Middle River was documented in 2013. One humpback whitefish that had been captured while moving downstream in the Oshetna River was recaptured 16 days later at the Curry Station, having covered a distance of roughly 111 river-miles. This same fish was then detected 27 days later at the Whiskers Slough PIT array moving a distance of approximately 131 miles from the original tagging location.

Work completed in 2013 is on-track for meeting Objective 2. However, small sample sizes may limit the ability to draw conclusions regarding seasonal movement patterns for some species. Downstream migrant trapping and biotelemetry efforts will continue during the next year of study to increase sample sizes and obtain additional information on fish movement patterns and timing.

6.3. Objective 3: Early Life History

Objective 3 of the Study of Fish Distribution and Abundance in the Middle and Lower Susitna River is supported by the Fish and Aquatics Instream Flow Study (Study 8.5). The intergravel temperature component of Study 8.5 was used to estimate fry emergence timing for planning and implementation of early life history sampling. Conversely, data obtained from Objective 3 will be used to inform fish periodicity information for analyses conducted as part of the Fish and Aquatics Instream Flow Study (Study 8.5), and emergence timing and movement data will be used to support the stranding and trapping component of Study 8.5.

Juvenile salmon fry were present at the majority of Middle and Lower River spring sampling locations. Both the number of species and counts of fish observed increased from the May to June sampling events. Chum salmon fry were the most common followed by sockeye, Chinook, coho and pink salmon. Length data suggested recent emergence for chum, pink and sockeye salmon in mid-April. In contrast Chinook and coho fry lengths were longer in April than in May and June indicating that some emergence may be occurring later in the spring for these species. The very low pink salmon catch compared to other species suggests pink salmon had emerged and moved past AEA's sampling locations prior to or coincident with break-up.

These data on emergence compare well with the findings in the 1980s. Pink salmon were reported to emerge earliest in March and April, followed by chum salmon emergence in April and sockeye salmon in April and May. In addition, the prolonged emergence for Chinook and coho salmon fry was inferred at that time, again based on lengths of fish in early summer samples.

Work completed in 2013 is on-track for meeting Objective 3. Work will continue in the next year of study in order to collect additional information about juvenile salmonid movement patterns and timing of movement from spawning to rearing habitats.

6.4. Objective 4: Document winter movements and timing and location of spawning for burbot, humpback whitefish, and round whitefish.

Objective 4 of the Study of Fish Distribution and Abundance in the Middle and Lower Susitna River is not dependent on other ISR studies. However, work completed under Objective 4 will be used to support the periodicity information needed for Fish and Aquatics Instream Flow Study (Study 8.5).

Work completed in 2013 is on-track for meeting Objective 4. In conjunction with Objective 2, seven burbot, seven humpback whitefish, and fourteen round whitefish were surgically implanted with radio tags and subsequently tracked using radio telemetry in 2013. To meet Objective 4 (i.e., document winter movement, timing, and spawning locations for burbot and humpback and round whitefish), these fish will continue to be tracked through the remainder of 2013 and into 2014 and results will be presented in the USR. Furthermore, additional fish may be radio-tagged as part of the ongoing Fish Distribution and Abundance surveys and will thus allow for greater sample sizes when tracking fish in the next year of study.

6.5. Objective 5: Characterize the seasonal size/ life stage structure, growth, and condition of juvenile anadromous and resident fish by habitat type.

Objective 5 of the Study of Fish Distribution and Abundance in the Middle and Lower Susitna River is not dependent on other Project studies. However, work completed under this objective supports four other ISR studies. Growth data, along with information on fish movement and habitat associations, will be used as inputs for bioenergetics and trophic analysis modeling for the River Productivity Study (Study 9.8). Additionally, growth and movement data will be used to support the stranding and trapping study component of the Fish and Aquatics Instream Flow Study (Study 8.5).

To meet Objective 5, nearly 15,000 paired length-weight measurements representing 18 species (Chinook salmon, chum salmon, coho salmon, pink salmon, sockeye salmon, Arctic grayling, burbot, Dolly Varden, lamprey, longnose sucker, northern pike, rainbow trout, sculpin, ninespine stickleback, threespine stickleback, Bering cisco, humpback whitefish, and round whitefish) were collected in 2013. Because data QA/QC is ongoing, growth analysis for the ISR was limited to two example species: Chinook salmon and Arctic grayling.

The fish growth analysis was limited to data available for 13 juvenile Chinook that were PIT-tagged and recaptured more than 7 days post-release. The analysis suggests that growth rates are influenced by both month and the size of fish at tagging. Such seasonal variation is likely related to water temperature and its effect on fish metabolism. It was also noted that smaller fish had greater growth rates. There was insufficient recapture data to compare growth rates among habitat types.

Condition factor analysis was conducted for 919 juvenile Chinook salmon and 600 Arctic grayling. Condition factors for juvenile Chinook salmon were greater than 1.0 in all Middle River habitat types and most Lower River habitat types. Chinook salmon condition factors were highest in Middle River main channel and Middle and Lower River upland slough habitat. Arctic grayling condition factors were less than 1.0 in all but one habitat type. On average Arctic grayling condition factors were higher in the Lower River than the Middle River. The highest Arctic grayling condition factors (approximately 0.9) were found primarily in fast water habitats.

Work completed in 2013 is on-track for meeting Objective 5. However, sample sizes for growth analyses are currently limited. Work will continue during the next year of study to increase sample sizes for the size-class, growth, and condition factor analyses.

6.6. Objective 6: Document the seasonal distribution, relative abundance, and habitat associations of invasive species (northern pike).

Objective 6 of the Study of Fish Distribution and Abundance in the Middle and Lower Susitna River is not dependent on other Project studies. However, results of this study objective will be used to: 1) complement information about harvest rates and effort expended by commercial, sport, and subsistence fisheries in support of the Fish Harvest Study (Study 9.15), and 2) inform the Future Watana Reservoir Fish Community and Risk of Entrainment Study (Study 9.10) on the presence/absence of northern pike and lake trout in the Watana Reservoir inundation zone.

Northern pike were the only non-native or invasive fish species documented in the Middle and Lower Susitna River study area during field surveys conducted in 2013. Pike were illegally transplanted into several lakes of the Yentna River in the 1950s (Delaney et al. 1981). During the 1980s Aquatic Studies Program, five northern pike were captured in the Lower River: one in Kroto Slough (PRM 34.1), one at the Yenta Station fishwheel, and three at the Flathorn Station fishwheel RM 22.4). Since the 1980s, the range of northern pike in the Susitna River basin has expanded greatly, and they are currently present in more than 100 lakes and more than a dozen tributaries of the Lower Susitna River (Oslund and Ivey 2010; Sepulveda et al. 2013). The expansion of pike and predation on salmonids is hypothesized to be a leading cause for the decline of multiple salmonid species in lower Susitna streams that once supported popular sport fisheries (Rutz 1999; Sepulveda et al. 2013). In the present study, northern pike distribution was limited to the Fish Creek/Kroto Slough area (PRM 34.1) near the Yentna River confluence and the downstream boundary of the study area. However, the known range of northern pike includes tributaries of the Susitna upstream of Fish Creek including: Deshka River (PRM 45), Caswell Creek (PRM 67), Montana Creek (PRM 80.8), Rabideux Creek (PRM 87.8), Birch Creek (PRM 92.5), and Trappers Creek (PRM 94.5) (Oslund and Ivey 2010). Preliminary radio telemetry results found that all surviving tagged fish (N = 4) remained within one mile of their tagging location at Fish Creek.

Northern pike have broad physio-chemical tolerances allowing them to inhabit a wide range of habitats from lakes to sloughs to streams; distribution and abundance is primarily a function of prey resource availability (SANPCC 2007). Most northern pike observations in 2013 occurred in tributary habitats, although some fish were also observed in the clearwater plume of Fish Creek, and a single fish was observed in a nearby side slough (Kroto Slough). At the mesohabitat scale, use of clearwater plumes, runs, glides, and pools was observed. Adults and juveniles were most commonly found in tributary glide habitat. Catch-per-unit-effort was also highest in tributary glide habitat within LR-4 (4.7 pike/angling hour; 40 pike/1,000 m^2 snorkeled).

Work completed in 2013 is on-track for meeting Objective 6. Although the radio telemetry sample size is currently limited, the presence of non-native species will continue to be documented during surveys conducted in the next year of study, and additional fish will be radio-tagged, when feasible. Furthermore, additional radio telemetry tracking data is expected to be available for describing seasonal distribution patterns.

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

Objective 7 of the Study of Fish Distribution and Abundance in the Middle and Lower Susitna River is not dependent on other Project studies. However, fish tissue sample collections are being used to support the Genetics Baseline Study for Selected Fish Species (Study 9.14). During fish distribution and abundance sampling in the Middle and Lower River in 2013, 799 tissue samples representing 15 species were collected for genetics analysis. Samples were collected from Chinook, coho and sockeye salmon, Arctic grayling, burbot, Dolly Varden, lamprey, longnose sucker, northern pike, rainbow trout, sculpin, ninespine stickleback, Bering cisco, humpback whitefish, and round whitefish. Results are presented and discussed in ISR Study 9.14.

Work completed in 2013 is on-track for meeting Objective 7. Work will continue during the next year of study to meet the established target sample sizes.

7. COMPLETING THE STUDY

[As explained in the cover letter to this draft ISR, AEA's plan for completing this study will be included in the final ISR filed with FERC on June 3, 2014.]

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9. TABLES

Table 2-1. Proposed methods by objective, task, species, and life stage.

Obj	Task	Species/ Life Stage	Study Sites	Proposed Methods by Season
1A	Distribution	Juvenile salmon, non-salmon anadromous, resident	Focus Areas + representative habitat types Select Focus Areas (accessible)	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, angling, DIDSON and video camera 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). Winter: • Based on winter 2012-2013 pilot studies • Potentially DIDSON, video camera, minnow traps, e-fishing, seines, and trot lines.
1B	Relative abundance	Juvenile salmon, non-salmon anadromous, resident	Focus Area study sites + representative habitat types	• Multi-pass sampling • 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. • Snorkeling, beach seine, electrofishing, fyke nets, gillnet, minnow traps, fish wheels, out-migrant traps, etc.
1C	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 meso-habitat type by season.

Obj	Task	Species/ Life Stage	Study Sites	Proposed Methods by Season
2A	Timing of downstream movement and catch using out-migrant traps	All species; juveniles	At selected out-migrant trap & PIT tag array sites	• Out-migrant Traps: Maximum of 6. 2-3 Main channel to indicate broad timing of out-migrants from all upstream sources. 3-4 in tributary mouths and sloughs, such as Fog Creek, Kosina Creek, Portage Creek, Indian Creek and possibly Gold Creek and Whiskers Slough. Combine with fyke net sampling to identify key site-specific differences. • Sampling in mainstem lateral habitats downstream of tributaries with fyke nets, seines, and out-migrant traps • Fishwheels (adults only) opportunistically in conjunction with the Salmon Escapement Study
2B	Describe seasonal movements using biotelemetry (PIT and radio tags)	All species		<u>Ice-Free Season:</u> • PIT tags: tags opportunistically implanted in target species from a variety of capture methods in Focus Areas. Antenna arrays in up to 10 sites at selected side channel, side slough, tributary mouth, and upland sloughs in the Middle River and Lower River. • Radio tags surgically implanted in up to 30 individuals of sufficient body size of each target species distributed temporally and longitudinally. . <u>Winter</u>: • Based on winter 2012-2013 pilot studies. • Potentially DIDSON, video camera, minnow traps, electrofishing, seines and trot lines. • 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 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

Obj	Task	Species/ Life Stage	Study Sites	Proposed Methods by Season
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
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 & snow machine tracking of radio tags to pinpoint winter aggregations of fish; sample these areas with trot lines (similar to 1980s). Trot lines are lethal sampling. • Collect, examine, and preserve gonads to determine spawning status.
5	Document age structure, growth, and condition by season	juvenile anadromous and resident fish	All study sites for Obj 1B and Focus Areas	• 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, 2013.

Location	ELH Event 1 (pre-break-up)		ELH Event 2		ELH Event 3	
	Start date	End date	Start date	End date	Start date	End date
	4/28/13	5/3/13	6/1/13	6/15/13	6/20/13	6/29/13
	Number of sites		Number of sites		Number of sites	
Middle River						
Fog Creek PRM 179.3			3[a]		3[a]	
Fog Creek Lake			1[a]		1[a]	
Devils Canyon (PRM 153.9-166.1)						
FA-144 (Slough 21)			6		6	
FA-141 (Indian River)			6		6	
FA-138 (Gold Creek)	2		6		6	
FA-128 (Slough 8A)	5		6		6	
FA-113 (Oxbow I)			6		6	
FA-104 (Whiskers Slough)	3		6		6	
Lower River						
Trapper Creek PRM 100.3			3[b]		3[b]	
Unnamed Tributary PRM 100.3					3[b]	
Sunshine Creek PRM 88.2					3[b]	
Rabideaux Creek PRM 87.8					3[b]	
Montana Creek PRM 80.8					3[b]	
Goose Creek PRM 76.2					3[b]	
Tributary Mouth PRM 63.5			3[b]			
Upland Slough PRM 63.5			3[b]		3[b]	
Little Willow Creek PRM 54.3			3[b]		3[b]	
Side Slough PRM 52.0					3[b]	
Fish Creek PRM 34.1			3[b]		3[b]	
Fish Creek Mouth PRM 34.1			3[b]		3[b]	
Grand Total	**10**		**58**		**73**	

[a]sampling consisted of 100 m (328 ft) unit

[b]sampling consisted of 3, 40-meter reaches within a 200 m (656 ft) unit

Table 4.1-2. Tributaries sampling effort for fish distribution in the Middle River above Devils Canyon by geomorphic reach, 2013.

Target Tributary	Geomorphic Reach	PRM	Listed in AWC	Average Wetted Width[1] (m)	Drainage Basin Area (km2)	Average Channel Width[2] (m)	Accessibility	Sample Type	Number of Sites
Tsusena Creek	2	184.5	No	10	374.3	NA	Unknown	Direct	2
Unnamed Tributary 184	2	184.0	No	NA	NA	NA	None	Direct	-
Fog Creek	2	179.3	Yes	9	381.2	20	Unknown	Direct	5
Fog Trib	2	N/A	Yes	NA	NA	NA	Unknown	Direct	6
Upstream extent Devils Canyon (PRM 166.1)									
Devil Creek	3	164.8	No	22	190.6	11	None	Direct	-
Impediment 3 in Devils Canyon									
Chinook Creek	3	160.4	Yes	9	58.3	8	Unknown	Direct	2
Cheechako Creek	4	155.9	Yes	12	94.3	8	None	Direct	-
Downstream extent Devils Canyon (PRM 153.9)									

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

Focus Strata	Habitat Strata	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	3	1	3	1	3	3	**17**	**12**
	Split Main Channel[f]		1						1	3	1	3		**6**	**3[f]**
	Multi-Split Main Channel[f]							3	1		1			**3**	**2[f]**
	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	**9**	**7**
	Side Slough Beaver Complex							3	5[c]					**3**	**5**
	Upland Slough			3	0[a]			3	3	3[b]	1[b]	3[b]		**12**	**4**
	Upland Slough Beaver Complex							3	3	3[d]	5[c]		3[c]	**6**	**11**
	Backwater				1			1	1	2	2			**3**	**4**
	Tributary			1	0[a]	1	0[a]	2	2	3[d]	3	1	1	**8**	**6**
	Tributary Mouth			1	1	1	0[a]	2	2	1[d]	1			**5**	**4**
	Clear Water Plume				1	1	1	1	1		1			**2**	**4**
	Subtotal Focus Areas Abundance	**5**	**5**	**14**	**12**	**5**	**3**	**27**	**24**	**21**	**19**	**16**	**13**	**88**	**76**
Non Focus Areas	Main Channel	3	3	3	1	3	2	3	3	3	1	3	2	**18**	**12**
	Split Main Channel[f]			3	1	3	1	3		3	2	3	1	**15**	**5[f]**
	Multi-Split Main Channel[f]							3				3		**6**	**0[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	**15**	**15**
	Side Slough Beaver Complex									3	3			**3**	**3**
	Upland Slough			3	0[a]			3	2[a]	3	1[b]	3	3	**12**	**6**
	Upland Slough Beaver Complex							3	3	3	5[c]			**6**	**8**
	Backwater			1	1			3	3	1	1	1	1	**6**	**6**
	Tributary			3	0[a]			3	2[a]	3	3			**9**	**5**
	Tributary Mouth			3	2	1	0[a]	3	3	2[d]	2			**9**	**7**
	Clear Water Plume			3	3			3	2	1	1			**7**	**6**
	Subtotal Non-Focus Areas Distribution[1]	**2**	**2**	**16**	**7**	**6**	**3**	**22**	**15**	**17**	**14**	**12**	**7**	**75**	**48**
	Subtotal Non-Focus Abundance	**2**	**2**	**9**	**7**	**4**	**3**	**11**	**9**	**11**	**11**	**7**	**6**	**44**	**38**
	Subtotal Non-Focus	**4**	**4**	**25**	**14**	**10**	**6**	**33**	**24**	**28**	**25**	**19**	**13**	**119**	**86**
Subtotal Samples For Distribution		2	2	16	7	6	3	22	15	17	14	12	7	**75**	**48**
Subtotal Samples For Abundance		7	7	23	19	9	6	38	33	32	30	23	19	**132**	**114**
Total number of sampling sites		9	9	39	26	15	9	60	48	49	44	35	26	**207**	**162**

__Notes:__

[a]:Site not accessible to sample CIRI Lands or Alaksa 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 modfied from IP table 5.3-1 with inclusion of FA-113 (Oxbow I) 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 site selection purposes

Table 4.1-4. Habitat types sampled for fish distribution in the Lower River by transect and reach in 2013.

Geomorphic Reach	Transect PRM	Sample Type	Habitat Type										
			Main Channel	Side Channel Complex	Bar Island Complex	Side Channel	Upland Slough	Side Slough	Slough Mouth	Tributary	Tributary Mouth	Additional Open Water	Total
LR1	100.3	Abundance	1	1				1	1	1	1		6
LR1	92.9	Distribution		1	1	1				1	1		5
LR2	85.6	Distribution	1	1									2
LR2	78.2	Distribution	1			1							2
LR2	70.8	Abundance	1	1						1	1		4
LR3	63.5	Abundance		1	1		1		1	1	1		6
LR3	56.1	Distribution			1	1				1	1	1	5
LR3	48.8	Distribution	1	1									2
LR4	41.4	Distribution	1	1			1	1	1			1	6
LR4	34.0	Abundance	1			1		1		1	1	1	6
Total Abundance			**3**	**3**	**1**	**1**	**1**	**2**	**2**	**4**	**4**	**1**	**22**
Total Distribution			**4**	**4**	**2**	**3**	**1**	**1**	**1**	**2**	**2**	**2**	**22**
Total Sites Lower River			**7**	**7**	**3**	**4**	**2**	**3**	**3**	**6**	**6**	**3**	**44**
Estimated in Implementation Plan			**10**	**10**	**10**	**6**	**4**	**0**		**2**		**2**	**44**

Table 4.1-5. Antenna orientation for fixed-station receiver locations in the Middle and Lower Susitna River, 2013.

Station	PRM	Install Date	Status	Antenna Orientation			Rationale
				Antenna 1	Antenna 2	Antenna 3	
Montana Creek	81	4-Jun	Installed	Down Montana Cr.	Up Montana Cr.	-	Salmon spawning stream
Middle River 102.4							
Whiskers Creek	105	5-Jun	Installed	Down Susitna	Up Susitna	Up Whiskers Cr.	Salmon spawning stream; Possible burbot holding area
Lane Creek	117	3-Jun	Installed	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	7-Jun	Installed	Down Susitna	Up Susitna	-	Monitor for Curry tagged fish moving upstream
4th of July Creek	134	8-Jun	Installed	Down Susitna	Up Susitna	Up 4th of July Cr.	Between Gateway and Indian. Rainbow trout stream.
Indian River	142	8-Jun	Installed	Down Susitna	Up Susitna	Up Indian	Salmon spawning stream
Upper Indian River	N/A	30-Jun	Installed	Down Indian	Up Indian	-	Salmon spawning stream; Accurate records of fish moving into tributary
Powerline	146	11-Jun	Replaced Portage Creek	Down Susitna	Up Susitna	-	Monitor fish moving upstream towards Portage Creek
Portage Creek	152	N/A	Not installed due to land access	Down Susitna	Up Susitna	-	Salmon spawning stream
Upper Portage Creek	N/A	N/A	Not installed due to land access	Down Portage Cr.	Up Portage Cr.	-	Salmon spawning stream; Accurate records of fish moving into tributary
Downstream extent Devils Canyon PRM 153.9							
Cheechako Creek	156	N/A	Not installed due to land access	Down Susitna	Up Susitna	-	Monitor site for fish passing above Impediment 1
Chinook Creek	160	N/A	Not installed due to land access	Down Susitna	Up Susitna	-	Monitor site for fish passing above Impediment 2
Upper Extent Devils Canyon PRM166.1							
Devils Island	167	27-Jun	Installed	Down Susitna	Up Susitna	-	Monitor site for fish passing above Impediment 3
Fog Creek	179	N/A	Not installed due to land access	Down Susitna	Up Susitna	Up Fog Cr.	Large accessible salmon spawning tributary with lake access

Table 4.1-6. Habitat types sampled during 2012/13 winter pilot study.

February 1-7	Habitat Type							
Gear Type	**Tributary**	**Tributary Mouth**	**Upland Slough**	**Side Slough**	**Slough Mouth**	**Side Channel**	**Main Channel**	**Other off-channel**
Minnow Trap	WS	WS	WS	WS	WS	WS		WS
Electrofishing								
Set Line	WS			WS				
Trotline					WS		WS	
Seine						WS		
Underwater Video	WS			WS	WS		WS	
DIDSON								
March 18-26	**Habitat Type**							
Gear Type	**Tributary**	**Tributary Mouth**	**Upland Slough**	**Side Slough**	**Slough Mouth**	**Side Channel**	**Main Channel**	**Other off-channel**
Minnow Trap	WS	WS	WS	WS	WS	WS, 8A		WS
Electrofishing	WS		WS		WS	8A		
Set Line		WS						
Trotline							WS	
Seine								
Underwater Video		WS	WS		WS		WS	
DIDSON		WS	WS	WS	WS			
April 7-13	**Habitat Type**							
Gear Type	**Tributary**	**Tributary Mouth**	**Upland Slough**	**Side Slough**	**Slough Mouth**	**Side Channel**	**Main Channel**	**Other off-channel**
Minnow Trap	WS	WS	WS, 8A	WS		WS, 8A		
Electrofishing	WS		WS, 8A			8A		
Set Line								
Trotline								
Seine								
Underwater Video		WS	WS	8A		8A		
DIDSON								

WS: FA-104 (Whiskers Slough)

8A: FA-128 (Slough 8A)

Table 4.2-1. Monitoring efficiency (percent operational) of LGL operated fixed-station receivers in the Susitna River drainage in 2013, by week. 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. Data are preliminary as of Setember 9, 2013).

	Fixed Station Location										
Week	Montana Creek (PRM 81)	Middle River PRM 102	Whiskers Creek (PRM 105)	Lane Creek (PRM 117)	Gateway (PRM 130)	4th of July Creek (PRM 134)	Indian River (PRM 142)	Upper Indian River	Powerline (PRM 146)	Devils Canton PRM 153.9-166.1	Devils Island (PRM 167)
6/2 - 6/8	1%		49%	73%	21%	2%	3%	-	-		-
6/9 - 6/15	37%		100%	100%	100%	100%	100%	-	64%		-
6/16 - 6/22	100%		100%	100%	100%	100%	100%	-	100%		-
6/23 - 6/29	100%		100%	100%	100%	53%	100%	-	52%		-
6/30 - 7/6	100%		100%	100%	100%	77%	100%	92%	78%		-
7/7 - 7/13	100%		100%	100%	100%	100%	100%	100%	68%		-
7/14 - 7/20	100%		100%	100%	100%	100%	100%	100%	49%		-
7/21 - 7/27	100%		100%	100%	100%	100%	100%	100%	64%		88%
7/28 - 8/3	100%		100%	100%	100%	100%	100%	100%	100%		100%
8/4 - 8/10	100%		100%	100%	100%	100%	100%	100%	100%		100%
8/11 - 8/17	100%		100%	100%	100%	100%	38%	100%	100%		100%
8/18 - 8/24	80%		100%	97%	100%	100%	100%	9%	100%		54%
8/25 - 8/31	0%		38%	0%	52%	54%	54%	0%	53%		14%

Table 4.2-2. Summary of aerial surveys of radio-tagged fish in the Upper Susitna River, 2013.

	PRM		Zone	Survey Date																																																													
Zone Name	From	To	#	6-22	6-23	6-25	6-26	6-28	6-29	6-30	7-1	7-2	7-3	7-4	7-5	7-6	7-7	7-8	7-9	7-10	7-11	7-12	7-13	7-14	7-15	7-16	7-17	7-18	7-19	7-20	7-21	7-22	7-23	7-24	7-25	7-26	7-27	7-28	7-29	7-30	7-31	8-1	8-2	8-3	8-4	8-5	8-6	8-7	8-9	8-10	8-11	8-12	8-13	8-16	8-17	8-19	8-20	8-23	8-24	8-25	8-26	8-27	8-30	8-31	9-2	9-3
Little Susitna River	-	-	3																																																															
Beyond Confluence	-	-	4																																																															
Confluence - Yentna	3.5	32.4	5																	H																																														
Yentna River	32.4	-	22		H			H						H													H								H								H											H				H					H			
Yentna - Deshka	32.4	45.0	35		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			
Willow and Little Willow	52.2	55.6	53		H			H						H						H							H								H							H							H					H				H					H			
Kashwitna River	64.7	-	54		H			H					H																													H							H					H				H					H			
Deshka - Kashwitna	45.0	64.7	55		H			H					H	H													H								H							H							H					H				H					H			
Caswell area tribs	65.8	76.3	63										H							H															H							H							H					H												
Kashwitna - Montana	64.7	80.7	65		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			
Montana - Sunshine	80.7	88.5	75		H			H					H							H							H								H							H							H					H				H					H			
Sunshine Creek	88.1	-	76																																														H					H				H					H			
Rabideux Creek	87.4	-	77		H								H																													H												H				H					H			
Talkeetna River	101.0	-	81		H			H					H														H							H									H						H					H				H					H			
Chulitna River	101.7	-	83		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			
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
Whiskers Creek	104.8	-	97																						H																	H				H			H	H		H			H		H			H		H		H		H
Trib off zone 95	110.5	-	98																																																	H			H		H			H		H		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
Lane Creek	117.1	-	106																						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		
Slough 8A	129.2	129.8	109																															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
Slough 9	131.4	133.5	112																															H						H						H				H		H			H		H			H		H		H		H
Sherman Creek	134.1	-	114																															H							H											H								H						H
MOB - 4th of July Creek	134.3	-	116	H		H		H					H											H										H						H	H					H				H		H			H		H			H		H		H		H
MOB - 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
MOB - Slough 11	138.6	-	118										H																											H						H				H		H			H		H			H		H		H		H
MOB - Gold Creek	140.1	-	119																											H											H					H				H		H			H		H			H		H		H		H
MOB - 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
MOB - 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
MOB - 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
MOB - Slough 21	145.1	145.6	136																											H				H			H			H						H				H		H			H		H		H			H		H		H
MOB - above Powerline	145.7	146.0	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
MOB - abv Powerline - Portage	146.0	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		H
MOB - Jack Long Creek	148.2	-	146			H						H					H						H	H						H											H					H				H		H			H		H		H			H		H		H
MOB - 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	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H		H	H	H		H		H	H	H	H	H	H
Lower Extent Devils Canyon (PRM 153.9)																																																															
MOB - 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	H	H	H	H	H
MOB - 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		H		H	H	H	H	H	H
MOB - 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	H	H	H	H	H	H	H	H	H	H	H	H	H		H		H	H	H	H	H	
MOB - 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	H	H		H		H	H	H	H	H	H
MOB - 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	H	H		H		H	H	H	H	H	H
MOB - 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	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H		H		H	H	H	H	H	
MOB - 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	H		H		H	H	H	H	H	H
MOB - Devil 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	H	H	H	H	H	H	H	H	H	H	H	H		H		H	H	H	H	H	
MOB - 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	H	H	H
Upper Extent Devils Canyon (PRM 166.1)																																																															
MOB - 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	
MOB - Fog Creek	179.3	-	192																					H							H					H											H						H			H					H				H	
MOB - 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	
MOB - Tsusena Creek	184.5	-	197																					H				H	H					H	H	H	H	H	H	H	H	H	H				H						H			H					H				H	

Table 4.5-1. Summary of PIT tagging effort in the Middle and Lower River Study Area, 2013.

Species	Life Stage	Tag Type	N	Median Length (mm)	Length Range (mm)
Chinook salmon	Juvenile	PIT	1,696	89	60-197
chum salmon	Juvenile	PIT	13	75	61-103
coho salmon	Juvenile	PIT	2,092	82	53-151
sockeye salmon	Juvenile	PIT	81	66	60-95
Pacific salmon, undifferentiated	Juvenile	PIT	67	70	60-122
Arctic grayling	Adult	PIT	29	349	330-477
Arctic grayling	Juvenile-or-adult	PIT	99	278	197-328
Arctic grayling	Juvenile	PIT	250	98	61-189
burbot	Adult	PIT	14	547	500-645
burbot	Juvenile-or-adult	PIT	92	400	287-493
burbot	Juvenile	PIT	117	135	87-275
Dolly Varden	Juvenile-or-adult	PIT	53	141	83-396
Dolly Varden	Juvenile	PIT	17	74	61-81
longnose sucker[a]	Adult	PIT	2	380	350-410
longnose sucker[a]	Juvenile-or-adult	PIT	6	289	270-340
longnose sucker[a]	Juvenile	PIT	3	177	157-181
rainbow trout	Adult	PIT	55	390	330-538
rainbow trout	Juvenile-or-adult	PIT	94	247	202-325
rainbow trout	Juvenile	PIT	160	144	60-198
salmonid	Juvenile	PIT	2	100	93-106
whitefish, humpback	Adult	PIT	5	394	364-400
whitefish, humpback	Juvenile-or-adult	PIT	23	293	280-350
whitefish, humpback	Juvenile	PIT	58	241	78-279
whitefish, round	Unknown	PIT	1	Unknown	-
whitefish, round	Adult	PIT	23	344	320-450
whitefish, round	Juvenile-or-adult	PIT	97	257	199-318
whitefish, round	Juvenile	PIT	179	100	68-196
whitefish, undifferentiated	Adult	PIT	1	424	-
whitefish, undifferentiated	Juvenile-or-adult	PIT	22	248	202-350
whitefish, undifferentiated	Juvenile	PIT	134	104	75-198

[a]: not a target species for PIT tagging

Note: All data are provisional and subject to ongoing QA/QC

Table 4.5-2. Summary of fishes radio-tagged in the Middle and Lower River Study Area, 2013.

Species	Tag Type	N	Median Length (mm)	Length Range (mm)
Arctic grayling	Radio	35	325	276-416
Burbot	Radio	9	409	335-676
Dolly Varden	Radio	9	330	290-384
Longnose sucker	Radio	28	336	269-402
Northern pike	Radio	5	580	492-642
Rainbow trout	Radio	44	387	265-500
Humpback whitefish	Radio	7	297	284-409
Round whitefish	Radio	21	331	278-428

Table 4.5-3. Radio tag allocation by season, Middle and Lower Susitna River, 2013.

	Middle-Lower Susitna River, 2013					
Species	**May/June**	**July**	**August**	**Sept**	**Total**	**Live [b]**
Arctic grayling	11 (0[a])	17 (10)	1 (10)	6 (10)	35 (30)	9
Burbot	2 (10)	0 (10)	5 (10)	2 (10[a])	9 (30)	3
Dolly Varden	1 (10)	6 (10)	2 (10[a])	0 (0)	9 (30)	4
Longnose sucker	13 (10)	8 (10)	6 (10)	1 (10)	28 (30)	2
Northern pike	0 (10)	0 (10)	5 (10)	0 (10)	5 (30)	4
Lake trout	0 (10)	0 (10)	0 (10)	0 (10)	0 (30)	0
Rainbow trout	11 (0[a])	17 (10)	3 (10)	13 (10)	44 (30)	20
Humpback whitefish	3 (10)	4 (10)	0 (10[a])	0 (0)	7 (30)	2
Round whitefish	11 (10)	3 (10)	0 (10[a])	7 (0)	21 (30)	10

Format: tags applied (target number of tags).

[a] FERC recommended tagging (n≥10) periods. Tagging during spawning periods conducted at the discretion of the surgeon as based on fish condition.

[b] Live tags as of aerial survey on January 29, 2014. Data subject to ongoing evaluation of tag status.

Table 4.8-1. Summary of size-at-life stage index used to classify Susitna River species, 2013.

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	Buckwalter et al. 2012
Arctic grayling	<190	190–328	>328	Buckwalter et al. 2012
Arctic lamprey	<125	125-219	>219	Heard 1966; Docker 2009; Vladykov and Kott 1978
burbot	<280	280–498	>498	Buckwalter et al. 2012
Dolly Varden	<83	≥83	-	Buckwalter et al. 2012
eulachon	Not Applicable			
longnose sucker	<188	188–348	>348	Buckwalter et al. 2012
northern pike	<330	330–448	>448	Buckwalter et al. 2012
sculpin (slimy)	<51	51–68	>68	Buckwalter et al. 2012
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			
humpback whitefish	<280	280–363	>363	Buckwalter et al. 2012
round whitefish	<199	199–318	>318	Buckwalter et al. 2012
Whitefish, undifferentiated	<199	199-363	>363	

Table 4.8-2. Summary of fish with length and weight measurements collected in the Upper, Middle and, Lower Susitna River by hydrologic segment, 2013.

	Hydrologic Segment			
Species	**Lower River**	**Middle River**	**Upper River**	**Total**
Chum salmon	60	56		116
Chinook salmon	672	1,366	123	2,161
Coho salmon	487	2,820		3,307
Pink salmon	7	39		46
Sockeye salmon	253	199		452
Pacifc salmon, undifferentiated	44	77		121
Arctic grayling	38	889	1,652	2,579
Burbot	152	280	85	517
Dolly Varden	13	167	299	479
Lamprey	123	19		142
Longnose sucker	661	560	126	1,347
Northern pike	44			44
Salmonid, undifferentiated		4	1	5
Sculpin	679	2,129	2,596	5,404
Stickleback, ninespine	140			140
Stickleback, threespine	884	457		1,341
Stickleback, undifferentiated	3	48		51
Trout, lake			1	1
Trout, rainbow	142	349		491
Whitefish, Bering cisco	2			2
Whitefish, round	108	472	173	753
Whitefish, humpback	8	102	8	118
Whitefish, undifferentiated	52	317	20	389
Grand Total	**4,572**	**10,350**	**5,084**	**20,006**

Table 4.8-3. Summary of PIT tagging efforts and recaptures for the Susitna River, 2013.

Species	Implanted	Recaptured and Measured	
	N	N	%
Chinook salmon	1,696	44	3%
chum salmon	13	0	0%
coho salmon	2,092	76	4%
sockeye salmon	81	5	6%
Pacific salmon, undifferentiated	67	1	1%
Arctic grayling	378	2	1%
burbot	223	8	4%
Dolly Varden	70	1	1%
longnose sucker	11	0	0%
rainbow trout	309	3	1%
salmonid	2	0	0%
whitefish, humpback[b]	86	1	1%
whitefish, round	300	1	0%
whitefish, undifferentiated	157	1	1%
Total	**5,485**	**143**	**3%**

4.8-4. Fish sample size used in condition factor assessment for the Middle and Lower Susitna River.

	Chinook Salmon	Arctic Grayling
Lower River		
LR-1	61	8
LR-2	50	7
LR-3	144	15
LR-4	33	3
LR-5		1
Middle River		
MR-1		87
MR-2	1	343
MR-5	3	25
MR-6	182	28
MR-7	132	5
MR-8	313	69
Tsusena Creek		9
Total	**919**	**600**

Table 4.10-1. Summary of Fish Distribution and Abundance tissue collection for genetic baseline development, 2013.

Species	Geomorphic Reach											Grand Total
	MR-1	**MR-2**	**Devils Canyon**	**MR-5**	**MR-6**	**MR-7**	**MR-8**	**LR-1**	**LR-2**	**LR-3**	**LR-4**	
Chinook salmon				2	27	7	12					**48**
Coho salmon						5	39					**44**
Sockeye salmon										2		**2**
Paficic salmon, unidentified						4						**4**
Arctic grayling	30	66		1	4	2		4	2	8	4	**121**
Arctic lamprey											9	**9**
Burbot	4	5		9	15	23	20	7	1	14	26	**124**
Dolly Varden		1					1	2	2			**6**
Longnose sucker	7	15		3	4	14	19	5	2	20	16	**105**
Ninespine stickleback										8	2	**10**
Northern Pike											18	**18**
Rainbow trout				5	5	3	4	6	1	1		**25**
Sculpin	27	25			44	14		7	25	8	6	**156**
Whitefish, Bering cisco									1		1	**2**
Whitefish, round	22	14		22	14	1	3	7	16	11	2	**112**
Whitefish, humpback					4	2					7	**13**
Grand Total	**90**	**126**		**42**	**117**	**75**	**98**	**38**	**50**	**72**	**91**	**799**

Table 4.11-1 Summary of fish collection for gut sampling, 2013.

Station	Sampling site	Habitat Type	Juvenile Chinook	Juvenile Coho	Juvenile Rainbow	Adult Rainbow	Total
FA-184 (Watana Dam)	RP-184-2	Side Channel	0	0	0	0	0
	RP-184-3	Main Channel	0	0	0	0	0
FA-173 (Stephan Lake Complex)	RP-173-1	Tributary Mouth	0	0	0	0	0
	RP-173-2	Main Channel	0	0	0	0	0
	RP-173-3	Side Channel	0	0	0	0	0
	RP-173-4	Side Slough	0	0	0	0	0
Devils Canyon PRM 153.9 -166.1							
FA-141 (Indian River)	RP-141-1	Tributary Mouth	19	24	0	11	54
	RP-141-3	Multi Split Main Channel	0	0	0	0	0
FA-104 (Whiskers Slough)	RP-104-1	Side Slough	24	16	0	11	51
	RP-104-2	Side Slough	10	17	0	9	36
	RP-104-3	Main Channel	0	0	0	0	0
	RP-104-4	Upland Slough	9	13	0	0	22
	RP-104-5	Side Channel	11	17	0	0	28
	Total		**73**	**87**	**0**	**31**	**191**

Table 5.1-1. Summary of fish distribution by Geomorphic Reach the in Middle and Lower Susitna River, 2013. Includes the following data sources: Early-Life History sampling (ELH), habitat stratified randomized sampling (GRTS), direct tributary sampling (Direct), rotary screw trap (RST), resident fish catch at Curry fishwheel (PRM 124), opportunistic sampling (Opportunistic), targeted sampling for radio tagging (RT) river productivity sampling (RP), and habitat suitability criteria sampling (HSC).

Location[a]	PRM	Chinook salmon	Chum salmon	Coho salmon	Pink salmon	Sockeye salmon	Salmon, undifferentiated	Arctic Grayling	Burbot	Dolly Varden	Lake Trout	Lamprey	Longnose sucker	Northern Pike	Rainbow trout	Sculpin	Stickleback, ninespine	Stickleback, threespine	Whitefish, Bering cisco	Whitefish, humpback	Whitefish, round	Whitefish, undifferentiated
Upper River Study Area	187.1-234.5	X						X	X	X	X		X			X				X	X	X
Proposed Watana Dam (PRM 187.1)																						
MR-1[a]	184.6-187.1							X	X	X			X			X					X	X
MR-2[b]	169.6-184.6	X						X	X	X			X			X					X	X
Upper extent Devils Canyon (PRM 166.1)																						
MR-3[c]	166.1-169.6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
MR-4[d]	153.9-166.1									X						X						
Lower extent Devils Canyon (PRM 153.9)																						
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
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

[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] Geomorphic reach MR-2 includes sites located in the mainstem Susitna River and its associated off-channel and tributary habitats within the Zone of Hydrologic Influence (ZHI), as well as directed sampling efforts outside of the ZHI in Fog and Tsusena creeks.

[c] Geomorphic reach MR-3 was not sampled during on-the-ground surveys in 2013.

[d] Geomorphic reach MR-4 only includes directed sampling efforts outside of the ZHI in Chinook Creek. The mainstem Susitna River and its associated off-channel and tributary habitats within the ZHI were not sampled during on-the-ground surveys in 2013.

Table 5.1-2. Middle Susitna fish observations, 2013. Includes the following data sources: Early-Life History sampling (ELH), habitat stratified randomized sampling (GRTS), direct tributary sampling (Direct), rotary screw trap (RST), resident fish catch at fishwheels, opportunistic sampling (Opportunistic), targeted sampling for radio tagging (RT) river productivity sampling (RP), and habitat suitability criteria sampling (HSC).

Geomorphic Reach /PRM	Habitat	Sample Type	Salmon, Chinook (adult)	Salmon, Chinook (juvenile)	Salmon, chum (adult)	Salmon, chum (juvenile)	Salmon, coho (adult)	Salmon, coho (juvenile)	Salmon, pink (adult)	Salmon, pink (juvenile)	Salmon, sockeye (adult)	Salmon, sockeye (juvenile)	Pacific salmon, (juvenile) undifferentiated	Arctic grayling	Burbot	Dolly Varden	Lamprey	Longnose sucker	Salmonid, undifferentiated	Sculpin	Stickleback, threespine	Stickleback, undifferentiated	Trout, rainbow	Unknown species	Whitefish, humpback	Whitefish, round	Whitefish, undifferentiated	Total
Proposed Watana Dam Location PRM 187.1																												
MR-1 / 184.6-187.1	Susitna River	GRTS, RP												110	12	2		12		357						32	2	**527**
MR-2 169.6-184.6	Susitna River	GRTS, RP	1	1										534	15	4		69		457				5		67	8	**1,161**
	Susitna River: Off-Channel	GRTS, RP												783	13	8		328		473				1		18	10	**1,634**
	Tributary	GRTS, RP, RT												62	4	2		3		103							1	**175**
	Tsusena Creek	Direct	1											74		4				25						3		**107**
	Fog Creek Tributary	ELH, Direct														10				30								**40**
	Fog Creek	ELH, Direct														315				95				1				**411**
	Fog Creek: Off-Channel	Direct														3				4								**7**
Upper Extent Devils Canyon PRM 166.1																												
MR-4 153.9-166.1	Chinook Creek	Direct														63				13								**76**
Lower Extent Devils Canyon PRM 153.9																												
MR-5 148.1-153.9	Susitna River	GRTS	3	5	31		34	21	26		7	6	7	32	12			12	1	101			15	9	3	34	4	**363**
	Susitna River: Off-Channel	ELH, GRTS			106			17	1	1	5	4		3	2	2		81		162			10			6		**400**
MR-6 122.7-148.4	Susitna River	ELH, RST, Fishwheel, GRTS, RT, HSC	4	180	67	68	42	585	312	1	3	92	46	297	57	16		326	5	555	2		43	25	36	134	297	**3,193**
	Susitna River: Off-Channel	ELH, GRTS, RP, HSC		597	222	1,022	4	1,099	3	1	191	1,495	47	179	103	10		289	59	816	3		24	11	38	55	367	**6,635**
	Tributary	ELH, GRTS, RT, Opportunisitic, HSC	12	147	276	16	24	637	3,312	2		28	22	195	4	57		9	28	427			50	11		11	4	**5,272**
	Indian River	RST, RT	10	567	85	150	47	1,745	655	411	2	289	37	78	3	23		25	2	294			103		7	25	7	**4,565**
MR-7 107.8-122.7	Susitna River	ELH, GRTS, RT, HSC	2	30	20	20	3	54	92		2	20	9	29	36	3		186		368	1		8	12	1	34	15	**945**
	Susitna River: Off-Channel	ELH, GRTS, HSC		122	6			2,181	17	4		106	450	27	81	9		111	2	135	7,069	177	20	0	12	28	24	**10,581**
	Tributary	GRTS, HSC		28			48	634	90			28	3	12	33	15	5	18	33	155	3		76				2	**1,183**
MR-8 102.4-107.8	Susitna River	RST, GRTS, RP, HSC	19	992	76	106	240	686	173	6	23	203	57	122	51	16	6	268	27	488	23		30	38	60	175	293	**4,178**
	Susitna River: Off-Channel	ELH, GRTS, RP, HSC		452	4	3	46	880				317	184	50	41	4	62	313	33	637	490	71	32	16	8	19	35	**3,697**
	Tributary	ELH, GRTS, RP, Opportunistic, HSC		179	5	9	66	199	2	1	3	6	3	78	5	8	6	9	5	94	13		46			2		**739**
Grand Total			**52**	**3,300**	**898**	**1,394**	**554**	**8,738**	**4,683**	**427**	**236**	**2,594**	**865**	**2,665**	**472**	**574**	**79**	**2,059**	**195**	**5,789**	**7,604**	**248**	**457**	**129**	**165**	**643**	**1,069**	**45,889**

Table 5.1-3. Lower Susitna River fish observations, 2013. Includes the following data sources: Early-Life History sampling (ELH), mainstem transect sampling (Transect), rotary screw trap (RST), opportunistic sampling (Opportunistic), targeted sampling for radio tagging (RT) and river productivity sampling (RP).

Geomorphic Reach /PRM	Habitat	Sample Type	Salmon, Chinook (adult)	Salmon, Chinook (juvenile)	Salmon, chum (adult)	Salmon, chum (juvenile)	Salmon, coho (adult)	Salmon, coho (juvenile)	Salmon, pink (adult)	Salmon, pink (juvenile)	Salmon, sockeye (adult)	Salmon, sockeye (juvenile)	Pacific salmon, (juvenile) undifferentiated	Arctic grayling	Burbot	Dolly Varden	Lamprey	Longnose sucker	Northern pike	Sculpin, undifferentiated	Stickleback, ninespine	Stickleback, threespine	Stickleback, undifferentiated	Trout, rainbow	Whitefish, Bering cisco	Whitefish, humpback	Whitefish, round	Whitefish, undifferentiated	Total
LR-1 87.9-102.4	Susitna River	Transect		6	34		4		3		1	2	2		5	1		92		106				1			12	19	**288**
	Susitna River: Off-Channel	Transect		13	181	18	52	15	2		2	279	3	2	18		5	8		38		76					4	4	**720**
	Tributary	ELH, Transect, Opportunsitic, RT	2	61	56	3	2	114	12		3	103	24	6	3	3	15	8		43	3	574	1	16			10		**1,062**
LR-2 65.6-87.9	Susitna River	Transect, RP		7		1	1	16	1			3	8	4	7	2		126		152		6		10	1		20	3	**368**
	Susitna River: Off-Channel	Transect, RP		9				12																					**21**
	Montana Creek	RST, Opportunstic, RT	3	1,302	32	825	9	207	400	6			20	2		23	10	1		72	2	150	14	95			4		**3,177**
	Tributary	ELH, Transect, RT, RP	1	61		18		29				1	1	4	2		9	7		186		24	1	7			10		**361**
LR-3 44.6-65.6	Susitna River	Transect	1	43				2	1			16	2	12	13	1	11	129		123	2	1					4	6	**367**
	Susitna River: Off-Channel	ELH, Transect		67		2	1	168	1			18		1	4		6	40		12	115	1,794		14			7	1	**2,251**
	Tributary	ELH, Transect		52		7	1	13	1			2		3	3		26	11		112	1	17		4			7	1	**261**
LR-4 32.3-44.6	Susitna River	Transect, RT			1	1			1				5	4	30		42	114		6		1				1	8	2	**216**
	Susitna River: Off-Channel	ELH, Transect		34		2	2	31			1	20	3	1	69		9	575	7	44	21	1,820	1	18	1	6	26	27	**2,718**
	Tributary	ELH, Transect, RT											10					4	55	3		6				1			**79**
Grand Total			**7**	**1,655**	**304**	**877**	**72**	**607**	**422**	**6**	**7**	**444**	**78**	**39**	**154**	**30**	**133**	**1,115**	**62**	**897**	**144**	**4,469**	**17**	**165**	**2**	**8**	**112**	**63**	**11,889**

Table 5.1-4. Total fish count by gear type for three seasonal fish distribution and abundance sampling events in Middle River Focus Areas, 2013.

Species	Life stage	Gear Type											Grand Total
		Snorkel	Minnow trap	Fyke Net	Seine	Backpack Electrofish	Hoop trap	Angle	Boat Electrofish	Dip Net	Gillnet, drift	Trotline	
Salmon, Chinook	Adult	12			1								**13**
Salmon, Chinook	Juvenile	65	459	179	234	17	2	31					**987**
Salmon, chum	Adult	325		14	39	1	10		1		2		**392**
Salmon, chum	Juvenile	6			15	6							**27**
Salmon, coho	Adult	85		8	19	2	2	8	10				**134**
Salmon, coho	Juvenile	1,169	1,631	816	524	125	23			8			**4,296**
Salmon, pink	Adult	3,073			32		33	17	1				**3,156**
Salmon, sockeye	Adult	48		8	8								**64**
Salmon, sockeye	Juvenile	658	30	147	607	44				4			**1,490**
Salmon, undifferentiated	Juvenile	212	80	350	17	5	1		6		3		**674**
Arctic grayling		610	16	145	296	204	7	25	6	1			**1,310**
Burbot			57	99	7	34	27		1			1	**226**
Dolly Varden		23	10	11	4	14	1	1	2				**66**
Lamprey		1	2	20		27							**50**
Longnose sucker		124	162	126	198	148	28		4				**790**
Salmonid, undifferentiated		51		1	1								**53**
Sculpin, undifferentiated		224	384	32	210	1,882	5		14				**2,751**
Stickleback, threespine		112	2,937	1,841	505	3							**5,398**
Trout, rainbow		49	37	59	9	9	5	11	8	3			**190**
Whitefish, humpback				2	15								**17**
Whitefish, round		4	8	37	113	24	2		15				**203**
Whitefish, undifferentiated		11	1	4	98	10			3				**127**
Grand Total		**6,862**	**5,814**	**3,899**	**2,952**	**2,555**	**146**	**93**	**71**	**16**	**5**	**1**	**22,414**

Table 5.1-5. Total fish count by gear type during three seasonal fish distribution and abundance sampling events in the Middle River outside of Focus Areas, 2013.

Species	Life stage	Gear Type							Grand Total
		Minnow Trap	Backpack Electrofish	Snorkel	Boat Electrofish	Angle	Fyke Net	Seine	
Salmon, Chinook	Adult			1					**1**
	Juvenile	37	7	9			2		**55**
Salmon, chum	Adult		1	17				1	**19**
	Juvenile	1	1						**2**
Salmon, coho	Adult					4			**4**
	Juvenile	666	198	20	1	5	6	1	**897**
Salmon, pink	Adult		0	151	2	12		2	**167**
	Juvenile		1		4				**5**
Salmon, sockeye	Adult			45		10			**55**
	Juvenile	17	41		5			3	**66**
Arctic grayling		5	171	83	88	19			**366**
Burbot		54	65		8		4	2	**133**
Dolly Varden		40	63	200					**303**
Lamprey			4						**4**
Longnose sucker		49	225	14	23		14	8	**333**
Salmonid, undifferentiated				55	1				**56**
Sculpin		214	1,146	4	11				**1,375**
Stickleback, threespine		1,812	155	27					**1,994**
Stickleback, undifferentiated		74	5	169					**248**
Trout, rainbow		21	13	12	6	4	10		**66**
Whitefish, humpback					9				**9**
Whitefish, round			41	3	71		4	6	**125**
Whitefish, undifferentiated			2						**2**
Grand Total		**2,990**	**2,139**	**810**	**229**	**54**	**40**	**23**	**6,285**

Table 5.1-6. Total fish count by gear type during three seasonal fish distribution and abundance sampling events in the Lower River, 2103.

Species	Life stage	Gear Type									Grand Total
		Minnow Trap	Seine	Hoop Trap	Backpack Electrofishing	Fyke Net	Boat Electrofish	Snorkel	Angle	Gillnet, drift	
Salmon, Chinook	Adult			1				2	1		**4**
Salmon, Chinook	Juvenile	50	59	65	20	17	1				**212**
Salmon, chum	Adult		5	3			3	21			**32**
Salmon, chum	Juvenile	4	16	2	3	1					**26**
Salmon, coho	Adult		4			2		50	2	2	**60**
Salmon, coho	Juvenile	70	36	80	17	67					**270**
Salmon, pink	Adult		1	5	1	1	1	12	1		**22**
Salmon, sockeye	Adult		1	1				2		1	**5**
Salmon, sockeye	Juvenile	35	253	8	46	11					**353**
Salmon, undifferentiated	Juvenile		1		2		29		1		**33**
Arctic grayling		2	18		3	6	4		3		**36**
Burbot		22	9	87	9	9	12				**148**
Dolly Varden			2		2	2					**6**
Lamprey		13		50	19	2	3				**87**
Longnose sucker		182	461	94	73	233	41				**1,084**
Northern pike		10	1		3		4	4	24		**46**
Sculpin, undifferentiated		103	80	15	474	2					**674**
Stickleback, ninespine		71	61	2	3	4					**141**
Stickleback, threespine		2,794	131	654	144	189		2			**3,914**
Stickleback, undifferentiated		1	1								**2**
Trout, rainbow		15	2	1	20	12					**50**
Whitefish, Bering cisco					1		1				**2**
Whitefish, humpback		1	1				5			1	**8**
Whitefish, round		24	45	15	6	5	1				**96**
Whitefish, undifferentiated		2	48	4	6		1				**61**
Grand Total		**3,399**	**1,236**	**1,087**	**852**	**563**	**106**	**93**	**32**	**4**	**7,372**

Table 5.2-1. Middle and Lower River rotary screw trap catch at Indian River, Susitna River at Curry Station, Susitna River at Talkeetna Station, and Montana Creek, 2013.

Location	Geo Reach	PRM	Chinook salmon		Chum salmon		Coho salmon		Sockeye salmon		Pink salmon		Pacific salmon, undifferentiated	Arctic grayling	Burbot	Dolly Varden	Lamprey, undifferentiated	Longnose sucker	Rainbow trout	Salmonid, undifferentiated	Sculpin, undifferentiated	Threespine stickleback	Whitefish, humpback	Whitefish, round	Whitefish, undifferentiated	Total
			Adult	Juvenile	Adult	Juvenile	Adult	Juvenile	Adult	Juvenile	Adult	Juvenile														
Indian River	**MR-6**	**142.1**	9	567	85	150	47	1,745	2	289	655	411	37	72	3	23		20	101	2	294		7	25	7	**4,551**
Susitna River at Curry Station	**MR-6**	**124**	1	133	14	42	23	541	2	18	189	1	31	99	7	5		42	13		14	2	26	28	196	**1,427**
Susitna River at Talkeetna Station	**MR-8**	**106.9**	17	873	50	91	240	375	23	63	158	6	23	106	16	8	3	96	19	18	45	1	52	143	270	**2,696**
Montana Creek	**LR-2**	**80.8**	3	1,254	32	799	9	189			400	6	10	2		22	10	1	80		20	20		4		**2,861**
Total			**30**	**2,827**	**181**	**1,082**	**319**	**2,850**	**27**	**370**	**1,402**	**424**	**101**	**279**	**26**	**58**	**13**	**159**	**213**	**20**	**373**	**23**	**85**	**200**	**473**	**11,535**

Table 5.2-2. Smolt to parr ratios for juvenile salmon caught in Middle and Lower River rotary screw traps, 2013.

Species	Indian River	Susitna @ Curry Station	Susitna @ Talkeetna Station	Montana Creek
Chinook salmon	3:1	0.2:1	40:1	5:1
Chum salmon	8:1	-	14:1	22:1
Coho salmon	0.5:1	0.01:1	2:1	2:1
Sockeye salmon	7:1	-	49:1	-

Table 5.2-3. Number of fish in the Middle and Lower Susitna River implanted with PIT tags in 2013, detected by stationary antennas, and recaptured during subsequent sampling events, by target species.

Species	Implanted	Detected at Antenna		Recaptured		Total Resighted[a]	
	N	N	%	N	%	N	%
Chinook salmon	1,696	187	11%	44	3%	223	13%
chum salmon	13	0	0%	0	0%	0	0%
coho salmon	2,092	286	14%	76	4%	352	17%
sockeye salmon	81	5	6%	5	6%	8	10%
Arctic grayling	378	41	11%	2	1%	42	11%
burbot	223	25	11%	8	4%	32	14%
Dolly Varden	70	9	13%	1	1%	10	14%
longnose sucker	11	0	0%	0	0%	0	0%
rainbow trout	309	73	24%	3	1%	74	24%
whitefish, humpback[b]	86	1	1%	1	1%	1	1%
whitefish, round	300	22	7%	1	0%	23	8%
Total	**5,259**	**649**	**12%**	**141**	**3%**	**765**	**15%**

Note: Values exclude a small number of PIT tags with missing implant records, multiple implant records, or inconsistent species identification upon recapture.

[a] Includes fish that were either detected at PIT antennas or recaptured. This includes 25 fish that were both recaptured and detected at an antenna.

[b] The lone humpback whitefish detected and recaptured in the Middle River (PIT tag 000183327483) was tagged and released in the Upper River at the Oshetna River rotary screw trap.

Table 5.2-4. Summary of PIT tag detections by species at the four stationary antenna arrays in the Middle and Lower Susitna River study area, 2013.

Species	Indian River (PRM 142.1)		Slough 8A (PRM 129)		Whiskers Slough (PRM 105)		Montana Cr. (PRM 80.8)		Total	
	Fish	Detections[a]	Fish	Detections[a]	Fish	Detections[a]	Fish	Detections[a]	Fish	Detections[a]
Chinook salmon	19	103	5	103	109	3,416	54	675	187	4,297
coho salmon	72	1,744	14	1,749	191	36,315	13	424	286[b]	40,232
sockeye salmon	1	3	4	15					5	18
Pacific salmon, undifferentiated							10	1,954	10	1,954
Arctic grayling	8	68	1	4	25	1,423	8	40	41[c]	1,535
burbot			9	511	16	2,237			25	2,748
Dolly Varden	4	17	1	42	3	45	1	7	9	111
humpback whitefish					1	1			1	1
rainbow trout	13	73,134	3	75	44	850	13	134	73	74,193
round whitefish	4	41	5	90	12	1,016	1	2	22	1,149
whitefish, undifferentiated	1	2			3	90	1	21	5	113
Total	**122**	**75,112**	**42**	**2,589**	**404**	**45,393**	**101**	**3,257**	**664**	**126,351**

Note: Values exclude a small number of PIT tags with missing implant records, multiple implant records, or inconsistent species identification upon recapture.

[a] "Detections" reflects the number of unique records for a given fish encounter with an antenna; each "detection" is typically comprised of many consecutive readings of the PIT tag by the antenna reader.

[b] Includes four coho salmon detected at the Whiskers Slough antenna and either the Slough 8A antenna or the Indian River antenna.

[c] Includes one Arctic grayling detected at both the Indian River and Montana Creek antennas.

Table 5.2-5. Juvenile Chinook salmon movement between macrohabitat types in the Middle and Lower River in 2013 based on a comparison of initial tagging events versus subsequent recapture or detection at PIT antennas. Values indicate the number of individual fish[a].

			Detection/Recapture Macrohabitat												
			Main Channel				Off-Channel				Tributary				
			Main Channel	Side Channel	Split Main Channel	Total	Side Slough	SS Beaver Complex	US Beaver Complex	Total	Not Reported	Single Channel	Split Channel	Tributary Mouth	**Total**
Tagging Macrohabitat	**Main Channel**	Main Channel	1	1		2	8			8		2			**2**
		Side Channel		1		1	23			23					
		Split Main Channel	1			1									
		Total	**2**	**2**		**4**	**31**			**31**		**2**			**2**
	Off-Channel	Side Slough					26			26					
		SS Beaver Complex					3	1		4					
		US Beaver Complex					6		9	15					
		Total					**36**	**2**	**7**	**45**					
	Tributary	Not Reported										7			**7**
		Single Channel					44			44	1	57			**58**
		Split Channel											2		**2**
		Tributary Mouth	1		2	3	4			4			18	10	**28**
		Total	**1**		**2**	**3**	**48**			**48**	**1**	**64**	**20**	**10**	**95**

[a] Values include fish that may have been detected or recaptured in multiple habitat types.

Table 5.2-6. Juvenile coho salmon movement between macrohabitat types in the Middle and Lower River in 2013 based on a comparison of initial tagging events versus subsequent recapture or detection at PIT antennas. Values indicate the number of individual fish[a].

			Detection/Recapture Macrohabitat										
			Main Channel			Off-Channel				Tributary			
			Main Channel	Split Main Channel	Total	Side Slough	SS Beaver Complex	US Beaver Complex	Total	Single Channel	Split Channel	Tributary Mouth	**Total**
Tagging Macrohabitat	Main Channel	Main Channel	3		3	34			34				
		Side Channel				7			7				
		Split Main Channel		3	3	61		5	66				
		Total	**3**	**3**	**6**	**102**		**5**	**107**				
	Off-Channel	Side Slough				11			11				
		SS Beaver Complex				8	1		9				
		Upland Slough				1			1				
		US Beaver Complex				18		31	49				
		Total				**38**	**1**	**31**	**70**				
	Tributary	Complex Channel				3			3		3		**3**
		Single Channel				31			31	20	8		**28**
		Split Channel									1		**1**
		Tributary Mouth	3	3	6	30		3	33		69	8	**77**
		Total	**3**	**3**	**6**	**64**		**3**	**67**	**20**	**81**	**8**	**109**

[a] Values include fish that may have been detected or recaptured in multiple habitat types.

Table 5.3-1. Total count of juvenile anadromous and resident fish captured during Early Life History sampling in the Middle and Lower Susitna River.

Location	Geomorphic Reach	Project River Mile	Chinook salmon	Chum salmon	Coho salmon	Pink salmon	Sockeye salmon	Salmon, undifferentiated	Arctic grayling	Burbot	Dolly Varden	Lamprey	Longnose sucker	Northern pike	Rainbow trout	Salmonid, unknown	Sculpin	Stickleback, ninespine	Stickleback, threespine	Whitefish, humpback	Whitefish, round	Whitefish, undifferentiated	Grand Total
Middle River (Dam Site PRM 187.1)																							
Fog Creek	MR-2	179									59						13						72
Devils Canyon (PRM 153.9-166.1)																							
FA-144 (Slough 21)	MR-6	144	3							14			41		2		19			1			80
FA-141 (Indian River)	MR-6	141	64	9	16	4		7		2	1		121		2		40			1		5	272
FA-138 (Gold Creek)	MR-6	138	17	1,013	4		191		1				3		6	6	162				5	2	1,410
FA-128 (Slough 8A)	MR-6	128	11	17	9		27	1		15	1		68		5	7	60				3	6	230
FA-113 (Oxbow I)	MR-7	113	40	19	89		1	15		8	3		75		2		26		62	1		4	345
FA-104 (Whiskers Slough)	MR-8	104	195	12	23	1	2			8		20	70		4	32	146		15	7	8	10	553
Lower River																							
Trapper Creek	LR-1	100	30		74		57					9					21		221		8		420
Sunshine Creek	LR-1	88.5	2	1								5					5		3				16
Rabideux Creek	LR-1	88		1	1		25										7		1				35
Montana Creek	LR-2	77	16	8	5												53						82
Goose Creek	LR-2	76	8	13	4		1					5	2				19		2				54
LR-63.5-US	LR-3	63.5	31		11		3						13				4		159		2		223
197.5 Creek	LR-3	63	1	7	2								2				1		1				14
Little Willow Creek	LR-3	56	27		4							8			2		32	1	6				80
LR-52-US	LR-3	52	3		1		3					5					3		2		1		18
Fish Creek	LR-4	34	9		1		2					4	13	10			4		11		1		55
Grand Total			**457**	**1,100**	**244**	**5**	**312**	**23**	**1**	**47**	**64**	**56**	**408**	**10**	**23**	**45**	**615**	**1**	**483**	**10**	**28**	**27**	**3,959**

Table 5.3-2. Number of juvenile salmon fry (fork length <50mm) observed during three Early Life History sampling events (April 28 to May 3, June 1 to June 12, and June 20 to June 29) in the Middle and Lower Susitna River, 2013.

Sampling gear types included dipnetting = DP, backpack electrofishing = EF, fyke netting = FK, minnow trapping = MT, seining = SN, snorkeling =SK.

Location	Geomorphic Reach	Project River Mile	Sampling Event	Number of Sites	Gear Types	Chinook salmon	Chum salmon	Coho salmon	Pink salmon	Sockeye salmon	Grand Total
Proposed Watana Dam Site PRM 187.1											
Fog Creek	MR-2	179	2	3	EF						0
			3	4	EF						0
Devils Canyon PRM 153.9-166.1											
FA-144 (Slough 21)	MR-6	144	2	6	EF, MT, SN						0
			3	6	EF, FK, MT						0
FA-141 (Indian River)	MR-6	141	2	6	MT, EF	2	3	1	2		8
			3	6	EF, FK, MT	30	6	2	2		40
FA-138 (Gold Creek)	MR-6	138	1	2	EF		18				18
			2	6	DP, EF, MT, SK		321			175	496
			3	6	EF, FK, MT, SK	14	674			16	704
FA-128 (Slough 8A)	MR-6	128	1	5	EF, MT					27	27
			2	6	EF, FK, MT	1	15	2			18
			3	6	EF, FK, MT, SN		2				2
FA-113 (Oxbow I)	MR-6	113	2	6	FK, MT	7	18	11		1	37
			3	6	FK, MT, SN	1	1				2
FA-104 (Whiskers Slough)	MR-6	104	1	3	EF	2	9	1			12
			2	6	EF, MT	1	1	1		1	4
			3	6	FK, MT, SK	8	2	3			13
Lower River											
Trapper Creek	LR-1	100	2	1	EF, MT					4	4
			3	2	MT, SN	9		44		46	99
Sunshine Creek	LR-1	89	3	1	EF						0
Rabideux Creek	LR-1	88	3	1	EF, SN		1	1		25	27
Montana Creek	LR-2	77	3	1	EF	5	4				9
Goose Creek	LR-2	76	3	1	EF	4	12	2			18
LR-63.5-US	LR-3	64	2	2	EF, MT					1	1
			3	1	MT			1			1
197.5 Creek	LR-3	63	2	1	EF		7				7
Little Willow Creek	LR-3	56	2	1	MT						0
			3	1	MT	5					5
LR-52-US	LR-3	52	3	1	EF	1				3	4
Fish Creek	LR-4	34	2	2	EF, MT					1	1
			3	2	EF, MT						0
All Sites	Event 1			10		2	27	1	0	27	57
	Event 2			46		11	365	15	2	183	576
	Event 3			51		76	702	53	2	87	920
Grand Total						**89**	**1094**	**69**	**4**	**297**	**1553**

Table 5.3-3. Average fork length of juvenile salmon fry (fork length <50mm) caught during Early Life History sampling in the Middle and Lower Susitna River.

Location	Geomorphic Reach	Project River Mile	Sampling Event	Chinook salmon	Chum salmon	Coho salmon	Pink salmon	Sockeye salmon
Proposed Watana Dam Site PRM 187.1								
Fog Creek	MR-2	179						
Devils Canyon PRM 153.9-166.1								
FA-144 (Slough 21)	MR-6	144						
FA-141 (Indian River)	MR-6	141	2	35	34.7	45	33	
			3	39.8	44.5	44	36	
FA-138 (Gold Creek)	MR-6	138	1		33.6			
			2		31			
			3	37.4	31.2			31
FA-128 (Slough 8A)	MR-6	128	1					35
			2	43	33.4	46		
			3		37			
FA-113 (Oxbow I)	MR-6	113	2	36	36.7			27
			3	38	36			
FA-104 (Whiskers Slough)	MR-6	104	1	45	34.2	47		
			2	39	39	34		36
			3	42.4	34	44		
Lower River								
Trapper Creek	LR-1	100	2					32
			3	39	37.6			41.3
Sunshine Creek	LR-1	89						
Rabideux Creek	LR-1	88	3		35	39		34
Montana Creek	LR-2	77	3	47	42.5			
Goose Creek	LR-2	76	3	44.8	39.7	41		
LR-63.5-US	LR-3	64	2					34
			3	47				
197.5 Creek	LR-3	63	2		36.9			
Little Willow Creek	LR-3	56	3	43.6				
LR-52-US	LR-3	52	3		45			35
Fish Creek	LR-4	34	2					30

Table 5.5-1. PIT tag recaptures for pilot species fish used for growth assessment in the Middle and Lower River, 2013.

Species	Implanted (N)	Detected (N)	Recaptured (N)	Number with Sufficient Duration (>7 days)
Chinook salmon	1,696	187	44	13
Arctic grayling	377	41	2	0
Total	**2,073**	**228**	**46**	**13**

Table 5.5-2. Specific growth rates of juvenile Chinook salmon in the Middle and Lower River, 2013. Only fish with a minimum of eight days duration between recapture events were used for growth assessment.

River	Reach	Stream Name	ISR Habitat Channel Category	ISR Macro Habitat	Implant Date	Implant Length	Recapture Date	Recapture Length	Duration (d)	Length Change (mm)	Growth (mm/d)	SGR (% length /day)
ML	MR-8	Susitna River	Main Channel	Main Channel	15-Sep-13	125	23-Sep-13	125	8	0	0.00	0.00
ML	MR-8	Susitna River	OCH	Upland Slough Beaver Complex	31-Aug-13	78	23-Sep-13	80	23	2	0.09	0.11
ML	MR-6	Susitna River	OCH	Side Slough Beaver Complex	09-Aug-13	90	25-Sep-13	102	47	12	0.26	0.27
ML	MR-6	Susitna River	OCH	Upland Slough Beaver Complex	25-Jul-13	91	30-Aug-13	105	36	14	0.39	0.40
ML	MR-6	Susitna River	OCH	Upland Slough Beaver Complex	24-Jul-13	104	30-Aug-13	119	37	15	0.41	0.36
ML	MR-6	Susitna River	OCH	Upland Slough Beaver Complex	24-Jul-13	108	30-Aug-13	125	37	17	0.46	0.40
ML	MR-8	Susitna River	OCH	Upland Slough Beaver Complex	03-Sep-13	111	26-Sep-13	113	23	2	0.09	0.08
ML	MR-6	Susitna River	OCH	Upland Slough Beaver Complex	24-Jul-13	116	30-Aug-13	131	37	15	0.41	0.33
ML	MR-6	Susitna River	OCH	Upland Slough Beaver Complex	30-Aug-13	131	27-Sep-13	132	28	1	0.04	0.03
ML	MR-6	Indian River	Trib	Trib Mouth	08-Jul-13	89	17-Jul-13	92	9	3	0.33	0.37
ML	LR-2	Montana Creek	Trib	Single Channel	07-Jul-13	82	25-Jul-13	90	18	8	0.44	0.52
ML	MR-8	Whiskers Creek	Trib	Single Channel	22-Jul-13	69	20-Sep-13	77	60	8	0.13	0.18
ML	MR-8	Whiskers Creek	Trib	Single Channel	20-Jul-13	84	28-Aug-13	97	39	13	0.33	0.37

Table 5.5-3. Condition factors for juvenile Chinook salmon captured in the Middle and Lower River, 2013.

MIDDLE RIVER

Macro Habitat	Segment	Sample Size	Mean	Mean Standard Error
MC	MR	3	1.32	0.105
SMC	MR	3	1.18	0.049
SC	MR	94	1.00	0.013
	MR-6	9	1.08	0.047
	MR-7	24	0.88	0.028
	MR-8	61	1.03	0.012
SS	MR	86	1.02	0.016
	MR-6	2	1.11	0.121
	MR-8	84	1.02	0.016
SSB	MR	35	1.09	0.020
	MR-6	30	1.08	0.022
	MR-7	5	1.13	0.059
US	MR	32	1.07	0.040
	MR-6	3	1.59	0.242
	MR-7	15	1.00	0.032
	MR-8	14	1.02	0.021
USB	MR	246	1.02	0.008
	MR-6	94	1.01	0.012
	MR-7	58	1.04	0.020
	MR-8	94	1.02	0.011
BW	MR	11	0.97	0.072
Trib	MR	111	1.02	0.018
	MR-6	24	1.00	0.059
	MR-7	27	0.98	0.017
	MR-8	60	1.04	0.022
Trib Mouth	MR	7	1.09	0.036
CWP	MR	3	1.06	0.033

LOWER RIVER

Macro Habitat	Segment	Sample Size	Mean	Mean Standard Error
MC	LR	2	0.95	0.100
SC	LR	30	1.12	0.024
SS	LR	2	0.95	0.10
US	LR	58	1.10	0.020
	LR-3	35	1.10	0.025
	LR-4	23	1.20	0.032
USB	LR	30	0.94	0.043
Trib	LR	111	1.12	0.022
	LR-1	48	1.08	0.023
	LR-2	35	1.21	0.048
	LR-3	28	1.09	0.042
Trib Mouth	LR	5	1.04	0.063
CWP	LR	50	1.09	0.028
	LR-1	7	1.06	0.065
	LR-2	4	1.39	0.226
	LR-3	30	1.09	0.026
	LR-4	9	0.97	0.027
	LR-4	9	0.97	0.027

Table 5.5-4. Condition factors for Arctic grayling captured in the Middle and Lower River, 2013..

MIDDLE RIVER

Macro Habitat	Segment	Sample Size	Mean	Mean Standard Error
MC	MR	97	0.92	0.018
	MR-1	48	0.90	0.026
	MR-2	22	0.87	0.042
	MR-5	20	0.97	0.032
	MR-6	1	1.17	n/a
	MR-7	2	0.90	0.080
	MR-8	4	0.94	0.071
SMC	MR	25	0.82	0.033
SC	MR	97	0.91	0.018
	MR-1	39	0.94	0.019
	MR-2	53	0.89	0.029
	MR-6	1	0.93	n/a
	MR-8	4	0.88	0.08
SS	MR	106	0.86	0.02
	MR-2	80	0.87	0.02
	MR-5	3	0.73	0.068
	MR-6	7	0.84	0.11
	MR-8	16	0.83	0.030
SSB	MR	1	0.74	n/a
US	MR	n/a	n/a	n/a
BW	MR	50	0.63	0.027
Trib	MR	55	0.83	0.011
	MR-6	1	0.87	n/a
	MR-8	45	0.83	0.012
	Tsusena Creek	9	0.83	0.029
Trib Mouth	MR	13	0.77	0.056
CWP	MR	122	0.89	0.016
	MR-2	111	0.88	0.017
	MR-6	11	0.99	0.069

LOWER RIVER

Macro Habitat	Segment	Sample Size	Mean	Mean Standard Error
MC	LR	1	0.92	n/a
SMC	LR	1	0.81	n/a
SC	LR	15	0.96	0.051
SS	LR	3	0.94	0.093
US	LR	1	0.90	n/a
Trib	LR	6	0.74	0.036
Trib Mouth	LR	1	0.94	n/a
CWP	LR	6	0.96	0.051

Table 5.6-1. Northern pike habitat associations by life stage, 2013.

Macrohabitat	Mesohabitat	Life Stage		Total
		Juvenile	Adult	
Clearwater plume	Clearwater plume	2	4	6
Side slough	Run	1	0	1
Tributary	Glide	12	30	42
	Pool	0	8	8
Total		**15**	**42**	**57**

Table 5.6-2 Angling CPUE for northern pike in Lower River geomorphic reach-4 during fish distribution and abundance sampling, 2013.

Season	Transect PRM	Habitat	Macrohabitat	Mesohabitat	Total Angling Effort (min)	Cast Count	Northern Pike Caught	CPUE (catch/hour^1)	CPUE (catch/50 casts)
Early Summer	41.4	Off-channel	Side Slough	Glide	54	51	0	0	0
Late Summer	34	Tributary	Tributary	Glide	280	250	22	4.7	4.4
Fall	34	Tributary	Tributary	Glide	131	30	2	0.9	3.3

10. FIGURES

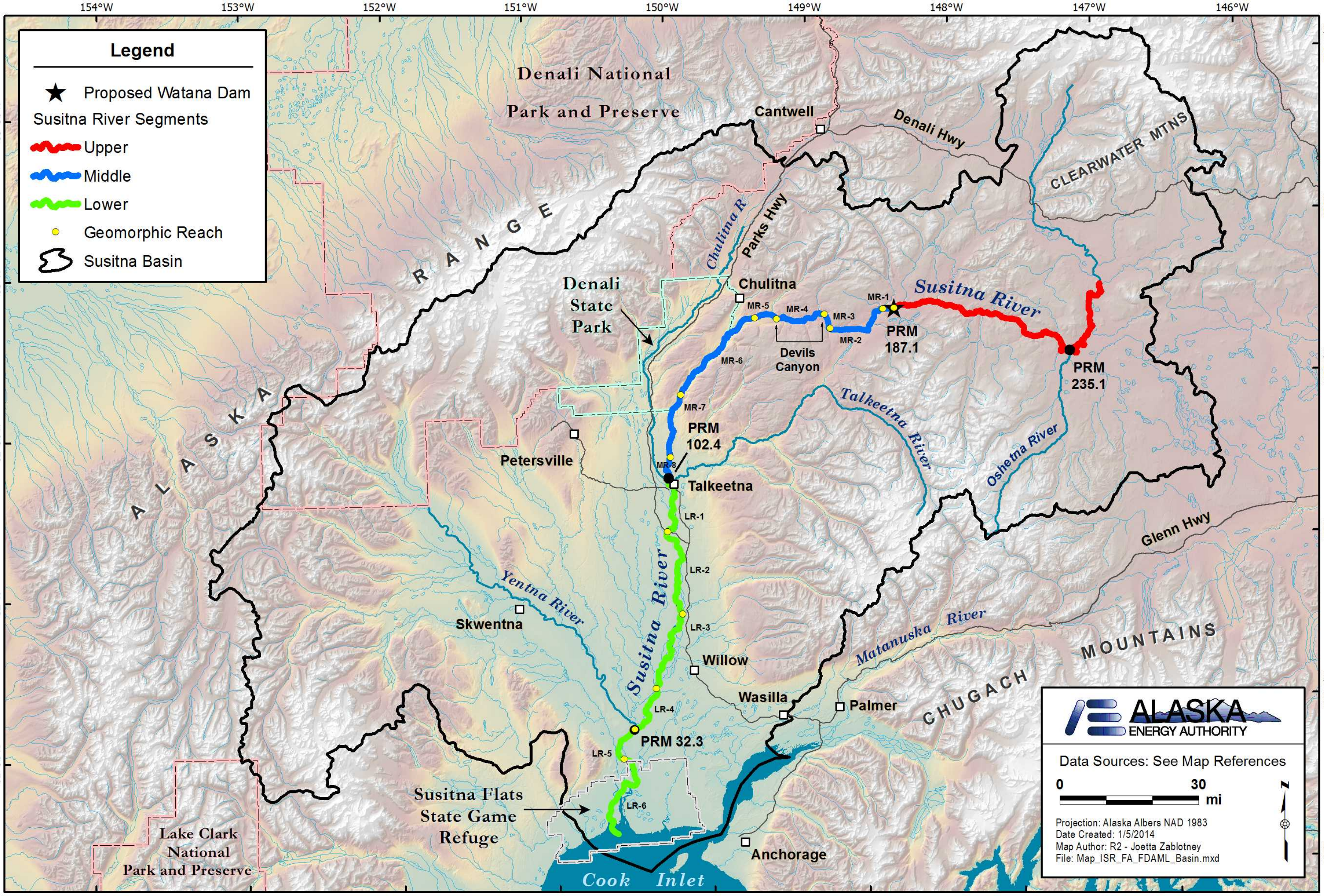


Figure 3-1. Upper Susitna River fish distribution and abundance study area.

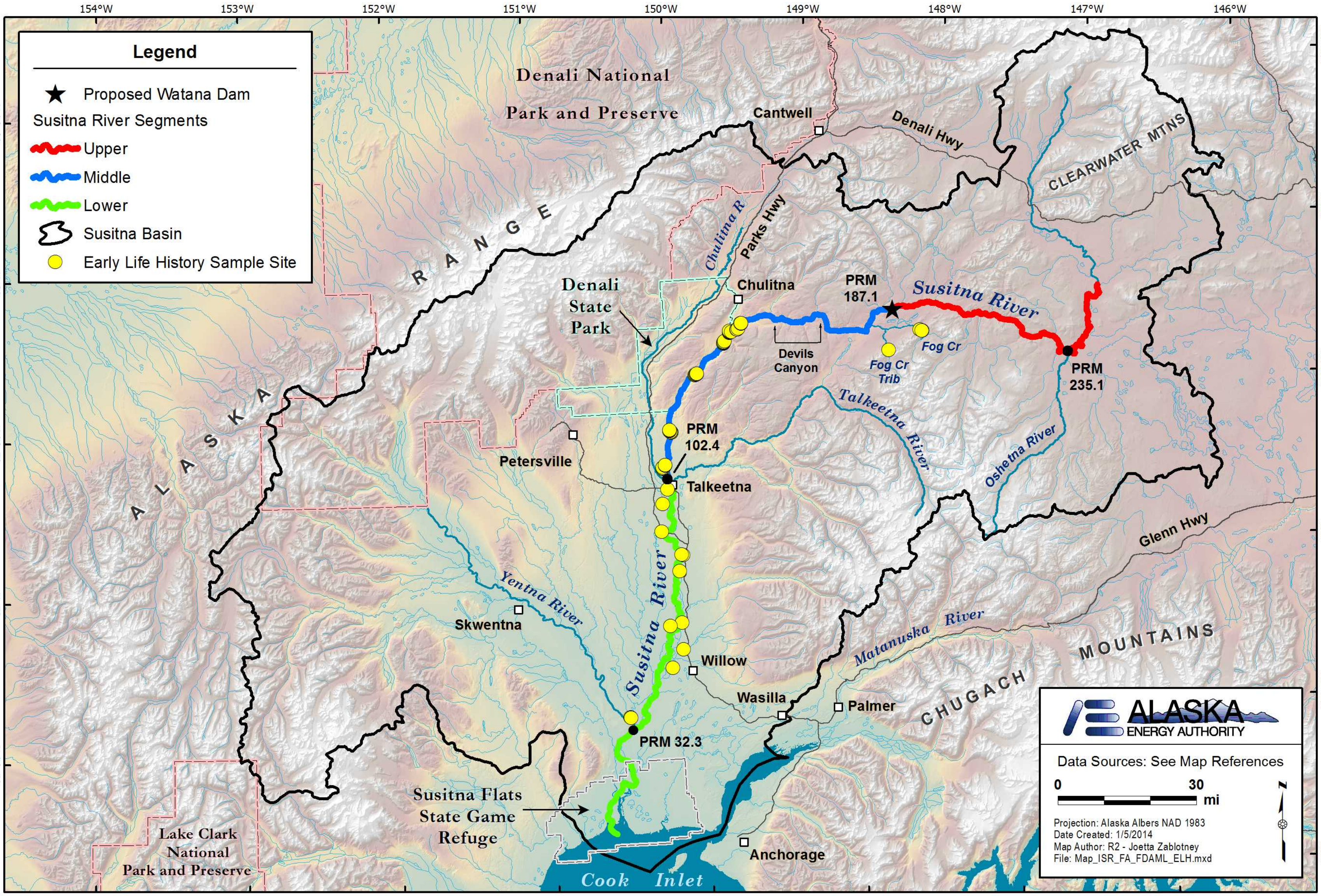


Figure 4.1-1. Spring early life history (ELH) sampling locations in the Middle and Lower Susitna River, 2013

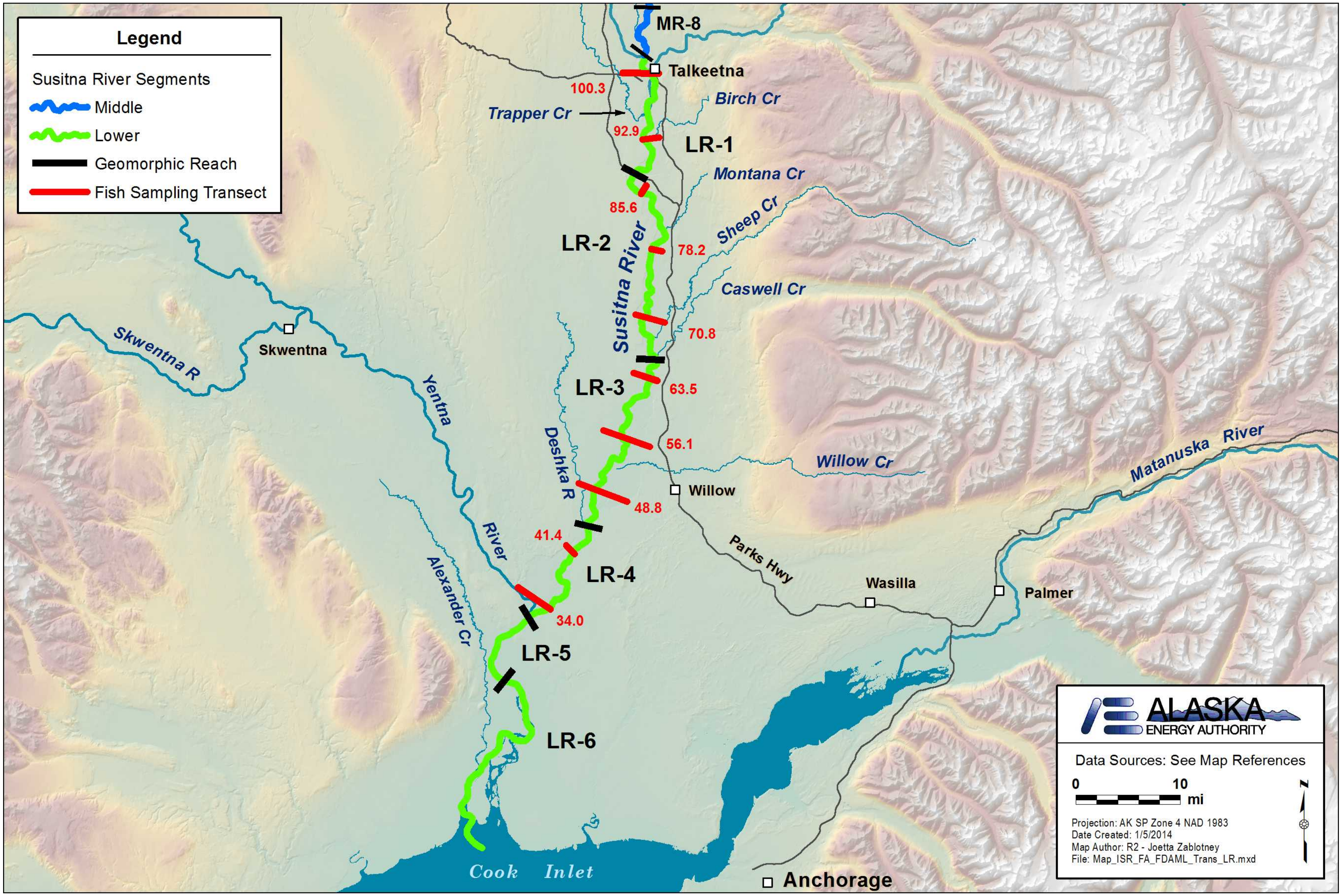


Figure 4.1-2. Fish distribution and abundance sampling transects in the Lower Susitna River, 2013.

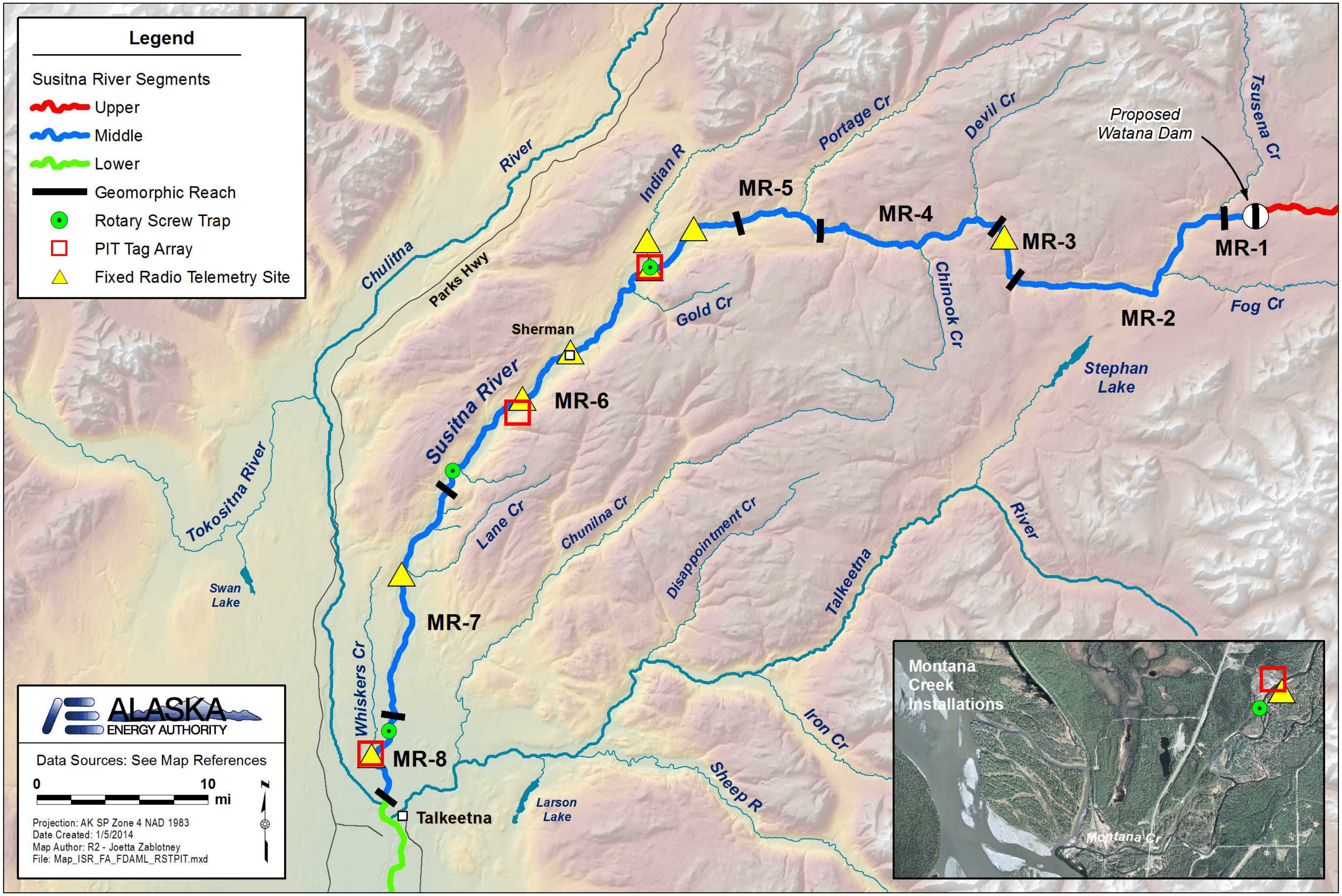


Figure 4.1-3. Outmigrant trap, PIT tag interrogation system, and radio fixed receiver locations in the Middle Susitna River, 2013

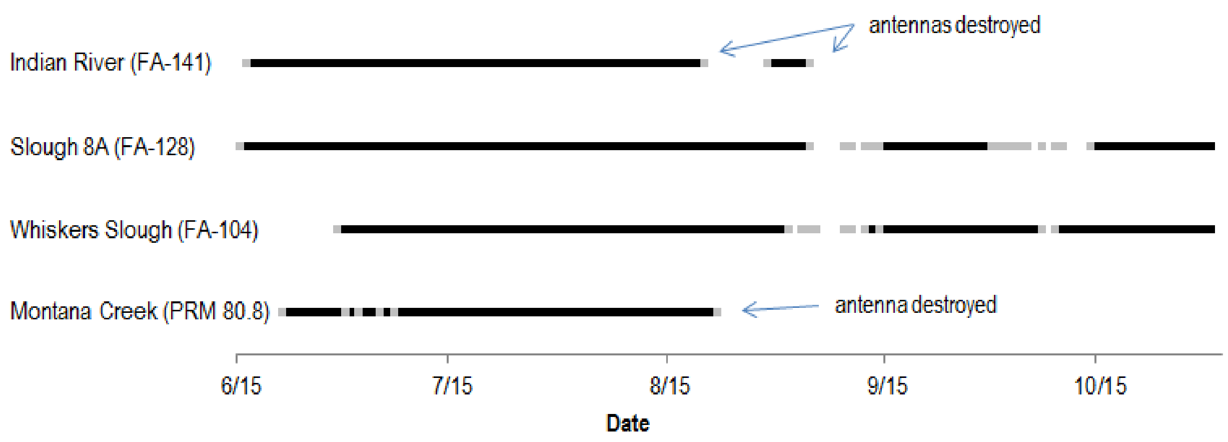


Figure 4.2-1. Summary of PIT tag interrogation system operation in the Middle and Lower Susitna River, 2013.

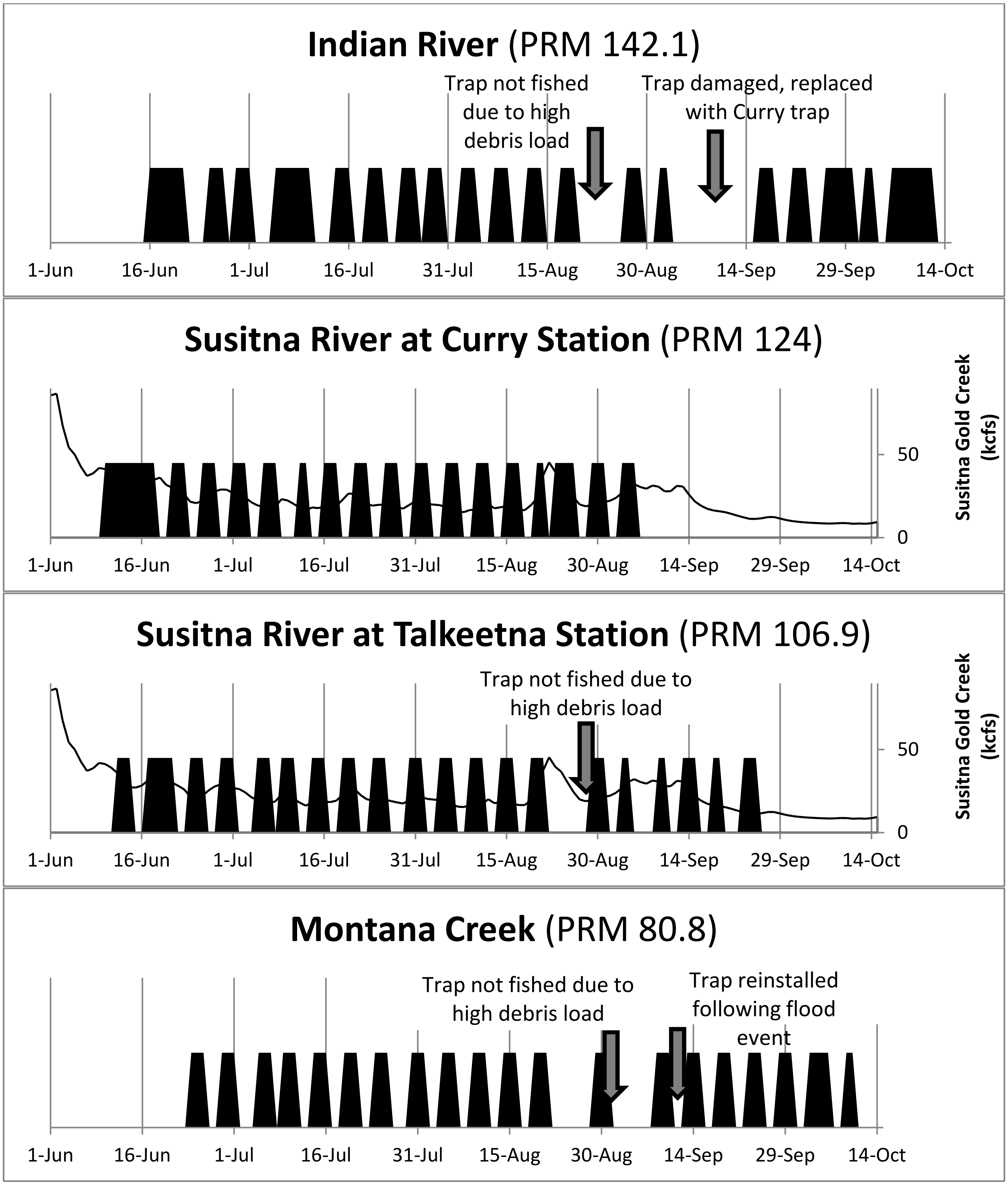


Figure 4.2-2. Rotary screw trap operation in the Middle Susitna River and in Indian River (PRM 142.1) and Montana Creek (PRM 80.8), 2013.

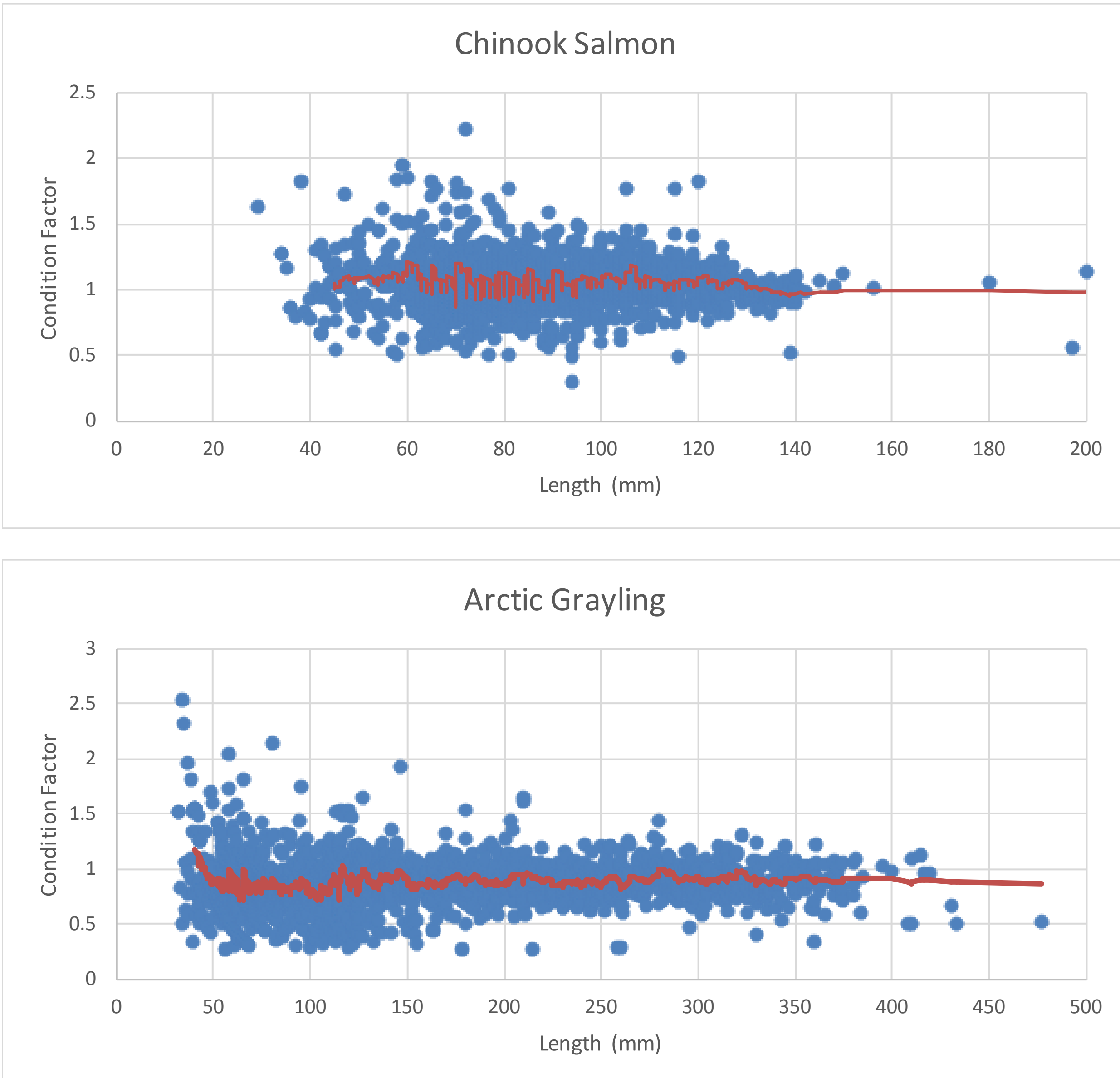


Figure 4.8-1. Condition factor of juvenile Chinook salmon (top) and Arctic grayling (bottom) as a function of length, 2013.

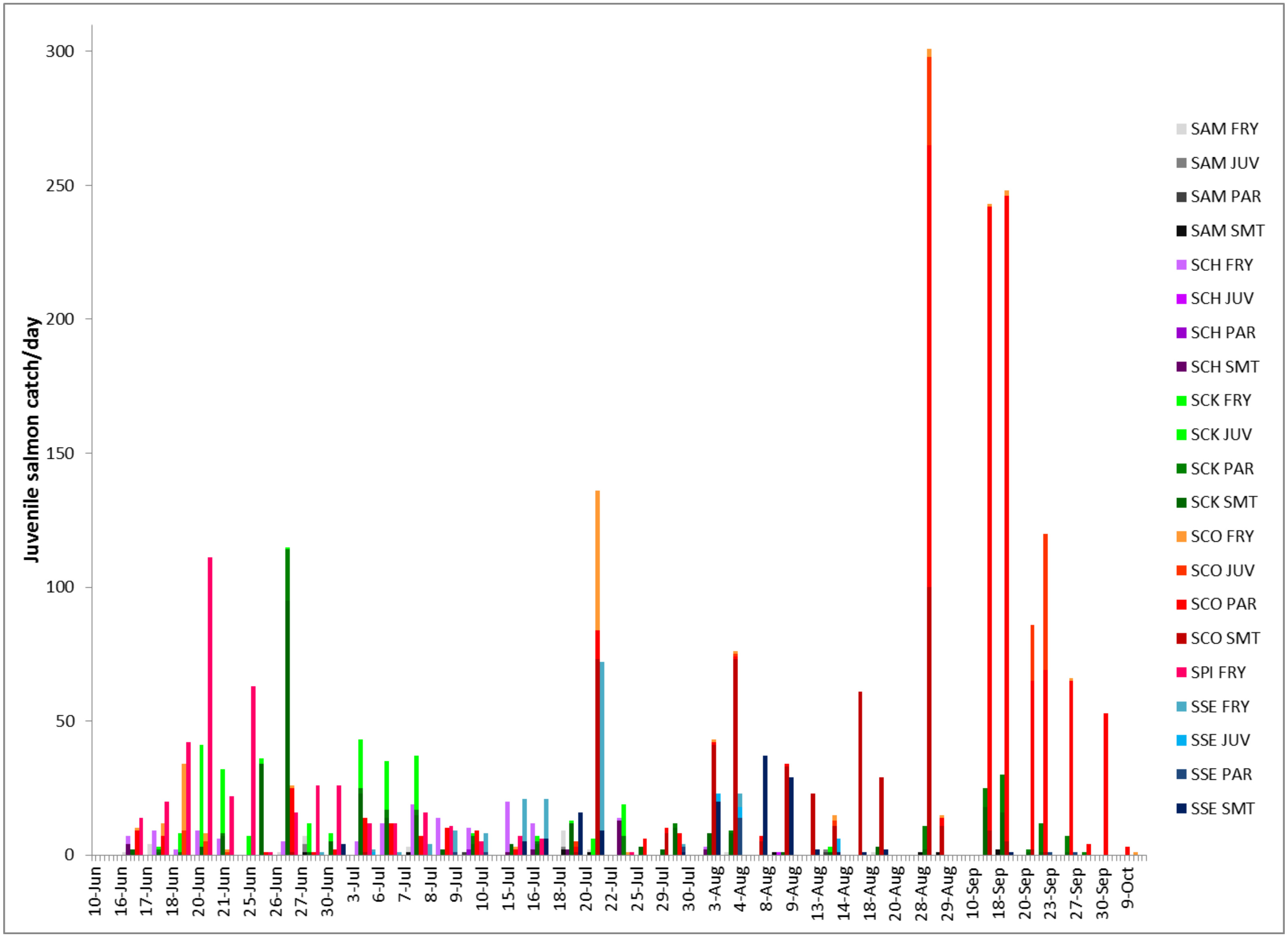


Figure 5.2-1. Juvenile salmon catch by life stage at the Indian River rotary screw trap (PRM 142.1), 2013. Species and lifestage codes SAM: salmon undifferentiated, SCH: chum salmon, SCK: Chinook salmon, SCO: coho salmon, SPI: pink salmon, SSE: Sockeye salmon, PAR: parr, JUV: juvenile, SMT: smolt.

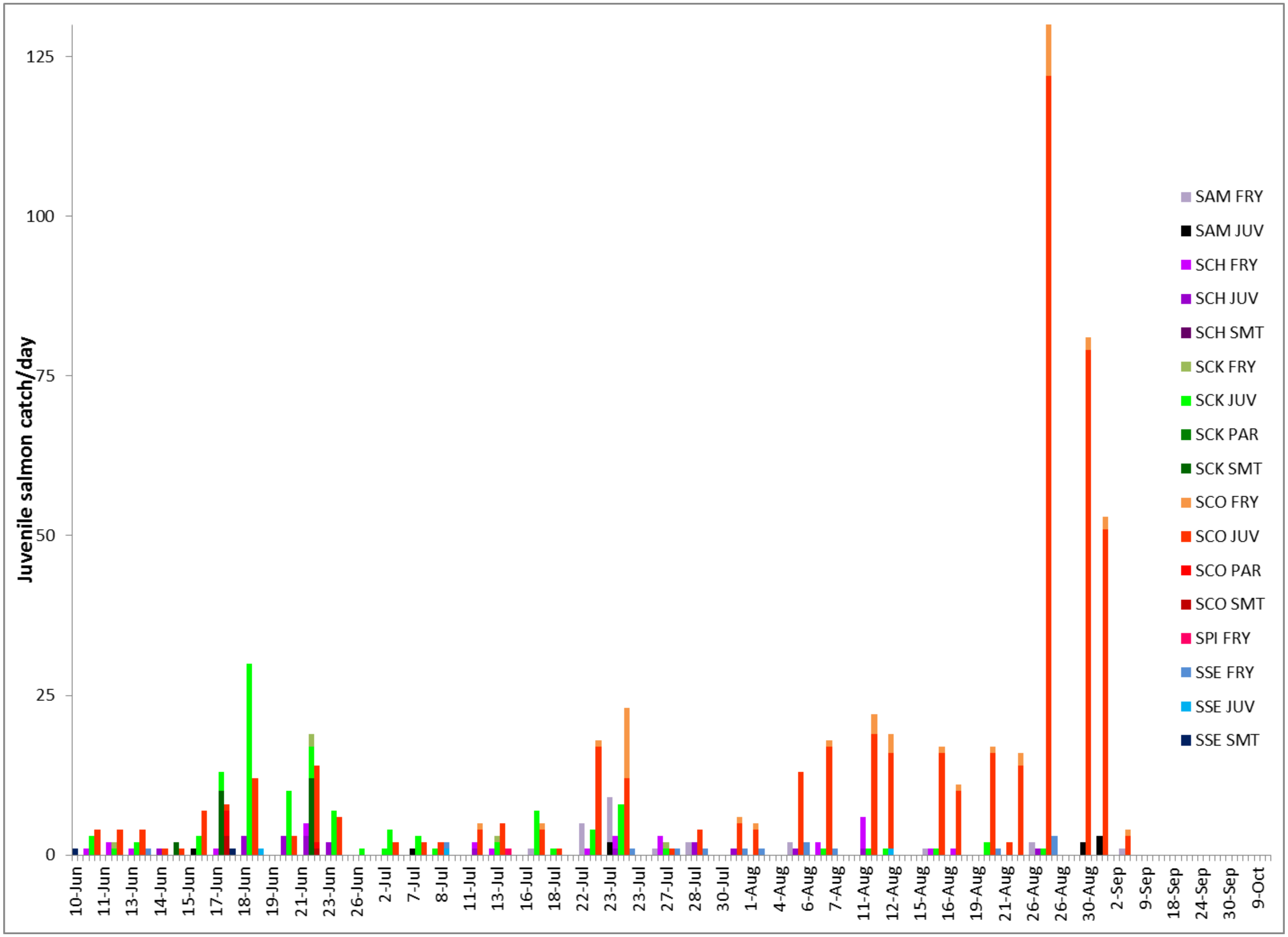


Figure 5.2-2. Juvenile salmon catch by life stage at the Susitna River at Curry Station rotary screw trap (PRM 124), 2013. Species and lifestage codes SAM: salmon undifferentiated, SCH: chum salmon, SCK: Chinook salmon, SCO: coho salmon, SPI: pink salmon, SSE: Sockeye salmon, PAR: parr, JUV: juvenile, SMT: smolt.

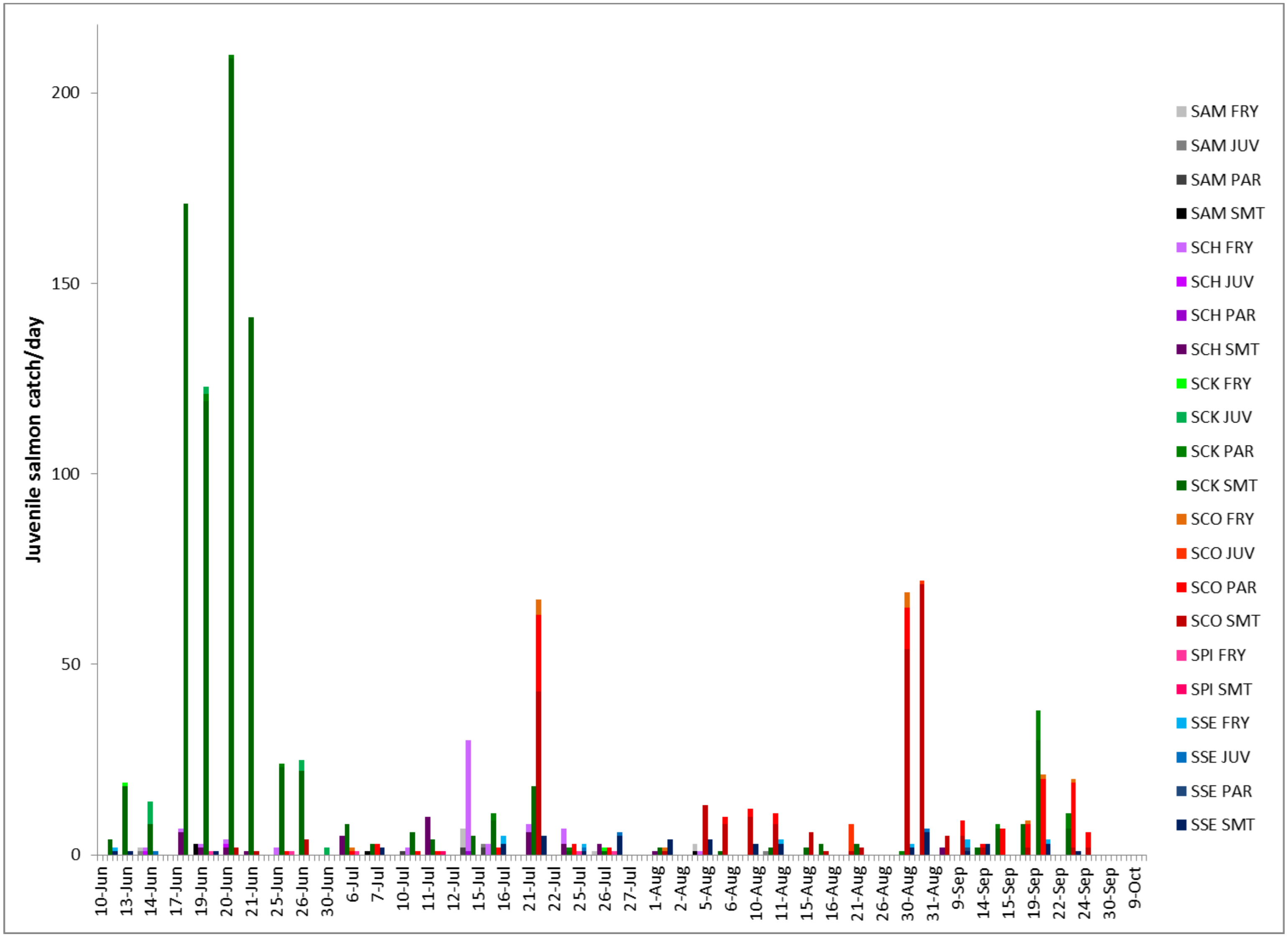


Figure 5.2-3. Juvenile salmon catch by life stage at the Susitna River at Talkeetna Station rotary screw trap (PRM 106.9), 2013. Species and lifestage codes SAM: salmon undifferentiated, SCH: chum salmon, SCK: Chinook salmon, SCO: coho salmon, SPI: pink salmon, SSE: Sockeye salmon, PAR: parr, JUV: juvenile, SMT: smolt.

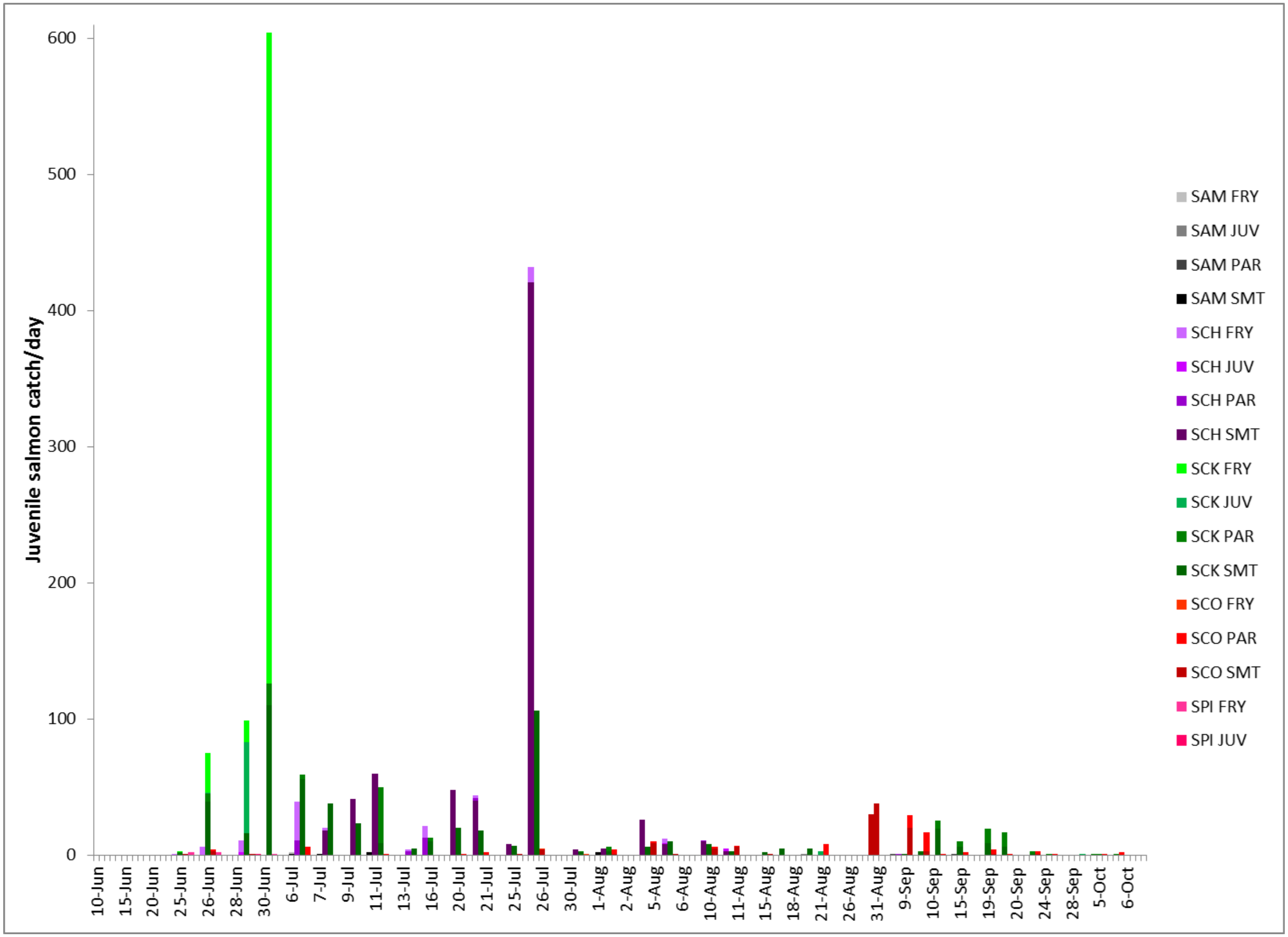


Figure 5.2-4. Juvenile salmon catch by life stage at the Montana Creek rotary screw trap (PRM 80.8), 2013. Species and lifestage codes SAM: salmon undifferentiated, SCH: chum salmon, SCK: Chinook salmon, SCO: coho salmon, SPI: pink salmon, SSE: Sockeye salmon, PAR: parr, JUV: juvenile, SMT: smolt.

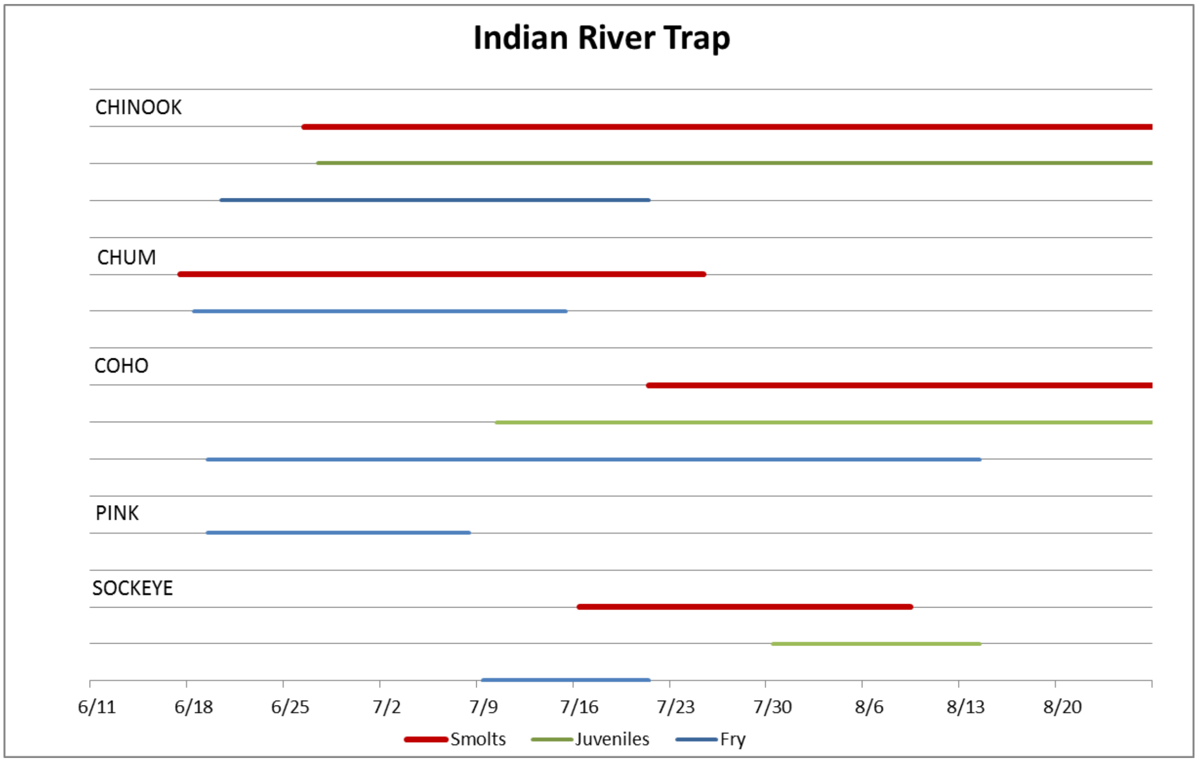


Figure 5.2-5. Timing of juvenile salmon catch (10th to 90th percentile cumulative frequency) by life stage at the Indian River rotary screw trap (PRM 142.1), 2013.

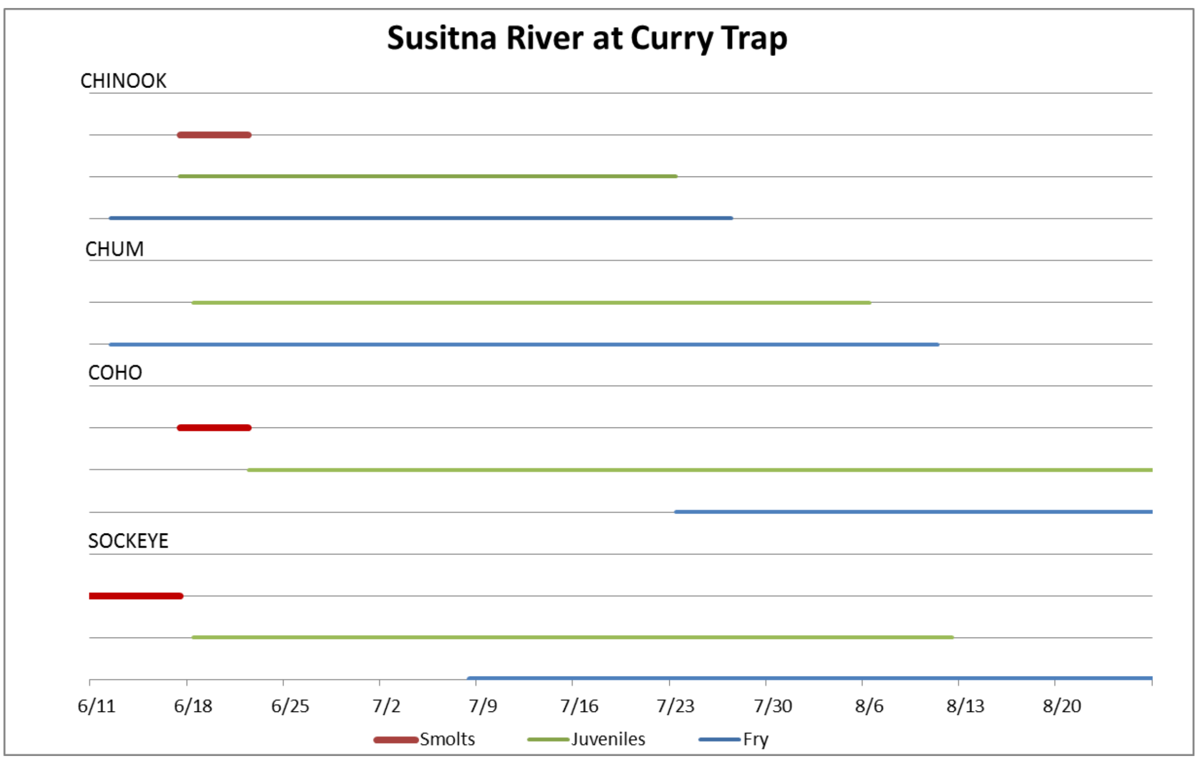


Figure 5.2-6. Timing of juvenile salmon catch (10th to 90th percentile cumulative frequency) by life stage at the Susitna River at Curry Station rotary screw trap (PRM 124), 2013.

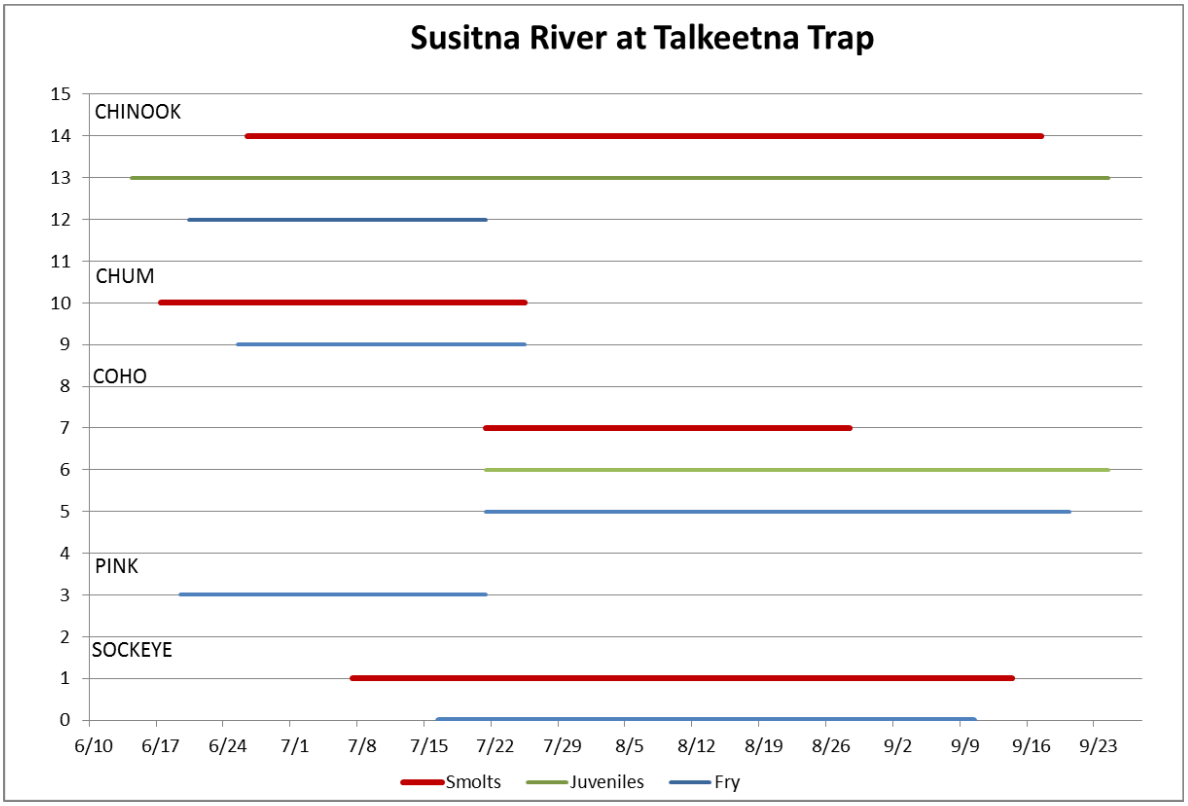


Figure 5.2-7. Timing of juvenile salmon catch (10th to 90th percentile cumulative frequency) by life stage at the Susitna River at Talkeetna Station rotary screw trap (PRM 106.9), 2013.

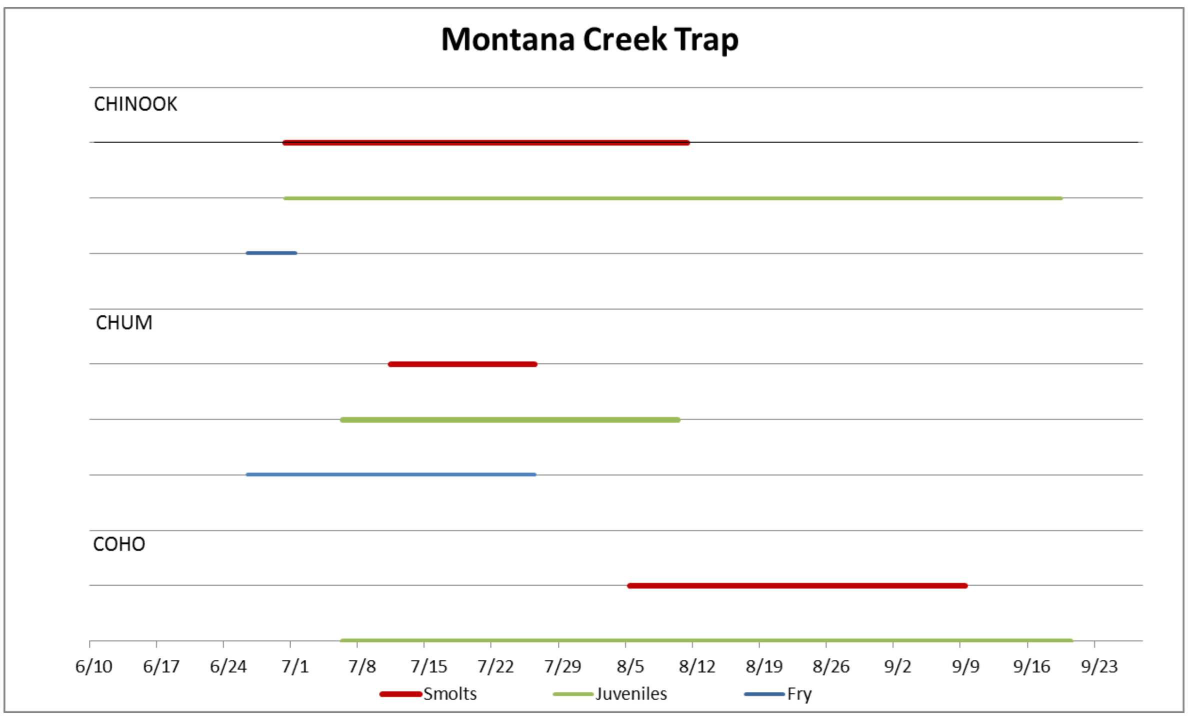


Figure 5.2-8. Timing of juvenile salmon catch (10th to 90th percentile cumulative frequency) by life stage at the Montana Creek rotary screw trap (PRM 80.8), 2013.

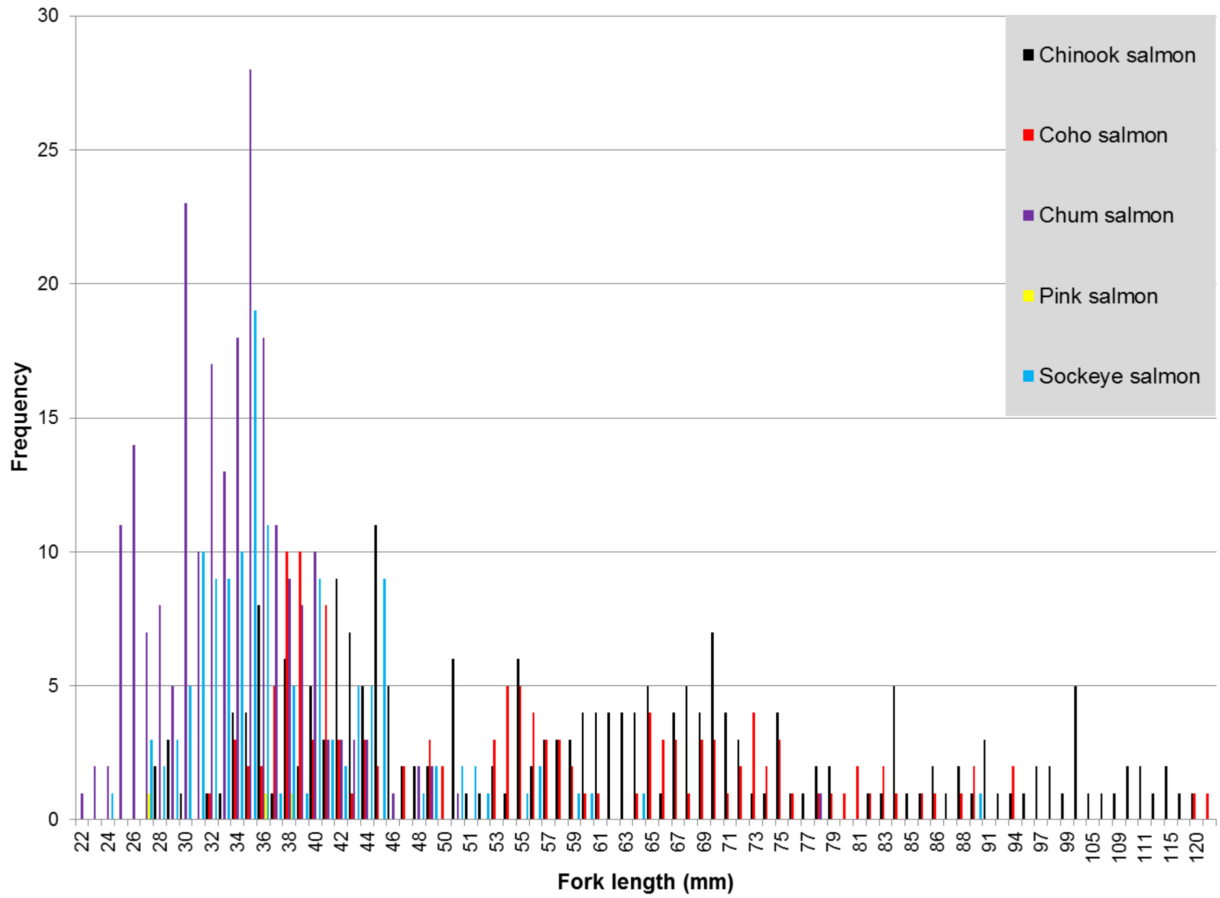
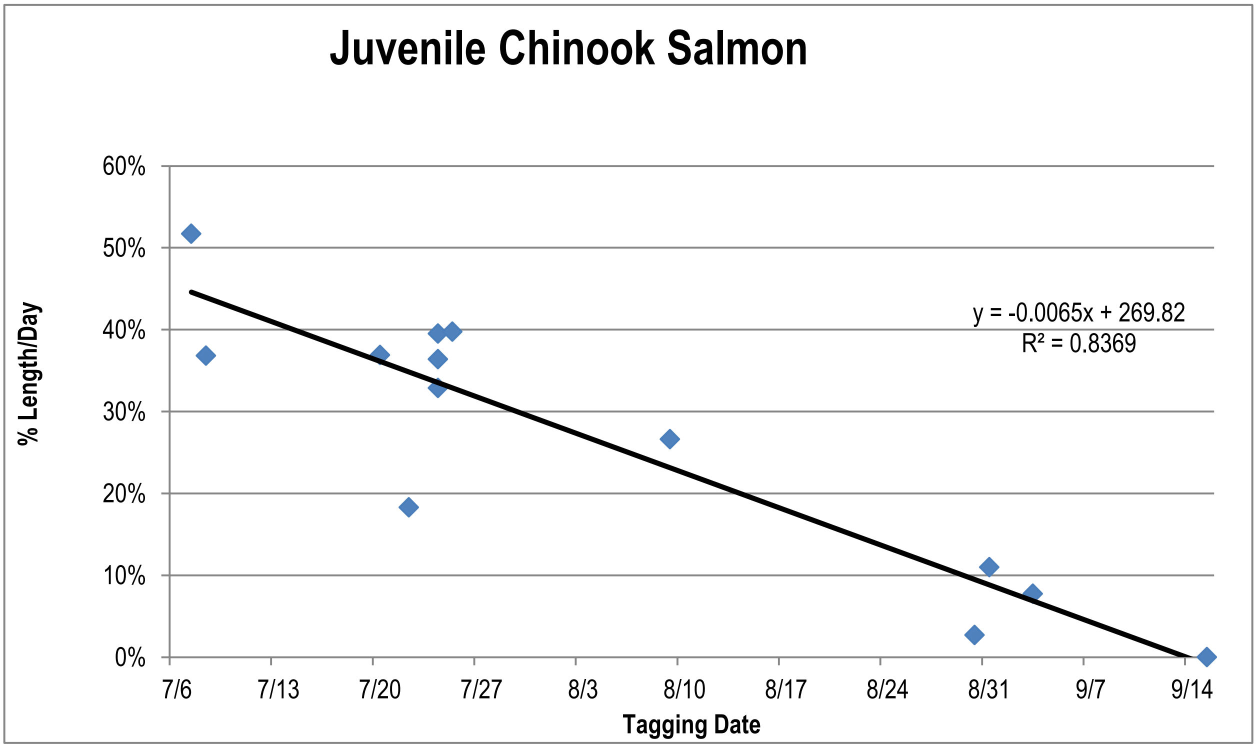


Figure 5.3-1. Length frequency of juvenile salmon in the Middle and Lower Susitna River during Early Life History sampling (April 29-June 29), 2013



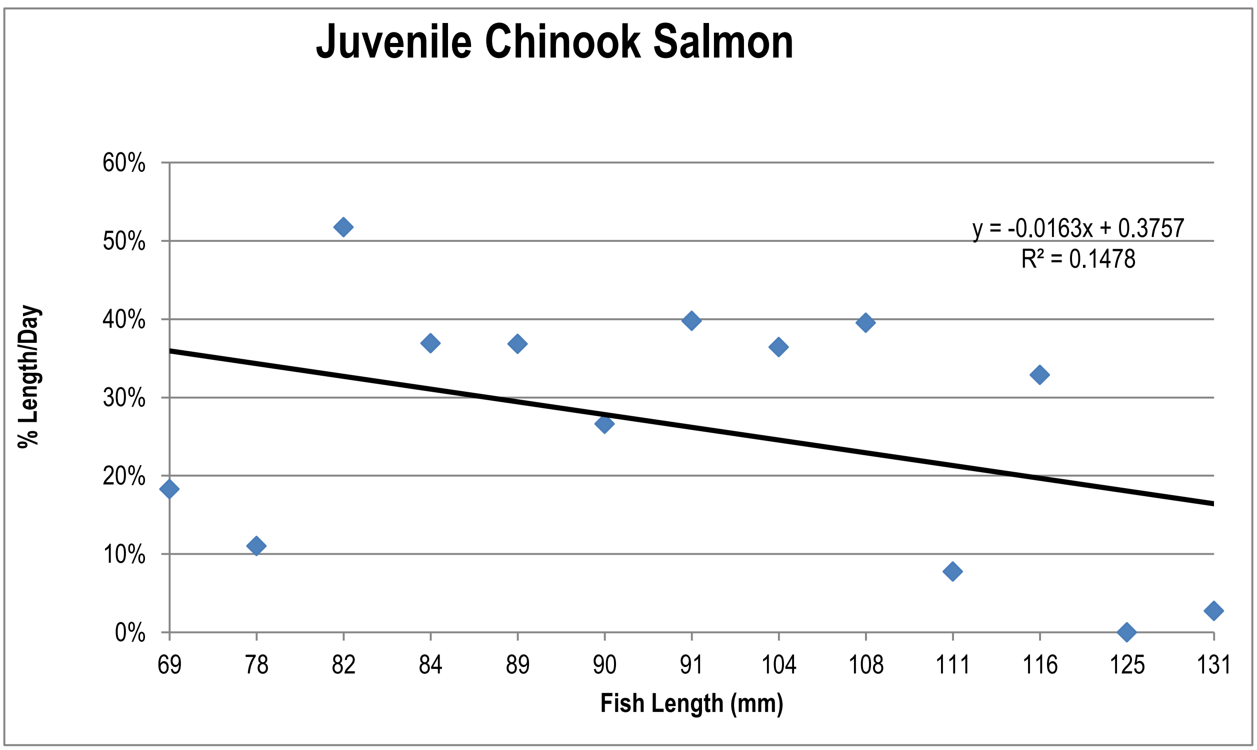


Figure 5.5-1. Regression of juvenile chinook salmon SGRs over the tag implant date (top) and fish implant length (bottom) in the Middle and Lower Susitna River; 2013.

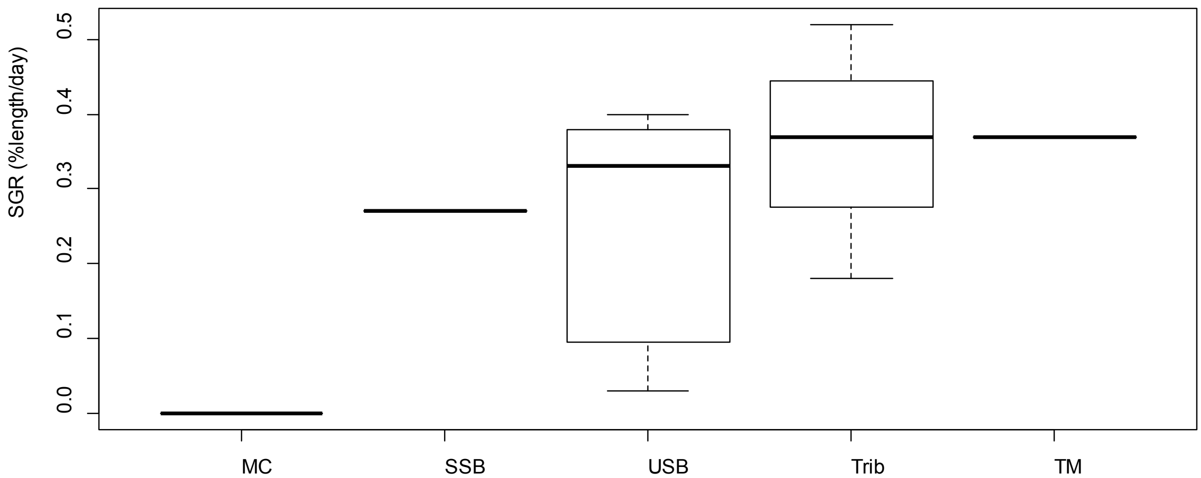


Figure 5.5-2. Boxplots of specific growth rates for 13 juvenile Chinook salmon plotted by habitat type for the Middle and Lower River, 2013. Note: Box widths are proportional to the sample size for each habitat type. MC = Main Channel; SSB = Side Slough Beaver Complex; USB = Upland Slough Beaver Complex, Trib = single channel tributary, and TM = Tributary Mouth.

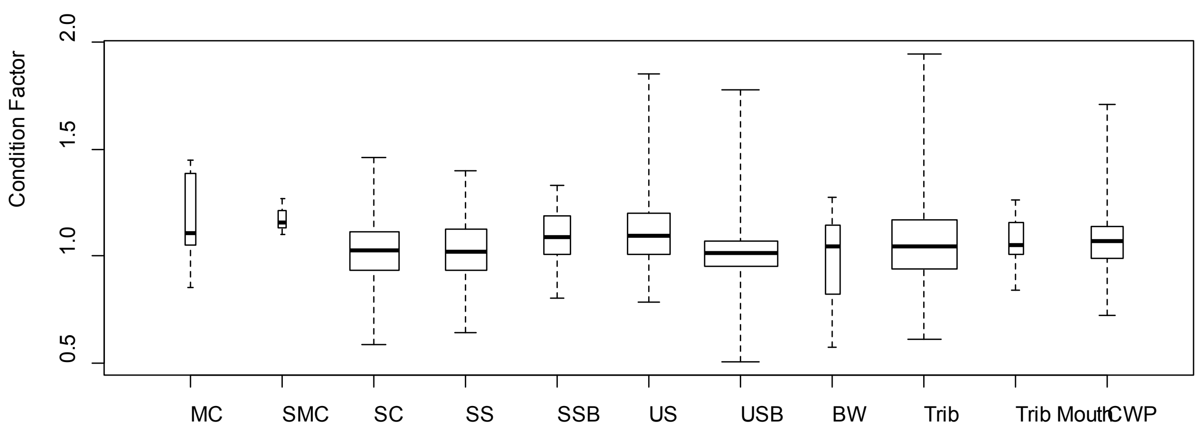


Figure 5.5-3. Boxplots of condition factors for juvenile Chinook salmon plotted by location for the Middle / Lower River, 2013. Note: Box widths are proportional to the sample size for each location**.**

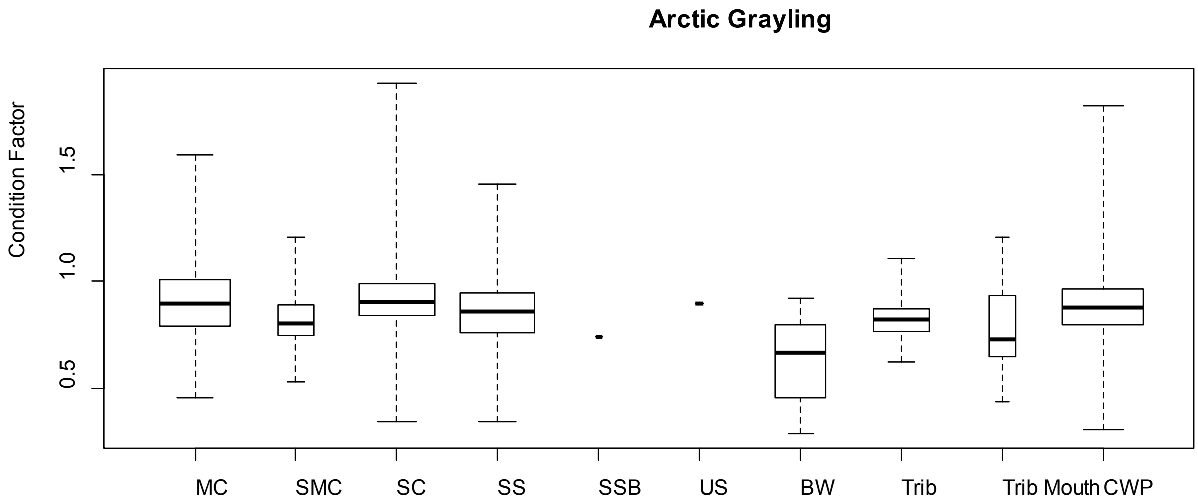


Figure 5.5-4. Boxplots of condition factors for Arctic grayling plotted by habitat type for the Middle / Lower River, 2013.
Note: Box widths are proportional to the sample size for each habitat type**.**

APPENDIX A: SAMPLING SITE MAPS

[See separate file for Appendix.]

APPENDIX B: DISTRIBUTION OF FISH RADIO-TAGGED IN THE MIDDLE AND LOWER SUSITNA RIVER, 2013

[See separate file for Appendix.]

APPENDIX C: WINTER SAMPLING REPORT

[See separate file for Appendix.]

APPENDIX D: FISH SEASONAL DISTIRIBUTION TABLES

[See separate file for Appendix.]

APPENDIX E: RELATIVE ABUNDANCE TABLES

[See separate file for Appendix.]

APPENDIX F: HABITAT ASSOCIATION TABLES

[See separate file for Appendix.]